

Recent Trends in French Historiography on Electricity

Samir Saul
Associate Professor (History)
Université de Montréal

An important body of research on the history of electricity has developed in France in the past quarter century. Activity got underway in the early 1980s, mainly at the initiative of economic historians specializing in the history of industry, railroads and public works. The world of electricity was largely unexplored. Much work had been done on the history of science, technology, banking, railways and industry, but not on the history of electric power, its production, its transmission and distribution, the variety of its uses, its economic impact, its social consequences and its cultural influence.

Yet France was one of the first countries to resort to electric energy. The Paris International Exhibition of 1881 was a showcase of electrical technology, attracting a wide public and educating it in the employment of this novel form of energy. Electrification did not proceed as rapidly in France as in other Western countries because of the relative narrowness of the market. Urban centres are major consumers of electricity, but, in the absence of a rural exodus, the expansion of French cities was fitful and slow. The growth of the country's population had stalled in the interwar years, after suffering heavy losses in the First World War. The Depression saw the economy nearly grind to a halt, wiping out what market demographic deceleration may have left. That said, France was an important producer of electrical energy and arguably the most interconnected country on earth. Hundreds of companies handled production, transmission and distribution. In 1946, when Électricité de France (EDF), the national public electricity provider, was created, the government nationalized no less than 2 400 private companies producing and distributing electricity in France. EDF was a huge firm, an ubiquitous monopoly, but an efficient and, all in all, a not unpopular one. Its background was a subject deserving the attention of historians. In this they were helped by EDF cadres, engineers and project managers ("electricians") who sensed the time had arrived to look back on their company's evolution and to reflect on the record. It is not uncommon for management in Europe to take an interest in the past of their company and that of the economic sector to which it belonged, and to rely on independent academics, mainly business historians. Although the intent may be to discover or define a "company culture", the outcome is legitimate scholarship and valuable contributions to economic history.

I. The Association pour l'histoire de l'électricité en France and Fondation Électricité de France

Historians in France seek to involve practitioners in associations dedicated to promoting the study of their area of work. The Association pour l'histoire de l'électricité en France (AHEF) was formed in 1982 with the support of EDF. It grew out of the joint effort of academic historians and EDF personnel to investigate the history of electricity in France, to favor interaction between academics and industry professionals, and to stimulate research by graduate students, many of whom were granted fellowships to do MA and PhD dissertations. The AHEF is at the origin of practically all the work done on the history of electricity in France. From 1983 to 2000, it organized 13 symposia, the proceedings of which were published in book form. In 1983, it began publishing a journal entitled *Bulletin d'histoire de l'électricité*, where articles by confirmed scholars and younger prospects disseminated the results of the latest research. The *Bulletin* also printed papers delivered at workshops

("journées d'étude") organized by the AHEF. Between 1988 and 1999, the AHEF published 9 books written by EDF engineers and staffers reviewing the history of branches and activities in which they were directly involved. The pivotal, defining project of the AHEF - spelled out in its statutes - was a three-volume wide-ranging multi-authored synthesis of knowledge accumulated on the history of electricity in France.¹

By the end of the 1990s, the phase of research inaugurated twenty years earlier came to a close or, more exactly, achieved its objectives. In January 2001, the AHEF was dissolved but its functions were assumed by the Fondation Électricité de France, the EDF foundation established to sponsor and support cultural activities. The AHEF had not succeeded in obtaining financial assistance from electrical companies. The new name was more in keeping with the fact that EDF was the sole supporter.² Transformation was a means to facilitate access to EDF archives and interviewees for research on contemporary subjects, and an opportunity to strengthen the international scope of the mission, for example by increasing the foreign membership on the steering committee. The *Bulletin d'histoire de l'électricité* was replaced by *Annales historiques de l'électricité*. The outlook changed somewhat, with issues becoming thematic and aimed at a wider audience. Abstracts are in French and in English and some articles are published in English. A commercial publisher is now entrusted with the periodical, although Fondation Électricité de France extends financial support. It has become less frequent, appearing once a year since it was launched in 2003. The Fondation EDF organized one symposium in 2003, with the proceedings appearing in 2004 as a special number of *Annales*. In 2001, a guide providing researchers with information about archival sources and publications on the history of electricity in France was published by the Fondation EDF.³

