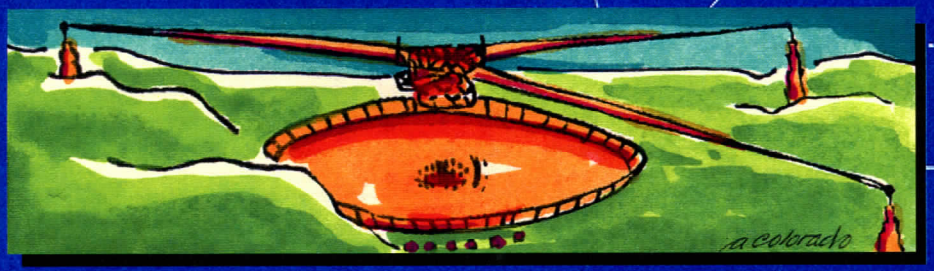
ARECIBO OBSERVATORY



ELECTRICAL ENGINEERING MILESTONE
MECHANICAL ENGINEERING LANDMARK
AWARD CEREMONY

SATURDAY, NOVEMBER 3, 2001

IEEE

NATIONAL ASTRONOMY AND IONOSPHERE CENTER
ARECIBO OBSERVATORY

IEEE HISTORY CENTER

Preserving, Researching, and Promoting the Legacy of Electrical Engineering and Computing

3 August 2001

Juan Ramon Falcon, Chair
IEEE Puerto Rico and Caribbean Section
Cond. Galeria 1
201 Arterial Hostos, Apt. 1606
San Juan, PR 00918

Dear Dr. Falcon,

On behalf of the IEEE History Committee and the IEEE Executive Committee, it is my pleasure to inform you and the IEEE Puerto Rico and Caribbean Section that NAIC/Arecibo Radiotelescope, 1963, has been approved as an IEEE Milestone in Electrical Engineering and Computing with the following citation:

The Arecibo Observatory, the world's largest radiotelescope, was dedicated in 1963. Its design and implementation led to advances in the electrical engineering areas of antenna design, signal processing, and electronic instrumentation, and in the mechanical engineering areas of antenna suspension and drive systems. The drive system positions all active parts of the antenna with millimeter precision, regardless of temperature changes, enabling the telescope to maintain an accurate focus. Its subsequent operation led to advances in the scientific fields of radioastronomy, planetary studies, and space and atmospheric sciences.

Arecibo thus enters the select list of sites that have been designated by IEEE at the Section level as having had great impact on engineering practice and on society.

It is my additional great pleasure to inform you that our sister society, ASME International, Inc., has agreed to simultaneously name Arecibo as a Landmark in Mechanical Engineering. You should be receiving direct confirmation from ASME shortly. You and your Section should therefore be doubly proud of the great technological and scientific achievements that took place within your area.

I understand that you are planning the designation ceremony for 3 November 2001. Please do not hesitate to let me know if I can be of further assistance.

Yours sincerely,

Michael N. Geselowitz

Michael N. Geselowitz, Ph.D., Director
m.geselowitz@ieee.org

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Phone +1 732 932 1066 • Fax +1 732 932 1193 • Email history@ieee.org
http://www.ieee.org/history_center

History and Heritage Committee
Founded 1971

ASME International

Three Park Avenue
New York, NY 10016-5990
U.S.A.

May 31, 2001

Michael Geselowitz, Ph D
IEEE History Center
Rutgers - The State University
39 Union Street
New Brunswick, NJ USA 08901-8538

Dear Dr. Geselowitz

ASME History and Heritage is pleased to join with IEEE's Milestone program to designate the NAIC/Arecibo Radiotelescope as, what for us is, an ASME Historic Mechanical Engineering Landmark.

