



COURTESY OF BRUCE CHALLGREN, THE BAKKEN MUSEUM

From Frankenstein to the Pacemaker

A Profile of the Bakken Museum

BY DAVID J. RHEES

On one cold February day in 1932, an eight-year old boy named Earl Bakken went to see a film named *Frankenstein* at a Minneapolis theater. Dr. Frankenstein's electricity not only sparked the creature to life, but it sparked Bakken's interest in combining electricity

and medicine. Bakken's passion for science, inspired by *Frankenstein* and tempered by his pastor's admonition to use science to help others, led to his lifework of using electricity to benefit humanity and to his founding of a unique museum.

Bakken received an electrical engineering degree from the University of Minnesota in 1948 and in the following year cofounded Medtronic, a pioneering medical technology company

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now in the Fortune 500. In 1957, he developed the first transistorized cardiac pacemaker. In 1975, Bakken created a museum devoted to the history of electricity and magnetism in the life sciences and medicine, housed in a beautiful mansion in Minneapolis. Today, the museum's historical collection numbers more than 11,000 books and 2,000 scientific instruments and is utilized by researchers from around the world. It includes a 13th-century encyclopedia, Ben Franklin's glass armonica, and a first edition of Mary Shelley's *Frankenstein*.

Earl Bakken also foresaw a need to interest more people in science, especially young people. In the 1980s and early 1990s, the Bakken Museum launched an exhibition program and educational programs for K–12 teachers and students, all utilizing an innovative combination of hands-on learning, history, and arts. The expansion of the museum's building in 1999 has allowed the Bakken Museum to become a leader in inspiring a passion for science and its potential for social good by helping people explore the history and nature of electricity and magnetism, particularly its applications in medicine and life sciences.

This article provides an overview of the development, collections, exhibits, and programs of the world's only museum devoted to the history and science of electricity in life.

The First Wearable Pacemaker

When Bakken and his relative Palmer J. Hermundslie founded Medtronic in 1949, they began by repairing and selling medical electronic equipment. Soon, though, Bakken began to design and produce custom devices. In 1957, at the request of Dr. Walton Lillehei, a cardiac surgeon at the University of Minnesota and one of the founders of open heart surgery, Bakken developed the first wearable, external, battery-powered, transistorized pacemaker (Figure 1). Utilizing only two transistors and a photoflash battery, this device fostered much greater mobility for the young patients on whom it was first used. With the invention of a new bipolar electrode by Dr. Samuel Hunter and Norman Roth, it also opened up the possibility of long-term pacing for elderly patients with heart block.

In 1960, Medtronic began producing and marketing a fully implantable cardiac pacemaker developed by engineer Wilson Greatbatch and physician William Chardack of Buffalo, New York. The remarkable success of the pacemaker and related therapeutic devices fueled the rapid growth of Medtronic and

dozens of spinoff companies, including major firms such as St. Jude Medical and Cardiac Pacemakers, Inc. (now part of Boston Scientific). Drawing upon the world-class resources of the University of Minnesota and the Mayo Clinic, these firms helped Minnesota develop into a leading center of biomedical technology which, by the 1980s, became known as the *Medical Alley*.

Founding of the Museum

As Medtronic grew and prospered, Bakken became interested in the historical antecedents of using electricity for therapeutic purposes. In 1969, he asked Dennis Stillings, who worked in the Medtronic library, to see if he could find some old medical electrical machines. Through his contacts with dealers and with other collectors of early electrical and electromedical books, Stillings assembled a sizeable collection of books and significant early electrical machines by the mid-1970s.

Bakken's collection was initially housed at the Medtronic corporate headquarters in St. Anthony Village, a suburb of Minneapolis, where a small museum was set up for their display. In 1975, the collection was moved to a Medtronic branch office in Brooklyn Park, another Minneapolis suburb, and one floor was turned over to the Medtronic Museum of Electricity in Life, as it was initially called. In October 1975, the Bakken Museum of Electricity in Life was incorporated as a nonprofit operating foundation with an independent board of directors and began searching for a new home to house its growing collection.

