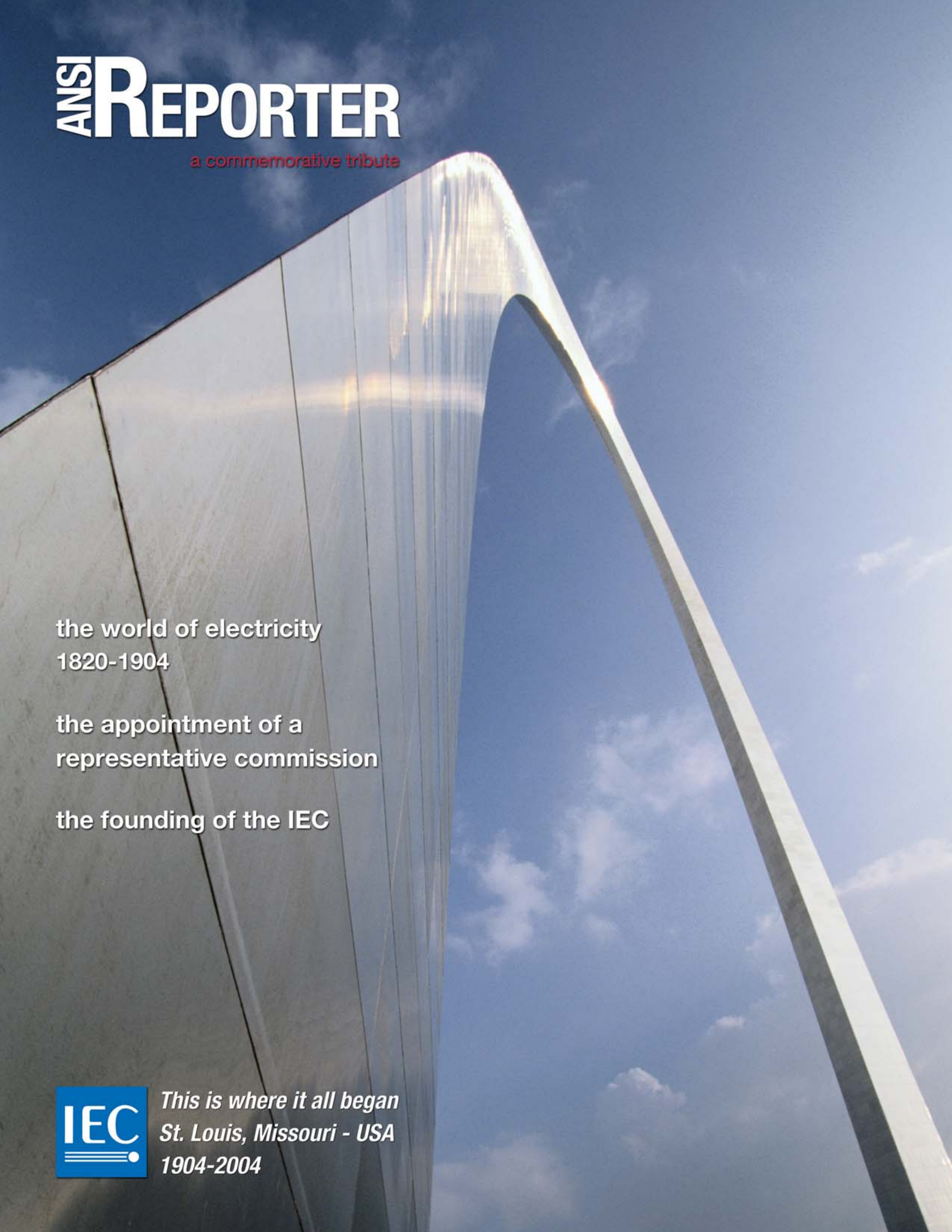

ANSI REPORTER

a commemorative tribute

the world of electricity
1820-1904

the appointment of a
representative commission

the founding of the IEC

IEC

This is where it all began
St. Louis, Missouri - USA
1904-2004

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On the Cover

Gateway Arch
St. Louis, Missouri, USA

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In 1904, leading scientists and pioneering industrialists from around the globe gathered at the Coliseum Music Hall in St. Louis, Missouri, to discuss the need for cooperation leading to the standardization of electrical apparatus and machinery. This pivotal meeting ultimately led to the establishment of the International Electrotechnical Commission (IEC) in 1906. One year later, in 1907, U.S. interests rallied to form a National Committee (the U.S. National Committee of the IEC, or "USNC") to oversee the country's participation in IEC activities. Today, the IEC promotes international cooperation on all questions of standardization and the verification of conformity to standards in the fields of electricity, electronics and related technologies.

In recognition of 100 years of global standardization efforts in the electrotechnical industry, and in remembrance of the historic meeting in St. Louis, Missouri, on September 22, 2004, the American National Standards Institute and its USNC proudly present this collection of commemorative articles to begin the IEC 2004 Centenary Celebration.

The articles in this commemorative tribute were commissioned by and are reprinted with the permission of the International Electrotechnical Commission (IEC).