Thank you for making it possible for us to participate in honoring this extraordinary example of multidisciplinary engineering. Arecibo will be added to the roster of mechanical engineering landmarks alongside such others as Edison's phonograph, the Stanford Linear Accelerator Center, Saturn V, and the Mount Wilson Observatory's 100-inch telescope, to name a few. In Puerto Rico, ASME also has designated the Hacienda La Esperanza Sugar Mill steam engine and the Barker turbine at Hacienda Buena Vista.

The unique design, principally the controlled movement of the suspended antenna, makes the Arecibo Radiotelescope an excellent representative of precision engineering and a significant step forward in the evolution of mechanical engineering.

Sincerely

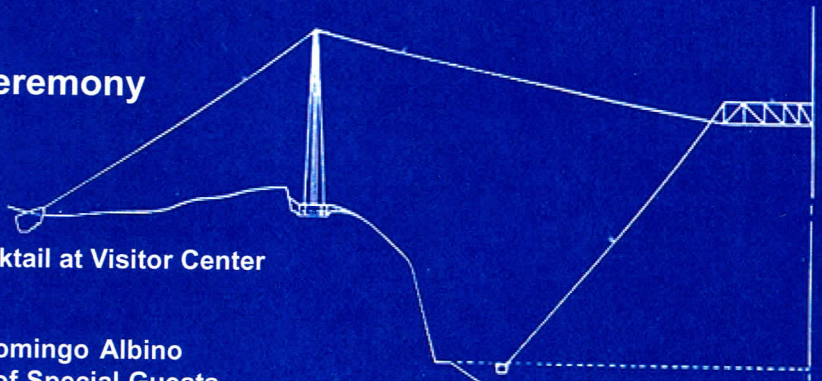
R. Michael Hunt, PE

cc Antonio J. Dajer Guerra, PE, Puerto Rico Section Chair
Carlos Garrett, Section H&H
Peter Hauser, Regional Director
Juan Ramon Falcon, IEEE Puerto Rico Section Chair

William E. Gordon

William E. Gordon was born in Paterson, New Jersey on June 8, 1918. He served in the Air Force during World War II, and earned a Ph.D. at Cornell University in 1953. He married Elva Freile in 1941, they have a son and a daughter. During the first half of his academic career (1948-66) at Cornell he conceived, supervised the design and construction, and directed the early operation of the Arecibo Observatory with its 300 meter spherical antenna. At Rice University (1966-86) he served as a Professor of Space Science and Electrical Engineering, as Dean of Sciences and Engineering, as Provost and Vice President, and is currently Distinguished Professor Emeritus. He is a member and Foreign Secretary (1986-90) of the National Academy of Sciences, a member of the National Academy of Engineering, a Foreign Associate of the Engineering Academy of Japan, a Fellow of the American Academy of Arts and Sciences, and the American Association for the Advancement of Science, the American Geophysical Union, and the Institute of Electrical and Electronic Engineers. He was the Vice President of the International Council of Scientific Unions (1988-93) and is an Honorary President of the International Union of Radio Science. He received the Balth.van der Pol Gold Medal in 1966, the Arctowski Gold Medal in 1984, a USSR Academy of Sciences Medal in 1985 for distinguished contributions in international geophysical programs and the Centennial Medal of the University of Sofia in 1988. He is currently a consultant for Northwest Research Associates on large radar facilities, an advisor to the Air Force and Navy on the HAARP facility in Alaska, a member of the Advisory Committee for the 2001 Asia-Pacific Radio Science Conference, a speaker at the Inauguration of the Indonesia/Japan radar facility on the equator at the source of El Ni o/El Ni a, and the father of the radio telescope at Arecibo, an IEEE Milestone in Electrical Engineering and an ASME LANDMARK .