In 1976, its present facility was acquired: a mansion located on the west shore of Lake Calhoun in southwest Minneapolis (pictured in the opening photo on page 78). The 12,000 ft² house was completed in 1930 for the Twin Cities businessman William E. Goodfellow, who named it *West Winds*. Exploring the mansion reveals the

dark interior paneling and carved details indicative of the Tudor style, along with pointed arches, stained glass, and decorations typical of the Gothic Revival style. Appropriately, the house acquired a reputation as *Frankenstein's Castle* among neighborhood children.

In 1999, to meet the growing demand for the museum's educational programs, a 13,000 ft² award-winning new wing was added, doubling the size of the facility. Classrooms, new exhibit halls, and a new library reading room were added, as

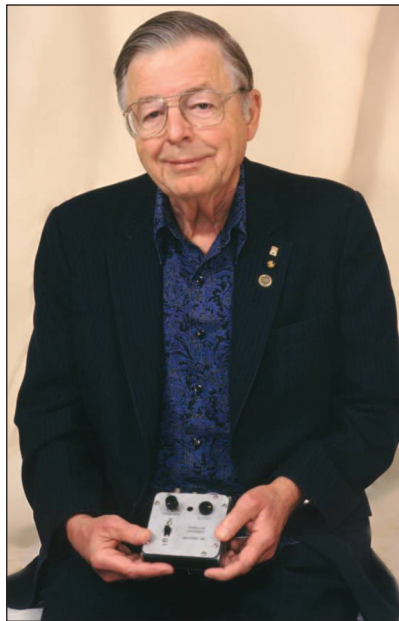


Fig. 1. Earl Bakken in 1997 with a prototype of the Medtronic 5800 wearable pacemaker. It was named an IEEE electrical engineering milestone in 1999.

The focus of the unique collections of the Bakken Museum is the history of electricity and magnetism, electrotherapeutics, and their accompanying instrumentation.

well as a student laboratory inspired by the basement shop of Bakken's childhood home. As a local reporter noted upon completion of the expansion,

The whole place . . . seems a throwback to another time when skilled craftsmen shaped stone, wood and glass into places with lasting appeal. Especially for the children who come to the Bakken, experiencing architecture of such quality may be as startling a revelation as feeling the spark of electricity.

Linda Mack

Minneapolis Star Tribune, 19 June 1999

West Winds and the new wing are surrounded by beautiful landscaping and the Florence Bakken Medicinal Garden. The

garden contains many plants known or believed at one time to have therapeutic properties. Interestingly, the increasing popularity of medicinal herbs that occurred in 19th-century America coincided with a rise in interest in electrotherapeutic techniques. Both were a reaction against the prevalent use of heroic (and often harmful) therapies such as bloodletting, blistering, and chemical medicines such as calomel (mercurous chloride). Herbs and electricity promised a gentler form of healing.

Historical Collections

The focus of the unique collections of the Bakken Museum is the history of electricity and magnetism, electrotherapeutics, and their accompanying instrumentation. Related subjects include magnetic cures, galvanism, electrophysiology, electrosurgery, electric baths, diathermy, electric stimulation, phototherapy, actinotherapy, cauterization, acupuncture, physiological therapeutics, suggestive therapeutics, animal magnetism and mesmerism, electric fish (such as the eel and the torpedo), atmospheric electricity, lightning, and lightning protection. Although primary sources date from the 13th century, collecting emphasis is on the materials of the 18th, 19th, and early 20th centuries.

Significant holdings include the writings of a number of 18th- and 19th-century natural philosophers, including J.-A. Nollet, Franklin, Galvani, Aldini, Volta, Duchenne, and Du Bois Reymond, as well as some important early works—not necessarily electrical—of science and medicine. There are extensive or complete runs of *Philosophical Magazine*, *Opuscoli Scelti*, *Annalen der Physik*, the Royal Society's *Philosophical Transactions* and *Proceedings*, and *Journal de Physique*.