ANSI REPORTER

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Publisher American National Standards Institute

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1820-1904

The World of Electricity

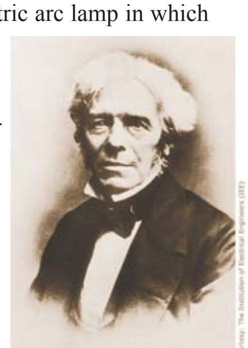
For much of the 19th century, the industrial revolution was in full swing, with electricity being harnessed for commercial purposes for the first time. This was a period of great industry and inventiveness. Author **Mark Frary**, with contributions provided by **Paul Tunbridge**, introduces many of the theoreticians and inventors that laid the foundation for the electrical world that exists today.

Following Alessandro Volta's experiments in 1800, which produced electricity by the mutual contact of discs of silver and zinc moistened with water, the study of electric current changed the direction of 19th century physics. In their search to find a continuous source of power, inventors in various parts of the world designed larger batteries but, as today, were defeated by the cost question. Mathematicians and physicists were engaged in a race to unravel the intimate relationship between electricity and magnetism. At the same time, inventors and engineers were trying to outdo each other with ingenious and ever more efficient devices and systems to produce, measure and harness it.

The "theoreticians"

The theoretical basis for understanding electricity began in the 1800s. In 1820 a Danish physicist, H.C. Oersted, demonstrated that a current passing through a wire would deflect a compass needle. This experiment enabled him to discover the magnetic effect of an electric current. When the demonstration was repeated by Professor de la Rive at the Académie des sciences in Paris, among those present was the distinguished mathematician André-Marie Ampère who began a series of researches on the phenomenon. Meanwhile, Georg Simon Ohm, a Bavarian physicist, established in 1827 the important relationship that the current through a circuit is proportional to the applied electric and magnetic fields and inversely proportional to the resistance.

The English chemist Sir Humphrey Davey, working to improve the safety of miners who relied on candles, had produced in 1802 the first electric arc lamp in which electricity was discharged between two pieces of carbon. His laboratory assistant was Michael Faraday, who in 1831, while Director of the Laboratory of the Royal Institution, investigated what he called the "evolution of electricity from magnetism." Faraday made minute and accurate measurements of electric forces. He also conducted numerous experiments through a process of magnetization and demagnetization, for which two separate insulated coils wound round an iron ring enabled him to successfully demonstrate the complex phenomena of induction. This discovery was later to pave the way for the development of electric generators and alternators. Faraday's experimental disk generator became the first to produce a continuous electric current.



Michael Faraday

In a series of papers between 1855 and 1873, the theoretical physicist James Clerk Maxwell used the mathematics of incompressible fluids to express Faraday's lines of force, establishing his famous series of equations and speculating that electromagnetism bore a remarkable resemblance to the properties of light. At the time, Maxwell said: "We can scarcely avoid the conclusion that light consists in the transverse undulations of the same medium which is the cause of electric and magnetic phenomena."

James Clerk Maxwell

However, Maxwell who died in 1879, did not live to see the experimental proof of his theory. This was left to Heinrich Hertz. Between 1885 and 1889, Hertz was a professor at Karlsrühe Polytechnic in Germany and carried out experiments in which he discharged a condenser across a spark gap, creating radio waves that were then detected by means of a resonator with a similar gap. This was the first successful transmission and reception of radio waves and Hertz was able to measure their wavelength and frequency. He subsequently showed that radio waves were reflected and refracted in the same way as light.

Sir Charles Wheatstone, an English physicist and inventor, was professor of experimental philosophy at King's College London. While in Heidelberg, Germany, studying anatomy, he attended a lecture in 1836 during which (*continued on page 4*) (*continued from page 3*) Professor Müncke demonstrated a single-needle telegraph. Impressed, Wheatstone designed the first commercially acceptable installation which two years later went into operation in England on the Great Western Railway. He also designed a workable ABC printing telegraph, which eventually failed to find a suitable market. In 1843 Wheatstone experimented with underwater telegraphy, but this model lacked the appropriate insulation for the conducting wires. Almost simultaneously, in the United States, Samuel Morse was conducting similar experiments and successfully operated a public service between Baltimore and Washington. Wheatstone is also remembered for having invented two new devices to measure and regulate electrical resistance and current: the rheostat and the Wheatstone bridge, which is named after him.

Thomas Edison was America's most prolific inventor with 1,093 patents to his credit.

The first international submarine cable service linking Dover with Calais was laid in 1851 by the British Electric Telegraph Company. In 1866, a British scientist, Lord Kelvin — who later became the first president of the International Electrotechnical Commission — went further and achieved worldwide fame with his Atlantic telegraph. Meanwhile, the mathematician Oliver Heaviside, who had worked as a telegraph operator, showed how Maxwell's equations could be reduced to more readily usable differential equations.

As public power generation became a practical reality, scientists turned their attention to the problems of dealing mathematically with electrical engineering. One of the key figures was Germany's Charles Steinmetz, who within three years of his arrival in the United States in 1889, had formulated the law of hysteresis, allowing electrical engineers to calculate and reduce power losses in motors, generators and transformers. Steinmetz went on to show how complex number theory could be used as an elegant means of predicting the behavior of alternating currents in circuits.

The inventors

While the first half of the century belonged to the "theoreticians," the second half was a period of creativity in science and engineering. Important inventors from this era included Thomas Edison, Nikola Tesla, Guglielmo Marconi and Colonel R. E. B. Crompton.