Thanks to the AHEF and the Fondation EDF, the history of electricity in France is now an established field of knowledge endowed with a considerable corpus of scholarly literature. In all, production directly due them and bearing their stamp, amounts to an impressive 22 370 pages. Here is the breakdown so far:

13 volumes of symposia proceedings - 6 105 pages

9 books - 4 906 pages

1 guide - 352 pages

3 volumes of *Histoire de l'électricité en France* - 3 633 pages

36 issues of *Bulletin d'histoire de l'électricité*, plus 3 special numbers - 6 690 pages

4 issues of *Annales historiques de l'électricité* - 684 pages.

This total excludes the books published on electricity outside the purview of the AHEF and the Fondation EDF, as well as the dozens of MA and PhD dissertations produced throughout France as interest in the history of electricity developed. The hectic pace of the first two decades has abated but publications on the history of electricity continue at a steady pace.

The intent of this paper is to take stock of the work accomplished and make it better known outside its original French setting. Its aim is to identify the themes which attracted attention, the outcome of the research done and some areas remaining to be investigated.

II. Symposia : avenues of original inquiry

¹ *Histoire de l'électricité en France* (Paris : Fayard). Volume I on the years 1881-1918 was published in 1991; volume II on 1919-1946 in 1994; volume III on 1946-1987 in 1996.

² Sophie Coeuré, "Développer l'histoire de l'électricité : mécénat et recherche universitaire", *Des barrages, des usines et des hommes* (Grenoble : Presses universitaires de Grenoble, 2002), pp. 55-60.

³ Arnaud Berthonnet, ed., *Guide du chercheur en histoire de l'électricité* (Caen: Éditions La Mandragore, 2001).

Each symposium was structured around a theme but the boundaries were not rigid and participants had some leeway to speak to related subjects. The first symposium in October 1983 established the parameters and laid the groundwork for the program of research that would follow by focusing on general problems and methodology of the history of electricity. In his opening remarks, Marcel Boiteux, president of the AHEF and former president of EDF, observed that electricity was by nature large scale; more than coal, this new source of energy had organizational properties and an inherent capacity to structure the environment.⁴

In the introductory paper,⁵ two historians tried to explain why, despite no lack of technical talent or know-how, France had fallen behind Germany and the US in the domain of electrification at the start of the 20th century. Dearth of venture capital was not the reason; electrical companies had sufficient financial means at their disposal, internally or on the financial market, to carry out investments. The other hypothesis pertains to market conditions for consumption of electricity. Demand for low tension domestic use, such as lighting, was sluggish, compared to other developed countries. France was not yet a mass consumer society. It was less wealthy on account of successive blows - loss of revenue and depleted savings during the agricultural depression of the 1880s, devastation during the First World War, inflation in its aftermath, deflation and stoppage of investment during the 1930s. Electrical producers and distributors emphasized high-tension industrial use in the wake of the post-World War I reconstruction effort. Imbalance ensued between production for industry and production for private consumption. With the onset of the Depression, industrial demand fell and the whole electrical sector found itself in a state of overcapacity.

The inclusive outlook of the research envisaged was highlighted by papers on the links between the history of electricity and that of technology, the economy, finance, law, local conditions, medicine, "mentalities", art, literature, the status of women, and politics. Extended questions-and-answers periods accorded to each paper were reprinted in the volume of proceedings. Although some of the presentations were tentative, the symposium revealed how quickly research had gotten underway, the large number of avenues the study of electricity opened and the wide range of subjects remaining to be delved into.

The next symposium was held in April 1985 around a wide theme loosely translated as France from the standpoint of electricians.⁶ It covered large sub-themes such as production and uses of electricity, electrical science and techniques, as well as relations between electricity and society. In his preliminary comments, Boiteux justifiably noted three features in the papers presented : the attention they paid to local conditions, the importance of hydro-electricity, and long-standing achievements in the history of science and technology. He also pinpointed areas insufficiently explored, such as the history of thermal power.