IEEE Milestone Ceremony
November 3, 2001



3:00 pm Welcome Cocktail at Visitor Center

4:00 pm Welcome

Invocation, Domingo Albino

Presentation of Special Guests

Puerto Rico Secretary of State - Honorable Ferdinand Mercado

Chairman of the IEEE Puerto Rico & Caribbean Section - Juan Ramon Falcon

President of the Puerto Rico Association of Engineers & Surveyors (CIAPR) - Ivan Nicolau, PE

President of the American Society of Mechanical Engineers - William A. Weiblen, PE

President of the Institute of Electrical and Electronics Engineers - Joel Snyder, PE

Award Presentation

Distinguished Professor Emeritus - Rice University - Dr. Bill Gordon

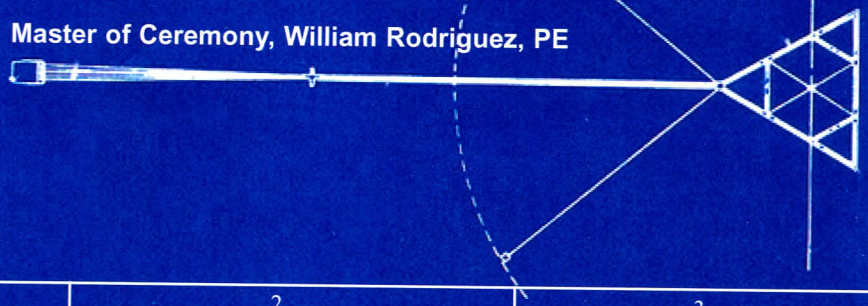
Deputy Director of the National Science Foundation - Dr. Joseph Bordogna

Director of the National Astronomy and Ionosphere Center - Dr. Paul F. Goldsmith

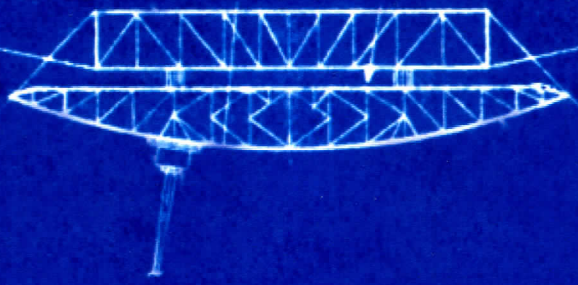
Director of the Arecibo Observatory - Dr. Daniel R. Altschuler

Closing

Master of Ceremony, William Rodriguez, PE



5:30 pm Cocktail



IEEE MILESTONE IN ELECTRICAL ENGINEERING AND COMPUTING
ASME MECHANICAL ENGINEERING LANDMARK

NAIC/Arecibo Radiotelescope, 1963

The Arecibo Observatory, the world's largest radiotelescope, was dedicated in 1963. Its design and implementation led to advances in the electrical engineering areas of antenna design, signal processing, and electronic instrumentation, and in the mechanical engineering areas of antenna suspension and drive systems. The drive system positions all active parts of the antenna with millimeter precision, regardless of temperature changes, enabling the telescope to maintain an accurate focus. Its subsequent operation led to advances in the scientific fields of radioastronomy, planetary studies, and space and atmospheric sciences.

November, 2001

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ESTADO LIBRE ASOCIADO DE PUERTO RICO

Sila M. Calderón
GOBERNADORA

MENSAJE DE LA GOBERNADORA PARA ANUARIO DEL INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS

Me siento enormemente orgullosa por la distinción otorgada al Radio Observatorio de Arecibo como hito en la historia de la ingeniería universal. Hasta las montañas que circundan este pueblo nuestro, renombrados científicos de todas partes del mundo llegan para escuchar los ritmos del universo.

El Observatorio es el hogar del telescopio radial más grande en la tierra. Y el disfrute que evidencian tantos puertorriqueños que lo han visitado, es incalculable.

Poder atravesar las fronteras de nuestro planeta por vía del telescopio es un hecho monumental, estimulante e inolvidable. Ha impulsado a nuestros estudiosos, en particular y a nuestro pueblo, en general, a extender su capacidad de imaginar otros mundos en el universo. También nos hace reconocer la profundidad de los logros tecnológicos del ser humano.

