Get Electrified!

Experience The Past, Present and Future!

energytech 2018

"Spirit of Innovation" Exhibition

Cleveland I-X Center, Oct. 23-24, 2018

An Imaginative and Inspiring Interactive Past-Forward STEM/STEAM Education Program for Middle and High School Students

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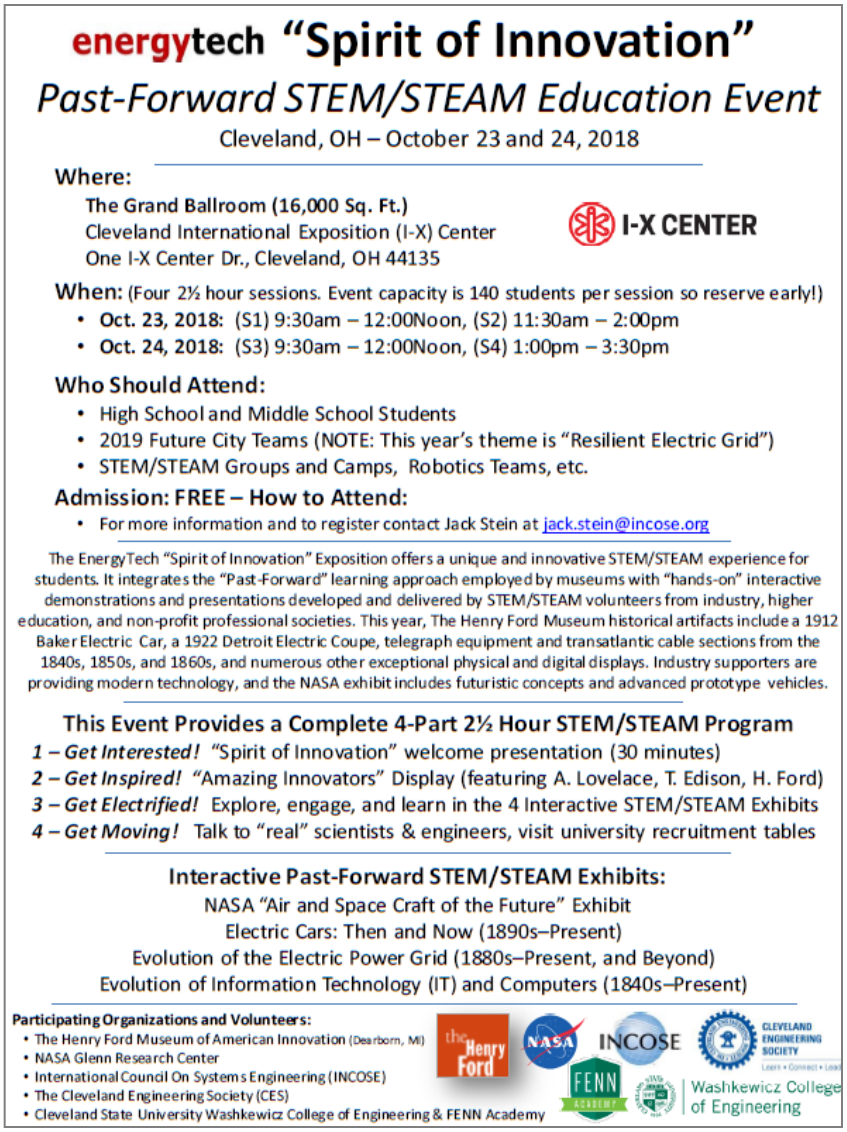
Past-Forward STEM/STEAM Education Program

A Unique Past-Forward STEM/STEAM Educational Event! *Serving Over 600 Students*



energytech "Spirit of Innovation"

Past-Forward STEM/STEAM Education Event

Cleveland, OH – October 23 and 24, 2018

Where:

The Grand Ballroom (16,000 Sq. Ft.)
Cleveland International Exposition (I-X) Center
One I-X Center Dr., Cleveland, OH 44135

I-X CENTER

When: (Four 2½ hour sessions. Event capacity is 140 students per session so reserve early!)

- **Oct. 23, 2018:** (S1) 9:30am – 12:00Noon, (S2) 11:30am – 2:00pm
- **Oct. 24, 2018:** (S3) 9:30am – 12:00Noon, (S4) 1:00pm – 3:30pm

Who Should Attend:

- High School and Middle School Students
- 2019 Future City Teams (NOTE: This year's theme is "Resilient Electric Grid")
- STEM/STEAM Groups and Camps, Robotics Teams, etc.

Admission: FREE – How to Attend:

- For more information and to register contact Jack Stein at jack.stein@incose.org

The EnergyTech "Spirit of Innovation" Exposition offers a unique and innovative STEM/STEAM experience for students. It integrates the "Past-Forward" learning approach employed by museums with "hands-on" interactive demonstrations and presentations developed and delivered by STEM/STEAM volunteers from industry, higher education, and non-profit professional societies. This year, The Henry Ford Museum historical artifacts include a 1912 Baker Electric Car, a 1922 Detroit Electric Coupe, telegraph equipment and transatlantic cable sections from the 1840s, 1850s, and 1860s, and numerous other exceptional physical and digital displays. Industry supporters are providing modern technology, and the NASA exhibit includes futuristic concepts and advanced prototype vehicles.

This Event Provides a Complete 4-Part 2½ Hour STEM/STEAM Program

1 – *Get Interested!* "Spirit of Innovation" welcome presentation (30 minutes)
2 – *Get Inspired!* "Amazing Innovators" Display (featuring A. Lovelace, T. Edison, H. Ford)
3 – *Get Electrified!* Explore, engage, and learn in the 4 Interactive STEM/STEAM Exhibits
4 – *Get Moving!* Talk to "real" scientists & engineers, visit university recruitment tables

Interactive Past-Forward STEM/STEAM Exhibits:

NASA "Air and Space Craft of the Future" Exhibit
Electric Cars: Then and Now (1890s–Present)
Evolution of the Electric Power Grid (1880s–Present, and Beyond)
Evolution of Information Technology (IT) and Computers (1840s–Present)

Participating Organizations and Volunteers:

- The Henry Ford Museum of American Innovation (Dearborn, MI)
- NASA Glenn Research Center
- International Council On Systems Engineering (INCOSE)
- The Cleveland Engineering Society (CES)
- Cleveland State University Washkewicz College of Engineering & FENN Academy

the Henry Ford · NASA · INCOSE · Cleveland Engineering Society · FENN Academy · Washkewicz College of Engineering

Four 2 ½ hour sessions on October 23rd and 24th :

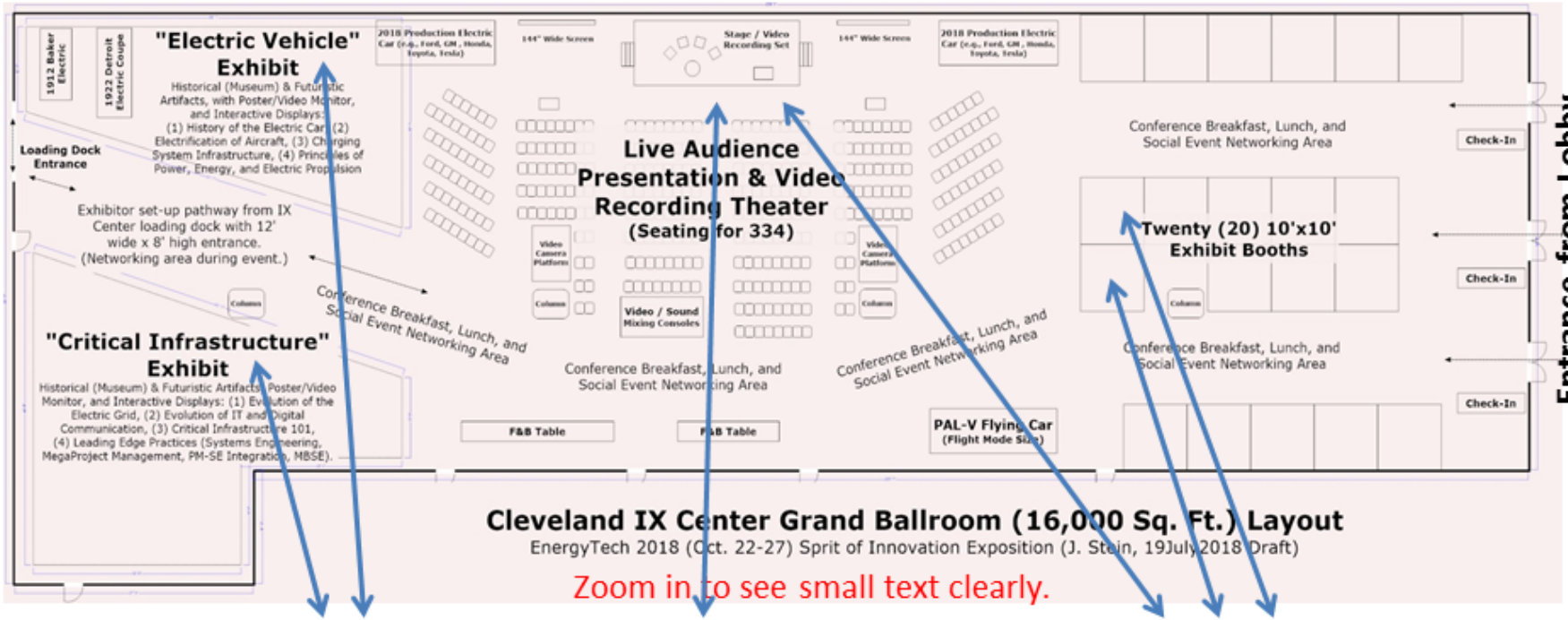
PROGRAM

30m: NASA Exhibit
30m: Presentation
90m: Interactive Past-Forward STEM/STEAM Exhibits

Admission: **FREE!**

Grand Ballroom, Cleveland I-X Center

16,000 Sq. Ft. of Theater and Exhibits!



Cleveland IX Center Grand Ballroom (16,000 Sq. Ft.) Layout

EnergyTech 2018 (Oct. 22-27) Sprit of Innovation Exposition (J. Stein, 19July2018 Draft)

Zoom in to see small text clearly.

