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THE A.W.A. REVIEW

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Cover image is of Ms. Kathleen Parkin of San Rafael, California, shown as the cover-girl of the Electrical Experimenter, October 1916. She held both a commercial and an amateur license at 16 years of age.

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Foreword

Again we are bringing you the AWA Review without charge to the membership. This comes as a free benefit to members—your dues are not affected by the distribution of this journal. The AWA Review is the AWA's peer reviewed journal. It serves as a historical record where the facts are verified by one or more anonymous reviewers. That gives it some extra credibility as a source of sound reporting of history. The free printing and distribution of this Review is again made possible by a generous donation from a long standing AWA member who wishes to remain anonymous. His gift is an indication that he is committed particularly to historical documentation as a key part of our hobby. A new feature this year is that I, as your editor, have been joined by two able and experienced associate editors. They are Erich Brueschke and David Bart, both former contributors to the Review, and both now enthusiastically helping with decisions about its publication.

This year’s volume reflects a number of trends. One is our continuing use of colour. Not many articles on early radio history need colour, but those that do, manage to make excellent use of it. Another trend in the AWA Review is the increasing participation by international authors. This year we have authors from Japan, England, Australia, Austria and Canada. Another trend is the increasing interest in the history of television, both in published articles and in the number of proposed articles.

This year’s volume exhibits a great deal of dedication and energy on the part of its authors. The result is a number of fine resulting efforts. Perhaps no one has exceeded the efforts of Tadanobu Okabe writing from Tokyo. He has provided us with two articles, and his work on them carried on through earthquake, tsunami and the resulting nuclear disaster. Tadanobu reported that the writing distracted him from the troubles at home.

• The History of Japanese Radio (1925 – 45) by Tadanobu Okabe. In this article, Okabe wants the English-speaking world to have an understanding of how the unique characteristics of Japanese geography and culture shaped the development of broadcast radio in that country. The country was not very large, and it was not surrounded by foreign countries broadcasting in the Japanese language. These and other factors made the development of radio unique.

• Henry Clifford – Telegraph Engineer and Artist by Bill Burns. Burns has long had an interest in telegraphy, and hosts the excellent website atlantic-cable.com which has been described previously in these pages. One of Burns’ projects has been to describe the life and contributions of cable pioneer Henry Clifford. Clifford was primarily responsible for the paying-out machinery on cable ships including the Great Eastern. With part of that story being told by means of oil paintings in the mid 19th century, the AWA Review with its colour pages seems a logical place to
describe this history.

- **Toyota Radio: 1946 – 49** by Tadanobu Okabe. This article, again by Okabe, explains why the car maker Toyota manufactured radios for a short time. A shorter version of this story was brought to the conference exhibit in Rochester last year, and it made a strong case for why this article should appear in the *AWA Review*. In effect, it is a logical second half to the author’s pre-war history article. In this article, Okabe describes how radio manufacturers adapted to post-war conditions.

- **Culture, Technology, Britannia: The BBC Handbooks** by A. David Wunsch. Prof. Wunsch describes how the BBC Handbooks give an overview of British culture, available technology and the political environment in Britain over the span of years they were published. The BBC is Britain’s public broadcaster, and Wunsch describes the differences in that concept between Britain and the U.S.A. The handbooks contain information about the content of broadcasts, and provide a really excellent insight into what the British public derived from radio listening.

- **John Graeme Balsillie, Australia’s Forgotten Wireless Pioneer** by Graeme Bartram. Bartram really began this story in Volume 13 of the *AWA Review* when he described the legal confrontation between the Marconi Company and the British Radio Telegraph and Telephone Company over the 7777 patent. Balsillie was a young Australian engineer who aggressively promoted a wireless system of his own design and had it adopted for a time as Australia’s national system. Over two years (1912 – 13) he built 19 coastal wireless stations. This article describes Balsillie’s meteoric rise and similar fall.

- **How the 1923 Radiola Season Really Came About** by Eric Wenaas. This article is a continuation of some ideas that Wenaas formed when writing his landmark book *Radiola*. He has researched obscure documents and artifacts, and is able to track corporate decision-making around the 1923 RCA model year. The result is a detective story as well as an account of events that have been hitherto not reported, that explain the 1923 Radiola season that was. Meticulous writing in the traditional Wenaas style.

- **Development of Television in Germany until 1939** by Franz Pichler. This article gives readers a unique view of television development—a perspective of events from ‘the other side’ leading up to World War Two. This side of TV development is somewhat known but not well understood by English speaking enthusiasts. Pichler describes how inventors, mostly in Germany, had advanced the art of TV until all development was sidetracked by the war effort. A grand plan to make TV available to widespread audiences for social purposes was abandoned.
• **Eddystone Radio and their Mid-1930’s All World Two** by Gerry O’Hara, Graeme Wormald and Ian McQueen. This article presents a brief history of the Eddystone Company in England, followed by a description of a small All World Two receiver. One receiver’s history is followed as it is sold in Papua New Guinea and then carried through the jungle to provide news reports to an Australian medical doctor. Finally we discover the condition of the set in current time, and the efforts made to restore it.

• **The Radio Products of the Globe Electric Company** by Glenn Trischan. This year marks the 100th anniversary of the Globe Electric Company. From the beginning they made storage batteries, and for a brief time they made radios too. They soon decided that radio parts were easier to market than radios. Trischan, who worked many years in one of the Globe family of companies, lovingly describes the whole known radio line from the 1920’s, and presents a photographic record of each set. The result is not only an interesting story but also the definitive article on the radio line of the Globe company.

• **The Airship America** by John Dilks. Dilks pieces together the story of how a Marconi wireless man, Jack Irwin, came to be assigned to fly on a hydrogen-filled airship destined to cross the Atlantic. The flight was unsuccessful and the crew had to be rescued at sea. Irwin’s wireless messages were essential to the rescue, and Dilks goes on to recount the subsequent lives of the crew members. About half of them were lost on a similar airship the Akron, with their wives watching from shore. Mercifully, our hero Jack Irwin was not among them. This article tells a dramatic story.

• **Origins of the IEEE Medal of Honor** by David and Julia Bart. After their success in writing about the Edison Medal of the IEEE in 2009 (*AWA Review* volume 22) these authors decided to tackle the history of the IEEE Medal of Honor. The IEEE shares their interest and their report will be located on the IEEE website. They describe in detail the accomplishments of the Medal winners, and indicate how these achievements mirror progress in the field of electronics.

• **Wireless Comes of Age on the West Coast** by Bart Lee. Lee takes a decidedly West Coast perspective on the development of wireless at the beginning of the 20th century. In his unique storytelling style, he describes individuals and events in a region that was responsible for much innovation. Told from this vantage point, we realize just how much of the development of wireless had its origins in this relatively isolated area of the U.S. Lee promises that this story will also appear on the CHRS website, and with more early photos.

• **Letters to the Editor** by Bart Lee and Eric Wenaas.

Again this year our sincere thanks go to these authors for their fine
We continue to use the services of experts in the field as peer reviewers. We believe that this process raises the overall quality of the AWA Review. Some of our reviewers have served in this role for a number of years now and deserve our special thanks. The reviewers for this issue are:

Neil Friedman, Bill Holly, Bruce Howes, Russ Kleinman, Joe Knight, Virginia Lovelace, Robert Lozier, Ludwell Sibley, Howard Stone, and Peter Yanczer

AWA members and others with an interest in wireless communications history are encouraged to submit manuscripts to the AWA Review. A section titled Tips for Authors follows. We try to make the publication effort more collaborative than challenging. The single most important message in this regard is to contact us early if you are considering writing an article.

A cumulative index of Tables of Contents of all previous issues of the AWA Review is maintained on the website of the AWA at http://www.antiquewireless.org. The index is found on the Museum page.

It is my distinct pleasure to bring you this volume of the AWA Review. I hope you enjoy it. I hope it stimulates you to think of new ways in which you can contribute to this satisfying hobby. I look forward to receiving your manuscripts for next year’s volume.

Robert P. (Bob) Murray, Ph.D.
Editor
Vancouver, BC, Canada

Tips for Authors

The AWA Review welcomes any submitted article on aspects of wireless communications history. In general, shorter articles can be directed to the AWA Journal and longer manuscripts to the AWA Review. If you are in any doubt about where your article should best appear, please contact the editor.

The AWA Review will accept and publish Letters to the Editor as space permits. This will be a suitable way to submit your comments if you wish to take issue with a recent article published here, or make other brief comments on wireless history matters. Letters will not be peer reviewed, but will be edited, primarily for length at the discretion of the Editor. The Editor reserves the right to publish responses. Galleys of letters to be published will not be returned to the author. Text is limited to 400 words and no more than 10 references.

For first time authors, articles can be prepared with the help of a more experienced co-author, or the editor can help with the text in the
editing process. Members with an interesting story to tell should not be
discouraged by a lack of writing experience. The AWA Review will accept
manuscripts in any clearly prepared writing style. A short style manual
produced by the American Radio Relay League is available on request. The Elements of Style by William Strunk Jr. and E.B. White is available in
most public libraries. Reference material should be cited within the text
of the article in any of the accepted reference styles. Reference lists should
include all of the sources mentioned in the text. Writers should look at
the articles in this volume or in recent previous volumes for examples.

Articles submitted to the AWA Review will be laid out on the pages in
a style made consistent within the entire publication. Therefore, please
do not arrange your illustrations on each page but rather send the text
in a file separately from the files for each illustration. This requirement
applies equally to the Journal and the Review. (see, for example, “From
the Editor” in the AWA Journal, April 2006, pages 4 & 5.) Text files
can be prepared on any word processing software, but preferably on
Microsoft Word. Please do not include idiosyncratic text styles (such as
small caps) since these will need to be stripped out when your article is
prepared for publication. Illustrations are best sent as JPG or .TIF files
with a resolution of around 300 dpi. JPG files should be Standard (not
Progressive). Files can be submitted as e-mail attachments directed to
the editor.

Manuscripts submitted to the AWA Review will be peer reviewed. That
is, they will be forwarded to one or more AWA member(s) with expertise
in the area of the article. The reviewer’s comments will be returned to
the author(s) anonymously, so that the reviewer is comfortable with be-
ing candid in his or her response. After the reviewers’ comments have
been addressed by the author, the article will be type set in a publishing
software (currently Adobe InDesign), following which galleys will be
returned to the author. This will be the last stage at which errors can be
corrected. Normally only one set of galleys will be sent.

Articles submitted to the AWA Review should be developed in concept
not later than early January of the publication year. A first draft should
be submitted around March. The editor’s deadline for submission of
the completed volume to the printer is May 1. Articles not submitted on
this schedule will be rescheduled for the next year’s volume. For more
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BEGINNING OF RADIO BROADCASTING (1925-28)

Before Broadcasting. Japan has a long history of researching wireless communication as well as the production of suitable devices. Three years after his experiments on the field of electric current by Hertz (1886), Hantaro Nagaoka gave a public demonstration of spark discharge at the University of Tokyo (1889).

Just after Marconi’s wireless communication in 1887, research started for its practical use by the Electro-technical Laboratory in Japan, and in 1899 production of domestic wireless equipment began. Thus wireless equipment gave excellent results at the Battle of the Japan Sea in 1914. After World War One, wireless was very often used, not only by the military but also in marine applications. In 1914, with regard to this situation, a Wireless Law and a Regulation for Private Wireless Telegraph were enacted. (1) (see Fig. 1)

After the first broadcasting worldwide started in 1920, in Japan research on broadcasting became very popular, and various experiments were carried out. Consequently many technical books, periodicals and magazines were published. With the confusion of the Great Earthquake and Fire Disaster in the Tokyo District in 1923, information routes were cut off. Ships anchored in Tokyo Bay gave the most effective results communicating by wireless. The necessity of inaugurating radio broadcasting was keenly felt both by the Government and by the general public.

Beginning of Broadcasting (2, 3). In the next year after the Earthquake, applications for establishing broadcasting stations were estimated to reach 64 throughout the country. However,
the Government completed the drafting of regulations pertaining to the radio broadcasting undertaking, and finally decided its policy of allowing it to be run only by a responsible person for the public benefit. The first broadcast stations were established in the three great cities in eastern (Tokyo), central (Nagoya) and western (Osaka) areas.

The Tokyo Broadcasting Station was thus established in November of 1923, (JOAK, Fig. 2), the Nagoya Broadcasting Station (JOCK) in January, 1925 and the Osaka Broadcasting Station (JOBK) in February of the same year. They were authorized in the form of corporate juridical entities.

On March 22, 1925, JOAK started temporary broadcasting with approximately 220W of power at Shibaura in Tokyo, which was the beginning of the Japanese history of radio broadcasting. The two other stations commenced their activities later in the same year, only 5 years behind the world’s first broadcast in the U.S.A. There was no technical cooperation among the three stations. While the radio sets then used were primitive, the maintenance cost and the subscription fee were rather expensive. In spite of this fact, the number of listeners increased rapidly. The
number of listeners was initially no more than 5,455, but it jumped to 390,000 by 1926.

**Amalgamating of Three Stations.** In view of the necessity of expanding the radio networks on a systematic basis, thereby creating a more uniform service area for the multiplying number of listeners, the Nippon Hoso Kyokai (the Broadcasting Corporation of Japan) was organized by amalgamating these corporations in August 1926. (4) With the establishment of the corporation, headquarters were established in Tokyo, and branches in the Kanto, Kansai, and Tokai districts within the sphere of influence of these three broadcasting stations.

**Radios at the Beginning of Broadcasting.** Under the ordinance the Regulation for Private Wireless Telephone promulgated in 1923 just before the beginning of broadcasting, radios were admitted as they obtained sanction from the Communication Ministry. A Technical standard was set on the basis of the ordinance "The Regulation for Electrical Appliances", Article 4 by the Communication Ministry issued in 1916, and it was decided that the wave length must be confined within 200-250m or 250-400m. Besides, radio waves must not be generated from the receiving antenna. Whoever passed the examination acquired a model certification by the Electrical Laboratory of the Communications Ministry. The manufacturer could indicate the passing number as well as the type approval stamp (created in 1924, Fig. 3).

As for approved receivers, a wave-length selector was required, and besides no generation of radio waves was permitted. Thus, a regenerative detector could not be used, and the sensitivity of such sets was low. (1)

Due to the unexpectedly large number of listeners who applied for licenses with the commencement of business, the demands of listeners surpassed by far the supply of approved receivers. In addition, foreign made receivers were excellent and comparatively cheaper than those made in Japan, and moreover, a good many radio fans constructed their own receivers at home. Then, in reality, lots of the imported and hand-made radios did not follow these rules.

On 18 April 1925 just after the beginning of broadcasting, Ordinance No.23 of the Communication Ministry was issued, which abolished the selector of wave length and limited wave length to less than 400m. In addition, permission for listening was given to non-approved radios. Accordingly, the type approval system became nominal. After Ordinance No.71 of October 1925, no more examinations were carried out. Between 1924 and 1925, type approval was given to 64 varieties of radios and parts, of which No.2 to No.71 (Nos. 1,6,11,12,13,35,36 missing) are in existence. Makers of communicating equipment such as Annaka and Shibaura which had produced lots of approved receivers withdrew from radio production several years after the beginning of broadcasting.

Seventy percent of Japanese radios at that time were of the crystal type listening with headphones (Figs. 4, 5). Battery operated tube radios using a loud speaker system were expensive, and consequently
not much in public use. Japan introduced techniques and appliances of radios from the U.S.A. Popular tubes were 201-A and 199 (Fig. 6).

FROM BATTERY TO AC SETS (1928-32)

Battery to AC. Early radios needed big, expensive, short-lived batteries. It was inconvenient. In the 1920s, power lines were available only in a city. From 1925, a radio power supply using the AC power line was developed. It was called a “battery eliminator”. However, the battery eliminator often added a “hum” noise. Battery eliminators ended up being installed inside of radio sets. In Japan, an AC set was called an “Eliminator Receiver”.

Japanese early AC sets used crystal detectors and 201-A tubes. To compensate for the loss of a crystal detector and reduce number of tubes, a reflex circuit was often used. Transformers and power supply units were put on the market. Many battery sets were modified into AC sets using such parts (Fig. 7). (5)

Two years after at the U.S. market, from 1928 to 29, new AC tubes (226, 227, 112A, 112B etc) were introduced and manufactured in Japan. In 1930, the new tetrode 224 was put on the market. The 224 renovated performance of the RF circuit (Fig. 8).

Prevalence of AC Sets. The Japanese radio industry could manufacture most of the required radio parts. The prices of radio sets and parts were reduced. AC sets prevailed rapidly. By 1931, the numbers of listeners reached 1 million. (6) In 1931 Matsushita Electric, soon after its founding, started manufacturing radios (Fig. 9). (7) Many other small manufacturers put cheap and low quality sets on the market. Big businesses had faded away from the radio industry due to the lack of competitiveness. The Japanese radio industry lacked leading big companies like RCA or Philips. This structure of industry affected the later history of Japanese radio. (8)

Metal Cabinets. From 1930, “bread board style” radios changed into metal chassis and metal cabinets were introduced to reduce
cost. Initially, the cost of manufacturing a metal cabinet was very expensive but the cost of the cabinet could be reduced by mass production. The Japanese radio industry was not yet suitable for mass-production. Labor was very cheap. The cost of metal cabinets was not reduced. Metal cabinets faded out and wooden cabinets returned (Fig. 10).

CATHEDRAL, TOMBSTONE AND MIDGET RADIOS (1932-36)

From the late 1920s, horn speakers were replaced by cone speakers. From the early 1930s, the shape of radio cabinets changed into a new style. The speaker was installed inside. Early inside speaker sets used a “cathedral” shaped cabinet until the mid 1930s, when the “cathedral” was changed into a “tombstone” shaped cabinet. (Fig. 11, 13) From 1935 on, small horizontal shaped table radios were available. (Fig. 14)

In Japan, only one small tabletop type set was used in most homes. There were only a few music programs. Console radios did not exist except for a few radio phonographs. (8) Under the Depression, low priced small sets were prevalent. These small radios were called "midget". In Japan, not
only small table-top sets but also cathedral and tombstone shaped sets were called "midget".

The tube line-ups of prevalent midget sets were as follows:

- **227-112A-112B** (Grid detector regenerative, transformer coupled)
- **227-247B-112B** (Grid detector regenerative, resistor coupled pentode amplifier)
- **227-26-112A-112B** (Grid detector regenerative, transformer coupled)

Low cost sets used magnetic cone speakers (Fig. 11).

The tube line-ups of high grade sets were as follows:

- **224-224-247B-112B** (TRF, 1-V-1, regenerative, magnetic or small electro-dynamic speaker)
- **235-235-224-247B-280B** (TRF, 2-V-1, electro-dynamic speaker) (Fig. 12).

High grade sets had an input terminal for the pick-up of a record player. A few superheterodyne sets existed as hi-end models (Fig. 12).

Manufacturing small chassis was difficult for amateurs or small manufacturers. Classic style AC sets were wired on a “bread board” and were manufactured until the late 1930’s.

Under the Depression, radios were provided as a new and economical amusement at home. In 1931, there were over 1 million listeners. Two years later they amounted to 1,700,000. Radios had spread in the city areas. However, in the country areas only 10% of all households had radios in 1932. In the late 1930s, midget and tombstone shapes changed into horizontal table radios (Figs. 13, 14). (6)
Many commercial broadcasting stations existed in the U.S.A. In Europe, listeners could receive many stations from neighboring countries. Many superheterodyne receivers were put on the market in the 1930s. However, the Japanese
market was different from those of the U.S. and Europe. Superheterodyne receivers were in the minority. The mainstream of Japanese radio was using poor regenerative straight receivers with 3 or 4 tubes.

(9) In May 1934, with the sanction of the Ministry of Communications, the Nippon Hoso Kyokai was reorganized. The amendment in 1934 resulted in the abolition of the divisional board of directors of the local branches, and placed Japanese broadcasting under one unified control. In the city area, two broadcasting frequencies existed. In other areas only one frequency was presented. The greater part of programming was sent through a transit system using telephone lines or radio relaying nationwide from a central station.

(2) Then, radio sets did not need selectivity and sensitivity. Foreign broadcasting stations using the Japanese language did not exist around Japan. Short wave listening was prohibited by the government. The Japanese market did not need superheterodyne receivers. In the country area, far away from the stations, listeners could not buy expensive high sensitivity radios. The buying power of people was small, and also the technology of manufacturers was poor. Cheap and simple sets were suitable for the Japanese market.

Nippon Hoso Kyokai built local stations and increased the power of the central stations to expand their service areas. Then Nippon Hoso Kyokai did not need to allow high performance radios. In 1935, Japanese broadcasting celebrated its 10th anniversary. Listeners increased to over 2.5 million. Production of radio sets increased to 150,000 a year and was established as an industry.

“Nami-Yon” Radio: 4 Tube Regenerative Receiver. The most common radio had a regenerative grid detector with 2 stages of amplification (transformer coupling) and a half wave rectifier. Early models used triodes: 227-226-226 (or 112A)-112B. After 1934, the shape of tubes changed from globe shape to shoulder shape. Tubes changed into the following line up: 27A-26B-26B (or 12A)-12B. After 1935, the tetrode 24B was sometimes used for the detector. In 1937, the price of new tubes was reduced. The new 56 was used for a detector and the new rectifier tube 12F was put on the market at the same price as the old 12B. The output current and plate voltage of the 12F were improved from the 12B. The 12B faded from the market. By the late 1930’s, the new pentode 57 was used for a detector. The line up of later models was 57-56-12A-12F.

A magnetic cone speaker (8”) was used.
always used (Fig. 15).

Such a prevalent four tube regenerative radio was of low performance and low cost. The persons concerned with the radio industry called such radios “Nami-yon”. The Japanese term “Nami” means “average”, and “Yon” means “four”. “Nami-yon” means “average four tube radio”. This term was used after around 1935 as a slang expression. After 1940, the term “Nami-yon” appeared on official documents. It became an official term.(10)

“San-Pen” Radio: 3 Tube Regenerative with Pentode Output Stage. Another prevalent radio was the 3 tube regenerative set with a single resistance coupled amplifier using a pentode tube. The line up of tubes was 24B-47B-12B (early model) or 57-47B-12F (later model). Such a radio was called “San-pen”. The Japanese term “San” means “three” and “pen” means “pentode”. This circuit created a small set, however the total gain was lower than with a 4 tube set. Therefore the “San-pen” radio was used mainly at high field intensity in the city area. The price of a pentode tube was higher than for a triode tube. The price of a “San-pen” radio was similar to that for a “Nami-yon” radio. “Nami-yon” and “San-pen” radios were always equipped with magnetic cone speakers (Fig. 16).

Interference by Over-Regeneration(11). Nami-yon and San-pen radios had no volume control. Volume was controlled by a tickler knob.

This control was difficult, and the stability of the set was poor. Regenerative sets sometimes oscillated and caused interference to other radio sets. The Broadcasting Authorities were having much trouble in dealing with the matter. The Ministry of Communications and The Broadcasting Authorities recommended “A No Interference Regenerative Set”. This set had a limited or pre-set tickler control. Manufacturers tried to develop such sets, however sensitivity was lower than ordinary regenerative sets. “A No Interference Regenerative Set” did not succeed (Fig. 17).

“Ko-Ichi” Higher Class TRF Receiver. The higher class radio set for medium or weak field intensity areas was a 4 tube TRF set (1-V-1). These radios called “Ko-Ichi” which means TRF with a single
RF amplifier. The early tube line up was 24B-24B-47B-12B. The later type was 58-57-47B-12F. (Fig. 18) The new small rectifier tube 12F could supply enough power to drive a small electro-dynamic speaker. Low cost dynamic speaker sets appeared after 1937. At that time 90% of Japanese radio sets were 3 or 4 tube regenerative sets. A few superheterodyne radios, and radio phonographs existed.

Design and Influence. Almost all Japanese radio cabinets were of wood-table style. The design was changed from tombstone style to a horizontal cabinet with an airplane dial. (Fig. 19) By the late 1930’s, the war continued in China. The Japanese market was dominated by munitions industries. Many high grade finished and sophisticated cabinets appeared, but gradually materials for civilian radio sets were restricted by war. The design of radios became simplified.

Japan started broadcasting only five years after the world’s first broadcasting. Until the late 1920’s, Japanese radio industries caught up to the U.S. and European technologies. However, after the 1930’s, the mainstream of Japanese radio sets stopped progress from TRF and regenerative circuits. In the early 1940’s, the progress of civilian electronics was stagnated by war. The level of radio industries could not catch up to the U.S. and Europe until the late 1950’s.

RECOMMENDATION SYSTEM OF WIRELESS APPARATUS

Broadcasting stations needed prevailing low cost and high quality radio. However, low cost radio sets manufactured by small factories did not have high enough quality. To create high quality sets and parts, an approval and recommendation system for radios and radio parts was started in 1928 by Nippon Hoso Kyokai (The Broadcasting Corporation of Japan).

According to the rules of the system, radio sets or component parts manufactured by general manufacturers were to obtain the approval and recommendation of
the broadcasting authorities before being put on the market. Before giving approval and recommendation, the broadcasting authorities were to test the qualities, construction and other specifications of radio sets and component parts in conformity with the rules. Manufacturers were also required to be able to produce goods of the same quality at proper prices and their productive power was also taken into consideration before obtaining approval from the broadcasting authorities.(1)

The first technical standard was suitable for crystal and battery sets. In 1934, the recommendation system for wireless apparatus was revised for the new AC set. The system of approval and recommendation applied to only low cost sets and parts (tubes, transformers, speakers, capacitors etc).

The system of approval and recommendation was certification for a submitted sample. The test sample was kept by Nippon Hoso Kyokai. If the sample passed the test, an approved number was given to the manufacturer. They could indicate approval and the recommendation mark on their products and advertisement. An approval number consisted of 5 digits or numbers. The first 2 digits meant types of radio and parts, the last 3 digits meant registration number starting from 011 (Fig. 20).

After 1934, approved radios and parts increased well. However, this approval system was not mandatory. The greater part of Japanese radios were not approved. To be certified under this system, high specifications and quality were demanded. The cost of an approved radio was increased. To avoid high
cost, many “using approved parts” radios were put on the market. These radios used one or two important approved parts such as the power transformer or speaker.\(^{12}\)

Approved radios did not prevail. Most of the reason was the high price. The price of an approved radio was twice as high as that of the cheapest set. A poor quality radio sold for popular consumption. The quality of cheap radios was very poor. Such radios sometimes failed prematurely or caused interference (Figs. 21, 22).

**RADIOS DURING THE WAR (1939-45)**

**Control and Standardization of Radios.** In the pre-war era, Japanese radio programs were dull. Entertainment (sports, music, drama etc.) programs were fewer than those of European and U.S. stations. Programs like this were only 20% of all programs. Almost all programs consisted of news, culture and education. From 1933 to 1937, the number of new listeners decreased. However, after 1937, people were interested in news of the war. Both listeners and the manufacturing of radios increased. However, saving strategic materials was very important in the design of radio sets at wartime. The supply of materials and products became controlled by the government.

**The change of Radio Set Design.** To reduce strategic materials, transformer coupling changed to resistance coupled amplifiers. The new pentode 57 was used for a detector. Transformers were downsized. The frame of the magnetic speaker was made from pressed paper (The original was used in the German model DKE, 1938). The material of cabinets and chassis was reduced. Designs were simplified. (Fig.23)

**Reinforcement of control for Radio.** After 1939, as the supply of materials became scanty, the design of radio sets changed. Classic transformer coupled amplifiers changed into resistance coupled. R.F. choke coils were replaced by resistors. The construction of chassis and cabinets were simplified.

In June 12, 1940, The Ministry of Commence and Industry standardized radio sets into 11 variations and they determined the official prices of radio sets and radio parts. Standardized radios included wide variations of regenerative 3 tube sets to 6 tubes superheterodynes. Almost all Japanese people used 3 or 4 tube regenerative or TRF sets. Usually superheterodyne sets were used by government or public offices.\(^{13}\)

After December, 1941, control for radio was reinforced by government. In September, 1942, the confederations of radio industrial unions were dissolved by reinforcement of control. The radio receiver control union, a subordinate organization of the association of electric machinery was organized. In 1943, a control system for radio production and supply was completed.

In 1941, the peak of produc-

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Fig.23 National Model KS-1 Matsushita Radio MFG. Co., Ltd.1939. Early war-time regenerative radio used 57 26B 12A 12F.
tion and the increase of listeners were celebrated. After 1942, the war situation grew worse. Limited materials that were available were supplied to military use. Materials for civilian radio sets were restricted. Production of radio sets decreased from 1943.

STATION-MODEL SETS
-STANDARDIZED SETS BY THE BROADCASTING CORPORATION OF JAPAN (1938-45).

The “Station-model set” is one of the well known Japanese radio sets. In the mid-1930’s, the broadcasting authorities suffered from the trouble of low quality cheap radio sets. The broadcasting authorities operated the recommendation system of wireless apparatus. However, expensive approved radios were not predominant. In 1933, the information about the “Deutsche Volks Empfanger” suggested how to spread high quality radios at low cost. The “Station-model set” was planned as the Japanese standard radio set. Like a German people’s radio, the design of standard radio is unified in a few models.

The details of construction (such as circuit, parts, design and measurements of cabinet) and price were fixed by regulations issued by the broadcasting authorities. All manufacturers were to produce the same types of sets. The standard radio was inspected and supplied by the broadcasting authorities at a reasonable price. Radio manufacturers and suppliers were opposed to this plan. However the controlled economy at wartime helped this standard radio project. In 1939, the “Station-model set” was certified by government as the standard radio. (14)

No.1 and No.3 model, first Station-model sets. In 1937, trial manufacture was undertaken. Four types of set were planned. Types No.1 and No.2 were regenerative 3 tube receivers. Types No.3 and No.4 was regenerative 4 tube receivers with an RF stage. These sets used a plate detector to improve tone quality. The sensitivity was lower than in a conventional grid detector set. No.1 and No.3 were basic models equipped with magnetic speakers. No.2 and No.4

Fig.24 No1 (Left) and Fig.25 No.3 (Right) Receiver, mfr: The Nihon Seiki Co., Ltd. (1939)
were high-grade models equipped with a dynamic speaker. During wartime high-grade models were not produced. In January 1938, the technical specifications for types No.1 and No.3 receivers were released. These were the first "Station-model set" (Figs. 24, 25).

In February 1939, Type No.1 and No.3 receivers were released from The Nihon Seiki Co., Ltd. However, the sensitivity of these sets was lower than for other conventional radios. These sets were not accepted by the market. Further, the designs of No.1 and No.3 receivers were not concerned with saving strategic materials. These sets were not matched to requirements of wartime. Type No.1 receiver was not supplied to customers. The No.3 receiver was not mass-produced except for an export model for China. Trial-produced sets were used by the broadcasting station as a public relations tool. (15)

**Type No.11 Receiver—Second Generation of a Station-model Set**-(16). Saving strategic materials is a very important demand for design of radio sets at wartime. In March 1, 1939, the technical specification of Type No.11 receiver was announced. The circuit of this receiver was a conventional 3 tube regenerative receiver. The line up of tubes was the same as in the Type No.1 receiver. It used a grid detector to improve sensitivity, and to reduce the size of the power transformer, an auto-transformer was used. In 1939, production of the type No.11 receiver was started, however sales were not strong. In August 7, 1939, the "Station-model set" was authorized as standard receiver by The Ministry of Communications. Then on August 10, an exemption of commodity tax for Type No.11 receiver was recognized. From 1940, production and sales were increased. In 1941, a subsidy for Type No.11 receiver was started (Fig. 26).

**No.122, 123 Receivers—Transformer-less Series**-(17). In August 1939, new tubes for transformer-less receivers were announced. These tubes were developed by the Technical Laboratory of Nippon Hoso Kyokai and Toshiba. To reduce power consumption, heater current was set at 150mA. Japanese radios used 3 or 4 tubes. Total voltage of the series connected 3 or 4 tubes was lower than line voltage (100V AC). A ballast lump was connected in the series of the tube heaters. Three types of ballast lump (B-37, B-49, B-61) were produced. The number of the ballast lamp means voltage drop. The power tube was not a beam...
type tube. To supply enough plate voltage, a multiplying rectifier was used.

Development of the new transformer-less receiver was continued by the technical laboratory of Nippon Hosokyo Kaikai. Three types of receivers were planned. Types No. 21 and 22 were 3 tube regenerative receivers. Type No. 23 was a 4 tubes receiver with an RF stage. Types numbers were finally changed into Nos. 121, 122 and 123. Type No. 121 used a half-wave rectifier to reduce power consumption. However the output power was not enough. Type No. 121 was not released. In October 1940, Types No. 122 and 123 receivers were released officially.

Type No. 123 receiver was the most mass produced “Station-model set”. The line-up of tubes was 12Y-V1 - 12Y-R1 - 12Z-P1 - 24Z-K2 - B-37. By using a multiplying rectifier, the chassis was always “hot”. To reduce electric shock, the chassis was isolated from the enclosure. The rear cover was fixed by screws and a caution label to avoid electric shock was indicated on the rear cover. Antenna and earth cables were isolated by capacitors (Figs. 27, 28).

Improvement of the Type No. 123 Receiver (18). According to the rules of "Station-model set", circuit, parts and design were due to follow the specification completely. However, to use the materials owned by manufacturer, some modification (color of chassis, design of speaker cloth etc.) was allowed. To reduce materials, some improvements were added to specification.

In 1942, the war situation grew worse. Limited materials were supplied to military use. Materials for civilian radio sets were restricted. Production of radio sets decreased from 1943. In 1943, the shape of type No. 123 receiver was changed into a simpler design. To reduce the thickness of plywood, the rounded shape of the front panel was changed into a square shape. The construction of the chassis was not changed. Two variations of dial existed. In 1944, production of the type No. 123 receiver was only 35,000 sets which was only 10% of the production of 1942 (Fig. 29).

Radio at the End of the War.
The peak of production of radios (1941) was 920,000. However, in 1945, production was only 87,000 (January to August). Technology did not progress. Lack of materials and men of talent caused poor quality and limited production. (19)

At 12:00, August 15, 1945, “The
Imperial Edict of the End of the War “was broadcast by Emperor Hirohito’s recorded voice. The Japanese people listened to his real voice through radio for the first time. He listened to his own voice by following his RCA radio at the palace in Tokyo (Fig. 30).


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Fig.30 RCA Victor Model 12X2 “Little Nipper”, RCA Manufacturing Co., 1942 This photo is the model in my collection. The real Emperor’s radio was displayed at The NHK Broadcasting Museum in Tokyo.
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PHOTO CREDITS
Unless otherwise noted, photos are by the author. Figs. 1 and 2 are from old postcards, no source indicated.

ABOUT THE AUTHOR
Please see author information with the article on Toyota Radio elsewhere in this volume.
Henry Clifford was born on 27 October 1821 near Hull, a major shipping port in the northeast of England, where his family had been connected with the sea for many years. Although Clifford showed considerable talent as an artist by the time he was in his teens, his father apprenticed him to a firm of mechanical engineers in Aberdeen, Scotland. Undeterred, he continued painting in watercolour during this period. On completion of his apprenticeship he returned to Hull, where in 1844 he entered into partnership with Thomas Brown, trading as the Cyclops Foundry. This firm subsequently joined forces with Edward Gibson to build ships entirely of iron, but Brown’s financial difficulties led to the dissolution of the company by the end of 1848.

Clifford, disillusioned by the failure of his business, at first thought of emigrating to New Zealand, and his life remained unsettled for a number of years. He applied for various positions in marine industries, considered taking up painting full time, and moved to London in 1849, where he lived in unsalubrious quarters and supported himself as a draughtsman and as a commission agent for machinery. In 1851 he took a position in Ireland with a company trying to pump out a flooded mine to put it back into operation. In 1852 he noted in a letter to his father that one of his sketches was to be published in a London
Henry Clifford newspaper; he was also engaged in making engineering drawings.

The mine venture, too, proved unsuccessful, and by the end of 1852 Clifford was back in London, where he continued with his newspaper work. He contributed sketches to The Age family weekly newspaper, and in 1852 designed an almanac for subscribers. An advertising leaflet included with a letter to his father dated 20 November 1852 described “the most elegant ILLUMINATED ALMANACK ever produced, designed and drawn by Henry Clifford Esq, which is to be presented Gratis on Saturday December 4th 1852 to regular subscribers.” Unfortunately, no copies of the Almanac are known to exist.

In 1853 Clifford’s fortunes began to improve. Charles Bright at that time was Engineer in Chief to the English and Irish Magnetic Telegraph Company, and following his marriage in May of that year to Clifford’s somewhat distant cousin, Bright and his wife met with Henry during a visit to London. Clifford recorded in his notebook: “Bright was very good in giving me some work in designing machinery for making and laying cables.” His work over the next three years is not documented, although he continued to live in London. (HDC)

THE ATLANTIC CABLE

In 1850 the first undersea telegraph cable had been laid from Dover to Calais; it failed almost immediately. A second cable laid across the Channel on the same route a year later was successful, and the cable era began; cables were soon laid on the relatively short routes to Ireland and between Britain and mainland Europe. Just a few years later, the New York industrialist Cyrus Field was proposing to lay a cable from Ireland to Newfoundland, to connect the old and new worlds for the first time, a cable twenty times longer than any so far laid.

Field gathered together a group of wealthy New Yorkers to invest in his enterprise, and as the centre of the cable industry was in Britain, in 1854 he made the first of many voyages across the Atlantic to begin making arrangements for the manufacture and laying of the Atlantic Cable. In London he met British cable pioneer John Watkins Brett, who with his brother had laid the 1851 Channel cable, and preliminary work began at the Newfoundland end. (Field, 1866)

By 1856 Field was ready to order the main run of 2000 miles of cable, and he engaged Charles Bright to head the English company which would be responsible for laying the cable. In May 1853 when Charles Bright was actually on his honeymoon, he had personally supervised the laying of his first submarine cable, between Donaghadee in Ireland and Portpatrick in Scotland; he was just 24 years old when Field gave him the responsibility for the era’s biggest engineering project.

Bright’s biography describes the gathering of the key personnel for the Atlantic Telegraph Company:

“When once the wheels had been fairly set in motion, it was necessary for Charles Bright to gather round him a competent staff of engineers, ready for the expedition. First of all, as his chief assistant, he secured the services of Mr. Samuel Canning, who had laid the Gulf of St. Lawrence cable for Messrs. Glass & Elliot, in the preceding year. The next place was filled by Mr. William Henry Woodhouse, who had laid cables for Mr. Brett in the Mediterranean. Then came Mr. F.C. Webb, who had probably been associated—in one capacity or another—with more early
cable work than any other single telegraph engineer. Finally, Mr. Henry Clifford joined. He was a cousin of the Taylors [Bright’s wife’s family], and was in this way introduced to the undertaking, besides being a mechanical engineer of considerable experience.” (Bright, 1898)

Henry Clifford was to serve as mechanical engineer on all five of the early Atlantic cable expeditions, from 1857 to 1866. Clifford’s work was on the paying-out machinery, which would remain his area of expertise through much of his subsequent career. An early book on the preparations for laying the Atlantic cable, published by the Atlantic Telegraph Company in July 1857, notes:

“The actual manufacture of the paying-out machinery, arranged by Mr Bright, has been carried on under the superintendence of Mr Henry Clifford, whose experience and talent in mechanical engineering has proved of great service to the Company.” (Mann, 1857)

The expedition got under way in August 1857, requiring two ships to carry the immense weight of the 2000 miles of cable, the British warship HMS *Agamemnon*, and the U.S. Navy’s new steam frigate, USS *Niagara*. *Niagara*, with Bright and Clifford on board, began laying the cable from Valentia on the west coast of Ireland, accompanied by *Agamemnon* which would take over the laying duties when *Niagara*’s half of the cable ran out. But just 335 miles into the voyage, the cable broke, the end was lost, and the expedition had to be abandoned. Bright’s biography describes a return visit to Ireland in October 1857, during which they recovered over fifty miles of the main cable and prepared the shore end for re-use the following year. Clifford again took the opportunity to do some drawing, and Bright sent this letter to his wife:

“Valentia, October 24th, 1857.

I send you a gift from Henry Clifford, a view from our window at the inn here. The steamer to the right is the Leipsig. The pier is the breakwater of Valentia Harbour. The queer-looking thing to the left is an apparatus I have fitted up for under-running the cable. It is composed of two very large long iron buoys fixed together like a twin ship with a platform of timber over it. On this, at each end, is a saddle with a deep groove for the cable to run in. The cable being on the near shore, it is towed along. When near the end of the heavy cable I shall take it off, cut the cable, buoy the heavy end, and begin winding up the small one as we go on.” (Fig. 2) (Bright, 1898)

This is the first mention in the cable histories of Clifford’s artistic talent. As an engineer he was obviously skilled in mechanical drawing, and he was also a good artist in watercolours and oils, taking the opportunity of quiet times during cable voyages to make drawings of the ships and the scenery. Some of his drawings were used as the basis for woodcuts in the *Illustrated London News* in 1858, and a number of his paintings are reproduced in Sir Charles Bright’s biography and in Charles Bright’s 1898 book, *Submarine Telegraphs*. More information on Clifford’s art appears below.

**TWO 1858 EXPEDITIONS**

Clifford was also involved with the preparations for, and sailed on, the two expeditions of 1858. The chief engineer of the USS *Niagara*, W.E. Everett, whose mechanical talents had been noted during the 1857 voyage, was engaged to superintend improvements in the cable paying-out machinery.
Fig. 2. Apparatus for Under-running the Cable, woodcut in the *Illustrated London News* 31 July 1858 after an 1857 drawing by Henry Clifford. Author’s collection.
“January 1858:

Mr. Everett was ... appointed to prepare, in consultation with Messrs. Lloyd, Penn, and Field, and assisted by Mr. Henry Clifford, an experimental set of paying-out machinery for the purpose of determining upon the changes in construction that might (in consultation with the Scientific Committee) be deemed advisable to remedy the defects of the former apparatus.” (Saward, 1878)

Everett spent about three months working at the premises of Easton & Amos, who were manufacturing the paying-out machinery, and in April 1858 invited his colleagues to inspect the work.

Author John Mullaly, who sailed on the expeditions of 1857 and 1858, quotes this letter from Clifford (Mullaly, 1858):

“London, April 23, 1858.

George Saward, Esq., Sec. Of Atlantic Telegraph Co.

SIR—I beg to say that I have attended at the works of Messrs. Boston & Amos every day during the construction of the new paying-out machinery, and saw it working on Thursday last. It is, in my opinion, well adapted to the intended purpose, and I have nothing to suggest that could render it more perfect. I am, dear sir, your most obedient,

Henry Clifford.”

Mullaly opens his book with verbal sketches of the dramatis personae of the Atlantic cable expeditions:

“Mr. Clifford.

Although occupying a comparatively subordinate position, Mr. Clifford is an engineer of great skill and ingenuity, and a draughtsman of more than ordinary ability and acquirements. He was connected with Mr. Everett as an assistant in superintending and forwarding the construc-

The first expedition of 1858 left Plymouth on 10 June, but a few days into the voyage the fleet ran into a week of gales, during which it was feared that the shifting cable would breach the sides of the Agamemnon. Clifford’s drawings of the ship in the storm were used as the basis for a series of woodcuts published in the Illustrated London News Supplement dated 31 July 1858. The cable fleet survived the storms, but the expedition had to be abandoned after the cable broke on 29 June.

It is interesting to compare the newspaper version of the scene of the great storm, re-drawn from Clifford’s original by the ILN’s woodcut artists (Fig. 3), with Clifford’s own illustration, in the form of an original painting still in the Clifford family (Fig. 4).

Accounts of the storm in books of the time report that the Agamemnon heeled over to 45 degrees in either direction, which Clifford has accurately reproduced in his paintings; the ILN evidently felt the need to exaggerate this for
Fig. 3. HMS Agamemnon in a storm in June, 1858, woodcut in the Illustrated London News 31 July 1858 after a drawing by Henry Clifford. Author’s collection.
Fig. 4. Original painting by Henry Clifford of *HMS Agamemnon* on which the woodcut from the *Illustrated London News* on the previous page was based. This painting has come down in the family to Jacy Wall, Clifford's great-granddaughter, and is reproduced by her kind permission.
dramatic effect. The *ILN* also published two more scenes from the storm based on Clifford's drawings (Figs. 5, 6).

The *Illustrated London News* article on the cable expedition included several views of Valentia, which may have also been from drawings by Clifford, who was credited only as follows:

“The engravings of the *Agamemnon* are from sketches obligingly forwarded by a gentleman who was on board that vessel during the expedition.”

After the return of the ships to Ireland, a second expedition was quickly mounted, setting out on 17 July 1858. Charles Bright was again in charge, with Canning and Clifford assisting him on the *Agamemnon*. The two ships of the cable fleet made a rendezvous in mid-Atlantic and spliced the sections of the cable that each was carrying. The *Niagara* then steamed for Newfoundland, and the *Agamemnon* for Ireland. Nearing the successful conclusion of the voyage, Clifford made a drawing of the *Agamemnon* as she approached Ireland on 1 August 1858 (Fig. 7). There is also a second drawing by Clifford from this expedition reproduced in Bright’s biography; the Irish shore-end of the cable being landed by small boats (Fig. 8). (vol 2 p 319)

“In the afternoon of Thursday, August 5th—as already described in The Times report—Charles Bright and his staff brought to shore the end of the cable, at White Strand Bay, near Knight’s Town, Valentia, in the boats of the Valorous, welcomed by the united cheers of the small crowd assembled.” (Bright, 1898)

Despite the cable’s early success, and the great celebrations in New York, unforeseen technical problems caused its early demise, and transmissions through the cable failed on 20 October 1858. The immense financial losses caused by this failure (the equivalent of tens of millions of dollars today) put a damper on the enthusiasm for laying long cables, compounded by the difficulty of raising more funding in America after the start of the Civil War in 1861. But Clifford was now well established in the cable industry, and he joined the London firm of Glass Elliot & Company, one of the earliest cable manufacturers.

**GLASS ELLIOTT & COMPANY**

One of his first projects for the company was the Cromer-Emden cable, made for the Submarine Telegraph Company. The cable was completed on 4 November 1858 by CS William Cory, with Henry Clifford and Samuel Canning (another veteran of the Atlantic projects) as engineers. (*Mechanics’ Magazine*, 1858)

In January 1859 Canning and Clifford were awarded a provisional UK patent for “Improvements in machinery for paying-out and for recovering or picking up submarine telegraph ropes, cables, or chains”, and in June of that year Henry married Elizabeth Alexander at Yeovil, Somerset. (HDC & BMD records)

An unsigned watercolour (PAG9922) in the Henry Clifford collection of the National Maritime Museum is captioned: “Maritimo E.N.E. 10 miles off September 26th
Fig. 5. Breaking Adrift of the Coal on Board the *Agamemnon*. *Illustrated London News*, 31 July 1858, based on a drawing by Henry Clifford. Author’s collection.

Fig. 6. Displacement of the Cable on Board the *Agamemnon*. *Illustrated London News*, 31 July 1858, based on a drawing by Henry Clifford. Author’s collection.
Fig. 7. *HMS Agamemnon*, painting by Henry Clifford dated 1 August 1858. Reproduced from Bright, 1898. Author’s collection.

Fig. 8. The Irish Shore End of the Cable being Handled by Small Boats, sketch by Henry Clifford, August 1858. Author’s collection.
1859". Now known as Maretimmo, this is the westernmost of three small islands off the coast of Sicily between Trapani and Marsala. Henry presumably painted this watercolour on the Malta/Sicily cable voyage described in the letter to his mother. This cable was laid for the Mediterranean Extension Telegraph Co using CS Lady Seale.

A further provisional patent was issued to Clifford in 1861 for “Improvements in apparatus to be employed in coiling and paying-out electric telegraph cables.”

In June 1861 Henry was engineer on the Malta and Alexandria cable expedition, again assisting Samuel Canning, and sailed on the Malacca. Wildman Whitehouse, the “electrician” of the 1857/58 Atlantic cables, was also on this expedition. On this voyage the Malta-Tripoli section was laid, and Henry arrived at Malta on 6 June. From there he went to Toulon to lay the Corsican cable, where he painted a watercolour titled “Ajaccio – Corsica” (Fig. 9).

Later that year, in September 1861, Clifford continued the cable from Alexandria to Benghazi (Bright 1898), and while on this expedition he painted two watercolours of Libyan coastal scenery between Ras al Milhr and Benghazi (Figs. 10, 11). Both were made on 21 September 1861, one at 3pm and one at 4pm according to the pencil captions on the back of each painting, during which time the ship had laid almost six nautical miles of cable.

Following the line of the cable from Ras al Milhr (near present-day Bardiya) for 139.1 nautical miles (~258 kilometers) gives a location for the paintings somewhere near Derna, on the Libyan coast. About the same distance again would have brought the expedition to Benghazi; the ship arrived there on 23 September 1861, two days after the date of the watercolours, and from there returned to England. The Malacca completed the final section, from Tripoli to Benghazi, between 26 and 28 September, and communication between Malta and Alexandria was then established.

In late July 1862 Canning and
Fig. 10. Watercolour sketch made on board *CS Rangoon* by Henry Clifford while laying cable between Malta and Alexandria. 3 P.M. Saturday Sept. 21st 1861. Libyan coast, 139.1 Nautical miles west of Ras al Milhr. Author’s collection.

Fig. 11. Watercolour sketch made on board *CS Rangoon* by Henry Clifford, titled Marabut, 4 P.M. Sep 21 1861. 145 Nautical miles west of Ras al Milhr. Author’s collection.
Clifford were engineers for the laying of the Lowestoft to Zandvoort (Holland) cable by CS Hawthorns. The cable was made and laid by Glass, Elliot for the Electric and International Telegraph Company. (Mechanics' Magazine, 1862)

In January 1863 the Sardinia to Sicily cable expedition used Canning and Clifford's paying-out machinery on CS Hawthorns. Samuel Canning was engineer on this voyage; it is not known if Clifford was also on board. In September of that year a second Malta to Alexandria cable was laid, with Clifford as engineer on CS Hawthorns. (The Times, 7 September 1863)

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY

Clifford now returned to the Atlantic cable enterprise. In 1864 Glass, Elliot merged with the Gutta Percha Company to form the Telegraph Construction and Maintenance Company Ltd. (Telcon). This merger formed a company whose main purpose was to make an attempt to lay the Atlantic cable in 1865 using Brunel's immense steamship, the Great Eastern.

Great Eastern, under Captain Birch, sailed in July of 1864 from Liverpool to Sheerness, where she was to take on the cable for the 1865 expedition, then being made by Telcon. Daniel Gooch, Samuel Canning and Henry Clifford were on board “with a view of watching the working of the machinery.” By December 1864 the ship was almost ready to load cable, the delivery of which was expected to begin in January 1865 (The Telegraphic Journal, 1864).

The expedition set sail on 15 July 1865, and this account of the voyage was written by John C. Deane:

“Samuel Canning, chief engineer of the Telegraph Construction and Maintenance Company was in charge of the laying with Mr. Clifford supervising the machinery. They were assisted by Messrs Temple and London plus eight engineers and mechanics. The cable laying staff was provided by Telcon.

This beautiful and ingenious machinery has been invented by Messrs. Canning and Clifford, and has worked up to this time with admirable regularity and precision. At noon yesterday, 531.57 nautical miles had been paid out, between 1,529 to 1,950 fathoms. Distance from Valentia 476 miles. We asked the Terrible to prevent any ships from crossing the cable astern, and she replied, “Yes, if possible.”

Practical conclusions unanimously arrived at by those engaged in various capacities in the expedition.

1st. That the steam-ship Great Eastern, from her size and consequent steadiness, together with the better control obtained over her by having both the paddles and screw, render it possible and safe to lay an Atlantic Telegraph, in any weather.

2d. That the paying-out machinery, constructed for the purpose by Messrs. Canning and Clifford, worked perfectly, and can be confidently relied on.” (Deane, 1865)

Clifford was largely responsible for the design of the paying-out machinery for the Great Eastern, which had been converted from a passenger ship for the cable expedition. A drawing of Clifford’s machinery by Robert Dudley, the official artist for the 1865 expedition, was published in William Russell’s book about the voyage (Fig. 12). (Russell, 1865)
Fig. 12. The paying out machinery in the stern of the *Great Eastern*. Painting by Robert Dudley from Russell, 1865. Author’s collection.
The 1865 expedition ended in failure when the cable broke and the end could not be recovered after many days of grappling. But much had been learned about working with cable in deep water, and it was obvious from the many successes of the voyage that completing the laying of an Atlantic cable was within reach.

With every expectation of a successful outcome, another expedition was mounted in 1866 using the Great Eastern with substantially the same crew, but with modifications to the equipment based on the experiences of the previous year.

“The previous paying-out machinery on board the Great Eastern was altered to some extent by Messrs. Penn to the instructions of Messrs. Canning & Clifford. Though different in detail, the main improvement over the 1865 gear consisted in the fact that a 70-horse-power steam-engine was fitted to drive the two large drums in such a way that the paying-out machinery, as in 1858, could be used to pick up cable during the laying, if necessary, thereby avoiding the risk incurred by changing the cable from the stern to the bows. This addition of Penn trunk-engines, as well as the general strengthening of the entire machinery, was made in accordance with the designs of Mr. Henry Clifford.

The principal members of the staff acting on behalf of the contractors in this expedition were the same as in that of the previous year. Mr. Canning was again in charge, with Mr. Clifford and Mr. Temple as his chief assistants.” (Bright, 1903)

The 1866 expedition was a complete success; the laying of the new cable was uneventful, and the ship then set out to recover the lost cable of the year before, returning to Heart’s Content after picking up the end in 12,000 feet of water and splicing on new cable to finish the run (Fig. 13).

“The scene at Heart’s Content, when the telegraphic fleet appeared the second time, was one that beggars description. Its arrival was not unexpected, for the success on Sunday morning, that had been telegraphed to Ireland, was at once flashed across the Atlantic, and the people were watching for its coming. As the ships came up the harbor it was covered with boats, and all were wild with excitement; and when the big shore-end was got out of the Medway, and dragged to land, the sailors hugged it and almost kissed it in their extravagance of joy; and no sooner was it safely landed than they seized Mr. Canning, Mr. Clifford, and Mr. Field in their arms, and raised them over their heads, while the crowd cheered with tumultuous enthusiasm.” (Field, 1867)

Despite his many duties during the laying of the cables, Clifford continued to sketch and paint on board ship. The Great Eastern was one of his favourite subjects; he painted several views of the ship engaged in the 1866 Atlantic cable expedition, including a number of variations of the same scene (Fig. 14). It’s likely that he made sketches or preliminary paintings while on board ship, and painted the finished oils when he returned to England. The National Maritime Museum at Greenwich has four oil paintings by Clifford in its collection, and others are in private hands.

