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European Research in Kodak's Early Years

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For nearly a century, knowledge management by the Kodak company relied on the circulation of technological information between the US and Europe. The firm's global influence on visual culture was largely shaped by strong transatlantic connections.

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In April 1880, George Eastman, a young bank clerk, got his first patent about a method of coating a photographic emulsion on glass plates. He resigned from his work the following year and soon rented commercial space in Rochester, New York. In 1885, he developed a flexible roll film, and continued to improve the technology of emulsion and base to make the photographic process as easy as possible. Eastman developed his first camera in 1888 and to name it, he created and registered the trademark that would revolutionize photography in the twentieth century: "Kodak" was a simple word with no meaning, but it sounded good in any language. It was the start of a small business, which progressively became one of the biggest firms of the photographic and cinematographic industry in the twentieth century.

This essay considers the development of the circulation of technical and scientific knowledge at Kodak, which started with the creation of a second factory in Harrow, England, in 1891. From that point on, the Atlantic Ocean took a role in the development of technological innovation at Eastman Kodak. It was a constraint, as it separated the Kodak managers and photochemists on each side of the "big pond." But it can also be seen as a carrier of knowledge, a path where photographic technology was constantly circulating with the help of transatlantic liners and submarine cables. If we use the theoretical approach of the actor-network theory developed by Callon and Latour, [1] we can consider the Atlantic as a nonhuman entity actively shaping the Kodak network of photographic experts and creating valuable social interactions. A "history of knowledge" approach is also particularly relevant to this essay, as its aim is to clarify how human societies produce and circulate knowledge. According to Philipp Sarasin, one of the theorists of the new field, "knowledge is always evolving, changing and 'realizing' through circulation between societal spheres." [2]

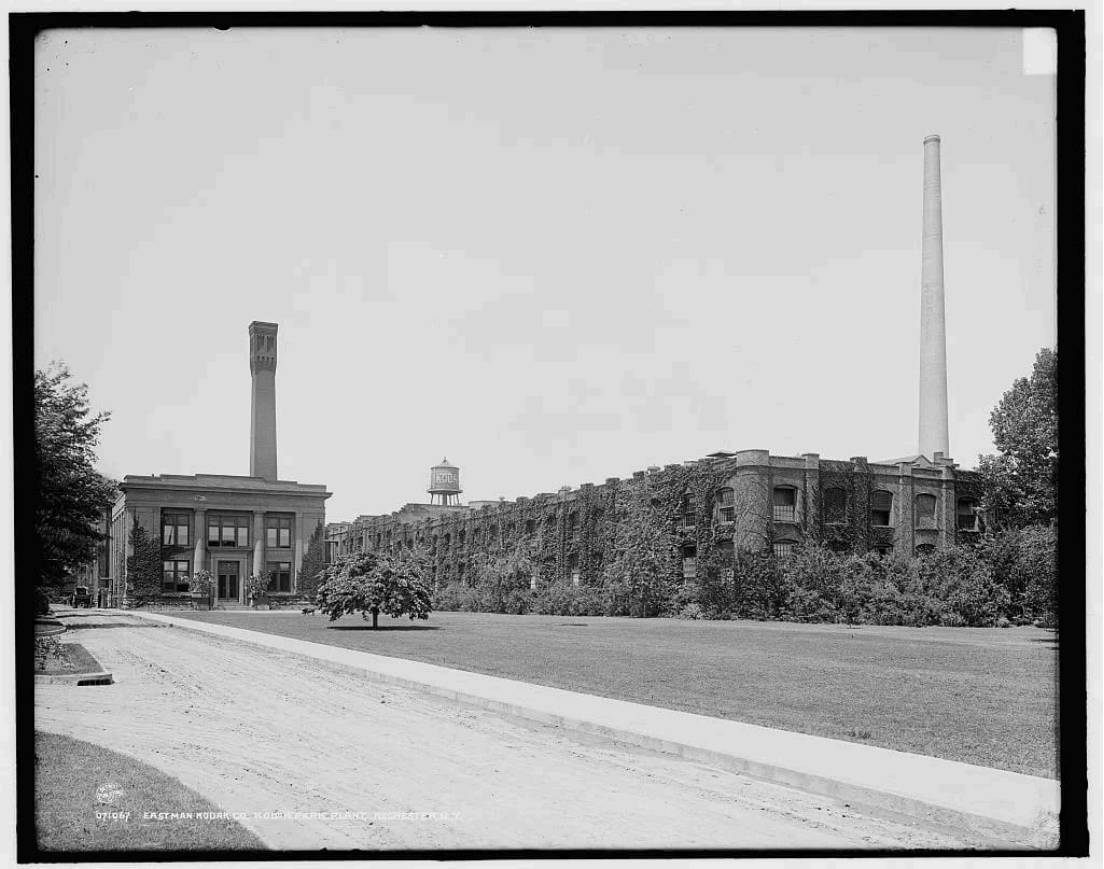
Historians of photography and historians of science consider the circulation of photographs and images as an important field of study, yet the transnational or transatlantic circulation of photographic knowledge has been studied less frequently. An interesting exception is Maria Inez Turazzi's recent book *The Oriental-Hydrographe and Photography*. Her study shows under what circumstances the art and technology of photography spread to South America, when the *Oriental-Hydrographe* ship left Paimbœuf, a small harbour in France close to Nantes, on 25 September 1839 to cross the Atlantic Ocean. Its long-haul captain Augustin Lucas was part of Daguerre 's circle and he had secured the order of two daguerreotypes, certified by their inventor before leaving. Lucas was the first to transport, disseminate, market and promote the daguerreotype device in Portugal and in South America, especially in Brazil and Chile. Turazzi analyzes how a group of entrepreneurs envisioned and planned the dissemination of photography in America.