Felicito al Institute of Electrical and Electronical Engineers, y muy en especial a su capítulo en Puerto Rico, por su decisión muy acertada en distinguir al Radio Observatorio de Arecibo como fuente esencial de investigación y descubrimiento.

A nombre del pueblo de Puerto Rico, les extiendo mi sincero agradecimiento por este singular honor.

Cordialmente,

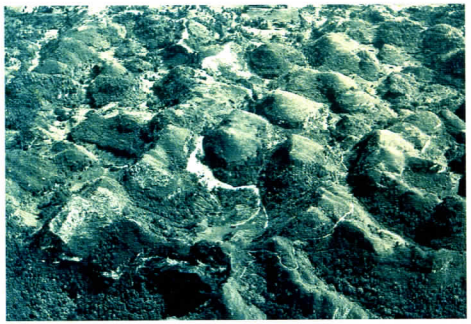
Sila M. Calderón

P.O. BOX 9020082 SAN JUAN, PUERTO RICO 00902-0082

The NAIC Arecibo Observatory

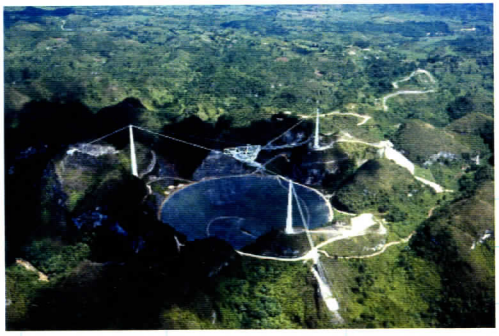
Daniel R. Altschuler
Director, Arecibo Observatory

Running along the north coast of the green island of Puerto Rico is a modern expressway linking the busy capital city of San Juan with Arecibo, a town on the north coast. On turning south form Arecibo and heading into the interior, the road becomes progressively narrower and the curves sharper. As the route ascends the rugged hills of the Karst terrain, images of the modern metropolis rapidly fade into a rural scene where cows and chickens roam freely and the slopes are covered with green vegetation, ferns, wild orchids, and the shiny broad leaves of banana plants. This is the Puerto Rico of the past.



But a few kilometers beyond the small town of Esperanza - the one you just passed on your way up here - you arrive at the gates of an island within this island - the National Astronomy and Ionosphere Center s Arecibo Observatory, a facility of the NSF. Suddenly the rural scene gives way to a technological landscape, one that is at the forefront of cutting-edge research. Here, the largest reflector on Earth, a shiny spherical bowl of gigantic proportions, catches feeble radio waves which come form the Earths Ionosphere or from the most distant objects in our Universe. It is a monument to human curiosity

In the summer of 1960, men and machines moved into a sink-hole in the northen Karst region of Puerto Rico to begin work to transform a dream into reality, to realize the ambition of being able to study the upper reaches of Earth s atmosphere, where our planet ends and space begins, with a new tool which would also be capable of studying the planets of the solar system and be sensitive to weak radio waves produced at the farthest reaches of the Universe.

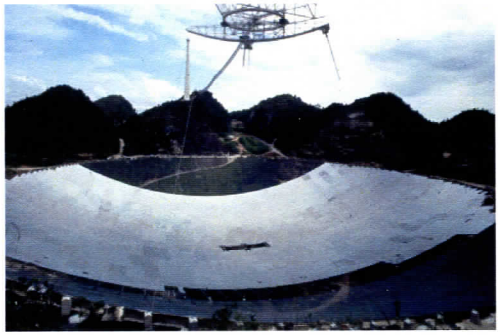


The Arecibo Ionospheric Observatory (AIO) as it was then known, was inaugurated on the first of November of 1963, William Gordon, then a professor of Electrical Engineering at Cornell University, becoming its first director. Gordon s research during the fifties had led him to the idea of radar backscatter studies of the Ionosphere, and his persistence culminated in the construction of the Arecibo radar/radio telescope.

On April 7 1964 , the first radar contact with Mercury was achieved, under the leadership of Gordon H. Pettengill, then associate director of the Observatory.