Clifford was at a celebration at Liverpool on board the Great Eastern on 20 September 1866, and attended the Lord Mayor’s banquet given for the members of
Fig. 13. Boat Attending to Lights on Cable Buoy, painting by Henry Clifford. Image courtesy of Jim Kreuzer collection.
Fig. 14. *Great Eastern*, on the 1865 Atlantic Cable expedition, painting by Henry Clifford, author’s collection.
Henry Clifford

the telegraph expedition and other notables at the Mansion House in London on 31 October. (The Times, 31 October 1866). His grandson and biographer notes that:

“Henry Clifford received many letters of congratulation from relations, friends and acquaintances, and attended many dinners and other functions in honour of those responsible for the success of the expedition. I have an invitation and Souvenir Card recording the Banquet given by the Liverpool Chamber of Commerce to the “Layers of the Atlantic Telegraph Cables” on Monday Oct 1st 1866. I do not know how the order of precedence for guests was decided, but Henry Clifford’s name appeared immediately after Samuel Canning, second on the list, above Captain Anderson, Willoughby Smith, Professor Thomson, Sir Charles Bright, J Chatterton and others.” (HDC)

In 1867 the 1866 Atlantic cable had to be repaired, having broken just off the coast of Newfoundland, and Clifford superintended the work (Timbs, 1867). By now Clifford was one of the most senior employees of the Telegraph Construction and Maintenance Company in Greenwich, becoming Chief Engineer in 1868, a post which he held until his retirement. There he supervised the manufacture and laying of many cables all over the world, and continued to advance the state of the art. In 1871 his salary was £1,250 per year. (HDC)

TEREDO WORMS

A problem encountered with submarine cables in warmer seas was the attack by so-called Teredo worms (marine borers) on the gutta percha, leading to loss of insulation and failure of the cable. A number of solutions were devised over the years, and in 1868 Clifford was awarded a patent for “Improvements in the manufacture of submarine telegraph cables”. The core of the cable (the copper conductor insulated with gutta percha, before the steel armouring wires are applied) was protected from the destructive insects by powdered silica adhered to yarn steeped in pitch or other material and wound upon the core. Others in the industry had proposed similar solutions, but Bright noted that “it is believed that none of these ideas have ever been put into practice on anything like an extensive scale.” (Bright, 1898).

The success of the 1866 Atlantic cable expedition was the beginning of a period of rapid expansion of the long-distance cable network. In 1869 Samuel Canning and Henry Clifford were again engineers on Great Eastern for the French Atlantic Cable expedition. (The Times, 4 Feb 1869). In 1872 and again in 1873, Clifford was among the guests at Cyrus Field’s celebratory banquets in London commemorating significant anniversaries of the Atlantic cables. (Banquets, 1872, 1873)

In October 1875 W.C. Johnson and S.E. Phillips founded the firm of Johnson & Phillips, Charlton, London, specialising in “Complete equipments of cable machinery, accessories and stores for cable laying and repairing steamers.” One of the founding partners, Walter Claude Johnson, had learned the business under Henry Clifford at Telcon; he started work there in 1869 at about age 23, and soon advanced:

“...he was engaged as a draughtsman by Mr. H. Clifford, the engineer of the Telegraph Construction and Maintenance Company’s works.

It was here, in working out
designs for improved cable machinery, under the immediate supervision of Mr. Clifford, that he obtained a clear insight into the most advanced form and construction of this important branch of engineering, and his keen observation had ample scope, not only in the direction to which his abilities so conspicuously tend, viz., in the design and construction of machinery, but also in the laying of all the original cables of the Eastern and Eastern Extension Telegraph systems.”

Johnson’s family diary records that he went into partnership with Phillips in October 1875, but continued to work at Telcon, and notes that in October 1876, a year later, he was “sacked,” presumably by Henry Clifford. (Brooks, 1950)

In 1878 Clifford again addressed the Teredo problem, for which his 1868 patent had described one solution. He now specified a spiral brass tape to be wrapped around the core of the cable before the outer coatings and armouring wires were applied, giving complete protection against the marine boring insects. This continued to be the standard method of protecting cables until the end of the telegraph era almost 80 years later. (Bright, 1898)

After laying the 1869 Atlantic cable with Samuel Canning, Clifford appears to have retired from the sea, for there are no further accounts of voyages that he made. Of course, as he was by then Chief Engineer of the cable company, it would have been difficult for him to take the time for the long voyages that laying cables required. He continued to prosper, making up for the difficulties of his earlier life; an indication of his success is that by the census of 1881 he and his wife had five servants: a governess, cook, housemaid, nurse, and parlourmaid. (UK Census)

In May 1886 Henry Clifford attended a demonstration of electric lighting at Paddington Station in London, powered by direct current from a central station. The installation was undertaken by his firm, the Telegraph Construction and Maintenance Company, which by then evidently had an electric light department, to test the practicability of central station lighting. (The Times, 18 May 1886)

RETIREMENT

On 15 May 1893, at age 71, Henry Clifford retired from his post as Chief Engineer at Telcon, but he did not lose his interest in the cable industry, retaining the title of Consulting Engineer (NMM). Bright notes that Clifford had worked at Telcon for over thirty years, succeeding Sir Samuel Canning as engineer-in-chief. (Bright, 1898)

In 1896 it was proposed to celebrate the upcoming jubilee of submarine telegraphy (in 1901) by a Memorial, and the controversy surrounding this led to what was perhaps Clifford’s last public contribution to the cable industry. The names of John Pender, James Anderson, and Cyrus Field were put forward as those to be honoured. This provoked a series of letters to The Times regarding the merits of these commercial men versus those of the scientists and engineers who made the cables work. Clifford, in a detailed letter recounting the history of the Atlantic cable enterprise, made it quite clear where he stood on the issue, thirty years after the event: “All the three names pressed forward in the proposed memorial are those of commercial men rather than of engineering pioneers in this great engineering work.” (The Times, 12 October 1896)
Henry Clifford died at age 83 on 18 May 1905 at his residence in Blackheath, just a few miles from the cable factory. He left a fortune of £89,210 9s. 4d. in his will, equivalent to about £5m today. He had worked as an engineer all his life, since his apprenticeship as a boy, and had risen to head the most successful company of the cable industry’s first half century, a firm which continued as a leading maker of cables until the 1970s.

ACKNOWLEDGEMENTS
Research into Henry Clifford’s life, and his engineering and artistic achievements, has been greatly aided by Jane Watson, Keeper of the Archives in Chiswick Parish Church; Jacy Wall, Henry Clifford’s great-granddaughter; Arthur Credland, Keeper of Maritime History at the Hull Maritime Museum; the library and picture archives staff of the National Maritime Museum, Greenwich; Porthcurno Telegraph Museum; Science Museum, London; Jim and Felicia Kreuzer.

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ABOUT THE AUTHOR

Bill Burns is an English electronics engineer who received a Bachelor of Science degree from the University of Leeds in 1968. He worked for the BBC in External Services Radio for three years, then moved to New York in 1971 after meeting his American future wife in London. He spent a number of years in the high-end audio industry at a Long Island company, during which time he also reviewed equipment and wrote articles on audio, video, and computers for a group of consumer magazines. Turning to computers full time in the late 1970s, he worked on both hardware and software, and in 1993 he established his own computer consulting business, which still occupies much of his time.

His research for articles on subjects as diverse as audio recording and reproduction theory, video tape recorder development, electronic music instruments, and the history of computing, led to a general interest in early technology. In the 1980s he began collecting instruments and artifacts from the fields of electricity and communications, and in 1994 a chance find of a section of the 1857 Atlantic cable led to his specialization in undersea cable history.

In 1995 he set up the first version of the Atlantic Cable website <http://atlantic-cable.com>, initially just a single page with a bibliography of books on undersea telegraphy. As he acquired more material - cable samples, instruments, books, documents, and other artifacts - each new find was added to the site, which now has over 850 pages on all aspects of undersea communications from 1850 until the present. Many site visitors have also contributed photographs, stories, and articles, and in several cases long-lost relatives and friends have been re-united through the website.

Bill’s interest in cable history has taken him to cable stations at Heart’s Content (Newfoundland), Valentia and Waterville (Ireland), Porthcurno (Cornwall) and Orleans (Cape Cod, Massachusetts), and to archives and museums in New York, Washington and Key West in the USA; London, Edinburgh, Manchester and Hull in Britain; and others in a number of European countries. He has presented papers on cable history to an IEEE/IEE conference at University College London, at cable company Hiberia Atlantic’s annual meeting, at the 150th Anniversary Celebration for the 1858 Atlantic cable at the New-York Historical Society (which he instigated and helped organize), and at the AWA Conference for the last three years.

Of his current research project on Henry Clifford, which has occupied him for the last three years, Bill writes:

“Clifford is mentioned in all the published accounts of the 1857-1866 Atlantic cable projects, but I had found little information on his life and career until my acquisition in January 2008 of a painting by him of the Great Eastern (Fig. 14). A trail of connections led me to the church at Chiswick, near London, where the grave of his distant relative by marriage, Charles Bright, had recently been rediscovered; the archivist there put me in touch with Clifford’s great-granddaughter in Devon, Jacy Wall. From her I learned that her late uncle had written an unpublished family history, and she directed me to...
Henry Clifford

the Maritime Museum in Hull, where I was able to obtain a copy of this and some original family documents and photographs. The trail continued to the National Maritime Museum in Greenwich, where I was able to examine and photograph a number of Clifford’s oil paintings and watercolours and another large selection of family documents, mostly relating to cable laying. There is still more material to be discovered.”

Bill Burns

Henry Clifford’s official seal from his mechanical engineering business in Hull, 1844-48. The image of the seal’s face has been reversed so it can be read. Author’s collection.
Toyota is well known as a major Japanese automobile manufacturer. After World War Two, from 1946-49, they were required to manufacture radio sets to survive. We will describe how this happened, and we will illustrate our presentation with artifacts from our collection.

THE HISTORY OF THE TOYOTA MOTOR CO., UNTIL 1945

In 1933, the Automobile Department was established in Toyoda Automatic Loom Works, Ltd. by Kiichiro Toyoda. He was the son of Sakichi Toyoda, founder of Toyoda Automatic Loom Works Ltd. They developed the Model A passenger car and the Model G truck in 1935. The first brand name was “Toyoda” after the founder's name (see Figs. 1 and 2). In 1936, the brand name was changed from “Toyoda” to “Toyota”.

In 1937, the Toyota Motor Co., Ltd was established. They built a large factory and started mass production. From 1935 to 45, Toyota manufactured 89,280 vehicles. However, almost all of their products were trucks for military use.
In 1943, a new luxury passenger car was ordered from the navy and army to replace old imported cars. Toyota's first auto radio was installed in this model. In 1944, only one prototype car was completed. The finish of this car was good and it succeeded in the test by the navy and army. However, the war situation grew worse. This model was not mass-produced but was used as Toyota's company car in the 1940's. The prototype is now missing. The details and specification of the first auto radio are unknown.

**WHY DID TOYOTA MANUFACTURE RADIOS?**

On September 2, 1945, Imperial Japan surrendered to the United Nations. World War Two ended. The Allied Powers occupied Japan. The Japanese post war era and reconstruction started. Under occupation, the products of the military industry and heavy industry were prohibited by the General Headquarters (GHQ). On December 8, 1945, the GHQ permitted the conversion from war production and the resumption of production of essential civilian commodities by the Toyota Motor Co. Many subsistence commodities had been lost in the war.

Military industries changed into peacetime industries in order to continue to operate their businesses. The production of automobiles was prohibited, and only limited production of trucks was allowed. Toyota Motor Co. started the production of farming implements, cooking utensils, and radios. Many radio sets had been lost in the war or failed due to the lack of replacement parts. Radios were in great demand.

As a tool for democratization, GHQ needed a widespread prevalence of radios. GHQ demanded increasing production of radios and parts. Many venture companies entered into the radio industry after the war. The big businesses, those who manufactured electric...
apparatus, communication equipment, and other machines, entered into the radio industry to keep their companies active.4

THE FIRST TOYOTA RADIO: MODEL K-2
The Kariya South Factory had produced electric parts for automobiles. Toyota tried to develop an auto radio in early 1940’s. The first model K-2 was developed and manufactured in this factory. This set used a 4 tube TRF circuit that was a typical Kokumin-gata radio (see Appendix 1) type No.2-A. The line up of tubes was 6D6, 6C6, 6ZP1 and 12F (see Appendix 2). The TOYOTA logo was indicated on the base of tubes. This example was the third revised version, model K-2-C. Model K-2-A is not found now. From model K-2-B we have found only the dial (See Fig. 3). This model K-2-C was approved by Nippon Hoso Kyokai, The Broadcasting Corporation of Japan, (NHK) on May 16, 1947.5 The approval number was 11163. (See Appendix 3) Quality was poor but this was the average level of Japanese industry at the time. In comparing the TOYOTA K-2-C with other maker’s products manufactured in the same era, it was apparent that they tried to maintain product quality notwithstanding the lack of material and resources. The Toyota radio’s brand “Apollo” appeared on the registration document. However, Apollo did not appear on the set (Figs. 4 - 6). While any words on the front of the set were printed in English, the manufacturers plate on the chassis was in Japanese (Fig. 7). This was typical of all surviving Toyota sets.

Figs. 4, 5. Model K-2-C front and inside views. (Speaker is not original)

Fig. 3. The Dial of Model K-2-B
We found a radio phonograph with a TOYOTA dial. This set was equipped with a TRF radio. The lineup of tubes was 6D6, 6C6, 76, 807A and 80. UY-807A was a variation of the 807 that was used for military equipment. Many 807A’s were sold as surplus from the Japanese Navy. (see Figs. 8, 9).

This radio phonograph did not have any nameplate or label. The name TOYOTA only existed on the dial. The parts and finish of chassis were similar to the TOYOTA K-2-C radio. I think that this set was made by the TOYOTA Motor Co., as a trial product or one-off product by special order.

NEW TOYOTA RADIO : FOUR
TUBE SUPERHETERODYNE MODEL RS-1

In 1948, the ministry of Posts and Telecommunications enforced type examination on the radio manufacturers replacing the approval by the NHK. The ministry of Posts and Telecommunications granted a “passed” number to passed radio sets from No.1 onward. All types of radio sets except those made by amateurs were the objects of this examination. From 05/1948 to 11/1949, 289 radios, radio phonographs, and amplifiers with radios were given a “passed” number. Many Japanese radios were inexpensive TRF radios. Superheterodyne sets were recommended by GHQ and the radio industry association.

TOYOTA changed their model designs to superheterodyne. The first such model was named RS-1. This model passed examination and was given the “passed” number 59 on June 23 1948. A four tube regenerative superheterodyne was low in cost and had enough selectivity, but had lower sensitivity than a TRF set. The tickler control was of semi-fixed type, with an adjusting screw placed behind the chassis. Regenerative superheterodyne sets did not prevail in the market. (Figs. 10, 11).

TOYOTA MARINE RADIO,

Fig. 10. Model RS-1 front view.

Fig. 11. Model RS-1 inside view (Knobs are not original).
TUBES: 6D6, 6C6, 6ZP1 and 12F, four tube Superheterodyne with Semi-fixed Regeneration, Permanent Dynamic Speaker (Diatone, 6.5” manufactured by Mitsubishi Electric)

MODEL UNKNOWN 1948?

Only four models of TOYOTA radio have been found. The remaining model was this TRF set with a metal cabinet. This model was probably made for a small fishing boat. Most Japanese small fishing boats did not have any radio. Short wave radio was very expensive. Installing a BC band radio was recommended to receive weather news. The information for TOYOTA radios was limited. The correct details of this model are unknown. (Figs. 12, 13).

Fig. 12. TOYOTA Marine Radio, front view. (Speaker broken)
THE END OF TOYOTA RADIO
- RECONSTRUCTION OF THE JAPANESE AUTOMOBILE INDUSTRY

In 10/1949, the production of automobiles was permitted completely by GHQ. In November 1949, the electrical division of Kariya south factory was moved to the Kariya north factory. In December 1949, the electrical division was separated from Toyota Motor Co. Toyota withdrew from the production of radios. Toyota's new vehicle models at post war were the Toyopet SA Sedan and the Toyopet SG Truck (see Figs. 14, 15). Some Toyopet SA Sedans were equipped with an optional auto radio made by Toshiba.

EPILOGUE

Since then, Toyota has not manufactured any radios. In 1955, a brand new medium class passenger car was introduced, the Toyopet Crown RS (see Fig.16). An optional auto radio made by Kobe Kogyo (TEN brand) was offered. (see Figs. 17, 18) This model was an early Japanese mass-produced auto radio.

In 1957, Toyota exported only 2 Toyopet Crown cars to the U.S.A. This was the beginning of export of Japanese cars to the U.S. market. The Kariya South Factory that had manufactured Toyota radios was separated from the Toyota Motor Co., Ltd. in 1949. Nippondenso Co., Ltd. was established. They grew to be a large auto electric and electronics parts supplier. They changed their company name into Denso Ltd. in 1996.
Fig. 15. Toyopet SG Truck (1953) (Load: 1.0 ton, Side Valve 995cc Inline 4, 28HP)

Fig. 16. Toyopet Crown RS (OHV 1,453cc Inline 4, 48HP) 1955

In 09/1945, the radio industry, METI, The Ministry of Posts and Telecommunications, and NHK, met and discussed post war radio. In 12/1945, the specifications of a standard receiver (preliminary version) appeared in the radio magazines. It was named “Kokumin-gata” radio. The Japanese term “Kokumin” means “national” and “gata” means “type”.8

The previous standard, old-fashioned regenerative set (0-V-2) was deleted. The heater voltage was changed from 2.5V to 6.3V and A.C. tubes for a transformerless set were used. The circuit was to be a four tube TRF (1-V-1 only). However, the supply of new tubes was limited. The standard ended up including the old-fashioned circuit and tubes. In 1946, the first editions of the standard of Kokumin-gata receiver were announced from Communication Equipment Manufacturer’s Association (CEMA).

The approval system for radios and parts by NHK continued after the end of World War Two. The scope of approval was mainly the Kokumin-gata receiver. The Kokumin-gata receiver was authorized as the standard receiver by The Ministry of Posts and Telecommunications. An exemption of commodity tax for the approved Kokumin-gata receiver was granted. METI gave a high priority for assignment of materials to approved radios. The approval was needed to participate in the shipment test by CEMA. Then many approved Kokumin-gata receivers were put on the market.

Table of “Kokumin-gata” Radios

<table>
<thead>
<tr>
<th>Type</th>
<th>Tubes</th>
<th>Output</th>
<th>Speaker</th>
<th>Note</th>
<th>Price (12/1946)</th>
<th>Price (02/1947)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>12Y-V1 12Y-R1 - 12Z-P1 24Z-K2</td>
<td>300mW</td>
<td>Magnetic</td>
<td>Transformerless</td>
<td>JPY 600</td>
<td>JPY 2,015</td>
</tr>
<tr>
<td>No.2-A</td>
<td>6D6 6C6 6Z-P1 12F</td>
<td>300mW</td>
<td>Magnetic</td>
<td>Standard</td>
<td>JPY 600</td>
<td>JPY 2,015</td>
</tr>
<tr>
<td>No.3</td>
<td>12Y-V1 12Y-R1 - 12Z-P1 24Z-K2</td>
<td>1W</td>
<td>Dynamic</td>
<td>Transformerless</td>
<td>JPY 1,025</td>
<td>unknown</td>
</tr>
<tr>
<td>No.4</td>
<td>6D6 6C6 42 80</td>
<td>1W</td>
<td>Dynamic</td>
<td>High Grade</td>
<td>JPY 1,025</td>
<td>JPY 2,728</td>
</tr>
<tr>
<td>No.5</td>
<td>57A 56A 12A 12F</td>
<td>170mW</td>
<td>Magnetic</td>
<td>Regenerative</td>
<td>JPY 402</td>
<td>JPY 1,436</td>
</tr>
<tr>
<td>No.6</td>
<td>57A 57A 47B 12F</td>
<td>300mW</td>
<td>Magnetic</td>
<td>Old TRF</td>
<td>JPY 582</td>
<td>JPY 2,034</td>
</tr>
</tbody>
</table>

Price is the official price

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Fig. 19. Typical Schematic Diagram of *Kokumin-gata* No.2-A Radio
Appendix 2: About Unique Japanese Tubes in this article

(The number of each pin connection is based on the RCA Receiving Tube Manual 1940)

6Z-P1

Power amplifier pentode tube of the heater-cathode type for use in the low power output stage of radio set with 6.3V heaters. Specification was similar to 6G6-G.

This tube was developed by Toshiba in 1942, and put on the market in 1946.

Pin connection : type 6B, Tube type: ST
Dimension: D39, L106 (with pin) (mm)max
Heater Voltage (AC) 6.3V, Heater Current 0.35A
Plate Voltage: 180V 250Vmax.
Screen Voltage: 180V 250Vmax
Grid Voltage: -10V
Plate Current: 15mA
Screen Current: 2.5mA
Plate Resistance (Approx): 130000ohms
1500000ohms
Transconductance (Approx.): 1750Micromhos
Load Resistance: 12000ohms
Total Harmonic Distortion: 8%
Power Output: 1W 1.5Wmax

KX-12F

KX-12F is a half wave rectifying tube of the filament type for use in the DC power supplies of small radio sets.

This tube was put on the market in 1937. 12F became the Japanese standard rectifying tube suitable for a radio set of up to 5 tubes with a magnetic or small dynamic speaker.

Pin connection : type 4B, The No.3 (N.C.) pin was deleted in the early 1940's to reduce the use of material.
Tube type: ST
Dimension: D39, L106 (with pin) (mm)max
Filament Voltage: 5.0V
Filament Current: 0.5A
A-C Plate Voltage : 300Vrms
D-C Output Current: 40mAmax
Appendix 3: Approval and Recommendation System of Wireless Apparatus

APPROVAL SYSTEM IN THE PRE-WAR ERA

Broadcasting stations needed a prevailing low cost and high quality radio. However, low cost radio sets manufactured by small factories did not have high enough quality. To identify high quality sets and parts, an approval and recommendation system for radio and radio parts was started from 1928 by Nippon Hoso Kyokai.

According to the rules of the system, radio sets or component parts manufactured by general manufacturers were to obtain the approval and recommendation of the broadcasting authorities before being put on the market. Before giving approval and recommendation, the broadcasting authorities were to test the quality, construction and other specifications of radio sets and component parts in conformity with rules. Manufacturers were also required to be able to produce goods of the same quality at proper prices and their productive power was, too, taken into consideration before obtaining the approval from the broadcasting authorities.

The first technical standard was suitable for crystal and battery sets. In 1934, recommendation system of wireless apparatus was revised for a new AC set. The system of approval and recommendation applies to only low cost sets and parts (tubes, transformers, speakers, capacitors etc).

Since then, approved radios and parts increased considerably. However, this approved system was not mandatory. The greater part of Japanese radios were not approved. To certify this system, high specifications and quality were demanded. The cost of an approved radio was increased. To avoid high cost, many “using approved parts” radios were put on the market. These radios used one or two important approved parts such as the power transformer or speaker. Approved radios did not predominate in the market. Mostly the reason was high price. The price of an approved radio was twice as high as cheapest set. The poorer quality radios sold for popular consumption. The qualities of these cheap radios were very poor. Such radios sometimes failed and caused interference.

SYSTEM AND REGISTRATION NUMBER

The system of approval and recommendation involved certification of a submitted sample. The test sample was kept by Nippon Hoso Kyokai. If the sample passed the test, an approved number was given to the manufacturer. They could then indicate an approval and recommendation mark on their products and in their advertising.

An approved number consisted of 5 digits. The first 2 digits meant types of radio and parts, The last 3 digits meant a registration number starting from 011 (Fig. 23).

Fig. 23. An example of an approval and recommendation mark.

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POST WAR APPROVAL SYSTEM

The approval system for radios and parts by NHK continued after the end of World War Two. The scope of approval was mainly the Kokumin-gata receiver. The Kokumin-gata receiver was authorized as the standard receiver by The Ministry of Posts and Telecommunications. The exemption of commodity tax for approved Kokumin-gata receivers was recognized. METI gave a high priority for assignment of materials to approved radios. The approval was needed to participate in the shipment test by CEMA. Then many approved Kokumin-gata receivers were put on the market. Approval was added in Osaka. The approval number issued in Osaka started from 11611

The need to be approved by NHK was criticized. After the dissolution of CEMA, the Japanese Ministry, GHQ and the radio industry discussed the situation. The result was that the type examination for radio sets by the Ministry of Telecommunications started from 1948. The approval for radio sets was stopped after 1948. The approval for parts was continued. At March 31, 1950, the approval system by NHK ended to harmonize with a new broadcasting law.

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PHOTO CREDITS

All photos by the author except Figs. 1, 2 and 14-18 by Hiroshi Osanai at the TOYOTA Automobile Museum, Aichi Pref., 2010.
ABOUT THE AUTHOR

Tadanobu Okabe graduated from the Department of Electronics Engineering, Tokai University in March 1986 with the degree of Bachelor of Engineering. He works for Accuphase Laboratory Inc. in Yokohama Japan since 1986 where he is Manager, Engineering Division. Accuphase manufactures hi-end audio equipment and Tadanobu is the electronics engineer for circuit design.

When I was a Junior high school student, there was a nasty attic in my house used as a storeroom, where I found a heap of radio magazines from around 1947 and a lot of dust-covered wrecked radios, parts and tools, which my father had gotten in his younger days. Since then I have taken a great interest in old radios. I assembled remaining parts into a complete 4 tube regenerative receiver for the first time, receiving instructions from my father and brother. Thus my collection of radios started. I built my collection basically through mending abandoned radios and TV sets. It was about 1978. Afterwards I have systematically collected mainly Japanese radios made between 1930 and 1950. My collection grew larger and now after 25 years of effort, it consists of more than 800 radios.

In 1991, the Antique Wireless Club (AWC) was established in Tokyo. I joined as one of the first members. In 2005 I set up a small exhibition room at a resort place in Nagano Prefecture. This Japan Radio Museum started its activities in March 2007 on a virtual museum of the Internet.

Papers Delivered (Written in Japanese)
In 1997 and 1999, I presented the following papers at The Technical Meeting on the History of Electrical Engineering, IEE Japan.

Consiideration of diffusion of radio sets from the statistics of manufacture and listeners. HEE-97-1, IEE Japan.

(Abstract) From 1935 to 1955, these 20 years are a very important era for the Japanese history of radio. 1936 was 10th anniversary of broadcasting. 1935 to 40, listeners were increased from 2.6million to 5.7million. Almost all listeners used cheap TRF receivers. 1941 to 45, during World War II, manufacture of home radio and parts was restricted. And many radios lost by war damage. 1945 to 51,Japan was occupied by the Allied Powers. The radio industry was reconstructed until 1949, but many manufacturers went bankrupt by deflation in 1949. In 1951, commercial broadcasting was started, and receivers changed into superheterodyne. In 1953, television broadcasting started. Radio was changed into personal media. I analyze some statistics of manufacture (by MITI) and listeners (by NHK).


(Abstract) Richard Sorge was a spy who was sent to Japan by the Soviet Union in 1933. He organized his own spy group. He obtained information about Japan. A short wave transmitter/receiver was used when they communicated with their controller, or when they sent an intelligence report. Max Clausen who was a radio specialist built up the radio sets and operated them. The transmitter had to be powerful enough to transmit over long distances. Receiver had high sensitivity to receive a weak signal. and the radio had to be small enough to carry and conceal with

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ease. Sorge and his group were arrested in 1941. The confiscated radio may have been lost in the war. I reconstructed the radio set based on the written evidence. This paper reports the investigation about the radio and the process of reconstruction.

I wrote the following papers in the magazine of the AWC.

*The changes of the naming of transistors in Japan.* AWC Review 1992 No.2.

(Abstract). In 1959, naming of transistors was standardized by Electronics Industries Association of Japan (EIAJ). I investigated the changes of the naming of transistors in Japan from 1955 to 1959.


(Abstract) In 1953, television broadcasting started. This year is end of the golden era of the radio in Japan. This list is all of the Japanese radio sets manufactured in 1953.

"KOKUSAKU-GATA" receiver -civilian receiver during WWII in Japan.* AWC Review 1994 No.3.

(Abstract) From 1939, many civilian radio sets called "KOKUSAKU-GATA" were produced. KOKUSAKU means the national policy in Japanese. This policy is economy of resources that were iron, copper, nickel etc. These type of receivers were nasty and cheap. I picked up some "KOKUSAKU-GATA" receivers from my collection, and investigated the circumstance of civilian radio sets during WWII.

*What is original?* AWC Review 1994 No.4.

(Abstract) Restoring or fixing old radio sets involves the danger that it will destroy the original condition and information. This article explains how to find the original condition.


(Abstract) When were radio sets using tubes made? Generally the start is clear, but end is uncertain. I investigate the end of the tube radio in Japan in this paper.


(Abstract) Until the end of WWII, SWL was prohibited in Japan. On Sep. 18,1945, GHQ lifted the ban on SWL. A great number of manufacturers produced new radio sets with short wave band(s) from 1946. The "All wave receiver" is usually a communications receiver. But from 1946 to the early 1960's, home use receivers with short wave band were called "ALL WAVE" in Japan. I pick up and analyze some Japanese early "all wave" radio sets in this paper.

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Tadanobu Okabe
The BBC Handbook was a remarkable annual publication of the British Broadcasting Corporation during its formative early decades—its “golden age.” The Handbook is of interest to collectors of books germane to radio history, to students of British broadcasting, to researchers of radio’s technical past and to historians of the UK of the 20’s, the depression, the war and postwar years. Handsomely designed, the volumes provide a description of how the BBC wished to present itself to the public and are remarkable not only for the technical sophistication assumed in its readers but for their record of the rich world of music, literature and theatre to which British wireless listeners were exposed. The Handbooks reflect the philosophy of the BBC founding director, Sir John Reith, a disciple of Mathew Arnold and his conception of culture.

COMPANY & CORPORATION
The letters BBC once stood for the British Broadcasting Company, the forbear of the pres-
Figure 1. Handbook cover for 1929.
ent Corporation. The Company, a monopoly created by statute of the British government, was the only entity permitted in the UK to broadcast to the public, and was owned by British companies manufacturing receiving sets, e.g., Marconi, and Metropolitan-Vickers. These members were required to pay to the BBC a 10 percent royalty on radios they sold. An additional source of revenue would be an annual 10 shilling licensing fee required of all households with radio sets—this money to be collected by the British Post Office which initially gave half of it to the Company.\textsuperscript{5} Licenses were to be granted to those set owners whose receivers were made by the member companies—which meant British companies.\textsuperscript{6} The first Company broadcasts began on November 14, 1922 from London. From its very start, advertising on the new BBC was forbidden and the number and placement of new transmitting sites carefully regulated—a decision based in no small part on how negatively the founders viewed American broadcasting in the twenties.\textsuperscript{7} By 1925, about 80% of the population of the British Isles could receive the BBC.\textsuperscript{8} The directors of the new Company appointed as its first General Manager John C. W. Reith, (1889-1971), whose name we will encounter throughout this essay.

The British Broadcasting Company was a profit-making institution. Public, nonprofit broadcasting in the UK began on January 1, 1927 when the British Broadcasting Corporation went on the air, replacing the Company. Although the reasons for this regime change are complex, much of the impetus came from Reith, who had a vision of the BBC as a vast educational and cultural public service—one that would be compromised by its connection to a profit-making company. Adding to the pressure for change was Reith’s resentment of the power held by the Post Office to restrict broadcasting of politically controversial material.\textsuperscript{9}

The Crawford Committee, created by the Government to steer the future of broadcasting in Britain, issued its report in 1926, and the result was the formation of the Corporation—a \textit{nonprofit} institution to be financed by license fees and enjoying a monopoly in radio. Because the new Corporation was authorized by a Royal Charter (which would periodically have to be renewed by the Government) and not by Parliamentary statute, it would have the appearance of being immune to political pressure. The Director-General of the Corporation was John Reith, (who was now Sir John); he held this title until June of 1938 when he resigned.\textsuperscript{10} Some refer to his stewardship as The Golden Age of Wireless, and indeed this is the title of volume 2 of Briggs’s vast history.

Each Handbook/Yearbook was devoted in considerable part to a discussion of the content of the previous year’s programs.\textsuperscript{11} Just a cursory glance shows that this material might, in today’s discourse, be described with the pejorative “elitist.” Even now, mention of the Reith era BBC can stir up passions deriving from class resentment. To understand this BBC culture one must know something of the man at the top.\textsuperscript{12}

My colleague at the University of Massachusetts Lowell, Todd Avery, has written a fine account of the Reithian BBC years, \textit{Radio, Modernism: Literature, Ethics, and the BBC 1922-1938}. Some of the book deals with the profound influence that the writing of the English poet and essayist, Matthew Arnold (1822-1888), had on the
BBC head. Readers may be familiar with his poem “Dover Beach” but more germane to our discussion is Arnold’s much quoted 1869 essay *Culture and Anarchy* – a defense of what is now called highbrow culture. Arnold recommends “culture as the great help out of our present difficulties; culture being a pursuit of our total perfection by means of getting to know, on all the matters which most concern us, the best that has been thought and said in the world....” [italics added]. Avery sees this as Reith’s “cultural agenda” for the BBC. For Arnold (and doubtless for Reith) anarchy was “doing as one likes.”

Arnold and Reith part ways in the matter of religion. Raised in a liberal Protestant household, Arnold was to become an agnostic—a fact evident in Dover Beach where the balm proposed for the loneliness and misery of man in an indifferent Godless world is: “Ah, love, let us be true/ To one another...” Reith, the son of a minister of Church of Scotland, practiced a strict Calvinism, and could be hard on his employees, e.g., firing the BBC’s Chief Engineer after his being named as a co-respondent in a divorce proceeding.

**THE NEW BOOKS**

The first two Handbooks, dated 1928 and 1929, deserve some scrutiny as they set the tone for these publications up to the outbreak of the Second World War. The BBC broadcast no commercials but there was no such ban in their print publications. Looking through the advertising in these early books one sees how rapidly technological change was affecting radio design. Although the crystal set was nearly obsolete, page 370 of the 1929 book carries an advertisement (Figure 2) for an improved crystal detector, the Excel, which brags of requiring no cat’s whisker. In advertisements for complete receivers we find quite a choice: crystal sets, and receivers of two or three valves (as the British called tubes) powered by batteries or the power mains. For accessories, we find ads for headphones as well as loudspeakers including the relatively new moving coil speaker, and a cornucopia of ads for batteries and battery eliminators as well as individual components (for the home set builder) e.g., coils, condensers, tube sockets, valves. For this reader what is striking about the advertisements for receivers is the number of sets being promoted that had only two or three valves at a time when American magazines promoted a plethora of radios with 5 or more tubes. Figure 3 shows an advertisement from page 389 of the 1930 Yearbook for a 2 valve radio. This American-British disparity doubtless arose from the crowded air waves in the US which...
would have demanded receivers having high selectivity in contrast to the UK where typically one could hear only one to three BBC stations; to be sure, British listeners often received broadcasts emanating from the European continent. In the 1931 Yearbook (page 131) there is an article “The American Listener – A British Impression” in which the visitor from the UK is struck that “two out of every three receiving sets are five or six valve sets... The American Listener expects to be able to tune in easily to a dozen or more stations...”

The introduction to the first Handbook was written by Reith himself and he states his manifesto: the BBC is to be “of public service.” He is motivated by “the state of things in America,” i.e., the world of radio commercials and, even worse, interference among radio stations, not to mention program material that he regarded as vulgar and unworthy of broadcast. Part of public service in Reith’s view is the purely technical: setting up transmitters such that the whole British population would be in “crystal range.” He extols a “common sense” censorship and as to news broadcasting, it must be “accurate brief and impartial.”

For music, “good music is preferred to bad” and he intends to broadcast “music that is addressed to the finer and quieter sources of emotion in a small audience” but he does not shrink from his intention to broadcast “challenging new work.” As for religious content, he’s equally straightforward: the BBC has and will continue to broadcast “a nonsectarian Christianity—confined in respect of doctrine, to those simple essentials to which all Christians of the west can adhere.”

The 1928 book notes that “The BBC observes Sunday in a religious non-sectarian way. Religious services are broadcast regularly from all stations, and no entertainment alternative is recognised.” Reith’s Calvinism is evident—you cannot avoid hearing a religious broadcast by switching to another BBC station. For nonbelievers, the temptation to listen to a secular broadcast in English from France or, later, Luxemburg was strong. 13

The BBC Handbook of 1928 was 384 pages in length while for 1929—a depression year—it was 100 pages longer. One purpose of each volume was to give a summary of the previous year’s activities of the Corporation. Since advertising made up 5-10 percent of the pages of the book, one might wonder what filled these hundreds of pages, and here it becomes evident how broadly conceived these volumes were.

First, the books contain much material on the rapidly advancing technical achievements of the BBC—improvements to broadcast-
ing from the London site as well as regional broadcasting from such places as Wales, Scotland, & Northern Ireland. Listeners in the London area are told in the 1929 book that soon they will be able to hear two different BBC stations (one national and the other regional) and are warned that they will need receivers of sufficient selectivity to separate the two signals, which will be broadcast from identical locations in North London but on different wavelengths. We’re informed of progress in Empire Broadcasting, meaning short wave service directed at the colonies and commonwealth countries.

Americans might be surprised to learn that, while much of BBC broadcasting in its first few decades took place within a spectrum of medium wave frequencies (comparable to the U.S. AM band), in 1925 the BBC opened a popular long wave station, 5XX, at 200khz (1,500 meters) radiating 25,000 watts. The station was situated in Daventry, near the center of England, and a picture of its antenna can be found on page 56 of the 1928 Handbook. Because of the long wavelength, the antenna had to be enormous and was supported by masts 500 feet high set 800 feet apart. The low frequency was chosen because of the resulting low attenuation of the ground wave; in this respect they were following in the footsteps of Marconi and his early wireless telegraphy work. Page 39 of the same book asserts that this step allowed 80 percent of the British population to receive the BBC without interruption via a mere crystal set. It was the first long wavelength station in the world to give regular programming.

On page 92 of the 1928 Handbook we are reminded of the bête noire of the BBC: the unlicensed receiver. Readers are advised: “It is illegal to operate a receiving set without first taking out a licensing costing 10s [shillings] a year, from the Post Office. Some people do manage to listen without a license, but it costs much more in the end. It costs a lot more in self respect.” Note the allusion to one’s honor.

This was already an old problem. A Profile of the BBC written for the 1973 Handbook remarks that when an amnesty was offered in 1923 to “license dodgers,” the number of licenses issued doubled in 10 days. How much was 10 shillings worth? It wasn’t trivial. The average weekly pay of a coal miner in Britain in 1927 was 53 shillings for a 5.5 day work week. A radio license could represent a day’s pay for a manual worker. The temptation to assemble a set from parts and not license it must have been enormous, particularly since there was no shortage of hobbyist magazines with instructions on this very subject. Incidentally, the Yearbook/Handbook cost from 2 to 2.5 shillings from the 1920’s through most of the 1940’s.

THE THIRTIES

Much of each annual describes the content of the previous year’s programs, and we suspect that were Mathew Arnold present to hear the wireless, in the Reith era, he would have been pleased. In the Panorama of Music for the 1930 Yearbook we learn that it is BBC policy to present as many works as possible by such composers as Haydn, Schubert, Bach, Handel and Mozart, and that these are the “bread and butter” of the daily fare of the lover of music. The BBC’s panorama consisted of live concerts of chamber, symphonic and operatic works not to mention—in 1929—a regular weekly series of Bach Cantatas as well as 13 weeks
of music devoted to Schubert’s Centenary. Although all the composers were white and male, not all were dead; Stravinsky and Delius, still in the land of the living, had their work conducted by Sir Thomas Beecham. The 1930 book contains a touching photograph of the aging Delius, then blind and living in France, while the previous year’s volume has a full page photo of Arnold Schoenberg (the father of twelve tone serial music) and his fur clad wife. This often difficult composer had come from Germany to rehearse and conduct the British National Orchestra in his work “Gurrelieder.”

The BBC’s commitment to serious music is even more evident in the 1931 Yearbook, which reports the founding of the legendary BBC Symphony Orchestra the previous year. Starting in 1930 the new orchestra was conducted by Adrian Boult and consisted of 114 full-time players tied to a “no deputy” system— which meant that if you were a member of this august body you’d better show up for work and not appoint someone to take your place because you had another gig. Pages 176-77 of the book shows a two page photo spread of the orchestra together with the name of every player. What is striking is the large (for its day) number of women in the ensemble. Of the 14 first violinists, 8 are identifiable as female. Where did the money come from to pay for what was to become one of the world’s great symphonies? The answer is on page 39: BBC license fees and revenues from publications adding up to over 1 million pounds for the year ending in 1929. One might contrast this orchestra with its closest American counterpart: the NBC Symphony which, although it could boast of a very great conductor, Arturo Toscanini, wasn’t founded until 1937 and was to last only 17 years. The BBC Symphony today is still one of the world’s outstanding orchestras.

Reading through all of these Handbooks/Yearbooks one should notice not only what is present but what is missing. The BBC took some risk in broadcasting the works of modern composers like Stravinsky, Bartok and Schoenberg. However, searching through these books of the twenties and thirties, one finds almost nothing about jazz. Reith is alleged to have hated the idiom. Instead, we find plenty of dance band music. Indeed, the BBC formed its own dance orchestra ahead of the BBC Symphony, a fact gleaned from pages 200-201 of the 1929 Hand- book. Having listened to recordings of British dance orchestras of this period I can say that these were housebroken versions of American jazz, divorced from the black influence, ethnicity, and daring that you might find in some of the great U.S. jazz groups of the era led by, e.g., Fletcher Henderson, Benny Goodman, and Count Basie. It would be wrong to accuse the BBC of racial prejudice: The 1930 Yearbook lists a July 1928 concert by the famed American Negro contralto Marian Anderson who carried an aura of high culture and could stun audiences with arias from great operas as well as the spirituals of her race. The 1931 Yearbook features a prominent photograph on page 114 of the great American Negro singer and actor Paul Robeson, who sang on the BBC.

Robeson appears on a list of Musicians of the Year. To look through these names is to be filled with envy for what listeners could have heard: under conductors we find Sir Thomas Beecham, Malcolm Sargent, Bruno Walter, Toscanini, and Sir Edward El-
Besides the two singers just mentioned we find Rosa Ponselle, Lauritz Melchoir, Elizabeth Schumann and Lotte Lehmann. Pianists include the composer Bela Bartok, Myra Hess, Walter Gieseking, and Artur Rubinstein. Wanda Landowska performed on the harpsichord.

Just as impressive in the 1931 book is a staggering list of BBC speakers for 1930. Drawn from seemingly every branch of intellectual endeavor we find such legendary authors as Virginia Woolf, T.S. Eliot, Andre Maurois, George Bernard Shaw and E.M. Forster. Among scientists, we encounter Albert Einstein, Oliver Lodge, James Jeans and Julian Huxley. Additionally, we recognize the economist John Maynard Keynes, anthropologist Bronislaw Malinowski, and Arnold Toynbee the historian. Einstein spoke on October 28, 1930, and his picture appears on page 34.

“BBC English” was for generations of Britons the standard pronunciation of their language. The accent did not arise by accident as a reader of the 1929 Handbook soon learns. An essay by A. Lloyd James observes that “The BBC is concerned only with questions of pronunciation, and the standard of pronunciation of its official speakers more and more, both within these islands and abroad, as a standard of accuracy to be aimed at.” He reveals that the BBC maintains an advisory committee on spoken English composed of such men of letters as The Poet Laureate of the UK, Robert Bridges, playwright George Bernard Shaw, and essayist Logan Pearsall Smith (an American!). It’s fitting that Shaw, the author of a play in which pronunciation is central, Pygmalion, should be on board.

Radio historian Mark Pegg observes that “...the accent of the announcers alone was to mark the social distinctions between the broadcasters and most listeners.”

Speaking of Shaw, perusing these BBC annuals one sees that radio drama was an important part of broadcast fare. The 1931 book remarks that 4 radio adaptations of plays of Shakespeare were performed the previous year. Shaw was represented with Captain Brassbound’s Conversion and St. Joan. Sometimes books and short stories were converted to radio plays, e.g. Joseph Conrad’s Typhoon and Lord Jim.

Andrew Crisell, a major British radio historian, convincingly defends the elitism of the BBC in the Reith years: “In pre-war Britain, universal education reached the age of about 14. Those temples of high art, the concert halls, opera houses and theatres were beyond the pockets of the great mass of people, and within the tiny minority who underwent higher education there was much more consensus than there is today about what in cultural terms was, good, significant or worthwhile.” Reith’s intention, he maintains, was to “…open up to all those who had been denied to them by a limited education, low social status and small income the great treasures of our culture.”

TECHNICAL MATTERS

For those interested in the technical history of radio, the
early years of the annuals are a treasure. These volumes contain a segment known variously as the Engineering or Technical Section.

In addition there was sometimes a reference portion that was rich in technical information. Altogether, the technical content might occupy one third of the overall volume.

By the late thirties these specialized sections were gone or much reduced.

The BBC did not patronize its audience. The level of discourse of the technical material is sometimes appropriate for degree holders in electrical engineering. Basically the information provided was of several kinds: technical advances and challenges facing the BBC engineering staff, help for the amateur home builder of receivers, which might include everything from schematic diagrams for radios as simple as crystal sets up to 6 tube superheterodynes, construction of receiving aerials, wave propagation over a conducting earth, the role of the ionosphere in radio wave transmission, and a glossary of technical terms which contains for example:

“Natural Frequency or Natural Period—The frequency or period at which a circuit containing inductance and capacity will naturally oscillate if set in electrical vibration. The natural frequency is given by the formula

\[ f = \frac{1}{2\pi\sqrt{LC}} \text{cycles per second}, \]

where L is the inductance in henries and C is the capacity in farads. At this frequency, the condition of Resonance occurs.” [italics in original].

What is interesting about the schematic diagrams is that they never supply quite enough information for one to build a wireless receiver; the BBC did not encourage home construction. If someone bought a wireless set from a store there would be a record of her having purchased a radio. She might be less likely to avoid buying the half pound license fee than a home constructor of radios who left behind no trail. It’s possible that the Yearbook/Handbook did not encourage home construction out of fear of antagonizing their numerous advertisers of ready-made radios. In the article “Some Hints for the Novice,” in the 1928 Handbook, the homebuilder is advised “In nine cases out of ten the results will be disappointing.” He (and it is always “he” in these articles) is then advised to buy the most expensive possible components if building a home set, and to eschew for example the “cheap foreign [valves]” because ... “British valves are the best on the market.” Of course it was British valves that were advertised in these books.

Sometimes one suspects that the information provided the hobbyist is not only deliberately sketchy but intentionally misleading as in this example (Figure 4) taken from page 341 of the 1930 Year Book. The schematic is for “... a simple but efficient short-wave circuit...and the values of the component parts should be near as possible to those given.” Not only are the values of some components not given but more striking is the value of the grid leak resistor connected to the first valve on the left. Its value of $3\Omega$ is off by a factor of one million. This might have been a careless error, but these books have so few typographical errors that one wonders if this wasn’t deliberate.

In a situation where the BBC is seeking to enhance the listening experience, without encouraging the building of an entire set, they could be very helpful. The 1929 Handbook contains instructions for the construction of a wave trap.
to eliminate interfering stations. Page 343 contains a clear diagram (Figure 5) detailing the construction of the inductor for the trap.

The use of a wave trap would increase the selectivity of a receiver. We are told in the same book that "the majority of ships" are using spark transmitters, a reminder that this crude technology, dating back to the early Marconi wireless telegraph era, was still in use. Wave traps were needed to block the resulting harmonics from reception.

The design of receiving antennas was of great interest to the set owner in the first decade of broadcasting, and the Handbooks/Yearbooks recognize this with construction advice. We learn from the 1928 Handbook (p.249) that using an antenna whose overall length exceeds 100 feet violates the terms of your license, while the 1931 Yearbook advises the use of the entire allowed length. Moreover they tell you, "In general it is not a good policy to make an aerial system inconspicuous; for example it is bad practice to hide the horizontal portion of the aerial by running it close to the eaves or roof of the house. Although aerials of this type usually succeed in being inconspicuous they are seldom efficient, for their effective height is small. If the roof of the house is covered with lead, which is usually in electrical contact with the ground, the aerial in effect is only slightly higher than ground level."

The same book presents (p. 379) a possible arrangement for an aerial, given here in Figure 6.

We notice how conspicuous this arrangement is; there is little chance that someone with this aerial would have the audacity to skip paying for a wireless license. One feels that this is not an accident. In fact there is no suggestion in any of the annuals that for someone using a regenerative or superheterodyne radio, a much smaller indoor antenna might do. As late as the 1940 Handbook (p. 98) the listener is advised to use an outdoor aerial.

The technical discussions in the Handbooks/Yearbooks of the early 1930’s could be at a very so-
phisticated level and this is most apparent in the chapter “Transmission” in the 1930 volume. Here we find an analysis of the direct and indirect waves in broadcast propagation that would be of most interest to radio engineers. A series of curves, based on Arnold Sommerfeld’s difficult mathematical theory of wave propagation over an imperfectly conducting spherical earth, shows the electric field strength vs. distance from the transmitter for various ground conductivities.

Of course engineers were also interested in the behavior of the indirect ray—the wave from the transmitter reflected back to earth by the ionosphere. The same chapter summarizes a paper delivered to the IEE by two members of the BBC staff, Peter Eckersley and a Mr. Howe, on this very subject. Using a mixture of theory and experimental results, the pair conclude that the strength of the signal returned to earth will be “.1 mv per meter for 1 kw radiated” at distances of from 300 to 1000 km. The preceding assumes a single reflection from what they call “the Heaviside layer.” Evidently credit was not to be given to Arthur Kennelly, who postulated such a layer independently and in the same year, 1902, as the Englishman Oliver Heaviside. Kennelly was an Irishman who was born in India and who settled in the United States, worked for Edison, and taught electrical engineering for decades at Harvard. It is not until the Yearbook for 1932 that we find the “Heaviside-Kennelly” layer and by 1934 the modern word ionosphere is used, perhaps reflecting the fact that it was by then known that there were several layers involved in the refraction of radio waves.

The British led the world, in pro-
viding regularly scheduled “high definition” broadcast television. From the 1937 Annual we learn that experimental t.v. was begun from Alexandra Place in London the previous year; one of its goals was to evaluate and compare the utility of two competing systems—the Baird and the Marconi-EMI. Both are discussed in some detail. The Baird would now be regarded in modern jargon as a “kluge;” it required a mechanical scanning disc, and worse, a photographic film as an intervening process in the transmission of the t.v. image. The book reports that in February of 1937 the Marconi-EMI system, which was all electronic, was adopted for permanent use, while the 1938 Handbook asserts that in 1937 the BBC was broadcasting 150 minutes of television per day with an estimated 10,000 people seeing the coronation of King George VI on their sets. By contrast, in the U.S. it wasn’t until 1939 that NBC began providing two hours of programs a week. The 1939 Handbook reports that, at the 1938 Radiolym-pia Exhibition in London, 22 firms exhibited televisions.

If one were to read just one annual because of its technical content, it would be the 1930 Yearbook. Here we find four articles, written for the lay person, on science and engineering by acknowledged experts in their field. For example, Sir William Bragg, Nobel Laureate and Fellow of the Royal Society (FRS), addresses what physicists now refer to as the “wave–particle duality,” i.e. the fact that some physical phenomena can be explained only by treating the transmission of electromagnetic energy by means of a wave model, while others are explicable only by using a particle model. Bragg calls
the particles “minute corpuscles proceeding from the luminous source.” In some respects the article is old fashioned—he avoids the modern term “photon” for the corpuscles in a stream of light. More curious is his use of the term “ether” to describe the medium in which both particles and waves propagate. The ether as a medium for electromagnetic radiation was discredited 25 years before with the publication of Einstein’s special theory of relativity and it is astonishing to find it still alive here.

Even more surprising is an article preceding Bragg’s titled simply The Ether and written by Arthur Eddington, FRS, one of the great British astrophysicists of the 20th century. His purpose is to proclaim his belief in the ether but he writes like a man on the defensive, acknowledging that we cannot ask what the ether weighs, is it a fluid or rigid, how fast does the earth move through it? He does concede that “A few distinguished physicists maintain that modern theories no longer require an ether—that the ether is abolished. I think that all they mean is that since we never have to do with space and ether separately, we can make one word serve for both together; the word they choose is ‘space.’” Since physicists speak of the properties of space (e.g., the speed of light in space), Eddington would have us assign these properties to something called the ether—a throwback to the 19th century era of Maxwell’s modeling of the medium containing electromagnetic fields.

Although in Eddington’s day he might speak of a “a few distinguished physicists,” no reputable physicist would, post World War Two, speak of the ether. Its demise was sealed by the eventual universal acceptance of Einstein’s work. What is especially puzzling about Eddington’s case is that he was the author of a very popular book explaining relativity: The Mathematical Theory of Relativity (1923). The Encyclopedia Britannica (15th edition) describes him as “the first expositor of relativity in the English language.” Eddington has also written about his philosophy of science, which includes the concept of “unobservables” and the reader curious about his defense of the ether should read his work.

Of more practical interest to the radio listener than the essays just mentioned is an article by Sir Edward Appleton, also an FRS. Appleton was to win the Nobel Prize in physics in 1947 for his research on the ionosphere and for his discovery in the 1920’s of what was for a time known as the Appleton Layer but which is now called the F layer of the upper atmosphere. He proposes to explain to the lay person the role of what he calls the Heaviside layer in radio wave propagation and why, as most listeners would have noticed, that certain stations are heard only at night and that the quality of their reception is highly variable. He also ties this variability to the sunspot cycle although what this connection is he does not explain—a reminder that the science of the upper atmosphere was still in its early years.

R. L. Smith-Rose was less well known than the three authors mentioned but his article, the fourth, on lightning and atmospherics is worth reading. Radio listeners were well aware of lightning, knowing it to be responsible for the clicks they might hear in their loudspeakers and headsets, especially in the summer. He explains the mechanism of lightning, the various kinds of lightning strikes, and the wavelengths of radio waves
most apt to suffer from lightning generated noise. The article is accompanied by advice on how to “earth” [ground] your set to reduce the likelihood of lightning damage.

HISTORY BOOKS

The annuals for the period 1928 to 1940, with their summary of the previous year’s events in broadcasting, can be read as a history of Britain during a difficult, indeed terrible, period. As in the case of the technical content, what is sometimes most interesting is the excluded or partially presented material. The most salient example is to be found in the 1937 Annual. On December 11, 1936 King Edward the Eighth abdicated the British throne in order to marry his twice divorced love, the American, Wallis Simpson. The following day Edward broadcast a farewell using radio. His message was broadcast not only by the BBC domestic service but by BBC short wave to the entire world where in some countries, including the US, it was rebroadcast on medium wave. In the age of Empire, he had been monarch to over 500 million people. H.L. Mencken, the American critic, waggishly observed that this was “the greatest story since the Crucifixion.” The Annual has a one-line reference to the broadcast on page 47 while page 88 has an entry, inexplicably placed in a reduced font, about the farewell, and remarking that his valedictory “... was probably listened to by the largest broadcast audience on record.” The abdication was surely not Britain’s finest hour, but an event of this magnitude in the history of broadcasting cries out for more coverage.