This essay argues that Kodak, a company governed by an "American-style" management, which provided the technology for a globalized visual culture, was built on transatlantic scientific networks and corporate culture. It sheds light on the significant and under-researched contribution of Kodak's European subsidiaries to the development of photographic knowledge.

Transatlantic sharing of industrial knowledge from the creation of the British Kodak factory

It should be borne in mind that the Eastman Kodak company was an international and, more specifically, a transatlantic organization from the earliest years. George Eastman, the founder of Kodak, not only decided to open its main factory at Kodak Park in Rochester, New York, to produce large quantities of photographic film in 1890. He also purchased a site near Harrow in the United Kingdom the same year to build another film plant for the European market. Eastman needed a technical expert to master the many

troubles of film production in Harrow. To this end, William Walker, his British Managing Director, hired the young Thomas Krohn. With a former experience as a chemist in a brewery, Krohn had no skills in photographic science. But this was typical for Eastman: he liked to recruit men without experience in the field to train them thoroughly.



Detroit Publishing Co., Publisher. Kodak Park plant in Rochester, New York [Between 1900 and 1910]

Source: Library of Congress

Thomas Krohn was hired in March 1891, and soon met Eastman in London. It was quickly decided that Krohn would learn the basic principles of emulsion-making at Kodak Park. The young chemist accompanied his top manager Eastman on his journey back to Rochester. There, he worked under the supervision of the photochemist Henri Reichenbach, who was in charge of the whole manufacturing process, and he was very impressed with his chemical skills. During these weeks of training, Krohn took a lot of technical notes including the description of the manufacturing of transparent film and formulas. He also received his first lessons in emulsion making and discovered that Kodak used only three for all its products: Permanent for bromide printing paper, Peerless for flexible film and Special to modify the nature of the two first emulsions. Once he was back in England, Krohn realized that these three emulsions were not insufficient in terms of quality and he helped develop new ones. At Rochester, he was also introduced to the complexity of the industrial equipment, particularly the long glass coating-tables used to coat a film or paper base with the emulsion. Krohn also learned that the large surfaces of glass constituting these coating-tables were made in France, and so had to cross the Atlantic before reaching Rochester to produce transparent film.

This training experience at Kodak Park initiated an important transfer of photographic knowledge from Rochester to Harrow, as Krohn returned in July 1891 to become the chief chemist at the factory. Yet during his career, the sharing of knowledge went the other way round as well. The young photo chemist was aware of the photographic literature of his time, and he had read Ferdinand Hurter and Charles Driffield's 1894 paper about the mathematical relationship between exposure and the density of the developed photographic material. [3] They had discovered the first principles of densitometry and sensitometry. In his typescript "Early Kodak Days", a memoir written in 1932 before Krohn's retirement at the request of his superiors, he discusses the benefits of the Hurter and Driffield work for emulsion-makers to better interpret the characteristics of an emulsion.