"Past Forward" Exhibit Learning

1. Principles of power, energy, propulsion & electricity, illustrated with interesting and inspirational "real world" artifacts/stories
2. Fundamentals of STEM/STEAM, system/critical thinking, innovation and creativity, systems engineering (SE), teamwork, project/megaproject management (PM), PM-SE integration, & infrastructure engineering excellence.

Presentations & Discussions

1. Presentations and panels by museum, education, industry, and professional society personnel tied to "Past Forward" displays and ET conference program topics.
2. Student leader talks (e.g., high schooler Lauryn Taylor, Detroit, MI)
3. Educational short films, TV-style interviews, possible live-streaming.

"EduVacation" & Career Info

1. "EduVacation" (educational vacation) 10'x10' exhibit booth with material and guidance for planning vacations and field trips that include museum visits.
2. 10'x10' "Career/Profession/Higher Education Planning" exhibit booth.
3. Presentations and booth staffing by museums, visitor bureaus, schools, and industry regarding (1) and (2).

Featured NASA Speakers

Nancy Hall
Research Scientist
Project Manager

Nancy Rabel Hall is both a research scientist and project manager working in the International Space Station (ISS) and Human Health Office at the NASA Glenn. She earned a Bachelor of Science in Space Sciences from Florida Institute of Technology and a Master of Science degree in Mechanical Engineering from the University of Toledo. She has been at NASA Glenn for over 28 years. Currently, she is the project manager for Fluids and Combustion Facility on the ISS. She previously managed ISS experiments that studied the behavior of polymers, liquid crystals, two phase flow systems, flow boiling and condensation systems and how these fluids and systems behave differently in microgravity as compared to here on Earth.

Ms. Hall is the HUNCH (High school students United with NASA to Create Hardware) project manager for schools within Glenn's region. She is the author of several scientific papers and a contributing author to the book "Frontiers of Propulsion Science." She is a Girl Scout Troop leader, amateur radio operator, enjoys playing golf, and reading science fiction and fantasy books. She likes giving talks to the public and showing students how math and science can be fun.

Featured NASA Speakers

Deboshri Sadhukhan
Aerospace Engineer

Deboshri began at NASA Glenn Research Center in May 2016, and currently serves as Safety and Mission Assurance (S&MA) support to evaluate and provide design options to increase the reliability, maintainability, and system safety of hardware and personnel throughout the system life cycle. She also serves within engineering in a more traditional engineering role for electrical hardware design, integration, and testing for space power systems and aeronautics technologies. Her roles Project Manager for Venus Imager for Planetary Exploration Research (VIPER), Lead System Safety Engineer for Flow Boiling Condensation Experiment (FBCE), and S&MA Engineer for the European Service Module (ESM) propulsion system. Ms. Sadhukhan holds a Bachelor of Science in Electrical Engineering from The University of Akron and is currently pursuing her Master of Science in Electrical Engineering at Penn State University.

Susanah R. Kowalewski
Electrical Engineer

Susanah began as a Pathways Intern at NASA Glenn Research Center in May 2016, and currently serves in the Diagnostics and Electromagnetics Branch of the Power Division. She works on the hardware design, electrical-mechanical integration, and system testing for electric motor inverters and power electronics for both space and aerospace applications. Prior to this, she has interned with NASA Glenn through the college and high school internship programs for several years. Ms. Kowalewski is currently pursuing her Bachelor of Science in Electrical Engineering at The University of Akron.

Featured Student Speaker

Lauryn Taylor
Aerospace Physiology Student

EMBRY-RIDDLE Aeronautical University
DAYTONA BEACH, FLORIDA

Renaissance High School
a Detroit Public Schools Community District School

THE ENGINEERING SOCIETY OF DETROIT
FOUNDED IN 1895

Lauryn Chanel Taylor is a graduate of Renaissance High School in Detroit, Michigan. At Renaissance, Lauryn was involved with JROTC, where she served as the Executive Officer of her Battalion, the National Honor Society, the Renaissance Swim team, and Orchestra where she has been playing the violin for seven years. Outside of School Lauryn participated in Girl Scouts for 11 years, Jack and Jill where she served as the recording secretary, and the Hartford Memorial Baptist Church youth choir. During her summers Lauryn has gone to JCLC (a leadership camp for JROTC cadets), the Tuskegee STEM academy in Compton California, Continuing the Legacy Program with Southwest Airlines and the Tuskegee Airmen, Michigan's Girl's State, and an Aerospace Career Exploration Camp at Embry-Riddle Aeronautical University. Lauryn has also been awarded scholarships from the Civilian Marksmanship program, the Judith Dianne Jackson scholarship fund, Hartford Memorial Baptist Church, and the Engineering Society of Detroit.

Lauryn now attends Embry-Riddle Aeronautical University. She majors in aerospace physiology with a minor in human factors. At Embry Riddle Lauryn does Army ROTC. When she leaves she plans on attending the Army's medical school with hopes of becoming an Army Flight Surgeon. Once she leaves active duty she will go reserves and begin working for NASA as a flight surgeon. After NASA and after retiring from the Army, Lauryn plans on running to become a United States Senator. Once her time as a Senator is up Lauryn will start a Helicopter tour agency.

While a Senior in high school Lauryn received the Engineering Society of Detroit (ESD) 2018 Outstanding High School Student of the Year Award.

WELCOME
TO THE

EnergyTech Conference

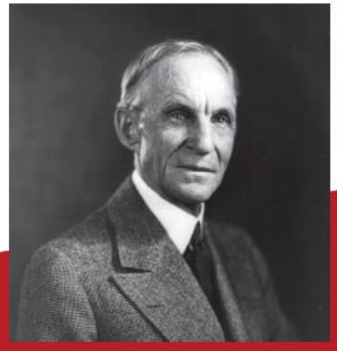
AND

Spirit of Innovation Exposition

the Henry Ford

energytech

NASA



"Mark my words, someday there will be *FLYING CARS."*

- HENRY FORD -
1926

Ford Flivver, "The Model T of the Skies," 1927

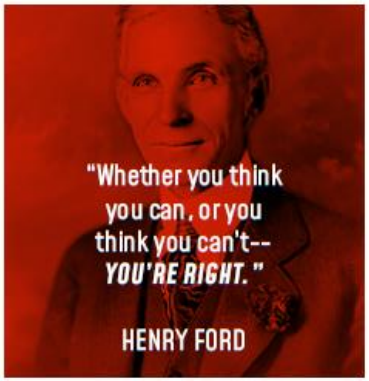
PAL-V, 2018
Production Flying Car

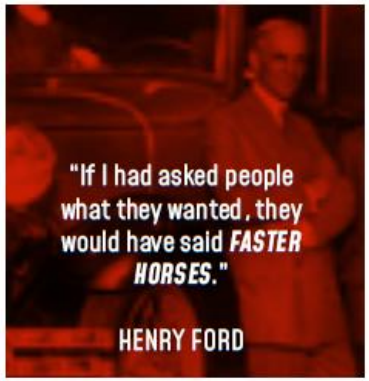
WHAT IS INNOVATION?

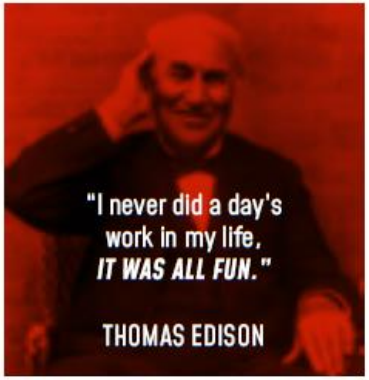
"The process of transforming a new or existing idea or invention into new or improved object, item, process or system that meets a new or existing need in a new or different, and better, way."

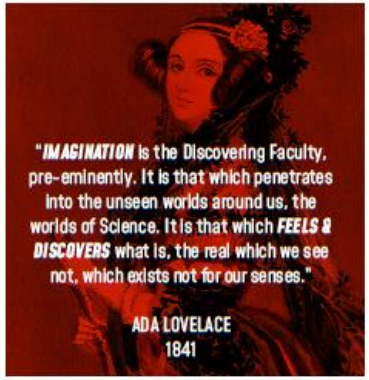
In fewer words, it's
"CREATING, OR DOING SOMETHING IN A NEW AND BETTER WAY."

Innovators are passionate people who love the work they do. Find the stories of three key innovators–Ada Lovelace, Thomas Edison, and Henry Ford–throughout the exhibit space, as well as dozens of others.









INNOVATION AGAINST THE ODDS

"MAN WILL NEVER REACH THE MOON, REGARDLESS OF ALL FUTURE SCIENTIFIC ADVANCES."

Dr. Lee DeForest, Father of Radio & Grandfather of Television, 1957

On June 20, 1969, American astronauts Neil Armstrong and Buzz Aldrin were the first men to walk on the moon.

During the 1960's and 1970's, men walked on the moon during 6 of the 9 NASA moon missions.

"I THINK THERE IS A WORLD MARKET FOR MAYBE FIVE COMPUTERS"

Thomas Watson, chairman of IBM, 1943

The total number of computers in the world is difficult to estimate, however: mobile phone users are expected to exceed 5 billion by 2019 according to statista.com. According to the Internet World Stats, there were 4,156 million Internet users (54.4% of the world's population) in December of 2017.

Note that in December of 1995, there were 16 million users or 0.4% of the world's population.

"THE HORSE IS HERE TO STAY BUT THE AUTOMOBILE IS ONLY A NOVELTY – A FAD."

The president of the Michigan Savings Bank advising Henry Ford's lawyer, Horace Rackham, not to invest in the Ford Motor Company, 1903

Not only has the automobile taken over the world, but we are now looking at flying cars.

Recall Henry Ford's comment in 1940, *"Mark my words, a combination airplane and motorcar is coming. You may smile, but it will come."*

"EVERYTHING THAT CAN BE INVENTED HAS BEEN INVENTED."

Charles H. Duell, Commissioner, US Office of Patents, 1899

U.S. Patent Number 10,000,000 was issued by the United States Patent and Trademark Office (USPTO) on June 19, 2018.

Half of the total patents issued since 1836 were issued in the last 30 years.

"OUR WRETCHED SPECIES IS SO MADE THAT THOSE WHO WALK ON THE WELL-TRODDEN PATH ALWAYS THROW STONES AT THOSE WHO ARE SHOWING A NEW ROAD."