To read the Handbooks/Yearbooks in the period 1934 through 1940 can be a dismal business because one knows what is going to happen: Britain and much of the world is headed inexorably for World War Two. The 1934 Yearbook has a photograph of the newly elected Chancellor of Germany; Adolf Hitler assumed office in January, 1933. We are told that with his election in Germany “the rebuilding of the bases of broadcasting has begun.” We learn that all employees of German radio who were Jewish or alleged to be “criminally suspect” were fired. The new head of German radio under the Nazis, Herr Hadamovksy is quoted: “My task... is to make broadcasting a sharp and reliable weapon for the government...” and furthermore “I have always ridiculed ... the old idea that there is such a thing as objectivity and neutrality per se.”

In the 1939 Handbook one of the larger sections is devoted to BBC coverage of “The Crisis [of 1938]”. It contains a photograph of a triumphant Neville Chamberlain at the Hester Aerodrome on September 30. He has just returned from Munich after meeting with Hitler. Mobile television units were at the airport, and the event was not only heard on the wireless but widely witnessed on British television. The Handbook proudly affirms that “[television] viewers were among the first to see him holding aloft that fluttering piece of paper (the writing was visible) bearing his own signature and that of Herr Hitler.” The Sudetenland of Czechoslovakia had just been handed over to Hitler in return for what Chamberlain would call “Peace in our time.”

Germany invaded Poland on September 1, 1939 and two days later Britain declared war on the aggressor. The 1940 Handbook, owing to wartime austerity, has shrunk to a mere 128 pages, less than a third of its size in its best
days. The BBC knew that war was coming and followed advanced planning in which it was recognized that “peace time methods of transmission would endanger the national safety by giving guidance to enemy aircraft.” The Handbook explains that on the day of the invasion all stations shifted to a common programming material which became known as the Home Service and which initially used only two wavelengths, 449.1 meters and 391.1 meters. The long wave transmitter and various regional services were shut down as was all television; however short wave services to the rest of the world did continue and the long wave service resumed before the war’s end. Page 33 carries the text of Prime Minister Neville Chamberlain’s speech, which the BBC broadcast from 10 Downing Street on September 3, 1939. He states, “You can imagine what a bitter blow it is to me that all my long struggle to win peace has failed.”

There is a touching photograph, opposite this page, captioned “Keep them happy, keep them safe” of children being evacuated from London.

One can in some respects trace the history of the war through the annuals. The 1941 Handbook has a photograph of the teenage Princess Elizabeth (the present day Monarch), accompanied by her sister Margaret, broadcasting a message to the children of the Empire. The same volume displays a picture of the results of a German air attack on the BBC headquarters at Broadcasting House in London. Again, this is one of those strange instances of partial reporting. On the 15th of October 1940 a 500 pound bomb landed in the BBC Music Library, killing 7 people, but the deaths are not mentioned.

Short wave and even medium wave services, especially to overrun countries, are discussed at length in the 1941 volume. We learn that “In Poland the Germans have made the possession of wireless sets illegal,” while in Czechoslovakia “anything broadcast by the BBC is known throughout the country in a few hours.” The same book has an essay by Harold Nicolson, Parliamentary Secretary to the newly formed Ministry of Information. He begins with a powerful summary of Hitler’s propaganda: “His avowed method is to appeal to the lowest instincts in human nature, namely to envy, malice, greed, fear, and conceit.” Nicolson is at pains to explain that his new ministry will not be imitating the German propaganda chief, Joseph Goebbels, but will indulge in “liberal propaganda,” which is based on “...true facts and common principles” and the belief “that there does exist a difference between right and wrong and that this difference is readily appreciated by the vast majority of mankind.” Facing the final page of the essay is a photograph of Winston Churchill, making his first broadcast as Prime Minister, on 14 July 1940. The 1946 Year Book, the first to appear after the war was over, remarks (p. 28) that, thanks to the BBC, Churchill’s words in the “darkest days” of the war were heard by 70% of the British population.

New in the 1940 Handbook is information about a wartime broadcasting service of the BBC which was to have consequences far beyond the hostilities. On the 19th of February 1940 broadcasting of the Programme for the Forces commenced. This went out on short wave as well as the medium wave 373.1 meters, later changed to 342.1 meters, and consisted of material designed for the men and women in uniform: news, popular music, dance music, swing,
crooners, comedy. The content is described in the story “Listening with the Forces” by Major Richard Longland, BBC Liaison Officer with the Army.

Many Britons on the home front listened to and enjoyed what became known as the General Forces Programme, a fact not lost on the BBC. In the 1946 Yearbook we find that the successor to the General Forces is the BBC Light Programme which went on the air in July 1945 essentially in competition in the UK with the still present traditional Home Service. There is a certain defensiveness in the description of the new service in the annual (pp. 53-54): “The title Light Programme does not mean that everything broadcast on it must necessarily be frothy or frivolous,” although the unnamed author concedes that it does contain “a higher portion of sheer entertainment.” This same Yearbook has auguries of a new service in the annual for 1947: the birth of the BBC Third Programme.

The Third Programme was born on September 29, 1946, broadcasting from 6 p.m. to midnight and was devoted to the high culture championed by Reith and his muse Arnold. There were no newscasts. An article by the novelist and travel writer Rose Macaulay on page 20 of the 1947 Year Book, “If I Were Head of the Third Programme,” gives some idea of what was broadcast, much of it serious music. She proclaims that the offerings were “proving more than all one hoped” with a week full of Beethoven’s String Quartets, and another of Byrd and Bach, and a performance of The Magic Flute. Modern music is not lacking – she speaks of Bax, Schoenberg and Webern. As for drama there were “good performances of the familiar great—Shakespeare, Ibsen, Strindberg, Shaw, Euripides.” The 1955 Handbook describes the Third Programme as intended for “Listeners of Cultivated Tastes and Interests.”

Thus, a year after the war ended the BBC had become revolutionized in ways that Reith had never wanted nor perhaps envisioned. His Corporation was now a cake of three layers, with the Third Programme, Home Service, and Light Programme providing entertainment for high, middle and lowbrows. This was anathema to Reith who felt that the strength of the old, heterogeneous system was that the public was forced—if only by chance—to be exposed to some high culture. Indeed, Reith wrote in his diary that the new arrangement was “an absolute abandonment of everything I stood for.”

Of course this restructuring and growing egalitarianism at the BBC was a manifestation of large social changes taking place in the UK. Even before the war ended the ruling Conservative party was voted out of control and Prime Minister Churchill was replaced by the Labour Party’s Clement Attlee on July 26, 1945. The frontispiece of the 1946 Yearbook is a photograph of the new Prime Minister. Railroads and coal mines were nationalized under the Labour Party and the National Health Service begun.

The cover of the 1946 Yearbook (Figure 7) shows the dove of peace launched from a hand shrouded by bombed ruins. Alas, peace was short lived. In four years Britain and the United States would have troops in Korea.

In the decades following the publication of this hopeful cover the Yearbook/Handbook would, like the BBC itself, become increasingly devoted to television. No book was published in 1953 or 1954 but the 1955 Handbook dwells on the banner broadcasting
Figure 7. Launch of the peace dove. Cover 1946 Yearbook
year of 1953—the coronation year of Queen Elizabeth II. In the UK alone, 12 million listened to the coronation on the radio but 20 million saw it on television (this out of a population of 41 million). This, reports the BBC, was the first time that the t.v. audience exceeded that of the wireless. Perhaps it is appropriate to end our examination of the books here.

Finally, one wonders what would be the reaction of Sir John Reith if he could now see his BBC in the age of the Internet. The three layer cake that was BBC wireless in 1946 has today evolved into BBC services numbered one through seven. All go out as broadcast radio as well as Internet stations. Although some services are restricted to popular music and news, BBC radio 3, 4 and 7 have an abundance of serious music, lectures, and drama --Arnold’s “best that has been thought and said,” with some leavening from light entertainment. Of course, if you spend the day listening to one of the other services you’ll miss “the best”, and this would not please Reith.

SOURCES

The entire run of Handbooks/Yearbooks/Annual Reports is available on Microfilm from Microform Academic Publishers.

http://www.microform.co.uk/archival-publishing.php

This Microfilm edition is accompanied by a brief and useful discussion of their contents by British radio historian Hugh Chignell.

The business branch of the New York Public Library has a complete set of the actual books. Lamont Library at Harvard University has them on microfilm as do doubtless many other university libraries.

ACKNOWLEDGEMENT

I wish to thank Mr. David K. Nergaard and Ms. Naomi Ossar for useful assistance with this paper. The images presented here were in most cases reproduced by courtesy of the BBC. Mr. James Codd of the BBC assisted me with that procedure.

ENDNOTES

1 The Handbook was replaced by “The Handbook, Incorporating the Annual Report and Accounts” in 1974 and continued with that title until it ended in 1987. During the Great Depression, The Handbook diminished rapidly in size and was a mere 129 pages by 1938. In postwar years it grew but never achieved the heft of its early days.

2 The Yearbook was the title used in 1930-3, 1943- 1952. The title Annual was used in 1935-7. There is no consistency in spelling from year to year and one can find Year Book and Hand Book.

3 The artist is given simply as E. McK.Kauffer. This is E. McKnight Kauffer, a distinguished American illustrator from Montana, who was better known in Europe than at home. See the website http://www.aiga.org/content.cfm/medalist-emcknightkauffer

4 Asa Briggs, The History of Broadcasting in the United Kingdom, vols 1-5, Oxford 1995

Andrew Crisell An Introductory History of British Broadcasting, Routledge, 1997


6 An “experimenter’s license” was available for those choosing to construct their own sets.

7 An interesting comparison of British and American radio can be found in the essay British Quality, American Chaos: Historical Dualisms and What They Leave Out, Michele Hilmes, in Radio (vol2), Andrew Crisell editor, Routledge, 2009 pp. 62-85,
It is unclear whether Reith resigned voluntarily or if he was encouraged to leave. See for example The BBC-The First Fifty Years, by Asa Briggs, Oxford, 1985, pp. 145-6.

The term “previous year” is only approximate, e.g., the Yearbook of 1930 covers Oct. 1928 thru Sept 1929.

Reith has written his autobiography Into the Wind, and there is a biography Only the Wind Will Listen by A. Boyle. Reith has published his own Diaries, which, Briggs warns us “Aren’t always what they seem.”

See Briggs (note 10), pp. 46-7 on foreign English language broadcasts directed to the UK from Europe. See Scannell and Cardiff (note 5) pp. 230-4 on Radio Luxembourg as well as a schedule for a typical BBC Sunday in the early thirties, which would have included a period of silence lasting nearly 2 hours.

The BBC still maintains a long wave service but its transmitters are not at Daventry. For more information see http://www.bbc.co.uk/reception/transmitters/radio/medium_long_wave.shtml

Wages: Statistics of United Kingdom, Encyclopedia Britannica, 14th ed. 1939 (vol 23, page 273)

Among these was the famed Wireless World, still published today but under the name Electronics World. In an effort to thwart the efforts of the home builder, The Radio Times—a BBC publication—would not accept advertising for certain radio components until 1926, a fact reported on page 12 of the 1933 Yearbook.

The first conductor, briefly, was Arthur Catterall. By 1930 Boult was the leader, and he remained in this position until 1950. The 1932 Yearbook lists Boult as the music director of the orchestra.

Forster was to discuss literature on the BBC on a regular basis as recently as 1960. A selection of his lectures has recently been published: The BBC Talks of E.M. Forster 1929-1960, edited by M. Lago, L. Hughes and E. Walls, University of MO, 2008 A photograph of Forster appears following page 96 in the Handbook for 1940.

In the 1936 Annual one finds that the Committee contains Alistair Cooke, a name many Americans will recognize from his hosting of Masterpiece Theatre on television. Shaw’s play became the basis of the musical show My Fair Lady.

The 1940 Handbook advertises a BBC pamphlet on how to pronounce 2000 British family names, e.g., Cachemaille.

Mark Pegg, Broadcasting and Society 1918-1939, Croom Helm, 1983, p. 98

Crisell (note 4), page 29.

Page 413 of the same book states that Ω is the symbol for resistance in ohms.

The books use the term “aerial,” not antenna. In the glossary aerial is defined while under “antenna” you find a reference to aerial. In general the British public preferred
the term “aerial” in this era. See for example the British publication The Practical Wireless Encyclopedia by F.J. Camm which went through 7 editions in the 1930’s. He asserts that “antenna” is an “obsolete” term for the preferred “aerial.”

27 The Handbook from two years before carries an advertisement for the Ormond 5 Valve Portable Set, which boasts that no outside aerial is needed.

28 Eckersley was the chief engineer, mentioned earlier, who was fired by Reith. The IEE is the British Institution of Electrical Engineers.

29 For example, Arthur Eddington. The Philosophy of Physical Science, University of Michigan Press 1958. He does concede (the book was completed in 1939) “…the aether has few friends nowadays.” p. 38

30 As quoted in the Baltimore Sun, December 15, 1996, Fred Rasmussen

31 Briggs, Asa, (note 10) page 194

32 As quoted in Crisell, page 63.

33 I have been unable to determine the artist who created this cover. The initials LP appear in one corner. According to my correspondent at the BBC, this was likely to have been Leonard Potter who did other artwork for them.

34 Some are broadcast on a free satellite radio service.

ABOUT THE AUTHOR

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John Graeme Balsillie was a central figure in the landmark patent case *Marconi v. British Radio Telegraph & Telephone Company*. Yet little has been written about his work in wireless telegraphy upon his return to Australia in September 1911. This paper therefore focuses on his role as the Commonwealth Radiotelegraphy Engineer responsible for the establishment of a network of coastal wireless telegraphy stations across Australia. On this journey Balsillie navigated a patent minefield, designed his own wireless telegraphy system, took on the might of both the Marconi and Telefunken companies and built nearly 20 wireless stations in the space of two short years. However his sudden departure from the role in 1915, followed by a series of failed ventures and his premature death in the United States several years later have long obscured a significant contribution to the development of wireless telegraphy.

The report was adopted by the Federal Labor government under Prime Minister Andrew Fisher (Fig. 1), a former Scottish miner who had migrated to the State of Queensland in Australia in 1885. A nation builder, Fisher was interested in the possibilities of wireless. He therefore immediately decided to appoint a ‘wireless expert’ to the Postmaster-General’s Department to take control of all government wireless activities. Fisher needed to act quickly as tenders had been issued under the previous government for the erection of stations at Pennant Hills in Sydney and Fremantle in Perth. Construction of these facilities (or ‘plants’ as they were referred to then) was to be undertaken by Australasian Wireless Limited, an offshoot of the German Telefunken Company, who had beaten four

**Figure 1 - Australian Prime Minister Andrew Fisher**
other bids in the tender, including that of the Marconi Company.\textsuperscript{8}

John Graeme Balsillie was born in the village of Toowong, Brisbane in the State of Queensland in September 1885, coincidently the same year Andrew Fisher had arrived in Australia from Scotland (Fig. 2). Graeme himself was the son of Scottish parents who had migrated to Australia in 1884. The young Balsillie family met with early tragedy when Graeme’s father James died in 1889, leaving his wife Eliza to raise two infant sons. Graeme’s early education took place at Brisbane Boys’ Central School and Brisbane Grammar School. Contemporary school reports from Brisbane Grammar show Graeme to be a diligent but not outstanding student who studied English, French, Latin, Science and Mathematics. He is noted as being “well behaved and industrious”.\textsuperscript{9} Economic circumstances probably forced Graeme into early employment, with him taking up a position as a warehouse clerk in December 1901. He described the role as that of a messenger boy and general office rousabout.

Graeme later attributed his initial interest in wireless as stemming from his education at Brisbane Technical College and in particular the lectures of E.C. Barton. Whilst there is no record of Balsillie enrolling at the College, E.C. Barton had certainly presented free public lectures at the College on wireless telegraphy since 1899. It is most likely that Graeme attended seven weeks of lectures and demonstrations given by Barton that were designed for the electrical trade commencing in early 1902. The first lecture in the series was entitled ‘Marconi versus The Cables’.\textsuperscript{10} Compared to warehousing, this exciting display of Hertz radiators, Branly coherers and operating Marconi equipment would have been more than enough to spark the imagination of a 16 year old boy.

Like Andrew Fisher, Graeme was a person of considerable drive and vision. Leaving Australia in 1902, he had embarked on a wireless career that took him to the United Kingdom, Germany, Russia and China culminating in the establishment of his own wireless company in 1909. His British Radio Telegraph & Telephone Company, Ltd ran foul of the Marconi Company in the U.K., eventually resulting in the historic court decision by Mr Justice Parker in Marconi \textit{v. British Radio Telegraph & Telephone Company, Ltd} in February 1911 (hereafter the \textit{British Radio} case). That decision effectively gave the Marconi 7777 patent of 1900 ‘master patent’ status, and was used ruthlessly in the UK to consolidate the Marconi Company’s commercial position. Balsillie’s British Radio was a casualty of the process, folding in March 1911.\textsuperscript{11} Later, in 1912, the court decision was used to devastating effect in the United States, forcing United Wireless, who controlled the De Forest patents, to sell its’ assets to American Marconi.\textsuperscript{12} This pattern of litigation, based on the \textit{British Radio} case precedent, was repeated in many countries throughout the world.\textsuperscript{13}

After the demise of British Radio Graeme Balsillie wasted no time looking back with regret and applied for the position of Commonwealth Radiotelegraphy Engineer with the Australian Government in May 1911.\textsuperscript{14} Graeme was not the Government’s first choice for the position. Although an Australian, at only 25 years of age, he lacked the perceived experience required for the role. However this all changed when Andrew Fisher, visiting Lon-
don for the Imperial Conference, personally took charge of the selection process. Like Fisher, Graeme was a Queenslander and hailed from Scottish parents. Graeme’s nickname at school was the ‘Scotch kiddie’, no doubt a reference to the broad Scottish brogue he had developed growing up around his mother and her extended family. The two men met in London and Graeme’s final appointment was sealed with a personal recommendation from Fisher. A handwritten note on Prime Ministerial letterhead read “I am of opinion that Mr Balsillie will suit the Commonwealth service best although he is mentioned on the list – in second place”.15

Graeme had the opportunity to consider the Australian patent situation at length during the long sea journey home when he left London in August 1911. As he studied the patent position he formed the view that Lodge’s synton patent of 1897, the Telefunken systems patents, the Poulsen patents and elements of the Marconi patents were not in force in Australia and could therefore be considered public property.16 Upon his return to Australia the following month the press proclaimed him the ‘wireless expert’.17

THE RIVALS

Balsillie would arrive in Australia to meet a rapidly emerging competitive environment for wireless telegraphy business. The key rivals were Australasian Wireless representing Telefunken interests, the Marconi Company and the lone entrepreneur Father Archibald Shaw. Each was intensely lobbying the Australian Government to gain a slice of a potentially lucrative wireless market. Political pressure was also mounting, with doubts about the Sydney and Fremantle construction programmes being expressed in Parliament. In order to maintain control Graeme would need to move fast to keep ahead of both potential competitors and doubting politicians.

Australasian Wireless, who had won the first tender for the erection of two wireless stations for the Government, was registered as a business in May 1910 with a capital of £5,000 to purchase the Telefunken rights for Australasia. The promoters of the company were the proprietors of the local magazine the Bulletin, Hugh Denison and William McLeod. Denison in particular had little interest in wireless and recapitalised his interests in the company for £45,000 soon after the tender was awarded, resulting in a substantial personal profit. A new company, The Australian Wireless Company Limited, was formed in April 1911 with a market capital of £65,000. Telefunken and Hugh Denison became the largest
shareholders. The Marconi Company itself had not fared well up to 1911 and had been beaten in tenders in both Australia and New Zealand. In May 1911 Ernest Fisk had arrived in Australia to represent Marconi Company interests (Fig. 3). Fisk had joined the Marconi Company in Liverpool England May 1906 as a trainee wireless operator and was soon posted as a ship board wireless operator on the trans-Atlantic run six weeks later. As chief wireless operator aboard the ship Otranto Fisk made two visits to Australia between June 1910 and January 1911 before relocating permanently to head up Marconi Australasian interests. By July 1911 Fisk had already written to the Government on the issue of protection of Marconi patent rights.

At the same time Father Archibald Shaw, a Catholic priest, had also lodged his first patents with the Australian Patent Office for a wireless telegraphy system in July 1911. Father Shaw, who became known as 'The Wireless Priest', had taken a strong interest in wireless telegraphy for a number of years, stemming it had been said from his training as an electrician and Post Office telegrapher before he had entered the priesthood and his strong desire to communicate with church missionaries in remote areas of the South Pacific (Figs. 4, 5). By 1911 Father Shaw had established what was to become variously known as the Maritime or Shaw Wireless Works as a large factory site making electrical equipment including wireless telegraphy components on church premises in the Sydney suburb of Randwick.
Graeme Balsillie arrived back in Australia on 17th September 1911, taking up offices at the Treasury Gardens in Melbourne, which at that time was the seat of the Australian Government. Over the next week he would undertake a series of meetings that would determine the direction of the development of wireless telegraphy in Australia.

There was little time to settle in, with Graeme’s first meeting to take place in Sydney with the Post Master General, Josiah Thomas on 21st September. The meeting lasted 5 hours and on the basis of those discussions Thomas immediately organised a visit for Balsillie to the Shaw Wireless Works at Randwick to inspect the workshops and to discuss the local manufacture of wireless equipment. Graeme met with Father Shaw and Marion A. Mulrony, a member of Father Shaw’s staff. During the visit he also had the opportunity to inspect the Shaw System of wireless telegraphy that had been the subject of recent patent applications.

Whilst in Sydney Graeme visited the construction site of the Pennant Hills wireless station the following day and met with the Directors of The Australian Wireless Company. At that meeting he outlined what he called the proposed ‘policy’ on wireless telegraphy which in essence said:

- absolute control in radio-telegraphy be vested in the Post Master General, and that radio-telegraphy be recognised as a Government monopoly
- wireless should be under the administration of the Post Master General’s Department as a separate branch
- all apparatus where possible be manufactured in Australia
- a factory was to be erected or purchased to manufacture all parts of the apparatus necessary for the scheme.

This ‘policy’ reflected the recommendations of the earlier government report of 1911. On 23rd September Graeme met with Ernest Fisk of the Marconi Company and again the ‘policy’ was outlined.

Over the next 2 days Graeme met again with Mulrony from the Shaw Wireless Works, this time seeking quotes for the manufacture of wireless equipment and lunched with Directors of Australian Wireless. By 25th September Mulrony had provided firm quotes for the manufacture of equipment, including provision for the purchase of rights to manufacture Marconi synchronous spark gaps. This was to later prove to be a significant stumbling block.

Graeme returned to Melbourne and dined with Prime Minister Fisher and Post Master General Thomas on 27th September. He was pleased with what he had achieved over the previous week - Marconi and Telefunken interests had been put in their place, the viability of local manufacture of wireless apparatus at the Shaw Wireless Works was demonstrated and the building blocks of the government ‘policy’ were in place. The upshot of the dinner was that the three men agreed to submit particulars of the patent position to Crown Law Officers for review. This Graeme did on 2nd October, but went much further, submitting a set of hand-drafted specifications for a wireless telegraphy system of his own design (Figs, 6, 7).

What is evident from the minute sent to the Crown Law Officers
and the draft specifications is that after just one week of discussions Graeme had decided to ‘go it alone’ with a wireless telegraphy system he had designed which he believed would skirt around the minefield of rival patents and company interests. This solution was a perfect fit for his sponsor Andrew Fisher, who in 1910 had been elected to lead the first majority Labor government in the world. Graeme’s proposed approach embodied Labor’s traditional nationalism – a system invented by an Australian and installed using Australian made wireless equipment.

By mid October a new Post Master General, Charles Frazer, had commenced to personally negotiate with Australian Wireless and the Marconi Company for the sale to the Government of patent rights to manufacture wireless apparatus. These negotiations proved unsatisfactory and in November Graeme was granted permission to make patent applications in his own right.

When word got out the Marconi Company responded quickly, with Fisk making a veiled threat in the press on 29th November that it would test the patent rights used in all systems of wireless.27 This was enough for the government to go public on its’ position. A Ministerial Statement was issued on 8th December, indicating that it intended to use what it called the ‘Balsillie System’ in the future.28 For his part Graeme committed to assign his patent rights to the government, which subsequently occurred on 26th February 1912.29

LITIGATION

Graeme’s problem at the beginning of 1912 was that he still did not have a complete wireless
system built, and in particular did not have a solution to the spark gap issue initially identified in the quotes from the Shaw Wireless Works in September 1911. From that point on it became a race for the Government to erect the network of coastal stations as quickly as possible. In the process Graeme would need to carefully navigate a minefield of potential patent infringements. In the background the threat of potential litigation loomed.

The result was an intensive period of experimental work that took place in early January 1912 at the Shaw Wireless Works. Various combinations were tried, including the use of a Poulsen generator. Working closely with Mulrony a design breakthrough was made on 10th January.30 Graeme subsequently reported the successful completion of the tests to the Post Master General and declared that the new spark gap device was clear of all competing patents (Fig. 8).

Manufacture of equipment now commenced at breakneck speed. The Shaw Wireless Works was commissioned to build four complete sets of wireless. Discussions continued between Balsillie and Mulrony on the construction of the spark gap over the ensuing two weeks. By 25th January the manufacture of the apparatus was completed and the first complete station set was forwarded to Melbourne for installation, arriving on 28th January and commencing operation on 7th February (Fig. 9).

The Marconi Company hit back immediately, taking out writs in the High Court of Australia alleging patent infringement and at the same time wrote to the Government requesting a right of access to inspect the Melbourne station. This was formally refused by the Government. In retaliation Marconi applied directly to the High Court for the right to inspect all plant and apparatus. The Marconi application was initially dismissed by the Court after the company refused to accept the appointment of independent inspectors. Later in April the Court would rule that inspection would only take place using an independent expert reporting to the High Court itself.

At the same time Australian Wireless lodged writs against the Shaw Wireless Works and the Adelaide Steamship Company (who were using the Marconi system) for alleged infringements of their patents.

Independently, two expert reports on the Balsillie System were commissioned by the Government to review the situation. Both reports were prepared by UK based experts, both of whom had given evidence on behalf of the Marconi Company in the British Radio case. This time however Messrs Swinburne and Duddell both reported in favour of the Balsillie System and cleared it of any potential patent infringements. Duddell’s analysis was cautious, given that he only had access to the draft pat-
Figure 9 - Balsillie commissioning the Melbourne plant

Figure 10 - William Duddell

Figure 11 - James Swinburne
ent specifications and was unable to observe the actual apparatus. He therefore relied on a detailed review of the competing patents, concluding that the proposed transmitter and receiver did not infringe any known patents. Swinburne’s report and conclusions were more sweeping, declaring that “there can be no serious question of Infringement.” (Figs. 10, 11)

BUILDING THE COASTAL NETWORK

What was different about the Balsillie System (or Commonwealth System as it was dubbed) now being offered to the government compared to that which had been struck down in the British Radio case in February 1911? This time Graeme was to place greater reliance on Sir Oliver Lodge’s ideas embodied in the 1897 syntony patent, which he knew was not in force in Australia. Graeme and later commentators summarised the significance of the system in the following terms:

“The Balsillie System is now recognised throughout the world as a distinct new system, involving a discovery. It is the first and only uni-directional impulse system known. Although its evolution started from Lodge’s idea of a syntonic system, and Wien’s theories as to impulse excitation, the fact remains that the inventor is the only person who has discovered a means of producing a theoretically perfect syntonic system. On this account, it is proved and admitted to be the most efficient of all known systems. The essential difference between this and the Marconi system is that there is no oscillatory current in the exciting circuit, and there is no gradual handling over of energy in small parts during each wave train. The Balsillie is thus entirely different from the Marconi System.”

From a technical point of view the main features of the System were:

- all energy of the charging or feeding circuits were stored in a condenser of large capacity, in series with the rectifying gaps and in circuit with the radiator
- energy was released in radiations when the condenser potential overcame the gap resistance
- the separation of the charging or feeding circuit from the radiating circuit meant that upon commencement of the oscillation in the radiator circuit it acted alone in its own time period and was not influenced by the charging or feeding circuit.

The result was that oscillations were prevented from taking place in the discharge circuit, so that the energy is transferred from the discharge circuit to the aerial by shock, or what was termed ‘impulse excitation’. The Balsillie System therefore differed from the Marconi and Telefunken spark gap systems because oscillations in the condenser discharge circuit were prohibited, and the energy contained in that circuit was not absorbed by the radiator but returned to the transformer via the charging circuit. As a result energy wastage was significantly reduced.

The air blast spark gap, which had been a significant design issue at the beginning of 1912, when installed in wireless stations consisted of electrodes composed of an amalgam of copper, silver and tin that were attached to conductors made of No.16 gauge copper tubing. The other end of the copper tubing was screwed to take a rub-
ber tubing connector for the passage of the air blast. The unit was enclosed in a wooden box and was mounted on porcelain insulators.34

Post Master General Frazer had initially committed to the Commonwealth System in December 1911. By September 1912 he had refused a final joint offer by the Marconi Company and Australian Wireless and announced that the Government would proceed to complete the erection of the balance of the coastal stations using the Balsillie System already employed.35 Such a programme was established and within 2 years with 19 stations in all being commissioned largely using the Balsillie or Commonwealth System.

The size and scale of such an enterprise was staggering for a young nation that had only formed a Federation a decade before. With a land mass of nearly 5 million square miles, 16 thousand miles of coastline and a population of only 4½ million people it was an ambitious task. But Andrew Fisher's vision for Australia matched Graeme's appetite for the job. The commissioning of the Melbourne station in February 1912 marked the beginning of an extensive programme of work.

In December 1911 Post Master General Frazer publicly committed to the construction of additional stations using the Balsillie System at a cost of £1,575 each compared to the Australian Wireless price of £4,600 per station being charged for Pennant Hills and Fremantle.36 In 1912 additional stations were commissioned in Brisbane (September) and Adelaide (October) along with Hobart (April) as well as the Telefunken stations at Pennant Hills (August) and Fremantle (September). For 1913 stations were built at Thursday Island and Port Moresby (February), Mount Gambier (March), Geraldton and Rockhampton (May), Cooktown

Figure 12 - Map of Australia showing position of wireless stations in 1914

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(June), Townsville and Broome (August) and Flinders Island (October). The programme was completed with the commissioning of Roeburn (January 1914) and the last station was Wyndham in Western Australia (May 1914). (see Fig. 12)

At a meeting of the British Association in August 1914 Graeme proudly reported that the Melbourne and Hobart stations communicated reliably with vessels at sea at 450 miles during the day with signals being detected at 1,500 miles at night. In March and April 1913 the Melbourne and Fremantle stations were regularly communicating with each other at a distance of 1,700 miles. At last the continent had been bridged by wireless.

A CHANGE OF FORTUNE

With such stellar success why was Graeme Balsillie to depart from his role in December 1915 almost as quickly as he had arrived four years before? At the height of his fame he was feted by the press with full page profiles on his life and achievements, attracted investment from private sources for his other inventions, presented to the British Association and had the ear of Prime Ministers and other senior government officials. For Graeme three critical and largely unforeseen factors were to come into play – the formation of Amalgamated Wireless (Australasia), the breakdown of his relationship with Father Shaw and the outbreak of World War 1. These three factors were to combine in such a way as to leave Graeme’s position untenable.

FORMATION OF AMALGAMATED WIRELESS (AUSTRALASIA)

Legal machinations with the Marconi Company continued into late 1912. Matters now appeared to be deadlock for both Marconi and Telefunken interests in Australia when the inconceivable occurred – the rivals merged in January 1913 to form Amalgamated Wireless (Australasia) or what became commonly known as AWA. At this point Graeme Balsillie’s work and his system of wireless telegraphy obviously forced the hand of the two industrial giants to join forces in creating what is generally perceived today as the first Australian wireless company.

With the formation of AWA in early 1913 the balance for the battle for control of wireless in Australia slowly started to shift. In March the High Court was to finally grant an order for plant inspections. Pressure continued to mount, and on this occasion the Government had no alternative but to bring James Swinburne to Australia at a cost of £2,000 to undertake physical inspection of the plants, which was done in October 1913 when he visited Melbourne. Publicly and privately Swinburne was supportive of Balsillie and his system of wireless telegraphy, indicating that in his opinion it was 33% more effective than the Marconi system and in his opinion did not infringe existing patent rights.

However James Swinburne was a realist and had seen first hand what the Marconi Company were capable of in its’ pursuit of patent rights in the United Kingdom and elsewhere. Upon his return home Swinburne wrote to the Australian High Commissioner in London in May 1914 suggesting that the Marconi Company intended to proceed with legal action in Australia and that it was preferable for the Australian Government to settle out of court. By July the Government had conceded the issue and
entered into a £5,000 settlement with the Marconi Company. In all it was a reasonable settlement – Marconi’s starting price was said to have been £75,000!41 Significantly for its part Marconi conceded the validity of the Balsillie System.

AWA were to go on to wage an ongoing and concerted campaign against Balsillie himself. Fisk accepted that Graeme was a competent wireless engineer but in a private briefing note to politicians prepared by Marconi interests in November 1912 it had already been alleged that Graeme was “the Australian liar… quite unfit to fill any position of responsibility or trust… full of the most wild cat schemes… always inventing imaginary things which he sold for imaginary fortunes.”42 Ernest Fisk and AWA were to remain dominant forces in Australian wireless and eventually radio for the next 30 years. AWA went on to write (or perhaps more accurately rewrite) the history of Australian radio, conveniently deleting anything other than a minimal reference to Graeme Balsillie and his contribution to the development of wireless.

BREAKDOWN OF RELATIONSHIP WITH FATHER SHAW

The relationship between Graeme and Father Shaw’s Wireless Works had shown the first signs of faltering as early as 1913. Shaw and Balsillie had each made their own applications to patent wireless systems, both gaining some government support in the process. However Graeme had both the lion’s share of that government support as well as the higher public profile in this first battle for control of wireless in Australia.

Allegations were to subsequently emerge about erasing names from Leydon jars made by the Wireless Speciality Company and removing nameplates from rotary spark converters made by Kilburn and Clark during the production of equipment at the Shaw Wireless Works in November 1912.43 Any patent infringements would have been potentially fatal to the Commonwealth System and shortcuts taken at the Shaw Wireless Works would have put at risk the government’s whole construction programme. It would also have exposed Graeme as he was entirely dependent on component manufacture of his System coming from Shaw.

With the government settling with the Marconi Company in late 1914 what was to emerge in 1915 was a full blown patent dispute between Balsillie and Shaw over who ultimately contributed most to the design of the Commonwealth System of wireless telegraphy. The arguments centred upon the design of the air blast spark gap. Shaw was to claim that the much vaunted ‘breakthrough’ spark gap design Graeme had made in January 1913 at the Shaw Wireless Works had been made stolen from him.

Initially the government put the whole matter on the backburner, particularly that now the potential Marconi litigation had been settled. However for Graeme it was a matter of pride and the outcome of the British Radio case of 1911 would have been still fresh in his mind. After all he had invented the Balsillie System, given it freely to the government and in few short years had completed construction of a network of stations throughout Australia. Now he found himself in a situation where Shaw was claiming that Balsillie’s System had in fact been stolen from him. It was too much for Graeme – he now ac-
cused Shaw of “an act of piracy.”

Government support for Graeme did eventually come, with a recommendation being made that a Royal Commission (i.e. a judicial inquiry) should be established into the Shaw/Balsilie dispute as it became known. Andrew Fisher remained a strong supporter, with the Prime Minister requesting a Supreme Court judge to head up the investigation. However Fisher was to lose office prior to the inquiry commencing and the new government was far less supportive, refusing to provide legal assistance to Graeme and he was forced to retain independent representation at his own expense.

The situation then suddenly degenerated into high farce. With the inquiry scheduled to get underway on 26th November 1915, the appointed judge resigned his commission a few days before, recommending that a technical expert be appointed to deal with the plethora of evidence submitted. In his letter of resignation the judge said that in preparation “I had a nearer approach to nervous-breakdown than I hope I shall ever experience. I simply feel afraid to go any farther.”

Father Shaw was by now taking a different path. A handwritten note in government files from February 1916 states “my information is that Father Shaw is now inclined to withdraw from the inquiry.” The reason became abundantly clear in July 1916 when the Australian government purchased the Shaw Wireless Works for £55,000, an extraordinary sum for the time. The deal was orchestrated by Jens August Jensen, the Minister for Navy appointed in July 1915 (Fig. 13).

To further aggravate the situation money issues had also emerged directly between Graeme and Father Shaw. Graeme had borrowed over £970 from Shaw to patent his wireless scheme overseas and by June 1915 this arrangement had come under the scrutiny of the Post Master General’s Department, as it was potentially a conflict of interest, as Shaw was the government’s equipment supplier and Graeme placed most of the orders.

All of this was to come to an unseemly end when Father Shaw was found dead in mysterious circumstances in Melbourne on 26th August 1916, the day before he was due to depart on a steamer to the United States. Shaw was just 44 years of age. The cause of death was put down to a stair fall but allegations were already afoot about £5,300 missing from the government’s purchase price, Father Shaw preparing to leave the country accompanied by a woman and eventually led to a Royal Commission in 1918 into the Wireless Works acquisition. This resulted in Jens Jensen’s removal from

Figure 13 - Jens August Jensen
office and another Senator being found to have been in receipt of payments directly from Father Shaw. Jensen was also suspected of receiving payments but this was never proven. In 1919 a politician called for the exhumation of Shaw’s remains, convinced that he had died from either deliberate poisoning or violence.

**OUTBREAK OF WORLD WAR ONE**

At the outbreak of World War One Graeme’s relationship with the military and naval authorities started off well enough, with him offering his services generally. One history of World War One records that “Balsillie, then Federal wireless expert, soon took on wireless, and through this offer much valuable information reached the military authorities.”

Graeme’s work establishing the coastal wireless network contributed directly to one of the most celebrated naval incidents of the war. In November 1914 the German raider *Emden* was destroyed by the Australian warship the *HMAS Sydney* near the Cocos Islands in the Indian Ocean. The sinking of the *Emden* was attributed to the interception of signals by wireless operators in the Cocos Islands and onboard the *HMAS Sydney*. As result the Melbourne and Fremantle stations relayed a wireless alarm in code to the Australian fleet who were in process of conveying troops to Europe. *HMAS Sydney* subsequently hunted down and sunk the *Emden* (Figs. 14, 15).

For its’ part the Navy had long sought control of wireless and one of its ongoing frustrations had been that it was under civil rather than naval jurisdiction. In April 1913 there had been disagreements between the Navy and the Post Office, when a dispute arose over the site for the Darwin station. William R. Creswell, later known as ‘the father of the Royal Australian Navy’, was very clear in his own mind that the Navy needed to run wireless telegraphy and Graeme was not going to be part of it. In August 1915 Creswell recommended that an expert be obtained from the British Admiralty to organise the Naval wireless service in Australia. Legislation transferring control of wireless from the Poster Master General’s to the Naval Department supported Creswell’s recommendations and by September had been passed by the Government.

William Creswell and Lieutenant Frank G. Cresswell, a fleet wireless telegraphy officer, appear to have been central to Graeme’s ultimate exit from wireless in Australia. A Naval Board minute submitted to the Minister for Navy on 25th October 1915 recommended that Balsillie’s services not be retained and that Lieutenant Cresswell assume control of all wireless services pending the arrival of an
more scathing in his assessment of the Shaw/Balsillie dispute when he reported privately that “the litigation resolves itself into a squabble between the parties which is being conducted at the expense of the Commonwealth,” recommending to William Creswell that all future government wireless stations install spark gaps based on Admiralty design. William Creswell had already written to the Naval Board after the collapse of the Shaw/Balsillie inquiry questioning the value of both Balsillie’s patents and his wireless telegraphy system altogether. Finally in December 1915 William Creswell blocked an offer made by Graeme to supply his system to Allied governments free of charge.

This was probably enough for Graeme and he immediately applied for 3 weeks leave. Instead he was instructed to handover to Lieutenant Cresswell and he was paid 2 months pay in lieu of termination. By the end of December the press had reported on ‘Mr Balsillie’s retirement’ from wireless work. Early in the New Year of 1916 Jens Jensen was asked to explain Graeme’s termination by the Australian Prime Minister.

NEW VENTURES
Characteristically, as the wireless door started to close, Graeme embarked on his next big project, this time bringing rain to the Australian desert. After all, how hard could it be after linking a continent by wireless?

In this journey he reached back into his own past, perhaps even recalling a series of newspaper articles written by his old mentor E.C. Barton at the turn of the century. One hundred years ago artificial rain making was considered a legitimate scientific pursuit. Inspired by a paper Sir Oliver Lodge had delivered at the meeting of the British Association in Melbourne in August 1914, Graeme turned his mind to artificial rain precipitation using electricity. The Australian government had an immediate need – the massive transcontinental railway project was about to be completed and reliable sources of water were needed to feed the huge steam boilers of the engines as they moved across the arid continent. Graeme’s theory in relation to rain precipitation

Figure 17 - Lieutenant F.G. Creswell standing rear left
was that discharges of electricity at high altitudes of 4,000 to 6,000 feet resulted in the condensation of water droplets producing rain. He devised a plant comprised of box kites, balloons, 11,000 feet of flexible galvanised wire and a grounded winching system (Figs. 18, 19).

Initial funding came from the wealthy Sydney-based Dixson Trust, who purchased a 10% interest in the rights to the Balsillie Artificial Precipitation Scheme for £2,000 in May 1915. The timing of the payment coincides with the £970 debt to Father Shaw. Balsillie later acknowledged the importance of the Dixson Trust “when I was up against it.”

Government funding commenced in 1915 and after extensive lobbying further public grants were again made in 1916, 1917 and 1918.

However by July 1919 the storm clouds were metaphorically brewing in the Government Meteorologists’ office, with the view being expressed that there was no scientific evidence to support the continuation of Balsillie’s experimental work. After a short reprieve by 1921 it was all over, with all experimental precipitation stations closed, staff laid off and the plants placed in permanent storage. In all the government had invested £6,300 with the Dixson Trust investing a similar amount. The mothballed rainmaking equipment was eventually written off and sold for scrap.

Is that the end you say? Well no, Graeme had another big plan. With avenues to government funding now all but closed in Australia he received the large financial backing of the Dixson Trust to launch...
into car headlamp reflector design, lodging a series of patents in Australia, Canada and the United States. The market for headlamps in the U.S. in particular was substantial\textsuperscript{65}, taking Graeme to Cincinnati Ohio in 1922. Graeme’s invention was ‘Flatlite’, a headlamp reflector using corrugated strips which was said to reduce glare by blending the light pattern from the high intensity centre close to the bulb with the dimmer edges of the reflector. In Cincinnati Graeme struck up a business relationship with Thomas G. Melish III, whose

\begin{figure}
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\includegraphics[width=\textwidth]{Figure_20_Flatlite_patent.png}
\caption{Figure 20 - Flatlite patent}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{Figure_21_American_Flatlite_Company.png}
\caption{Figure 21 - American Flatlite Company}
\end{figure}
family were connected with the Bromwell Wire Works. It seems likely that The American Flatlite Company, who manufactured Flatlite, was connected to or was owned by the Melish family (Figs. 20, 21).

Things were looking up for Flatlite when in July 1924 Graeme’s health suddenly deteriorated over a two week period and he was admitted to Cincinnati’s Christ Hospital with nephritis. After a few days in hospital he was to die on 10th July at the age of just 38. Graeme was still inventing to the end - his obituary in the Cincinnati Commercial Tribune said that at the time of his death he was working on a device to eliminate static and his ashes sent to Melbourne Australia.68

BALSILLIE’S LEGACY

At a general level John Graeme Balsillie was a visionary on a grand scale, linking a new nation by wireless and dreaming of bringing rain to the deserts of the driest continent. His business methods were unorthodox to say the least but he was not a fraud or a charleton. Rather he was a man of almost limitless resourcefulness and enthusiasm, moving seamlessly from one project to another.

More specifically Graeme left behind a tremendous legacy in the field of radio. As an Australian he undertook pioneering work in the U.K., Europe and China at the dawn of the wireless era. His British Radio company took on the might of the Marconi Company and, for a time, dared to challenge the dominance of the 7777 patent. In Australia he built a network of wireless stations which linked a new nation, designing and constructing nearly 20 stations in two short years. In doing so he also forced the hand of Marconi and Telefunken interests combine to become the iconic Australian company AWA.

Like Father Shaw, Graeme’s early death meant that his contribution to wireless was quickly erased to leave the official record to only celebrate the achievements of Ernest Fisk and his AWA.

Hopefully this story goes some way to addressing that imbalance.
ENDNOTES


4. See M.J. Gooley A Report on Early Wireless Telegraphy in South Australia Postmaster General’s Department Adelaide 1964 on Professor William Bragg’s experiments in Adelaide in 1899 and The Brisbane Courier 18th April 1899 at p.4 and 21st April 1899 at p.7 on the Marconi demonstration set that was installed at Brisbane Technical College in the same year.


8. Curnow op. cit. at p.59.


13. Bartram op. cit. at p.72.


15. Andrew Fisher 26th June 1911 NAA : A2911/1, 1411/1911; The Advertiser (Adelaide) 29th June 1911 at p.11, The Brisbane Courier 29th June 1911 at p.5 and The Western Australian 29th June 1911 at p.7.


20. The Argus (Melbourne) 27th July 1911 at p.9.


23. The Argus (Melbourne) 18th September 1911 at p.6.

24. This chronology of meetings is taken from ‘Statement by J.G. Balsillie. Shaw and Balsillie Patents and Dispute Part 6’ NAA : A432/86, 29/2756 PT 6 Appendix K.


26. ‘Statement by J.G. Balsillie, Shaw and Balsillie Patents and Dispute Part 6’ NAA : A432/86, 29/2756 PT 6 Appendix K.

27. The Argus (Melbourne) 29th November 1911.

28. The Argus (Melbourne) 9th December 1911.

29. Memorandum from F.G. Cresswell to the Naval Secretary listing patents held by the Australian Government 27th June 1919 NAA : MP472/1, 1919/4980.


31. William Duddell ‘Report to the High Commissioner of Australia on the Question of Infringement of Marconi and Telefunken Patents’ 1st August 1912 NAA : A2911/3, 228/12.

32. James Swinburne ‘Mr Balsillie’s System of Wireless Telegraphy’ 17th July 1912 NAA : A2911/3, 228/12.


36. Curnow op. cit. at p.62.


38. See e.g. The Scientific Australian Volume 19(2) December 1913 at p.13.
39. The Dixson Trust in Sydney became a significant investor in a number of Balsillie's subsequent schemes and inventions of rain precipitation, headlamp design and zinc extraction.

40. Letter from James Swinburne to the Australian High Commissioner in London 8th May 1914 NAA: A2911/3, 228/12.


43. Statutory Declaration of Samuel Marr regarding his work at Maritime Wireless NAA: MP1049/1, 1915/0222.


47. Post Master General’s Department 22nd June 1915 NAA: MP341/1, 1915/10152.


49. Amos op. cit. at p.8.

50. Dr Maloney, a member of the House of Representatives, made this suggestion. See Commonwealth Parliamentary Debates House of Representatives Volume 89 12th September 1919 at p.12327.


55. Memorandum from Minister for the Navy to Prime Minister (W.M. Hughes) 5th January 1916 NAA: MP1049/1, 1915/0222.

56. Naval Board Minute 25th October 1915 NAA: MP1049/1, 1915/0222.

57. Memorandum from F.G. Cresswell to W.R. Creswell 29th October 1915 NAA: MP1049/1, 1915/0222.


59. Memorandum from Minister for the Navy to Prime Minister (W.M. Hughes) 5th January 1916 NAA: MP1049/1, 1915/0222.

60. Barton was also an amateur meteorologist who published on the potential of artificial rainmaking in 1902: see The Brisbane Courier 18th January 1902 at pp.4,9; The Queenslander 15th January 1902; The Queenslander 8th February 1902; The Brisbane Courier 12th February 1910 at p.13.

61. See Sir Oliver Lodge The Electrification of the Atmosphere, Natural and Artificial The Journal of the Institution of Electrical Engineers Volume 52 Number 229 2nd March 1914 at pp.333-352. Lodge delivered a similar paper entitled 'The Artificial Electrification of the Atmosphere' on 18th August 1914 at the British Association Meeting in Sydney but no copy appears to have survived: Report of
the Eighty-Fourth Meeting of the British Association for the Advancement of Science Australia: 1914 July 28 – August 31 London 1915 at p.501 and correspondence to the present author from the Australian Academy of Science 3rd September 1997.

62. On the construction of the Australian transcontinental railway see David Burke Road Across the Wilderness New South Wales University Press 1991. It was reported that four sets of wireless equipment designed by Balsillie were ordered by the Government to aid communications during the construction of the railway line: The Argus (Melbourne) 26th April 1914.

63. Balsillie to R.C. Dixson 11th September 1916 Dixon Trust Ltd Balsillie Correspondence File.

64. ‘Rainfall Experiments in Mallee and Riverina Districts by Mr Balsillie’ 1918-1923 NAA: A106/1, G25/338.


67. Correspondence to the present author from the Sexton of Toowong Cemetery, Brisbane 17th December 1995.

68. The Cincinnati Enquirer 11th July 1924.

PHOTO CREDITS

Figure 1 – Australian Prime Minister Andrew Fisher from www.electricscotland.com/.../andrew_fisher.htm (downloaded 26th March 2011).

Figure 2 – John Graeme Balsillie from The Scientific Australian December 1913 at p.13.

Figure 3 – Ernest Fisk from www.thebakeletteradio.com/page112/page112.html (downloaded 26th March 2011).

Figure 4 – Father Archibald Shaw photograph from the collection of Mr Brian Kirkby.


Figure 6 – Hand drawn wireless specification from ‘Statement by J.G. Balsillie. Shaw and Balsillie Patents and Dispute Part 6’ National Archives of Australia: A432/86, 29/2756 PT 6 Appendix K.

Figure 7 – Hand drawn wireless specification from ‘Statement by J.G. Balsillie. Shaw and Balsillie Patents and Dispute Part 6’ National Archives of Australia: A432/86, 29/2756 PT 6 Appendix K.

Figure 8 – Spark gap drawing from Statement by T.M.C. Mulrony 27th September 1916 National Archives of Australia: A432/86, 29/2756 PT 4.

Figure 9 – Balsillie commissioning the Melbourne plant from The Weekly Times 3rd February 1912 at p.27.

Figure 10 – William Duddell from http://podcollective.com/rychard/lecture-01/duddell.jpg (downloaded 26th March 2011).

Figure 11 – James Swinburne from www.scienceandsociety.co.uk/pix/PER/80/10303180_T.
Figure 12 – Map of Australia showing wireless stations in 1914 produced by the present author.

Figure 13 – Jens August Jensen from www.adbonline.edu.au/biogs/A090475b.htm (downloaded 26th March 2011).

Figure 14 – Emden from www.gutenberg.org/.../images/wn15-36b.jpg (downloaded 26th March 2011).


Figure 16 – W.R. Creswell from www.silvanpioneers.blogspot.com/-041kdgoGETs/TW44uVPXf51/AA (downloaded 26th March 2011).


Figure 18 – Balsillie Rain Precipitation Patent from Australian Patent Office Patent No.1781 of 1916.

Figure 19 - Balsillie Rain Precipitation Patent from Australian Patent Office Patent No.1951 of 1916.

Figure 20 – Balsillie Flatlite Patent from Australian Patent Office Patent No.12,818 of 1919.

Figure 21 – Present author's own collection of photographs.

Figure 22 – Present author’s own photograph.

ABOUT THE AUTHOR

Graeme Bartram is a Graduate in Arts and Law from the University of Sydney and is currently Director of Human Resources and Company Secretary, South Pacific for a major international company. He has held a long standing interest in wireless and radio history dating back over 25 years. Graeme has previously published in the AWA Review on a variety of topics.


Graeme’s wife Jo Earl once again assisted in copying the Figures into a JPEG format so they could be appropriately reproduced.

Graeme is still interested in following up on all aspects of Graeme Balsillie’s life, particularly his work in the United States from 1922 until his death in Cincinnati in 1924 and may be contacted by email at graeme.bartram@boc.com.
John Graeme Balsillie
How the 1923 Radiola Season Really Came About

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It was July 25, 1922 when RCA issued memos defining characteristics of three new broadcast receivers assigned model designations Radiolas II, III, and IV, the only new models RCA had planned for the 1923 Radiola season. The ink had hardly dried on these memos when something dramatic happened which caused RCA to drop the new Radiola III as well as four holdover models originally planned for the 1923 lineup. Even more surprising was the decision to add seven more new models to the plan with only two months remaining before production was to begin in early October 1922.

The original 1923 Radiola lineup, the sudden and dramatic changes in the lineup, and the reasons RCA made these changes have never been chronicled. The only changes reported previously were the replacement of the poorly designed Aeriola Grand with the Radiola Grand,1 and the deletion of the original Radiola III (ER-885) just prior to its planned production in late 1922—for which there has never has been a plausible explanation.2 I was not aware of the original 1923 lineup and the many changes that soon followed at the time my book Radiola was published in 2007.3 Unfortunately, the description of the evolution of the 1923 season in Radiola is quite incomplete,4 and it was only after finding two additional prototypes in 2009 having a direct bearing on the subject that I came to understand how the 1923 Radiola season really came about.

The story of the changes to the 1923 lineup is distinctly different from the story of the equally extensive changes made in the 1924 lineup to make way for the superheterodyne, a story which was chronicled by Wolkonowicz et al. in the June 1999 edition of Antique Radio Classified.5 The number of sets affected in both years was about the same, but changes to the 1924 lineup began more than seven months before production, whereas the changes to the 1923 lineup occurred in a two-month period just before production in early October 1922. This
article tells the surprising story of the changes to the 1923 lineup with its many twists and turns, including explanations of how the changes were implemented in such a short period of time.

BACKGROUND
In the summer of 1922, RCA selected the new receivers for its 1923 line from among the models proposed by its three principal manufacturers, General Electric (GE), Westinghouse, and Wireless Specialty Apparatus (WSA). RCA was constrained to purchase 40% of its broadcast radio equipment from Westinghouse beginning in 1922 as a result of cross-licensing agreements signed on June 30, 1921 by RCA and the three manufacturers, among other signatories. Westinghouse was able to negotiate such a large percentage of orders from RCA because it held exclusive rights to the Armstrong regeneration and superheterodyne patents—the regeneration patent being crucial to making low-cost sensitive receivers in the early 1920’s. Sets made by WSA for RCA were included in GE’s 60% share, but RCA purchased very few models from WSA for resale into the broadcast radio market after 1922.