The British Library also keeps several letters dating from 1898 to 1899 between Krohn and Darragh De Lancey, Kodak Park Works' manager, which reveal that Krohn tried to convince Rochester to adopt some of Hurter and Driffield's equipment and improve emulsion formulas, at De Lancey's request. The two British chemists' method was objectively discussed and its potential underlined.

> *"At the same time I felt from the very first what you express in one of your letters that here was promise of a really scientific method for studying emulsions and that it only required patience & perseverance to understand how to apply the method for the purpose of discovering the true laws which govern the speed of emulsions, the laws of exposure, the laws of development and many other questions."* [9]



Darragh De Lancey, photograph. MIT Museum, Cambridge MA.

Source: MIT Museum

In the same letter, Krohn reported to De Lancey that he had met Driffield to get additional information about his method. De Lancey's response emphasizes the benefit of what can be described as scientific collaboration.

> *"I hope to have Mr. Harris, our chemist, prepare a statement of what we have been able to accomplish so far and will send it to you shortly together with his reply to what you have been told us in your letter. I think that a full interchange of ideas and experiments on such matters will only result in great benefit to the Company, and you may be sure that we appreciate the care and the trouble to which you went in giving us such a full account of your own work."* [10]

This collaborative work was carried out outside academic research circles. Hurter and Driffield both had degrees in chemistry, but they were already working at the chemical plant of Gaskell, Deacon and Co. near Manchester, England, as chief chemist and chemical engineer respectively. The small scientific network formed by Krohn therefore involved small-scale industrial research, at least one manufacturer of measuring instruments, Marion and Company's, and one or more independent experts also working on the method developed by Hurter and Driffield, such as the photographer John Sterry. Later in 1898, Krohn installed a photometer and an exposure machine at the Harrow Works and sent the same equipment to Kodak Park in Rochester, continuing to instruct De Lancey and his technical team about the best method for using it. [4]

This first case of cooperation between independent researchers and several Kodak managers from two continents represents an important turn in innovation. Krohn's recollections demonstrate that the new strategy which led to the opening of a research laboratory in 1912 did not suddenly emerge from scratch. On the contrary, they reveal that the previous laboratory work at Kodak was not just about solving production issues, and involved fruitful exchanges of technological knowledge between both sides of the Atlantic.

Recruiting a British expert to direct Kodak's first Research Laboratory

As a matter of fact, the creation of the Kodak Research Laboratory at Rochester had a strong transatlantic background. George Eastman was deeply influenced by the advances of the German chemical industry in basic and applied research. In the winter of 1911, he visited the Bayer company's chemical plant in Elberfeld in Germany. His main interlocutor, Dr. Duisberg, told him that their research department employed 700 chemists, and wanted to know how many researchers were working at Kodak Park. George Eastman avoided answering the delicate question... But something was clear: he wanted a strong and organized Kodak Research Laboratory at Rochester. Again, "Old Europe" provided him a perfect expert in the young and complex science of photography.



"George Eastman with motion picture camera", Photograph. MIT Museum, Cambridge MA.

Source: MIT Museum

In 1903, the young Kenneth Mees and his University of London classmate and friend Samuel Sheppard discovered the research work of Hurter and Driffield about the sensitiveness of photographic plates and soon developed a true passion for photochemistry. They got their doctorate in 1906 from the publication of eleven papers, and authored that same year the influential *Investigations on the theory of the photographic process*. Finally, Mees decided to start a career in the photographic industry. He became the young managing director of Wratten & Wainwright in Croydon, a small firm manufacturing panchromatic plates, colour filters and safelights from 1906 on. He helped improve the company's technology for plate production and develop new products. Mees was networking with the German industry and got access to promising sensitizing dyes made by the Hoechst company, near Frankfurt. He managed to create a new panchromatic plate (i.e., photosensitive to the whole spectrum of visible light).

In 1909, Mees crossed the Atlantic for a professional trip and paid a visit to Eastman, asking to visit Kodak Park. It was his first meeting with Kodak's founder, and Eastman never forgot Mees. In January 1912, Eastman came to London and visited Wratten and Wainwright's small factory with Mees, being especially interested in their production of photographic filters. The next day, he offered Mees the job of creating, organising, and directing a new research laboratory in the heart of Kodak Park in Rochester. For Eastman, the deal was meant to organize of a transfer of European technology to the United States to maximize his chances to produce scientific knowledge and develop innovative marketable products from the new research structure. After some hesitation, Mees accepted the position, provided that Eastman took over Wratten & Wainwright, moved its production to the United States and continued to manufacture the filters under the Wratten name. The request to buy the company Mees worked for and owned shares in came from its founder Frederick Wratten and his son Sidney. It was their condition to let Mees leave for Kodak.