Observations of Mercury on April of 1965 led to a determination of it«s rotation rate which instead of 88 days turned out to be 59 days.

Over forty long years have elapsed and the Arecibo telescope has become a household word. To the scientific community it is known for its many contributions to science, and to the public it is known from uncountable media exposures, including two major films (Goldeneye and Contact), as well as from the many (false) stories about how at the Arecibo Observatory we regularly communicate with them .



The Arecibo telescope has undergone two major upgrades, one in the mid-seventies to replace the giant reflector with a new high precision surface and equip it with a new planetary radar transmitter, and a second upgrade in the mid nineties, including a new and more powerful transmitter and providing the telescope with new optics to greatly enhance its capabilities.

The telescope has been used to study the properties of thousands of distant galaxies, helping to map the geography of our universe. Hundreds of pulsars have been studied, one study leading to the award in 1993 of the Nobel Prize for Physics to Joseph Taylor and Russell Hulse for their discovery of the pulsar PSR B1913+16. The pulsar, first detected on July 2, 1974, is one of the few which we know are part of a binary system. Here the pulsar is in orbit about another neutron star with a period of only seven hours and forty-five minutes. (Compare this with one year for the period of the earth about the sun). Precise measurements of the pulse arrival times, which continue at Arecibo, confirmed the prediction of Einstein s general theory of Relativity for the production of gravitational waves. In 1991 the first extrasolar planetary system was discovered at Arecibo, an exotic system orbiting a pulsar

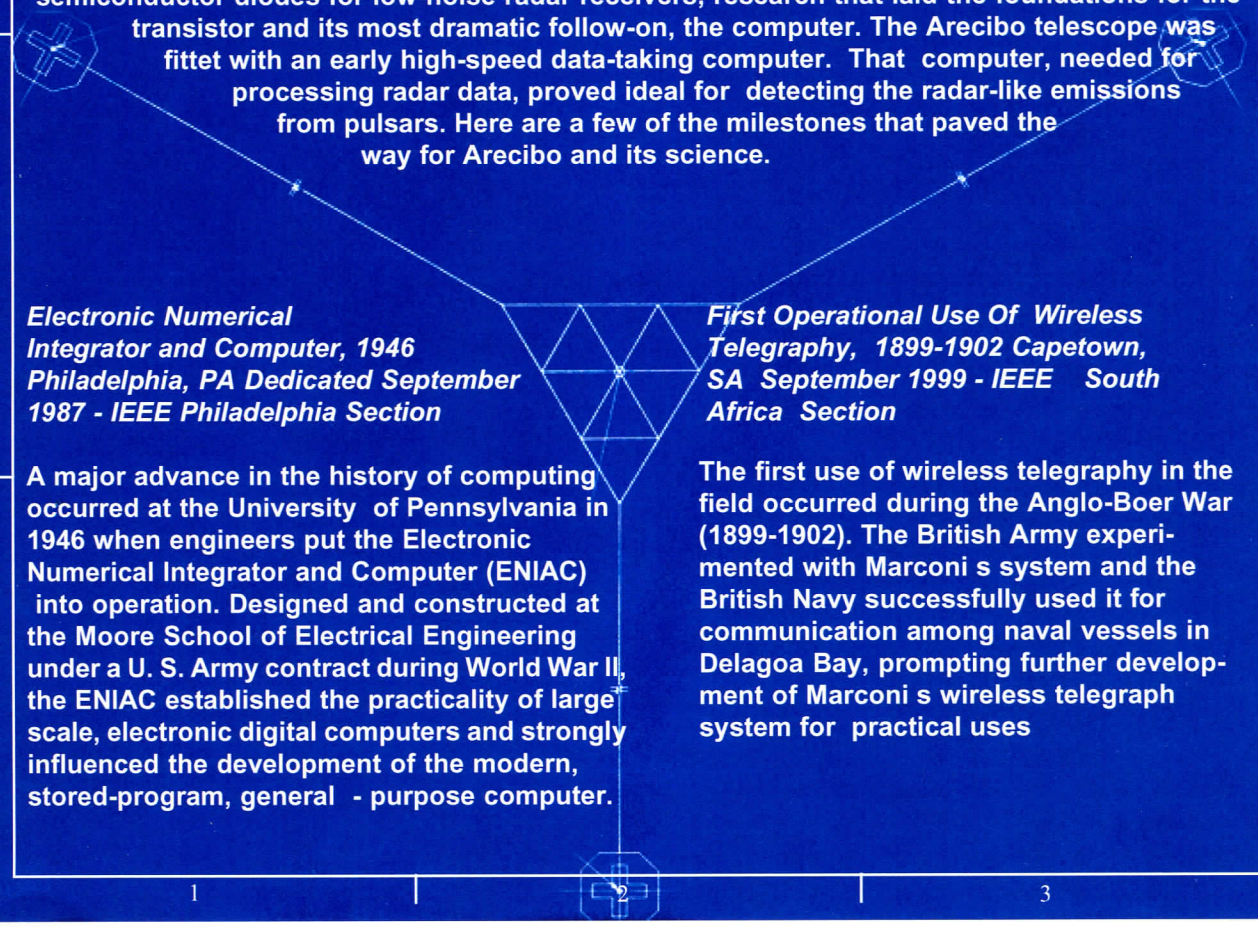
The powerful radar has studied the surface of Venus, the moons of Jupiter and Saturn, has detected ice on the poles of Mercury and looks at a growing number of small near earth crossing asteroids with unprecedented resolution.