By mid-1922, it had become obvious that RCA was far behind in its commitment to purchase 60% of its radio equipment from GE and WSA—a direct result of the popularity of Westinghouse sets that year. Westinghouse models (RC, Aeriola Jr., Aeriola Sr. and Aeriola Grand) were outselling GE models (ER-753, AR-1300 and AA-1400) and WSA models (AR-1375, AA-484, AA-485 and IP-501) by a wide margin. Although RCA planned to introduce two new GE models (Radiola I and AA-1520) in August of 1922, it also planned to introduce the new Westinghouse Aeriola AC amplifier at the same time. Given the size of these orders, there would be no reduction in the spiraling GE deficit.

RCA intended to make up for the GE revenue deficit in 1922 by assigning General Electric all three new models planned for 1923 (Radiolas II, III, and IV). Selected holdover models from 1922 would supplement the three new sets to round out the 1923 line. To further assure that GE would receive the orders necessary to make up for the 1922 deficit—well above its nominal share of 60% for 1923—RCA planned to give preference to GE models in its national advertising campaigns.

RADIOLAS II, III, AND IV MEMOS
The story of the 1923 plan begins with three memos from RCA executive W. M. Derrick to executives A. D. Mc Kenzie and P. H. Boucheron dated July 25, 1922 which documented RCA’s decision to purchase the three new Radiolas II, III, and IV for the 1923 season from GE. A digitally enhanced version of the memo describing the Radiola II is reproduced in Fig. 1; the other two are identical in form, differing only in the model designation and technical characteristics of each. While these memos do not specifically state GE was to be the manufacturer, it was implied by specifying the new UV-199 tube made by GE. Indeed, other RCA documents described later confirm it was to be GE.

The characteristics of the new Radiolas II, III, and IV specified in the three RCA memos are summarized in Table 1 where the key features can be directly compared. First, note all three sets were to have a single-circuit tuner followed by a regenerative detector.
Table 1. Model descriptions for the three new broadcast receivers Radiola II, III, and IV planned for production as of July 25, 1922.

<table>
<thead>
<tr>
<th>Model Feature</th>
<th>Radiola II AR-800</th>
<th>Radiola III ER-875</th>
<th>Radiola IV AR-880</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet Style</td>
<td>Wood box</td>
<td>Carrying case</td>
<td>Art cabinet</td>
</tr>
<tr>
<td>Circuit</td>
<td>Single circuit, regenerative</td>
<td>Single circuit, regenerative</td>
<td></td>
</tr>
<tr>
<td>Stages</td>
<td>Detector and one stage of audio amplification</td>
<td>Detector and two stages of audio amplification</td>
<td></td>
</tr>
<tr>
<td>Tubes</td>
<td>UV-199 tubes [2 tubes]</td>
<td>UV-199 tubes [3 tubes]</td>
<td></td>
</tr>
<tr>
<td>Batteries</td>
<td>Not in cabinet</td>
<td>Filament and plate batteries mounted in the cabinet or case</td>
<td></td>
</tr>
<tr>
<td>Speaker</td>
<td>Not in cabinet</td>
<td>Loud speaker and horn mounted in cabinet or case</td>
<td></td>
</tr>
</tbody>
</table>
and either one or two stages of audio amplification. It is logical to conclude that the circuits and components used in the first two stages of all three sets were to be identical, an assertion supported by the existence of identical circuits and components in the first two stages of the Radiola II and IV receivers that were actually produced. Further, the components are the same as those appearing in a two-tube prototype made by GE in early 1922, two photographs of which are reproduced here from *Radiola* as Figs. 2 and 3. A more detailed description of this prototype also appears in *Radiola*.

Second, note the Radiola III and IV receivers were to be identical, the only difference being the cabinet style. The Radiola IV was to have a stylish cabinet characterized as an “art cabinet,” while the Radiola III was to be portable with a carrying case presumably similar to the one used on the Radiola II actually produced. The two were to be the first complete receivers manufactured by RCA with batteries and a loudspeaker enclosed in a single cabinet, thereby fulfilling David Sarnoff’s dream of a “Radio Music Box.”

Third, note the Radiola II was originally to be a very simple and inexpensive two-tube set with a regenerative detector and one stage of amplification enclosed in a simple box without a self-contained speaker or batteries. Of course, the Radiola II actually produced by GE turned out to be a self-contained receiver with batteries enclosed in a portable case with handle and headphones mounted on the inside of the lid. The portable cabinet style used on the actual Radiola II manufactured by GE was much closer to the description of the cabinet style in the Radiola III memo than the one in the Radiola II memo.

**DRAMATIC CHANGES TO THE ORIGINAL 1923 LINEUP**

Apart from the three memos dated July 25, 1922, there is virtually no description of the original plan or the many changes that occurred shortly after it was finalized in late July of 1922. The final lineup is well known, however, because the sets actually offered in 1923 are documented in RCA catalogs, price sheets and ads published in 1923. The models which actually appeared in the 1923 lineup are listed in Table 5-1 of *Radiola*.

It was not long ago that I first realized the original plan and the changes thereto could be reason-

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![Fig. 2. A two-tube regenerative receiver prototype was made by GE for RCA in early 1922 with the first two stages virtually identical to those found in the Radiola II and IV receivers. (*Radiola*, p. 177)](image1)

![Fig. 3. The interior view of the prototype reveals components such as the variometer and audio transformers which were virtually identical to those found in the both the Radiola II and Radiola IV. (*Radiola*, p. 177)](image2)
ably deduced from RCA forms akin to blank spreadsheets that were printed by RCA to keep track of the inventory available for shipping to RCA jobbers/distributors throughout 1923. These forms with the date July 13, 1922 printed in the top margin, listed the broadcast radio equipment by manufacturer that RCA planned to market in 1923. RCA entered inventory quantities and jobber prices on these forms periodically throughout the year by typewriter. A few of the many forms completed by RCA were saved by RCA historian George H. Clark, and now reside in his *Radioana* collection.\(^{11}\)

Models added to the original plan after the forms were printed circa July 13, 1922 can be easily identified because they were inserted on the forms by typewriter, while models in the original plan were printed with the form. These differences are obvious in all GE and Westinghouse spreadsheets, two excerpts of which are reproduced in Fig. 4. On the left is an excerpt from a typical GE sheet in which Radiolas II, III, and IV were printed on the form, confirming they were assigned to GE in the original plan. By contrast, Radiolas V and VI were clearly inserted by typewriter, which means they were added to the 1923 lineup later. Similarly, the RS, AR, and RT excerpted from a Westinghouse sheet to the right of the figure were typewritten, meaning they were also added to the lineup later.

Models dropped from the plan after July 1922 can also be inferred from these forms. The ER-753 crystal set, AR-1300 receiver and AA-1400 amplifier were printed on the GE list, meaning they were in the original plan in July. However, all three were dropped from the RCA price list dated August 21, 1922, soon after the original plan was finalized. The General Electric AA-1520 RF amplifier does not appear anywhere on the RCA stock sheets, which is something of a mystery because this set appeared continuously on RCA price sheets issued from August 21, 1922 to the end of 1923.

No stock sheets were found for WSA, but of the four WSA models sold by RCA in 1922, the AA-484 and IP-501 had been dropped prior to preparation of the distributor price list dated August 21, 1922. The remaining two models, the AR-1375 crystal set and the AA-485 amplifier, were planned holdover sets as evidenced by their presence in various RCA documents published in the second half of 1922 and early in 1923.\(^{12}\)

Surprisingly, WSA was assigned...
a new model, the Radiola VII, in late 1922, which, considering the orderly assignment of Roman numerals to the Radiola trade name, must have been given its designation after the Radiola VI. According to George Clark, the Radiola VII was to be ready by February of 1923, but in fact, it was unavoidably delayed until September 1923, only to be dropped a few months later and replaced by the markedly different Radiola VII-B.¹³ No reason for the late addition of Radiola VII to the 1923 line has ever been offered. Perhaps WSA successfully argued that with all the new models being added, it should be assigned at least one new set.

The original eighteen RCA models planned as of July 1922 are shown in the first column of Table 2, grouped by manufacturer. Of these eighteen sets, only the three indicated by an asterisk were to be entirely new models using the new UV-199 dry-cell tube—the remaining fifteen were somewhat dated holdover sets. The five sets in the original plan dropped before the 1923 season are those entries in the first column with a dashed line appearing directly opposite in the second column, signifying their respective deletions.

Clearly, RCA must have approved the production of all new sets in this table by October 1922 in order to have them available at the end of December or early January. That all new GE and Westinghouse sets listed in this column were, in fact, available for sale to the public by January 15, 1923 is confirmed by a memo from an RCA salesman selling broadcast receivers at an exhibition sponsored by Bamberger’s Department Store in New York City during the week of January 15-24; the salesman specifically listed all of the new GE and Westinghouse sets appearing in the second column of Table 2 by model name or number as ones he sold to the public at the exhibition.¹⁴ The changes in the 1923 lineup were both significant and remarkable. First, despite the fact RCA was well behind on its 60% purchase commitment to GE from the 1922 season, RCA changed the lineup by assigning four new sets to Westinghouse including the two-tube RS regenerative receiver, the RT antenna coupler, the AR threetube RF amplifier, and the entirely redesigned Radiola Grand which began as a replacement for the Aeriola Grand but ended up as the top-of-the-line receiver for 1923. Even more perplexing was the fact that RCA inexplicably dropped the Radiola III, leaving GE with only two models based on new technology, the Radiolas II and IV.

RCA did assign two additional

<table>
<thead>
<tr>
<th>Mfg’r</th>
<th>Approved Sets circa July 25, 1922</th>
<th>Approved Sets circa Oct. 1, 1922</th>
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<tbody>
<tr>
<td>ER-753</td>
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<tr>
<td>AR-1500</td>
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<tr>
<td>AA-1400 Det/Amp</td>
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<td>Radiola I*</td>
<td>Modified Radiola II*</td>
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<td>Radiola III*</td>
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<td>Radiola IV*</td>
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<td>Radiola V*</td>
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<tr>
<td>RA-Tuner</td>
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<td>DA-Amp</td>
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<tr>
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<td>AR-485 Amp</td>
</tr>
<tr>
<td>AR-1375</td>
<td>AR-1375</td>
<td>Radiola VII*</td>
</tr>
</tbody>
</table>

¹New models for 1923 season
¹¹Name change only
new models to GE, Radiolas V and VI, but most likely as a quid pro quo for the new AR and RT models assigned to Westinghouse. This assignment was something of a sop to GE because many of the new Radiola V and VI models were made by reconfiguring existing AR-1300 and AA-1400 units that RCA had already purchased in 1922. Further, individual AR-1300 and AA-1400 models were then dropped, making the sale of Radiolas V and VI essentially a zero-sum game for GE.

WHAT WAS BEHIND THE SUDDEN SHAKEUP?

The sudden shakeup in the 1923 lineup must have been the result of something dramatic happening between July 25, 1922 (the date of the memos) and early October when production began. The most significant event for RCA occurring between July and October of 1922 was its decision to replace the poorly designed Aeriola Grand with the Radiola Grand using the same cabinet as the Aeriola Grand, but with entirely different circuits and tube types.

The decision to replace the Aeriola Grand was announced to RCA dealers in a five-page memo issued by E. E. Bucher, Manager of the RCA Sales Department—a digitally enhanced version of which is reproduced here in its entirety as Appendix A. It is startling in its candor as it describes the many deficiencies of the Aeriola Grand and the improvements incorporated into the replacement Radiola Grand. At the top of the fourth page, RCA authorized its dealers to supply a new Radiola Grand without charge to all customers who bought an Aeriola Grand and subsequently expressed dissatisfaction with the instrument.

The memo is undated, but from its content one can infer that it was written no earlier than August 21, 1922; at the bottom of the third page there is a reference to a revised RCA discount schedule dated August 21st, as if it had already been issued. It can also be inferred that it was written no later than early October 1922—most likely sometime in September. Beginning in the last line of the first page there is a reference to early October as being in the future: “It [the Radiola Grand] will be put into production in early October of this year.” Indeed, the earliest Radiola Grand sets had name plates with a production date of (10-4-22).

While there were many problems with the Aeriola Grand identified in the memo, the most significant was its lack of sensitivity. It was a regenerative receiver with a fixed degree of regeneration that could not be adjusted by the user to maximize sensitivity; further, it incorporated three stages of resistance-coupled audio amplification which lacked voltage gain afforded by transformer coupling. As a result, the sensitivity was so poor that only local stations could be heard with the loudspeaker. Worse yet, there was no jack for headphones so that the user could not even listen in with headphones on distant stations too faint to drive the speaker. This lack of sensitivity was unacceptable for a top-of-the-line receiver selling for $325.

The new Radiola Grand was also a regenerative receiver, but with a regeneration control allowing the user to optimize gain. It utilized two stages of transformer-coupled amplification, the last stage using two tubes in a push-pull configuration. A headphone jack was included along with a volume control—both of which were absent...
from the Aeriola Grand. The lack of a headphone jack must have been a real source of irritation to owners because ads for the Radiola Grand contained this unusual statement, presumably to differentiate it from the Aeriola Grand: “A telephone jack is provided in order that head telephones may be employed for the reception of broadcasting over great distances.”

RCA clearly had not made the decision to replace the Aeriola Grand before July of 1922 when the original 1923 plan was finalized. To the contrary, RCA was planning a huge national ad campaign in July to sell off the exiting inventory of Aeriola Grand sets—well before the introduction of the new Radiola line in January. Two different ads for the Aeriola Grand appeared in a large number of magazines with national distribution during the months of August and September 1922. One of these ads featured a gratuitous quote from none other than Guglielmo Marconi stating the Aeriola Grand was “the supreme achievement in designing and constructing receiving sets for the home...” Obviously, this was not true, and RCA was well aware of it. RCA ads focused on two features of the Aeriola Grand including its unrivaled tone quality and simplicity of manipulation with an on-off snap switch and a single tone lever for tuning; noticeably absent was any reference to sensitivity or range, something ads for most receivers marketed by RCA and many of its competitors routinely touted.

RCA focused its broadcast radio advertising budget on the Aeriola Grand during the months of August and September by placing a large number of ads in numerous nationally distributed magazines to the exclusion of virtually all other sets. Indeed, I have been able to find only one ad for an RCA set in national magazines during August and September. Likewise, I have been unable to find any ads for the Aeriola Grand either before August or after September. This ad campaign was unique for RCA in its intensity coupled with its brevity.

The cynic might say that well before July 1922, RCA planned to dump the Aeriola Grand with a blitzkrieg ad campaign, knowing full well that, depending on customer reaction, it might have to replace it soon with an entirely new set. Indeed, Westinghouse must have been working on the new Radiola Grand long before the decision to replace the Aeriola Grand was made circa September. Otherwise, Westinghouse could not have put the new Radiola Grand into production by October 4, 1922, the date appearing on the earliest Radiola Grand name plate.

The ploy to sell the Aeriola Grand and then exchange it free of charge for the Radiola Grand later, whether by design or happenstance, generated revenues of $1.3M (about $40M today) for RCA on sales of an estimated 4,000 Aeriola Grand sets priced at $325 without the base. RCA would have lost much of this revenue without the marketing blitz, which was undoubtedly responsible for most of the Aeriola Grand sales in 1922.

RCA must have received a huge number of complaints from customers buying this set as a result of the ad campaign because the memo sent to dealers circa September 1922 states: “... the experience of the past few months convinced the Sales Department that the public demand was for an instrument which would not only give satisfactory operation from nearby broadcasting stations, but
which would enable the home user to ‘tune in’ to other than local stations.” The decision to replace the Aeriola Grand with a new and equally expensive Radiola Grand so late in 1922 was also a de facto decision to add it to the 1923 lineup.

THE RADIOLA III PORTABLE IS REPLACED

It is quite possible that RCA did not fully grasp the impact that producing the new Radiola Grand would have on the remainder of the 1923 lineup at the time of the decision. RCA had already planned two high-end receivers for 1923, the Radiola IV in a deluxe cabinet, and the Radiola III which was basically the Radiola IV in a lower-cost portable cabinet. The decision to produce the Radiola Grand and the de facto decision to add it to the 1923 lineup resulted in three new high-priced models for 1923 versus the original plan with only two. Further, the Radiola Grand priced at $325 without the base replaced the Radiola IV priced at $275 as the flagship model for 1923.

The RCA Marketing Department must have realized that offering a new line of receivers with three expensive models and only one inexpensive model at popular prices would not bode well for RCA, particularly in view of the soft radio market at the time. Given the decision to produce the Radiola Grand and Radiola IV models at the high-end, RCA efforts to balance the line would have to focus on the Radiola III, either by eliminating it outright or by changing its design to lower the retail price. It would appear that RCA did, in fact, explore less expensive options for the Radiola III, a conjecture supported by a prototype that surfaced in 2009 which appears to have all features described in the Radiola III memo except for the self-enclosed speaker.

Radiola III Prototype: A recently discovered prototype using what appears to be a preproduction Radiola IV panel is shown in Fig. 5. The cabinet has the look of a factory set complete with an old patina, construction techniques used on other GE cabinets, and a hand-stamped identification number in the box lid similar to those found on other factory-made Radiola cabinets of the day—most notably, the Radiola I and Radiola IV. The receiver portion including the Radiola IV panel is clearly not a production unit because the panel lacks a serial number and other engraved labeling, unlike all known production units which have a serial number and engraving (see Fig. 6). Further, the prototype panel was a very early one because it lacks the veneer control knob added to the front panel of later production units, which strongly suggests it was made just before Radiola IV production began in October 1922.

The battery complement accessed through the rear panel of the cabinet included four small 22½-volt “B” batteries producing
90 volts, one 4½-volt “C” battery, and room for up to four 4½-volt “A” filament batteries, each with a diameter of 1¼” and a length of 7½” of the same type used in the Radiola II (see Fig. 7). With 90 volts applied to the plate of the audio output tube and 4½ volts applied to its grid, it is clear that this prototype was specifically intended for driving an external speaker.

By using the same basic receiver unit as the Radiola IV, perhaps with different knobs and trim on the panel, this prototype could have been put into production quickly and economically. However, we know that RCA did not choose this option; instead, they chose the two-tube option described next.

**Two-Tube Option without a Speaker:** A second alternative for the Radiola III was a two-tube set complete with batteries in a carrying case and a set of headphones stored in the lid in lieu of a built-in speaker. This option would have used the same two-tube circuit described in the Radiola II memo, but unlike the planned Radiola II, it would have been a complete portable with self-contained batteries in a carrying case just like the one described in the Radiola III memo. By using the then-existent...
Radiola II panel, this option could have been readily implemented in the brief time available prior to production scheduled for early October.

We now know that RCA chose this option, but it gave it the Radiola II designation. So, what happened to plans for the original two-tube set in a simple box without batteries described in the Radiola II memo of July 25, 1922? Responsibility for making this two-tube set was transferred to Westinghouse and the designation was changed to RS, consistent with the Westinghouse designation scheme for radio equipment in which all equipments were given a two-letter designation. This transfer left both the Radiola II and III designations available for the modified set. RCA obviously chose the Radiola II designation in lieu of Radiola III, perhaps because the panels had already been fabricated for the original two-tube set using the Radiola II name, or perhaps because the “II” would be evocative of a two-tube set.

This view that the Radiola III was replaced by a modified Radiola II rather than being eliminated outright conflicts with the traditional view in which the Radiola II was built by GE as planned, and the Radiola III was simply dropped. I believe the former view is correct because 1) the Radiola II described in the original plan was built by Westinghouse as the Radiola RS, 2) the Radiola II actually manufactured by GE was not built according to the original plan, and 3) the modified Radiola II built by GE with the portable case, self-contained batteries and headset looked more like the original Radiola III described in the memo than the original Radiola II with a simple box enclosure.

Regardless of which view is embraced, RCA restored a balance to the new receiver line for 1923 by selecting two high-end sets and two inexpensive sets. At the high end, RCA marketed the GE Radiola IV at $275 and the Westinghouse Radiola Grand without a base at $325, the two often appearing together in ads where they were characterized as “DeLuxe” [sic] instruments. At the low end, RCA marketed the GE Radiola II with a portable case and headphones at $97.50 and the Westinghouse Radiola RS in a box with headphones at $87.50. The Radiola II was heavily marketed relative to the RS; the two never appeared together in ads.

**THE ORIGINAL RADIOLA II BECOMES THE RADIOLA RS**

Sometime after July 25, 1922, responsibility for manufacturing the set described in the original Radiola II memo of Fig. 1 was transferred to Westinghouse and assigned the Radiola RS designation. The only difference between the RS and the original Radiola II was the Westinghouse WD-11 tube used in lieu of the GE UV-199 tube. It may never be known for certain why RCA assigned the manufacturing responsibility for the original GE Radiola II to Westinghouse. After all, GE had the original Radiola II ready for production, and GE was still well behind in its 60% share allocation.

One reason for the transfer may have been the looming scarcity of the General Electric UV-199 tube foreseen by GE in late 1922. In fact, GE produced only about 200 satisfactory tubes a day in early 1923, hardly enough for the Radiola IV alone. On the other hand, Westinghouse had no scarcity of WD-11 tubes. The cynic might respond by pointing out that RCA
could have delayed the introduction of the original Radiola II by several months until UV-199 tube production rates increased, and indeed GE was producing over 3000 good tubes a day by April. It turns out that RCA did not even begin national advertising of either the Radiola II or RS until August anyway, most likely to reduce heavy inventories of RC’s and other holdover sets from 1922—but certainly not because of any scarcity of UV-199 tubes.

Regardless of the reason for the transfer, the question arises as to how Westinghouse could have put the RS into production on Oct. 16, 1922, the date appearing on its name plate, so soon after RCA gave approval for the transfer circa September 1922. Obviously, Westinghouse must have had a two-tube prototype in the wings, along with all the necessary components that appeared in the production version of the RS. In fact, a prototype of a two-tube set closely resembling the Westinghouse RS surfaced in the auction market in 2009. This prototype shown in Fig. 8 is the missing piece of the puzzle which explains how the transfer was accomplished so quickly and seamlessly.

**RS Prototype Pedigree:** That this prototype was made by Westinghouse can be confirmed by the unique variometer which appears prominently in the interior view shown in Fig. 9. While this six-inch-long variometer appears to be the ubiquitous variometer seen in all early Aeriola Sr. sets with a wood panel, a close examination reveals it is a unique example that never appeared in any production unit, and therefore was not available to the general public. This variometer can be distinguished from all six-inch variometers used in production units by 1) the absence of a hole drilled in the top center of the form which allowed access for a screwdriver to tighten the screw holding the variometer to the wood panel, and 2) the absence of a small semicircular cut taken out of one end of the variometer to facilitate tightening a binding post nut located just beneath the
These two intrusions into the form are clearly apparent on variometers used on all early Aeriola Sr. sets such as the example shown in Fig. 10. Note the hole in the top of the variometer and the semicircular cut out of the left end appearing just above the nut on the binding post at the top. Neither type of intrusion appears on the prototype variometer. Variometers used on other Westinghouse models such as later Radiola Sr. sets with bakelite panels and all RS sets do not have these intrusion, but it would be difficult to confuse them with the one in the prototype because they have a distinctly different appearance and they are $\frac{3}{4}$" shorter.

One might ask how the variometer in the prototype was attached to the panel without these intrusions into the form. The answer is that two relatively crude handmade metal brackets shown in the photograph of Fig. 11 were used to mount the variometer. A factory-made version of these mounting brackets was used on all RS sets and later Radiola Sr. sets with bakelite panels, both of which were first introduced in 1923. Because the factory-made version of these brackets did not appear on any Westinghouse unit until 1923, the presence of these brackets on the prototype presaging the later factory version is virtual proof that the prototype could only have been made by Westinghouse.

RS Prototype Dating: The prototype can be dated by the parts used in its construction. It is remarkable that the prototype did not use a single part that appeared in the production Radiola RS, and further, several key parts were not even manufactured by Westinghouse. For example, the audio transformer used in this prototype is a Federal 226-W model (available as early as January 1921) rather than the unique transformer made by Westinghouse, first used in the Aeriola AC amplifier, and later in the Radiola RS. Consequently, this prototype must have been made before the Westinghouse transformer became available from the Aeriola AC project.

Since the Aeriola AC first appeared in the RCA distributor price list dated August 15, 1922, it is safe to assume that production began no later than July, and that the transformer itself must have been available for test and evaluation well before that. Since the transformer was apparently not
available when the prototype was made, it follows that the prototype must have been developed before July 1922, that is to say, before RCA transferred responsibility of the two-tube set to Westinghouse.

The panel layout also offers evidence that this prototype was made even before the Aeriola AC amplifier was designed, much less before it went into production. Note that the binding posts on the prototype are on the opposite side of those found on the production RS. The obvious reason they were moved in the production version was to locate them adjacent to the binding posts on the AC Amp so the RS could be directly connected to the Aeriola AC Amplifier when the two were operating together. That RCA intended the RS to operate with the AC Amp is affirmed by the bulletin RCA published with instructions for connecting the AC Amp to the RS receiver. The development of the prototype with binding posts on the “wrong side” strongly suggests that this prototype was made before the AC Amp was even designed—long before July of 1922.

I believe this prototype was actually made sometime during the second half of 1921 when Westinghouse was busy developing a whole line of inexpensive broadcast radio receivers for the public—first the Aeriola Jr. crystal set which was released in July 1921, followed by the one-tube Aeriola Sr. which was released in December 1921. The two-tube receiver now known as the Radiola RS would have been the logical follow-on to the one-tube Radiola Sr. under development during the second half of 1921.

THE ORIGINAL RADIOLA III DESIGN CONCEPT

There is no record of a prototype of the Radiola III according to the original specifications, nor has an actual prototype matching the original specifications ever surfaced. It is likely that GE produced a prototype prior to the July 25, 1922 memo specifying its basic design parameters, which in fact, would have been used as the basis for the memo. It is of some interest to speculate regarding the appearance of such a set, not only for historical interest, but also as a template to use in the search for such a prototype in the future.

The Radiola III was to be a three-tube set contained in a carrying case with a speaker and batteries, very likely using the same panel and circuitry as the Radiola IV. It is also likely that the set had a carrying case with a hinged cover on the front for access to the controls and a hinged cover in the rear for easy access to the batteries, just like the Radiola II made by GE and the three-tube prototype shown previously in Fig. 5.

GE was known to use speakers by other manufacturers in its prototypes—for example, GE used the Firth “Dodge” speaker in its two-tube prototype shown previously in Fig. 3. Although this speaker would have been too small for the Radiola III prototype, Firth also made the larger Vocaloud speaker shown in Fig. 12, which was available as early as July of 1921. That RCA was experimenting with this Vocaloud speaker is documented in a photograph appearing in Radio Digest Illustrated with the daughter of E. E. Bucher, RCA Sales Manager, posing in front of this speaker with several RCA sets in the very time frame the Radiola III prototype would have been made [see Fig. 13].

The Vocaloud speaker actually fits neatly within the height and depth constraints of the three-tube
prototype shown previously in Fig. 5—requiring only an extension of the case width to accommodate the speaker. Consequently, if GE did use the Vocaloud speaker in its prototype, it might have looked something like the conceptual set shown in Fig. 14. The approximate dimensions of this prototype set would have been 24” wide, 11” deep, and 12” high—about the same size as the portable Radiola 24 offered in 1925. The projected weight of 23 lbs. without batteries or 31.5 lbs. with batteries was arrived at by weighing the prototype set with the Vocaloud in its enclosure, both with and without batteries. While 31.5 lbs. may seem heavy for a portable by today’s standard, it should be noted that the Radiola 26 with batteries was successfully marketed two years later in 1925 as a portable with a whopping weight of 38 lbs. Undoubtedly, the size and weight of a production unit with a custom-made molded speaker manufactured by GE, perhaps similar to the one used in the Radiola IV, would have been somewhat smaller and weighed less.

Whether or not the Radiola III prototype looked like the conceptual model present here, it would have been radically different from the ubiquitous version of the Radiola III produced by Westinghouse in 1924 shown in Fig. 15. It is interesting to note that almost 300,000 copies of the Radiola III were manufactured in 1924 to meet public demand—even though the demand for the RS with the same two-tube circuitry was so small in 1923 that production was limited to about 4,600 sets. The huge demand for the 1924 Radiola III was undoubtedly fueled by the low price of $35 as compared to $85 for the RS, and the fact that it was heavily advertised in 1924.

Fig. 12. The Firth Vocaloud speaker would have been the right size and shape for use in a GE prototype of the Radiola III.

Fig. 13. RCA was known to experiment with the Firth Vocaloud as evidenced by this photograph taken with the daughter of RCA Sales Manager, E. E. Bucher, along with three sets marketed by RCA. (Radio Digest Illustrated, Aug. 12, 1922, p. 16)

Fig. 14. This image is the author’s best guess of how a prototype of the original Radiola III might have appeared with a portable case and carrying handle as originally described in the ER-875 memo.
as compared to the RS, which was thinly advertised in 1923.

**RADIOLAS AR, RT, V AND VI ARE ADDED**

It is unlikely that the introduction of the Radiola Grand, per se, had any direct bearing on the introduction of the Radiolas AR, RT, V and VI, but the numerous changes that resulted from its introduction would have made these late changes more palatable. The approval for the AR and RT in August or September was likely prompted by a rapidly accumulating inventory of RC and RA-DA pairs caused by a large order of 30,000 of these sets placed by RCA in late May 1922, coupled with an unexpected downturn in radio business in the second half of 1922. RCA was clearly interested in any marketing ploy that would help sell off this mounting inventory.

It happened that Westinghouse was working on the Radiola RT antenna coupler and the Radiola AR three-tube RF amplifier as potential complements to the RC receiver. The basic intent of these units was to increase the RC’s selectivity to make it more attractive to a large number of listeners who lived in geographical areas with potentially interfering stations. Westinghouse proposed that RCA market the AR and RT with the RC as a ploy to reduce the rapidly increasing glut of RC sets in the inventory, and RCA obviously approved the proposal. Indeed, the AR and RT sets were always grouped with the RC or RA/DA receivers in 1923 ads, where they were described as the “Radiola Superselective Combination” or a super-selective “RT-RA-AR-DA Combination.”

Undoubtedly, Westinghouse had been working on the AR and RT well before July of 1922 because, according to dates on the name plates on these sets, production began on October 4, 1922 for the AR and two months later on December 12, 1922 for the RT. An RT set believed to be a preproduction unit with a name plate dated October 16, 1922, indicates the RT was actually ready for production in October as well. Since the preproduction unit was almost identical to the production unit, it is not clear why production of the RT was delayed by two months. Perhaps the two sets were made on the same production line, and the RT was delayed until production of the AR was completed.

Westinghouse’s proposal to market the RT-RA-AR-DA combination was said to have prompted GE to offer competing Radiola V and Radiola VI combinations. This view is supported by George Clark, who stated in his *Radioana* papers: “The General Electric Company countered [the RT-RA-AR-DA combination] with a similar agglomeration [sic], using its AR-1300, AA-1400, and AA-1520.”
While there is no evidence GE had been working on combining these units, it could have been done on very short notice. All that was needed was a change in the design of the knobs, a fresh coat of paint to change the existing metal boxes from green to a marbled maroon, and a new wood base and top cover. RCA accepted the GE counterproposal for Radiolas V and VI, which in view of the George Clark comment, was clearly an afterthought.

A 1923 SEASON RETROSPECTIVE

The original plan to have GE manufacture all three new Radiolas II, III, and IV in 1923 would have assured GE the lion’s share of the orders from RCA. However, the decision to replace the defective Aeriola Grand in September with the Radiola Grand, which did not become available in quantity until December 1922, was also a de facto decision to add it to the 1923 line. This decision resulted in three new high-end sets offset by only one new low-priced set, prompting RCA to rebalance the line by dropping one of the three high-end sets and adding a second low-end set. For reasons unknown, RCA transferred manufacturing responsibility for the original Radiola II design, a two-tube set in a simple box, from GE to Westinghouse and renamed it the Radiola RS. RCA then tasked GE to manufacture a modified Radiola II in lieu of the portable Radiola III—specifically, a two-tube portable, complete with self-contained batteries and earphones.

The remarkable changes in the lineup did not stop there. Westinghouse proposed to complement the RC with a new AR amplifier and RT coupler to increase its selectivity. As inventories of the venerable RC receiver accumulated, RCA accepted Westinghouse’s proposal in hopes of reducing inventories by attracting new customers who wanted a more selective receiver that would suppress stations transmitting on interfering wavelengths. GE quickly countered with a proposal to combine its 1300/1400/1520 units to make two new high-performance receivers, Radiolas V and VI. Not to be left out, WSA then proposed a new receiver, the Radiola VII. RCA accepted all three proposals, which, when added to Radiolas II and IV, resulted in a total of nine new models for 1923.

In the end, the distribution of new models was well balanced with two high-end models (Radiolas Grand and IV), four mid-range models (Radiolas AR, RT, V and VI, and VII), and two low-end models (Radiolas RS and II). However, since GE and Westinghouse now had an equal number of new and competing models, it was unlikely that GE would receive enough orders from RCA in 1923 to make up for previous deficits. The WSA Radiola VII selling at $290 was also a new high-end model, but it was not introduced until September 1923, and very few sets were made or sold.

The actual revenues received by Westinghouse and GE for receivers sold in 1923 are listed in Table 3 for the new high-end, medium, and low-end models as well as the holdover models. Retail prices and the number of sets manufactured are taken from tables in Radiola, while GE and Westinghouse revenues received from RCA were computed from jobber prices which RCA had entered on the stock spreadsheets referred to previously. Historically, RCA charged the jobber/distributor about double the price it paid...
Broadcast receiver revenues for GE in 1923 were dominated by RCA purchases of the Radiola IV ($770K) and Radiola V ($760K), while revenues for Westinghouse were dominated by purchases of the Radiola Grand ($960K). At the bottom line, GE received an estimated $1.9M amounting to a 60% share of RCA’s broadcast receiver orders, while Westinghouse received an estimated $1.3M amounting to a 40% share.\(^26\) Purchases of WSA sets, which were included in GE’s 60% share by terms of the cross-licensing agreements, were not substantive in 1923, and therefore do not appear in the table. Assuming that sales of tubes and other ancillary radio equipment were proportional to receiver sales, GE may have held their own in orders from RCA for the year, but it would have to wait for the superheterodyne in 1924 before GE would make up for the large deficit in revenues which had accumulated by the end of 1922.

The late inclusion of the Radiola Grand obviously had a huge impact on both the lineup and the financial results of the 1923 season. Absent the Radiola Grand and the changes it wrought, Radiolas II, III and IV—without competition from new Westinghouse sets—would have generated the revenues GE needed to make up for its deficit from RCA orders in 1922. It is ironic that Westinghouse profited so much in 1923 as a result of manufacturing what amounted to an inherently defective Aeriola Grand in 1922.

ENDNOTES
1 One of the first to report that the Aeriola Grand was “returned to the factory as unsatisfactory” was R.G. Thorn, “A Contribution to Aeriola Grand/Radiola Grand History,” Radio Age, Vol. 14, No. 7, March 1988, pp.3-4.
4 Ibid., pp. 171-173.
5 J. P. Wolkonowicz with A. Douglas, J. Terrey and R. G. Wolven, “RCA’s Intended Models for 1923-1924...
6 RCA offered its IP-500 and IP-501 marine receivers for sale to the public in 1921 for broadcast radio reception because they were the only two complete receivers for broadcast radio available to RCA at the time; the IP-501 receiver was carried over until August 1922, although its production continued for RCA's communication business.
7 Memos from W. M. Derrick to A. D. McKenzie and P. H. Boucheron regarding assignment of model designations Radiola II, III, and IV dated July 25, 1922 (kindly provided by Alan Douglas).
8 E. P. Wenaas, Radiola, p. 171.
10 E. P. Wenaas, Radiola, p. 170.
12 The AA-485 appeared continuously in RCA price sheets between August 21, 1922 and Sept. 15, 1923; the AR-1375 first appeared on the April 1, 1922 RCA price list and last appeared in 1923 on a list entitled "Present Line of Broadcast Receivers for 1923" in an RCA engineering report entitled "Broadcast receivers for 1924," dated January 16, 1923. In April 1923, the set was converted to the one-tube Radiola Special.
14 G. C. Clark, Radioana, Memo to RCA General Sales Manager E. E. Bucher and B. H. Clark from an RCA salesman dated January 25, 1923 summarizing the results of a three-day show in January 1923 at Bamberger's Department Store in New York City; see also E. P. Wenaas, Radiola, pp. 173-174.
15 The first page of this memo was reproduced in "Recently Discovered," Radio Age, Vol. 18, No. 7, July 1993, p. 7.
19 Ads for the Federal Model 226-W transformer appear in Wireless Age issues as early as January, 1921; see for example The Wireless Age, January, 1921, Vol. 8, No. 4, p. 3.
24 The production date (12-11-22) for the RT was erroneously reported as (2-11-22) on page 194 of Radiola, although it appeared correctly on page 419 in a discussion of serial numbers.
25 E. P. Wenaas, Radiola, 194; in describing this quote in Radiola, I stated that George Clark must have had it reversed because GE had the 1300, 1400, and 1520.
units on the market before the Westinghouse AR and RT, but in the context of how the 1923 season actually evolved, it is now clear that Westinghouse proposed to group their RT-RA-AR-DA sets as the Radiola Superselective Combination before GE proposed to group their 1300, 1400, and 1520 sets as the Radiolas V and VI. 26 GE revenues derived from the Radiola V should be reduced to account for an unknown number of 1300/1400 units already in RCA inventories used in its manufacture; similarly WH revenues from the Radiola Grand should be reduced to account for an unknown number of returned Aerola Grand cabinets and speakers used in its manufacture. The net effect of these corrections would likely reduce GE’s revenue share even further.

ABOUT THE AUTHOR

Eric P. Wenaas has had a lifelong passion for antique radios beginning with his first Radiola and crystal set given to him as a young man growing up in Chicago by family friends. He experimented with radio devices and repaired radios and televisions as a hobby while in high school, and went on to study electrical engineering at Purdue University, graduating with B.S. and M.S. degrees in Electrical Engineering. He then went to the State University of New York (SUNY) at Buffalo where he earned a Ph.D. degree in Interdisciplinary Studies in the School of Engineering. After graduating, he spent most of his career at Jaycor, a defense company in Southern California—first as an engineer and later as the President and Chief Executive Officer.

Upon his retirement in 2002, he set out to research the early days of wireless and document interesting historical vignettes based on original documents of the era. He has written numerous articles for the AWA Review, the AWA Journal and the Antique Radio Classified, and has published a critically acclaimed book in 2007, Radiola: The Golden Age of RCA - 1919-1929, covering the early history of RCA—including the formative years of the Marconi Telegraph Company of America. For this work, he received the AWA Houck Award for Documentation in 2007. He is a life-time member of the AWA and a past member of both the IEEE and the American Physical Society. Dr. Wenaas resides in Southern California and continues to enjoy collecting radios, researching the early days of wireless and writing articles.
Appendix A. Radiola Grand Memo

TO WHOLESALE DISTRIBUTORS:

SUBJECT: RADIOLA GRAND (formerly AERIOLA GRAND)

The Aeriola Grand in its present form was designed for a specific field of utility. It was intended to provide the novice, or the members of the average home with a broadcasting radio receiver calling for a minimum number of adjustments and which could be operated by purchasers possessing a limited knowledge of the technicalities of the art. To this end it was provided with a single circuit receiver, and a fixed regenerative coupling. Ballast lamps were substituted for the usual filament rheostats. The instrument, therefore, required but two operations to put it to practical use, namely, to close the switch controlling the filaments and rotate the tuning control handle until the desired station was heard.

The Aeriola Grand gives satisfactory operation at moderate distances from a broadcasting station, but the experience of the past few months convinced the Sales Department that the public demand was for an instrument which not only would give satisfactory operation from nearby broadcasting stations, but which would enable the home user to "tune in" to other than local stations. Expressed otherwise sufficient evidence came to hand that the desires of the discriminating public could be met only by a refined instrument of the Grand type which would afford long distance reception with a telephone and which would provide a greater volume of reproduction with a loud speaker.

Careful analysis and study of the public’s wishes in this matter pointed to the advisability of remodelling the Grand to meet these specifications. The Sales Department is pleased to announce that such an instrument has been developed and it has more than met the expectations of all concerned. It will be put into production early in
October of this year.

The new instrument will carry the Radio Corporation's standard trade name for radio entertainment sets and accordingly will be known as the "Radiola Grand". It is confidently believed that the Radiola Grand will become one of the best sellers in the market.

The Radio Corporation is now able to offer the trade an exceptional instrument which is far more sensitive than the Aeriola Grand, and which will provide a surprising increase in the volume of reproduction. The operating adjustments are, however, as simple as that of the Aeriola Senior, and can be easily carried out by the average user. It will give satisfactory operation with an antenna of smaller dimensions than that required by the Aeriola Grand, which in itself is distinctly a point in its favor. The general appearance of the cabinet will remain the same.

The improvements which have been incorporated in the Radiola Grand are the following:

1. Four Aeriola WD-11 tubes, operated by four independently connected dry battery cells, are used in place of the tubes formerly provided.

2. No ballast tubes are employed but a filament rheostat is provided by which the low voltage filaments of the dry battery tubes can be connected to any type of battery giving a maximum potential under two volts. The filaments thus may be operated from a two volt storage cell or from one and one-half volt dry cells.

3. A single circuit tuner with a continuously variable tickler adjustment is provided. This enables the user to obtain maximum amplification.

4. An intensity control is placed at the rear of the panel thus enabling the volume of reproduction to be cut down when the instrument is installed within distances of 10 to 15 miles from a broadcasting station.

5. A telephone jack is provided at the side of the box enabling an external head set to be used in place of
6. A grid condenser and leak is provided for the detector tube.

7. The amplification circuits are transformer coupled, the second tube being an audio-frequency amplifier coupled to the detector bulb and the third and fourth tubes are the "push and pull" elements of a transformer coupled, audio-frequency, second stage of amplification.

8. All tubes are mounted on a shock proof mounting, the detector tube being mounted on a second shock proof mounting supported on the first mounting as an extra precaution against vibration.

9. The reproducing horn is mounted on rubber supports to avoid jarring the tubes by the horn vibration.

10. A third-volt grid bias battery, in the form of a flash-light unit, is provided for the amplifier tubes.

11. A condenser is connected across the plate battery to aid in the elimination of the noises inherent in some types of "B" batteries.

12. A new loud speaker developed by the Westinghouse Elec. & Mfg. Co. is provided.

13. Terminals are provided whereby the common negative lead from all the one and one-half dry batteries is connected to a single binding post and the positive lead from each battery is connected to a separate binding post. In this way each tube is fed from its own dry battery and the discharge of good cells through a poor cell, placed in parallel therewith, is avoided.

14. Rigid form wiring is used throughout the instrument.

The improved features of the Radiola Grand together with the pleasing and satisfactory operation which it provides will cause a nationwide demand for the instrument for which distributors and dealers should prepare themselves at once. The Radiola Grand will list at the same price as the Aeriola Grand, and the discounts applying to the Aeriola Grand in the revised discount schedules of August 21st, will apply to the Radiola Grand.
There are a number of users of the Aeriola Grand who are satisfied with its performance but the retail dealer who has sold the Grand to customers who have expressed dissatisfaction with the instrument, are authorized to supply such customers with a new Radiola Grand without charge.

The Radio Corporation will also replace each Aeriola Grand now held in the dealers' or distributors' stock. In order that the Sales Department may handle the matter of exchanges equitably, it is requested that distributors supply us with an inventory of their stock of Aeriola Grands and the number that have been supplied to their dealers and to the dealers' customers.

As soon as the Radio Corporation has obtained complete reports from its distributors covering the number of Grands that have been placed in their particular territory, the Sales Department will distribute the new Radiola Grands equitably until all of the instruments in the hands of jobbers, dealers and dissatisfied customers are replaced. Upon receipt of the reports, jobbers will be required to return a definite number of the old instruments which immediately will be replaced by the Radiola Grand. None of the Aeriola Grands now held in stock should be returned to the Radio Corporation until definite shipping instructions are given by the Sales Department.

Although it is contemplated that the Radiola Grand will be in production during October, the date is not definite and in the meanwhile the Radio Corporation realizing that its nation-wide advertising campaign with respect to the Aeriola Grand will create a demand for the instrument, requests that the present Aeriola Grand be sold in localities where the dealer is sure that the instrument will operate to
the satisfaction of the customer. In this way, the dealer and the
distributor will obtain their normal profit on the sale, less the carrier
and handling charges in providing the new instrument. It is believed
that this is the more satisfactory way of handling the situation pending
delivery of the Radiola Grand and, therefore, the full cooperation of the
distributor and the dealer in carrying out this plan is requested.

Distributors are urged to promptly provide the New York
and Chicago Offices of the Sales Department with a statement of the number
of Grands in their stock, in the stock of their dealers and in the hands
of the dealers' customers.

AERIOLA GRAND TUBES:

Distributors and dealers are requested to carry a suitable
stock of the Aeriole Grand tubes to meet customers requirements until the
new Radiola Grand has replaced the present instrument.

On or about January 1st, 1923 the Sales Department will
announce a policy with respect to Aeriole Grand tubes which the dealers
and distributors may possess in their stock at that time.

The Sales Department shall do everything within its
power to expedite the distribution and shipment of the Radiola Grand.

Very truly yours,

MANAGER - SALES DEPARTMENT

EEB/ABT
1923 Radiola Season

124 AWA Review
In our paper we aim to provide an overview on the state of engineering research and development of television in Germany during the years from 1933 to 1939. In Germany, as in other countries in 1933, there was the strong belief that a television technology based on optical and electrical methods (“mechanical television”) would become of practical use. In 1939 it was already clear that only electronic methods would provide the means for practical television systems (“electronic television”). Half way between, the 1936 Olympic Games gave Germany a chance to show the state of the art of television in providing the public with another dimension via television programs. The years 1933 and 1939, however, also mark important political changes in Germany which influenced the development of television. The year 1933 brought the Nazi regime to Germany, which immediately showed its interest in controlling the media. The year 1939 marks the beginning of World War Two and the end of any effort to provide Germany with a public television system. The 1936 Olympic Games in Berlin, however, were welcomed by the political leaders and especially by the Minister of Propaganda Josef Goebbels. Our paper will mainly deal with the technical part of television starting from the year 1933 onward. However, for completeness and for a better understanding we also include the contributions of the most important German television pioneers who paved the way in the years before.

TELEVISION EXPERIMENTS IN GERMANY PRIOR TO 1933

The most important contribution to the development of television was certainly the patent “Elektrisches Teleskop” of Paul Nipkow, a student of the Technische Hochschule Berlin.1 We assume that the reader is familiar with the principle on which the invention of Nipkow was based. He used a rotating perforated disk with a
spiral of holes for scanning an image in connection with a selenium cell to get an electrical signal on the transmitting side. In the receiver a similar disk had to rotate at the same speed. A light source which was controlled in its intensity by the received electrical signal had to pass the holes of the disk and would form the image again, which could be observed through an eyepiece. Although the invention would give the right answer for realizing an electrical television system it took another 30 years before a moving image got transmitted in 1925 by the British inventor John Logie Baird by means of a Nipkow disc. This was the start of “mechanical television”. In Germany, as also in many industrially developed countries, a number of inventors and experimenters tried to make a contribution to the engineering development of television. In the following we discuss briefly the work of Denes von Mihaly, Max Dieckmann, August Karolus and Manfred von Ardenne.

Denes von Mihaly. Denes von Mihaly (1894-1953), a Hungarian baron, devoted his interest first to the field of picture telegraphy, where he followed the work of the well known inventor Arthur Korn. In about 1920 he turned his interest to television where he developed his “Telehor” system. In his book v. Mihaly claimed that already in 1920/21 he was successfully transmitting simple pictures and their instantaneous movements with his Telehor. However, proof consisting of a public presentation of this result seems not to be available. The main components in the transmitter of his system were a mirror-oscilloscope which, by the movement of the mirror, produced the scanning of the optical image followed by a selenium-cell connected with a 3-stage amplifier using high-vacuum Telefunken triodes type EVE 173. On the receiving end, after amplification by a similar amplifier the electrical signal again drove a mirror-oscillograph to write the transmitted image on a screen. Figures 1 and 2 show the transmitter and the receiver, respectively, of v. Mihaly.

In Berlin in about 1928 Denes von Mihaly founded his own company, the “Telehor A.G.” and was skilled enough to get the support of the Deutsche Reichspost for his promising research. Also the Telehor A.G. established cooperation with TeKaDe (TeKaDe = Süddeutsche Telefon- Apparate, Kabel- und Drahtwerke A.G., Nürnberg). In the year 1928 at the annual German radio exhibition in Berlin, TeKaDe showed a television receiver with great public success. This receiver, however, was not based on the original set-up of v. Mihaly and his Telehor system but on a conventional construction using a Nipkow disc. It showed a 30 line picture with a speed of 10 pictures per second. In 1930 TeKaDe bought the patents of v. Mihaly and manufactured the kit “System Telehor” to be sold to television experimenting enthusiasts. During this time the Deutsche Reichspost transmitted from the normal AM radio transmitter Berlin-Witzleben at 418 m an experimental television program with a (horizontal) 30 line image during night-time. From London one could receive from the transmitter of the BBC an experimental program by the Baird Television Company at a wavelength of either 356.3 m or 261.3 m with a (vertical) 30 line image.

Denes von Mihaly returned later to his original idea to make use of moving mirrors in television. In cooperation with the British International Television Corporation a new kind of television receiver, the
Fig. 1: Telehor transmitter of v. Mihaly

Fig. 2: Telehor receiver of v. Mihaly
Mihaly-Traub receiver was developed. The essential part, which is shown in Figure 3, was a fast rotating mirror-wheel together with a ring of fixed mirrors mounted inside which accomplished the scanning of lines. The vertical scanning, to put the different lines together to make the image, was done by a Weiller mirror-wheel. As a light-relay the Mihaly-Traub receiver used a Kerr-cell. Figure 4 shows an experimental version of the Mihaly-Traub television receiver. Receivers of this kind met the 1935 British standard of the Baird Television Company of 240 lines and 25 pictures per second.

Max Dieckmann (1882-1960) received his academic education at Göttingen, Leipzig and Strasbourg, where he got his doctoral degree with Prof. Ferdinand Braun as his advisor. In 1921 Dieckmann constructed at the Technische Hochschule Munich a kind of experimental picture transmission system in which he made use of the cathode ray tube of Braun in the receiver. In that year Dieckmann got a German patent for a complete television system. For scanning he used a mirror-oscil-loscope together with a photo-cell as an optical/electrical transducer in the transmitter, similar to the method of Arthur Korn and Denes von Mihaly. However, according to his earlier patent the cathode ray tube of Braun was used in the receiver. For wireless transmission of the signals of the image and for information on the coordinates of image points, Dieckmann applied the method of frequency multiplexing, already known at that time from telephony. Figure 5 and 6 show by a schematic the principal construction of the transmitter and the receiver of Dieckmann’s experimental television system.

During WW I Max Dieckmann worked on problems of navigation for the “Luftschiffertruppen” (literally translated as “air ship troup”) and after the end of the war he stayed in the field of navigation. Together with Rudolf Hell he investigated a possible electronic solution in radio direction finding and got an important patent, which later was useful for the Fernseh A.G. in the development of its Farnsworth-Bildsondenröhre. In 1936 Max Dieckmann became a full professor at the Technische Hochschule Munich. During World War Two he again...
was involved with work in the field of radio beam direction finding. After World War Two he got an offer to work in a leading position at the Wright Patterson Air Force Base in Ohio, U.S.A. However, illness forced him to give up this post and return to Germany.

Fig. 5: Dieckmann experimental transmitter

Fig. 6: Dieckmann experimental receiver
August Karolus (1893-1972) studied physics at the University of Leipzig, Germany. His early research there concentrated on the development of an electrical/optical transducer which was based on the Kerr effect. In cooperation with the Telefunken Company, the “Karolus-cell” found application in picture telegraphy. In 1924 Karolus performed experiments in television at the physics institute. To get synchronisation of two Nipkow discs both were mounted on and driven by a common shaft. Following the success of John Logie Baird in 1925 in the transmission of moving images, Karolus, in cooperation with Telefunken, developed a television system for the transmission of movies in 1927. The sending equipment consisted of a 4-fold Nipkow disc with a diameter of 1 Meter together with a photo-cell for optical/electrical conversion. In the receiver, the light signal generated the image on a screen by means of a Nipkow disc and a drum with lenses for optical switching of the individual spirals after electrical/optical conversion of the signal by a Karolus-cell. To have an alternative to the method of scanning by a Nipkow disc, Karolus got interested in the method of image scanning by the mirror wheel of Lazare Weiller. The result was a projection-receiver which used a mirror wheel of 96 mirrors and had a screen of size \(\frac{3}{4}\) times \(\frac{3}{4}\) meter. Both systems were successfully shown to the public in Berlin at the Radio exhibition of the year 1928. The mirror wheel was also applied to the construction of a studio scanning device. In 1929 Telefunken presented a studio scanner with 48 lines based on a mirror wheel.\(^6\)

Manfred von Ardenne (1907-1997) can be considered one of the most prominent German researchers in the fields of radio and television. Special attention in his research was given to the subject of improving the cathode ray tube for its application in oscilloscopes. This concerned the improvement of the chemistry of the screen to improve light intensity and the improvement of the control of such a tube by its Wehnelt cylinder. With his improved cathode ray tube he was able to carry out a suggestion of R. Thun to achieve direct electronic scanning of positive film images. Figure 9 shows the principle of his experimental demonstration.

Fig. 7: Mirror-wheel receiver of Telefunken in the year 1928

Fig. 8: Mirror-wheel with 96 mirrors of the projection receiver of Telefunken in 1928
of electronic image transmission in a closed loop which he successfully presented at the Berlin exhibition of 1931.7

Fig. 9: Experimental set up for electronic scanning in 1931

**TELEVISION DEVELOPMENT FROM 1933 TO 1936:**
contributions of Telefunken, Fernseh A.G. and Deutsche Reichspost.

The success of the presentations of experimental television at the annual Berlin radio exhibitions motivated the companies Telefunken and Fernseh A.G. and also the Deutsche Reichspost to increase their activity in this new field of communication. In 1933 the political leaders changed in Germany. The Nazi regime under Adolf Hitler took over. In the first years this had no influence on the development of television. However, from 1935 on this changed. The Olympic Games of 1936 in Berlin could be covered by television for the first time in history and they could present Germany and its politics in the best light. In the following paragraphs we will discuss research and development of the two most important companies in television of that time in Germany, the Telefunken Company and Fernseh A.G. In addition, the activities of the Deutsche Reichspost, which had the responsibility for the provision of the necessary infrastructure is discussed.