Finally, the newly appointed director went to Rochester in April 1912 to start the building of the laboratory and Wratten & Wainwright merged with Kodak Limited. Mees also had his own doubts about his new position and duties, and the prospect of leaving London for Rochester was not a pleasant one. He asked himself if he was the right man for the many responsibilities to come. As Mees wrote, "I told to Mr. Eastman, "I'm too young", and he said: "That is a trouble that will get a little better every day"." [5]



Kenneth Mees, c. 1912

Source: Wikicommons

It is worth mentioning that in 1912, the Atlantic Ocean could have ended Eastman's dream of a research laboratory. When the RMS Titanic sank on April 14, Kenneth Mees was cruising back to England. Fortunately for Eastman, his new research director did not become a victim of the Titanic tragedy, as he was travelling on the RMS Caronia:

> *"On the morning of April 15, the steward woke me with the news that the Titanic had sunk about 700 miles from us. We had turned back to go to her aid, but at that distance could do nothing, and the Carpathia of the same line was very much nearer."* [11]

Without Mees, Kodak research would have been totally different. It is hard to say if lenticular Kodacolor in 1928, tri-color Kodachrome in 1935 and even Eastman Color negative motion picture film in 1950 would have been introduced to the market without his strategic influence. Lenticular Kodacolor was an unfinished color process which nevertheless demonstrated the great capabilities of Kodak research. Tri-color Kodachrome, initially introduced as amateur color motion-picture film, was of considerable importance in both amateur and professional photographic use until its production was discontinued in

2009. The Eastman Color negative process was the basis for a wide range of Kodak Eastmancolor products, which dominated film production in the second half of the twentieth century. Thus, the visual culture of the Atlantic world during the last century was partly shaped by Mees' technological and managerial legacy.



New-York Tribune.

NEW-YORK, THURSDAY, APRIL 18, 1912—FOURTEEN PAGES. * PRICE ONE CENT

TITANIC'S SURVIVORS, STORM DELAYED, EXPECTED TO-NIGHT; NAMES OF 442 SAVED NOW KNOWN

DIAGRAM SKETCH OF THE TITANIC AND AN ICEBERG OBSERVED NEAR THE SCENE OF THE DISASTER.

Weather Conditions and Aerial Interruptions Prevent Details of the Disaster Reaching Shore Stations from Steamship with Survivors.

CARPATHIA HAS BUT 705 SAVED, UNCONFIRMED MESSAGE STATES

Unsubstantiated Reports of Scenes of Terror and Panic on Titanic Gain Circulation—Preparations Made to Care for the Sufferers When They Land.

MEXICO TELLS U. S. "KEEP HANDS OFF"

LIST OF TITANIC CABIN SURVIVORS ON CARPATHIA

HALIFAX HEARS THE BALTIC MAY HAVE 250 SURVIVORS

ASTOR NOT ON CARPATHIA

TAFT'S MESSAGE NOT TAKEN

New-York Tribune (New York, NY), Apr. 18 1912

Source: Library of Congress

The young research director was not the only British citizen to cross the Atlantic in 1912. He wisely selected his team of researchers and hired his friend Samuel Sheppard, the emulsion-maker at Wratten James Baker, as well as another ex-employee, John Capstaff, and John Crabtree, a young English chemistry student. Capstaff would take an important role working at Rochester in the development of cinematographic color processes. Mees did not just recruit several of his acquaintances or former colleagues. Focusing primarily on technical and scientific skills, he was well aware of the importance of recruiting contacts in the German chemical industry in particular, in order to benefit from its lead in dye synthesis. However, he did not succeed in recruiting the Russian-born expert Emanuel Goldberg, a skilled scientist who would later work for Zeiss Ikon and invent the Kinamo, and the German dye chemist at Hoechst Dr. E. Koenig.