In the opening paper, a CNRS researcher⁷ pointed out that, until the 1880s, small rivers and waterfalls were the leading source of power in France. Only then did steam engines become more important than water-driven machines. After 1919, progress in high tension transmission of electricity and greater interest in the potential of glaciers made large-scale production of hydro-electricity feasible, as populated areas in the north could be supplied with current generated from the mountainous regions of the south-east. The coming of large amounts of "white coal" definitely marginalized the more modest production of "green coal". Although the 1940s and 1950s were the heyday of hydro-electric power and construction of dams, the interwar years witnessed the launching of many projects. Hydraulic electricity was

⁴ *L'électricité dans l'histoire. Problèmes et méthodes* (Paris : Presses universitaires de France, 1983), pp. 6-7.

⁵ Maurice Lévy-Leboyer and Pierre Lanthier, "Histoire de l'entreprise et histoire de l'électricité", pp. 13-24.

⁶ *La France des électriciens, 1880-1980* (Paris, Presses universitaires de France, 1986).

⁷ Serge Benoît, "De l'hydromécanique à l'hydro-électricité. Les rôles des sites hydrauliques anciens dans l'électrification de la France : 1880-1914", pp. 5-36.

already more important than thermal electricity in France on the eve of the Second World War. The Kembs dam (Alsace) was inaugurated in 1932 and Génissiat (on the Rhône river in the Alps), begun in 1937 and terminated in 1949, spanned the two periods. Papers were devoted to each of the works.⁸ There were other major works in the Alps, such as Tignes and Roselend-La Bathie, finished in 1952 and 1961 respectively.

One contribution by an economic historian explored the reasons for the relative lack of success of French exporters of electrical equipment, products and components.⁹ It pinpointed the refusal of foreign firms - such as General Electric, Westinghouse, AEG or Philips - to allow their French subsidiaries or licensees to compete with them on the international market, absence of a sales network inside and outside France, unreliable demand at home and weaknesses in the structure of the nation's industry in general.

Some of the other subjects dealt with in the section on uses of electricity were rate policy; the flight in 1884 of "La France", the first electric dirigible; military uses of electricity; and the history of fluorescent (neon) lamps in France since their introduction in 1937. A section on science and technology comprised studies on electrotechnique (applications of electricity), Zenobe Gramme's dynamo, radiotelecommunications, electropathology (accidents due to electricity), supraconductivity (absence of resistance to electricity), magnetohydrodynamics (motion of an electrically conducting fluid through a magnetic glass), and lasers. The final section on electricity and society contained papers on the teaching of electricity in elementary school and at the École Polytechnique, the science fiction novelist Jules Verne, the science popularizer Louis Figuier, the press in the 19th century, philately and the mythology of electricity.

In April 1986, the AHEF held its first international gathering, which was also its third symposium.¹⁰ Its object was the electrification of France but it kept in mind the international context and encouraged the comparative approach. The situation in Sweden, Finland, Scotland, Italy, Spain, Belgium, Germany, Hungary, Rumania and the provinces of Québec and Ontario came under review. In a section on techniques and engineers, papers examined the birth of high tension and galvanometry (the measurement of the strength of electric currents), the Swedish heavy electrical industry, the use of hydraulic resources in southern Italy, the formation of electrical engineers in Italy, Japan and Great Britain. A paper presenting the Thomas E. Edison Papers Project was preceded by one revealing the methods used to give Edison's incandescent lamp the edge over that of the British inventor Joseph W. Swan at the Paris exhibition of 1881. The competing products were of comparable quality but Edison had public relations advance men in Paris whose techniques of persuasion included payments to the press. Hitherto critical establishment newspapers were not above showering praise upon transfer of cash, a crude and telling illustration of media mores. The paper is based on correspondence from the archives at the Edison National Historic Site at West Orange, New Jersey.¹¹ The last section on industry and society dealt, among other subjects, with the technological-determinism-versus-social-determination-of-technology dilemma, finance and the electrical industry in Switzerland, the electrification of the workshop, the

⁸ Michel Banal, "Un événement dans la morosité de 1932 : l'inauguration de Kembs", pp. 47-62; Dominique Barjot, "Une réussite technique à valeur de symbole : Génissiat (1937-1949)", pp. 63-78.