In the United States, Thomas Edison, a former newsboy, started in business making telegraph instruments. Transmitting a single signal along a telegraph cable was time-consuming and costly. Edison's multiplex telegraph enabled more than one signal on a single cable. In 1877, Edison expanded his factory to manufacture complete generators and lighting systems including his own design of filament lamp. After commercial success with his invention of the phonograph, he went on to develop the first commercially successful incandescent light bulb.

Nikola Tesla was born in 1856 in Smiljan in Croatia (then part of the Austro-Hungarian Empire) to Serbian parents and emigrated to America in 1884. He held 112 patents in the U.S. alone, including Patent 382,280 on the electrical transmission of power, for which he is best remembered.

In this patent, Tesla wrote: "By producing an alternating current, each impulse of which involves a rise and fall of potential I reproduce in the motor the exact conditions of the generator, and by such currents and the consequent production of poles the progression of the poles will be continuous and not intermittent."

Guglielmo Marconi

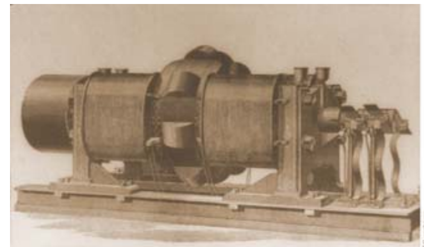
Guglielmo Marconi was born in Bologna, Italy, in 1874. By 1896, he had come to England and was helped in his experiments in wireless telegraphy by William Preece, the engineer-in-chief of the Post Office. In a letter to Preece in November of that year Marconi remarked that "this very rapid charging and discharging of the capacity throws the ether all around into vibrations which affect the conductor at the receiver." In April 1897, he admitted to Preece that "I have not yet been able to find a satisfactory explanation as to how the signals get to the other side of the hills."

The interests of Colonel Crompton ranged from automobiles, bicycles, military tanks and road engineering to electric lighting, power generation and electrical equipment. The English engineer went on to form one of the most successful engineering firms of the century, Crompton and Co. By the end of the century, despite military service in the Boer War, the proliferation of electricity and electrical devices brought him to appreciate the need for standardization at both the national and international level.

Colonel R.E.B. Crompton

The "power" generation

The first practical dynamo-electric machine to appear on the market was invented by Zénobe Gramme, a Belgian carpenter turned industrial



Brush arc lighting dynamo ca. 1882

model-maker, who in about 1870, improving upon existing machines, produced his own design. Other makers followed Gramme's initiative including Siemens in Germany and their offshoot in Britain, as well as Emil Bürgin in Switzerland. In the United States, electric power came to the masses in autumn 1882 with the opening of Edison's Pearl Street generating station in lower Manhattan.

Sebastian Ziani de Ferranti was born in Liverpool, England, in 1864. His precocious interest in electricity led him to design lighting for his father's photographic studio at the age of 13. At 16, he patented a dynamo and at 21 was made chief engineer of the London Electric Supply Corporation. It was in this role that he was instrumental in the design and construction of the world's first high voltage AC power station at Deptford in London. On its opening, the station generated power at 10,000 volts and supplied electricity to most of central London.

In the United States, the inventor George Westinghouse was particularly interested in the area of safety. He devised the world's first air brakes, automatic signals for railways and a system for transporting natural gas safely, but in 1884 he turned his attention to electrical power generation.

Tesla A.C. motor ca. 1888

Westinghouse had followed developments in AC power generation in Europe with interest. Employing the newly arrived Nikola Tesla to develop AC generators and motors, Westinghouse opened a hydroelectric power station at Niagara Falls in 1895, starting the trend for siting generating capacity at a distance from consumption — something for which AC was better suited.

Emergence of regional electrotechnical societies

The rapid pace of change at that period is particularly reflected in the growth of the learned societies between 1870 and 1890. Countries in various parts of the world started forming their own electrotechnical societies. In 1871, the Society of Telegraph Engineers was founded in London. The overlap between telegraphy and electrical engineering then led to the society broadening its name nine years later to become the Society of Telegraph Engineers and Electricians. That name lasted even less time and in 1888 it became the Institution of Electrical Engineers (IEE), the name it retains today.

In 1883, the Société Internationale des Electriciens was formed in France and the Elektrotechnischer Verein in Vienna, Austro-Hungary. The following year saw the establishment of the American Institute of Electrical Engineers. The Canadian Electrical Association appeared in 1891, followed two years later by Germany's Verband Deutscher Elektrotechniker and in 1897 by Italy's Associazione Elettrotecnica Italiana.

The British Association for the Advancement of Science appointed in 1861 a specialized committee under Lord Kelvin (then William Thomson) to study the question of electrical units. Foremost to recognize their importance, Kelvin insisted that 'when you can measure what you are speaking about, and express it in numbers, you know something about it.' The following year, as well as recommending the use of the metric system, he emphasized the need for a coherent set of electrical units.

At the 1881 Paris Congress, although lacking precise definitions, the ampere, volt, and ohm were recommended as practical units. Kelvin's pioneer work in the British Association and at the series of International Congresses contributed to the establishment of a solid foundation of electrical units and standards, and up to his death he more than any other, paved the way for their international adoption. In 1967 the unit 'kelvin' (symbol K) was assigned to the unit of thermodynamic temperature as one of the base units of the International System of Units.