Fig. 10: Electronic scanning device of Manfred von Ardenne
The Telefunken Company was founded in 1903 by the companies Siemens & Halske and the AEG, the “Allgemeine Elektrizitäets Gesellschaft”. The goal was to weaken the leading position of the British Marconi Company in wireless ship and shore communication. As soon as television experiments showed interesting results Telefunken and its research director Fritz Schroeter got active. The cooperation with August Karolus was continued and gave results in television projection as we will report later. A main research result of Telefunken, however, was the development of the “Linsenkranz Abtaster” by Emil Mechau, a huge motion picture Nipkow disc scanner of a special kind. The scanning disc was made by a heavy ring of stainless steel with two rows of holes equipped with optical lenses made by Zeiss Ikon of Jena. Part of it was a double spiral of lenses for scanning motion pictures which were moved by Maltese cross mechanics, the other was a ring of lenses for scanning motion pictures with continuous motion movement. The “Linsenkranz Abtaster” supported the definition of 180 lines with 25 full frames per second. As we will later point out, it worked successfully at the Olympic games of 1936.

In the same year Telefunken was interested in keeping up as much as possible with the development of an electronic camera tube. By the exchange of information with RCA, knowledge about the ikonoscope of Zworykin was received. In 1936 Telefunken was able to present its “Ladungsspeicher-Röhre”, which was influenced by the construction of the ikonoscope.

Another activity at Telefunken was the design and manufacturing of television receivers. The type FE I of 1933 still used a gas-filled cathode ray tube and delivered an image of 90 lines. The models of 1934 (FE II), 1935 (FE III) and 1936 (FE IV) already had high vacuum cathode ray tubes and supported a definition of 180 lines.
The company Fernseh A.G. was founded in 1929 by the Robert Bosch A.G., Stuttgart, the Radio A.G. Loewe, Berlin, the Zeiss Ikon A.G., Dresden and Baird Television Limited, London. From the beginning research was directed towards the development of a sensitive television camera system for outdoor applications. In 1931 a patent for the method of “intermediate film recording” had been applied for, and in 1935 final results of the application of this method for television were reached. The method worked as follows: The outdoor scene was recorded by a usual motion picture camera, the film got directly developed by a fast method and then scanned by a special type of Nipkow disc scanner. It was reported that the delay in getting the electrical signal from the scene was only about 30 seconds. The Nipkow disc of the scanner had four rows of holes and it ran in a vacuum at 6000 revolutions per minute.\(^\text{10}\)

To achieve mobility for this special kind of television recording, a motor car, the “Aufnahmewagen” was designed for Fernseh A.G. On the occasion of the Berlin radio exhibition of 1934 the “Aufnahmewagen” was used to transmit the opening speech of the minister of propaganda Dr. Josef Goebbels. Later it was used by the “Reichsrundfunk-Gesellschaft” at the 1936 Olympic Games in Berlin. Fig. 15 shows the “Aufnahmewagen”, Fig. 16 shows schematically the inside of it.

![Fig. 14: Telefunken television receiver model FE IV of 1936](image1)

![Fig. 15 „Aufnahmewagen“ for intermediate film recording](image2)

![Fig 16 Inside of the “Aufnahmewagen”](image3)

Having powerful Nipkow discs for scanning available, Fernseh A.G. made use of them to design a light spot scanner for studio recording and long distance television telephony and also in the design of a film scanner.
Just as was the case with Telefunken, Fernseh A.G. was at this time interested in developing an electronic camera tube. The result in 1936 was its “Bildsondenröhre”, a version of the dissector tube of Farnsworth. The “Bildsondenröhre” of Fernseh A.G. was used to develop an electronic camera to record the Olympic Games 1936 in Berlin.
The "Deutsche Reichspost" was the official government institution in Germany to handle all postal and communication oriented services. It was also responsible for the planning and development of the television network in Germany. Dr. Fritz Banneitz, being an expert in wireless telegraphy and telephony, took a leading position in this work. From 1932 at Berlin – Witzleben, a UHF transmitter, designed by Telefunken, was in operation and also was available for television experiments. In the year 1935 a fire ruined this transmitter. Telefunken had to build a new transmitter. In the same year the Deutsche Reichspost started the planning of a nation-wide television network. It would cover the whole “Dritte Reich” which meant that cities such as Breslau (today the polish city Wroclaw), Danzig (today the polish city Gdansk) and Koenigsberg (today the Russian city Kaliningrad) should be included. To make transmitting experiments at different locations possible a mobile 10 kW transmitter was designed. It consisted of 12 Daimler-Benz motor vans. Five of them contained the transmitter for the image signal, and another five were used for transmitting the audio signal. The remaining two vans contained the light spot film scanner by Fernseh A.G. and the office and workshop. This transmitter is remembered for its size, and recalls the efforts that were taken to carry the mule back transmitters of military wireless telegraphy in early times.

At the VDE conference in Hamburg of June 1935 the working mobile television transmitter was presented. The mobile transmitter was little used since the planning of the television network
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for Germany was stopped as soon as the Nazi regime started to emphasize military projects.

**Television Projection Systems**

A method to make television possible for the general public was to present such programs similar to movies in a film theatre. A possible method for this was the development of projection systems, which allowed the presentation of the pictures on a large screen. August Karolus presented for Telefunken at the radio exhibition of 1935 in Berlin, a television projection system based on mirror wheel scanning where a picture of 2 x 2 Meters was produced by an array of 100 x 100 = 10,000 electrical lamps. The scanned light beam which represented one line of the picture was fed to a line of 100 Caesium photo cells. Its electrical output, after electronic amplification, provided the power for the row of electric lamps.

The discussed television projection system of Telefunken was intended mainly for the presentation of a speaker on a big screen. However, there is no evidence that this projection system was put into practical use. It might be that there was some fear that the political leaders of that time, such as Adolf Hitler, Dr. Josef Goebbels or Hermann Goering, if shown as a big picture, would not look attractive enough.

Besides Telefunken, Fernseh A.G. tried to contribute to the development of a television projection system. Here the goal was to get a projection system which would enable the delivery of “Radiomovies” in the sense of the American inventor Charles F.
Jenkins. At the Berlin exhibition of 1933 a projection system based on the intermediate film processing method was presented. It worked with a definition of 120 lines and was able to show a picture of 3 x 3.5 Meters in size. In Fig. 26 the principle of this method of television projection system is shown. However, from 1939 on such types of projection systems were outdated since powerful cathode ray tubes for projection became available.

Germany had in 1936 a highly developed state of knowledge for provision of television signals for broadcasting and for building a television network. However besides having the UHF transmitter in Berlin-Witzleben in operation, the creation of a country wide television network did not develop beyond the state of planning. The television receiver was already fully electronic in Germany in 1936. To keep up with the development in the U.S.A. (RCA) and in England (Marconi-EMI) Telefunken and Fernseh A.G. developed their own electronic camera tubes, the “Bildspeicher-Röhre”, the ikonoscope of Telefunken and the “Bildsonden-Röhre” image dissector of Fernseh A.G.. In general Germany had reached a technical level in television which was comparable to that of the U.S.A. and of England in 1936. However, as we will explain later, it could not be used to establish a television system for the general public.

OLYMPIC GAMES OF 1936 IN BERLIN

As soon as January 30 of the year 1933 the NSDAP (NSDAP = National Sozialistische Deutsche Arbeiter Partei), the party under the leadership of Adolf Hitler came to power, radio broadcasting was taken under their control. The first version of the “Volksempfänger”,
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the peoples radio got the type DYN 301 on this date. Television was at this time not yet considered as a medium to manipulate people and stayed for a while under the responsibility of the Deutsche Reichspost. However, in 1936 this was changed. Television was now the responsibility of the minister of aviation Hermann Goering, the technical infra structure was in future to be provided by the Deutsche Reichspost. The control of television programming was given to the „Reichsminister fuer Propaganda“ Dr. Josef Goebbels. For the 1936 Olympic Games there was a plan to cover them in the best possible manner by television, to impress the world and to show the abilities of the new regime in Germany. However this expectation could only partly be fulfilled. With the lack of an existing nation-wide television network the television programs of the Olympic Games could only be followed in Berlin and its surrounding neighborhood. In addition only a small number of private television receivers existed. To improve this situation the Reichspost had to establish „Fernseh Stuben“, television parlours at different locations in Berlin and Potsdam, in all 27 in number, where the public could follow the programs.

On the „Reichsportfeld“, the official sporting ground for the games, four different camera systems could be used. Two of them were ikonoscope cameras of Telefunken, another was an image dissector camera of Fernseh A.G. and the fourth was the motorized van with the intermediate film processing and scanning system. In the Olympic studio a spot light scanner in the form of the “Linsenkranz Abtaster” of Telefunken was installed.

A definition of 180 lines with 25 full frames per second was used. The wavelength of the UHF transmitter Berlin-Witzleben, now called the “Paul Nipkow transmitter” was 6.77 m for the image and 7.06 m for the audio signal. In the Telefunken-Zeitung W. Federmann gave a report in detail on
the equipment and its use at the Olympic Games. The following is a translation done by the author. Federmann wrote:

"The Telefunken television camera had to fulfill difficult optical and mechanical requirements due to the giant size of the sport ground. The camera was posted 10 Meter away from the finish line of the race track. The distances to the objects which would be televised was at most about 150 Meter, and to the centre of the sporting ground about 70 Meter. The size of the ikonoscope mosaic plate was about 9-12 cm. Different object lenses with 250,900 and 1,600 mm focal length could be used. The light intensity was not allowed to be below 1/5 of the focal length. The rather large focal length had the disadvantage that for the camera operator it was difficult to follow in the small view when there was fast movement of the athletes. The best results could be reached for competitions which had narrow boundaries such as the hammer throw or the shot put".

Federmann reported also that:

"The operation of the camera system at the sporting ground needed five persons. Two of them were needed at the camera, two had to control the amplifier; the fifth person had to give help by the changing the objective lenses or in special unexpected situations".

TELEVISION DEVELOPMENT FROM 1936 TO 1939.

To state it from the beginning: While the years from 1933 to 1936 brought successful results for the development of television in Germany, this can not be said for the years from 1936 to 1939. It seems that during these years German industry and also the Reichspost had to follow the military plans of Adolf Hitler and his party leaders. This can also be seen by the reduced number of scientific publications during this time on the topic of television. An exception is Fernseh A.G. which continued its research activities in television. Traditionally, as in past years, the Berlin exhibition offered an opportunity to present the newest results. In 1937 the Reichspost had announced the new television definition of 441 lines interlacing with 25 half frames per second. The increased number of lines needed a bandwidth of at least 2 MHz for transmission. The exhibition of 1937 took notice of the new definition. Fernseh A.G. presented an electronic camera tube of the ikonoscope type with good quality. Furthermore a spot light scanner with the "Bildson-
Fernseh A.G. was certainly the leading company in television in Germany in the years 1936 to 1939. Besides the design and manufacture of television equipment, their research on electronic tubes for television was remarkable. Fig. 33 shows their collection of denröhre" (image dissector) was presented.

In April 1938 Fernseh A.G. gave a report on its newly developed "Fernkinosystem" (cinema television system). The scanning of the films was done with an image dissector tube which was integrated to a secondary emission multiplier. For image projection a special cathode ray projection tube was used. From the existing close contact of Fernseh A.G. with Baird Television in London it can be guessed that this system was similar if not the same as the cinema television system of Baird Television which was used in June 1938 to transmit the London Derby to the Tatler Cinema in London. Fernseh A.G. also offered in 1938 a small television receiver Type DE 7, which could be considered a preliminary contribution to the planned development of a "Volks-Fernsehapparat" (peoples television set) similar to the "Volksempfänger", the peoples radio of the year 1933.

On July 28, 1939 the 16th Berlin radio exhibition was opened. From the promise of the political regime to establish in 1939 a television program for the public, the emphasis was on television receivers. The most attention was paid to the "Einheitsempfänger" E1, a kind of standard television receiver affordable by common people. The E1 design was done in cooperation by the companies Fernseh A.G., Telefunken, Lorenz, Radio Loewe and TeKaDe. The cathode ray television tube type RFB/T2 was a technical novelty with a rectangular screen 19.5 x 22.5 cm, with a diagonal of 30 cm and an overall length of
39 cm. The television receiver E1 needed in all 15 tubes. The tuning was fixed to a certain frequency in the UHF domain. In case of a change the responsible UHF module had to be changed.20,21

The price of the E1 was fixed at 650 Reichsmark. It was planned to produce 10,000 E1 sets and they would have been available at the time of the introduction of public television.

Fig.34: „Einheitsempfänger“ E1

At the time of the exhibition of 1939 there was a strong belief that the experimental time of television in Germany was coming to an end. Already in 1938 the Reichspostminister Ohnesorg had made the statement (translation by the author):

“We know that with television great opportunities that are still silently hidden will be important for human life and for culture in the future; therefore we want and have to be one of the first to occupy this field”

However, the future turned out to be different. With the beginning of World War Two on September 1, 1939, the introduction of public television in Germany was cancelled and the production of the E1 was stopped. From that time on the engaged companies had to serve military projects. It is reported that in all only 50 television receivers of type E1 were produced. I have been told that only two of them have survived in German museums today.

During World War Two the “experimental” television service continued in Berlin. Its programs were mainly oriented towards patients in hospitals and “Lazaretts” (military hospitals) where television parlours existed. On November 26, 1943, a bombing raid destroyed the Paul Nipkow transmitter in Berlin. This ended television in Germany. After World War Two public television in Germany started again in the year 1951.

**BOOKS (RECOMMENDED FOR FURTHER READING)**


Television in Germany


REFERENCE NOTES

2 Telehor is constructed from the Greek words „tele“ = far and „horao“ = seeing. Thanks to Dr. Antonia Traugott-Hajdu for giving me this information.
6 An excellent overview on the reported facts is given by W. Ilberg: Ein Jahrzehnt Bildtelegraphie und Fernsehen (10 years picture telegraphy and television). Telefunken-Zeitung 1933, Nr. 65, pp. 5-26.
11 Hartmann, Werner: Die Bildsondenröhre (the image dissector tube): Hausmitteilungen der Fernseh A.G. 1939, pp. 130-134.
Franz Pichler was, during 1950-54, an apprentice telephone technician at the "Fernmelde-Monteur-Schule" in Graz, Austria and was excited to build crystal sets and radios. Later he studied mathematics and physics at the University of Innsbruck, Austria, where he received the degree Dr.phil. in 1967. During his visit in 1982/83 to the State University of New York at Binghamton, he bought at an auction in Vestal N.Y. a US battery radio of the twenties which he restored to operation and showed to his students. Jim Spalik, an AWA member, took him to the spring meet in Holcomb in 1983 and to the AWA museum there where he got bitten by the radio bug. Since then he has collected books, radios and telegraph equipment. Ilse, his wife, allows him to display his collection all over the home. Since 2004 he has retired as an Emeritus professor (Systems Theory) of the Johannes Kepler University of Linz, Austria and he enjoys writing papers and books dealing with the history of electricity and information technology. He is a member of AWA, TCA and the Austrian club "Freunde der Mittelwelle" (friends of AM radio).
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Franz Pichler
ABSTRACT

This is primarily the story of a diminutive Medium / Short Wave receiver, a British-made Eddystone ‘All World Two’ (AW2; Fig. 1). Part of the story is told by Ian McQueen, the son of the set’s original Australian owner, Dr. George McQueen. Another part was by an Eddystone enthusiast and radio restorer, Gerry O’Hara, recruited (most willingly) by the present owner, Louis Vermond, to conserve, test and render the set operational. In addition, and by way of context, Graeme Wormald presents a brief history of Eddystone Radio for those that are unfamiliar with this marque. Additional information on Eddystone Radio can be found at the Eddystone User Group (EUG) website, http://eddystoneusergroup.org.uk/, and in ‘A Century of Achievement—The Laughton Story, 1860-1960’ [1].

Fig. 1. The Eddystone All Wave Two

A BRIEF HISTORY OF EDDYSTONE RADIO

The story of Eddystone Radio is forever linked with the City of Birmingham, in the Midlands of England, 100 miles north-west of London. Birmingham is one of Britain’s ‘newer’ cities, having grown enormously after the introduction of the canal system in the late 18th century. Metal goods of every description were produced and it was rightly known as ‘the city of a thousand trades’.

In the year 1860, Stephen Jarrett of Gloucestershire joined in partnership with Charles Rainsford of Birmingham. The former was a pin manufacturer and the latter a commercial traveller. Thus was started the firm of Jarrett & Rainsford and premises were taken at 7 Broad Street, Islington, Birmingham (Fig. 2). Stephen Jarrett was also a manufacturer of jewellery of all descriptions, but the main business was the
manufacture of pins. In 1870 the firm moved to larger premises at 48 Broad Street, where they were to remain for the next 39 years until early in the 20th century.

Jarrett & Rainsford acquired a new office boy in 1898. He was 15-year-old George A. Laughton who had two years' previous experience in a coal merchant's office. By all accounts, G.A.L. (as he was always thereafter referred to) was a bright young man and soon showed the entrepreneurial instinct which was to create an empire. By 1904 he was an assistant manager with the firm. (Fig. 3) In 1909 the firm moved to Kent Street, near the Birmingham markets area and just round the corner from the Bromsgrove Street location of the Balmoral Works; later to become the home of Eddystone Radio.

In the year of the Coronation of King George V, 1911, G.A.L. was running a small section of Jarrett & Rainsford, manufacturing and selling coronation badges and flags. Components were bought in from a small supplier who suffered from the ravages of alcohol and supplies were erratic. Eventually G.A.L. bought the supplier's business and acquired four hand presses and two young female workers. He named this enterprise 'Stratton'. The following year, 1912, G.A.L. was elected a director of Jarrett & Rainsford at the age of 29. The two companies followed their parallel courses, with Stratton & Co Ltd. concentrating on men's jewellery. During World War 1 the firm manufactured parts for the SE5 British fighter plane and acquired much experience in the use of aluminium and duralumin alloy. This was later to be of great value in the radio manufacturing business. In 1919 Jarrett & Rainsford became Jarrett, Rainsford & Laughton Ltd., and the following year acquired Stratton & Co Ltd. Although jewellery was back in production after World War 1, pins were still a staple part of the company's output.

In November 1922 the British Broadcasting Company ('BBC', and forerunner of the present Corporation) was formed and started broadcasting with low power transmitters in major British cities. The best known of these stations was '2LO', the London station located in the Strand. The Birmingham station '5IT' was opened the next day. Thereafter, young George Stratton Laughton soon became an enthusiastic of wireless technology and of the fledgling radio entertainment
industry.

The cinema had become a major source of entertainment during World War 1. The 'Roaring Twenties' were created by this media, especially by the film 'Flaming Youth' starring 'Jazz Baby' Coleen Moore. She introduced the 'page-boy' haircut, which needed no hairpins at all – thus Jarrett, Rainsford & Laughton Ltd.'s primary market dwindled alarmingly almost overnight. This happened towards the end of 1923 and Stratton Laughton (Fig. 4) suggested to his father, G.A.L., that the shortfall in sales be made good by entering the radio component market.

Stratton's first radio-related patent was filed in February 1925, as was the Trademark 'Eddystone' and the Lighthouse device used in the company's logo (Fig. 5). The first written reference to an Eddystone receiver is in the Wireless World listings for spring 1926 (the 'Eddystone Twin'). By the early-1930's, radio sets were being produced by the company in a bewildering variety (Fig. 6).

Eddystone receivers were used by many scientific expeditions of the 1930s, such as the British Arctic Air Route Expedition and the Hudson Strait Settlement Expedition. In 1935 work started on VHF experiments and portable Eddystone five-metre equipment was used by the 1936 Mount Everest Expedition. It was during this period that the set featured in this article, the All World Two, was produced by the company.

Like most other electrical and mechanical manufacturing companies in the UK, Stratton was brought into the war effort in 1939 to manufacture components for military use. However, disaster struck the company during bombing raids on Birmingham in October and November 1940 - virtually nothing survived the bombing and we are dependent on salvaged ephemera for all information on the company pertaining to the 1920's and 1930's. Jarrett, Rainsford & Laughton Ltd., in conjunction with the UK Air Ministry (for whom they were manufacturing radar components), took over a disused 'Lido' (holiday resort) known as 'The
Fig. 6. Eddystone receivers of the 1930s from issues of *Wireless World*
Bath Tub’ at West Heath on the southern outskirts of Birmingham (Fig. 7). During the remainder of World War 2 no further damage took place to the company’s facilities and over 4.5 million components for use by H.M. Forces were manufactured by Eddystone. Just over 4,500 transmitters, 7,264 receivers and 45,000 other supplementary pieces of equipment were supplied, for Police, Army, Royal Air Force, but mainly Admiralty requirements.

After World War 2 ended, times were difficult in the radio manufacturing business – in particular, war surplus equipment and components depressed world markets and the UK populace were facing austerity measures. At this time, the company decided to concentrate on specialised communication equipment, well-constructed for performance and stability and selling on these points rather than price; a policy which brought success for many years. In 1964 the death of G.A.L. brought the company to a crossroads. Eddystone Radio was the odd man out in a family company that produced goods largely for the cosmetic market. The family felt that the communication business had grown in complexity beyond their understanding and a decision was made to sell the radio business to one of their largest customers, Marconi, in 1965. Shortly afterwards, Marconi made a policy decision that Eddystone Radio should pull out of retailing and concentrate purely on the production of professional-grade receivers. Also at this juncture, the HF receiver market in the UK was starting to shrink as competition from the Far East started to bite. The size of ships grew, requiring fewer radios and the ocean liner ‘cabin set’ market vanished in the new ‘air travel for all’ regime. In addition, satellite communication became a practical reality – opening up some new markets, but closing others. Around 1980 the company entered the broadcast transmitter field in partnership with the BBC. This was very successful and took things into the 1990’s when Eddystone and the BBC pioneered the new Digital Audio Broadcasting (DAB) technology.

Fig. 7. “The Bath Tub” at West Heath, Birmingham
In 1995 the lease on the premises at West Heath expired and the company relocated to a small industrial estate in Selly Oak, within the City of Birmingham, ready to take up the digital challenge. Unfortunately the expected expansion didn’t materialise: the end of the cold war had seen a significant reduction in government orders for radio equipment and the increase in satellite communication further reduced the demand for professional HF receivers. Combined with an economic crash in Malaysia, where a large VHF/FM broadcast transmitter order was cancelled, this spelled the end of Eddystone’s ownership by Marconi, itself in a perilous state by the close of the 20th century. In 1999 the company was bought by Megahertz Communications. After three years in the doldrums Megahertz went into receivership and Eddystone Radio (receivers) was sold to Ring Communication. The transmitter section was then sold to SBS of Hastings and became known as ‘Eddystone Broadcast’, producing FM and TV transmitters, exciters and repeater equipment.

BACKGROUND TO THE EDYSTONE ‘ALL WORLD TWO’

The short wave enthusiast (‘short wave listener’, or ‘SWL’) and the radio amateur market of the mid-late 1930’s was a very different place than it was in the 1920’s [2]. Radio amateurs were up against more and powerful commercial stations closing-in on their short-wave ‘territory’, higher levels of man-made interference and the temptation of buying commercially-built receivers from a variety of manufacturers. There were few commercially-manufactured transmitters available and radio amateurs mostly constructed their own. In the US, companies such as National were producing the famous HRO receivers by the mid-1930’s, which could be argued set the standard for the next decade in terms of short wave receiver performance. Such receivers were, however ‘pie in the sky’ for the average radio amateur or SWL, especially in the UK. Instead, the radio press, eg. *Wireless World* and *Practical Wireless* in the UK, and in the US, eg. *Radio Craft* and *Short Wave Craft*, was prolific in publishing designs for simple receivers that claimed to be the best and that could squeeze the pips out of one, two or three tubes (Note 1), [3]. A number of component suppliers provided the necessary parts to supply this section of the market, including Stratton and Co. Ltd, under their trade name ‘Eddystone’ including complete radio receivers and kits of parts for set designs as published in the *Eddystone Short Wave Manual* (ESWM) series of publications [4,5].

All Eddystone sets up to 1934 (except the somewhat mythical 1924 ‘Regional One’ that apparently only had a single tube detector) were Tuned Radio Frequency (TRF) designs, with varying permutations of RF and AF amplifier stages [6]. This included all Eddystone kits and built receivers from the ‘Eddystone Two’ in 1926 (detector and AF amplifier only), through the various ‘Atlantic’, ‘Scientific’, ‘All-Wave’ and ‘Kilodyne’ models, the ‘Homeland’, ‘Empire’, ‘Sphinx’, ‘Overseas’ and ‘Quadradyne’ sets, culminating in the ‘All World Four’ and ‘Homelander’ designs of 1934/35. The ‘Super Six’ (Note 2), introduced around 1934, was Eddystone’s first superhet design, followed by the ‘All World Eight’ in 1936, the lat-
ter having a tuned RF stage, mixer, local oscillator, two intermediate frequency (IF) stages, detector and a push-pull AF stage – quite a leap forward in technology.

The RF or detector stage was often made to be ‘regenerative’ in TRF designs. A carefully-controlled level of positive feedback at RF could be applied to the stage concerned using a ‘reaction’ (or ‘regeneration’) control to increase sensitivity. That could bring the stage into oscillation so CW signals could be detected. Eddystone were rather conservative, in that if RF amplification was used in their TRF designs, only one stage was provided (for reasons of economy). Other manufacturers, especially in the US, frequently used two or more stages of RF amplification in lieu of the extra gain that could have been afforded by the ‘fiddly’ regenerative detector stage.

Receiver designs by the mid-1930’s, were almost universally adopting the superhet topology with screen grid tubes (Note 3) in the RF and IF stages over the TRF designs with screen grid tubes. The introduction of the pentode allowed yet more gain and stability to be achieved, though with some additional noise at higher frequencies with the earlier tube designs of this type.

Although by the mid-1930’s, Eddystone had ventured into the realm of superhet receivers, as noted above, their product line mainly comprised of simple regenerative detector designs supplied in kit form, using largely Eddystone-manufactured parts, or as ready-made sets. When compared to superhets, these regenerative designs were much simpler to construct (or manufacture) and were also much cheaper – tubes were at the time very expensive (Note 4) and squeezing the last ounce of value out of each one of them was paramount to the prudent buyer in the UK.

The ‘All World Two’ (AW2), a regenerative detector and single audio stage two tube set (the popular ’0-V-1 configuration – Note 5) was introduced in 1936 and remained in the Eddystone catalogue through to 1939 (Fig. 8). This set was probably the ‘Cinderella’ of the Stratton production line in the late-1930’s due to it using receiver techniques from the early-1930’s and being firmly in the ‘bargain basement’ price bracket – Note 6. However, it was a popular set and it continued to be sold until the outbreak of World War 2 and was then used by ‘Voluntary Interceptors’ (V.I.s – Note 7) during the early part of World War 2, before superlative National HRO’s and the mighty AR88’s were brought in from North America for this purpose – Note 8. A full description of the AW2 and its construction from a kit is available [4].

A number of tube types can be used in the AW2. The ready-built sets were supplied with a Mazda SP210 (pentode) and an Osram KT2 (tetrode) – Note 9. Alternate audio amplifier tubes are listed as Mazda Pen 220, Osram PT2 and Mullard PM22A (pentodes – noted as costing 13s 6d), or Mazda P220, Osram LP2 and Mullard PM2A (all triodes – noted as costing 7s in the ESWM3 article, down from the 1931 advertised price of 10s and 6d in a contemporary advert in Popular Wireless).

THE SET’S HISTORY

The provenance of the particular AW2 featured in this article is known and the set has a very colourful early-life, told here by Mr. Ian McQueen, son of the set’s original owner:

“The former owner of this Ed-
Fig. 8. Ad for the All World Two from *Wireless World*, 1938

dystone All World Two (AW2) radio was my father, Dr. George McQueen, late of Adelaide, Australia. Although my father died in 1989, the AW2 came to light while my wife and I were trawling through my late mother's estate in 2010. Both my father, and consequently the radio itself, have an interesting history:

My father, a physician, took up a position as a Medical Officer in New Guinea in 1932, because of the severe impact of the Great Depression on his medical practice in rural Tasmania. (in those days, the eastern half of New Guinea was administered by Australia, while the western half was administered by The Netherlands). He moved to Madang on the north coast of New Guinea, and life became reasonably settled, although of course highly isolated and at times highly challenging. (Fig. 9)

Periodically, trading ships brought basic commodities to the local general store and offered the chance of shopping for something more exotic. It may have been on one of these visits by a trading ship in the late-1930's that my father bought the AW2. Alternatively, he may have bought it on one if his periods of annual leave in Australia. Whatever the case, it would have fulfilled an increasing desire to have a contemporary knowledge of what was happening in the world beyond Madang.
– particularly in the politically highly-charged years preceding World War Two. It was known that the Japanese were relentlessly advancing southwards through east and south-east Asia. For my father, the AW2 was economical, conveniently portable and ran on batteries. It provided the means to listen to radio reports from all over the world. By the early-1940’s, the Japanese were within striking range of northern New Guinea. They had conquered present-day Indonesia (just to the north of Australia) and the Philippines. Madang itself was bombed. Fortunately for the AW2, the main target was the local gaol – the Japanese pilots probably thought that it was a military barracks – an understandable mistake, but a terrifying experience for the prisoners.

The Australian civilians in Madang asked the Australian Government for evacuation. However, the Australian Govern-
ment said that it was not possible. Rather than wait to see if the Japanese invaded (which indeed happened shortly afterwards), the Australian civilians decided to abandon Madang and retreat inland through then-unexplored territory to Mount Hagen in central New Guinea. My father was again faced with having to lose virtually everything he had acquired and take the bare minimum for the journey. It seems that he took a Bible, medical supplies, the AW2, an 8 mm Bell and Howell clockwork movie camera, movie films, some clothes and little else. They negotiated their way on foot across tropical and mountainous terrain of northern New Guinea to Mount Hagen with the aid of a school atlas. Eventually they returned to Australia, together with the AW2. Once back in Australia, he enlisted in the Australian Army and was allocated to a medical unit bound for New Guinea. As the military campaign progressed, he eventually reached Madang, from which he had earlier escaped! At the end of the War, he took up a public health position in the South Australian Government in Adelaide.

The AW2 thereafter settled into a very long hibernation at the bottom of a kitchen dresser, where it remained until 2010. The dresser moved from one family house to another, and the radio simply moved with it. For most of the last 50 years, the dresser was consigned to the shed, and the radio was joined by various household cast-offs, old income tax records and miscellaneous tools. The radio survived the periodic purges of unwanted household items, which are put out on the footpaths for later collection by large local government rubbish trucks. The climatic conditions were severe: Adelaide has a hot, dry climate, like southern California, with minimum temperatures down to about 5 °C in winter and occasional highs of 45 °C in summer. However, these conditions seem to have aided its preservation. The radio needed minimal work on its components to achieve operation – a truly remarkable outcome after being switched off for more than 50 years."

CIRCUIT DESCRIPTION AND CONSTRUCTION

As noted earlier, the AW2 is a 0-V-1 topology receiver of very simple design. The article in the ESWM3 [4] notes:

‘The theoretical circuit embodies a screened H.F. Pentode valve followed by an audio stage which can use either triode or pentode valve as desired. The aerial input circuit, although simple in design, was only satisfactorily developed after protracted experiments on many types of aerials. It ensures complete freedom from tuning blind spots [Note 10], thus saving the extra cost of an H.F. stage which is the generally accepted medium for overcoming such trouble. Regeneration is obtained by a modified Reinartz circuit [Note 11], feedback current being controlled by varying the S.G. voltage with a potentiometer [Note 12]. The high tension battery is suitably isolated to prevent current leakage through the potential divider circuit.’

The AW2 was supplied either as a ready-built set or as a kit of parts. On careful examination of the quality of construction of this set – especially the quality and consistency of the soldered joints, it was concluded that this was most likely a set that had been supplied ready-built from Eddystone.
CIRCUIT

The AW2 circuit is very straightforward (Fig. 10): the aerial is capacitively-coupled to the (aperiodic) primary winding of the aerial coil (transformer) via a trimmer (4-50pF) to adjust for varying types/lengths of aerial. The transformer primary is inductively-coupled to the secondary winding, tuned by the tank capacitor (10-150pF) in parallel with the bandspread capacitor (3-17pF), coupled to the grid of the directly-heated pentode regenerative detector tube (SP210) via a silver mica capacitor (100pF). The grid of the pentode is biased via a grid leak resistor (3Mohm). The anode load of the pentode is a 100Kohm resistor coupled to the HT line (nominal 115v DC). A portion of the amplified RF signal on the anode of the pentode is fed back to the tuned input circuit via a trimmer capacitor (70-140pF) and the small ‘tickler’ winding on the transformer. Gain of the pentode is adjusted by varying the voltage on the screen grid via the reaction control potentiometer (50Kohm) that forms a potential divider, along with a 40Kohm resistor, from the HT line to ground. The screen grid is decoupled to ground at RF and audio frequencies by a 1uF capacitor. The suppressor grid of the pentode is at ground potential. Detected audio present at the anode of the pentode tube is coupled via a silver mica capacitor (0.002uF) to the grid of the directly-heated tetrode (or triode) AF amplifier tube (KT2). The grid of the AF amplifier tube is self-biased biased via a 1Kohm resistor, decoupled to ground by a 1uF capacitor, and 1Mohm grid leak resistor. The anode load of the AF amplifier is formed by the high impedance ‘phones (nominal 2Kohms) and the anode is decoupled at RF and higher audio frequencies by a silver mica capacitor (0.002uF). The on-off switch connects the negative filament supply and negative HT supply to chassis ground (the latter via the 1Kohm bias resistor).

It is interesting to note that the ESWM3 mentions that the performance of the AW2 can be extended by the use of an RF amplifier (a suitable RF amplifier is described in the same issue of the ESWM [5]).

PASSIVE COMPONENTS

The quality of the passive components, in particular the coils and the bandspread tuning unit, as well as the use of a rigid die-cast aluminium chassis, really set this radio apart from many other sets of similar circuitry. The bandspread tuning unit was sold as a

![Fig. 10. All World Two schematic](image-url)
component ‘outfit’ by Eddystone at the time, comprising a ‘tank unit’ (‘Patented Tank Condenser with Knob and Graduated Dial Plate’, #1042) and a ‘bandspread unit’ (‘Bandspread Condenser Unit with Slow Motion Head, Knob, Dial and Cursor’, #1043). (Fig. 11) The description in a contemporary Eddystone catalogue [7] reads:

“The “EDDYSTONE” bandspread method of short wave tuning is devised to simplify station selection. Two Condensers are used, the first or Tank Condenser being a compact Air Dielectric unit having a capacity range of 10 x 140m.mfd. This is achieved with a patented stop device graduated in 10 steps. Each step covers a capacity of 14 m.mfd, band settings being accurately pre-determined and controlled by a black bakelite switch knob moving over a metal dial plate graduated 0-10.

Parallel with the Tank capacity, the “EDDYSTONE” bandspread slow motion trimmer having 9:1 reduction ratio is used. It has a capacity range slightly greater than each separate step of the Tank Condenser. This enables each 10th section of the whole to be spread over 180°, and provides a tuning ratio of 90:1. It gives a definite advantage in short wave tuning, in that a fairly large movement of the bandspread condenser is necessary to effect small changes in tuning, thus separating stations which with generally accepted tuning circuits appear too close to one another to allow clear separation [Note 13]. The trimmer is absolutely noiseless in operation and has a smooth positive control action.’

The bandspread and tank capacitors are both of Eddystone manufacture and are of very high quality construction in brass – the tank capacitor having a 10-position detent plate fitted.

The coils used in the set are from Eddystone’s range of air cored 1.5” diameter 6-pin, 3 winding ‘low-loss interchangeable coils’, #959, that cover 9m through 2,000m in nine ranges (according to the contemporary Eddystone catalogue [7]). These three winding coils (there is also a 4-pin range of two winding coils) were specifically designed for regenerative receiver designs (Note 14). The two coils supplied as standard with the AW2 were ‘6LB’, #959, Code EXLIB (light blue spot), covering, according to the Eddystone catalogue, 12 – 26m (25 – 11.5MHz) and ‘6Y’, #959, Code EXYEL (yellow spot), covering 22 – 47m (13.6 – 6.4MHz). A single mating 6-pin base (#964) is provided on the chassis. Actual frequency coverage with each coil in the AW2 varies somewhat from that listed.
in the catalogue and is closer to that indicated in the AW2 manual, where the ‘6LB’ is noted to cover 15.5 – 20.7m (19.35 – 10.1MHz) and the ‘6Y’ is noted to cover 26.5 – 52.7m (11.35 – 5.69MHz). The actual range covered by each coil will vary between receivers and also with tweaks to the reaction and aerial trimmers. Additional information on the coils can be found in [8].

The reaction control potentiometer (unknown manufacturer) is a 50Kohm unit - likely wire-wound, but it was not opened-up to check, described in the ESWM construction notes as a ‘Special 50,000 ohm Variable Potentiometer’. This has a very smooth feel to it and is likely a high-quality unit.

The remaining passive components comprise five carbon composition resistors (Erie manufacture), three silver mica capacitors (Dubilier manufacture), two mica compression trimmers – aerial trimmer (‘Eddystone Short Wave Mica Trimmer Condenser’, #1023) and 70-140 pF reaction pre-set (unknown manufacture), There is a dual 1uF oil-filled paper capacitor (rated at ‘500v AC test’) in a can embossed with the Eddystone logo, a ‘three point switch’ (one pole connects to the other two when ‘on’) of ‘Arrow’ manufacture, and 1/8” ‘Clix’ parallel (‘Wander’) sockets for high-impedance ‘phones and aerial/ground.

**TUBES**

As noted earlier, a number of different tube types can be used in the set [9]. The ready-built sets, such as this one, were supplied with a Mazda SP210 (pentode) used as the regenerative detector, and an Osram KT2 (tetrode) used as the AF amplifier. The SP210 has a coating of grey metallic paint over the glass envelope that acts as an RF screen, which is connected to pin 4 of the tube. This screen on the supplied SP210 was damaged immediately above the tube base so continuity with the lower part of the metallization was suspect. Otherwise, the two tubes were physically in good condition on arrival.

**CONSTRUCTION**

The set is constructed on a cellulose-painted aluminium box casting and a crystalline black-finished steel front panel. The chassis is housed in a welded steel cabinet (#1061) finished with the same black crystalline paint as the front panel (Fig. 12).

Looking from the front of the set, the RF components are located to the left and center of the chassis, and the reaction potentiometer and audio circuitry to the right. Point-to-point wiring is used throughout (not surprising on such a simple design), however, it is evident that careful thought has gone into the layout – typical of Eddystone – including grounding points and wire dressing to afford reliable operation free of unwanted feedback even at the higher frequencies covered by the set, as well as ergonomics and symmetry of the...
Generally, one component that does not withstand the test of time (and use) too well is rubber insulated wiring. The rubber insulation tends to become either brittle or turns to a sticky 'goo' with age. Although the wiring used in the AW2 is of this type, apart from the ends of the battery wires (where the insulation was very brittle and falling off), the rubber was fairly supple and did not need to be replaced.

INITIAL IMPRESSIONS, TESTING AND SWITCH-ON

Each of the components was tested in-situ. The only visual clue that there may be something amiss was that there was an oily residue on the twin 1uF capacitor block.

All resistors tested within 20% tolerance apart from the 1Mohm one, this providing bias voltage to the grid of the AF amplifier tube – rather surprising as many resistors of this age (particularly higher value ones) have drifted well out of tolerance, sometimes by as much as an order of magnitude. The value of the 1Mohm resistor was found to be only slightly high (and is not critical), so the original part was left in circuit. The silver mica capacitors showed no leakage and were very close to their marked values. Both coils showed continuity through each of their windings and the tank and bandspread capacitors functioned as they should. The only real issues identified were:

- The potentiometer, while testing at a nominal 50Kohms, showed some erratic behaviour when rotated through its range (likely attributable to dirt on the track); and
- The 3 position power switch was intermittent in its action (not always switching both the HT and LT to ground when ‘on’)

With the passive components generally testing ok and the tube filaments having continuity (and readily-available tube testers not having the correct sockets to test them further), it was decided to apply some power to the set and see if it worked. The perished section of the power supply leads from the AW2 were removed and the rubber insulation beneath the fabric sheath found to be supple and in good condition. The insulation was stripped-back, the wires labeled per the manual and connected to a homebrew ‘Farm Radio’ (Note 15) power supply set for 2v filaments and 135v HT. With the tubes removed from their sockets, it was confirmed that the correct voltages were present at the tube sockets and on the anode cap connector of V1. The tubes and one of the coils (yellow spot) were re-inserted and high impedance ‘phones, a short vertical aerial and a ground connected to the set. Unfortunately the ‘phones were open circuit, so, instead, a 2.2kohm resistor was connected across the phones socket and coupled to a small (computer-type) amplified speaker, isolated using two 0.1uF,
250vW capacitors. On switching the set on again a nice 'wooshhh' sound was heard when the reaction control was wound up, breaking into oscillation if wound even higher. On tuning around, several stations came in as well as some heterodynes – a little practice and operating the three controls became second nature. A signal generator was set to 10MHz, the set tuned until it was roaring in, and on switching the signal generator off WWV was heard loud and clear, followed by many other stations on the 31m and 40m bands - it is quite amazing what a couple of tubes and less than a handful of components can do!

CLEANING-UP AND CONSERVATION OF THE CHASSIS AND CASE

On opening the case it was noted that it contained an ounce or so of fine sand(!) – with only minor levels of grime on the upper side of the chassis, some splashes of flux on the underside, and an oily residue along rear edge of the bottom of the inside of the case. There was a minor build-up of fluff and dust on the lubricated parts of the slow-motion drive (bandspread tuning capacitor) and in the tank capacitor, a coating of (leaked) oil on the dual 1uF capacitor can and some oily residue on one resistor (from the capacitor can). Warm soapy water and a small stiff brush cleaned off most of the remnant grime after brushing off loose dust with a small soft paintbrush and vacuum, the oily residue being wiped clean with lighter fluid. The flux residues were carefully picked-off. Once cleaned, De-Oxit was applied to the tank and bandspread capacitor moving contact surfaces and a little moly grease applied to the tank detent mechanism (ball bearing) and bandspread capacitor shaft ball bearing.

The painted steel front panel and cabinet were generally in good, clean condition. However several areas of bare metal and/or rust were present, particularly on the corners/edges and along one side of the cabinet (looks like the receiver had been pushed into a recess and rubbed against something), as well as some isolated areas on the top and base of the cabinet. The condition of the paintwork, whilst not perfect, was reasonable and a decision was made by the owner to conserve rather than restore this set, thus preserving its history. It was therefore decided to stabilize the rusted areas using 'Naval Jelly' (phosphoric acid gel) rust converter/inhibitor applied topically to the affected areas. The treated areas were then toned-in to the surrounding paintwork using a black marker pen. In a couple of areas the paint was flaking off and this was re-affixed to the underly- ing metal with a spot of superglue.

The main tuning knob was cleaned with warm soapy water and then polished using Novus #3, #2 and #1. Only the minor scratches were removed, with the deeper scratches being left in place as patina. The grub screws in the two smaller knobs were stuck tight. Penetrating oil was applied and left in for a week, trying at intervals to loosen the grub screws – but to no avail. Rather than risk breaking the grub screws, it was decided to clean the knobs in-situ, using warm soapy water, then Novus #2 and #1.

The black Tank and Reaction control escutcheons were wiped gently with warm soapy water, as was the bandspread tuning escutcheon. The pencil marks on the bandspread tuning (likely representing favourite stations of
Dr. McQueen) were left in place, again to preserve the set’s history (Fig. 14).

The two plug-in coils were carefully cleaned with warm soapy water and Q-Tips and a light coat of De-Oxit applied to the prongs and to the tube and coil holders.

**FINAL TESTING AND INITIAL USE ON THE AIR**

Having now cleaned the receiver, and, in particular cleaned and lubricated the variable capacitors, it was time for another air-test, this time with it installed in its case. However, on switch-on, the on/off switch was found to be still intermittent in operation. So, the switch was removed from the chassis, held with the toggle facing upwards and De-Oxit sprayed into the movement. After several such applications and working the switch on/off several times, the contact resistance dropped to less than 1 ohm and its operation was now reliable. The switch was re-installed into the chassis and the chassis back into the case.

A short vertical aerial was again coupled up, as was a ground, and the homebrew power supply, together with the external anode load resistor, isolating capacitors and amplified speakers. The set worked much as before, although tuning repeatability was better and the set just ‘felt better’ looking cleaner, tidier and much as it would have done at the outbreak of World War 2.

The AW2 was lined-up against a couple of other (more recent) Eddystone receivers – a trusty Eddystone S.750 (dual-conversion tube set dating from 1950) and a Model 1830/1 (solid state set dating from 1973) using the same aerial.
Whilst it must be admitted that the AW2 was not in the same league as either of these much-later and more technologically-advanced sets, it did not put in a hopeless performance either. It pulled-in all of the strong and most of the medium-strength stations that the later models did, but, as expected, was much more susceptible to interference from strong stations close to the tuned frequency.

Amateur bands covered by the two coils supplied with the set are 20m, 30m and 40m. The AW2 was tried out on 40m to see what sort of bandspread the set had for the Morse code (CW) section of that band (lower 35kHz) and the tuning characteristics were found to be as follows (using the 6Y coil):

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Tank Capacitor</th>
<th>Tuning Cap.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.00</td>
<td>6</td>
<td>41.1</td>
</tr>
<tr>
<td>7.10</td>
<td>6</td>
<td>30.7</td>
</tr>
<tr>
<td>7.15</td>
<td>6</td>
<td>0.0</td>
</tr>
<tr>
<td>7.15</td>
<td>5</td>
<td>86.2</td>
</tr>
<tr>
<td>7.20</td>
<td>5</td>
<td>76.5</td>
</tr>
<tr>
<td>7.25</td>
<td>5</td>
<td>68.9</td>
</tr>
<tr>
<td>7.30</td>
<td>5</td>
<td>59.4</td>
</tr>
<tr>
<td>7.35</td>
<td>5</td>
<td>49.9</td>
</tr>
</tbody>
</table>

The bandspread capacitor shaft is fitted with a 1:9 reduction drive, giving a $\frac{1}{4}$ turn of the main tuning knob = 10 divisions of the bandspread scale.

Some CW signals could be heard on the 40m band, though no phone signals were detected on this band. Nothing much was heard on the 30m band, but several CW signals were detected on 20m. The exciting thing was that several SSB signals were also heard loud and clear on 20m. This is maybe not stellar performance, but given the poor aerial not unexpected – and, of course, the set was not really meant for amateur band use (and certainly not under 2010 conditions).

Two new old stock tubes arrived after this initial testing (a Mullard PM22A and Mullard SP2) and were eagerly tried in the set. Performance was much the same as with the original tubes (Mazda SP210 and Osram KT2), though the reaction control needed to be cranked-up a little higher with the SP2 in the set (Fig. 15).

What really made a difference though was using a pair of Stromberg-Carlson high-impedance 'phones – these really made the set more sensitive and 'come alive' – much more so than the speakers as the 'phones also act as a mechanical audio filter, accentuating speech frequencies. The full tuning range of each coil was explored with the new tubes fitted. A set of calibration curves for the Bandspread dial for each setting of the Tank capacitor was prepared and is posted on the EUG website (http://eddystoneusergroup.org.uk/).

CONCLUSION

The AW2 is a very simple, yet very effective short wave receiver. Considering its low component count it gives a very good showing for itself on the short wave broadcast bands – it can be seen...
why it was a popular set for those on a budget and/or those wanting portability (it weighs-in at a mere 6lbs and measures 8.5” x 6” x 7"). What set it apart from many of its competitors is the high-grade components, in particular the coils and variable capacitors – a mini-showcase for the Eddystone short wave component catalogue (Ref 7). Ease of use was looked-after by the superlative bandspread tuning feature and the very smooth reaction control characteristics. Albeit this set was introduced in the twilight years of the regenerative receiver, when simple TRF sets had become all but eclipsed by the mighty superhets, these characteristics allowed the set to be marketed up to the onset of World War 2 and used into the war years by the Voluntary Interceptors – quite a remarkable achievement for such a diminutive radio.

Louis, VE3AWA, present owner of the set, will be matching-up the AW2 with his ‘one-valver’ self-excited transmitter having a majority of 1920s era English wireless components. He is planning on using this set-up in the annual Antique Wireless Association’s ‘Bruce Kelley Memorial 1929 QSO Party’ in December, 2010 (www.antiquewireless.org/ - see ‘Upcoming Amateur Radio Events’).

ENDNOTES
1) For example, refer to the ‘1934 Official Short Wave Radio Manual’ originally produced by Short Wave Craft, edited by Hugo Gernsback and reproduced in 1987 by Lindsay Publications (often still available second-hand). This volume includes many simple receiver designs with enticing claims / names such as ‘Reaches the 12,500 Mile Mark’, Globe Trotter’, ‘Wonder Set’ and ‘Tinymite’, along with many more complex receiver (and transmitter) designs for the home constructor.

2) Not mentioned in the ‘Quick Reference Guide’ (QRG), downloadable from the Eddystone User Group (EUG) website (http://eddystoneusergroup.org.uk/), but is covered in Lighthouse issues 71 (p15), 80 (p20) and 96 (p44). Very few were made. (‘Lighthouse’ and its forerunner the ‘EUG Newsletter’ can also be downloaded from the EUG website).

3) Screen grid tubes much-reduced the Miller Effect, giving higher gain/more stable TRF designs without the need for neutralizing. They were developed in 1919, but not introduced into general use until 1927.

4) At one point a royalty was paid on each tubeholder in a set – another reason to keep the tube count down and maximise what the tubes you did have could achieve.

5) This nomenclature was often used to depict the line-up of tubes in a set. The ‘V’ stands for the detector tube, with the preceding digit identifying the number of radio frequency amplifier tubes and the subsequent digit the number of audio frequency amplifier tubes.

6) The QRG notes that it was offered in 1936 as a kit (plus tubes and case) for £3 7s 6d or ready-built and tested (complete with tubes and case) for £5 5s, falling to a mere £3 17s 6d by late-1939. The set, complete with headphones and batteries (1930’s version of ‘plug and play’?) was also offered on ‘Hire-Purchase’ terms were offered to tempt short wave listeners on a limited income, for only £1 down and six monthly payments of 16s and 4d – the starting pay for an office boy at the time is noted as being around 5s weekly.

7) V.I.s were civilian amateur radio enthusiasts and short wave listeners who monitored enemy Morse signals from their homes for military intelligence purposes.

8) These sets were in a completely different technological (and financial) league to the diminutive AW2 and must have been a
revelation to the V.I.s.

9) The KT2 is a 'critical-distance' tetrode design based on a patent taken out by J Owen Harries, a British engineer who identified that when the distance between the second grid (screen) and anode is extended a critical distance, the potential between the anode and screen becomes low due to the space charge, limiting the tendency for secondary electrons from the anode to travel to the screen. This type of tetrode is efficient only in lower power applications (up to half a Watt) and should not be confused with the ‘kinkless’ aligned-grid beam tetrodes (such as the KT66) which were capable of much higher output power. The term ‘kinkless’ refers to a tetrode tube that has design features that mitigate an undesirable characteristic of a normal tetrode tube that exhibits a kink in the anode current v anode voltage characteristic curves caused by secondary electrons emitted by the anode reaching the screen grid.

10) ‘Tuning blind spots’ were common in such simple designs, caused by damping of the aerial tuned circuit by excessive loading from the aerial and/or unwanted resonances resulting from stray capacitance/inductances or a combination of stray and circuit component capacitance/inductances.

11) Reinhart was a well-known radio amateur in the early-part of the 20th century. He designed a receiver that would oscillate to whatever frequency the grid was tuned to. The original Reinhart circuit featured a combination of capacitive and inductive feedback using a specially wound ‘spiderweb’ coil with tapped primary, secondary, and ‘tickler’ (positive feedback) windings. The primary winding tuned the antenna and provided loose-coupling to the secondary.

12) Controlling the regeneration in this way, by varying the gain of the tube, provides a much more stable and controllable method than by attempting to vary the coupling between input and output of the tube (in the AW2 circuit, this coupling, provided by a trimmer capacitor, is set once and then not adjusted again).

13) Maybe a little misleading at face-value: yes, the bandspread would allow greater movement of the tuning knob for any given frequency span covered, however the usefulness of this facility is really limited by the selectivity of the receiver.

14) An excellent article on Eddystone coils is presented in Radio Bygones issue No. 125 (see link from http://www.epemag3.com/) and is a ‘must read’ for anyone that owns some of these coils and would like to identify them and/or put them to good use.

15) ‘Farm Radio’ is a term often used in Canada and the US for battery-operated sets that continued to be sold to farmers and folks in small towns through the 1930’s onwards that did not have an electrical power utility supply (‘mains’).

REFERENCES

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5. One Tube High Frequency Amplifier. Eddystone Short Wave Manual Issue No. 3 (ESWM3), pp34-38, can be downloaded
from the EUG website, [http://eddystoneusergroup.org.uk/](http://eddystoneusergroup.org.uk/)


7. 1936-7 *Eddystone Components Catalogue*, can be downloaded from the EUG website, [http://eddystoneusergroup.org.uk/](http://eddystoneusergroup.org.uk/).


9. *Eddystone All World Two* Battery Operated Receiver. Instruction Manual For Installation and Operation (original provided with set), can be downloaded from the EUG website, [http://eddystoneusergroup.org.uk/](http://eddystoneusergroup.org.uk/).

**PHOTO CREDITS**

Photos 1, 5, 12–15 by Gerry O’Hara.

Photos 2 – 4, 7 from *A Century of Achievement*, G.A. Laughton.

Photo 6 from *Wireless World*, 1938.

Photo 9 from

Photo 10 from the Eddystone AW2 Instruction Manual.

Photo 11 from the *Eddystone Components Catalogue*, 1936-37.

**ABOUT THE AUTHORS**

Gerry O’Hara, BSc (Sp. Hons), M.Phil (Eng), C.Eng, P.Eng VE7GUH/G8GUH was born in 1955 in Carlisle, UK. He became interested in electronics in 1968 – initially inspired by his father, who had constructed a tube audio amplifier/pre-amplifier for Gerry’s 13th birthday. He became a licensed radio amateur with the call G8GUH in 1972. Gerry graduated from Sheffield University in 1976 and gained a masters degree in engineering in 1990. Family, travelling and career pressures put a hold on his radio interests between 1982 and 2004 when he saw a breadboard construction 5 tube TRF receiver for sale at a local flea market. Restoring that radio re-kindle his interest in radio as a hobby and since then he has enjoyed restoring many Canadian, US and UK-manufactured domestic radios and ‘classic’ communication receivers. In 2006 he became bitten by ‘Eddystone radio bug’ and has now restored over twenty communication receivers manufactured by Eddystone.