Also included are a sizeable collection of manuscript and printed materials on mesmerism and animal magnetism; 19th-century ephemera concerning alternative electromedical therapies, consisting of about 200 advertisements, programs, broadsides, circulars, and instructional pamphlets (Figure 2); miscellaneous scientists' letters of the 18th and 19th centuries; and more than 400 trade catalogs and price lists, most from the period of 1850–1930. The trade catalogs depict electrical apparatus, surgical and dental instruments, medical appliances, and early X-ray and high-frequency apparatus (Figures 3 and 4). The wealth of images in the trade catalogs, ephemera, and books is supplemented by slides, photographs, portraits, prints, medallions, and other works of art. The library also has a support collection of histories, biographies, and reference works.

The instrument collection includes electrostatic generators, magnetoelectric generators, induction coils, physiological instruments, recording devices, and accessories. Some highlights include an 18th-century portable Hauksbee electrical demonstration kit by Nairne and Blunt, an electric egg for producing spectacular discharges, and a small collection of electrical toys, including an orrery, a carousel, a tight-rope



Fig. 2. The message of this 19th-century ad for electric belts was clear: customers can throw away their medicine bottles in the new era of electrical healing.

walker, and a thunder house. Nineteenth-century artifacts include a D'Arsonval diathermy solenoid and various types of shockers for applying healing currents to the body.

One of the strengths of the Bakken Museum is that it maintains a fairly even balance between its library holdings and artifact collections. A conscious effort has been made to acquire literary material that illuminates the instruments and vice versa. For instance, the Bakken Museum owns several editions of George Adams' popular *Essay on Electricity*, (Figure 5) including the first, published in 1784, and it also possesses a medical electric kit made by Adams, which is depicted in the frontispiece of his book.

To cite a more recent example, the Bakken Museum holds more than eight boxes of the papers of Albert Abrams (1863–1924), a San Francisco physician who was denounced by the American Medical Association as the dean of all 20th-century charlatans. Not only does the Bakken Museum own most of Abrams' books and pamphlets, but also a number of his machines, including a very early oscilloclast, which supposedly diagnosed disease by analyzing electrical vibrations in blood samples.

Treasures

As the world's leading collection on the history of electricity in life, the Bakken Museum holds many treasures. A few of the highlights are as follows:

- a 13th-century vellum manuscript encyclopedia by Vincent of Beauvais, the *Speculum Naturale (Mirror of Nature)*, which is the oldest book in the collection
- the first printed version (1558) of the 1269 treatise of Petrus Peregrinus on the magnet
- the first edition of William Gilbert's *De Magnete* (1600)
- the exceedingly rare 1791 reprint of Luigi Galvani's work on animal electricity, *De viribus electricitatis*
- many editions of the scientific papers of Benjamin Franklin and his supporters
- various editions of the works on magnetism of Athanasius Kircher, the 17th-century polymath
- the 1745 edition of Johann Krüger's *Zuschrift (Thoughts on Electricity)*, which contains probably the earliest statement of the idea that electricity has therapeutic applications.

The collection also includes less spectacular examples of the printer's art that are nevertheless of great historical interest:

- several editions of a domestic medical manual, *Primitive Physick*, written by John Wesley, founder of Methodism, and his little book on electricity, *The Desideratum, or Electricity Made Plain and Useful*
- early American books on electricity's role in alleviating pain and illness, such as T. Gale's *Electricity, or the Ethereal Fire* (Troy, NY, 1802)



Fig. 3. Arcade shocker for treating headache, neuralgia, and nervousness ca. 1900. Customers grabbed the handles to receive therapy.