Voltaire

When Thomas Edison's friend and associate said, "Isn't it shame that with the tremendous amount of work you have done you haven't been able to get any results?" Edison replied, ***"Results! Why, man, I have gotten lots of results! I know several thousand things that won't work!"***

Featuring 3 “Amazing” Innovators

ADA LOVELACE 1815-1852

“IMAGINATION is the Discovering Faculty, pre-eminently. It is that which penetrates into the UNSEEN WORLDS AROUND US, the worlds of SCIENCE.”

LEARN MORE ABOUT ADA LOVELACE:

In the 1800s, MATH and SCIENCE were subjects for boys. But Ada’s mother felt they were important for her daughter to learn, too. Because of her unique education, Ada became a great mathematician with interests in modern technology like steam engines and complicated machinery.

Ada, age 17

When she was 17, Ada met Charles Babbage, who was working on his “ANALYTICAL ENGINE”. A complex mechanical calculating device, it is considered the WORLD’S FIRST COMPUTER.

Already interested in this kind of work, Ada saw the possibilities for Charles’ machine, and that it could be used for solving complex mathematical computations. IN 1843, ADA WROTE THE WORLD’S VERY FIRST COMPUTER PROGRAM. She was over 100 years ahead of her time!

HENRY FORD 1863-1947

“Whether you think you can or you think you can’t, YOU’RE RIGHT.”

LEARN MORE ABOUT HENRY FORD:

Curious and hands-on, young Henry loved to experiment. At 10, he was building small steam engines with classmates, and shortly after started tinkering with watches. When he was 13, he first saw a steam vehicle going down the road under its own power, and the thrill he felt drove him to become an ENGINEER.

Teenage Henry

At 16, Henry left his family farm in Dearborn and moved to Detroit to learn about mechanics. He would later take a job at the Edison Illuminating Company, working for THOMAS EDISON.

The Ford family farm, now located in Greenfield Village, Dearborn MI

He built his first engine in 1893, and it operated in his kitchen sink. Three years later, he built his first vehicle. After many trials and two failed companies, he started FORD MOTOR COMPANY, which is still making cars today.

THOMAS EDISON 1847-1931

“I have not failed. I’ve just found 10,000 ways that won’t work.”

LEARN MORE ABOUT THOMAS EDISON:

When Thomas was 8, he moved with his family from his home in Milan, OH to Port Huron, MI. After only 12 weeks in his new school, his teachers said he was “UNABLE TO LEARN”. He was hyperactive and had trouble focusing--today, he would probably be diagnosed with ADHD. Not discouraged, his mother brought him home and taught him herself.

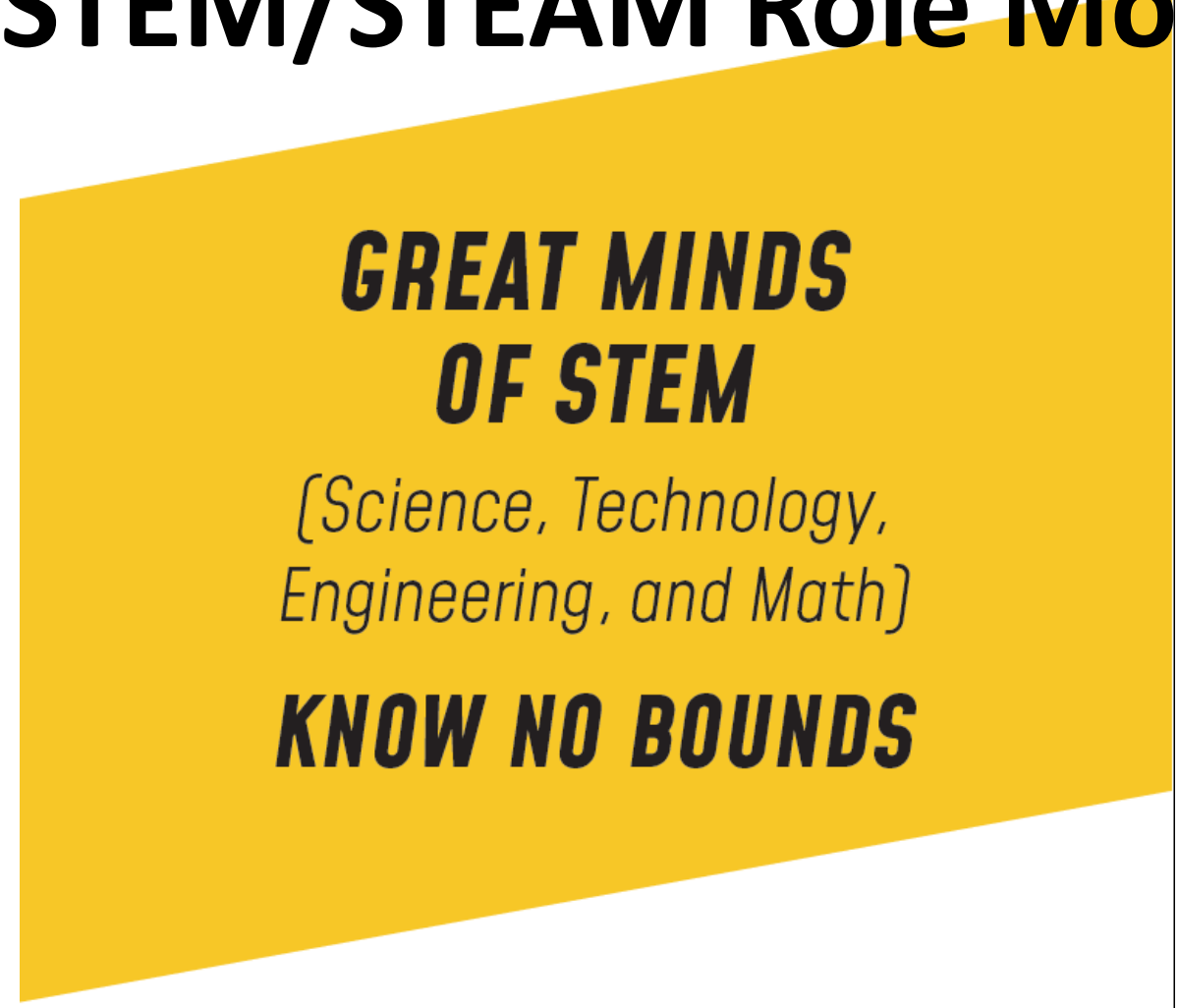
The Edison Birthplace Museum

By age 11, Thomas loved to learn, reading books on a wide range of subjects on his own. He developed a process for SELF-EDUCATION and learning that he carried with him into adulthood.

Thomas, age 14

Over his lifetime, Thomas received 2,332 PATENTS. Many were for things that we still use today, from an efficient LIGHTBULB, to the MOVIE CAMERA, to the PHONOGRAPH, the first device for playing recorded sounds, to the MIMEOGRAPH--an early copier.

36 STEM/STEAM Role Models



Diversity of backgrounds and interests are essential ingredients for innovation.

Dr. Mario Molina (1943-Present)

Chemist, Environmental Researcher, & American Professor

Co-discovered how chlorofluorocarbon gases (CFCs) deplete the ozone layer and the 1st Mexican-born person to receive a Nobel prize in Chemistry (1995).

Hedy Lamarr (1914-2000)

Actress & Inventor

Co-invented and was awarded a patent for spectrum technology which formed the technical skeleton that makes cellular phones, fax machines and Wi-Fi services possible. She was also a popular actress, appearing in 35 films.

National Inventors Hall of Fame

Dr. Grace Hopper (1906-1992)

Mathematician & Physicist, Naval Rear Admiral

A computer programming pioneer, Dr. Hopper developed the first computer compiler and the COBOL programming language. Received 40 honorary degrees, and numerous other awards and honors.

Image courtesy of the Mathematical Society of America

Lewis Howard Latimer (1848-1928)

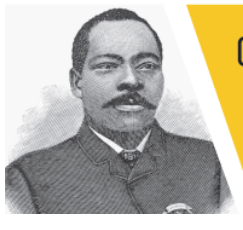
Electrical Engineer & Inventor, Son of Escaped Slaves

Invented improved method of producing carbon filament and threaded socket for Edison's lightbulb, an improved toilet system for railroad cars, an early air conditioner, and helped Alexander Graham Bell draft the patent for the telephone. Charter member and only African American in Edison Pioneer Group.

Dr. Maria Telkes (1900-1995)

Physical Chemist & Biophysicist

Invented the thermoelectric generator, a thermoelectricity-operated refrigerator, and was awarded 20+ patents. 1st recipient of the SWE Achievement Award and the National Academy of Sciences Building Research Advisory Board's Lifetime Achievement Award.



Granville Woods (1856-1910)

Inventor, Known as the "Black Edison"

Invented the multiplex telegraph for communication with and between moving trains. Alexander Graham Bell bought his patent of a combined telephone/telegraph, and Thomas Edison unsuccessfully sued him over his induction telegraph invention and then offered to make him a partner. Awarded 50+ patents.

Dr. Mark E. Dean (1957-Present)

Computer Scientist & Engineer

Leader on team designing the Industry Standard Architecture (ISA) bus enabling multiple devices to be interfaced with a computer, awarded 20+ patents including 3 of IBM's 1st 9 patents.

Marie Van Brittan Brown (1922-1999)

Nurse & Inventor

Invented 1st closed circuit TV, and was the 1st to patent a home security system with a motorized camera, 2-way audio, and a way to contact the police.

Otis Boykin (1920-1982)

Electronics Inventor

Invented 25 electronic devices, including a pacemaker control unit and a variable resister for guided missiles, and thick film resistors for computers.

Edith Clarke (1883-1959)

Electrical Engineer

Invented/patented a new graphical calculator for electricity, worked as a "human calculator". 1st female EE, 1st MIT EE Master's Degreed woman, 1st female professor of EE at Univ. of Texas at Austin, and 1st female IEEE Fellow.

National Inventors Hall of Fame

Dr. Shirley Ann Jackson (1946-Present)

Theoretical Physicist

Her experiments led to touch-tone telephone, portable fax, caller ID, call waiting, and fiber-optic cable. 1st African American woman to earn a Doctorate at MIT in Nuclear Physics and the 1st woman to be named U.S. Nuclear Regulatory Commission Chair, and holds 53 honorary degrees.