In the future a new multibeam receiver system, under construction, will allow large-scale surveys of the sky to be conducted with unprecedented sensitivity to find new and interesting pulsars, to map the plane of our Milky way in neutral hydrogen, to search for new galaxies not visible with optical telescopes and to develop new modes of observation.

A few selected past IEEE milestones and the Arecibo Telescope

Jon Hagen
Senior Engineer
Arecibo Observatory

Almost all the key elements of the Arecibo telescope were based on technology that was ready and waiting - milestone advances made in electronics during and immediately after World War II. This technology had already produced megawatt klystron tubes, reflector antenna theory, and servomechanisms for the control of antenna drive systems. Wartime research had also produced semiconductor diodes for low-noise radar receivers, research that laid the foundations for the transistor and its most dramatic follow-on, the computer. The Arecibo telescope was fittet with an early high-speed data-taking computer. That computer, needed for processing radar data, proved ideal for detecting the radar-like emissions from pulsars. Here are a few of the milestones that paved the way for Arecibo and its science.

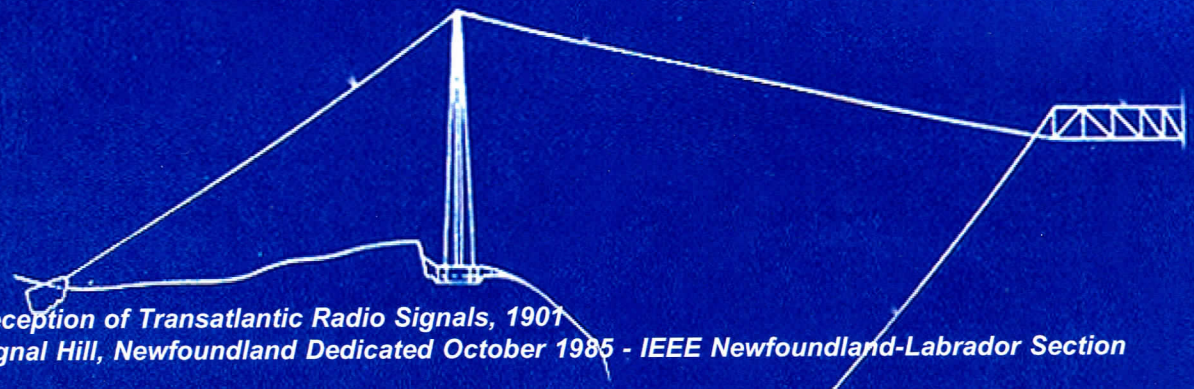


Electronic Numerical Integrator and Computer, 1946 Philadelphia, PA Dedicated September 1987 - IEEE Philadelphia Section