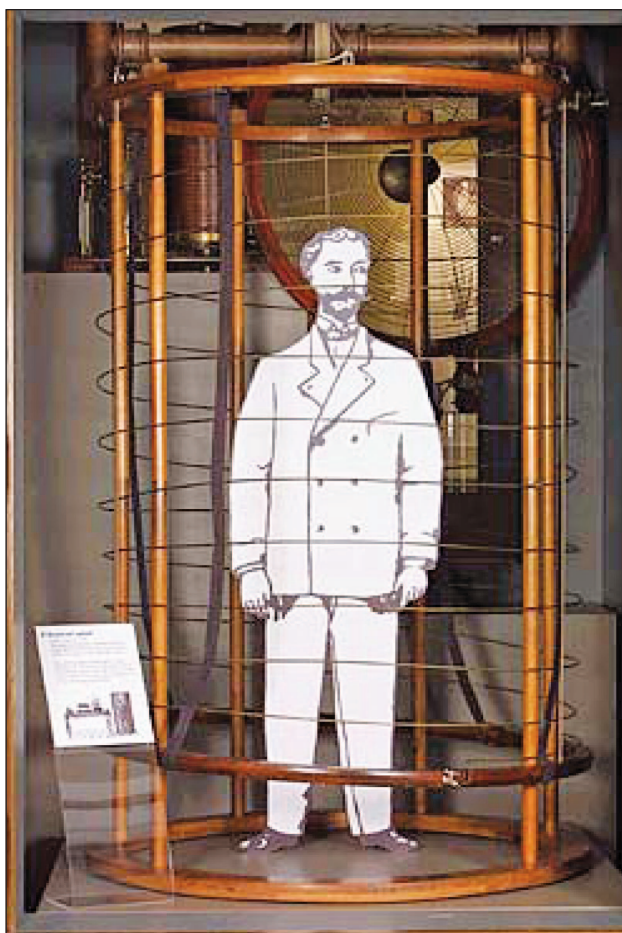


Fig. 4. Exhibit of D'Arsonval solenoid: an early form of electromagnetic diathermy.

► numerous editions of a classic late 19th-century book by the Americans George Beard and David Rockwell on the medical and surgical uses of electricity (Figure 6).

Illustrative of the collection's diversity is a book written by Delaborde in Paris in 1761 describing an electric harpsichord; some 18th-century books on electricity written in verse, such as Giulio Civetti's *L'electricismo*, and the first (London, 1818) and other editions of Mary Shelley's *Frankenstein* (Figure 7). On a more modern note, the Bakken Museum holds a collection of several dozen oral history interviews with the pioneers of Minnesota's medical device industry.

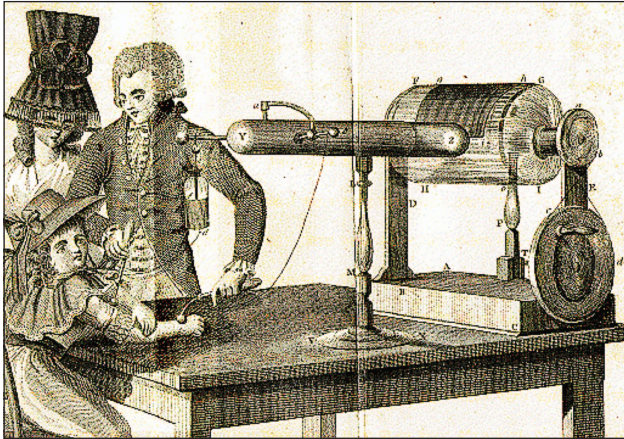


Fig. 5. These ladies are receiving electrical shock treatment, perhaps for pain or paralysis. From George Adams, *Essay on Electricity* (London, 1787).



Fig. 6. The doctor applies electricity from a medical coil to the patient's head via the electric hand. From Beard and Rockwell's popular *Practical Treatise* (1871).