⁹ Albert Broder, "Le commerce extérieur des matériels électriques et électrotechniques en France de 1892 à 1939. Étude comparative avec l'Allemagne", pp. 127-159. Before 1914, France's exports of electrical goods amounted to no more than 7% of the combined total of Great Britain, Germany and the US. Henri Morsel, "Panorama de l'histoire de l'électricité en France dans la première moitié du XX^e siècle", 1880-1980. *Un siècle d'électricité dans le monde* (Paris : Presses universitaires de France, 1987), p. 96.

¹⁰ 1880-1980. *Un siècle d'électricité dans le monde* (Paris : Presses universitaires de France, 1987).

¹¹ Robert Fox, "Edison et la presse française à l'exposition internationale d'électricité de 1881", pp. 223-235.

redployment of urban industrial activities in Canada and France, the role of urban transport in Britain's electrification, and the Italian branch of the Edison company from 1881 to 1919.

The fourth symposium, held in May 1987, was devoted to consumers.¹² It was pointed out at the start that, until 1914, demand for electricity in France tended to exceed supply. After the war, structural limitations of the market caused demand to lag behind available energy, forcing producers to conduct campaigns during the 1920s to promote consumption. The fare is generous but the majority of papers focus on the pre-1914 period. Subjects include consumption in the south west of France, electrification of the home as portrayed in the popular literature, agricultural applications of electricity, the recourse to electricity to produce substitutes for chemicals, such as nitrates, used in explosives during the First World War, demand by aluminum producer Pechiney, and Jean Dourgnon's use of lighting as an artistic application of science. Papers in the second section present the varieties of ways devised to stimulate consumption of electricity and "construct demand," such as meters, rate policy, exhibitions and advice to consumers.

From consumption, research turned to production, moving from a downstream (*aval*) to upstream (*amont*) standpoint. The fifth symposium held in April 1988 was all about civil engineering, electrical construction firms and installers.¹³ The majority of participants came from industry. The section on civil engineering provided an overview of France's hydro-electric dams, conceptual tools employed by French electrical engineers in the interwar period, hydro-electric works in mountainous regions, the role civil engineering in the electrification of North Africa, and a study on the Grands Travaux de Marseille, an important public works company and the first major French civil engineering firm to take an interest in power stations. Contributions in the electrical construction section scrutinized Neyrpic, a manufacturer of large hydraulic machinery for dams, Jeumont-Schneider and Alsthom, two leading manufacturers of electrical equipment, and the Tréfileries et laminoirs du Havre, a wire-drawing mill. As expected, the section on installers confirmed the existence of a large number of actors in this domain. In his closing remarks, the economic historian François Caron concluded that, notwithstanding the role of demand as a driving force, technology was subject to internal dynamics independent from the pressure of demand. The question as to whether technological development is mainly determined by the demand pull of economic forces or by the supply push of exogenously operating factors is a classic in economics and the history of science.

The second international symposium - and sixth of the AHEF - brought together 42 speakers from 20 countries in July 1990.¹⁴ The reader of the proceedings is given a ground-level tour of the state of research on the history of electricity around the world. The panorama is breathtaking. Five sections were concerned with scholars and engineers, the history of electrification, the socio-economic context, and industry. The Italian, Brazilian, Norwegian, Belgian, American and French cases were represented by more than one paper. This publication remains a reference work.

Financing electrification was the theme of the seventh symposium which took place in December 1991.¹⁵ Financial strategies of French electricity companies prior to nationalization in 1946 was the theme of the first section. The *Énergie industrielle*, the *Union d'électricité*, the *Société d'électricité de Paris*, the *Énergie électrique du littoral méditerranéen*, the Alexandre Giros and Louis Loucheur group and their *Société générale d'entreprises* came under review. Financing the electrification of France, especially rural areas and railways, took up the second section. The third dealt with external financing of the electrical industry

¹² *L'électricité et ses consommateurs* (Paris : AHEF, 1987).

¹³ *Des entreprises pour produire de l'électricité. Le génie civil, la construction électrique, les installateurs* (Paris : AHEF, 1988).

¹⁴ *Électricité et électrification dans le monde* (Paris : AHEF, 1992).