A major advance in the history of computing occurred at the University of Pennsylvania in 1946 when engineers put the Electronic Numerical Integrator and Computer (ENIAC) into operation. Designed and constructed at the Moore School of Electrical Engineering under a U. S. Army contract during World War II, the ENIAC established the practicality of large scale, electronic digital computers and strongly influenced the development of the modern, stored-program, general - purpose computer.

First Operational Use Of Wireless Telegraphy, 1899-1902 Capetown, SA September 1999 - IEEE South Africa Section

The first use of wireless telegraphy in the field occurred during the Anglo-Boer War (1899-1902). The British Army experimented with Marconi s system and the British Navy successfully used it for communication among naval vessels in Delagoa Bay, prompting further development of Marconi s wireless telegraph system for practical uses



Reception of Transatlantic Radio Signals, 1901
Signal Hill, Newfoundland Dedicated October 1985 - IEEE Newfoundland-Labrador Section

At Signal Hill on December 12, 1901, Guglielmo Marconi and his assistant, George Kemp, confirmed the reception of the first transatlantic radio signals. With a telephone receiver and a wire antenna kept aloft by a kite, they heard Morse code for the letter S transmitted from Poldhu, Cornwall. Their experiments showed that radio signals extended far beyond the horizon, giving radio a new global dimension for communication in the twentieth century.

Poulsen-Arc Radio Transmitter, 1902
Lyngby, Denmark Dedicated May 1994 - IEEE Denmark Section

Valdemar Poulsen, a Danish engineer, invented an arc converter as a generator of continuous-wave radio signals in 1902. Beginning in 1904, Poulsen used the arc for experimental radio transmission from Lyngby to various receiving sites in Denmark and Great Britain. Poulsen-arc transmitters were used internationally until they were superseded by vacuum-tube transmitters.

MIT Radiation Laboratory, 1940-1945
Cambridge, MA Dedicated October 1990 - IEEE Boston Section

The MIT Radiation Laboratory, operated on this site between 1940 and 1945, advanced the allied war effort by making fundamental contributions to the design and deployment of microwave radar systems. Used on land, sea, and in the air, in many adaptations, radar was a decisive factor in the outcome of the conflict. The laboratory s 3900 employees made lasting contributions to microwave theory and technology, operational radar, systems engineering, long-range navigation, and control equipment.

The IEEE

The Institute of Electrical and Electronics Engineers, IEEE (eye-triple-E), is a non profit, technical professional association of more than 350,000 individual members in 150 countries. Through its members, the IEEE is the leading authority in technical areas ranging from computer engineering, biomedical technology and telecommunications, to electric power, aerospace and consumer electronics, among others.

The IEEE World is geographically divided among 10 regions which are the sponsors to the basic local entity called the IEEE section. The Region that houses Puerto Rico is Region 9 known as the IEEE Latin America Region .

There are more than 300 IEEE sections around the globe for member networking and information sharing. In the Caribbean area we have two of these sections; the IEEE Puerto Rico and Caribbean and the Western Puerto Rico sections. These sections groups more than 1,200 individual IEEE members including 6 student branches and 9 technical Society chapters. The IEEE presence in Puerto Rico dates back to the 1920 s in the form of the oldest student Branch in Region 9, the University of Puerto Rico Mayaguez Campus IEEE Student Branch. The professional section was formed in the 1960 s and is known as the Puerto Rico and Caribbean Section. The Puerto Rico and Caribbean section is the sponsor of the IEEE Electrical Engineering milestone award granted to the Arecibo Observatory.

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