International standardization

Although the importance of electrical measuring units had been universally recognized, by the end of the 19th century the lack of standardization of electrical equipment had become a worldwide problem. With the development of economic generators, filament lamps, fittings and reliable cables, local authorities and distributors for the first time could choose between the merits of different designs. But in the absence of agreed ratings and recognized performance criteria they were often obliged to follow the advice of experienced consultants. Manufacturers, on the other hand, began to appreciate that to facilitate repetitive production, simplification of designs was essential especially in reducing cost for the consumer, meeting competition from foreign producers, and providing recognized guarantees.

> **When you can measure what you are speaking about, and express it in numbers, you know something about it.**
>
> — Lord Kelvin

In Britain a committee set up under the auspices of the Institution of Civil Engineers in 1901 considered the advisability of standardizing iron and steel sections. One year later the committee was enlarged to include electrical plant. It was this committee under Sir John Wolfe Barry that finally emerged as the British Standards Institution.

The American Institute of Electrical Engineers (IEEE) had already set up a committee in 1897 to deal with electrical standardization but it was not until 1918 that the American Standards Engineering Institute (later ANSI) came into existence.

Electrical engineers in the early 20th century began to see the need for closer collaboration embracing terminology, testing, safety and internationally agreed specifications. While the 19th century had been the era of electrotechnical innovation, the emphasis was now on consolidation and standardization. While the series of International Electrical Congresses, particularly those between 1881 and 1900, had been solely concerned with electric units and standards, it was at the St. Louis, USA, congress, held in 1904 that, in the interests of commercial transactions and trade, the proposal was made for the setting up of a permanent international commission to study the unification of electrical machines and apparatus. ■

the appointment of a representative commission

Why did St. Louis host a world's fair in 1904?

Why was electricity such an important topic that people came from all over the globe to propose an international commission?

What were the steps the organizers took to convene such an august group?

What were the outcomes of these efforts?

Author **Jeanne Erdmann** answers all these questions . . . and more.

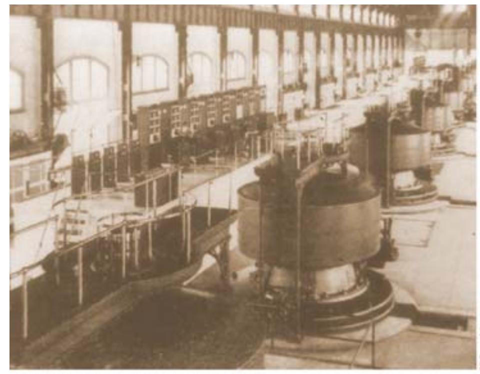
In 1903, the city of Niagara Falls bustled at the center of the North American electrical industry. By then, the power of rushing water had been channeled into electricity. George Westinghouse had built a power station there using two-phase alternating current generators patented by Nikola Tesla. Factories moved to the area because no comparable abundant power was available.

Beginning in July of that year, perhaps unnoticed by those outside the sphere of amperes and volts, Niagara Falls, USA, hosted the planning committee for a week-long International Electrical Congress in 1904. Four similar congresses, held during the preceding 23 years in different parts of the world, had all pointed towards this final one. It was to be a special part of the Louisiana Purchase Exposition in St. Louis, Missouri, which took place from May to December of that year. This congress would set the stage for a permanent International Commission on electricity.

Niagara Falls

There was a lot at stake for the Niagara committee, which was organizing the scientific sessions of the Electrical Congress. Although electricity was still in its infancy, the commercialization of electrotechnology was well underway. Incandescent lamps were beginning to illuminate streets and homes, offices and laboratories. Telephones connected households, telegraphs connected cities, and transoceanic cables connected continents. Now, international standardization was needed for electrical science so that scientists in every country could use the same words for this emerging technology.

The Niagara planning committee decided that when the International Congress met in St. Louis in 1904, a special group of government appointed delegates would address international electromagnetic units and international standardization. Such standardization was necessary to promote communication among scientists, to support safety, function, and performance of all things electrical, and to spur international commerce. Earlier congresses



Power house at Niagara Falls 1904

had adopted terminology, such as Gauss and Maxwell for units of magnetic field and magnetic flux, but not all scientists used that terminology. And the electrical world was divided about the need to name every unit.

These issues were in the forefront on July 1, 1903, when the Niagara organizing committee held its first meeting. On that day, the members elected Elihu Thomson, inventor and founder of the General Electric Corporation, as president of the 1904 congress. The committee also elected other officers and appointed a 25-member advisory board. In addition, the Niagara committee divided the work of the congress into two sections: general theory and applications.


Elihu Thomson

During the second meeting, held again in Niagara Falls two months later, the committee asked the secretary, Arthur Kennelly, to issue invitations “among all interested in electricity or its applications” to join the congress. In the letter, Kennelly outlined plans for the congress and described a strategy by which the St. Louis congress would host a Chamber of Delegates, appointed by respective governments. The delegates would serve as the official representatives to the St. Louis congress and would address standardization issues such as nomenclature.