James West (1931-Present)

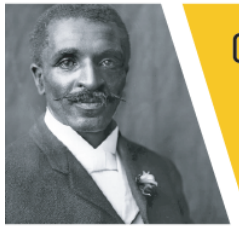
Physicist & Inventor

Invented microphones and techniques for making polymer foil-electrets, "technology later used in 90 percent of contemporary microphones," awarded 47 U.S. patents & 200+ foreign patents.

Dr. Rosalyn Yallow (1921-2011)

Medical Physicist

Co-invented a very sensitive way to measure hormones in the body named radioimmunoassay (RIA) which is still used today. Awarded NOBEL Prize in 1977.



George Washington Carver (1864-1943)

Inventor, Born into Slavery

Created 300+ products from peanuts, once he discovered that they were a crop that could be rotated with cotton to add nutrients back into the soil.

George E. Alcorn, Jr (1940-Present)

Inventor

Invented and patented method for fabricating an imaging x-ray spectrometer in 1984. Recipient of the NASA/GSFC Inventor of the Year award.

Ellen Swallow Richards (1842-1911)

Engineer & Chemist

'Invented' new engineering fields, known as "the woman who founded ecology". Denied a PhD from MIT, she later taught--mostly unpaid--MIT engineering students who became leaders in environmental science and modern sanitation.

Jan Ernst Matzeliger (1852-1889)

Inventor, Surinamese Immigrant

Invented machine to attach soles to a shoe top 15x faster than by hand.

Dorothy Johnson Vaughan (1910-2008)

Mathematician

NASA "human computer" for the Apollo space program. One of the women depicted in the film "Hidden Figures".

Ellen Ochoa (1958-Present)

Engineer & Astronaut

1st Hispanic woman astronaut, serves as Director of Flight Crew Operations at the Johnson Space Center and has received numerous awards including NASA's Exceptional Service Medal and the Outstanding Leadership Medal.

Dr. Charles Drew (1904-1950)

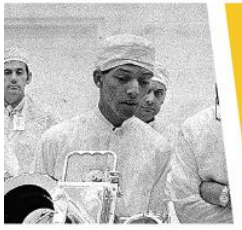
Surgeon & Researcher

Invented the modern blood bank.

Sarah Goode (1855-1905)

Inventor, Born into Slavery

Invented and was awarded a patent in 1885 for a folding cabinet bed which could also be used as a desk (30 years prior to the Murphy bed), 1st African American to receive a U. S. patent.



Dr. George Caruthers (1939-Present)

Astrophysicist

Invented the ultraviolet camera/spectrograph used by NASA in Apollo 16 in 1972 and thereafter.

Patricia Bath (1942-Present)

Ophthalmologist

Invented and patented a device refining laser cataract surgery. 1st African American female doctor to receive a medical patent.

Alexander Miles (1838-1918)

Barber & Inventor

Invented automatic doors for elevators.

T. DAVID PETITE (1956-PRESENT)

CHIPPEWA INDIAN INVENTOR

Invented the Smart Meter Technology, and founded the Native American Inventors Association. Holds 30+ patents.

ELIJAH McCOY (1844-1929)

MECHANICAL ENGINEER, SON OF ESCAPED SLAVES

Invented a lubricating cup that distributed oil evenly over a steam engine's moving parts. Awarded 60 other patents including an ironing board and a lawn sprinkler.

DR. LILIAN GILBRETH (1878-1972)

INDUSTRIAL ENGINEER & PSYCHOLOGIST

'Invented' Industrial Psychology, her book, Psychology of Management, "is the most important in the history of engineering thought", widely known as a pioneering woman engineer.

NORBERT RILLIEUX (1806-1894)

CHEMICAL ENGINEER & INVENTOR, MOTHER WAS A NATIVE AMERICAN & FREED SLAVE

Invented the multiple-effect vacuum evaporator for refining sugar.

ANDREW J. BEARD (1849-1921)

INVENTOR, FREED SLAVE

Invented a flour mill, a rotary steam engine, two kinds of plows, and the Jenny Coupler which automatically locks train cars when they bump.

DR. BARBARA McCLINTOCK (1902-1992)

SCIENTIST & CYTOGENETICIST

Researched chromosomal changes in corn during reproduction, 1st woman to receive NOBEL prize unshared in Physiology.

DR. SEVERO OCHOA (1905-1993)

PHYSICIAN & BIOCHEMIST

Co-awarded NOBEL Prize in 1959 in Physiology or Medicine for discovering an enzyme that enables the synthesis of ribonucleic acid (RNA), one of 4 major macrohydrates essential for all known forms of life.

DOROTHY CROWFOOT HODGKIN (1910-1994)

BIOCHEMIST & X-RAY CRYSTALLOGRAPHER

"Mapped the structure of insulin", and was awarded a NOBEL Prize for Chemistry.

GARRETT AUGUSTUS MORGAN (1877-1963)

TAILOR & INVENTOR, SON OF FORMER SLAVES

Invented the 1st automated traffic signal device, a sewing machine, the zig-zag stitching attachment, and patented the 1st gas mask.

DR. MARIE CURIE (1867-1934)

FRENCH PHYSICIST & CHEMIST

With her husband, Pierre Curie, researched polonium and radium. Was the 1st woman awarded a NOBEL prize (with husband Pierre Curie in Physics), and first person to be awarded a 2nd NOBEL prize (Chemistry).

FREDERICK McKINLEY JONES (1893-1961)

ENTREPRENEUR & SELF TAUGHT ENGINEER

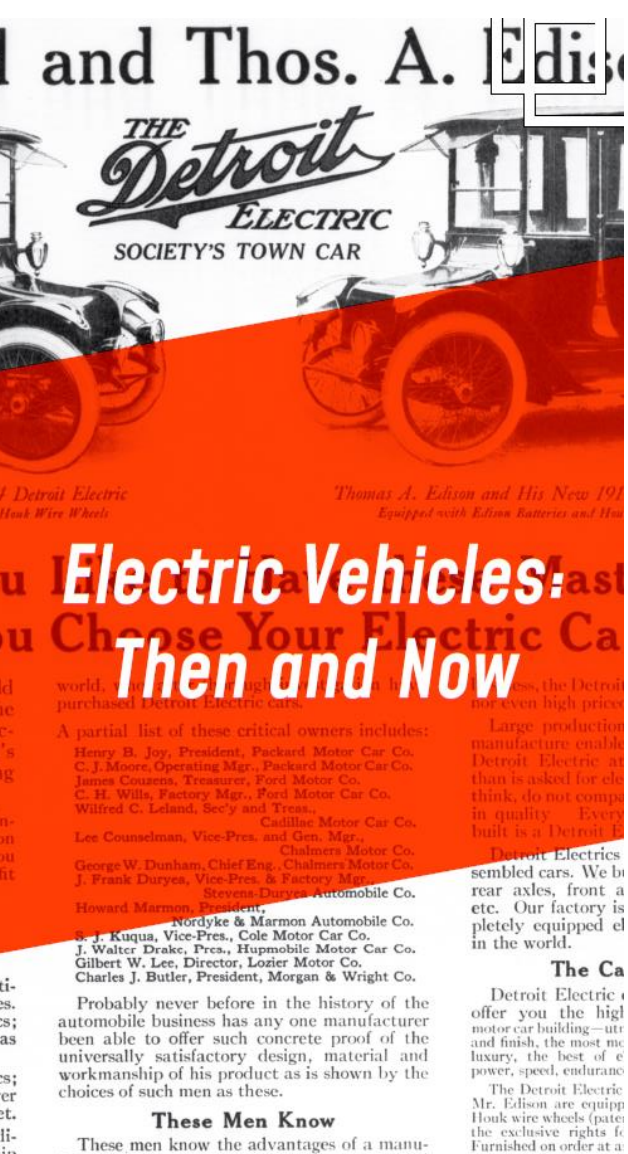
Invented a device to combine sound with motion pictures, and patented an automatic refrigeration system for long-haul trucks and railroad cars. Awarded 60+ patents.

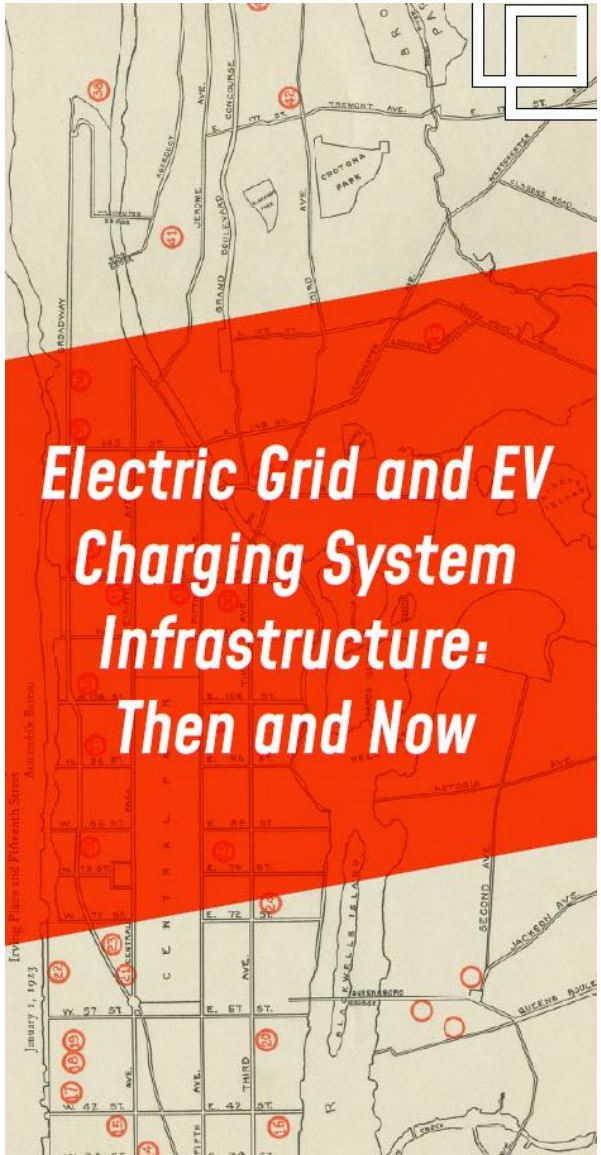
DANIEL HALE WILLIAMS (1856-1931)