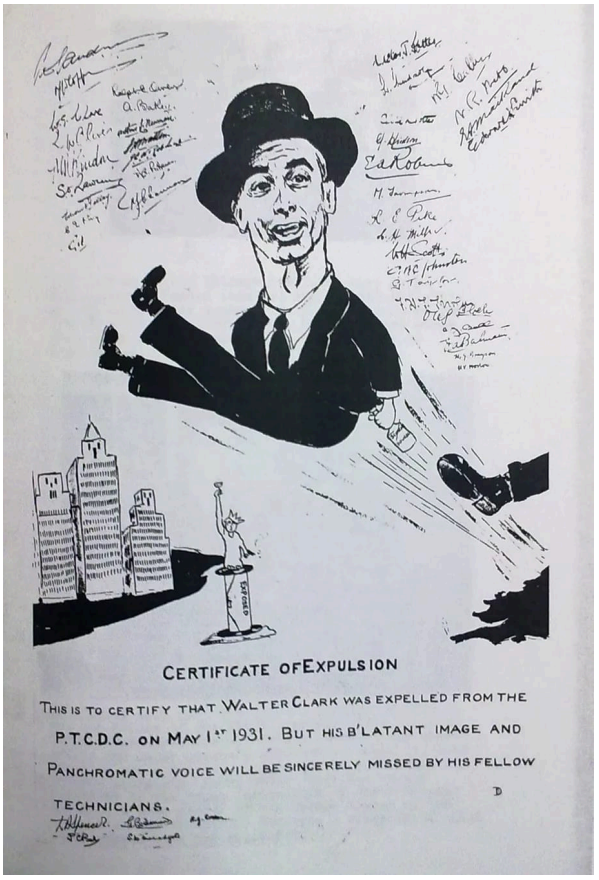
A transatlantic network of research centers

The Kodak Research Laboratory did important work to increase the scientific knowledge of photographic processes in the 1910s. But Eastman and Mees increasingly considered the desirability of using European know-how in research and innovation. When Mees had to temporarily replace the director of Kodak Limited in London from 1923 to 1924, he was disappointed by the absence of a research laboratory, in

addition to the standard works laboratory performing testing and analysis of raw materials. The potential benefits of creating a transnational scientific organization, as has been stressed by Sally Horrocks in 2007, through fundamental research activities in the context of industrial innovation, might have also pushed Mees to open a research facility in England. We know from an internal report filed in the 1970s that Mees was disappointed during one of his visits to the Harrow factory that the research reports coming from Rochester were not classified in a technical service but at the head office in Kingsway in central London. The risk was that reports would not circulate between the capital's heart and the factory. This suggests that Mees decided that a major reason to add a research laboratory in Harrow was to make use of the photographic knowledge sent by the team of the American Kodak laboratory. To direct the new facility, Mees approached Walter Clark, a skilled photochemist at the British Photographic Research Association who carried out pure research in photography and photochemistry. As Clark testified in the 1970s:

> *"So I went up to see Dr. Mees who said: 'Clark, I have followed your work with interest. I want to start a research laboratory for Kodak in England. Would you like to run it for me?' I said 'Yes.' 'Good,' Mees said, 'You must come to Rochester and see how we do it there.'"* [12]

It is striking to see how Mees replicated the recruitment technique used by George Eastman with Thomas Krohn and himself to instruct the freshly hired staff by sending them to Rochester "to see how things are done." [6] Once again, the trip to the United States was necessary to collect industrial knowledge and share it with colleagues back in England. In May 1931, Walter Clark left the direction of the British Laboratory for Rochester and joined the American one as the assistant director of research. His British colleagues presented him with a particularly relevant caricature, a so-called *certificate of expulsion* showing him being literally kicked out of the United Kingdom, and sent flying over the Atlantic. Welcoming him is the Statue of Liberty, which stands on top of a roll of Kodak film as its base. Clark would cross the Atlantic again in 1939 to approach Gabriel Cromer's widow on Kodak's behalf, and eventually acquire a collection of some 6,000 photographs, which was fundamental in the foundation of the Eastman House Museum.