¹⁵ *Le financement de l'industrie électrique, 1880-1980* (Paris : AHEF, 1994).

through the financial market. Then came a section on international comparisons, specifically Germany and Great Britain. Financing EDF and investments by EDF constitute the final section.

The eighth symposium, on electrical networks and installers (or fitters), was held in October 1992.¹⁶ The majority of speakers came from industry. Interconnection in France before nationalization was the theme of the first section. The specialist on the electrification of Paris spoke about how the governing ideas of unification, standardization and economies of scale led to interconnection in the Paris region.¹⁷ The next section dealt with technical constraints, for instance in the construction of overhead cables and high tension relay stations. The last section was about firms and the profession. Taking the long view, the historian of France's public works companies gave a paper on the Société générale d'entreprises.¹⁸ Others examined the export of electrical cables by CEGELEC; the Empain group and the Parisienne électrique; its successor since 1944, the Société parisienne pour l'industrie électrique (SPIE); l'Entreprise industrielle; Force et lumière (Forclum); and Trindel.

The centenary of the École supérieure d'électricité in 1994 inspired the ninth symposium which was also the third international gathering. It took place in December 1994 and had as a covering theme the formation of electrical engineers and engineers in electrotechnology. The approach was comparative. European and non-European experiences were weighed with a view to explaining the interplay of formation, research and growth of the electrical industries in the nineteenth and twentieth centuries.¹⁹

The tenth symposium, concerning electricity and railroads, followed in May 1995.²⁰ The intertwining of the history of technical innovation, business history and entrepreneurship was the underlying *problématique* of the gathering. Firms were often hesitant and not always in tune with technological change. Some missed opportunities to remain at the cutting edge. Not unexpectedly, much attention was paid to collaboration between electrical and railway companies, and to the challenges inherent in establishing ties of partnership.

In April 1996, on the fiftieth anniversary of the nationalization of electricity and gas in France, the eleventh symposium asked a direct question : did nationalization proceed from technical necessity or political considerations ?²¹ In their introductory comments, Dominique Barjot and Henri Morsel noted that historians concurred that political concerns were present, but were not of one mind about technical necessity.²² The symposium drew a large attendance, as well as the media. The first section looked into the state of the 2 400 companies on the eve of nationalization. Financially, at least, they seemed to be in good shape, although a need for technical harmonization was felt. Then came sections on the actors in the world of business and in politics, and their ideas; another on the legislative dimension; and the last on comparisons with the rest of Europe.

¹⁶ *Réseaux électriques et installateurs* (Paris : AHEF, 1995).

¹⁷ Alain Beltran, "L'interconnexion dans la région parisienne dans la première moitié du XX^e siècle", pp. 31-43.

¹⁸ Dominique Barjot, "Un grand constructeur de lignes : la Société générale d'entreprises (1899-1970)", pp. 171-207

¹⁹ *La naissance de l'ingénieur-électricien. Origines et développement des formations nationales électrotechniques* (Paris : AHEF, 1997).

²⁰ *Électricité et chemins de fer. Cent ans de progrès ferroviaire en France par l'électricité* (Paris : AHEF, 1997).

²¹ *La nationalisation de l'électricité en France : nécessité technique ou logique politique ?* (Paris : AHEF, 1996).

²² François Caron considers that companies were not facing serious financial difficulties and that nationalization was a political act. "Dynamique des systèmes techniques et 'capitalisme' : le cas de l'industrie électrique en France 1880-1939", *Histoire, économie et société*, 19/3, 2000, p. 410.

Management and human resources was the theme of the twelfth symposium held in February 1999.²³ In the section on the international context, light was thrown on the situation in France, Belgium, Switzerland, the United Kingdom and Italy. Special attention was given to the effect of the two world wars in the second section. The third was devoted to decision-makers and accounting and management methods.

The thirteenth gathering and fourth international symposium, held in June 2000, was about electricity in the colonial world.²⁴ In the introduction, D. Barjot observed that electrification of the colonies was an upstream (*amont*) process, more in tune with European need for raw materials than with local demand for electricity, more concerned with transportation and industrial uses than with lighting. Generation of hydro-electric power came as a by-product of the construction of dams for purposes of irrigation. The proceedings are divided in four parts : the archives about the overseas territories; uses of electricity; actors and the place electricity overseas occupied in the strategic decisions of firms companies and banks; and policies of colonial powers.