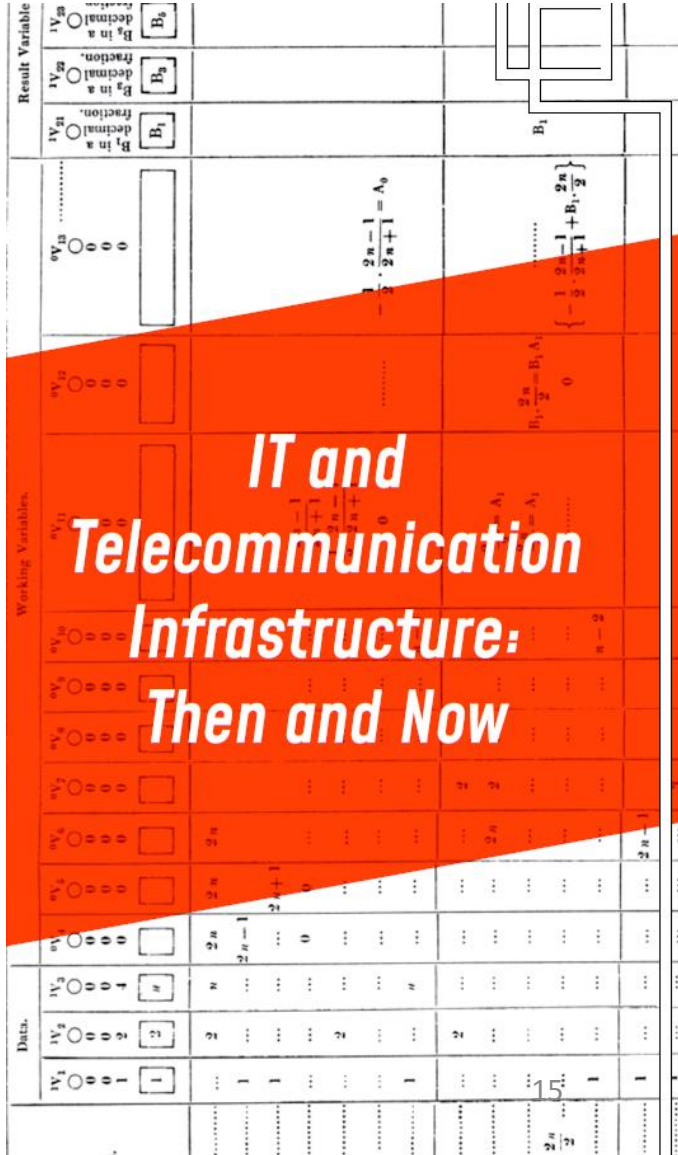
PHYSICIAN

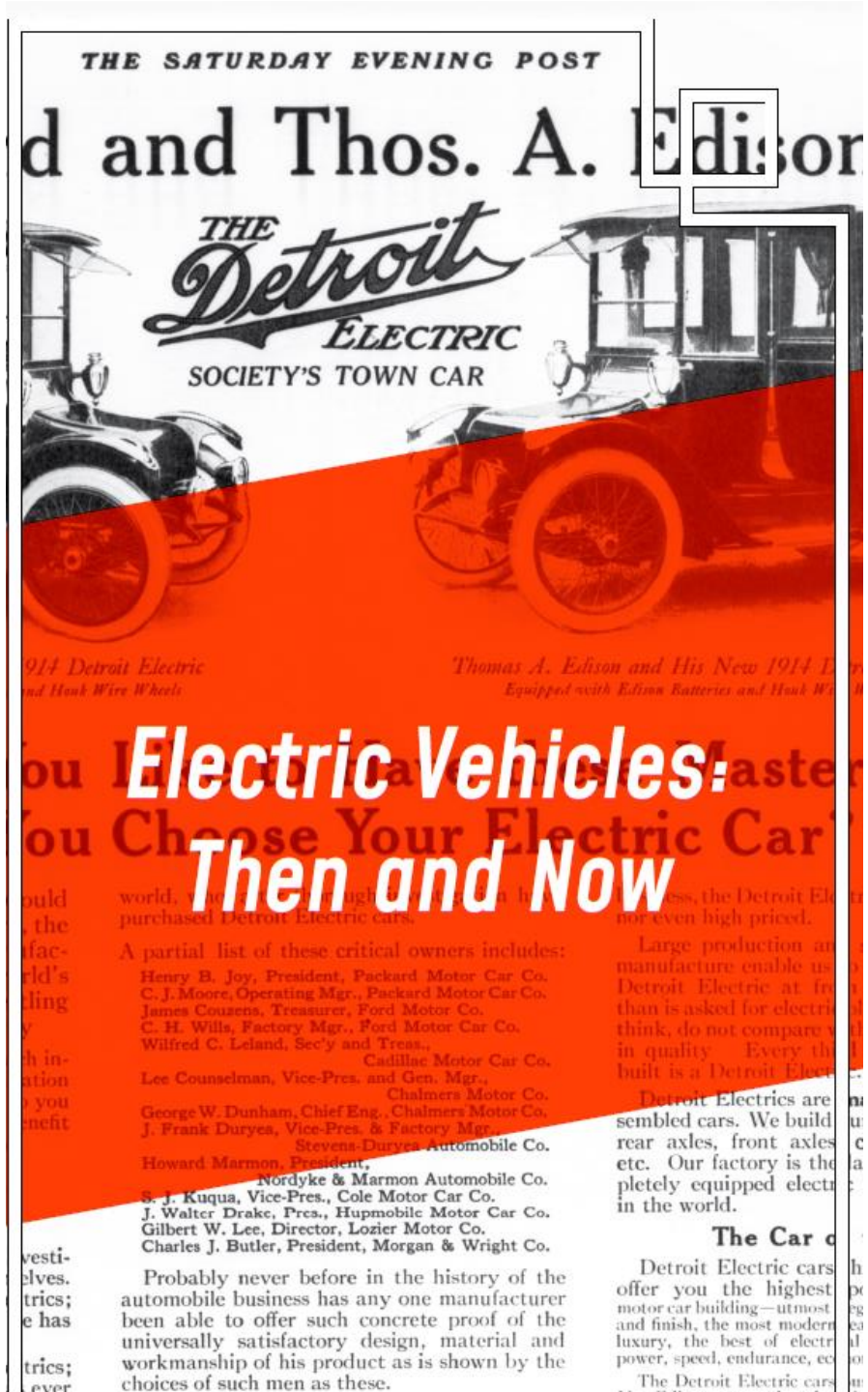
Performed the 1st prototype open-heart surgery in 1893, and in May 1901 established the nation's 1st hospital for African Americans with a racially integrated staff.

3 Interactive Past-Forward Exhibits With Museum Artifacts From The Henry Ford Museum of American Innovation, Dearborn, MI








THE SATURDAY EVENING POST
d and Thos. A. Edison
THE Detroit ELECTRIC
SOCIETY'S TOWN CAR
Thomas A. Edison and His New 1914
Equipped with Edison Batteries and Hauk
Electric Vehicles:
Then and Now
You Choose Your Electric Car
A partial list of these critical owners includes:
Henry B. Joy, President, Packard Motor Car Co.
C. J. Moore, Operating Mgr., Packard Motor Car Co.
James Couzens, Treasurer, Ford Motor Co.
C. H. Wills, Factory Mgr., Ford Motor Car Co.
Wilfred C. Leland, Sec'y and Treas., Cadillac Motor Car Co.
Lee Counselman, Vice-Pres. and Gen. Mgr., Chalmers Motor Co.
George W. Dunham, Chief Eng., Chalmers Motor Co.
J. Frank Duryea, Vice-Pres. & Factory Mgr., Stevens-Duryea Automobile Co.
Howard Marmon, President, Nordyke & Marmon Automobile Co.
S. J. Kuqua, Vice-Pres., Cole Motor Car Co.
J. Walter Drake, Pres., Hupmobile Motor Car Co.
Gilbert W. Lee, Director, Lozier Motor Co.
Charles J. Butler, President, Morgan & Wright Co.
Probably never before in the history of the automobile business has any one manufacturer been able to offer such concrete proof of the universally satisfactory design, material and workmanship of his product as is shown by the choices of such men as these.
The Car
Detroit Electric cars
offer you the highest
motor car building—utmost
and finish, the most modern
luxury, the best of electr
power, speed, endurance, ec

In 1900, 38% of cars were electric, 40% ran on steam, and 22% used gasoline. Edison advocated the advantages of the electric car.

Thomas Edison with his first electric car, an Edison-Baker, 1895

"*ELECTRICITY IS THE THING.*

There are no whirring and grinding gears with their numerous levers to confuse, no dangerous and evil-smelling gasoline and no noise."

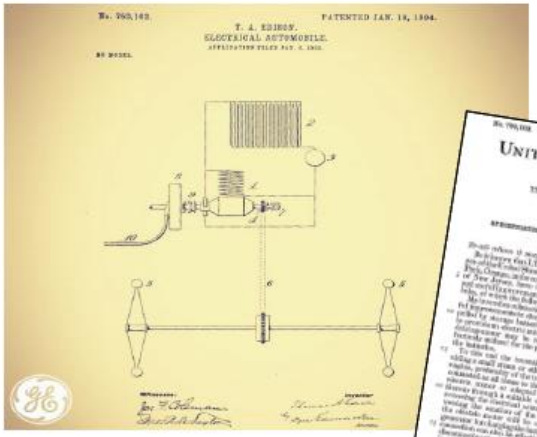
Thomas A Edison

- THOMAS EDISON -

EDISON'S ELECTRIC CAR

In 1904, Thomas Edison patented his ***"ELECTRICAL AUTOMOBILE."*** It was one of many patents he held related to the electric vehicle, including:

1884: Electric Generator or Motor
1891: a Means for Propelling Electric Cars
1900: a Reversible Galvanic Battery
1901: an Electrode for Batteries
1904: an Alkaline Battery
1912: an Electrical System for Automobiles



"The combination of an electric motor, an armature having a driving-shaft, a sprocket-wheel thereon, one or more idle-pulleys supported by the field magnet of the motor, a sprocket-chain passing around said wheel and idle-pulleys, and a driven sprocket-wheel outside of the chain and in engagement therewith ... "

From Edison's patent on a Means for Propelling Electric Cars (1891)

1912 Baker Electric Automobile

President William Howard Taft motorized the White House in 1909 when he purchased a steam-powered White, two gasoline-powered Pierce-Arrows and a Baker Electric. Three years later, Taft replaced the 1909 Baker with this 1912 Victoria model for the First Lady's use. It remained in use until 1928, serving Helen Taft, Ellen Wilson, Edith Wilson, Florence Harding and Grace Coolidge.