Gerry resides in Coquitlam, near Vancouver, Canada with his wife and two grown-up children, and is licensed there with the call VE7GUH. When his job allows (he is a Senior Principal of a major international consulting engineering company), he can be found in his own workshop, the workshop of the Society for the Preservation of Antique Radio in Canada (SPARC) radio museum ([http://www3.telus.net/radiomuseum/](http://www3.telus.net/radiomuseum/)), where he is a Director, or editing ‘Canadian Vintage Radios’, the publication of the Canadian Vintage Radio Society (CVRS). Gerry is the author of many articles on Eddystone receivers and radio restoration in general and his work has been published in Radio Bygones and Radio Waves. His email address is [gerryohara@telus.net](mailto:gerryohara@telus.net).
In his early years, **Graeme Wormald** was a 1st Lieutenant Flying Officer in the Royal Air Force (RAF). On leaving the RAF he joined the British Broadcasting Corporation (BBC) as a laboratory technician in 1953, working at several BBC transmitter installations, including those at Skelton, Cumbria and Sutton Coldfield, West Midlands. After the BBC he worked for Associated Television (ATV), then Central Independent Television (Central), as a Vision Controller, a position from which he took early retirement. Graeme currently lives in Bewdley, Kidderminster, Worcestershire, UK.

Graeme became a licensed Radio Amateur in 1949 with the call G3GGL, which he holds to this day. He has had an interest in the Eddystone marque of receiver for many years, becoming involved with the production and distribution of the Eddystone User Group (EUG) Newsletter in 1996 and then took over as editor of this publication in 2000 when it became ‘Lighthouse’. He remained editor (and a major contributor) for Lighthouse until it ceased publication in 2006, by which time he had grown it into some 50 pages per bi-monthly issue. Although the EUG ceased to exist as a subscription-based group in 2006, it lives on as a web-based resource for Eddystone radio enthusiasts ([http://eddystoneusergroup.org.uk/](http://eddystoneusergroup.org.uk/)) and forum ([http://uk.groups.yahoo.com/group/eddystone_radio_users/](http://uk.groups.yahoo.com/group/eddystone_radio_users/)). Graeme is also Treasurer for the EUG Trust that runs the website.

**Ian McQueen** is the son of George McQueen, the original owner of the Eddystone AW2 radio described in the article.
The formal establishment of Globe Electric Company as an electrical sales and manufacturing concern has reached its centennial anniversary in 1911. Originally founded to offer electrical plants for smaller communities and rural applications, the changing business climate required new products and markets to survive. One market, though short-lived, was the manufacture and sales of battery operated radios. Although production lasted only about four years, a proliferation of models was sold. A number of examples, as well as factory documentation, have survived to the present day. The objective of this paper is to document the range of radio receivers produced and review the distinguishing features of the major model variants.

February 1, 2011, marked the centennial anniversary of the Globe Electric Company. On this date in 1911, Articles of Incorporation were filed by G. W. Youngs, David Decker, and J.H. Gugler with the state of Wisconsin to charter a company to produce and deal in electricity and associated power plants for both public and private uses. The new business had a working capital of $200,000. (1) Little else is known about the earliest years of operation, but it appears the company functioned as an incorporated partnership. (2)

Seeds for the new business were actually sown as early as 1905, when Oscar Werwath realized that students at his Milwaukee School of Engineering (MSOE) needed financial assistance to attend the school. To provide such assistance, Werwath founded the Milwaukee Electric Construction Co. at which students coupled their training with salable products. One such product was a lead-acid storage battery. The battery business grew to the point that Werwath transferred the line to private investor associates in 1911, leading to the formation of Globe Electric Co. (3)

Formal organization of the company was not documented until April 18, 1914, when the corporate charter was received from the state and stockholders and officers were established. The initial slate of officers was:

- G. W. Youngs President
- J. H. Gugler Vice President
- D. M. Youngs Secretary
- W. H. Cameron Treasurer

It was subsequently announced that U.S. Patent 940008, for an electric lighting system and associated appliances would be assigned to the company by the inventor, J. H. Gugler, in exchange for 1500 share of common stock, par value $150,000. (5) The initial business meetings were held at 195 Broadway Street in Milwaukee. (1) Note that Milwaukee street names and addresses were reorganized in 1930. The
original Globe location continues to exist at the present day address of 161 N. Broadway.

The earliest known reference to a Globe power plant was an integrated set of components initially operated in March, 1914. A Venn Severin oil engine was used to drive a 21kW C&C Manufacturing Co. generator. Located at Bagley, IA, the installation was included in a state-wide power plant survey conducted by Iowa State College. (6)

The earliest known catalog published by Globe Electric Company appeared in April 1915. Although it states “This is our first attempt at issuing a descriptive catalog,” it is labeled Catalog Number 2. The products described are more apropos for farm and rural lighting, consisting of dynamos producing 800 – 1400 W of power at 30 VDC. (7).

The business grew to the point such that by 1919 other parallel and competitive businesses were acquired. (8, 9) At the same time, new company officers, C. O. Wannvig and his brother J. D., Jr., joined the company. (9) Globe Electric was operating at three downtown Milwaukee locations. (10, 11) The following year, all manufacturing operations were relocated to a 45,000 sq ft factory located at 14 - 28 Keefe Avenue, Milwaukee (present day 900 E. Keefe Avenue), Figure 1. (9, 12, ) It appears that by this time the company had consolidated their product offerings to direct or belt driven generators producing 1250W at 32VDC and a variety of storage battery capacities, appropriate for farm and rural use. (13-15)

The post World War One depression hit Globe Electric hard. By 1921, sales had dropped to $300,000 with losses reaching $100,000. The business was kept alive through the personal financial contributions of its board. (12) Miraculously, Globe was saved through the sale of 100 generating sets to the U.S. Army in 1922 and both sales and profitability improved. (9) In spite of this large sale, the lighting plant business was on a deteriorating course. It was during this period that the company entered both the automotive and radio battery businesses. (9) An early illustrated ad for Globe’s radio storage batteries appeared in 1922, Figure 2. (16) The complete line of Globe’s radio storage batteries were summarized in their Bulletin number 2. (17)

Although many company documents identify 1923 as the start of radio production, some evidence would suggest that the first radios were actually built and sold some time in 1922. Perhaps this started as a trial jobbing activity that grew

Fig. 1. Globe Electric Company Plant on Keefe Avenue, Milwaukee. (36)
to a full business operation. The radio business took off, as production had reached 60 sets per day by November, 1923, and was still growing. (12) Demand for workers was so great by October 1924, it was suggested that women be hired for radio assembly, a suggestion that was not implemented during the years of radio production. (9)

A variety of surviving company documents and histories incorrectly state that radio production ended in 1925. (9, 18) In fact production continued through the whole product season of 1926, concluding some time in 1927. This is substantiated by publicity of the 1926 models in trade journals (19), as well as a surviving copy of Sales Bulletin including the radio product line dated February 10, 1927. (20)

After production of an estimated 27,000 radios, Globe Electric discontinued radio set production some time during 1927, although the exact date is uncertain. A number of factors led to this conclusion. First, despite attempts to modernize the appearance of their products, Globe continued to use battery operated TRF circuitry at a time when superheterodynes and line voltage operation were penetrating the market. To seriously compete would require major redesigns of their products. Second, with the 1925 acquisition of the Central Radio Laboratory (Centralab, CRL), Globe had entered the radio component manufacturing business with the potential to supply common products to a much wider customer base of radio manufacturers. (9) In addition, CRL possessed patent coverage for a popular compression resistance rheostat/potentiometer design, many examples of which survive today. This was a much less risky proposition than radio set production and disposal of completed inventory, sales of which were dependent on consumer acceptance. Globe had already experienced the impact of market place unpredictability, as they had to dispose of obsolete inventory through a series of Radio Bargain Price Lists in 1926. (21, 29, 39) Finally, Globe’s storage battery business was swept to new volumes with its supplier agreement with Sears, Roebuck and Company and exceeded the capacity of their single plant. (9) C.O. Wanvig, who succeeded as Globe’s president in 1925, did not indulge marginal product lines. The radio receiver business was simply no match for the sales generated by the storage battery and radio component businesses. (9, 22)

Throughout their approximately 4 years of radio production, Globe products were in a state of continuous change. Individual...
model numbers apparently were assigned almost at random. A single number may actually have been used for multiple electrical chassis variations and/or physical appearances, some associated with model seasons and others not. In addition to the base model (with no tubes, batteries, or accessories) Globe generally offered an intermediate package of radio plus tubes as well as a high-end complete package including radio, tubes, earphones/speaker, batteries, and antenna. The three levels of completeness generally employed catalog numbers similar to the radio model numbers, all for a single model receiver. Attempts to assess the original retail prices meet with similar variety, as Globe employed a number of different sales structures as well as substantial discounting to dispose of obsolete models. A final confounding factor in assigning priority of a given model is the general lack of accurately dated material, including a number of surviving Globe product catalogs. The most useful items for documentation are dated price lists, newspaper and magazine ads, and a sequential serial number system apparently implemented some time in 1923.

In a survey of factory and published literature, as well as the radio collecting community, a total of 50 different Globe model numbers and configurations have been identified. A quick review of the summary of known Globe Electric model numbers in Table 1 reveals little discernable pattern in their numbering scheme. Overall, it appears that there is no predictability in how a particular model number may fall in the production or chassis sequence, panel design, or layout. In fact, Globe Electric radios reflect a true work-in-progress to the extent that a single model number could be used for at least 2 major and multiple minor design changes across model runs/years. The best approximation for dating the vintage of a Globe radio lies in the nameplate style and serial number (when present). Figure 3 illustrates the major nameplate styles. Globe instituted a sequential serial numbering system some time in late 1923 – early 1924 that extended through the remaining production years. Earliest examples were hand etched numbers on the rear of the front panel (serial numbers below approximately

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![Image of Globe Electric radio and nameplates]

**Fig. 3.** A – Earliest Globe Nameplate ca 1923; B – Globe Lightning Bolt Logo on Metal Nameplate, Second Style; C – DuoDyne Engraved Panel, Third Style; D – Globe Lightning Bolt/DuoDyne Engraved Panel ca 1926
2250), as well as the more typical nickel plated zinc serial number strip located at various locations on the top of the chassis. Beyond this, few useful generalizations are possible.

The balance of this article is intended as a photo survey of the major model types in approximate order of original introduction. In cases where limited examples were available, general condition and/or minor modifications are evident in the examples presented. The author welcomes any information of undocumented models as well as model and serial number identifications from additional radio collections.

**MODEL 605 / 610 / 615**

The first documented Globe radios consisted of the Model 610 detector, 615 two-tube amplifier, and 605 single panel combined detector and amplifier, shown in Figures 4 and 5. The brass nameplate includes an illustration of a world globe. An internal paper label on the detector lid appears on the earliest variations. These models predate the earliest known company price list of July, 1923. Radio production apparently started some time in 1922, appearing in an early Montgomery Wards ad as a Model 610 detector without the Globe nameplate. This is not surprising, as Globe jobbed radios for several different retailers during their early radio production. In addition to Wards, an identical two piece detector & amplifier set and a single panel combined set were offered by Monroe McKillip of Chicago as the Monroe D-7, A-7, and DA-7, respectively. These sets were in every way identical to the Globe models, down to the BASCO (Briggs & Stratton) components used in their construction, with sets illustrated throughout the 1923 issues of QST. It is unclear if this was a simple jobbing relationship or parallel use of components. A last possible nameplate variation appears in Globe company records that report detector and amplifier units bearing the “Amana” name.
Although the configuration of these units is uncertain, as examples of either literature or hardware of these models are unknown, it is speculated that these were rebranded examples of the Models 610 and 615.

**MODEL 607 / 611 / 616**

Following the pattern set in their first models, Globe offered the Model 611 one-tube regenerative detector, 616 two-tube amplifier, and the 607 three-tube detector-amplifier combination, Figures 6, 7, and 8. (28) The nameplates appear to have the encircled globe logo similar to the earlier Models 610 / 615. List retail prices were $25 a piece for the detector and amplifier and $55 for the one piece model 607. A complete regenerative outfit with tubes, batteries, headphones, and antenna retailed for $100 including the 611/616 (outfit 600) or $105 including the 607 unit (outfit 601). (24) Reportedly, these sets were described in detail in a pamphlet titled “Globe Regenerative Radio” (29); however, copies of this brochure are unknown.

The only known example of the 611 detector, Figure 9, is substantially different from the catalog illustrations in appearance. A peephole was retained and a larger black and aluminum nameplate with a new “lightning bolt” Globe logo appeared. Unlike the earlier 610, the 611 employed spider-web wound coils, “acknowledged the most efficient type known for radio purposes”, for both inductance and regeneration. (28) It is unclear if the catalog illustration versions of the 611/616 were ever actually built for sale.

The Model 607 is the first of the tall panel models that Globe offered. Consistent with catalog illustrations this model does have...
peepholes; however, existing models consistently feature the newer ‘lightning bolt’ nameplate. Examples of this model having either two (Figure 10) or three peepholes have been observed.

An unusual feature found in both the 616 detector and the 607 detector/amplifier is an additional Klitzen metal nameplate/patent license tag attached to the inside hinged covers. It is known that Klitzen sub-licensed their Armstrong license to other manufacturers, which also appears to be the case with the Globe regenerative sets. Unlike the Klitzen/Michigan Radio sets, no serial numbers were added to the license tags in the Globe radios.

MODEL 820

The Model 820, shown in Figure 11, is a single panel, 4-tube combined detector-amplifier radio that appears in Radio News in the February, 1924 issue. (30) The Globe advertising brochure, “Modern Magic”, reportedly describes this model in detail (29), unfortunately copies of this document are unknown. Other Globe literature had described the 820 as “An ideal set for country use, 50 miles or more from 500 watt or higher powered stations.” (29) One UV200/300 detector tube and three UV201/301A tubes were recommended. With appropriate adjustment of filament voltage, the user could also employ either UV199 or WD12’s with an adjustment of the voltage on the B20+ binding post. (31) The 820 employs a single variable tuning condenser and two filament rheostats. Oddly, three peepholes are used to observe the 4 tubes. All components are mounted on a wood chassis.

Although the 820 has not been found under any other nameplate except Globe’s, several interesting derivative models exist. The Advance Electric Co. (Milwaukee) Model 1820 appears to be the Globe 820 with the inclusion of individual peepholes and rheostats for each of the four tubes. (Figure 12) Construction and components are otherwise identical. City directories for this period provide the same Keefe Avenue street address.
for both Advance Electric Co. and for Globe Electric. (32) Company records and other documents do not clearly indicate the reason for creation of a separate nameplate.

A second variation, identical in layout and construction to the Advance 1820, exists in the form of a Fidelity Model 1280. (Figure 13) This set was sold by New England Mills, a Chicago retailer. They offered a broad catalog of radios, household appliances, sporting goods, and automobile accessories. (33) One notable auto item was their “Fidelity” auto bodies, which were made to fit and upgrade Model T Fords and Chevrolets in the early 1920’s. (34)

The final and most puzzling variation is a Globe radio that bears a model 820 nameplate, but is unlike other existing 820 models. (Figure 14) A large “Antenna” tuning knob has been included to the left of the standard large “Selector” knob and the peepholes have been removed. The chassis is wood and employs components and construction methods consistent with the more prevalent Globe 820 sets. It appears this design change was intended to improve the selectivity of the receiver and was perhaps a prototype. Comparable sets, advertising, or other documentation have not been found related to this specific design.

By July, 1923, the 4-tube Model 810 Radio Frequency Receiver and Amplifier appeared in Bulletin No. 21 as Globe’s top offering. (Figure 15) It is described as having “a new circuit and tuning device of special design.” (28) This model incorporates a unique vernier condenser with a moving stabilizer “can” behind the antenna condenser knob. (Figure 16) (28) The stabilizer can is moved by a push rod to cover or expose the tuning condenser, adjusting the capacitance. The 810 is the first Globe model to exhibit serial numbering, which appears as crudely hand cut numbers on the interior side of the front panel. The lowest serial number documented, #246, appears on the earliest version of the 810. A complete 801 outfit including receiver, tubes, batteries, headphones, antenna, and Magnavox R-3 Loud Talker listed at $173 retail. (24)
Originally introduced in 1924, the Model 815 was one of Globe’s most complex models in a simple table top configuration from the operator’s stand point. The basic radio is a two-dial, 5-tube, TRF having two stages of radio frequency amplification, designed to operate with either a loop or 30 foot aerial. (35, 36) It appears in at least 3 visibly different configurations that span a 2 year production window.

The earliest 815 version employs a 6” x 21” front panel in a plain rectangular cabinet. (Figure 17) The nameplate is silver plated brass featuring the Globe lightning bolt logo. Parts are mounted on a wood chassis. This is the first model to include a voltmeter function to measure A and B battery condition. The wood chassis version does not appear to have been serially numbered, which suggests that this model was originally introduced before the Model 810.

The second 815 version (815-1924) appears in a more ornate mahogany cabinet and is illustrated in the “Maximum Radio Results” pamphlet. (Figure 18) (37) The front panel is again 6” x 21”. The metal nameplate has been replaced by a bold engraved DuoDyne name with Globe Electric in small print. This set was one of the first to display the DuoDyne name. This model represented “An outstanding refinement of... controlling radio frequency oscillation” and “uses a variable 500,000 ohm resistance of graphite that is noiseless and practically everlasting, the operator can always adjust his set at greatest efficiency for his particular local conditions. This device, furthermore, is an ideal volume control....” (38) Internally, parts are mounted to a bakelite chassis. This radio was designed for loop or aerial of 30 foot or greater length. (37) The second version retailed for $110. (37) This model was also available in a desk style console with built-in Magnavox R3 reproducer and battery compartment, designated model 825, which retailed for $290. (37) This cabinet was identical to that used on the model 902, discussed below.

The final 815 version (815-1925) uses a 7” x 21” bakelite front panel that also exhibits the engraved DuoDyne name. Aside from the taller panel height and corresponding cabinet size, the overall appearance is virtually identical.
to the second version. Parts are mounted to a single bakelite strip and also appear to be identical to the second version.

**MODEL 4L**

The Model 4L is a bit of a mystery, as no factory photos, specifications, or labeled examples have been found. It is suspected that all of the 4L models were sold without a nameplate as the 1925 Montgomery Wards Airline Grand 4-tube model, retailing for $49.50. (Figure 19)(40) The same receiver was offered with a built in horn speaker and rather unusual textured oak finish cabinet. (Figure 20)(40) Both models featured a front panel 7" high by 21" long mounted on a bakelite chassis, the most visible feature being the positioning of the two tuning dials to the left on the front panel. This model appears to be an updated version of the unusual 2 – dial Model 820 variation, referenced above, and reportedly employed the 770-1924 circuit. From existing serial number information, it is not clear if the 4L was introduced before or after the Model 770-1924. The 4L-1924 employed straight line capacitance tuning. The 4L-1925 appears identical in layout but employed straight line wavelength tuning. The 4L-1925 was available for either storage battery or dry cell battery configurations. (40)

**MODEL 770 / 770D / 702**

The Model 770 is a 4-tube TRF set that was first introduced in 1924 and remained in production with several major and minor variations through the final 1926-1927 season. (41, 42) The model is found in multiple packaging variations and model numbers, having two distinct circuit designs/components, and sold under several different trade names.

The earliest 770-1924 variation (35, 37, 42) boasts a silver plated brass nameplate with chemically blackened background displaying the Globe lightning bolt logo. White border pin striping and dial pointer highlighted the polished bakelite front panel. (Figure 21) These models employed a bakelite chassis for all components. The spider web coil was removed from the bakelite cylindrical enclosure of previous models and installed as a semi-exposed coil pan caked between one or two disks of bakelite. Straight line capacity tuning was used in this model. A dry cell version of the 770 designed to operate on WD-12’s was also offered. This model was designated Model 770D on the nameplate and has a “D” suffix appended to the serial number. The 770-1924 model was originally offered for
The 1924-770 circuit and components were also incorporated into other contemporary Globe receivers including the Advance Electric Model 4LS and a New England Mills ‘Fidelity’ model.

The 770 chassis, minus the Globe nameplate, also was offered in a desk-sized console version identified as Model 772, having a built-in ‘loud talker’ and battery compartments. (35, 37, 42) This cabinet was also used for the models 825 and 902. One interesting feature was “The volume may be varied by opening or closing one of the hinged doors.” (42) Originally retailing for $140 (37) the price was later reduced to $135. (35)

The second major 770 variation was introduced in 1925 and was used as late as September, 1926. (38, 43) Initial models used the silver plated nameplate and panel layout appeared the same as the 770-1924. Internally, a change was made to low loss straight-line wavelength variable condensers, but was otherwise similar in appearance.

The final variation was primarily a cosmetic change with the removal of the white pinstriped panel border, reduced font size of the engraved control identifications, and replacement of the metal nameplate with an engraved name, which displayed both the Globe lightning bolt logo and DuoDyne name with equal prominence, a design used on the last models. (Figure 22) (44) The first and second stage audio jacks of the earlier models were reduced to a single jack and the push/pull “A” battery switch was replaced with a 2-point on/off lever switch. Clearly, cost reductions were implemented in this last variation which was offered until discontinuation of Globe’s radio manufacturing efforts.

In aggregate, the 770 represents the biggest overall production model produced by Globe. The early metal nameplate Model 770-1924 appears to have had the biggest production run of all Globe Electric models, based on the number of sets still appearing in collections and sales.

MODEL 775

The Model 775 was introduced in May, 1924, apparently in concurrence with the 770-1924 models. (36, 42) The DuoDyne trade name appeared for the first time and was boldly engraved on the front panel with the Globe Electric Co. name in fine print below. The front panel is a heavy 9" x 16" mounted in a mahogany cabinet. (Figure 23) This receiver uses an identical circuit to the 1924 model 770. The receiver alone retailed for $80 and a corresponding complete outfit including a Magnavox R-3 Loud Speaker listed at $175.00. (36, 37) The Model 775 was the last of Globe’s tall panel cabinet models. It was obsolete by Febru-
During this middle period, Globe introduced a series of five panel sets intended for use in phonograph cabinets. Three models, the 1010, 1020, and 1060, were all based on the 770-1924 electrical design. The models 1110 and 1160 were five-tube models based on the model 880 circuit. The 1010 and 1110 were intended for horizontal installation and employ exposed tubes. The 1060 and 1160 models were designed for vertical installation and have hidden tubes. Model 1020 was unique among the Globe panel sets, as well as the entire product line, having been designed specifically to use 4 UV199 tubes. Retail prices for the various panel models ranged from $55 to $90. Single examples of the 1010 (Figure 24), 1060, and 1110 are known to exist.

MODEL 880

The DuoDyne Model 880 was introduced in the 1924-5 production season, along with the model 900. The set was a typical 5-tube, 3-dial, TRF design with two stages of radio frequency amplification, intended to operate with aerials of 70 – 125 foot length. In addition to the standard ‘01A configuration, the 880 could also be purchased to operate with WD-12 dry cell tubes and was designated the Model 880D. Unfortunately, examples of this model are not known. The white-bordered 7” x 21” bakelite front panel was prominently engraved with the DuoDyne name, having Globe Electric in small print. (Figure 25) The size and spacing of two plugged holes between the middle and right tuning dials would suggest that this model was originally intended to have a metal nameplate, similar to the earlier 1924 models. Probably due to timing and/or cost cutting, the metal nameplate was dropped after panels had already been drilled. The Model 880 originally retailed for $90.
MODEL 5L
One of the puzzling models in the Globe family is the DuoDyne Model 5L, Figure 26. Exterior cabinet and front panel appearance is identical in size and layout to the Model 880, including the plugged nameplate holes. Two subtle changes are visible. The engraved model number omits the 880 designation and is replaced by 5L. The loop antenna jack has been deleted. In at least one case, a pre-drilled hole in the front panel for the loop jack was plugged with a metal plug. It is speculated that the 5L was a transitional model in late 1925 between the 880 and the 830; however, factory literature detailing this model has not been found. This model number was also offered under the Advance Electric Co. name. (23)

Fig. 26. Globe Model 5L, 5-Tube Receiver

MODEL 900 / 900S / 902 / 930 / 934
The Model 900 (Figure 27) appears to have originally been introduced in the 1924-5 season and was the most elegant tabletop set offered by Globe. (43) The original 900 model was electrically identical to the model 880 chassis with the addition of an A/B battery voltmeter and configured to turn off power to a horn speaker field-coil, such as the Magnavox R-3. The initial voltmeter selector switch consisted of a unique 3 position spring lever switch to the left of the meter (Figure 28). The early voltmeter faces were printed paper, displaying the Globe name and voltage scales. Like the 880D, a Model 900D for dry cell operation was offered, although no examples have been found to date. (46)

The Model 900S was produced concurrently with the first production 900 models. Electrically and cosmetically identical to the early 900, its distinguishing feature is its compact size and identification engraved on the front panel. The 900S panel measures 6" tall by 21" long, compared to the standard model 900, which measures 7" tall by 26" long. The same ornate cabinet design was used for the 900S, only proportionately smaller. Company records indicate this was a sample model, the only set designated as such throughout the Globe product history. (29)

Changes in the Model 900 appearance seem to have occurred rather quickly into the model season, based on the limited number of pinstriped front panel sets observed to date. A cosmetic variation, using the 880 chassis, deleted pin striping and integrated the voltage selector switch into the voltmeter housing. (Figure 29) This model was offered at a retail price of $120. (35) This chassis
was also available in a desk height console, Figure 30, with built-in Magnavox R-3 reproducer and battery compartments, identified as a Model 902. The original retail price was $310 (37), which was later reduced to $295.00. (35)

With the start of the 1925-6 production season, the electrical chassis of the model 900 was changed to the electrical duplicate of the new Model 830, using exposed tubular RF coils. The exterior appearance is virtually unchanged from the late 1924-5 model. (Figure 31) A metallic meter face having both voltage scale and the Globe lightning bolt logo, is the most visible change. The wavelength switch was altered to a 3 position switch numbered 1 – 3. A single jack for the speaker connection, located beneath the voltmeter, replaced the two jacks found on earlier models. This 900 chassis could also be installed in a Model 904 drop front high boy, with built-in loud speaker and having sufficient space for the A and B batteries, as well as battery charger. (38) The 904 used the same cabinet as the model 834, Figure 33, below. Although exact pricing is not available, it appears likely that the 904 was the most expensive radio model offered by Globe. The Model 900 with 830 chassis continued through the final production season of 1926-7. (38)

One of the most obscure Globe models is the 930. None of the Globe advertising or factory literature examined to date discusses this model in any detail, except as

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Fig. 29. Globe Model 900, 5-Tube Receiver, Middle Model, 880 Chassis

Fig. 30. Globe Model 902, 5-Tube Receiver in Console Cabinet, 900/880 Chassis (37)

Fig. 31. Globe Model 900, 5-Tube Receiver, Late Model, 830 Chassis

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a line item in a surviving parts list. From a surviving example, the 930 is clearly a compact version of the late 900/830 chassis, using open tubular RF coils rather than fully encased coils of the 900/880 chassis. It is comparable in size to the petite 900S and appears to use the same pinstriped panel and separate voltmeter switch of the early 900 models.

**MODEL 830**

The Model 830 was introduced in October, 1925. Although encased in a mahogany cabinet, the Model 830 takes on the appearance of many 3-dial TRF sets, having minimal markings on the 7” x 21” panel and none of the border pin striping characteristic of the previous Globe models, Figure 32. Consisting of a 5-tube TRF chassis using exposed tubular RF coils, this was the successor to the Model 880. Two variations exist. The earlier 830-1925 model used straight line capacitance tuning condensers, and later 830 models incorporated low-loss straight wavelength tuning condensers. The latter configuration is considerably more common than the former. The 830 chassis was also used in the Model 834 (Figure 33), which employed the same high boy cabinet and loud speaker as the model 904, noted above. As mentioned above, the 830 electrical chassis was also transplanted into the later versions of the deluxe 900 and 930 radios. The 830 lasted through the final 1926-7 production run, as the mid-range price offering, retailing for $65. By the final production, Globe stated that “Thousands of this model radio receiver (are) now in use giving excellent results”.

**MODEL 2-53 / 2-60 / 2-61**

The original Model 2-53 was introduced in October, 1925, as the low-end model of a series of tilted panel, three dial receivers. (38) (Figure 34) It employed a 5-tube design, which was another incarnation of the 830 chassis electrically. Atypical of the Globe DuoDyne models, this set does not exhibit a model number engraved into the bakelite front panel. Initially, the set was sold as a basic receiver, standard non-vernier tuning dials, and space for a B battery compartment. Two variations, the 2-60 with a compact internal...
horn speaker and the 2-61 with vernier tuning dials and internal horn were also offered. The 2-53 was the last of the table top models to incorporate a battery compartment in the cabinet and was available through the last production run of 1926-7. Retail price without tubes and accessories was $70 for the 1926-7 line. (43)

MODEL 3-53

Visually distinctive with an upper exposed horn speaker grille above the tuning panel (Figure 35), the Model 3-53 utilized the identical chassis as the 2-53. (38) While the 2-53 could be considered a rather petite radio, the 3-53, weighing in at 55 lbs., was much more massive and would command a rather large tabletop. Accordingly, the 3-53 also commanded the highest retail price of the October, 1925, receiver offerings at $135 retail. (47)

MODEL 526

The Model 526 was one of two new designs introduced for the 1926-1927 model year. It was originally scheduled for retail release on September 15, 1926 (41, 43). Only one version of this 5-tube set has been documented. (Figure 36) The design uses a two knob friction drive tuning condenser unit. Each knob drives a marking disk past an open panel window in which to mark station locations on the dials for easy retuning of a preferred station. Lacking the tubular bakelite coil form, the open RF coils have been frequently damaged by de-lamination and/or denting through the years. In spite of these apparent advancements, one finds the electrical chassis breadboarded on a wood chassis, carefully worked to accommodate under-the-panel tube sockets. The 526 originally retailed for $55 without tubes or accessories. (41, 43, 44) Although this appeared to be produced for only a single year, this model is found with reasonable frequency.
MODEL 626

The Model 626, Figure 37, was the most revolutionary design produced by Globe, introduced for the 1926-1927 model year. (44) Retail release was anticipated during the period September 25 – October 1, 1926, (41, 43) which would make this the last of the Globe production radio models. Unlike any other Globe model, it employed a one-piece integrated steel front panel and chassis. This is the only Globe set that employed six tubes, 3 in RF circuits, 1 detector, and 2 audio amplifiers. It used the same integrated 2-dial friction drive tuning assembly and fragile open RF coils as used in the model 526. Cosmetically, the nameplate used on 626 is unique, consisting of a brass oval impressed with the Globe lightning bolt logo. The 626 was the highest priced set in the 1926-7 Globe line at $80 without tubes or accessories. (43) Based on highest serial number found, #18475, the 626 was the last model from the Globe production line.

MODEL 510 / 1608

Two mystery models, the 510 and 1608, were recorded in Globe part designations that have no associated descriptive literature or known surviving examples. (28) The author would appreciate any information related to these models.

Based on surviving Globe models, serial numbers, and company references to production rates, the total number of radios produced with and without serial numbers during the 1922 – 1927 period has been estimated to be about 27,000 units. As additional surviving sets and serial number information is compiled, this estimate can be refined further. The author welcomes any additional comments or contributions to this survey.

EPILOG

The Globe Electric Company, through its descendants, is celebrating its 100th anniversary in 2011. From a rather inauspicious beginning in a small store-front and a single patent, the company grew from a distributor of electric light and power plants to the largest global manufacturer of automotive lead-acid storage batteries today in the form of the Power Solutions business of Johnson Controls, Inc. (JCI) Along the way, Globe experimented with different products to enhance their year-round productivity, expanded product lines through development and acquisition, and was an early employer of women in electronic parts manufacturing. During their history they have manufactured battery and automotive related products, as well as totally unrelated items, spanning specialty batteries, radios, radio and electronic components, spark plugs, electric vehicle prototypes, golf clubs, and roller skates. In their endeavors, Globe cut across many local business histories in the Milwaukee area, including MSOE, Briggs & Stratton, Cutler-Hammer, and TMRL/WeEnergies. The Keefe Avenue plant, long the corporate headquarters and manufacturing site, continues to build...
lead-acid batteries for uninterruptible power supplies under the ownership of C&D Technologies. Globe Electric Co. was succeeded by Globe-Union, Inc., which was acquired by Johnson Controls, Inc. in 1978. Globe-Union's former headquarters now house the JCI corporate offices.

ACKNOWLEDGEMENTS
Content of this article was greatly enhanced by access to Globe-Union/Johnson Controls, Inc. archival materials. In addition, many radio collectors graciously and anonymously contributed serial number information and photographs of models in their collections for this compilation. Collectors who have particularly encouraged and aided the development of this article include, Stew Oliver, Merrill Bancroft, Dale Boyce, Ralph Larson, Carl Knipf, Jim Clark, Craig Ball, the late Ed Bell, the late Dick Bury, and members of the Wisconsin Antique Radio Club (WARC).

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ABOUT THE AUTHOR

Following completion of post-graduate education and work as an environmental analytical chemist, Glenn Trischan chose to return to the Milwaukee area when offered a job in the Corporate Applied Research Group of Globe-Union. Although the Centralab Division was sold within the year, Glenn has directed materials projects cutting across the Johnson Control’s product lines, including building controls, advanced and automotive batteries, and automotive components. Much to his surprise, he has continued his tenure through varied positions for over 30 years and is currently the Manager of Technical Resources at Johnson Controls – Saft, where he is responsible for the Lithium-Ion Cell Development Lab, supporting the company’s efforts to commercialize advanced battery technologies for hybrid electric vehicles.

Glenn’s interest in radio, television, and electronics in general dates back to grade school, when the family’s idled pre-war Zenith Kenwood was rejuvenated and started receiving shortwave signals. He is a native of the Milwaukee area with interests in both local history and radio collecting. Early during his employment, he learned of the Globe radio products. Quite casually he and his very patient and supportive wife, Edna, began to search local flea markets, antique stores, and ultimately radio swap meets in search of an elusive example. In radio collecting, one thing always seems to lead to another and soon there was an unexpected proliferation of Globe radios and artifacts, along with other interesting battery radios and paraphernalia, which provided the basis for the present work. His interest in further documenting
## Table 1. Summary of Globe Electric Company Radios in Order of Introduction

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Glenn Trischan

The Globe product line, including model and serial number correlations, continues. Other radio collecting interests focus on wireless and battery era apparatus built in Wisconsin and Iowa. He can be contacted at gnets142@att.net.

Glenn is a founding member of the Wisconsin Antique Radio Club. In addition to AWA, he holds memberships in a variety radio clubs around the country. He has previously authored an article on Lee de Forest and the American Wireless Telegraph Company, published in Volume 14 of the AWA Review.
The Airship America

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JACK IRWIN, MARCONI WIRELESS MAN

In August 1901 the Marconi Wireless Company built a station at Siasconset, on the island of Nantucket. Another station was installed aboard the Nantucket Lightship No.66 forty-two miles away which would become the first point of contact for ocean liners bound for New York. Sometime around 1906 a young wireless operator named Jack Irwin (Fig. 1) was assigned to Siasconset (Fig. 2) as one of the

Fig. 1. Jack Irwin in 1909, four operators.

On the morning of October 15, 1910, Jack Irwin was awakened about 4 o’clock and told to go aboard the America. There was not a breath of wind. A dense fog dripped down over everything. The crew of the ship consisted of Messrs. Walter Wellman, commanding; Melvin Vaniman, chief engineer; Louis Loud and Fred Aubert, assistant engineers; Murray Simon, navigator; and Marconi Wireless man Jack Irwin. With the help of a few hundred police and firemen, they proceeded to launch the largest non-rigid airship ever constructed. What follows is the story of the launch of America on its first trans-Atlantic flight, followed by her demise and the rescue of her crew a few days later.

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The wireless operator aboard the Republic was Jack Binns who was also quite a hero. Jack Irwin returned to sea duty after that. But it was his next assignment that would make big history.

One hundred years ago last October he made history by using wireless to call CQD himself from an airship to a ship at sea. Again the rescue was successful but I’m ahead of myself. The story about how he got to the point where he needed to be rescued is really interesting. His airship adventure would begin in Atlantic City.

THE FIRST AIRGOING WIRELESS MAN
In the words of Jack Irwin ...

“In the spring of 1910 I received what, at that period in the history of radio, was the strangest assignment a wireless operator ever had. I had returned to New York after a trip to England as radio operator on the old American Liner St. Louis. The Marconi Wireless Telegraph Company of America was then a small organization and I was one of the four sea-going operators in its employ (there were only fifteen operators in the company’s entire service). To be in charge of one of the four ship stations the company controlled was considered, in those days, a good job. I was contented with my lot and satisfied with what life offered, a fine ship, good fellows for shipmates, and a pleasant run.

It was then customary, in that small family-like organization, for ship operators to report after each voyage direct to the Chief Engineer of the company, Mr. Frederick M. Sammis. He occupied a similar position to Poo Bah that extraordinary and versatile character in Gilbert and Sullivan’s “Mikado.” He acted in almost every capacity. Without any other thought in mind, except, perhaps, the usual operator’s genius for smelling a salary advance, I entered Mr. Sammis’ office and made the customary report. It was then I received the jolt he had prepared for me. He nonchalantly inquired whether I was prepared for a transfer to another ship, just as though it was an everyday duty with him. In a few words he tendered me the job of operator on the airship America, then being constructed at Atlantic City. Whether I jumped at this offer or not I cannot remember now, but I found myself in the course of a day or two in Atlantic City, duly signed on as a member of the crew of a dirigible and committed to make the first attempt to cross the Atlantic by air line.” So started Jack Irwin’s recounts of his famous voyage in a 1924 Radio Broadcast magazine (Fig. 3).

“My contract with Mr. Walter Wellman, who commanded the expedition, called for my services not only as a wireless man, but as a general aide. And the months intervening between June, when I joined the crew, and October 15th, when we sailed, found me handling many jobs and assimilating a knowledge of aeronautics. There was also born in me a love for the flying game that has persisted to this day.”

WHO WAS WALTER WELLMAN?
He was a newspaper man from Chicago who also made the news.
He did this by finding something exciting to do that no one else had done, for instance, like discover the North Pole. To get funding he promised great stories to be written about his adventures. Newspapers and magazines jumped on board and soon he was trying to cross the great ice expanses to find the north pole. He was not successful the first time on foot, but pioneered on thinking he could float above the unforgiving ice in a balloon. Eventually he purchased a motor-powered non-rigid airship from a company in France. He was not successful this time either. As he was planning another attempt by air he found out that Robert E. Peary (accompanied by Donald MacMillan, later of Bowdoin Schooner fame, and Matthew Henson, America’s greatest African-American Arctic explorer) discovered the North Pole on April 6, 1909.

Then the idea stuck him, why not take the airship, have it rebuilt, and be the first one to cross the Atlantic Ocean by air. Knowing he was not alone in this idea, he rushed the rebuilding in France and had it transported to America onboard the liner Oceanic then sent to Atlantic City where it would be put back together.

Atlantic City was chosen because there was a Aero club there who would fund the building of a giant hanger for Airship America’s construction, and the prevailing winds would assist the airship with its journey eastward to Europe. Another factor I’m sure is, that summer Atlantic City hosted a huge gathering of air pioneers, who of course brought their airplanes with them. Everybody who was anybody in the airplane business was there that summer. An “Air Carnival” as it was called, was held on the beaches and flying boats landed in the inlet. Since this was the first event of this kind several records were recorded: Walter Brookins set an altitude record of 6175 feet, and another was by Glenn Curtiss who flew 50 miles and returned in one hour and 14 minutes. Atlantic City was air crazy and the airship project fit right in. (Bader Field in Atlantic City became known as the first “air-port” in 1919, a name given it because of its close proximity to the ocean and because it could also service seaplanes.)
THE AIRSHIP AMERICA

Quoting again from Irwin:

“The America was what is known as a non-rigid type of dirigible, cigar shaped. She was 228 feet long and 52 feet in diameter at the central or thickest part. This great gas reservoir was made of cotton, silk and rubber and beautifully tailored, all seams being wide lapped, sewn and gummed, and extra strips cemented over to prevent leakage of hydrogen. The huge envelope contained when fully inflated, 345,000 cubic feet of hydrogen gas. This lifted a load of 28,000 pounds.

Under the balloon or gas envelope was built a huge steel frame, enclosed with varnished linen, and attached to the balloon by eighty steel cables fastened to the balloon about ten feet below its equator and extending its full length. This frame was fashioned of the best steel tubing and wires, strung as a bridge, the whole being 156 feet long, 8 feet wide at the top, V-shaped, and at the bottom of the V there was a staunch steel cylinder two feet in diameter, divided into ten compartments, with a capacity of 1,500 gallons of gasoline. Along the top of this cylinder ran a thin boardwalk 2 feet wide, forming the floor or deck of the car. Celluloid windows were placed at intervals in the linen sides of the car enclosures; and about the engine rooms, amidships, steel screenings replaced the linen. Non-inflammable paint was employed to minimize fire risks. In this car were the crew’s quarters, engine rooms, dynamo, and control or navigating bridge (Figs. 4, 5).

Slung under the central portion of the car was the lifeboat. This lifeboat was then the last word in boat-building. It was built of hewn, laminated mahogany - 27 feet long, 6 feet wide, with a depth of 3½ feet amidships. Each end was decked over and made into a water-tight compartment by simply battening down a circular hatch in each deck. Amidships was a spacious cockpit in the center of which was a self-bailing device and in the forward end a cubby-hole for the wireless apparatus (Fig. 6).”

This lifeboat is where Jack Irwin would be the first airborne wireless operator to use a “spark wireless” transmitter with a huge bag of Hydrogen gas hanging above. I can’t imagine having guts enough to push that key for the
first time. The antenna was the steel framework which was all around the gas bag. The ground was the trailing equilibrator, designed to help stabilize the airship and carry additional gasoline and fresh water.

100 YEARS AGO
Continuing Jack Irwin’s report:

On the morning of October 15, 1910, I was awakened about 4 o’clock and told to go aboard. There was not a breath of wind. A dense fog dripped down over everything. The crew of the ship consisted of Messrs. Walter Wellman, commanding; Melvin Vaniman, chief engineer; Louis Loud and Fred Aubert, assistant engi-
neers; Murray Simon, navigator; and the writer. With the help of a few hundred police and firemen we proceeded to launch the largest non-rigid airship ever constructed. At 8 AM all was in readiness and the crew climbed aboard (Fig. 7). The last to embark was our mascot, a pretty foundling kitten that had been a pet around the hangar. The crew had jokingly told visitors that the kitten was going along with us and just as the word to “let go” was passed, somebody in the crowd threw the kitten into the lifeboat where I had taken my station. Up we went and the cat was one of us! Kitty, at first, appeared scared and raised an awful “holler,” but he (yes, it was a Tom!) soon settled down. In the long days and longer nights that followed, I will admit I was grateful for that kitten’s affectionate company. It was always to be found cuddled up to me in the wireless corner of the boat (Fig. 8).

We did not start our motors immediately, but preferred to be towed out through the narrow entrance called “The Inlet” at Atlantic City. Reaching the open water our tug cast off our line and we started our engines. We were flying at an altitude of only 200 feet, with a portion of the equilibrator trailing on the surface of the ocean. This low altitude was due to the heavy cargo we carried and the fact that the morning was cold and wet. The moisture of the fog contracted the hydrogen with a consequent loss of lifting capacity.

Not everyone was happy having the cat aboard. His name was Kiddo. He was at first caught and placed into a sack; and with a rope attached was lowered down toward the tug’s deck. But by now the wind was pushing the airship out to sea faster than the tug could go to keep up. So rather than drop him into the water, he was pulled back up to become a member of the crew.

Irwin continues: During the first hour of the flight I was busy making various adjustments. Listening in, I could hear “Bobby” Miller, at the old United Wireless station “AX,” on Young’s Pier at Atlantic City calling “W,” the call letter assigned to the America. The signals dissipated any doubts I may have had about the cat’s presence on board.
For months we had discussed the possibility of sparking in the rigging and the risk of burning a hole in the fabric of the balloon, so when the moment came to “sit” on the key of the transmitter, I think I can be pardoned for my nervousness. I am sure I experienced the moment that a suicide passes through when he is about to pull the trigger. Stationing the crew in different parts of the ship to report any sparking, I threw in the sending switch and answered Miller’s repeated calls. I shall never forget my expansive satisfaction when he came back and told me my signals were clear and strong. I had opened the coupling of the transmitter for a minimum radiation; therefore, with only a few miles separating us from the nearest station, I had established radio communication for the first time between a ship of the air and the earth. I had plenty of power in reserve and knew that we had reliable communication within certain limitations. Mr. Wellman, during the time I had been engaged in these preliminary tests, had been sitting at my elbow, anxiously waiting the result. But as he afterwards wrote in his book describing the trip, he could tell by the pleased grin on my face that we had succeeded in establishing communication (Fig. 11).

By reference to my log, I find that communication was established with AX at 10:30 AM and that at 11:05 AM I had sent eight messages to Miller; At 12:30 PM I made an entry of receiving two messages from AX, while at 1:30 PM, there was this notation in the log, “Received one message and sent two to Atlantic City. Everything going fine, sensation very fine, all happy.” Thus was the first airship traffic conducted, and it had soon developed into the ordinary routine. I had been very busy, these hours, without time to reflect upon my strange surroundings or give thought to the unusual experience of flying. I have spent hundreds of hours in the air since and been asked innumerable times what my first sensations were, but I can truthfully say I cannot recall them, if I had any. My only anxiety was regarding the success of the installation of wireless; once

Dilks

Fig. 9. Atlantic City wireless station “AX” located at the ocean end of Young’s pier, from an old postcard, author’s collection.

Fig. 10. Artist conception of airship America under way. Scientific American, Oct. 1, 1910. Author’s collection.
that was assured I felt nothing but elation. While I was busy at the radio key, successfully maintaining constant touch with Atlantic City, things were not going so smoothly with the engineering department of the ship. After several hours in the air the dense fog in which we started condensed upon the huge surface of the dirigible, adding a great weight to an already overloaded ship. Instead of steadily rising, as the heat of the sun increased and expanded the gas, we slowly descended and lost altitude. We were compelled to jettison some of the cargo. Due, also, to the lack of trial flights, the engines required tuning and we proceeded very slowly during the morning of the first day. Several times during that morning either one or the other of the engines had to be stopped, caused by sand in the bearings. Our hangar at Atlantic City was in a most exposed spot where every wind that blew brought clouds of sand. However we continued to make progress.

At 3:30 PM on that first day, I received my last message direct from Atlantic City. At that time I find that a notation in the log states that I was no longer able to hear him, because his signals were weak. The motors made a fearful noise. The only means I had of deadening the sound of those big engines was the slight protection provided by the cotton battens, I had fashioned. From then until 8 PM, with the exception of intermittent motor trouble, the voyage was uneventful. At that time, still in a dense fog, we almost ran into a large sailing ship. So close did we pass that we could see the crew running round the decks. Later we
passed very close to a large steamer, which we eventually learned was the Coamo. From time to time I tried to get into communication with various shore stations, without success. It is quite possible that some of them answered me, but the engines killed anything but the very strongest signals.

AN ENGINE GONE BAD

During the night, our best engine had to be stopped, permanently out of commission. It appears that the bearings of the propellers had broken, causing one of them to wobble alarmingly. Up to this time there had been no wind at all, but now it began to freshen up a bit which drove us eastward, but in a northerly lee-way. The fog still persisted and we were compelled to jettison some fuel to prevent descending into the sea. Another danger which became apparent when night fell was the stream of sparks from the exhaust. We were afraid that they would cause an explosion and Wellman wanted to stop the remaining engine. Vaniman, however, talked him out of this, explaining that we had been running all day and that, if we stopped the engine we would undoubtedly drift over Long Island. Furthermore, the balloon by this time was so saturated with water from the condensed fog that we ran little risk of fire. So, through all that night we proceeded under one engine. The engine that had gone bad on us was the one to which the dynamo was belted and that meant that we would be unable to charge our battery. With this in mind, I began to hoard the battery juice and used the wireless only when positive that there was something to use it for: As subsequent events proved, it was well I did.

THE CQD AND RESCUE

At 5:05 AM on the 16th, my log shows that the engines had stopped and that I was listening to all stations talking about us and calling W. I heard the Sagaponack (Long Island) station inform Siasconset that we were 60 miles South of Scotland Light at 6:50 PM the previous night when we had been sighted by a steamer and reported by radio. All this time the wind was steadily increasing but was in our favor and we made such good time that we decided to allow our remaining engine to cool off. I waited until Siasconset station was very strong before I attempted to communicate. At 10:35 AM I
established communication with SC (Siasconset, Nantucket Island) sending him several messages. We were very close to that island during the day, so close, indeed, and so strong our signals, that I afterwards learned that the boys at the stations ran outdoors to try to sight us (Fig. 12).

Our expedition had been financed by several newspapers and Mr. Wellman, a newspaperman himself, commenced to file voluminous messages to them. I sent the short ones, but as they became lengthier I protested that the batteries were running down and that we should conserve our power in case we needed help. He promptly agreed with me.

The wind now increased to a gale and began to bear us southeast. When night fell we again experienced trouble in remaining in the air. We were compelled constantly to throw supplies overboard.

C Q D
That night I attempted to obtain assistance, calling C Q D, which at that time was the signal of distress. Our engines were now useless. The voyage had failed and our one concern was to get away with our lives. I early realized that there was no hope of assistance while we were in the air and that we would have to take to the lifeboat. However, with the sea then running and the gale blowing, we simply had to stay in the air. Engineers Loud and Aubert commenced to take the large motor apart and throw it overboard, to lighten the ship. At daybreak on Monday, the third day out, I find I made a note reading, “7 AM All ready during the night to leave in the boat, but the breeze too strong for launching. Listened-in and heard the SS Main (German) very strong. Now hear Cape Sable sending a message to some ship for us. Copy it. It is from the New York Times and is about the weather.”

At 7:20 that morning our navigator took his first sight for position and made us in Longitude 65.51 West. This was 210 miles east of Nantucket. We were steadily drifting south in a beautiful sunny morning.

From that time on, we drifted in a southeasterly direction. From my log I find that I listened in all day and into the evening. The last note made in the air in the radio log reads: “7 PM Hear wireless stations working from Cape Sable to the Southern States.” In that early day, that meant that I heard just about every station in North America.

The following, taken from my log, tells the remainder of the story:

“October 18th, 1910. Notes made after arrival on board the Royal Mail SS Trent, made from memory and the log of the Trent’s wireless operator.”

“Remained on watch until 3 AM, 18th, listening to various stations working, static very bad. Unable to read Cape Cod but hear him working. I turned in at 3 AM, but was awakened about an hour later by calls of a ship in sight. Descended into the lifeboat and called C Q D. Nothing doing. Then got an electric torch and commenced calling in Morse lamp fashion. Was eventually answered by the Trent and signaled him that we were in trouble and required help. Also conveyed to him that we were equipped with wireless. The Trent’s operator was awakened, and he called us.” (Fig. 13)

WHEN WIRELESS STEPPED IN TO RESCUE
As I had my head phones on all this time, I answered him and instant radio communication was
established. I am indebted to Mr. Louis Ginsberg (the Trent’s operator) for copies of the following messages which were copied and sent by him; I did not do so, merely reading out his messages to Mr. Wellman as he sent them.

Trent: Do you want our assistance?
America: Yes. Come at once, in distress, we are drifting, not under control.
Trent: What do you want us to do?
America: Come ahead full speed, but keep astern, we have a heavy tail dragging.
Trent: OK. Am standing by wireless in case of trouble.
America: You will pick us up at daybreak, you will be better able to see us then.
Trent: OK.
America: Come in close and put your bow under us, we will drop you a line but do not stop your ship as you will capsize us.
Trent: OK.
America: Who are you and where bound?
Trent: SS Trent bound for New York.
America: Have one of your boats ready to launch, as we will probably capsize when we launch our boat.
Trent: OK boat manned.
America: We are going to launch the boat, stand by to pick us up.

Fig. 13. Louis Ginsberg, wireless operator on the Royal Mail Steampacket Line’s SS Trent who received the “CQD” from Jack Irwin, operator of Walter Wellman’s airship America on October 18, 1910. Library of Congress LC-DIG-ggbain-08629.

Fig. 14. The lifeboat of the America being pulled toward the rescue ship. Operator Irwin is wearing the straw hat and seated on the starboard side of the boat. Charles H. Huesgen in Radio Broadcast, Aug. 1924, author’s collection.
Wireless communication then ceased. I cut the antenna and ground wires, put the watertight doors on the wireless cupboard, and stood by. The boat was successfully launched, a most hazardous operation. We were drifting fifteen miles an hour, with the boat swinging beam on to the sea and behind us the ton-and-a-half trailer. At the signal to “let go” both clutches holding the boat to the car were jerked. The boat fell into the water, lurched gunwale under, then righted. The trailing equilibrator hit us, stove a hole in the boat above the water line, and bruised Loud and myself. The *Trent*, ploughing along at 16 knots, almost ran us down. We fell astern and waited for the steamer to come about and pick us up. After considerable maneuvering she came alongside, and with her derricks, lifted the lifeboat aboard. Thus was I able to save the entire wireless equipment (Fig. 14).

The *America*, with the weight of the lifeboat and crew released from it, shot up in the air several thousand feet and soon drifted out of sight (Fig. 15). Before leaving her we opened the gas valves so that, eventually she would come down on the sea and not cause damage by landing or dragging over a city. We never heard of her again.

Nobody but those who have experienced it, can imagine the feeling we had upon arriving on
the *Trent*. We were overwhelmed with kindness. Two days later we arrived in New York where we found that our attempt to reach Europe in an airship had attracted extraordinary interest (Fig. 16). We had occupied the front pages of the press of the world for several days. We failed, but in later years I had the gratification of knowing that other Americans accomplished what we had attempted.

**FIRST RADIO DISTRESS CALL FROM AIRCRAFT**

In a 1950 letter, early flight and wireless pioneer Elmo N. Pickerill, said, “Louis Ginsberg of 218 Main Street, Hackensack, NJ, who was the retired operator on the Royal Mail Steampacket Line’s SS *Trent* and received the “CQD” from Jack Irwin, operator of Walter Wellman’s airship *America* on October 18, 1910. He sent the story of the rescue of the six-man crew to me at the “WA” Waldorf-Astoria hotel in New York for the Associated Press and the United Press. The Trent picked them up and brought them back to New York. The airship travelled 1008 miles after taking off from Atlantic City enroute to Europe and was caught in a tropical hurricane off the coast of Nova Scotia and blown down to a point midway between New York and Bermuda when they were sighted and rescued. No doubt that was the first radio distress call ever handled from any type of aircraft and one which proved successful.”

**WHAT HAPPENED AFTER THE RESCUE?**

This is the epilogue of Jack Irwin and the Airship *America* story. I wanted to extend the history of what followed for Jack and others of the America’s crew.