Walter Clark leaving Kodak Limited for Eastman Kodak at Rochester, New York, in May 1931

Source: "The Harrow Research Laboratory. Origins and Growth 1928-1976. A Retrospective Album" (unpublished report, Harrow Research Laboratory, Harrow, 1977), 9 (De Montfort University, Kimberlin Library, KC 338.4777 HAR)

The creation of the British research laboratory was not Mees' only action to develop Kodak Research across the Atlantic. In 1927 Charles Pathé, founder of the French Pathé Frères company and one of Kodak's main competitors, wanted to sell his business of cinematographic and photographic film manufacturing. Eastman took advantage of this opportunity and bought the Pathé-Cinéma Works in Vincennes, keeping the technical and research staff. After the merger was finalised, Mees encouraged teamwork between the British and the French researchers, but Kodak-Pathé ended up having its own research laboratory, beginning probably in the early months of 1928. Mees did not choose a manager from the former staff of Pathé-Cinéma to direct the new research structure. On the contrary, he appointed the photochemist Marcel Abribat, a former technical consultant of the *Société Anonyme Française Kodak* (Kodak S.A.F.), the French subsidiary of Eastman Kodak opened in 1897. The Kodak research transatlantic network had extended its reach to produce and circulate technical and scientific knowledge. This circulation not only happened in the context of internal research among the Kodak laboratories, but also in the framework of collaborations with independent inventors, like the photochemist Karl Schinzel and the project of creating a new research laboratory in Switzerland.

Increasing the circulation of photographic knowledge

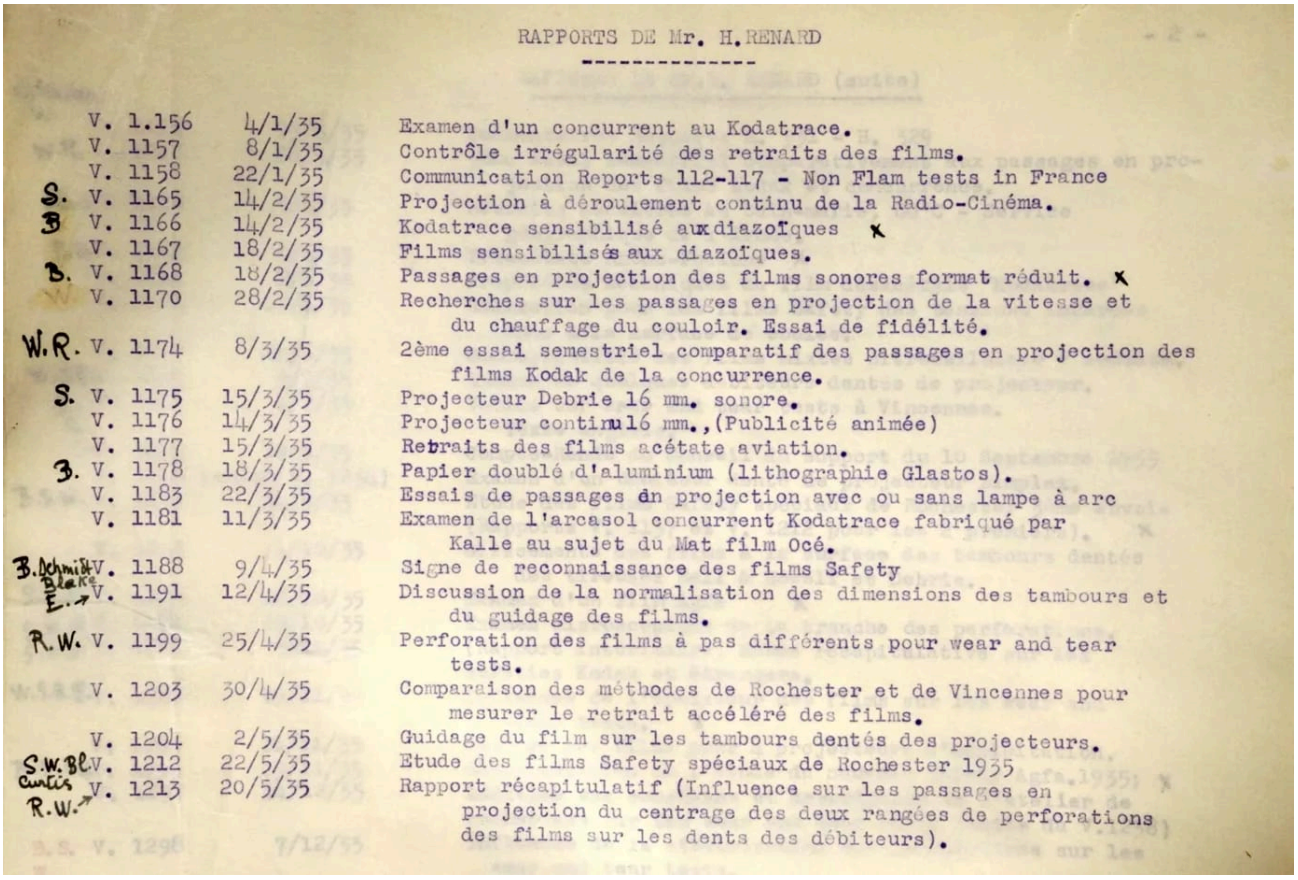
The procedures used by Kodak to promote the sharing of photographic knowledge can only be sketched briefly. One of the key tools was the progressive constitution of a body of research reports by the three research centers. This bureaucratic process was institutionalized by Kenneth Mees at the American Kodak laboratory, and taken up by its British and French counterparts from the beginning. The industrial strategy required to keep scientific and technical knowledge within the company assets, and to share it amongst the three laboratories and production departments. The Kodak-Pathé archive at Chalon-sur-Saône contains some evidence of this circulation of knowledge for the year 1935. A typescript inventories the titles of reports produced in Vincennes by 13 French researchers. It also includes a list of 2 American and 6 British addressees and states whether the report must be shared with Harrow or Rochester, with initials next to the title to indicate the identity of each colleague. At Kodak Park, the main addressee was Albert F. Sulzer, general superintendent of film manufacture and then general manager of Kodak Park from 1929 on. As the top manager of the Kodak Works he was certainly in a position to circulate the French research reports within the production departments and the American laboratory. Sulzer received 25 reports out of 159 from France in 1935 (16%). Among the many topics covered, I can mention the following:

• a study of the 16mm Debrie projector including sound playback (v. 1175) and a study of the production of Safety film at Rochester (v. 1212), by one Mr. Renard.

• a project of solvent recovery at the Sevran factory by Mr. Bousquet (v. 1278)

• a study of the quality of triacetate made by the French supplier Usines du Rhône, by the analytical chemist Mrs. Cuissard (v. 1249)

• a study of wood pulp cellulose nitrate, a key element in the making of photographic base, by the photochemist Alfred Landucci who would become President of Kodak-Pathé in 1946 (v. 1206). [7]



RAPPORTS DE Mr. H.RENARD

	V. 1.156	4/1/35	Examen d'un concurrent au Kodatrace.
	V. 1157	8/1/35	Contrôle irrégularité des retraits des films.
	V. 1158	22/1/35	Communication Reports 112-117 - Non Flam tests in France
S.	V. 1165	14/2/35	Projection à déroulement continu de la Radio-Cinéma.
B	V. 1166	14/2/35	Kodatrace sensibilisé aux diazoïques
	V. 1167	18/2/35	Films sensibilisés aux diazoïques.
B.	V. 1168	18/2/35	Passages en projection des films sonores format réduit.
	V. 1170	28/2/35	Recherches sur les passages en projection de la vitesse et du chauffage du couloir. Essai de fidélité.
W.R.	V. 1174	8/3/35	2ème essai semestriel comparatif des passages en projection des films Kodak de la concurrence.
S.	V. 1175	15/3/35	Projecteur Debrie 16 mm. sonore.
	V. 1176	14/3/35	Projecteur continu 16 mm.,(Publicité animée)
	V. 1177	15/3/35	Retraits des films acétate aviation.
B.	V. 1178	18/3/35	Papier doublé d'aluminium (lithographie Glastos).
	V. 1183	22/3/35	Essais de passages en projection avec ou sans lampe à arc
	V. 1181	11/3/35	Examen de l'arcasol concurrent Kodatrace fabriqué par Kalle au sujet du Mat film Océ.
B. Schmidt Blake E.	V. 1188	9/4/35	Signe de reconnaissance des films Safety
	V. 1191	12/4/35	Discussion de la normalisation des dimensions des tambours et du guidage des films.
R.W.	V. 1199	25/4/35	Perforation des films à pas différents pour wear and tear tests.
	V. 1203	30/4/35	Comparaison des méthodes de Rochester et de Vincennes pour mesurer le retrait accéléré des films.
	V. 1204	2/5/35	Guidage du film sur les tambours dentés des projecteurs.
S.W.Bl.	V. 1212	22/5/35	Etude des films Safety spéciaux de Rochester 1935
Curtis R.W.	V. 1213	20/5/35	Rapport récapitulatif (Influence sur les passages en projection du centrage des deux rangées de perforations des films sur les dents des débiteurs).