From the Collections of The Henry Ford, Dearborn, Michigan
28.264.1

the Henry Ford

Historic electric vehicle provided by The Henry Ford Museum of American Innovation, Dearborn, MI.

Cleveland's Baker Motor Vehicle Company advertised its less expensive Baker electric coupe in this 1915 ad. Similar advertisements touted the Baker electric vehicle as simple to use, reliable, clean, and elegantly styled. By 1915, however, sales of "electrics" were in decline. Gasoline-powered vehicles with internal combustion engines were dominating the market.

From the Collections of The Henry Ford, Dearborn, Michigan
THF201763

1922 Detroit Electric Coupe

Height: 71" Width: 65" Length: 159" Wheelbase: 100"

The elegant Detroit Electric was the best-known and most long-lived American electric car company. Detroit Electric built cars from 1907 to 1942, although after 1930 production was limited to custom orders. This four-passenger Model 90 coupe was in regular use from 1922 to 1934. A large battery provided electricity for the vehicle's electric motor. The car had a driving range of ***70 to 100 miles*** between charges and a top speed of about ***25 miles per hour***.

From the Collections of The Henry Ford, Dearborn, Michigan
34.371.1

Historic electric vehicle and charger provided by The Henry Ford Museum of American Innovation, Dearborn, MI.

HENRY FORD and ***THOMAS EDISON*** headlined this 1914 advertisement for the Anderson Electric Car Company. According to the ad, each had owned three electric vehicles—all Detroit Electrics. The ad also lists other well-known motor company executives who owned Detroit Electrics. Anderson Electric Car Company hoped to parlay these ownership examples into larger sales.

From the Collections of The Henry Ford, Dearborn, Michigan
THF89885

HOME CHARGING YOUR EV A CENTURY AGO

In 1900, 38% of cars traveling America's roads were powered by batteries. The popularity of electric cars made having ways to charge them critical. There were free, public stations available for use, but car owners also charged their vehicles at home.

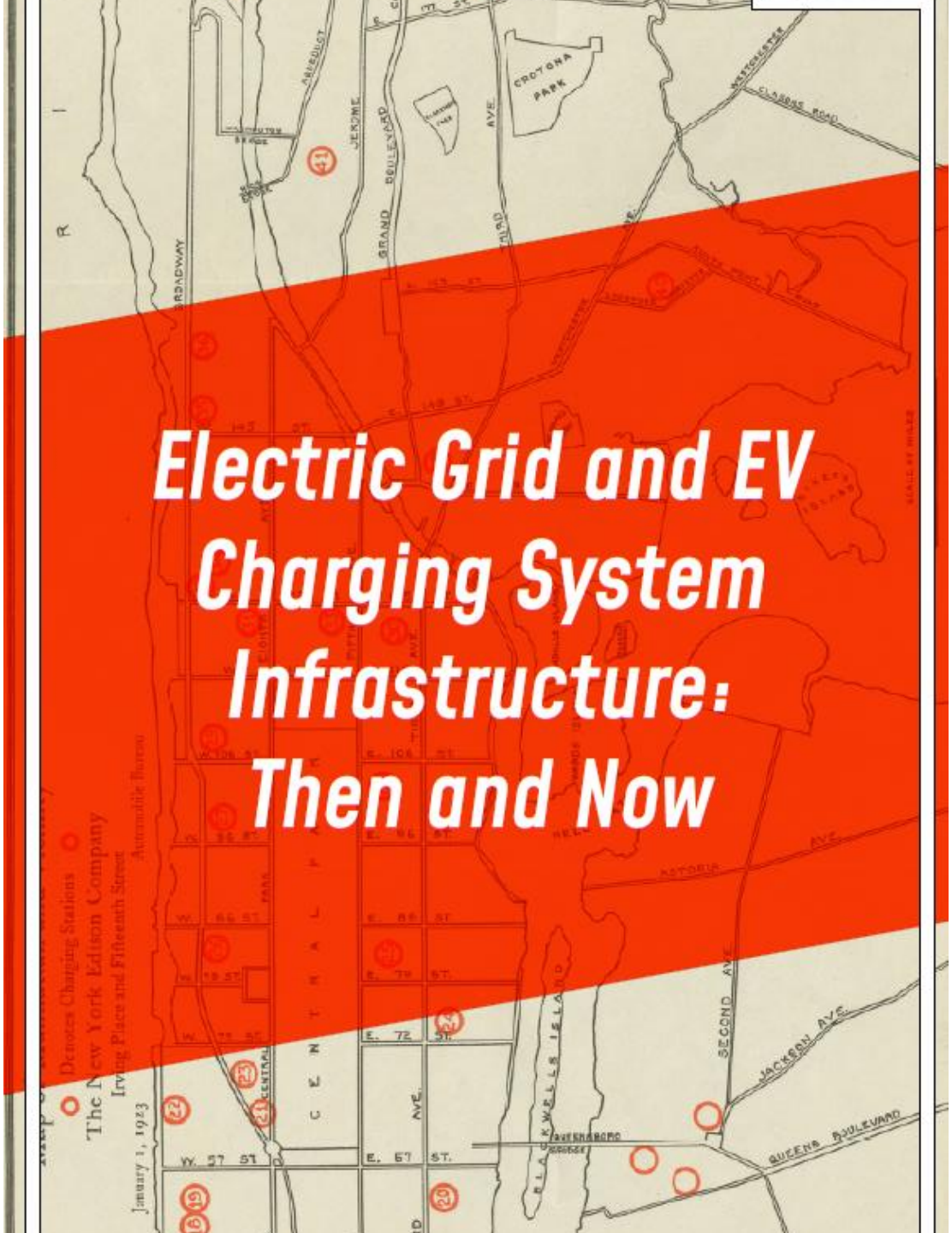
Electric automobiles offered advantages over early internal combustion engine cars. They were ***CLEAN AND QUIET***. They were also relatively ***EASY TO OPERATE***, with no hand crank needed to start them and no gears to shift. But batteries were expensive and required several hours to recharge. And, though electricity was readily available in cities, rural electrification wasn't widespread until the 1940s.

Battery Charging of a Detroit Electric Automobile, circa 1919

From the Collections of The Henry Ford, Dearborn, MI
THF285902

Child Charging an Electric Car in a Home Garage, 1917

SAFETY WAS A FREQUENT THEME IN ELECTRIC AUTOMOBILE ADVERTISING. Certainly electric cars were safer to start than hand-cranked gasoline cars. But manufacturers also stressed that electrics were safe to charge. This illustration, from a 1917 Rauch and Lang Carriage Company catalog, vividly makes the point with a child holding the plug while mother turns on the power.


Electric Grid and EV Charging System Infrastructure: Then and Now

EV CHARGING STATION INFRASTRUCTURE: THEN

Public charging stations in the early 1900s were modeled after horse stables and were sometimes referred to as called "Electric Stables." Charging stations could charge more vehicle than today's charging stations with a capacity to charge 8-20 vehicles at a time.

Image from Book, Electric Automobile Charging Stations in New York City and Vicinity, 1923

Americans still drove electric cars in the 1920s. The New York Edison Company's Automobile Bureau published this booklet for electric-car owners. It included a map and address listings for local charging stations in New York City. Stations outside the immediate area, as far as Boston and Philadelphia, were also listed.

From the Collections of The Henry Ford, Dearborn Michigan
THF101666

EV CHARGING STATION INFRASTRUCTURE: NOW

Today's typical public EV charging stations can charge one or two vehicles at a time.

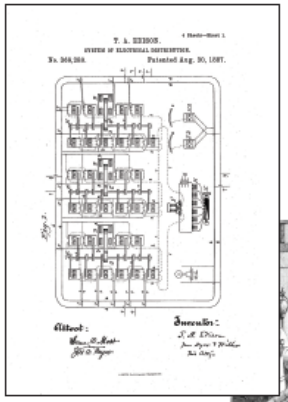
Home EV chargers today work much the same as home chargers in the early 1900s.

Chargers in Manhattan, as of September 2018

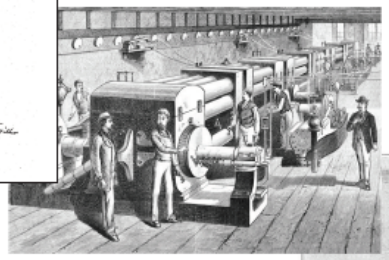
Visit the U.S. Department of Energy (DoE) On-Line Charging Station Locator to find EV charging stations. Is there a public charging station near your house? What are the different types of charging stations?

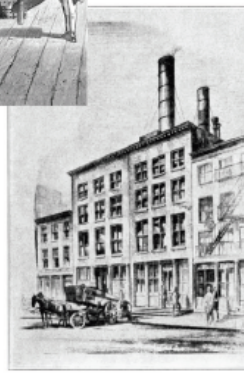
THE BEGINNINGS OF THE ELECTRIC GRID

The electric power grid as we know it began in the 1870s with a building of small-scale isolated and power generation systems in various parts of the world. In the 1880s Thomas Edison pioneered a successful system for electric power generation and distribution that used DIRECT CURRENT (DC) technology. At the same time other inventors were experimenting with systems that used ALTERNATING CURRENT (AC) technology.



In 1880, ***THOMAS EDISON*** filed for the patent "System of Electrical Distribution," and built his first commercial electric lighting system at the center of New York City's financial district in lower Manhattan. The patent was granted on August 30, 1887.