Front row (left to right) : Herr W. Litzrodt (Germany), Prof. Dr. S. Arrhenius (Denmark and Sweden), Dr. R.T. Glazebrook (Great Britan), Prof. Elihu Thomson (United States), Prof. Moise Ascoli (Italy), M. Guillebot de Nerville (France), Señor Antonio Gonzalez (Spain)

Back row (left to right) : Prof. H.J. Ryan (United States), Ing. A. Maffezzini (Italy), Dr. F.A. Wolff, Jr. (U.S. Bureau of Standards), Herr Bela Gati (Hungary), M. Dennery (France), Ormond Higman, Esq. (Canada), Dr. A.E. Kennelly (United States), Señor M. Otamendi (Spain), John Hesketh, Esq. (Australia), Capt. Ferrié (France), Col. R.E.B. Crompton (Great Britain), Prof. Jorge Newbery (Argentine Republic), Prof. L. Lombardi (Italy), Marquis Luigi Solari (Italy), Dr. S.W. Stratton (United States), Prof. H.S. Carhart (United States), Prof. John Perry (Great Britain), J.C. Shields, Esq. (India)

By October, the Niagara committee had mailed 14,900 typed and signed invitations to join the congress. Letters to potential foreign participants were sent in English, French, and German. The USD 5.00 membership fee included admission to scientific meetings, a copy of the transactions, and, for the foreign delegates, an invitation to a circular tour that would precede the Exposition. The Niagara committee's efforts found success. By the time the Fifth International Electrical Congress opened in St. Louis on September 12, 1904, as many as 16 technical societies in the U.S. and abroad had accepted the invitation, 719 electrical scientists had registered, and 15 governments had appointed a total of 29 delegates [*see inset photo at right*].

The Palace of Electricity

Opening ceremonies for the Louisiana Purchase Exposition were held on April 30, 1904. The exposition celebrated the purchase of the Louisiana Territories from France for USD 15 million in 1803 (the centennial celebration came one year late as the Exposition planning committee needed additional time). While New Orleans had been discussed as a possible site for the celebration, St. Louis was chosen for its central location and because it was the largest city in states that had emerged from the Purchase.

Although the International Electrical Congress would not begin until September, electricity took front and center at the Fair. On April 30 during the formal opening, President Theodore Roosevelt sat in the east room of the White House in Washington D.C. and pushed a telegraph button sending the message that signaled the official opening. Flags unfurled and fountains gushed to life. On the south side of the Palace of Electricity, three motor-driven pumps sent nearly 100,000 gallons of water streaming down the Cascades. A transformer room under the Cascades supplied power to illuminate the rushing water with alternating lights of red, green, and opal, each color controlled by a triple-throw switch on a separate wiring system.

Palace of Electricity, 1904 St. Louis World's Fair

The Palace of Electricity served as a centerpiece for the Exposition. Despite the high tariff imposed by the United States on products of foreign factories, nearly half of the 109,973 square feet (10,216 square meters) exhibit area in the Palace held international electrical exhibits. Visitors watched electricity at work. There were running demonstrations of alternating and direct current. Fair goers positioned at telephone stations on either side of the Palace could speak to each other on telephones, "without any metallic connection between the two." Visitors saw working demonstration of dynamo, a model of a monorail train from Great Britain, and a wireless telegraph, which was used by the press during the Exposition to file stories.

On September 12, the Electrical Congress opened at the Exposition. During that week, on September 14, Electricity Day was celebrated with parades and demonstrations. At the Palace on that day, visitors watched demonstrations of the mega-volt transformer. The output of 1,000,000 volts shot a "flaming arc" into the sky as loud cracks of sound rippled across the fairgrounds.

The Palace of Electricity needed a "large amount of power" for the USD 4 million worth of exhibits. The lack of standardization was reflected in the many types of power that needed to be supplied to exhibitors. Little power was available for purchase at the time, although some was purchased at a cost of USD 3.04 per rated kilowatt, to help power the intramural railway plant. But each country brought exhibits requiring different power: direct current and alternating current; 25- and 60-cycle alternating current; 1-, 2-, and 3-phase alternating current, and numerous direct current voltages.

The 1904 Electrical Congress

Members of the Chamber of Delegates addressed this lack of consistency when the congress assembled from September 12 to 17. When the General Congress opened in the Coliseum Music Hall on the morning of September 12, Professor William Goldsborough, chief of the department of electricity, spoke to more than 1,000 people. He told participants that the "cooperative spirit that animates electrical workers" had already produced better nomenclature, uniform standards and a system for producing accurate records among international scientists.

That work was far from over. Four previous international electrical congresses had already started the dialogue on nomenclature and standardization that began with the first congress, which met in Paris in 1881, where the centimeter-gramme-second (c.g.s.) system was adopted. By the time the fifth congress convened in St. Louis, the terminology of kilowatt had replaced horsepower, but no two countries had yet defined units in the same way.

At the General meeting of the congress, several of the (*continued on page 8*) (*continued from page 7*) 158 research papers that were read dealt with standardization of units. Professor Moise Ascoli head of the delegation from Italy, Associazone Elettrotechnica Italiana, read a paper that discussed the merits of the Giorgi versus Heaviside systems. The previous day, Arthur E. Kennelly, then a professor of engineering at Harvard, addressed the importance of nomenclature when his paper on alternating current theory on transmission speed over submarine cables was read. Frank A. Wolff, of the National Bureau of Standards [*Editor's Note: The NBS later became the National Institute of Standards and Technology*], read a paper that detailed efforts for standardization during the four previous international congresses. Following Wolff's paper, a long debate began, which covered: accurate measurement of units, nomenclature, and the differences in laws regarding electricity among countries. Dr. Kennelly was a long-time supporter of naming all of the absolute units, as he mentioned the previous day, when his paper was read, because "all germs and even weeds have names."