The last symposium was held in December 2003 on the twentieth anniversary of the publication Thomas P. Hughes' *Networks of Power : Electrification in Western Society, 1880-1930* (Baltimore : Johns Hopkins University Press, 1983).²⁵ Hughes held that technology was socially constructed and technologies socially shaped. Based on the experience of the United Kingdom, the United States and Germany, he hypothesized that leadership in the field of electricity passed from inventors to industrialists, then finally to financiers. Using his concepts as starting points, 17 French and non-French historians examined the notion of networks as it applied in technology, human resources, regulation and deregulation, culture, innovation and colonies.

As research on electricity diversifies and specializes, quality improves markedly, giving almost all contributions a pathbreaking character. Singling out ones that stand out or, on the other hand, finding common threads or overarching conclusions becomes an insurmountable challenge.

III. Journals : a record of ongoing research

The *Bulletin d'histoire de l'électricité* began modestly in 1983 with two articles, a document and two bibliographies. The number grew to three then four in the next two issues. Over the years, the number increased steadily. From a yearly publication in 1983 and 1984, it became semiannual from 1985 to 2000. Articles covered the range of subjects relating to electricity, from the technical aspects to business history and cultural meaning, from the national perspective to local history.

The *Bulletin* published proceedings of workshops (*journées*) the AHEF held. Appropriately, the first in 1985 was about scientific discoveries and technical innovations.²⁶ The second, a year later, was organized around the theme of electrical and telecommunications networks in France from 1840 to 1940. Subsequent workshops were about medicine and electricity, the electrical profession, regional history, art and electricity, women and electricity, international comparisons of production and distribution, weapons and

²³ *Stratégies, gestion, management. Les compagnies électriques et leurs patrons, 1895-1945* (Paris : Fondation EDF, 2001).

²⁴ *L'électrification outre-mer de la fin du XIX^e siècle aux premières décolonisations* (Paris : Société française d'histoire d'outre-mer and Fondation EDF, 2002).

²⁵ Proceedings in *Annales historiques de l'électricité*, #2, June 2004.

²⁶ *Bulletin d'histoire de l'électricité*, #5, June 1985.

defense, the status of electricians, toys and electricity, the Nivernais and electricity, utopias and electricity.²⁷

Among noteworthy articles is H. Morsel's portrait of the business leaders in the electrical sector during the interwar period.²⁸ Another is D. Barjot's demonstration of the way French companies overcame the problem of finding capital and continued to invest in increasingly expensive equipment during the interwar years.²⁹

Issues of *Annales historiques de l'électricité* are either wholly devoted to a theme or contain a thematic *dossier*. One has been published each year since 2003. The first was entitled nationalizations and denationalizations of electricity; articles covered France, Canada, China, the US, the UK, Japan, Mexico and Argentina. The second was about networks of power. The *dossiers* in numbers 3 and 4 took up the issues of electricity and the environment, and of the display of electricity at fairs and exhibitions.

IV. Books : monographs, memoirs and a *magnum opus*

The following is a selection of key publications in the French historiography on electricity. Exhaustiveness would be utterly unrealistic. Some idea of the distance traveled in the study of the history of electricity in France can be gathered from the fact that no further back than three decades ago the subject of nationalization was handled by a playwright and essayist.³⁰ Historians soon began to write the history of EDF, but on the basis of interviews of decision-makers and other actors.³¹ In a study of the economic and social role of innovation and technology, F. Caron showed how electricity moved from the periphery to the centre of the economic system.³² In 1991, two historians attempted to depict how French society integrated electricity. Their book is an illustrated cultural history of electrical technology or a history of uses to which electricity was put. Starting as a "mysterious fluid," electricity then displayed its wonders in the form of streetcars, metros and lighting. Overcoming resistance due to fear and suspicion, it spread quickly once social demand became firm.³³ Two thirds of the book is devoted to the pre-1914 era.