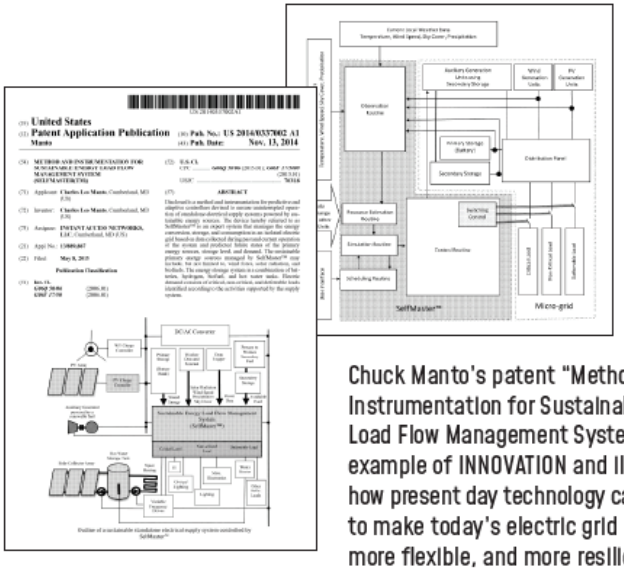
PEARL STREET STATION quickly grew from serving 82 customers in 1882, to 508 in 1884. As the world's first cogeneration plant, it provided both grid electricity and used the steam byproduct to serve local manufacturers and warm nearby buildings in Manhattan.

THE ELECTRIC GRID TODAY

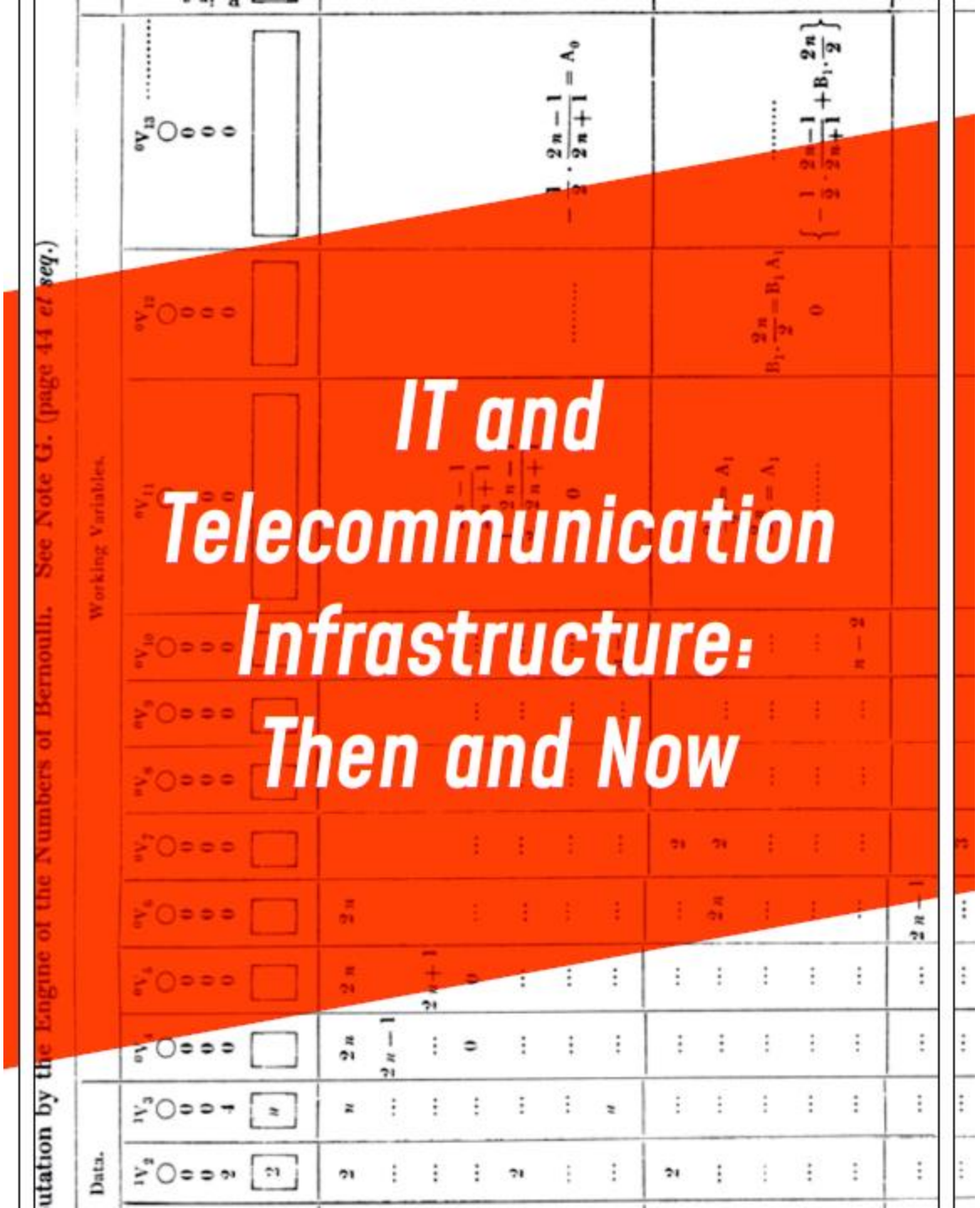
In the 1890s there was a "***BATTLE OF THE CURRENTS***" between the ***DIRECT CURRENT (DC)*** and ***ALTERNATING CURRENT (AC)***. Because AC power could be transmitted over long distances much more efficiently than DC power, AC power became the technology used for electric power generation and distribution.

In the 1900s the growth and unification of the independent power systems into an interconnected AC electric power 'grid' helped raise the quality of life of people of all classes.

Today, our interconnected electric power grid is highly complex and utilizes the latest technologies available to generate and control the distribution of electricity. The use of computer controls and the Internet has led to what has become to be known as the "smart" grid. In addition, many sources of energy are used to generate electricity. These include energy sources such as coal, oil, hydro, nuclear, geothermal, wind, and solar.



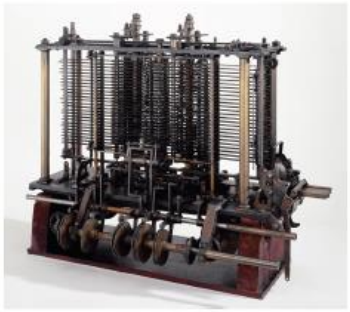
Chuck Manto's patent "Method and Instrumentation for Sustainable Energy Load Flow Management System" is an example of INNOVATION and illustrates how present day technology can be used to make today's electric grid "smarter," more flexible, and more resilient.

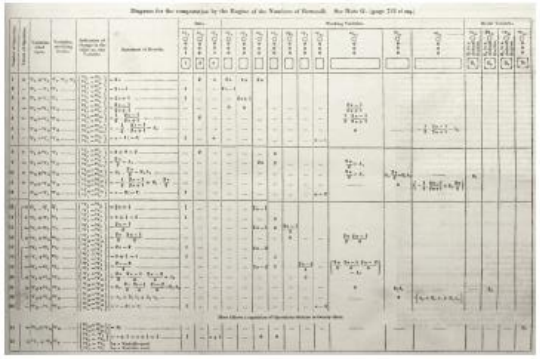

IT and
Telecommunication
Infrastructure:
Then and Now

THE ANALYTICAL ENGINE & FIRST COMPUTER ALGORITHM, 1843

In the late 1830s, the computer pioneer ***CHARLES BABBAGE*** began work to design his ***"ANALYTICAL ENGINE."*** This marked the transition from mechanized arithmetic computation to full-fledged general purpose computation.

The major innovation of the Analytical Engine was programming using ***PUNCH CARDS***. The design also included other elements we still use in our computers today, such as ***SEQUENTIAL CONTROL***, ***BRANCHING***, and ***LOOPING***. These innovations enabled the results of preceding computations to be used as input to the next computation of the mechanical calculator. Babbage continued to work on the Analytical Engine until his death in 1871.





Above: The Analytical Engine

Left: Ada Lovelace's original algorithm

ADA LOVELACE was an English mathematician and writer. She was the first to recognize that the machine had applications beyond pure calculation, and published the ***FIRST ALGORITHM*** intended to be carried out by such a machine. Ada Lovelace is recognized by many to be the first computer programmer, and the object-oriented high-level computer programming language "Ada" (1980) is named in her honor.

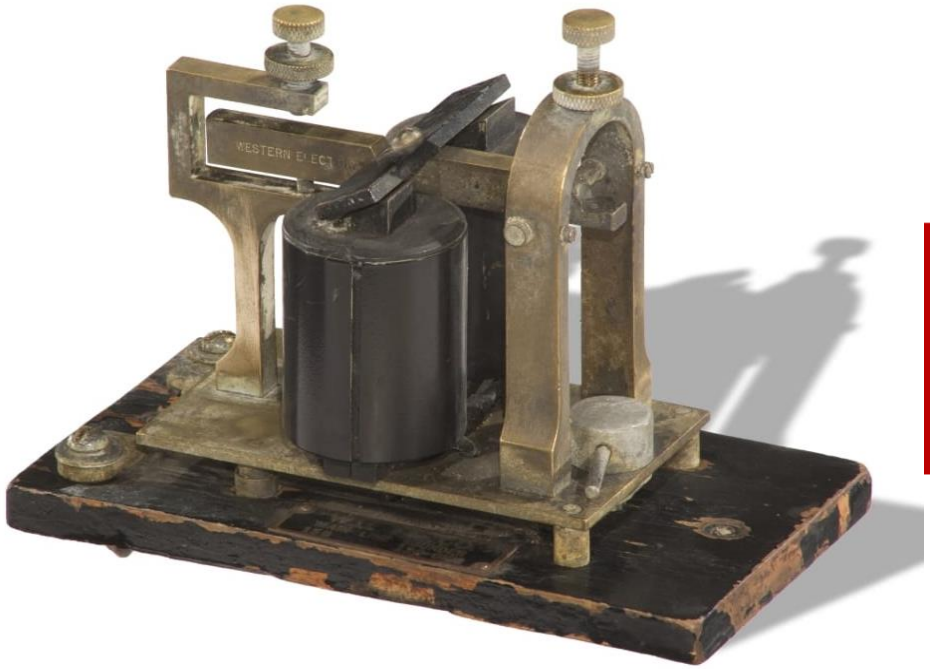
THE ANALYTICAL ENGINE & FIRST COMPUTER ALGORITHM, 1843

Babbage and Lovelace both knew how important the Analytical Engine was, and that the ideas behind it would shape the future of science and information. They were right—it's hard to even imagine a world without computers today.