The Bakken Museum welcomes researchers from around the world as well as local students working on history day projects. Research travel grants and visiting research fellowships are awarded annually to facilitate research by scholars from afar. A number of important publications have drawn heavily on the collections, including *Machines in Our Hearts* by Kirk Jeffrey, *The Body Electric* by Carolyn Thomas de la Peña, and *The Taming of the Ray* by Marco Piccolino. Two former visiting research fellows, Peter Heering and Oliver Hochadel, helped Bakken organize an international conference commemorating Franklin's invention of the lightning rod. The essays, *Playing with Fire: A Cultural History of the Lightning Rod*, will appear in 2009. Information on fellowships, how to access the collection, and online finding aids to books and artifacts are on the Bakken's Web site at www.thebakken.org.

Exhibits

Exhibits at the Bakken Museum typically blend historical objects with hands-on interactive displays. Topics are presented within a cultural context that may utilize history, literature, ethics, and arts. Perhaps, the most popular exhibit is *Frankenstein: Mary Shelley's Dream*, a dramatic multimedia immersion into Victor Frankenstein's laboratory and Mary Shelley's study. The body electric is a major theme of displays such as *Electric Heart* (Figure 8), where visitors can see, hear, and feel the natural electricity of their own heart, and *Mindball* (Figure 9), where visitors use electroencephalography (EEG) feedback to play a competitive game by relaxing.

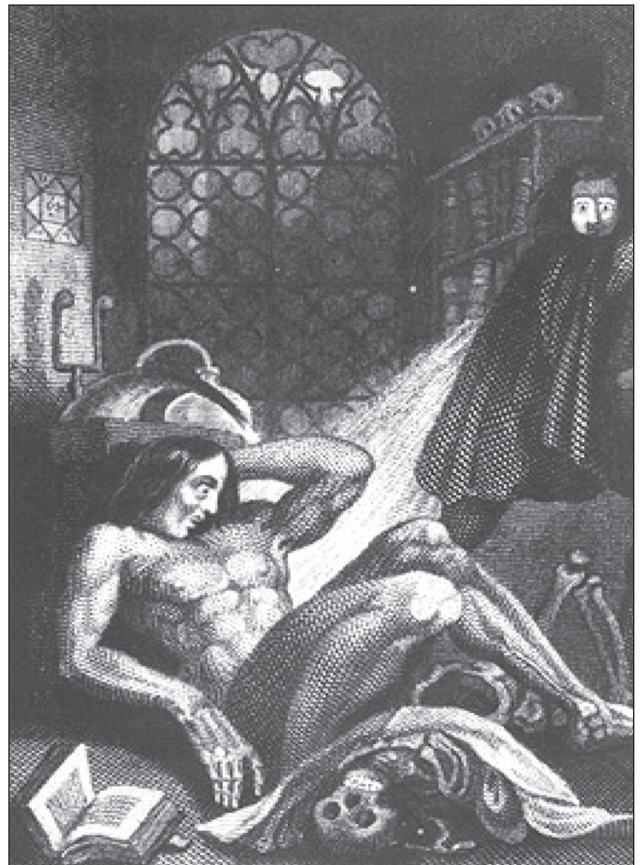


Fig. 7. The Bakken's 1831 edition of Mary Shelley's *Frankenstein* contains the first printed image of the monster.

An Inventor's Club program teaches invention skills through hands-on projects and interaction with volunteer mentors from the local engineering community.

Other major exhibits include an aquarium room of electric fish, a working theremin model (the world's first electronic musical instrument), *Mysteries of Magnetism*, *Electrifying Minnesota* (a temporary exhibit that explores the impact of electrification as well as new trends in renewable energy), and an exhibit on electricity in the 18th century, featuring a hands-on *electricity party* that replicates classic experiments from the days of Benjamin Franklin.

Education Programs

The Bakken Museum offers a variety of education programs designed to spark the interest of children, youth, families, and teachers. As with exhibits, these programs emphasize hands-on learning within a cultural-historical context that helps

humanize science and technology and make it more accessible. Some programs are the drop-in type, such as Super Science Saturdays, which engage families with hands-on theme-based activities such as the heart, brain, and earth month. Other programs are targeted at schools, such as field trips on static electricity, batteries, or magnetism, which attract more than 11,000 students and their teachers each year. The Bakken Museum recently won a major award from the Minnesota High Tech Association for its outreach program that will soon reach all fourth graders in Minneapolis and help train their teachers. Getting girls interested in science is emphasized in girls-only summer camps and through an "I'm Electric!" Junior Girl Scout badge that introduces girls to bioelectricity and to careers in biomedical technology (Figure 10).