Among the books published by the AHEF and written by actors in the history of electricity in France, three stand out. Over three quarters of France's electricity comes from nuclear plants. One book relates the history of EDF's nuclear program in great detail.³⁴ Equally rich is another publication about the development of hydro-electricity.³⁵ EDF was a nationalized company expected to be a model of good labour-management relations. One book dispassionately weighs the role played by labour unions at EDF.³⁶

In 1991 the first volume of the AHEF's primary objective, an all-encompassing quasi-encyclopedia history of electricity in France, appeared. Nine historians and three engineers

²⁷ *Ibid.*, #7, June 1986; #9, June 1987; #11, June 1988; #13, June 1989; #17, 1991; #19-20, June-December 1992; #22, December 1993; #23, June 1994; #29, June 1997; #31, June 1998; #33, June 1999; #35, June 2000.

²⁸ H. Morsel, "Le patronat de l'électricité en France dans l'entre-deux-guerres", *Bulletin d'histoire de l'électricité*, #18, December 1991, pp. 31-60.

²⁹ D. Barjot, "Le financement des entreprises de production-transport-distribution de l'électricité de 1919 à 1946", *Ibid.*, #25, June 1995, pp. 5-49.

³⁰ René Gaudy, *Et la lumière fut nationalisée. Naissance d'EDF-GDF* (Paris : Éditions sociales, 1978).

³¹ A. Beltran, M. Bungener, J.-F. Picard, *Histoire(s) de l'EDF* (Paris : Dunod, 1985).

³² François Caron, *Le résistible déclin des sociétés industrielles* (Paris : Perrin, 1985), pp. 87-126.

³³ Alain Beltran and Patrice A. Carré, *La fée et la servante. La société française face à l'électricité, XIXe-XXe siècle* (Paris : Belin, 1991).

³⁴ Georges Lamiral, *Chronique de trente années d'équipement nucléaire à Électricité de France* (Paris : AHEF, 1988), 2 vols.

³⁵ Pierre Gérard, *L'épopée hydroélectrique de l'Électricité de France* (Paris : AHEF, 1996).

³⁶ Jean-Philippe Papin, *Les syndicats d'EDF, 1946-1996* (Paris : AHEF, 1996).

contributed to volume I. *Histoire de l'électricité en France* is about as complete as can be on every aspect of electricity in France from 1881 to 1987. It can be read in whole or in part, as an autonomous publication or as a reference work.

In his progress report to the 2nd symposium in 1985, Caron pointed out that a basic challenge was how to relate the economic and social history of electricity to its scientific and technical history. The first sentence of volume I³⁷ stated that the intent of the book was to elaborate a global history of electricity which would serve as a model to a more general history of technical systems. Its aim was both to comprehend the reasons for the rise of electricity as a system and to depict the original characteristics of electric civilization. The course adopted was that of working in terms of the dynamic of structures.

Volume I identified a three-stage process by which electricity made its way in French society : first opportunities offered by the new technology created social demand; then, to satisfy this demand and displace gas, it was understood that only large and powerful central stations, rather than private production, were technically rational and economically viable; finally, by the 1890s, in light of that objective, the best solution seemed to be a long-distance transmission network using high tension alternating current (AC) and a system of transformers and converters to provide consumers with low tension current, alternating or direct (DC). The years 1880 to 1919 were those of transition from a phase where availability of electricity set the pace to one where need for electricity became the engine of growth. Electrification was supply-driven, then demand-driven. The history of electro-technology is approached from two angles, that of inner technical logic and that of strategies of firms. Neither angle is given a priori preference.

Starting in the late 1880s, past initial emphasis on lighting of streets and public spaces, the electrification of urban transportation gave a decisive impulse and established a close relationship between electrification and urbanization. Lighting was not the leading sector at first. Large-scale production, transmission and distribution created a widening economic space, eventually monopoly conditions and legislative intervention intervention by government. The law of 15 June 1906 recognized for the first time that distribution of electricity was a public service which could justify work or right of passage on private property. Authors pinpointed 1906 as a turning point in the take-off of electrification in France. From 1906 to 1919 the system achieved critical mass and adequate size.