Detail from the typescript identifying the research reports made by the researcher H. Renard in 1935 and transmitted to other researchers and managers at Kodak Limited and Eastman Kodak

Source: Association CECIL, Kodak-Pathé archive, ref. 33498, « Liste des rapports (par noms d'auteurs) faits à Vincennes au cours de l'année 1935 », n.p.

The circulation of this photographic knowledge progressively increased in tandem with the growth of Kodak's research staff, especially after World War II. It was useful to share scientific findings or to solve production issues that could occur in one of the group's manufacturing plants. It was also fundamental to achieve consistency in the production of the same black & white or color film on both sides of the Atlantic. Given the experimental nature of the optimisation of film manufacturing processes and the numerous physico-chemical parameters involved, this standardization of the production was not self-evident, despite its industrial nature and the large volumes produced. Concerning the linguistic aspect of the transmission of knowledge, while some French reports were translated before they were sent, we are not aware of any English or American reports being translated into French. During the 1950s, it seems that English became the working language of the Kodak international research network.

Conclusion

For Kodak managers and researchers, it was worth enduring the constraints of geographical distance to take advantage of the best of both worlds: the old, flexible and learned Europe with its expertise in photochemistry and the dynamic and industrial United States with its know-how of engineering and project management. They succeeded in this long-lasting enterprise through back and forth crossings on transatlantic liners, but also through shared research, bureaucratic procedures and instrumentation. During this long-term process, photographic knowledge did not only circulate, it also matured and flourished. It can be argued that these successful research activities provided Kodak products with a

hegemonic imprint on Atlantic visual culture. The three-color Kodachrome process, introduced in 1935, is a perfect example. The result of a long-term collaboration between Kodak researchers and the two inventors Leopold Mannes and Leopold Godowsky, the process was optimized in the year of its launch in particular by members of Kodak's British research laboratory, and its production technology was quickly disseminated to Kodak's factories in Europe and Australia. During the latter part of the twentieth century, Kodak researchers improved the exposed Kodachrome film developing process [8] and thereby ensured the continued availability of this iconic color film in Western markets and its hegemonic use among the professional and amateur photographic population. Thus, with this transnational organization and this continuous circulation of knowledge, Kodak progressively managed to build up the aesthetic and practical aspect of twentieth century photography on several continents. This situation continued until the late 1970s, when competition from Agfa-Gevaert and Fujifilm began to erode Kodak's market share, and the economic potential of the then nascent digital photography emerged.

NOTES

1. Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford, New York: Oxford University Press, 2005).
2. Philipp Sarasin, "Was ist Wissensgeschichte ?," *Internationales Archiv für Sozialgeschichte der deutschen Literatur* 36 (2011): 159-165.
3. F. Hurter and V. C. Driffield, "Photochemical Investigations and a New Method of Determination of the Sensitiveness of Photographic Plates," *Journal of the Society of Chemical Industry* 9, no. 5 (1890): 455-469.
4. Krohn to De Lancey, n.d., 7 pages, ref. A1398, box 116, KHC-BL.
5. Thomas Howard James, *A Biography-Autobiography of Charles Edward Kenneth Mees, Pioneer of Industrial Research* (Rochester: Photographic Research Laboratories, Eastman Kodak Co., 1990), 50-52.
6. "It also provided a good idea of the hospitality of our American confrères, especially as the devices for evading the alcohol-prohibition laws had even penetrated technical circles." W. Clark, in "The Harrow Research Laboratory, 12-13.
7. "Liste des rapports (par noms d'auteurs) faits à Vincennes au cours de l'année 1935," typescript, ref. 33498, association CECIL, Kodak-Pathé archive, n.p.
8. Simplified process in 1938, K-11 process in 1955, K-12 process in 1961, K-14 process from 1974 to 2009.
9. Krohn to De Lancey, 30 April 1898, ref. A1398, box 116, Kodak Historical Collection, British Library (KHC-BL).
10. De Lancey to Krohn, 11 May 1898, ref. A1398, box 116, KHC-BL.
11. James, *A Biography-Autobiography*, 60.
12. Walter Clark, in "The Harrow Research Laboratory. Origins and Growth 1928-1976. A Retrospective Album," unpublished report (Harrow: Harrow Research Laboratory, 1977), 10.