An Inventor's Club program teaches invention skills through hands-on projects and interaction with volunteer mentors from the local engineering community (Figure 11). Through a simple but effective invention method (think it,



Fig. 8. *Electric Heart* exhibit allows visitors to make music with their heartbeat, visualize arrhythmias, and understand historical discoveries about the heart's natural electricity.



Fig. 10. The Bakken Museum partnered with the Girl Scouts to develop a badge called *I'm Electric!*



Fig. 9. *Mindball* exhibit uses a neurofeedback game to teach visitors how to better control their brains.



Fig. 11. Youth in the Bakken's Inventor's Club learn to love to invent.

The Magnetism drawn by Sergeant,
engraved by Toyuca, ca. 1785



A mesmerist session, or *séance*, showing fashionable Parisians standing or seated around a *baquet*, or tub filled with iron filings and mesmerized water. Patients grasped the moveable iron rods protruding from the water and applied them to their ailing body parts, thereby transferring therapeutic magnetism to their bodies, where it was intended to dissolve and break up any obstructions to the free circulation of their own magnetic fluid. Sometimes this provoked a crisis, such as the lady on the right is experiencing. Another woman is being carried off to a crisis room in the background. This engraving is probably poking fun at the overheated atmosphere that many amused or skeptical French suspected prevailed at a mesmerist session.

build it, improve it, show it), children learn to express their natural inventive talents in ways that solve real-world problems. Some students repeat these sessions over and over,



Fig. 12. A Bakken staff member demonstrates the exploding thunder house in the Museum's Great Hall.

eventually returning to mentor their younger peers. Some of the Bakken's graduates have gone on to distinguished collegiate programs in electrical, computer, mechanical, and nuclear engineering.

Theater and performing arts play a vital role in the Bakken's educational approach. Kinesthetic techniques and story telling can often hook kids into liking science even if they think they hate it. Short plays and puppet shows featuring historical characters have proven effective. "Shocking News About Your Heart," for instance, teaches kids about sudden cardiac arrest through audience participation and humorous portrayals of historical characters who were influential in cardiac medicine. "Finding Frankenstein," aimed at middle- and high-school students, is a live performance from a professional actress who portrays the teenaged author of *Frankenstein*, Mary Wollstonecraft Shelley. And there's nothing like a dramatic circle shock or demonstration of Franklin's thunder house to engage the full attention of young audiences Figure 12.

Conclusions

Inspired 77 years ago by seeing the *Frankenstein* film starring Boris Karloff, Earl Bakken invented the wearable pacemaker, launched Minnesota's *Medical Alley*, and founded a public museum that inspires people with a passion for science and its potential for social good. Today, with support from a broad range of individuals, corporations, and foundations, the Bakken Museum offers unique collections, exhibits, and programs focused on the history and science of electricity and magnetism, with special emphasis on biological and medical applications. Housed in an expanded Tudor mansion and surrounded by medicinal gardens, each year the Bakken offers an electrifying experience to more than 60,000 people of all ages and backgrounds. For further information, see www.thebakken.org.

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David J. Rhees received his Ph.D. degree in the history of science from the University of Pennsylvania. He served as a Fellow at the Smithsonian Institution and has been the executive director of the Bakken Museum since 1992 and has led the process of expanding its facilities, staff, and programs.

He is currently an adjunct professor in the program in history of medicine at the University of Minnesota. His research, publications, and exhibits have focused on the history of electricity, chemistry, medical technology, the popularization of science, and the body electric. He initiated and directs the Bakken Museum's oral history project on the history of electromedical device industry.

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