**THE LIGHTNING JERKER**

In the November, 1911, issue of the *Marconigraph* (a Marconi employee magazine), Jack Irwin related his story about the Airship *America* and its rescue. He also went on and commented on what happened next in his life. When he arrived in New York he found his services were in demand, not as a radio operator, but in vaudeville. Surrounded by booking agents, he signed a ten-week contract at a “satisfactory salary.” After that he signed with the Sullivan and Considine circuit. He commented, “I remained on the stage eight months enjoying a tour of the United States and part of Canada, which seldom comes the way of a “lightning jerker.” [“lightning jerker” is early slang for telegraph operator or professional radio operator]

“In July of this year I returned east, and was offered the position of Marconi operator with Vaniman’s new airship *Akron*, in which he will again tempt the fates in an attempt to reach Europe by dirigible balloon. I promptly accepted, and am now assisting in its construction. The new airship will be 258 feet long; it will contain 400,000 cubit feet of hydrogen, and have a lifting capacity of 13 tons. It will have a total of 317 horsepower, and will carry a 3-kw Marconi set of special construction.”

**THE AKRON FLIGHT IN 1912**

Melvin Vaniman had contacted the Goodyear company and arranged for them to sponsor the new airship and Goodyear would manufacture the balloon portion which would hold the hydrogen. At this point Walter Wellman was also involved. The huge hanger in Atlantic City would again be host to the team and house the airship as it was being constructed.

On the trial flight the crew of
six contained three of the original 1910 crew, Melvin Vaniman, Louis Loud, and Jack Irwin. The three new crew members were, Calvin Vaniman (Melvin’s brother), George Riffard and Thomas Blotcher.

Newspaper reports hinted that all was not happy with the crew as there were disagreements between some of them. I gathered from some of the reports, they were critical of Vaniman as he seemed to be rushing the construction and testing.

On Tuesday July 2, 1912 the Akron was brought out of the hanger with fire and police crews assisting, as in 1910. The crew had some major changes indicating the severity of the disagreements. They were: Melvin Vaniman, skipper; Calvin Vaniman, steersman; George Bourtillion, electrician (and assumed he was also the wireless operator [ed.]); Frederick Elmer, deckhand; and Walter Guest, deckhand.

The newspapers would report that all started well and the airship rose to above 1000 feet, where a plume of black smoke appeared, the balloon exploded and the remains fell into about 10 feet of water. Rescue boats were soon on the scene but no survivors were found.

It was reported in one paper (reports vary) that Mrs. Vaniman and the three other widows, Mrs. Elmer, Mrs. Bourtillion and Mrs. Guest, were sitting on the balcony of the Vaniman cottage watching the balloon when it exploded. “They are all suffering and are in the care of physicians,” the paper reported.

Searching for bodies started immediately and four were recovered within a couple of days. The bodies of Melvin Vaniman and Fred Elmer were finally found on July 15, 1912.

The remains of the airship were piled on a barge and towed to Gardners Basin in Atlantic City and shipped to Goodyear in Akron, Ohio, for examination. The
gasoline tank was intact and had not exploded. Parts of the airbag were examined and found that it had not burned but did burst it was believed, due to expanding gas within and it split at the seams. (The entire gasbag was not examined due to souvenir hunters having taken pieces.)

Jack Irwin continued his career in radio working at the Radio Broadcast magazine laboratories and writing articles. He served honorably in the Army during World War I, and served with the Signal Corps at Fort Monmouth. Col. Jack Irwin died in action during World War II. General order 42, November 30, 1945, designated Irwin Avenue at Fort Monmouth.

Kiddo was renamed Trent after the rescue ship, and for a while he was displayed in a gilded cage in the window of Gimbel’s department store. He would later go home with Wellman’s daughter Edith and live a quiet life.

**MURRAY SIMON THE BRITISH NAVIGATOR**

Murray Simon later wrote: “You must never cross the Atlantic in an airship without a cat - more useful to us than any barometer.”

I recently met Anthony Simon, a retired executive who lives in Belgium and is Murray Simon’s grandson. He has forwarded some additional information.

“My grandfather received marriage proposals from damsels captivated by his adventure,” Anthony Simon, the navigator’s grandson, recently told the BBC. “Offers for vaudeville, lectures and articles rained down from the skies.”

Anthony continued, “In 1936, to his great joy, he was invited to fly on the maiden transatlantic voyage of the Hindenburg, at that time the biggest airship in existence.”

In an interview with a fellow passenger on the Hindenburg, Murray Simon said, “I vowed at the time that I’d fly across the Atlantic yet - and now that moment has come. I’m supremely happy.”

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Fig. 18. Remains of the Akron loaded on a barge in the bay. Author’s collection from an old postcard.
Airship America

Simon died in 1969.

LIFEBOAT FOUND IN OHIO

Constructed by S.E. Saunders of East Cowes on the Isle of Wight in 1910, the boat was thought locally to have been destroyed in the crash. However, it has been in storage since 1912 at Goodyear. It was the only significant piece to be recovered from the Akron’s accident.

The Goodyear Tire & Rubber Co. has made a gift to the Smithsonian National Air and Space Museum. The 100-year-old lifeboat is from Goodyear’s earliest lighter-than-air endeavor, the ill-fated airship Akron in 1912. It was also used in 1910 on Wellman’s airship America.

“The National Air and Space Museum is delighted to add this survivor of the very first Goodyear airship to its collection of historic air and spacecraft,” Tom Crouch, senior curator of aeronautics, National Air and Space Museum, said in a press release. “It will have a place of honor in a section of the Steven F. Udvar-Hazy Center housing the Double Eagle II, the first balloon to fly the Atlantic, and the Concorde, which whisked travelers across the Atlantic at supersonic speeds.”

WHERE DID AIRSHIP AMERICA END UP?

No one knows for sure but, Mr. A.H. Savage-Landor, in Across Unknown South America, vol. II, p. 425, tells a story that was told to him, by the people of Porto Principal, Peru, in January, 1912 -- that, some years before, a ship had been seen in the sky, passing over the town, not far above the tree tops. According to his interpretations, it was a “square globe,” flying a flag of Stars and Stripes.

Mr. Savage-Landor thinks that the object might have been the airship which Wellman abandoned about 400 miles east of Hatteras in 1910. Whatever this thing in the sky may have been, or we think that it may have been, it returned at night, and this time it showed lights.

A shorter version of this article appeared in QST in the Fall of 2010. More information and a forty-five minute video presentation about the airship and rescue is available on my web site, www.k2tqn.com/

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ABOUT THE AUTHOR

John Dilks, K2TQN has been an amateur radio operator since high school (1956), Dilks first became interested in radio history in the 1970’s. Remembering when he was younger, having seen some of the great “ham radio” stations of the past, he began to collect early radio equipment and historical documents. Much of this came from the owners of these older ham stations as they were downsizing and shutting down.

In the mid 1990’s Dilks built a mobile radio museum in a 27-foot RV-like vehicle that had been a mobile office. The purpose of the mobile museum was to travel to radio events where there was an enthusiastic audience. Traveling up and down the east coast to these events he eventually came to the attention of the American Radio Relay League in Connecticut. The League (ARRL) publishes QST, the popular amateur radio magazine. Dilks was invited to write a monthly column about radio history starting in the January 2000 issue. Since that time Dilks has penned more than 130 columns.

A member of the Antique Wireless Association since the 1990’s, Dilks travelled to the yearly conferences in Rochester with his mobile museum.

In 2001 after a 38-year career with the telephone companies, he joined the Egg Harbor Township school district where he was the Distance Learning Coordinator at the Fernwood Avenue middle school. He also ran a computer lab and maintained the computers in the building until recently.
The Institute of Electrical and Electronics Engineers’ Medal of Honor
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The Institute of Electrical and Electronics Engineers (IEEE) is the world’s largest technical society with approximately 400,000 members in 150 countries. The Medal of Honor is the IEEE’s most prestigious award for meritorious accomplishments in the fields of electronics and electrical engineering. Since 1917, the most important contributors to these fields have received the Medal in recognition of their critical roles in laying the foundations of the modern electric world. This article presents the story of the Medal, its origins, connections to other major awards, and its legacy of honor.

FIRST PROFESSIONAL ASSOCIATIONS
By the mid-1850s, electricity had made its grand entrance into society. The technology for employing electrical telegraph communications was developing rapidly following the work of Charles Wheatstone and Samuel F.B. Morse. Indeed, this technology was now nearly twenty years old. The joint American and British effort to span the Atlantic with a telegraph cable was currently underway. Clocks coordinated by telegraph were being used to standardize time management and schedule the railroads. Burglar alarms and electric elevators were on the horizon, and new uses for electricity were being developed daily (Century of Electricals, 1984; Ryder & Fink, 1984).

Prior to 1860, most scientific and technical information was disseminated through the publications of learned societies, books and privately published letters, correspondence and pamphlets. The most respected scientific journals were “refereed” by the British Royal Society (Barton, 1998). The rapid growth of telegraphy and new applications of electricity further stimulated demand for sharing more information in an organized and timely manner. Soon, new technical journals emerged to bridge the gap between scientific discoveries and their engineering applications. The Elec-

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trician began publication in 1861, and The Telegraphic Journal was published weekly from 1861 to 1899 when it was renamed The Electrical Review.¹ The British telegraph industry was particularly driven by the influence of Sir William Thomson (later known as Lord Kelvin) and its many renowned electrical engineers. They created demand for, and organized, the first professional societies and journals specifically catering to the electrical sciences. With the success of the 1866 Atlantic Cable, most scientific and popular magazines or journals carried articles about submarine telegraphy (Barton, 1998).

Between 1870 and 1890, professional, technical and academic societies were helping to facilitate greater communication and the direct exchange of knowledge and ideas in many fields (Frary, 2008). Thomson worked to establish a dedicated technical society and corresponding journal that catered to the unique interests of telegraphers and electrical engineers. In 1871, he became a founding member and the first vice-president of the new British Society of Telegraph Engineers (BSTE). Thomson regarded the society as a vehicle that would bridge the gap between theory and practice in the electrical sciences by providing a place for organized cooperative discourse on topics of common interest. The BSTE was the first professional society focused specifically on the new science and technology of electricity.²

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Americans were not far behind their British counterparts.³ Beginning in the 1860s, new American publications emerged that provided a platform for telegraphers and electrical workers to share information. The National Telegraph Union founded The Telegrapher in 1864. The Operator was founded in 1874, and the Journal of the Telegraph was founded by Western Union in 1877. Unlike their British colleagues, American telegraphers were not heavily involved in the creation of submarine cable telegraph systems. Therefore, they were less interested in creating a “science” of electricity based on the laws of induction. Instead, the Americans were driven by practical experience and a spirit of invention. Nevertheless, American telegraphers increasingly sought a formal means to communicate scientific and technical discoveries. Many Americans were members of the BSTE, but they needed a society of their own. The American Electrical Society was founded in 1875; but it, and a number of smaller societies that followed, did not survive the decade (McMahon, 1984; Israel, 1992).

By 1880, advanced automated technologies were being applied to telegraphy, and the telephone was making inroads into the communication field. The Civil War was a distant memory, and the nation was united by the trans-continental telegraph and the trans-continental railroad. Thomas Edison had installed the world’s first central station for electric power generation in New York City, and electric lighting was beginning its march across the country. The industry’s leading professionals soon made two more attempts to form a national society for electricians; founding the New York Electrical Society in 1881 and the Franklin Institute’s electrical section in 1882. (McMahon, 1976; Israel, 1992).

The International Electrical Exhibition hosted by The Franklin Institute was scheduled to take place in Philadelphia in September, 1884. Nathan S. Keith, an inventor
and electrometallurgical engineer, wanted American professionals to form their own organization so that they could participate in the Exhibition on an equal footing with their international peers. Keith, along with Thomas Edison, Elihu Thompson, Edwin Houston, Edward Weston and twenty other prominent leaders in the American electrical sciences, issued three published “calls” to create a national organization. Their calls noted that the Philadelphia Exhibition would be attended by numerous “foreign electrical savants, engineers, and manufacturers” and that “it would be a lasting disgrace to American electricians if no American electrical national society was in existence to receive them with the honors due them from their collaborators in the United States” (McMahon, 1984; Reiman, 1984). Keith organized a formal meeting on May 13, 1884 at the American Society of Civil Engineers (the oldest American professional society founded in 1852) to “unite those involved in the art of producing and utilizing electricity” (Century of Electricals, 1984). The attendees drew up a charter and named themselves the American Institute of Electrical Engineers (AIEE). The first technical session of the newly formed AIEE was held at The Franklin Institute during the ten day Exhibition. By far, the largest numbers of new members were inventor-manufacturers and corporate managers, but electrical engineers, electricians, professors and instructors were well represented. Nine future presidents of the AIEE were among the Exhibition’s eighty-nine American representatives (McMahon, 1976 & 1984).

Over time, the AIEE would deliver a distinguished group of presidents including Alexander Graham Bell, Charles Proteus Steinmetz, Schuyler S. Wheeler, Dugald C. Jackson, Michael I. Pupin and Titus G. LeClair (IEEE Global, 2011f). Although early topics included telegraph and telephone communications, the challenges of electric power generation and the design of electric motors soon dominated the interests of the AIEE. The standardization of electrical units, definitions and nomenclature were also top priorities. Edison’s legendary battle with Nikola Tesla and George Westinghouse regarding alternating versus direct current technologies grabbed headlines and fostered scientific research. Increasingly, communications technology was relegated to a secondary concern of the society (see Note 3).

THE FIRST WIRELESS ASSOCIATIONS
The science and technology of wireless telegraphy traces its
roots to the experiments of Oliver Lodge and Heinrich Hertz and to Guglielmo Marconi’s development of a working system in the late 19th century. Professional engineers, amateur experimenters and academic scientists raced to claim new inventions and discoveries that would enable the new technology to succeed. But, the technology underlying wireless involved the use of many more scientific and theoretical concepts than land-line telegraphy. Limited practical approaches once used to propel the growth of the telegraph industry were no longer robust enough to meet these new challenges. University trained engineers, academic scientists and advanced amateurs with specialized interests soon dominated early progress in the field. Applications of engineering theory, rather than practical mechanical expertise, were now playing the key role (McMahon, 1984; Israel, 1992). This was seen in the AIEE’s leadership which, by 1900, was dominated by corporate electrical engineers and no longer had manufacturers in leadership positions. Ten years later, over 85% of AIEE’s leadership were

directly employed in the electrical industry or were consultants for large companies, and the need for college training was indisputable (McMahon, 1976).

Demand for professional associations dedicated to radio and wireless communications could have provided the impetus for change within the AIEE. But, given the AIEE’s focus on electrical power generation, and its lack of emphasis on communications technology, a new association would have to satisfy the growing demand by professionals for a society that was relevant to their

Fig. 2. International Electrical Exhibition Broadside for the First Electrical Exhibition in America. (Century of Electricals, 1984.)
interests. Even at a time when companies were intensely competitive and protective of their technological secrets, professionals still needed a place to share ideas and to learn from one another (Proceedings, 1952; Whittemore, 1957). In 1912, the Institute of Radio Engineers (IRE) became the premier professional organization satisfying this demand. Its roots lie in the consolidation of two smaller predecessor organizations, the Society of Wireless Telegraph Engineers (SWTE) and The Wireless Institute (TWI).5

SWTE was founded in Boston on February 25, 1907 by John Stone Stone6 with eleven members of the engineering staff of Stone Wireless Telegraph Company and its successor the Stone Telegraph & Telephone Company (collectively, "STTC").7 At the outset, SWTE provided a forum for STTC's staff to read and discuss technical papers, focusing on “the mathematical treatment of wireless problems” in order that the engineers might “speak the same language” (Clark, 1946). All employees who were not out of town were required to attend. John Stone was SWTE’s first President. The SWTE published a small booklet in 1908 outlining its aims, membership and management. Membership soon expanded to include “the technical staff of any wireless telegraph or wireless telephone company, or a wireless telegraph engineer” (Clark, 1946) Notably, the membership included Reginald Fessenden’s National Electric Signaling Company (NE-SCO). Lee de Forest and then Fritz Lowenstein succeeded Stone as President. SWTE’s goal was to help “crystallize” ideas and to share information about the work being performed (Clark, 1946). Although SWTE did not publish proceedings, or a journal, it did share scientific papers among its members. As an organization, it remained more of a club and discussion group than a professional society (see Note 5).

TWI was the first truly professional organization dedicated to

Fig. 3. John Stone Stone, Founder of the Society of Wireless Telegraph Engineers. (IEEE Global History, 2010b.)

Fig. 4. Robert H. Marriott, Founder of The Wireless Institute and First President of the IRE. (IEEE Global History, 2010c.)
radio-telegraph communications. On May 14, 1908, Robert H. Marriott, then the Assistant Scientific manager of the United Wireless Telegraph Company, issued a circular soliciting some 200 people regarding their interests in forming a professional society focused on radio engineering. Discussions and inquiries continued across the summer. Finally, on January 23, 1909, Marriott formed TWI with fourteen members and was elected as its first President. He remained its president through 1912. TWI was dedicated to the new fields of wireless communications and radio engineering. By design, TWI was modeled after AIEE, but sought an international membership. Given the larger number of wireless operators and radio engineers in New York City compared to Boston, TWI soon became a much more active organization than SWTE. TWI published the first dedicated professional journal in the wireless engineering field known as *The Wireless Institute Proceedings* (see Note 5).

In 1910, just two years after organizing the SWTE, the Stone businesses ceased operation. In the meantime, NESCO relocated to Brooklyn, effectively moving a significant share of SWTE’s membership away from Boston (see Note 9). Coincidentally, Fessenden became involved with the newly formed Radio Club of America (RCofA) as its first Consulting Engineer (see below). TWI lost a significant number of members following the July, 1911 collapse of New York based United Wireless Telegraph Company, then the largest wireless company in the U.S. (Clark, 1942). The financially strapped TWI was soon struggling to pay its debts and was placed into

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Fig. 5. IRE Dinner at Luchow’s Restaurant in New York City in 1915. (IEEE Global History, 2011b.)
receivership (see Note 5).

INSTITUTE OF RADIO ENGINEERS

In 1912, Marriott, on behalf of TWI, and Alfred N. Goldsmith and John V.L. Hogan, on behalf of SWTE, met informally to review the fate of both organizations. On May 13, 1912, TWI and SWTE gathered at Columbia University in New York City and approved the constitution of a new consolidated organization, the Institute of Radio Engineers (IRE). The creation of the world’s first professional association of radio engineers came just a few weeks after the historic sinking of the RMS Titanic on April 14, 1912. Radio signals carried the distress calls that saved more than 700 lives in the tragedy, and radio was now a hot topic (New York Times, 1942). Efforts to form a new independent professional society serving radio engineers culminated on August 23, 1913 when IRE incorporated under the laws of New York. Marriott became the first President. Ironically, AIEE had finally authorized creation of a Radio Transmission Committee the same month, but it was too little, too late. The first IRE meetings were held at Sweet’s Restaurant on Fulton Street in New York within blocks of at least ten prominent radio companies. Membership in the new IRE quickly grew from 46 in May, 1912 to 231 by January, 1914. By the next year, 83 members were registered from foreign countries (see Notes 5 & 9).

The IRE’s goals included both the presentation and preservation of technical papers. This led to publication of the Proceedings of the IRE beginning in January, 1913. The IRE’s structure and organization were based on TWI, which had itself followed the AIEE model; but, as with TWI, IRE’s membership was, by design, international in scope, rather than principally American. The organization’s new emblem featured the IRE’s initials, representing the mathematical symbols for current, resistance and electromotive force, placed within a triangle, together with a symbol for electrical and magnetic forces. The IRE now stood completely independent of AIEE, focused on electronics and electrical communications.

Over the next fifty years, the IRE expanded to ninety countries. By December, 1961, the IRE had 96,551 members. A list of its officers is a who’s who of the electronics communication field. IRE past presidents include such notables as Greenleaf W. Pickard, Arthur E. Kennelly, Michael I. Pupin, Ernst F.W. Alexanderson, Alfred N. Goldsmith, Lee de Forest, C. Stuart Ballentine and L.A. Hazeltine (Whittemore, 1957 & 1962).

IRE’S MEDAL OF HONOR

By 1917, the IRE had more than 1,000 members and had become the leading technical and scientific society in the wireless field with major sections located in New York, Washington, Boston, Seattle and San Francisco (Wireless Age, 1917a).

Professional medals of recognition and accomplishment were now well established among engineers and academic scientists. The AIEE’s Edison Medal and the John Fritz Medal were regularly presented and were more than a decade old (see below). Yet, the community of electrical specialists interested in communications had no award of its own. On February 15, 1917, the IRE established its own medal to recognize the prominent advances made in radiotelegraphy and radio-telephony (Proceedings, 1919a).

The IRE announced the cre-
ation of its new award in May, 1917. The candidates were to be named annually at the April IRE meeting as the person(s) who, during the prior two calendar years, made public the greatest patented or unpatented advance in radio communication. The advance was to be publicly and completely described in a scientific or engineering journal of recognized standing, and it was required to be operational. Preference was given to widely adopted devices or explanations of previously unexplained phenomena accompanied by rigorous analytical treatment of the subject. The advance or the explanation had to be relevant to the art of radio communication, such as patented or unpatented inventions, scientific analysis or explanation, and it could extend to a system of traffic regulation or control, a system for administration of radio companies or even legislative programs. A “Board of Direction” called upon IRE members for suggested candidates and then nominated up to three eligible candidates by the April IRE meeting. The award recipient was then selected by majority vote of the Board of Direction during the four weeks following the April IRE meeting. The official presentation of the medal was scheduled to occur at the subsequent May or June meeting.16

Two years later, the rules changed, eliminating the time period for the production and publication of the medal candidate’s advancement. Recipients could now be awarded the medal regardless of when they performed or published their work (Proceedings, 1919a & b).

A DESIGN FOR THE MEDAL

The IRE awarded the task of designing its medal to the well known sculptor Edward Field Sanford, Jr. of New York. Sanford was born in New York in 1886. He studied at the Art Students League and the National Academy of Design in 1907 and 1908, and attended the Academie Julian in Paris and the Royal Academy in Munich. Sanford’s best known works included the Charles Francis Adams Memorial at Washington and Lee University in Lexington, Virginia, and the two colossal bronze groups for the Core Mausoleum in Norfolk, Virginia. Sanford was at the forefront of a new movement in American art during the 1920s that supported large public sculpture.

Fig. 6. The Medal of Honor Beginning 1917. (Wireless Age, 1917a.)

He later produced many colossal Gothic figures and bronze facades for power companies, cemeteries and court houses, as well as the base panels of the New York State Roosevelt Memorial. Sanford also designed medallions and bronze reliefs.17

Sanford’s design for the obverse (face) of the IRE’s Medal of Honor was inscribed with the words “Institute of Radio Engineers” and an allegorical representation of electromagnetic waves interlinking the magnetic and electric forces in space. The reverse (back) includes a laurel wreath surrounding the inscription “To____, In Recognition of Distinguished Service In Radio Communication” followed by the date (Wireless Age, 1917a; Proceedings, 1919a).
FIRST RECIPIENT OF THE MEDAL OF HONOR

Due to the U.S. involvement in World War I, the IRE postponed its presentation of the first Medal of Honor, although the IRE did announce it would be presented to Captain Edwin H. Armstrong for his work on receiving apparatus. His selection was seen as an inspiration to amateur radio experimenters since “Mr. Armstrong’s regenerative circuit was evolved in his amateur days” (Wireless Age, 1917b). The IRE postponed the presentation of Armstrong’s 1917 Medal and did not award a Medal of Honor in 1918 due to the war. Finally, in April, 1919, the IRE announced that Mr. (now Major) Edwin H. Armstrong would receive his 1917 Medal “in recognition of his work and publications dealing with the action of the oscillating and non-oscillating audion” (Proceedings, 1919a).

EARLY CONFLICTS AND CONTROVERSIES

The Medal of Honor has been awarded annually since 1919 with the exception of 1925, 1947, 1965 and 1976 (IEEE Website, 2011b). In its early years, it was referred to as the “Gold Medal” of the IRE, and it was presented at a special dinner event with multiple speakers and an evening program (George H. Clark Radioana, 1923). The ensuing history of the Medal of Honor includes legendary stories about important award recipients and major controversies.

Guglielmo Marconi’s well known work in radio-telegraphy laid many of the foundations of wireless communication. The IRE selected Marconi to receive its third Medal of Honor in 1920. The award was presented on June 20, 1922 to an audience of more than 1,000 cheering radio scientists and engineers. Marconi took
The opportunity to demonstrate experiments in directional radio signals and short wave transmission during his acceptance speech (New York Times, 1922). He also presented and later published “Radiotelegraphy,” a sweeping history of the early years of radio and his own experimental work (Marconi, 1922). This was actually Marconi’s second visit to the U.S. On January 13, 1902, he was the guest of the AIEE when he formally announced to the scientific community his historic trans-Atlantic broadcast of the Morse code letter “S” across the ocean on December 12, 1901.18 Upon his receipt of the IRE Medal in 1922, Marconi thanked his American hosts for their “generous encouragement and valid support so heartily extended to me practically at the commencement of my career, when perhaps I most needed it” (Marconi, 1922).

Reginald Fessenden was awarded the fourth Medal of Honor in 1921 for his landmark work in radio. Known for his difficult personality, Fessenden was deeply suspicious. Fessenden had heard that Marconi’s earlier medal was made of solid gold, so he had his own medal analyzed and discovered it was an alloy, not pure gold. Fessenden returned the medal to the IRE and requested that his name be stricken from the list of award winners. Greenleaf W. Pickard, a close friend, investigated and determined that both medals were...
made of exactly the same composition. Only then did Fessenden agree to take the medal back. His award contains no citation or description of his contributions (Coe, 1996; IEEE Website, 2011b).

By 1934, Edwin Armstrong’s twenty years of intense rivalry and protracted litigation with Lee de Forest, regarding the legal priority to the regenerative circuit, came to a head. An initial case had been decided by the U.S. Supreme Court in 1928 in favor of de Forest. For the first time in its history, the U.S. Supreme Court heard the same patent litigation twice. In May, 1934, the Court issued its final landmark decision based primarily on the dates of notes contained in various laboratory notebooks. The Court recognized that de Forest’s work on feedback circuits, beginning in August, 1912, preceded the work of Armstrong. The Court also decided that de Forest’s work preceded the claims of Irving Langmuir at General Electric and Alexander Meissner in Germany which had been independently performed. Although de Forest had essentially invented a telephone circuit with the potential for radio amplification, and Armstrong had invented his circuit specifically for radio, the Court ruled in favor of de Forest. Armstrong was devastated.19

On May 28, 1934 Armstrong walked into the IRE’s ninth annual convention, with nearly 1,000 members in attendance, intent on returning the Medal of Honor awarded to him in 1919. As Armstrong began his composed speech, Charles Jansky, Jr., IRE’s President, addressed Major Armstrong directly from his chair, “...by unanimous opinion of the members of the Board, I have been directed to say to you...that the present Board of Directors, with full consideration of the great value and outstanding quality of the original scientific work of yourself and of the present high esteem and repute in which you are held by the membership of the Institute and themselves, hereby strongly reaffirms the original award, and similarly reaffirms the sense of what it believes to have been the original citation.”20 The meeting erupted into a standing ovation reaffirming that, despite the Supreme Court’s decision, to the engineers, Armstrong was the inventor of the regenerative circuit. Thus, by the unanimous decision of the Board, with many senior representatives of AT&T and the powerful Radio Corporation of America in its ranks, the scientific and engineering community issued their definitive opinion that the scientific credit for the invention belonged to Armstrong. For his part, Armstrong considered the IRE’s Medal of Honor, bestowed by his fellow radio engineers, to be the highest honor he received (Lessing, 1956; Lewis, 1991). With tears in his eyes, Armstrong closed his statements with “This is the highest honor a radio engineer can hold. I give you my heartfelt thanks, and I assure you they come from the bottom of my heart” (Lessing, 1956).

AN EVOLVING RANGE OF MEDAL WINNERS

In its early years, the Medal of Honor was primarily awarded to recognize achievements in the field of radio. John A. Fleming received the 1933 Medal “for the conspicuous part he played in introducing physical and engineering principles into the radio art” (Brittain, 2007). Fleming’s contributions included the two-element “Fleming Valve” and over one hundred technical articles and twenty-one textbooks (Brittain, 2007). The
The IEEE Medal of Honor

The 1941 Medal was given to Alfred N. Goldsmith, not only for his contributions to radio research and engineering, but for his leadership in standardization and the establishment of the Proceedings of the IRE. Vladimir K. Zworykin received the 1951 Medal for his development of television and other advances. The IRE made no comment and simply sidestepped any debate with Philo T. Farnsworth over who was really responsible for the invention of television. In 1954, William L. Everitt won the award for his contributions to establishing electronics as a branch of electrical engineering and his leadership in the IRE (IEEE Website, 2011b).

In 1963, the IRE merged with AIEE, forming the IEEE (see below). Although IEEE officially commenced operations in 1963, the awards committees for the IRE and AIEE remained separate that year due to delays in their consolidation and the time needed to meet the logistical requirements of their awards processes. Two candidates were selected for the 1963 Medal of Honor: George C. Southworth, a research engineer at Bell Telephone Laboratories, renowned for his pioneering work with waveguides, and John H. Hammond, Jr., a prolific inventor with more than 700 inventions, including a remote controlled boat, radio-controlled torpedoes and radio directed missiles. The proponents of the two candidates refused to compromise. A subsequent deadlock arose within the new Board of Directors as it struggled with setting the precedent of IEEE’s new direction while creating a broader scope for the IEEE Medal of Honor. The Board resolved the impasse by awarding the 1963 Medal of Honor to both candidates. It was the only time that two Medals of Honor were given in one year (Gannett, 1998).

After 1963, the range of recipients broadened to include subjects beyond the original scope of the IRE into areas that which were formerly recognized by AIEE. The awards now included new topics such as mathematical theorists (Claude E. Shannon in 1966), lasers (Charles H. Townes in 1967), holography (Dennis Gabor in 1970), transistors (John Bardeen in 1971), digital computers (Jay W. Forrester in 1972), systems theory (Rudolf E. Kalman in 1974), the beginning of integrated circuits (Robert N. Noyce in 1978) and the discovery of magnetic resonance imaging (Calvin F. Quate in 1988) (IEEE Website, 2011b).

THE EDISON MEDAL

America had made significant and society-altering contributions to industrial technology in the late 19th century, including electric lighting, the telegraph, telephone, electric railway transportation and the phonograph. Thomas Edison was a household hero and was
perhaps the most easily identified public personality associated with the development of electricity. 1904 was the 25th anniversary of Edison’s invention of his incandescent lamp. Samuel Insull, Charles Batchelor and a group of Edison’s friends, former employees and associates decided to commemorate that anniversary on the occasion of Edison’s birthday. They formed the Edison Medal Association with Samuel Insull (Chairman), Charles Batchelor (Vice-Chairman) and 124 additional members including J. Pierpont Morgan, Reginald A. Fessenden, W.S. Mallory, Frank J. Sprague and Nikola Tesla. The group planned to name an endowed academic medal after Edison that would be awarded through the AIEE, with AIEE acting as trustee of the medal. The medal was intended to “serve as an honorable incentive to the youth of America to maintain by their works the high standard of accomplishment by the illustrious man whose name and features shall live while human intelligence continues to inhabit the world” (Science, 1904). While Edison’s anniversary celebration was a success, little progress was made on the actual design or awarding of the Edison Medal. After 1904, the initial excitement of the Edison celebration faded, and the medal languished (Bart & Bart, 2009 & 2010).

THE JOHN FRITZ MEDAL
Meanwhile, the John Fritz Medal, the highest American award in the engineering profession, was being presented each year. Established in 1902, the Fritz Medal recognized scientific or industrial achievement in any field of pure or applied science. Fritz had achieved fame and recognition for his development of American iron and steel manufacturing. The medal named in his honor was jointly established on Fritz’s 80th birthday by the American Institute of Mining Engineers (AIME), the American Society of Civil Engineers (ASCE), the American Society of Mechanical Engineers (ASME), and the AIEE. Sponsorship eventually included the American Association of Engineering Studies (AAES) as well.21 The first four Fritz Medals were given to John Fritz (1902), Lord Kelvin (1905), George Westinghouse (1906) and Alexander Graham Bell (1907) (John Fritz Medal, 2009a). Thomas Edison received the fifth Fritz Medal in 1908 for his “invention of the duplex and quadruplex telegraph; the phonograph; the development of a commercially practical incandescent lamp; the development of a complete system of electric lighting, including dynamos, regulating devices, underground system protective devices and meters” (John Fritz Medal, 1910).

Fig. 11. Guglielmo Marconi’s 1922 John Fritz Medal. (Museum of the History of Science, University of Oxford, 2011b.)

Fig. 12. The First Edison Medal Awarded to Elihu Thomson in 1909. (IEEE Global History, 2008: Images 410 & 535.)
EDISON MEDAL BECOMES AIEE’S HIGHEST AWARD

Finally, five years after the initial 1904 organization of the Edison Medal Association, the Edison Medal Awards Committee officially named its first Edison Medal recipient. Dr. Elihu Thomson was cited for his “meritorious achievement in electrical science, engineering and arts as exemplified in his contributions thereto during the past 30 years” (Edison Medal Committee, 1910). Thomson’s accomplishments were wide ranging and internationally acclaimed. He was also active in the AIEE. The Edison Medal Association presented Thomson with a parchment certificate constituting official notice of the award at AIEE’s annual dinner on February 24, 1910. He received the Edison Medal at AIEE’s annual meeting on May 17 (Edison Medal Committee, 1910).

Over the ensuing years, AIEE’s focus remained on electric power generation as demonstrated by the following innovators of alternating current technology who received Edison Medals during its first decade: Elihu Thomson (1909), Frank J. Sprague (1910), George Westinghouse (1911), William Stanley, Jr. (1912), Charles F. Brush (1913), Nikola Tesla (1916) and Michael I Pupin (1920) (IEEE Website, 2009c).

TIES WITH THE EDISON AND FRITZ MEDALS

Medal of Honor recipients are well represented among the winners of both the Edison Medal and the Fritz Medal.


Columbia University’s legendary Professor Michael I. Pupin was the only person to receive all three engineering awards. He received the Edison Medal in 1920, the Medal of Honor in 1924 and the Fritz Medal in 1932. Pupin was president of the IRE in 1917 and President of the AIEE from 1925-1926. He received the Edison Medal “For his work in mathematical physics and its application to the electric transmission of intelligence,” and he received the IRE Medal of Honor “In recognition of his fundamental contributions in the field of electrical tuning and the rectification of alternating currents used for signaling purposes” (IEEE Global, 2011). He received
the Fritz Medal as a “scientist, engineer, author, inventor of the tuning of oscillating circuits and the loading of telephone circuits by inductive coils” (Electrical Engineering, 1932). In 1915, he was made a Fellow of both the AIEE and IRE. A student of Hermann Von Helmholtz and Gustav Kirchhoff, Pupin was a highly regarded scientist who was a mentor to Nobel Prize winners Robert A. Milliken and Irving Langmuir, as well as Gano Dunn, Edwin Armstrong, Alfred Goldsmith and the larger community of radio engineers (Architects, 1984; Brittain, 1999).

ASSOCIATIONS WITH THE NOBEL PRIZE

The Nobel Prize, the world’s highest award in science, has many ties to the Medal of Honor. The Nobel Prize was established in 1895 by Alfred Nobel. Between 1901 and 2010 there have been 543 Nobel Prizes, including 104 in Physics and 102 in Chemistry (Nobel Prize, 2011).

The winners of the Nobel Prize in Physics include twenty-one members of the IEEE and its predecessors, the AIEE and IRE. Two other IEEE members received the Nobel Prize in Chemistry and Medicine. Irving Langmuir, the 1932 recipient of the Nobel Prize in Chemistry, was President of the IRE in 1923 (Nobel Prize, 2011).


The importance of developing a system of wireless telegraphy was considered so significant that Guglielmo Marconi remains the only person to have received the Nobel Prize and two of the most prestigious engineering awards. He received the Nobel Prize in 1909, the Fritz Medal in 1923 and the Medal of Honor in 1920 (IEEE Global History, 2009; John Fritz Medal, 2009a). Contrary to popular misconception, Marconi never received the Edison Medal (IEEE Website, 2009c). Marconi noted in his 1909 Nobel Lecture that “Whatever may be its present shortcomings and defects, there can be no doubt that wireless telegraphy - even over great distances - has come to stay, and will not only stay, but continue to advance” (Marconi, 1909).

TIES TO THE RADIO CLUB OF AMERICA’S ARMSTRONG MEDAL

Edwin H. Armstrong played a prominent role in linking professional electrical engineers and amateur experimenters. The recipients of IRE’s Medal of Honor share a common history with the Radio Club of America’s Armstrong Medal.

The Radio Club of America (RCofA) is the oldest radio communications society in the world. It was initially formed in 1907 as the Junior Aero Club of the U.S. On January 2, 1909, the club was renamed the Junior Wireless Club Ltd. reflecting its new focus on wireless telegraphy and telephony. On October 21, 1911, the club changed its name to RCoA.
Membership quickly grew to include amateur wireless operators and professional radio engineers. The word ‘club’ is actually a misnomer, because RCofA operated as a blend of professional society and amateur experimenter’s association. RCofA effectively bridged the gap between the amateurs and professionals, but it remained a smaller society promoting cooperation among those interested in the advancement and study of radio communications; versus the orientation of the IRE and its successors as large international professional organizations.

RCofA’s focus was on experimentation, and many seminal papers were presented at RCofA’s meetings that were later published in the Proceedings of the RCofA. Its membership included IRE founders Marriott, Goldsmith and Hogan as well as notable industry leaders, including David Sarnoff (Radio Corporation of America) who was also Secretary of the IRE from 1915-1917. Fessenden was RCofA’s founding Consulting Engineer, and Armstrong served as President from 1916-1920. The club’s membership is a digest of communications visionaries who advanced wireless technologies and then two-way and amateur radio; radio and television broadcasting; paging, wireless voice, data and messaging; and modern cellular communications (see Note 24).

RCofA’s first major honor was presented to its President, Edwin H. Armstrong, on November 19, 1919, just months after he had received the IRE’s Medal of Honor. When Armstrong returned from World War One, he was widely heralded as one of the foremost contributors to radio’s development, and he was one of RCofA’s pre-eminent members. RCofA held a banquet at the Hotel Ansonia to celebrate Armstrong’s achievements in regenerative circuit design and his contributions to the U.S. Army Signal Corps during the war. The sixty-four guests encompassed many IRE members and its founders, including Hogan, Goldsmith and Pupin as well as George C. Clark and J. Andrew White. RCofA did not conduct another banquet until 1926.

Fig. 13. Radio Club of America Banquet to Honor Edwin Armstrong November 19, 1919. (Wireless Age, 1919.)
RCofA’s first major award was established in 1935 when it inscribed a testimonial scroll presented to Major Armstrong dedicating an RCofA medal in his name. The scroll was presented to Armstrong following a special reading by Armstrong of his paper on Frequency Modulation on December 19, 1935. Armstrong was taken completely by surprise (Radio Club, 1959).

RCofA’s Armstrong Medal was subsequently designed by John Vassos, W.B. Stevenson and J.P. “Jack” Barnes. All three worked for the Radio Corporation of America as artist/designers. The sculptor was Harry Straubel. The obverse (face) features a portrait of Armstrong with his accomplishments inscribed around the edge. The reverse (back) names RCofA, the Armstrong Medal and the recipient. The reverse includes allegorical representations of the earth and planets joined by an electrical charge between two coils.

Louis A. Hazeltine received the first medal in 1937. Hazeltine had been active in both IRE and RCofA and was IRE’s President in 1936 (Radio Club 1959; Brittain, 1999). RCofA’s Board of Directors awards the Armstrong Medal to candidates within RCofA’s membership who have made an important contribution to the art and science of radio. The Armstrong Medal is not awarded every year, but only after careful consideration of the candidate proposed by the awards committee. All of the Armstrong Medals have been granted to people who made contributions in the fields of radio, television and other communication media (Radio Club, 2011a).

In October, 1950, a special issue of the Proceedings of the RCofA described in detail the December, 1921 successful transmission of the first short wave radio signals across the Atlantic Ocean by members of RCofA and the American Radio Relay League. This was a success noted by amateur experimenters who had made so many contributions in the early days of radio and which again reflected Armstrong’s leadership. Armstrong received the 1950 RCofA Armstrong Medal for this accomplishment. Armstrong and RCofA had again brought together the amateur, professional and scientific commu-
Out of the forty-four recipients of RCofA’s Armstrong Medal since 1935, six were Medal of Honor winners. The Armstrong Medal was awarded to two of IRE’s founders who also administered the Medal of Honor: Greenleaf W. Pickard [MOH 1926, AM 1940] and John V.L. Hogan [MOH 1956, AM 1947]. Other Armstrong Medal winners included Melville Eastham [MOH 1937, AM 1956], Harold H. Beverage [MOH 1945, AM 1938], and Harold A. Wheeler [MOH 1964, AM 1964]. Armstrong’s long time collaborator, Harry W. Houck27, received the Armstrong Medal in 1941, but never received any other major honors (Radio Club, 2011a; IEEE Website, 2011b).

Armstrong is the only person to be recognized twice by RCofA’s Armstrong Medal, receiving the scroll in 1935 and the medal in 1950 (Story, 1950; Radio Club, 2011a).

**GROWING IMPORTANCE OF THE MEDAL OF HONOR**

In 1942, the IRE staged demonstrations of mechanical color television, and Armstrong demonstrated his FM transmitter at Alpine, New Jersey to commemorate the 30th anniversary of the organization. The IRE had grown to over 7,000 members with more than 1,000 attending its anniversary conference. Medal of Honor winners now included Alexanderson, Pupin, Hooper, Kennelly, Fleming, Dellinger, Espenwald and Goldsmith. The IRE’s list of presidents now included such radio engineering legends as Pickard, Langmuir, Morecroft, Ballentine, Hazeltine, Beverage and Pratt. In one way or another, the IRE and its members had led the development of electronic communications.28

Within ten years, IRE was overtaking AIEE in growth and leadership in electronics. In 1952, the IRE hosted 27,500 participants at its conference with over 200 technical papers presented. Displays included guided missile, long distance television, home video and transistors (New York Times, 1952).

The field of electronics was rapidly expanding. Just one year ear-
lier, in 1951, Vladimir K. Zworykin received the Medal of Honor for his work in developing television. He stated that the Medal “means to me more than recognition of my past efforts by the group of engineers who shared in them and are best qualified to judge them” (Proceedings, 1951). His acceptance speech went on to describe a future in which medicine would apply the principals of radio and television to the development of new devices capable of diagnosis and treatment. In mid-century, Zworykin anticipated the eventual explosion of the electrical sciences and electrical engineering into entirely new fields of endeavor that would become part of 21st century life (Proceedings, 1951).

THE IRE AND AIEE MERGER

In 1963, IRE and AIEE merged to form the IEEE. Several attempts had been made to consolidate the organizations dating back to 1922, but the AIEE was resistant to giving adequate time and attention to communications related topics, and IRE members wanted to retain their independence. At the end of the Second World War, the AIEE had a total membership of 21,400, twice the size of the IRE. But rapid changes in electronics technology, shifting student enrollments, the expansion of telecommunications, and the use of electronics in the defense and space industries were changing the playing field (McMahon, 1984).

After the war, the two organizations became more and more competitive (Goldsmith & Hogan, 1952; Should the IRE, 1962). By 1961, the purposes of the two organizations increasingly overlapped as they fought for dominance. Neither organization represented the full scope of electrical technology, nor efficiently served the broad range of related industries or academic interests. Many professionals were actually members of both organizations and questioned the need for two competing groups. The proposal to combine both organizations resolved to merge all fields of interest, including both power engineering and the newer fields of electronics and communications, and sought to accommodate new technologies as they emerged (Century of Electricals, 1984; Ryder & Fink, 1984).
These professional trends revealed a shifting landscape that was very evident in the membership statistics. By 1961, AIEE had approximately 70,000 members in the U.S. and Canada. IRE had 91,000 members with significant international participation. Some 6,000 members belonged to both societies (IRE Almanac, 1961).

Just two years later, IRE could claim 96,500 members while membership in AIEE had declined to 57,000 members (Reiman, 1989; IEEE Global, 2011f & h).

Most compelling was the dramatic shift in engineering student memberships that represented the future of both organizations. Between 1955 and 1962, the number of student members climbed from 7,000 in each organization to 21,000 in the IRE, versus only 10,000 in the AIEE. During the five years prior to 1955, student memberships in AIEE had already fallen from 20,000 to 7,000 (Ryder, 1984; Ryder & Fink, 1984).

The reasons for the eventual merger were summarized by L.V. Berkner, President of the IRE, in 1961. Essentially, by the late 1950s, the subjects addressed by the AIEE and IRE were “migrating onto the same ground” and competition between the societies was seen as dissipating professional resources at a time when AIEE was trying to broaden its interests and IRE was growing in size. More than 85% of IRE’s membership favored consolidation for the benefit of the profession (Berkner, 1961; Should the IRE, 1962). At the time of the vote, both IRE’s and AIEE’s members each favored the merger by an overwhelming 87% majority (Ryder & Fink, 1984; Reiman, 1990).

The IRE’s former Medal of Honor, its highest award, was selected to be IEEE’s highest award in the field of electrical engineering. The IEEE also continues to present the Edison Medal, which remains the oldest award in the field of electrical engineering (Century of Honors, 1984; IEEE Awards, 2010).

QUALIFICATIONS AND TODAY’S AWARD

The Medal of Honor is granted for “an exceptional contribution or an extraordinary career in the IEEE fields of interest” (IEEE Website, 2010). Contributions are evaluated based on the “substantial significance of achievement; originality; impact on society; impact on the profession; publications and patents relating to the achievement” (IEEE Website, 2010). Nominations consider the candidate’s leadership in the field, breadth of work, achievement in other fields, inventive value (patents), individual versus group contributions, publications (articles, books, etc.), originality of contribution, quality of nominations, society and professional activities and honors, and the quality of endorsements.32

In conjunction with the merger of the two organizations, the design of the Medal of Honor was modified. The obverse (front) now includes the name “The Institute of Electrical and Electronics Engineers.”

The original award included a gold medal, bronze replica, a cer-
certificate and a small honorarium. Today, the honorarium is $50,000. The Medal may only be awarded to an individual. It is considered of such importance that recipients are no longer eligible to receive any other IEEE institute-level medal, technical field award or recognition (IEEE Website, 2010; IEEE Awards, 2010).

THE LEGACY OF THE MEDAL OF HONOR

The Medal of Honor is the only major award for achievement in the field of electronics that is not named for an inventor or scientist. Other awards such as the Edison Medal, Armstrong Medal and Fritz Medal were intended to inspire and recognize achievement by noting the examples of their namesakes. The Nobel Prize, awarded in many fields, seeks to recognize an individual’s contributions to humanity as an ideal, but also commemorates its namesake Alfred Nobel. Only the Medal of Honor celebrates outstanding accomplishment through a purely institutional recognition of both excellence and personal contributions to science and technology.

The 2010 Medal of Honor was awarded to Andrew J. Viterbi, developer of the Viterbi Algorithm and co-founder of Qualcomm Incorporated. The Viterbi Algorithm involves a coder and decoder used in disk drives and MP3 players. It is also utilized to transmit images from deep space. Third-generation mobile telephones also employ one or more of the Viterbi systems (IEEE Website, 2011b).

Viterbi’s work in the field of applied mathematics and computers seems far removed from Armstrong’s development of the regenerative radio circuit first commemorated by the IRE in 1917. The tremendous progress achieved in electronics and electrical science over the past century, which is characterized by the recipients of the Medal of Honor, has made it a living testament to the life and work of these major contributors to our modern world.

ACKNOWLEDGEMENTS

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Fig. 19. The Medal of Honor After 1963. (IEEE Global History, 2011a.)
### IEEE Medal of Honor Recipients

<table>
<thead>
<tr>
<th>YEAR</th>
<th>RECIPIENT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1917</td>
<td>E. H. ARMSTRONG</td>
<td>Action of the oscillating and non-oscillating audion</td>
</tr>
<tr>
<td>1918</td>
<td>NO AWARD</td>
<td></td>
</tr>
<tr>
<td>1919</td>
<td>E. F. W. ALEXANDERSON</td>
<td>Long distance radio communication, frequencies, amplifiers</td>
</tr>
<tr>
<td>1920</td>
<td>GUGLIELMO MARCONI</td>
<td>Radio-telegraphy</td>
</tr>
<tr>
<td>1921</td>
<td>R. A. FESSSENDEN</td>
<td>(No citation)</td>
</tr>
<tr>
<td>1922</td>
<td>LEE DE FOREST</td>
<td>Three electrode vacuum tube, radio-telephonic communication</td>
</tr>
<tr>
<td>1923</td>
<td>JOHN STONE-STONE</td>
<td>Contributions to the radio art</td>
</tr>
<tr>
<td>1924</td>
<td>M. I. PUPIN</td>
<td>Electrical tuning, AC rectification</td>
</tr>
<tr>
<td>1925</td>
<td>NO AWARD</td>
<td></td>
</tr>
<tr>
<td>1926</td>
<td>G. W. PICKARD</td>
<td>Crystal detectors, antennas, wave propagation, atmospherics</td>
</tr>
<tr>
<td>1927</td>
<td>L. W. AUSTIN</td>
<td>Quantitative measurements in radio wave transmission</td>
</tr>
<tr>
<td>1928</td>
<td>JONATHAN ZENNECK</td>
<td>Radio circuits, author</td>
</tr>
<tr>
<td>1929</td>
<td>G. W. PIERCE</td>
<td>Crystal detectors, magnetostriiction devices, author</td>
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<tr>
<td>1930</td>
<td>P. O. PEDERSEN</td>
<td>(No citation)</td>
</tr>
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<td>1931</td>
<td>G. A. FERRIE</td>
<td>Radio communication in France, international radio cooperation</td>
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<tr>
<td>1932</td>
<td>A. E. KENNELLY</td>
<td>Radio propagation phenomena, theory and measurement of AC</td>
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<tr>
<td>1933</td>
<td>J. A. FLEMING</td>
<td>Physical and engineering principles into the radio art</td>
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<td>1934</td>
<td>S. C. HOOPER</td>
<td>Radio communication in the Government Service</td>
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<tr>
<td>1935</td>
<td>BALTH. VAN DER POL</td>
<td>Circuit theory and electromagnetic wave propagation</td>
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<tr>
<td>1936</td>
<td>G. A. CAMPBELL</td>
<td>Electrical networks</td>
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<td>1937</td>
<td>MELVILLE EASTHAM</td>
<td>Radio measurements, laboratory practice, IRE leadership</td>
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<td>1938</td>
<td>J. H. DELLINGER</td>
<td>Radio measurements and standards, wave propagation</td>
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<td>1939</td>
<td>A. G. LEE</td>
<td>International radio services</td>
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<td>1940</td>
<td>LLOYD ESPENSCHIED</td>
<td>Radio telephony, international radio coordination</td>
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<td>1941</td>
<td>A. N. GOLDSMITH</td>
<td>Research, engineering, standardization, IRE Proceedings</td>
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<td>1942</td>
<td>A. H. TAYLOR</td>
<td>Piezoelectric controls, HF wave-propagation, Naval Research Labs.</td>
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<td>1943</td>
<td>WILLIAM WILSON</td>
<td>Radio-telephony, IRE service</td>
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<tr>
<td>1944</td>
<td>HARADEN PRATT</td>
<td>Extension of communication facilities to distant lands, IRE service</td>
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<td>1945</td>
<td>H. H. BEVERAGE</td>
<td>Radio research, IRE service</td>
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<td>1946</td>
<td>R. V. L. HARTLEY</td>
<td>Oscillating circuits, triode tubes, information transmission</td>
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<td>1947</td>
<td>NO AWARD</td>
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<td>1948</td>
<td>L. C. F. HORLE</td>
<td>Radio, standardization, electron tubes, IRE service</td>
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<td>1949</td>
<td>RALPH BROWN</td>
<td>Contributions to radio, IRE leadership</td>
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<td>1950</td>
<td>F. E. TERMAN</td>
<td>Teacher, author, scientist and administrator</td>
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<tr>
<td>1951</td>
<td>V. K. ZWORYKIN</td>
<td>Television, application of electronics, national security</td>
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<td>1952</td>
<td>W. R. G. BAKER</td>
<td>Engineering projects, IRE service</td>
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<td>1953</td>
<td>J. M. MILLER</td>
<td>Electron tube theory, crystal controlled oscillators, receivers</td>
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<td>1954</td>
<td>W. L. EVERITT</td>
<td>Distinguished career, contributions establishing electronics, IRE</td>
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<tr>
<td>1955</td>
<td>H. T. FRIIS</td>
<td>Spectrum of radio frequencies, leadership</td>
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<tr>
<td>1956</td>
<td>J. V. L. HOGAN</td>
<td>Lifetime achievement, founder IRE, inventions</td>
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<tr>
<td>1957</td>
<td>J. A. STRATTON</td>
<td>Teacher, physicist, engineer, author and administrator</td>
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<tr>
<td>1958</td>
<td>A. W. HULL</td>
<td>Electron tubes</td>
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<tr>
<td>1959</td>
<td>E. L. CHAFFEE</td>
<td>Research contributions and training for leadership in radio</td>
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<tr>
<td>1960</td>
<td>HARRY NYQUIST</td>
<td>Thermal noise, data transmission and negative feedback</td>
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<tr>
<td>1961</td>
<td>ERNST A. GUILLEMIN</td>
<td>Scientific and engineering achievements</td>
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<td>1962</td>
<td>EDWARD V. APPLETON</td>
<td>Ionosphere and radio waves</td>
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<td>1963</td>
<td>GEORGE C. SOUTHWORTH</td>
<td>Microwave physics, radio astronomy, waveguide transmission</td>
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<td>YEAR</td>
<td>RECIPIENT</td>
<td>DESCRIPTION</td>
</tr>
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<td>------</td>
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<tr>
<td>1963</td>
<td>JOHN H. HAMMOND, JR</td>
<td>Radio control of missiles, basic communication methods</td>
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<tr>
<td>1964</td>
<td>HAROLD A. WHEELER</td>
<td>TV resolution, antennas, microwave elements, circuits</td>
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<td>1965</td>
<td>NO AWARD</td>
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<td>1966</td>
<td>CLAUDE E. SHANNON</td>
<td>Mathematical theory of communication</td>
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<tr>
<td>1967</td>
<td>CHARLES H. TOWNES</td>
<td>Quantum electronics, maser and the laser</td>
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<td>1968</td>
<td>GORDON K. TEAL</td>
<td>Single crystal germanium, silicon technology, transistors</td>
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<tr>
<td>1969</td>
<td>EDWARD L. GINZTON</td>
<td>High power klystrons and linear particle accelerators</td>
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<tr>
<td>1970</td>
<td>DENNIS GABOR</td>
<td>Holography</td>
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<td>1971</td>
<td>JOHN BARDEEN</td>
<td>Conductivity of solids, transistors, theory of superconductivity</td>
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<td>1972</td>
<td>JAY W. FORRESTER</td>
<td>Magnetic-core random access memory</td>
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<td>1973</td>
<td>RUDOLF KOMPFNER</td>
<td>Traveling wave tube amplification</td>
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<td>1974</td>
<td>RUDOLF EMIL KALMAN</td>
<td>System theory and algebraic structures</td>
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<td>1975</td>
<td>JOHN R. PIERCE</td>
<td>Satellites, traveling wave tubes, electron beam optics</td>
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IEEE: Institute of Electrical and Electronics Engineers
IRE: Institute of Radio Engineers
RCoF: Radio Club of America

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NOTES

1 See Bright, 1898; Lynch, 1985; Beauchamp, 2001.

2 The society soon evolved into The Society of Telegraph Engineers and Electricians, and eventually became the Institution of Electrical Engineers (IEE) in London. It survives today as the Institution of Engineering and Technology (IET), which was formed by a consolidation of the IEE and the Institution of Incorporated Engineers (IIIE) on March 31, 2006. See Frary, 2008; IET, 2008.