"A noxious germ is not used because it is named," remarked Mr. H.E. Harrison in the discussion following Wolff's paper. Harrison continued by saying that naming the two absolute systems would bring confusion to people reading research papers. At the 1900 Paris congress, continued Harrison, the names Gauss and Maxwell were adopted but in England "only one in 100 engineers" would know what these terms mean.

After a long discussion on the volt standard, Kennelly said: "It seems only reasonable that fundamental units which have to be used, at least in theoretical investigations, should receive names, and perhaps the simplest method of naming these units is to employ prefixes in connection with the practical units." Others, such as John Perry and Doctor R.T. Glazebrook, both of Great Britain, thought Kennelly was insisting on "far too many names" because the c.g.s. system is self-evident.

The debate lasted long after the session adjourned. When the discussion led to a comparison of laws, participants noted the vast inconsistencies in how units were defined. Those differences could be costly, Kennelly noted, because a "question of one-tenth of a volt in one hundred and ten", could involve "large sums of money in regard to a contract for incandescent lamps."

A permanent organization

For the Chamber of Delegates, these issues were not theoretical or academic. The 29 delegates hailed from 15 countries including the USA, France, Great Britain, Mexico and India. Their meetings were held separately from the scientific sessions of the congress so the delegates could formally address issues regarding international standardization.

Jefferson Hotel, ca. 1904

At 3:15 p.m. on September 12, 1904, delegates held their first meeting at the Hotel Jefferson (shown above) in St. Louis. They adjourned fifteen minutes later after having nominated Elihu Thomson as president of the Chamber. Delegates also appointed a committee to consider officers for a permanent International Commission. On Tuesday, September 13, delegates met at the Hotel Jefferson for a second time. They appointed a committee to investigate international standardization of electrical science.

On September 15, delegates awoke to sunshine and a cool day. That afternoon, they met for the third time. During the meeting, Thomson and his colleagues unanimously adopted many resolutions addressing the lack of uniformity regarding "laws relating to electrical units." One resolution took the first official action toward a permanent international congress: "That steps should be taken to secure the cooperation of the technical societies of the world, by the appointment of a representative commission to consider the question of the standardization of the nomenclature and ratings of electrical apparatus and machinery." The Chamber adjourned when all resolutions were adopted.

On Friday, the delegates met for the final time. They agreed to report back to their respective governments and technical societies regarding actions taken in St. Louis. They thanked Thomson and other officers for their service.

The congress officially came to a close during a General Meeting on Saturday, September 17. Many speeches were given in regard to the potential of international standardization. Professor Webster, of Clark University, president of the American Physical Society said: "We feel that the work accomplished at this congress will render it a memorable one not only on account of the subjects under discussion but also for the move that has been taken in regard to the International Commission."

Elihu Thomson, who played an integral role beginning with the Niagara planning committee, expressed confidence that efforts towards standardization of nomenclature and units would be handled by an appropriate deliberating body. "I have no doubt that this Commission will soon be a fact, and will then be able to take up questions which are not, or for which many of us thought are not, proper to be discussed during an exposition," said Thomson.

When addressing specifically the foreign delegates, Thomson said, "I have found that the unanimity of action, the absence of any disagreement whatsoever has been remarkable. As soon as a measure was known to be a proper thing, all votes were unanimous and this bodes well for future work of the International Commission."

Thomson went on to note the "boundless" future of electrical science and closed his remarks with: "prepare then to accept an electrical universe." ■

In 1908, Thomson would become the IEC's second president, following the death of Lord Kelvin.

FOUNDING IEC

THE FOUNDING OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION

What took place between September 1904 in St. Louis and June 1906 in London when the IEC officially came into being? Who spoke to whom, who decided what, who had the lead and what kinds of personalities did they have? Ultimately, how did it all come together for the founding meeting in London? **Mark Frary** provides insight into the two years leading up to the founding of the International Electrotechnical Commission.

Much was going on in the world during the period from 1904 to 1906. Einstein published his paper on the *Special Theory of Relativity*; U.S. engineers had just begun work on the Panama Canal; and the picture postcard, the ice cream cone and the jukebox were invented.

On both sides of the Atlantic, factories and townships were clamoring for more electricity to replace outmoded gas and oil lighting systems. H.G. Wells, in the *North American Review* (1901), predicted the electrical century ahead when houses and factories would be heated, ventilated and operated by electricity.

In the world of electrical engineering much was happening, too. John Ambrose Fleming, Britain's first ever professor of electrical engineering, invented the thermionic valve while in the U.S., Lee De Forest invented the triode. This was the period that saw the beginnings of the International Electrotechnical Commission (IEC).

The road to the organization's existence really began in St. Louis. The Missouri city was a busy place in 1904. Not only was it host to the Olympics and the Universal Exposition held to celebrate the centenary of the Louisiana Purchase, electrical engineers from around the world came to the city for the International Electrical Congress, the fifth in the international series.

At the congress, a Chamber of Delegates, made up of engineers from 15 countries, including the Argentine Republic, France, Germany, Great Britain, Switzerland and the United States, carried a resolution to the effect that:

> Steps should be taken to secure the co-operation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardization of the Nomenclature and Ratings of Electrical Apparatus and Machinery.