Volume II³⁸, involving 14 historians and four "electricians", showed that the First World War broke the momentum set in 1906. However, in 1916-1917, military considerations gave electrification an impetus which it maintained well after the end of conflict. During the war, transmission continued to be a leading sector for electricity. As the north of France was transformed into a battle zone, emphasis was laid on hydro-electricity to be found in the south. For practical reasons, northern France had relied on thermal power, whereas the south was more hydraulic. The building of dams and the preference for current obtained from hydraulic sources did not abate after the war. One problem volume II aimed to take up was the contradiction between the entrenched idea that the business elite was Malthusian and the expansion and concentration of electrical firms.³⁹ After 1919, overcapacity inherited from the war and high levels of investment made the search for consumers essential. There lay the limits to electrification in the interwar period. Demand reached a plateau as population ceased to grow and urbanization faltered. 1932 stood out as a turning point, only confirmed by the onset of the Depression. Production itself stagnated, as the constraints of the market exerted

³⁷ *Histoire de l'électricité en France. Tome premier. Espoirs et conquêtes, 1881-1918* (Paris : Fayard, 1991).

³⁸ *Histoire de l'électricité en France. Tome deuxième. L'interconnexion et le marché, 1919-1946* (Paris : Fayard, 1994).

³⁹ Alsthom, an important manufacturer of electrical equipment, was born in 1928.

their influence. On the eve of the Second World War, the record on electrification was ambiguous; the process had progressed but it remained uncompleted.

In volume III published in 1996, there emerged a clear succession of stages in the postwar history of electricity in France. During the years 1946 to 1960, 60% of electricity came from hydraulic sources, as dam construction was accelerated. With the fall in the price of oil, then the increased use of natural gas, fuel and gas became the main substances used in power stations. Hydro-electricity lost its primacy. When the oil crisis broke out in 1973, France turned resolutely to nuclear sources. In 1990, France's electricity was 75% nuclear, 14% hydraulic, 11% thermal (fuel, gas, coal). The share of nuclear power is now 80%.

Beyond the immediate program of the AHEF, historians published monographs on their own. Two deserve special mention; both were doctoral dissertations. The first investigated the history of *Énergie industrielle*, a major company which, less than two decades since its establishment in 1924, became France's second distributor, trailing only the *Compagnie parisienne de distribution électrique* (CPDE). The key to its success was the priority it gave to the lighting of homes, whereas the competition was more concerned with transportation and industrial demand.⁴⁰ Originally a massive doctorat d'État in the tradition of French universities, the second monograph is an ambitious historical study of the public works sector in France over a century. Electricity was not the main focus but it was inseparable from the construction of dams. From 1900, electricity was a growth sector in the economy, only held back by stiff competition from gas - considered safer, at first - and by undynamic demand due to slow urbanisation. Consumption leapt around 1904-1905 as need for power to be used in transportation and lighting of large cities made itself felt.⁴¹

Conclusion

Beginning practically from scratch about a quarter century ago, a vast storehouse of knowledge has been collected on the history of electricity in France and elsewhere. Caron described the publications by the AHEF as a sort of database.⁴² We know a lot more about production and consumption, about companies and people active in the electrical sector, about economic results and social effects, about the legal framework and the political context, about the cultural and artistic aspects of the novelty that was electricity. A large number of historians and graduate students have worked on many fronts. None can be said to have been neglected. That was the predominant trend. Recent historiography tried to embrace all of the history of electricity. To a large extent, it succeeded. What remains to be done ?

Three suggestions can be advanced. First, more attention has to be paid to the very recent history of electrification. As time passes and EDF archives become available, more work based on sources will be done on the immediate past. Second, the international dimension has to be strengthened, in two respects. On the one hand, comparisons between France and other countries need to be encouraged. On the other, connections between national electrical systems remain hazy and require clarification and understanding. Third, greater use has to be made of the interdisciplinary approach, electricity being a subject at the crossroads, at the very least, of science, technology, economics, politics, sociology, literature, art and, of course, history.

⁴⁰ Catherine Vuillermot, *Pierre-Marie Durand et l'Énergie industrielle. L'histoire d'un groupe électrique, 1906-1945* (Paris : CNRS Éditions, 2001).

⁴¹ D. Barjot. *La grande entreprise française de travaux publics (1883-1974)* (Paris : Economica, 2006).

⁴² *Annales historiques de l'électricité*, #1, June 2003, p. 7.