"A NEW, A VAST, AND A POWERFUL LANGUAGE IS DEVELOPED FOR THE FUTURE USE OF ANALYSIS, in which to wield its truths so that these may become of more speedy and accurate practical application for the purposes of mankind than the means hitherto in our possession have rendered possible."
– ADA LOVELACE

"The whole of the developments and operations of analysis are now capable of being executed by machinery ... As soon as an Analytical Engine exists, it will necessarily ***GUIDE THE FUTURE COURSE OF SCIENCE.***"
– CHARLES BABBAGE

"The Analytical Engine has no pretensions whatever to originate anything. ***IT CAN DO WHATEVER WE KNOW HOW TO ORDER IT TO PERFORM***... But it is likely to exert an indirect and reciprocal influence on science itself."
– ADA LOVELACE



THE BEGINNINGS OF TELECOMMUNICATION AND CODE

HOW QUICKLY CAN YOU SEND A MESSAGE ACROSS THE COUNTRY? Before the 1830s, your best option was to mail a letter. The ***ELECTRIC TELEGRAPH*** was the first means of sending "instant messages" via long distances.

SAMUEL B. MORSE created the first commercially practical telegraph in 1838, and ***MORSE CODE*** to efficiently communicate with it. In 1851, the Western Union Telegraph Company was organized to create one unified system of transmitting messages throughout the United States. Western Union completed the first transcontinental telegraph line in 1861. The next step was to take the telegraph international.

the Henry Ford

Historic telegraph artifacts provided by The Henry Ford Museum of American Innovation, Dearborn, MI.

Today, the most well-known use of Morse Code is to signal "***SOS***":

... ––– ...

Try tapping out a word using this chart, then check out the telegraph key and cables in the nearby case!

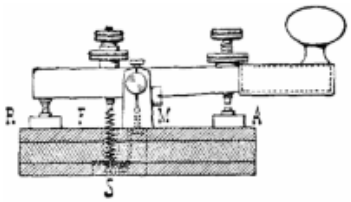
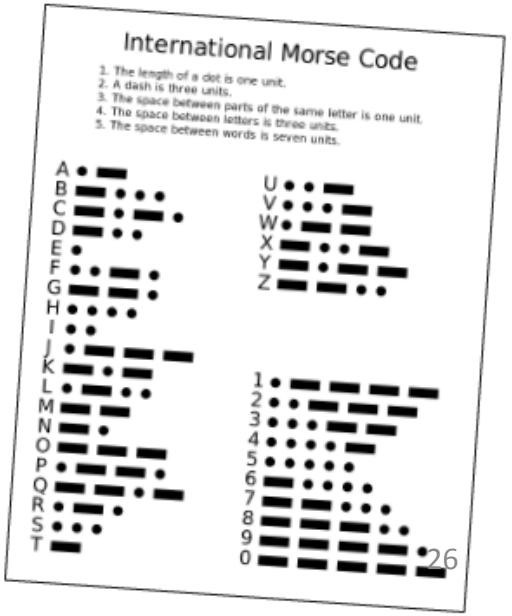


Fig. 6.

A Morse telegraph key



Transatlantic Cable Display Cables: 1858-1928

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Historic submarine telegraph cable artifacts provided by The Henry Ford Museum of American Innovation, Dearborn, MI.

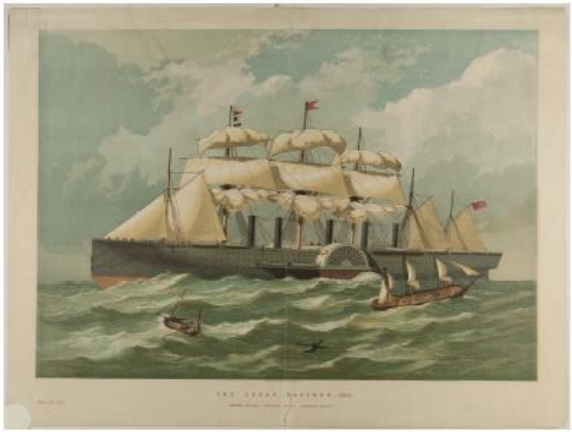
TRANSATLANTIC CABLE "MEGAPROJECT"

In ***1854***, Cyrus West Field conceived the idea of the telegraph cable and secured a charter to lay a well-insulated line across the floor of the Atlantic Ocean.

In ***1856***, Field established the Atlantic Telegraph Company. Beginning in 1857, obtaining the aid of British and American naval ships, ***FOUR UNSUCCESSFUL ATTEMPTS*** to lay a cable were made. In July of 1858, four British and American vessels–the Agamemnon, the Valorous, the Niagara, and the Gorgon–met in mid-ocean for the fifth attempt. By August 5, the cable had been successfully laid, stretching nearly 2,000 miles across the Atlantic at a depth often of more than two miles.

On ***August 16, 1858*** U.S. President James Buchanan and Queen Victoria of England ceremoniously exchanged the ***FIRST OFFICIAL TRANSATLANTIC TELEGRAM*** between North America and Europe. Unfortunately, the cable proved weak and by the beginning of September had ceased functioning. However, Field did not give up!

In ***1866***, the British ship ***GREAT EASTERN*** succeeded in laying the ***FIRST PERMANENT TELEGRAPH LINE ACROSS THE ATLANTIC OCEAN***. Cyrus West Field was the object of much praise on both sides of the Atlantic for his persistence in accomplishing what many thought to be an impossible undertaking. He later promoted other oceanic cables, including telegraph lines that stretched from Hawaii to Asia and Australia.



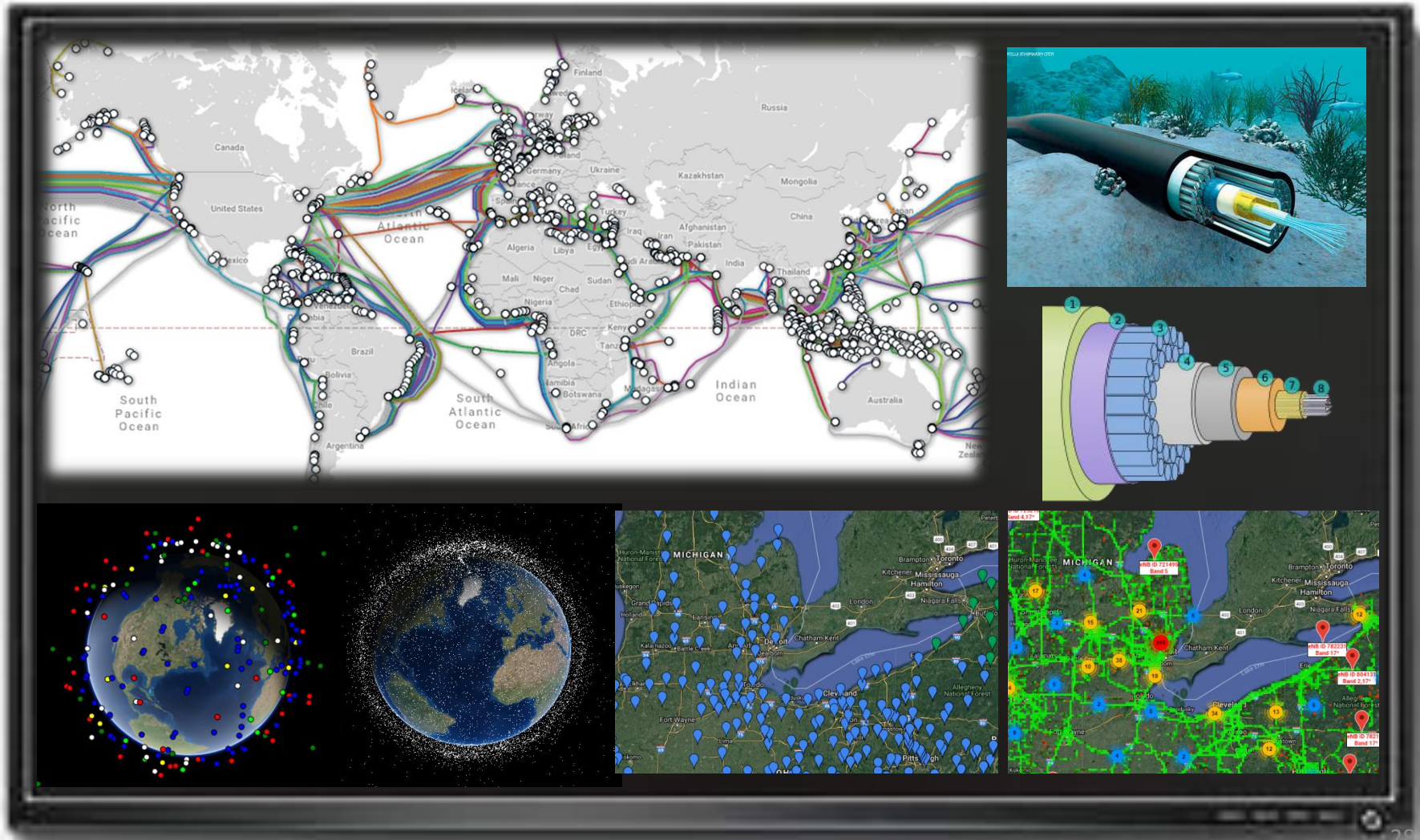
Chromolith, "SS Great Eastern Afloat," 1857

The Great Eastern was the largest passenger ship ever built at the time of its launch in 1858. In 1866, it was converted to lay the second–and first successful–***TRANSATLANTIC CABLE***. During its career, this ship laid multiple submarine communication cables totaling over ***32,000 MILES***.

IT and Telecommunications Infrastructure: Today

Interactive On-Line Maps and Web Sites

Submarine Fiber Optic Cables *Satellites* *Microwave and Cell Towers*



Innovating Into the Future!

NASA Exhibit: Selected Displays and Hands-On Activities From The NASA AirVenture Pavilion at EAA

Unmanned Aircraft Systems *SB-3 Viking* *Electrification of Aircraft*