The delegates were then charged to return to their respective technical societies to take action on this resolution and "communicate the results of such action to Colonel R. E. B. Crompton, Chelmsford, England and to the President of the American Institute of Electrical Engineers, New York City."

Colonel Rookes Evelyn Bell Crompton, who had been asked by Britain's Institution of Electrical Engineers (IEE) to accompany the IEE president, J. K. Gray, to America to represent British electrical engineering, was a key figure in the industry.

The inimitable Colonel Crompton

Colonel R.E.B. Crompton

Courtesy: The Institution of Electrical Engineers (IEE)

Colonel Crompton was born in Yorkshire, England in 1845 and like many Victorian era engineers had a panoply of interests. His Kensington Court power station in London was one of the first in the city and he was involved in many of Britain's early public lighting and electricity supply schemes. Crompton was also fondly keen of all forms of vehicular transport, particularly bicycles, and was also a founder of the Royal Automobile Club as well as being involved in the invention of the military tank.

Crompton had been singled out by the Chamber of Delegates because of a paper he gave at the congress on the subject of standardization in electrical engineering. In his autobiography, *Reminiscences*, Crompton remembers: "My paper had this effect, that at the end of the session I was officially requested to do my best (*continued on page 10*)

London, 26th and 27th June 1906: The first meeting of the IEC
C. Dettmar, W. Smitt, E. Feldmann, D. Harsanyi, Boucherot, Farny, L. Gerard, Al. Siemens, P. Janet, Col. Crompton, H. Rosenberg, Mailloux, Crocker, David, Semenza, Le Maistre

(*continued from page 9*) to form a permanent International Electrotechnical Commission, which should deal with electrical standardization from an international standpoint. I foresaw great difficulties, but these difficulties were eventually overcome."

On his return, Crompton communicated the desire of the congress to the British Engineering Standards Committee, which brought together engineers from all disciplines, including the Institution of Mechanical Engineers, the IEE and the Institution of Civil Engineers (ICE) to discuss matters regarding standardization. This committee held its sittings under the direction of ICE and so it was this organization that Crompton first approached.

Initially, the ICE Council were positive about the international proposal but felt it too early. The council commented at the time: "The appointment of such a Commission though in every way desirable, would at present be premature; but we believe that preliminary action may, with advantage be taken with the aim of paving the way to the ultimate formation of such a Commission, if the Council approves the general object."

In February 1905, ICE President Sir John Wolfe-Barry, the engineer who had designed London's Tower Bridge, conferred with the then IEE president Alexander Siemens regarding Crompton's proposal and suggested that the IEE should take the lead in the matter by appointing an Executive Committee.

For the two presidents, conferring was a relatively easy task as the two institutions shared premises at One Great George Street in London's West End. The rapidly expanding Electrical Engineers did not move to their Savoy Place home — where the IEC eventually held its first plenary meeting — until 1907.

Oui, Si, Yes, Ja and Hai

At the end of 1905, Colonel Crompton announced to the IEE Council that he had sent out preliminary enquiries regarding the Commission and had received favorable responses from the electrical societies of nine countries. These were the American Institute of Electrical Engineers, France's Société Internationale des Electriciens, Italy's Associazione Elettrotecnica Italiana, the Canadian Electrical Association, Germany's Verband Deutscher Elektrotechniker and Austro-Hungary's Elektrotechnischer Verein. The electrical societies of Denmark, Sweden, Norway also expressed their interest in the proposals.

Six months later, the IEE Council announced it had appointed an Executive Committee to "consider and report upon a scheme for the constitution of such an International Commission." The members included among others the new IEE president John Gavey, the immediate past president Alexander Siemens, Post Office chief engineer Sir William Preece, Lord Kelvin and Colonel Crompton.

June 1906 looked to be an ideal time for the Commission to come together. The IEE Council had already extended invitations to several of the world's electrotechnical societies to come to London "in some measure to return the courtesies received in former years from the electrical institutions in Europe and America."

Thus meetings were set up for June 26-27, 1906, under the chairmanship of Alexander Siemens, president of the Executive Committee. As with many international get-togethers, social events were also arranged including a post-meeting ten-day tour of England and Scotland by specially chartered train in which the visiting engineers would visit various electrical companies and local branches of the Institution of Electrical Engineers around the country as well as the sights of the Lake District and Shakespeare's Stratford-upon-Avon.

In the event, three of the nine countries who had accepted Crompton's invitation — Denmark, Sweden and Norway — had not been able to appoint delegates to attend by the time of the London meetings. However, representatives from Belgium, Holland, Japan, Switzerland and Spain had added to the original list of countries.

As for a venue to hold this prestigious meeting, there was only really one choice.

Europe's largest hotel

London's premier hotel in the early 1900s was the Hotel Cecil, with an entrance on the Strand and overlooking the River Thames. At the time, it was the largest hotel in Europe and had more than 800 luxuriously decorated rooms. The Cecil was at the height of its popularity, and was a regular haunt of visiting Americans. The IEE held its annual dinner there each year.

Opening the first meeting on Monday June 26, Siemens explained that "the first business of the meeting was to constitute the commission by adopting a set of rules. A draft which had been provisionally prepared and circulated previously to the delegates was then

Hotel Cecil

referred to a subcommittee for detailed consideration." The subcommittee adjourned until the following day.

That evening, the IEE threw a banquet at the Cecil for 450 guests and delegates in honor of the foreign visitors. According to a report of the event in the *Times* later that week, IEE president John Gavey proposed a toast. Speaking in French, he said it gave him "the greatest happiness to see the solidity which existed between the great professions, whether political, religious or national. He thought that this solidarity was the most pronounced among engineers."

The following day saw more meetings, including the adjourned meeting of the subcommittee that was examining the rules for the operation of the proposed Commission. The principal rules agreed at that meeting were as follows:

- the Commission is to be known as the *International Electrotechnical Commission* (IEC) for the standardization of nomenclature and ratings of electrical apparatus and machinery…;
- any self-governing country desiring to join the IEC may form a local committee. These committees are to be formed one for each country, by the technical societies of each country. In a country having no such technical societies, the government may appoint a committee;
- each committee is to send delegates to the Commission. Each country is entitled to one vote only, whatever the number of delegates…Only such decisions may be published as those of the IEC which have been passed unanimously by the Commission. All decisions passed by a divided vote may be published only when the names of the countries voting for and against are given;
- the central offices of the IEC are for the present in London, at the office of the Institution of Electrical Engineers. The methods of carrying out the objects of the Commission are in the hands of a Council consisting of a) the President of the Commission b) the Presidents of the local committees c) one delegate from each local committee d) the Honorary Secretary;
- in general, the business of the IEC will be conducted by correspondence, but the President may summon a meeting of the Council or of the Commission when he sees fit…. These meetings are to take place in London, or in such other places as the majority of the Commission determine. Each local committee is to find funds for its own expenses, and to contribute an equal share to the expenses of the Central Office.

With the modus operandi for the IEC now worked out, all that remained was to appoint the first incumbents of the two unfilled positions on the fledgling IEC Council.

Kelvin for president

Because of his major role in bringing the Commission to fruition, Colonel Crompton was an obvious choice for one of the roles and he was duly appointed as the IEC's first Honorary Secretary.


Lord Kelvin

The role of first IEC President was bestowed upon Lord Kelvin. Best remembered for his work on thermodynamics and in particular for the concept of absolute zero, the temperature at which all molecular motion ceases, Kelvin had a prodigious output as a scientist and electrical engineer.

His 1856 paper, "*Dynamical illustrations of the magnetic and helicoidal rotary effects of transparent bodies on polarized light,*" laid the groundwork for James Clerk Maxwell's subsequent theories on electromagnetism while the mirror galvanometer that he designed was crucial in the successful laying of the first transatlantic submarine cable in 1865. It was for this latter work that he was named to Britain's House of Lords.

To celebrate this highly satisfactory outcome, Lord Kelvin and Colonel Crompton were among 1,700 guests who went that evening to the Natural History Museum for an 'a conversazione' evening, entertained by the string band of the Royal Engineers. The next day the visiting engineers departed on their tour of country, happy in the knowledge that they had embarked upon a new journey of international co-operation.

Although Kelvin and Crompton were the first public faces of the IEC, the contribution of a third person should not be forgotten.

The American influence

In his autobiography *Reminiscences*, Crompton claimed that Professor Elihu Thomson (*see photo on page 6*) had been the "real originator of the International scheme at the St. Louis Conference."

Professor Thomson was born in 1853 in Manchester, England, but his family moved to Philadelphia when he was five. Initially his interests were in the field of chemistry and indeed his professorship was in this area. But by 1880, Thomson had become totally absorbed into the rapidly developing field of electrical engineering. He was granted a multitude of patents, including the electric welding machine, and the firm he founded with E. J. Houston merged later with Edison's firm to create the General Electric Company.

Professor Thomson was therefore a natural choice for the role of president of the 1904 St. Louis congress. Speaking about those early years of international co-operation to Colonel Crompton a few years after the IEC's inauguration, Professor Thomson said:

> "No work of such huge importance to the electrical industry has exceeded that of the work commenced during the last few years in the international exchange of electrical ideas. It is a very difficult thing to carry on these matters internationally; there are many jealousies to be overcome, many susceptibilities to be met; and it is something to be proud of that no quarrels and no troubles have yet arisen."

That same spirit of co-operation persists today as the IEC celebrates its hundred years of existence. ■

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Today's ideal standards scenario centers on the development of a single, internationally recognized, technically valid document. International standards make it clear how to improve the safety of products for the protection of consumers. They support the worldwide sale of products and prevent regions from using local standards to favor local industries.

U.S. experts have worked extensively with both national and international standards bodies to ensure American interests are well represented in the development of international standards.

Within the electrotechnical community, the USNC serves as the U.S. link to the International Electrotechnical Commission and as the primary U.S. electrotechnical industry interface with regional standards bodies such as the CENELEC, Pacific Area Standards Congress (PASC), the Pan American Standards Commission (COPANT), and the Council for Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA).

The USNC advocates on behalf of U.S. interests that international standards must be based on the principles of the World Trade Organization Technical Barriers to Trade (WTO/TBT) Agreement and adopt the concepts of valid justification, global relevance, consensus, openness, balance, impartiality, transparency, due process (including prompt appeal), flexibility, coherence and timeliness. The USNC also promotes the concept of "one test and one certification" based on the marketplace demand.