3 The early history of the American electrical profession, the beginnings of American professional societies and the emergence of the AIEE are explained in Ryder & Fink, 1984; Century of Electricals, 1984; McMahon, 1984; Israel, 1992. The history of the IEEE and its predecessor organizations is also at IEEE Global, 2011e-k; Reiman 1984, 1989a&b.

4 AIEE’s founders included Norvin Green, President of Western Union and the first President of the AIEE, plus Alexander Graham Bell, Charles Cross, Thomas Edison, George Hamilton, Charles Haskins, Frank Pope, Charles Brush, Elisha Gray, Edwin Houston and Theodore Vail (Ryder & Fink, 1984; McMahon, 1984, IEEE Global, 2011f & 2011h). See also Note 2.

5 The early histories of the SWTE and TWI and their consolidation into the IRE are contained in Radio Pioneers, 1945; Hogan, 1951; Proceedings, 1952; Goldsmith & Hogan, 1952; Whittemore, 1957 & 1962; and IEEE Global History, 2010b. See also Clark, 1942 & 1946; McMahon, 1984; Reiman, 1980.

6 Stone was a telephone engineer with the American Bell Telephone Company in Boston. In 1901 he formed the Stone Wireless Telegraph Syndicate which was followed in 1902 by the Stone Telegraph and Telephone Company (collectively, “STTC”). Stone developed telephone battery systems and carrier current transmission systems. In radio, he pioneered adjustable tuning methods focusing on selectivity, single wave emission and the use of loose-coupled circuits. After the collapse of STTC in 1910, Stone became a consultant and expert witness in patent cases, eventually going to American Telephone and Telegraph Company in 1920. During the course of his career, he obtained 120 patents on his radio and telephone inventions (Dunlap, 1944; Clark, 1946; Architects, 1984).

7 STTC was one of the first companies to receive permission from the U.S. Navy to install and test wireless systems at naval installations and onboard ships (Howeth, 1963; IEEE Global History, 2010b). Lee de Forest would later credit Stone with having provided de Forest important assistance with the mathematics and theory of radio circuits. On June 21, 1943, the U.S. Supreme Court recognized Stone’s Feb. 8, 1900 patent application (No. 714,756) for tuned antenna circuits and loose-coupling plus the work of Nikola Tesla in 1897 and others as preceding the work of Guglielmo Marconi. The Court then invalidated Marconi’s U.S. Patent No. 763,772 filed Nov. 10, 1900 for his “four-tuned-circuit” which was dated nine months later than Stone’s patent (U.S. Supreme Court, 1943; Dunlap, 1944; Clark, 1946; de Forest, 1950).

8 Marriott was responsible for a number of patents and was the author of many papers and articles on the development of radio. He did experimental work for a number of early radio concerns, was a radio aide of the U. S. Navy in 1915-1925, and was a consulting engineer for the Federal Radio Commission in 1928-1929. He founded TWI and co-founded the IRE, serving as its first President in 1913 (Whittemore, 1957; Architects, 1984; IEEE Global History, 2010c).

9 In radio’s early years, New York City had a large concentration of
wireless companies including the American Marconi Company, Lee de Forest’s various enterprises, Harry Shoemaker’s International Wireless Telegraph Company and the United Wireless Telegraph Company. Boston was the home of STTC and NESCO. Walter W. Massie’s companies straddled the corridor between New York and Boston with the Massie Wireless Telegraph system. NESCO’s move to Brooklyn helped permanently focus the communications industry in New York (Radio Pioneers, 1945). By 1912, at least ten major wireless companies were located within a few blocks of Fulton Street in New York City (Clark, 1942).

Goldsmith worked at the General Electric Company, Marconi Wireless Telegraph Company of America and at Radio Corporation of America making significant technical contributions. He is best known for his work shaping the professional organizations in his field. He was a founder of IRE, forty-two year Editor of the Proceedings of the IRE and also served as its President in 1928 (Whittemore, 1957; IEEE Global History, 2011c).

Hogan was a laboratory assistant to de Forest, and worked for Fessenden and NESCO at the famous Brant Rock station where he served as a telegraph operator. He helped develop Fessenden’s 1910 crystal detector, single control tuning in 1912, and discovered the “rectifier heterodyne” in 1913. He also developed the first ink tape siphon for recording transatlantic radio signals using an audion amplifier. Hogan later developed FM radio station WQXR, a facsimile transmission system, and worked with radar and guided missiles for the U.S. Army Signal Corps. He was instrumental in forming the SWTE and the IRE, and was elected President of the IRE in 1920. He served as the U.S. Navy’s chief research engineer at its Arlington Station and was a commercial manager for NESCO and its successor, the International Radio Telegraph Company (Radio Club, 1959; New York Times, 1960; Reiman, 1992; IEEE Global, 2011m).


Pickard had been the only person who was a member of both STWE and TWI, the IRE’s predecessor organizations (Whittemore, 1957 & 1962).

See Electrical World, 1917; Wireless Age, 1917a; Medal of Honor, 1917.

Sanford also produced the renowned sculptural figures of the Great Dane, Ajax and Pegassus; a commemorative tablet at Columbia University; designed fountains for the estates of wealthy patrons; and the sculpture and pediments for the State Capitol at Sacramento, California. In the mid-1920s, he reorganized the department of sculpture of the Beaux-Arts Institute of Design, became the

18 On January 13, 1902, Marconi was the guest of honor at a hastily assembled dinner of the AIEE. The affair was a celebration of his historic accomplishments that was attended by many leading figures in electrical engineering, including Charles Proteus Steinmetz, Michael I. Pupin, Alexander Graham Bell and Elihu Thomson. Letters and telegrams of congratulations were read from notables including Thomas Edison and Nikola Tesla. Marconi would state, “I can hardly find words to express my gratitude and thanks for the reception I have received here tonight” (New York Times, 1902). See also AIEE Annual Dinner Program, 1902; Annual Dinner, 1902.

19 The long history and differing personal perspectives on this complex litigation are described in de Forest, 1950; Lessing, 1956; Legacies, 1991; Lewis, 1991 and Coe, 1996. See also U.S. Supreme Court, 1934. Over the years, 13 separate court decisions issued by thirty judges had been split evenly between Armstrong and de Forest. Despite the legal confusion, the scientific and technical societies of the time conducted their own investigations and rendered their own opinions. “There is no doubt that the great majority of well-informed radio engineers regard Armstrong and not de Forest as the inventor of the regenerative circuit” (New York Times, 1934b). Nevertheless, de Forest received many awards for his invention of the triode tube including the prestigious Edison Medal, the Franklin Institute’s Cresson Medal and the IRE’s own Medal of Honor; but, he never received an award for the regenerative circuit. Armstrong would also receive the AIEE’s honorary lifetime membership (the first granted to Lord Kelvin) and a fellowship to Great Britain’s Royal Society for the Encouragement of Arts, Manufacturers and Commerce, an honor granted to few Americans. Ironically, Armstrong served as President of the RCoA from 1916-1920, and de Forest served as president of the IRE in 1930. See Bart & Bart, 2009 & 2010 regarding the AIEE’s awarding of the Edison Medal to Armstrong.


21 For a complete history of John Fritz and the Fritz Medal including its winners, see Science, 1902; John Fritz Medal 2009a & 2009b; John Fritz Medal, 1910; Trainer, 2008.

22 Dr. Elihu Thomson is not related to Sir William Thomson, known as Lord Kelvin. Elihu Thomson’s accomplishments included approximately 700 patents, work on electric arc lighting, establishing the Thomson-Houston Electric Company (which would eventually merge with the Edison General Electric Company to become General Electric Company), the Thomson Electric Meter, alternating current devices, the electric air drill, methods of electric arc welding, investigating X-rays and research on fused quartz for use in reflecting astronomical telescopes. Thomson was active in the AIEE, contributed to many other societies, and received the John Fritz Medal in 1916. He later became the President of the Massachusetts Institute of Technology. In addition to the Edison Medal, Thomson was the first American recipient of the Kelvin Gold Medal issued by the Institute of Civil Engineers in Great Britain in 1923. The Kelvin Medal is awarded for “distinguished service in the application of science to engineering” (Presentation to Thomson, 1917; Brittain, 2004; IEEE Explore, 2008; ICE, 2009).
Pupin was a legendary Columbia University Professor who made contributions in the fields of wave propagation, long distance telephony and induction. He discovered the electrically tuned circuit and developed the loading of telephone circuits with induction coils which effectively removed the barriers to long distance telephone communication. He was the first to suggest the use of an electrical rectifier for use in receiving radio signals. Pupin also developed a method of rapid X-ray photography. His autobiography *From Immigrant to Inventor* won the Pulitzer Prize in 1924. See John Fritz Medal, 2009a; IEEE Website, 2009c & 2011b. For Pupin's biography, see Gherardi, 1932; Michael, 1935; Architects, 1984.

RCofA continues to conduct meetings, events and banquets, and it continues to publish. Recent awards were given to Martin Cooper, inventor of the first hand held Motorola cell phone, and to Dr. Donald Cox for his development of land mobile radio and communications. See First Amateur, 1923; Radio Club, 1959, 2009 & 2011; Perry, 2010.

Vassos designed radio and television cabinets including RCA's art deco lines. Barnes worked for RCA/Victor drafting phonograph styling designs. The medal was "drafted" by Barnes, "designed" by Stevenson and "done" by Vassos. Straubel crafted the bronze medal (Schultz, 2011). Thirteen silver medals were made. One finished medal was given to each of the designers for their services. The remaining ten were retained by RCofA together with the master. Since the last of the ten medals was presented in 1956, RCofA authorized a new mould to be cast from the Master, and a new supply of Armstrong Medals was produced for future use (Radio Club, 1959; Schultz, 2011).

Seven small versions of the Armstrong Medal were awarded in 1950 to Ernest V. Amy, Major Edwin Armstrong, George E. Burghard, Minton Cronkite, Paul F. Godley, John F. Grinan and Walker P. Inman in recognition of their achievement (Story, 1950; Radio Club, 2011a).

Houck was much more than Armstrong's assistant. He served in the U.S. Army Signal Corps in France during World War I working with Armstrong to develop the super-heterodyne method of reception. He was an engineer for the International Radio Telegraph Company, Chief Engineer for Dubilier Condenser and Radio Corporation, a consultant to the Federal Telegraph Company, and President of Measurements Corporation. He was responsible for designing the second harmonic super-heterodyne, the first type to be placed in large scale commercial production, and his work on capacitors made possible the filter systems used in all modern radio receivers (Harry W. Houck, 1931; Radio Club, 1959).


See the Special Merger Supplement, 1962 for the agreements between the AIEE and IRE and the principals of consolidation. The merger is further explained at Reiman 1989 & 1990; Ryder & Fink, 1984; *Century of Electicals*, 1984; McMahon, 1984; IEEE Website, 2009c.

Alfred N. Goldsmith, a founder of the IRE, and Arthur E. Kennelly, a past president of both the IRE and AIEE, had long advocated a merger of the two organizations (Reiman, 1989; Ryder & Fink, 1984; McMahon, 1984).

The stated purpose of the AIEE in 1961 was "the advancement of the theory and practice of electrical engineering and of the allied arts and sciences, and the maintenance of a high professional standing among its members." The stated purpose of the IRE was "to advance theory and practice of radio and allied branches of engineering,
ABOUT THE AUTHORS

David and Julia Bart reside in the Chicago area. Together, they have published numerous articles on telegraph, radio and broadcasting history.

David received both his Bachelor of Arts Degree in Anthropology and Statistics (1985) and his Masters Degree in Business Administration (1993) from the University of Chicago. He is a member of the Board of Directors of the Antique Wireless Association, Chairman of the Museum Advisory Board and Technical Curator for the Museum of Broadcast Communications in Chicago, and the former President of the Antique Radio Club of Illinois where he continues to serve on its Board. He is also Chairman of the Historical Committee of the Radio Club of America. He has provided many presentations, exhibits and displays on topics of communications history, including at the New York Historical Society, the American Association of Physics Teachers and American Association For The Advancement of Science Joint AAPT/AAAS Meetings, the Antique Wireless Association and the Radio Club of America.

Julia received her Bachelor of Arts Degree in Behavioral Sciences (1987) from the University of Chicago and a Master of Arts in Reading from Concordia University (2007). Julia is the Editor for the Antique Radio Club of Illinois’ publications, a past Treasurer and continues to play an active role as a volunteer and advisor to the Board of Directors. Julia also provides advisory services to the Antique Wireless Association and has co-authored several peer-reviewed articles for the AWA.

David and Julia’s recent work on the Edison Medal and the Medal of Honor is included on the Institute of Electrical and Electronics Engineers’ Global History Network website.

David and Julia are founding members of the Webster Club for the history of scientific instruments at the Adler Planetarium in Chicago and are members of the Scientific Instrument Society in London. David and Julia have collected radio, telephone, phonograph and telegraph devices for over twenty years; and, with their two sons John and Michael, have enjoyed providing programs for the Boy Scouts of America, school groups and local historical societies.

Julia & David Bart
The IEEE Medal of Honor
This is a story primarily about young men and what they accomplished in a remarkable time, the first two decades of the 20th Century, and in remarkable places – especially in California in the Western United States. Guglielmo (William) Marconi, in his early twenties, electrified the technical world of the late 19th Century with his successes using Hertzian electromagnetic waves to communicate at distance, what we now call “radio.” He did this without the wired connections to which the world had turned with enthusiasm earlier in the century. The telegraph, including undersea cables, and the telephone, needed wire, and lots of it. Communication without such wires, at first wireless telegraphy, opened new vistas. This was particularly so looking out to the world’s oceans. Communication with ships at sea (Marconi’s primary initial interest) was now possible. Then, a challenge to the expensive cable monopolies could be mounted. This was so because the new “wireless” meant exactly that: no expensive, capital-intensive investments in cables, only in terminal stations. As the amateurs in these new arts soon showed, wireless also freed communications from pre-existing geographical networks. Men and boys, capitalists and hobbyists, could now explore and stake interests in what inventor Lee de Forest called the “Invisible Empire of the Air.”

As a result of the then new networks of communication, the late 19th century was blessed with nearly immediate knowledge of many of the world’s events. Scientific and technical advances were reported and widely published worldwide. Interested people ranging from university professors, to entrepreneurs, to back-room tinkerers, followed these developments, and sought to replicate them. They were able to do so by reason of the uniformity of the laws of physics. And they sought to go beyond into new devices, new arrangements and new technologies.

San Francisco, from its Gold Rush days, had
been a cosmopolitan world city. Nearby Stanford University (at Palo Alto, California) first flourished in the 1890s. Its electrical engineering department was instrumental in development of hydro-electric facilities for electrical power. It provided a sound foundation for research, technical experiments and what were then high-technology business formations. The people of San Francisco, like much of the world, enjoyed *Scientific American, McClure’s Magazine* and a host of other publications. Events reported in such publications also catalyzed technical work on the West Coast of the United States. It wasn’t “instant messaging” but it was current and thorough explanation of advances.

The independent wealth and the geographical isolation of the West Coast fostered an independent development of communications and electronic technology. These developments ranged from the first American use of wireless at San Francisco in 1899, the first reliable worldwide communications systems from California’s Federal Telephone and Telegraph less than 20 years later, even the invention of electronic television in San Francisco by Philo Farnsworth in 1927, up to the Silicon Valley of today’s digital world. It is the goal of this note to tell some of the stories of that independent development, from the primitive marine wireless of August 1899 in San Francisco to the advent of radio-telephone broadcasting by Lee de Forest in San Francisco in 1920, with much in between in these 21 years. While there were many regional successes as well, there were not a few dead-ends.

Several important stories stand out through the mists of time – and San Francisco’s fogs. The 1899 success in using the first American maritime Wireless installation (a spark coil on a lightship) for journalism and public notice was seminal in all later developments. This is so because it was such big news, nationwide. The experimental use of the arc technology to generate continuous waves, in which Lee de Forest played a major role, brought on two novel successes. First, the arc succeeded in communications circuits. These high power circuits eventually ranged worldwide. The Federal Telegraph and Telephone Company of Palo Alto, California, the predecessor of ITT, implemented them. Victory in World War One required these reliable circuits. Second, the arc provided the basis of early broadcasting. ‘Doc” Herrold in San Jose broadcast programs and music well before the First World War. The improvement of the vacuum tube technology of Lee de Forest’s three-element triode vacuum tube “Audion,” was work largely done by de Forest in Palo Alto at Federal. This work provided the basis for supplanting both the spark and the arc technology of earlier years, at the end of the First World War and by the beginning of the 1920s. The post-war boom of the 1920s saw radio broadcasting, using vacuum tube transmitters and receivers, become a nationwide unifying and standardizing cultural force.

History, said Henry Ford, is “just one damn thing after another.” But it’s all that the word “after” implicates that is so interesting.

**GENESIS: AMERICAN WIRELESS TELEGRAPHY IS BORN IN 1899 IN SAN FRANCISCO**

In August, 1899 the *San Francisco Call* newspaper successfully used wireless to scoop a competing newspaper about the appearance of a long-await-
ed troopship in the fog seven miles off the Golden Gate, San Francisco. The USS Sherman brought a California regiment back from the 1898 Spanish American War campaign in the Philippines. Lightship 70 of the U.S. Lighthouse Service, a predecessor of the Coast Guard, signaled the arrival of the troopship to a receiving station near the Cliff House. By 1901, the Lighthouse Service began regular installation of wireless sets in Lightships.

In April, 1899, wireless test signals between San Francisco’s Telegraph Hill and its downtown (at the Call building), were successful enough to justify further development by the San Francisco Call. In 1899, McClure’s Magazine began to report, worldwide, Marconi’s wireless success in Great Britain. Early newspaper reports told of the use of wireless by the Lightship Goodwin to summon aid after a collision. The San Francisco use of the Lightship 70 as a transmitting station, and the spark and coherer technology employed, appears to derive directly from the report in McClure’s Magazine. The San Francisco experimenters used the then standard laboratory equipment Rhumkorff inductance coil to generate a high voltage, high current spark. They ran it up a 82 foot long vertical antenna on the Lightship 70. At the Cliff House, a similar antenna came down to a coherer and an inker as the receiver. “Sherman in sight” is the text of what is likely the first working wireless message in America. Some of the headlines of the Call coverage show the technical impact of the success: “Wireless telegraph Excites Much Interest – Information Solicited Regarding Method of Procedure – Associated Press Asks for Full Details of the recent Successful Experiment by the Call.” A “Description of the Apparatus” followed, characterized as “the latest marvel of the 19th Century.” Some of the Call story appears nearby along with images of some of the facilities.

Fig. 1. The site of the April, 1899 tests to Telegraph Hill, San Francisco. Postcard.

Fig. 2. The site of reception of the first American wireless message. The Cliff House, 1899. Postcard.
used.

In January, 1897, *Scientific American* had reported Marconi's initial successes with telegraphy without wires in England. “An invention which promises to be of the greatest practical value in the world... Mr. Marconi had come... with such a system.... [Y]oung Marconi had solved the problem [communication without wires] on entirely different principles, ... ma[king] a successful test on Salisbury Plain at a distance of three-quarters of a mile.” This news, and that of Marconi's following feats, sparked great attention in both commercial interests and in experimenters. In communicating across the English Channel in March, 1899 Marconi opened the eyes of the world to the potential of wireless. In California, a young Stanford student, Charles D. Herrold (later affectionately known as “Doc”) went to work even earlier. Herrold repeated Marconi's 1895 wireless-at-a-distance tests the very day he read the newspaper reports of their success. Herrold had observed similar lab experiments of a Dr. Taylor at Stanford. Herrold, in his test, achieved one mile's distance with a Rhumkorff coil and a Branley coherer. No doubt enthusiastic young men performed such replicating experiments around the country as news of Marconi's successes spread. The fact that Marconi himself was so young provided a model for ambitious exploration of the new world of communications.

Commercial interests leapt at the opportunities of 1899; in retrospect some were just stock selling frauds but many at least put enough money into their stations to advance the art. In November, 1899, American Wireless Telephone and Telegraph Company, the first such enterprise, incorporated in Arizona. It held the communications patents of Professor Amos E. Dolbear of Tufts University, giving it a patina of technical respectability. (The patents were good enough to require the Marconi interests, ultimately, to buy the rights). American sold a lot of speculative stock. The promoter was Dr. Gustav P. Gehring but the Chief Engineer was Harry Shoemaker. Shoemaker's pioneering technical work earned the respect of many and he trained several of the next generation of wireless pioneers.

**THE NEW CENTURY OF RADIO BEGINS**

By 1901, wireless began to provide real service. In March, 1901: The Mutual Telephone Company of Hawaii linked the main Hawaiian Islands by wireless. Stations began to use call letters on the model of the abbreviations of landline telegraphy; Oahu's call letters are “HU,” Molokai Island's call letters are “AM,” Puaho is “KA,” Lahaina on Maui is “LA,” and Nawiliwili on Kauai is “NW.”
In these early days, companies, and other wireless operations chose their own callsigns. Usually they bore some relation to place or provided some clue as to operation, but that is not easy to decipher in retrospect.

The United States Army as early as 1900 and 1901 used wireless to communicate with the Coast Artillery post on Alcatraz Island from Fort Mason in San Francisco, according to radio historian George H. Clark. Three such Coast Artillery forts controlled the entrance to the Golden Gate. The officer in charge was a Capt. Dyer, the engineer Carl Kinsley. Both the Army and the Navy saw the importance of wireless for command, control and communications, and soon for intelligence purposes as well, as others also used wireless communications.

In December of 1901, Marconi’s successful transatlantic test received wide publicity on the West Coast as in the rest of the world. He heard the famous “S” – three dits in Morse Code – from Polhu in Cornwall in far West Great Britain at St. John’s in Newfoundland on December 12 and 13. The news got out quickly. The value of the stock of the Atlantic cable companies fell by half at the prospect of such lower cost competition. Wireless became an even more interesting business opportunity. It also provided an even more promising stock selling proposition. The promoters such as Gehring often modeled the sales pitch on the lucrative returns to early investors in Bell’s telephone company. But wireless was undoubtedly opening new technical and business frontiers.

A. Frederick Collins, in 1902 and earlier, published many articles about wireless, in Scientific American and elsewhere. In San Francisco, a very young and commercially ambitious Francis McCarty put together a primitive radio-telephone using the spark coil design by Collins. (His father, “White Hat” McCarty, also dabbled in wireless). Francis McCarty tested his device in Western San Francisco, at Ocean Beach. McCarty interests followed up with an early arc system, known as the “peanut whistle.” In 1905 McCarty demonstrated his wireless telephone from the Cliff House in San Francisco. McCarty managed to garner considerable local press for his enterprise, including a 1905 newspaper interview. McCarty’s system engendered a great deal of publicity and public interest. In the 1905 interview, McCarty recounted:

“... I’m always reading about this kind of work whenever I find in a book or magazine any report of some man’s experiment with a diagram the apparatus with which he made his tests, I set right at building a duplicate to see if I can get the same results. You really can’t understand the problem and the way he worked it out unless you do this.”

“I had been working for the wireless telegraph company, and it seemed to me that since we could send the wave signals without direct connection we should

Fig. 4. Collins promotional photograph of his wireless telephone, circa 1902. The operator is not Collins. (Author’s collection)
be able to send exact tones. They said this could not be done because the rate of vibration of the human voice was so much lower than of the Hertzian wave, but I was not convinced. If we could only have the right transmitting instrument I thought it could be done, and I kept on trying. Finally, I struck the right plan.

“The first telephone outfit I made was very small and crude. The transmitting instrument was in the front of the house and the receiving on the porch in the rear. The aerial wires were suspended on posts not over five or six feet high and the ground plates were laid on the floor. It worked all right over a distance of about fifty feet and anything that was said, even in a very low voice and with the intermediate doors closed, could be heard plainly.”

McCarty died in a road accident in May, 1906 at age 17. His ambitions died with him but his company lingered on, promoted by his brothers and capitalized as the National Radio Company. Direct successors to McCarty included Cyril Elwell, the later principal of San Francisco’s Federal Telegraph and Telephone, who evaluated McCarty’s system. Doc Herrold worked for National from San Jose in 1908, perfecting the arc radio-telephone.

July, 1902 saw the first commercial wireless traffic on the West Coast and in America. Gehring had established as part of his nascent and would-be wireless empire the Pacific and Continental Wireless Telegraph and Telephone Company. It was an American Wireless subsidiary. Robert Mariott, the Chief Engineer, had worked with Harry Shoemaker. Mariott went on to a distinguished career. He set up stations on Catalina Island, off the California coast, and in Los Angeles, apparently on his own initiative. He adopted callsign “A” for Avalon on Catalina, and callsign “G” for the San Pedro, Los Angeles station. This circuit carried the first paid wireless traffic, a distance over water of 26 miles. It stayed in operation in various modes including wireless telephone, for many years.

In 1903 the Revenue Marine was a predecessor of the Coast...
Guard, as was the Lightship Service. It authorized the Revenue Cutter *USS Grant* out of Tacoma, Washington to install wireless to communicate with Tacoma (and Friday Harbor). The primary purpose was intelligence to suppress opium smuggling and for other law enforcement. By 1910 seventeen cutters were equipped with wireless on both coasts. On the West Coast later, the Revenue Cutter *USS Bear* employed the callsign RCB.17

Alaska, by reason of winters and isolation, provided a good opportunity for wireless to prove its worth on the ground. In August 1903 the United States Army established the Alaska Wireless network. It was the predecessor of decades of effective radio networks in Alaska. Stations and callsigns were: FB Fairbanks, FD Nome, FE Mouth of the Yukon, FG Fort Gibson, FK Circle City, FM Fort St. Michael (reported to be the first station in the West), FP Petersburg, FQ Fort Egbert, FX Fort Worden.18

In 1903, another San Francisco experimenter, Rev. Richard Bell, sent wireless messages from San Francisco to San Jose, about 60 miles. In 1907 and thereafter, he and Doc Herrold in San Jose communicated by wireless telephone.19 Wireless telephone attracted both experimenters and stock promoters. Established companies (dubious though many were) had implemented wireless telegraphy. But the hope of a wireless telephone could engender both enthusiasm and investment. These early developments came to naught, but provided a foundation for vacuum tube generated carrier wave amplitude modulated broadcasting in the next decades.

In April, 1903 the Mare Island Naval Station just North of San Francisco first employed wireless.20 It put into service a German Slaby-Arco two kilowatt open gap spark transmitter. Ironically, the Navy sited it in the former homing pigeon loft. The Navy took to wireless with enthusiasm for shore to ship, ship to shore, and ship to ship communications, sometimes to the distress of Captains whose discretion was thus managed by shoreside officers. Wireless offered worldwide central control to the Admiralties of the major naval powers.

By 1904 the Navy established a network of three Northern California stations, San Francisco on Yerba Buena Island in the Bay (call letters TI) and Mare Island (call letters TG) with landline telegraph links, and one on the Farallon Islands 27 miles off the Golden Gate (call letters TH).21 In November, 1904 the Mare Island and the San
West Coast Wireless

Francisco (Yerba Buena) Navy stations began regular weather broadcasts by wireless telegraph. The ability to gather and to disseminate regionally meteorological information, especially storm warnings, early proved radio's utility. Time signals, so useful for navigation, soon followed. So too, Navy stations soon sent out press summaries to ships at sea. For example, Point Loma near San Diego, established about 1903 with a ten inch spark gap, did so with the preface “CQ de NPL – press.” Point Loma used the callsign TL before using NPL.\textsuperscript{22}

Commercial interest radio appeared in San Francisco in the summer of 1904. The DeForest Wireless Telegraph Company established its first West Coast station in the Palace Hotel on Market Street in San Francisco. Its operator, Tim Furlong,\textsuperscript{23} naturally enough adopted the callsign “PH.” Sam (Sydney) Maddams built the station in 1903-04. Maddams had been Marconi’s operator at Poldhu in Cornwall in 1901 who first sent the “S” in tests, the “S” heard by Marconi across the Atlantic.\textsuperscript{24} In 1904 the de Forest company exhibited at the St. Louis Exposition and successfully got messages through to Chicago.\textsuperscript{25} Charles B. (“C.B.”) Cooper was de Forest’s operator at St. Louis, and he later came west through Denver, Colorado to California as one of the more colorful wireless personalities. He enjoyed a long career in radio.\textsuperscript{26}

Also in 1905, at Fort Mason in San Francisco (the site of the earlier circuit to Alcatraz Island), Major George O. Squire of the Signal Corps experimented with trees as receiver antennas for wireless communications. They worked. He was able to communicate several miles from Yerba Buena Island in the Bay and nearby Alameda and Santa Clara Counties. Squire as a general officer later became Chief of the Signal Corps in World War One.\textsuperscript{27}

About 1906, the call signs used on the West Coast suggest several chains of stations, or proposed stations. Avalon on Catalina Island and Los Angeles had used “A” and “G” respectively in their earliest transmissions under the aegis of the Pacific and Continental Wireless Company. Pacific Wireless Telegraph Company succeeded Pacific and Continental Wireless in August, 1903 and bought the Catalina Island circuit and stations. Pacific’s stations included at least: A at Avalon, Catalina Island, California; G in Los Angeles, California; D in Port Townsend, Washington; DA in Seattle, Washington and SF in San Francisco, California.\textsuperscript{28}

Continental is reported to have
operated a station at Portland, Oregon that employed the callsign “O-2;” another such station operated out of Seattle with the call “S-2,” from Queen Anne Hill with five kilowatts of power.29

Another network used callsigns starting with D or P, plus a second letter, in California, Oregon, Washington and Alaska. The “D” stations may have derived from the de Forest name, and the “P” stations from the Pacific Coast on which the were sited by the Pacific Wireless company. The D and P stations ended up as United Wireless stations (some erected by the DeForest Company); United’s West Coast headquarters was in Seattle.

RA in Safety Harbor, Alaska is listed to United; the Army Signal Corps established a Safety Harbor station in 1903 with de Forest equipment. Nome, Cordova and Sitka, Alaska operated with callsigns SA, SN and SO, respectively.

United Wireless is reported to have been operating thirty coastal and inland stations between 1900 and 1906. The inland stations were not intended to handle maritime traffic, but rather to compete with landlines; United Wireless, like Pacific Wireless, sold large amounts of stock to the public without significant commercial revenues from its actual, let alone projected, stations. On the other hand, it did operate stations and employ competent designers, operators and technicians.

As of 1906, the now known primary stations on the West Coast include the United chains, the Navy chain, the Army Alaska chain, PS at the Presidio Army Headquarters in San Francisco, California and PT at Fort Bragg, Oregon (both also listed to United).30

1906: EARTHQUAKE AND DISASTER

The use of wireless telegraphy in disaster response came early. For example, in March of 1906, a storm took out wired communications between Los Angeles and San Diego. The De Forest Company provided all communications by wireless, earning the gratitude of the disabled companies and the public.32 This was a precursor to “The Big One.”

The next month, April, 1906 the Great Earthquake and Fire leveled San Francisco. The Navy Cruiser USS Chicago, at sea, returned and tied up at the docks at the foot of Telegraph Hill. It handled outbound San Francisco traffic, over a thousand messages. This traffic was managed by a young officer, S.N Hooper, later known as the Father of Navy Radio (and RCA), who had some landline telegraph experience. Yerba Buena Island (TI) acted as a relay to Mare Island (TG). Mare Island connected to the telegraph landlines that conveyed to the world the extent of the disaster.33

Station PH was lost with the loss of the Palace Hotel to the Great Fire. An amateur radio operator by the name of Ray Newby lost his 70 foot tower and antenna in San Jose to the earthquake. Newby was later an American Marconi operator and Doc Herrold’s station operator in San Jose, holding the license. In San Francisco, McCarty
offered to transmit wireless traffic from the West part of the City.  

The 1906 earthquake delayed Pacific Wireless’s proposed California and Hawaii circuit. Antenna towers did go up on Mount Tamalpais. The earthquake did not take down the tall towers. Persons unknown, rumored to be associated with a competitor, caused the fall of the towers in December. Haradon Pratt investigated and found that someone had cut the guy wire anchor rods. Pratt later enjoyed a distinguished career in radio at the highest levels.

A.F. Krenke had been the operator at “G” in Los Angeles on the Catalina Island circuit. He was the station manager and in charge of construction for Mt. Tamalpais. Pacific Wireless was regarded by many, then and now, as primarily a promotion to sell stock, hyped by comparison to the success of the Bell Telephone Companies. So too, the Gehring companies and the DeForest companies were then and are now widely seen as fraudulent enterprises. The engineers of such companies, such as Harry Shoemaker and Lee de Forest did, however, make very significant contributions to the art, most importantly de Forest’s Audion vacuum tube triode of 1906. Pacific’s ambitions for a San Francisco and Hawaii circuit made good business sense, as later developments showed.

In about 1906, as many as 40 commercial wireless stations operated on the West Coast: DeForest - United include: California - 9, Washington - 9, Oregon - 6, Canada - 3, Alaska - 2; Pacific Wireless, California -3, Washington -2; Massie Wireless had one (in San Francisco); Hawaii had five stations.

SAN FRANCISCO RECOVERS, WIRELESS MARCHES ON

“PH” had been in operation in early 1906, first as a DeForest Company station and then as United Wireless. Formerly at the Palace Hotel, it moved to Russian Hill to the North, just West of Telegraph Hill after the Great Fire after the Earthquake burned the Palace Hotel down. Its site had a magnificent view of San Francisco Bay but it did not carry much traffic for want of wireless equipped ships. It was, however, a nuisance to its residential neighbors, so it shortly moved to Hillcrest in Daly City, South of San Francisco. This site was soon called Radio Ridge on Mount San Bruno (full of radio towers to this day). When American Marconi absorbed United Wireless in 1912, PH at about the same time was destined to migrate North to Marin County for its radio operations. PH became KPH with the assignment by the government of official call signs. Much later it operated its transmitters from Bolinas and its receivers at Marshall.

Another Pacific Wireless station in San Francisco used the call sign “SF.” The Presidio station in the Army installation at San Francisco’s Presidio signed “PS.” Many amateurs were active as early as 1906 as well. For example, Butler (Bert) Osborne of San Francisco, later W6US, started in 1906 at age 12. In 1908 he was on the air, shortly with five kilowatts of spark and callsign CG.

In about 1907, the legendary Lawrence A. Malarin was known to all by his personal sine “LM.” The sine, as in “sign,” was an operator’s unique self-chosen personal abbreviated identifier. He began his wireless career as the operator at San Francisco’s PH in the Palace Hotel. The Navy insisted that he be fired as the PH operator on Rus-
sian Hill for using so much inventive in the ether. He then became the United Wireless Manager downtown. He later became the American Marconi Manager. His idiosyncracies included assigning similarly named operators to the same duty stations: Mr. West would get to work with Mr. East, Mr. Baer with Mr. Wolf. Operators penned doggerel verse about him, for example:

“LM” once handled the great PH,
Is what I have been told,
He did his work, he’d never shirk,
And now he’s the Chief quite bold.

Navy Commander Richard Johnstone, an early (1907) wireless amateur in San Francisco and later a KPH operator, was first hired by United Wireless after impressing Malarin with his skills. They became friends over the years. Dick Johnstone provides interesting biographical information on Malarin in his colorful 1965 book of wireless reminiscences.

One of San Francisco’s first coast stations, the Massie station, operated with the call sign “IAA” in 1907. It used two 200 foot tall masts to support its antenna. Pioneer wireless engineer Arthur A. (“A.A.”) Isbell established it for the Massie company. He had just earlier parted ways with Reginald Fessenden’s company. Isbell had constructed and operated the station in Scotland with which Fessenden had communicated from Brant Rock. Isbell had been a classmate of Lee de Forest’s at the Mt. Hermon School in 1892–93 and in 1902 had worked for de Forest as one of the earliest wireless operators.

Isbell also chose his initials reversed for the Massie stations call letters. He set it up near the Cliff House at Ocean Beach for maritime work. After setting up the Massie station, Isbell found a bullet hole in his residence window, which he attributed to a competitor.

Isbell had arrived in May 9, 1907 on the steamship SS President of the Pacific Steamship Company, coming around the Horn. This was the first ocean liner to be fitted with wireless in the Pacific. Isbell was its operator. It used a three-kilowatt Massie system on 400 meters, callsign V-2. It set distance records during its voyage. Isbell went on to set up wireless and radio stations all over the world, initially in Hawaii circa 1908, and enjoyed a long career American Marconi, successor to United Wireless, and then with RCA. Isbell was for a time the United Wireless San Francisco Manager, for whom Malarin worked. He drove one of the first automobiles in the City. With the coming of American Marconi in 1912, absorbing United, Isbell became the Marconi Manager. His San Rafael marriage in 1912 was a newsworthy event, headlined “Belle Elopes With Marconi Mag-
Isbell was all too honest a man. He accused the United Wireless management of chicanery ("liars, cut-throats and thieves"). They sued him for criminal libel. He was, of course, right, and the United Wireless principals went to prison for stock fraud.

The utility of wireless for business coordination became clearer and clearer. In about 1907 the sailing ship Archer, which was a bulk carrier, was the first commercial vessel to install and use wireless on the West Coast. It communicated with its home company near Seattle, Roche Harbor Lime Company, station RH, which ran ten kilowatts spark.

In 1907 amateur wireless operators formed the Bay Counties Wireless Telegraph Association. Haraden Pratt of San Francisco was an active member. He was later telecommunications advisor to Presidents Truman and Eisenhower. Another active member was Ellery W. Stone of Oakland, later Radio Inspector, naval officer, and a distinguished technical author. The club issued licenses to operate as club members, along with club callsigns. They were three letter calls starting with "S." A member had to copy 20 words per minute in Morse code and pass a technical test in order to qualify. By 1912 some 50 operators held "S" calls licensed by the club. Haraden Pratt, President of the club, held SKH. Ray Newby, who also worked with Doc Herrold, held SEW. The later careers of the members of this club show how important engagement by amateurs with the evolving technology was for commercial success. At each meeting of the Bay Counties club, the President assigned one or more topics for scientific investigation and discussion.

The first amateur wireless man in the San Francisco area was Bill Larzelere, a member of the club. His call was SWL; circa 1908, he ran 5KW at 720 meters. His station operated from the second floor of a barn at his home in San Francisco. Many of the amateurs went to sea as wireless operators as
In 1908 the Bay Counties Wireless Association pioneered sports radio. It reported by wireless on the “Big Game,” to Palo Alto and Alameda from Berkeley. This was (and is) the annual clash of the football teams of Stanford University and the University of California at Berkeley.

Before callsigns were required and assigned after 1910, vessels of varying ownership used calls of the form letter-number like the SS President, rather than two letters; for example:


Two letter calls were more common. For example, by 1907 The Southern Pacific Company had equipped three vessels with DeForest gear at two kilowatts each on 300 meters. They used the callsigns KA, KM and KR. In 1908 United Wireless equipped and manned its first maritime installation on Union Oil Barge No. 3. Tim Furlong, PH’s first operator, had the key. Wireless became an important asset in inland waterways as well as on the high seas.

United Wireless leased its equipment for each vessel (as did Marconi), at $200 a month and paid its operator $40 a month, 25% more than Marconi paid on the East Coast. A five-dollar a month premium was paid for operators in tankers. In today’s money, $40 then is somewhere between $1,000 and $5,000 now. It was good pay, although Dick Johnstone did not think so at the time, because ships’ officers got more. KPH operators earned $90 a month.

Early in 1908 the United States Navy stations at Mare Island and in Panama communicated with the fleet in the South Pacific. This was the beginning of transpacific Navy communications. Other potential Naval applications of the new technology were coming to mind. In 1908 Doc Herrold fired explosive mines at a distance using wireless signals, and controlled small boats. Many experimenters explored just how effective wireless could be in managing weapons, including Nikola Tesla. He demonstrated a wireless torpedo in New York in 1907, with attendant publicity.

Shoreside, in 1908 a daily wireless circuit ran between San Francisco’s soon to be Chief Electrician, Ralph Wiley, and operator George Kellog of the Fire-alarm control station at Jefferson Square. Radio has been part of the public works and public safety infrastructure of San Francisco and all other cities ever since. Wiley’s “wireless outfit” appeared in Modern Electrics in 1909, his photo and description winning First Prize ($3).

In October, 1908 Lawrence Malarin in San Francisco at PH and Arthur Isbell, now at HU in Honolulu, first established wireless contact between California and Hawaii. Malarin, at PH on Russian Hill, heard “Aloha.” He realized it was Isbell testing in Hawaii and responded: “O.K. Isbell Hu 1:35 a.m. Hawaiian Wireless Company: Congratulations. United
Wireless Company”; Isbell replied: “Hu Isbell Cx Dh 1:38 a.m. Hu 11 United Wireless Company, Ph., San Francisco, Thanks Same to you. Isbell.” Isbell immediately, in his next message, suggested soliciting press traffic. “CX” was Isbell’s sine. HU ran ten kilowatts and PH about five kilowatts.

Hawaii thus joined the union of national communications. This circuit had been the goal of the sabotaged 1906 Pacific Wireless Mt. Tamalpais station. Similarly, in 1908 United’s Monterey, California and Friday Harbor, Washington stations maintain regular nightly contact up the coast.73

MUSIC IN THE ETHER
In 1908 the Navy Battleship USS Ohio of Teddy Roosevelt’s world-cruising Great White Fleet broadcast music over its DeForest Company wireless telephone. The ship used a Lee de Forest arc system and the callsign DC. Engineer O.C. (Oscar) Brill was the DeForest technician for the Fleet. When calling on San Francisco on the West Coast leg of the cruise, first the ship’s band went out over the ether, and then phonograph records obtained in port.74 The broadcaster was Chief Electrician H. J. (Herbert) Meneratti.75 Sam Maddams at PH early on monitored music from the Fleet, and reported it to the press.76 Many commercial and amateur operators heard these broadcasts77 as well as the Navy stations. Chief Meneratti played his records over the radio-telephone in many of the Fleet’s ports of call around the world. Chief Meneratti could thus well lay claim to the title of first radio broadcaster and “disk jockey.” In 1938 he was a Lt. Commander in the Navy and told the story in some detail to historian George H. Clark.78
must have a fine receiving set.”

Meneratti had a special record made of a fighting song, played often. One chorus proclaimed:

*Coming round the Horn, boys,*
*With a hundred thousand tons*
*Of Yankees and their battleships,*
*And a hundred ten inch guns.*

This bellicosity, including some “Yellow Peril” lyrics, was directed at the Japanese. This record, however, was not played for the Japanese when the Fleet got to Tokyo. Their wireless operators were proficient in English: this record was “stowed.” The Japanese wireless men enjoyed other music.

Meneratti’s own 1948 memoir notes that: “During the first part of June [1908] we gave music regularly to the Mare Island station about 30 miles distant. We were in San Francisco Bay at the time. The record shows that from 1 June to 5 July we did not miss a day giving out music to the Fleet [i]n the Bay at the time.” On July 6th, Meneratti did an interview with a prizefighter: “This is no doubt the first time a fighter broadcast.” When the Fleet got to Hawaii in July, Chief Meneratti continued his playing of music over the radiotelephone. Engineer O.C. Brill, with the [DeForest] “Radio T & T Co.” came “over to test phones. All OK.” The Fleet continued into the Pacific. Meneratti broadcast at each port of call to the delight of wireless men everywhere.

In 1908, Dick Johnstone, as a very new amateur, heard nearby McCarty experimenters sending out voice and recorded music: “ – a real first in wireless transmission.” A year later, in 1909 Doc Herrold broadcast voice and music from “San Jose Calling” using a spark gap. He soon identified his station as “FN.” He then designed his own arc transmitter, which operated as low as 20 kHz and later as high as 500 kHz. In 1909, however, he worked with a spark transmitter. Whether he had heard or read about Chief Meneratti’s “giving out” music into the local ether a year earlier is not known, but probable. The De Forest Company arc on the Ohio may also have provided an impetus to explore that relatively successful technology.

### THE YOUNG TECHNOLOGY OF WIRELESS EVOLVES


In November, 1914 the *SS Hanalei* wrecked off Point Reyes near American Marconi’s station KPH. Its wireless operator Adolph J. Svenson died. In May, 1916 the *SS Roanoke* foundered near San Luis Obispo. Wireless operator George E. Chamberlain’s last transmission, taken by Dick Johnstone at KPH, gave the ship’s position as 90 miles South of San Francisco. Marconi man Chamberlain died at sea. Shortly before, he had written this poem:

*We list through the night, To our comrades afar*
*On the tropical seas, Or beneath the North Star,*
*We flash out glad tidings – Some of sorrow and hate,*
*Of a tempest arising, Or a ship warned too late.*
*Now we’re hearing a ship, And her cries of appeal*
*Of the wave-wrecked reef, That is clutching her keel.*
Ah! Her set is now still; Not a spark rends the air,
And we dream of the story, Of death and despair.
We think of a face – He – my pal to his death;
It is hard to believe, He has breathed his last breath.
He's a man among men, E'en the Devil's defied;
He has now met his God, As the wireless men died.

Other wireless operators in San Francisco and around the world died at their keys at shoreside stations while taking storm distress traffic, especially SOS messages. They knew the risk to their lives from lightning strikes to the high antennas but they stuck to their posts in hopes of helping foundering ships. If they escaped death from a lightning strike, severe injury was likely.

By 1909 the Navy’s wireless chain included Tatoosh Island, Washington (callsign SV), and Cape Blanco (TA), Table Bluff (TD), Point Arguello (TK) and Point Loma (TM) in California. These stations used Massie, Telefunken, Shoemaker and DeForest gear as the Navy sought the best technologies. (The Navy refused to lease Marconi gear and Marconi refused to sell it). Some of these stations are reported to have had two “humps” in their wavelengths. This indicates simultaneous although not intentional operation on two center frequencies. These were broad frequency ranges because spark systems centered a band of radio frequency hash at one wavelength or another. Too tight coupling of the last inductances gave rise to the two humps.

In 1909 station United Wireless station “CH” operated from the San Francisco Chronicle building. According to Johnstone, it contacted ships coming in for details of arrival to publish. Such stations, including similar stations in New York, often sent out “press” to ships at sea. Passengers and crews valued these news summaries. “PH” moved from Russian Hill to South San Francisco to “Hillcrest” on what became Radio Ridge, with CH filling in during the interregnum. Engineer O.C. Brill initially supervised the new construction. To the North, the Canadian Government operated a wireless station on Gonzalez Hill at Victoria, B.C., and at a lighthouse at Triangle Island, 45 miles out in the open Pacific. These were its outposts for communications with ship traffic to Japan via the shorter great Circle Aleutian Islands northern route.

In 1909 young amateur wireless operators at the initiative of then 12 year-old Henry Dickow formed the San Francisco Radio Club. Several others clubs also met regularly. A San Francisco newspaper ran a full page story on the young wireless operators of San Francisco associated with Lowell High School, on December 26, 1909:

“This is amateur morning in the wireless world. San Francisco and adjoining suburbs alone have between 200 and 300 young wireless operators; amateurs who rank as such principally in name, who are everywhere dotted about the city and country for a stretch of miles that extends way beyond the city and county boundaries. The handiwork of the young wireless expert is seen all about on house-top and barn top in the form of a pole a few feet long projecting above the gables, with a few wires running to it top window. Such signs denote the residence of a lad who may some day, somewhere, if not in San Francisco, assist materially in perfecting the system of wireless telegraphy that, while considered
by electrical wizards to be still in an embryo condition, is one of the greatest achievements of modern times."

The 1909 Modern Electrics call-book, the Wireless Blue Book of the Wireless Association of America, lists only ten of the many amateur operators in California. It includes Ray Newby, as EZM. It also lists the Ozone Wireless Company of San Francisco, as callsign MJ, perhaps its principal’s initials. In 1919, ten years after its founding in 1909, the San Francisco Radio Club incorporated. It has met continuously since then (but for wartime interruptions) and uses the callsign of an early member, W6PW, for its club station/repeater.

In 1910 the then new Federal Telegraph Company demonstrated a wireless telephone circuit between Sacramento and Stockton. It used the arc technology that Cyril Elwell had acquired, mostly by gumption, from Vladimir Poulsen of Denmark. Elwell initially succeeded to McCarty’s work, and the National Radio Company of San Francisco was formed. Elwell found McCarty’s system inadequate. In July 1910, as Federal Telegraph, Elwell put the Ocean Beach Station in operation in San Francisco with the original 12 kilowatt Danish arc (as callsign “FS,” later KFS).

Wireless also took to the aeronautical air in 1910. Ralph Heintz, was then 18 years-old and was later a distinguished engineer and successful businessman. He received the messages on the ground from an aircraft temporarily equipped for wireless signaling. Then in 1911 the Army used Tanforan Field just South of San Francisco in San Bruno for the first military tests of air to ground wireless signaling. By 1916, aircraft over the Pacific had signaled 125 miles to shore.

Not all the action was in San Francisco. In San Jose in April, 1910 Doc Herrold and his radiotelegraph signals from his San Jose College of Engineering and Wireless reached out as far as the Farallon Islands and Mare Island, 90 miles to the North. Ray Newby operated a one-inch Electro Importing (EI) spark coil from Hugo Gernsback’s New York company. Doc Herrold certified the feat in an affidavit sent to Electro Importing, which it published in its catalog. Gernsback’s Modern Electrics in 1910 also featured a photograph of Doc Herrold (at the key) and Ray Newby operating their wireless.

In Oakland, across the Bay, lived Fong Yee, an immigrant from China. In about 1910 he constructed and operated both a home wireless station and a well regarded portable station for field work.

![Image of Cyril Elwell certificate](image-url)
use. He also built and flew a biplane on the model of the Curtis biplane. He was called to China in 1911 in furtherance of the Sun Yat Sen revolution. He died in a crash of his airplane in China in 1912 at age 29.

In Seattle in 1910 William Dubilier, then a young man about 16, demonstrated a wireless telephone. A 300 foot tall antenna mast gave him some range. In 1910 he was also selling his then-novel mica condensers, and by 1916 to the Navy, the beginning of a long and successful career. 108

Oregon had its share of activity as well. Joe Hallock started as an amateur in Portland in 1906. By 1910 he was an operator at Portland’s DZ (and O-2 and KE). He later went to sea in 1911, then to station PC at Astoria, Oregon. Later he became the Portland Federal Communications Commission (FCC) administrator after instituting Portland’s first broadcasting station in the 1920s. He also had worked on the 1,000 kilowatt (1 MW) Federal arc station in France. Joe Hallock was one of several old time wireless operators chronicled in Radio & Television News in the early 1950s. 110

At station United station DZ in Portland, Oregon, in 1910 a beautiful young blond woman, Abba Lindsay, worked the day shift, the first trick, in the front office: “...she dressed in a snappy blue marine operator’s uniform and made quite an impression on the customers.” 111 United Wireless also operated station KE in St. Helens, Oregon, and 37 other West Coast stations. 112

In Los Angeles in 1910 Howard Seefred as a teenaged amateur

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Fig. 17. The Federal Beach Station, interior, 1910; the first big arc in service (12 KW). (Mayes).

Fig. 18. The first airplane flight to send a wireless signal, to Ralph Heintz on the ground, in artist Edwin Ingalls’s conception; a demonstration performed just south of San Francisco in 1910 (Morgan).

Fig. 19. Doc Herrold, center, at his San Jose arc radio station FN circa 1912 and thereafter, with his wireless school and station engineering staff. (Photo courtesy of Mike Adams, CHRS, Perham Collections image, History San Jose).
operator monitored stations each a thousand miles North: Friday Harbor, Washington, callsign PD, and Seattle callsign PA. Later as W6EA, he ran the American Radio Relay League (ARRL) Pacific Division. The League, formed in 1914, fostered cooperation among amateurs and created a traffic handling relay network for nationwide distribution of personal and emergency messages. California and the West took considerable benefit from this public service.

By 1910 the commercial chains of wireless stations on the West Coast, operated as United Wireless, included, in two categories:

1) Commercial Stations largely intended to compete for landline telegraph business, a challenging proposition: DA Perry Hotel, Seattle, DB Tacoma, DE Pasadena, DF Santa Barbara, DF Vancouver, BC, DG Sacramento, DK Everett,


The “P” in the callsigns stood for Gehring’s old company Pacific. Gehring’s East Coast Atlantic Wireless Company used callsigns starting in “A.” The Marconi company had little West Coast presence. But evolving technology numbered the days of these spark stations, as early as 1910. Stock promotion frauds also doomed these chains. The operators and technicians paid for the sins of the promoters.

United Wireless crashed in 1911 with the indictment of its principals for fraud (vindicating Arthur Isbell). It continued to operate only ten West Coast stations, focusing on maritime installations. 

It is true that some wireless promoters engaged in much skullduggery, and sometime outright fraud and embezzlement. But it is also true that prosecuting authorities were deaf, dumb and blind to the possibilities of the new technology. Anyone, such as Lee de Forest, who would predict, for example, transatlantic radio-telephone communications, the authorities regarded as an intentional fraud and maybe a madman. The prosecutors of Lee de Forest argued that the triode Audion was worthless as a device and wasn’t even a very good lamp-bulb.

After the failure of United Wireless, American Marconi in July, 1912 acquired United’s assets, including its West Coast operations. Until this acquisition, American Marconi was primarily an East Coast operation with little West Coast presence. American Marconi’s chief operator in San Francisco was Lawrence Malarin, LM, coming from United. Malarin and American Marconi maintained offices in San Francisco’s Merchants’ Exchange Building, where every seagoing operator checked in when in San Francisco. American Marconi also bought out Massie’s West Coast system including the San Francisco land station and 13 shipboard installations. Also in 1912, the American and the English Marconi companies committed to the Marshall receiving station and Bolinas transmitting station (KET, later KPH) in Northern California, using a powerful but soon obsolete rotary spark system.

As the spark stations continued to hurl Morse code into the ether, the radio-telephone pioneers continued development. In 1911 the Navy station at Tatoosh Island, Washington monitored radio-telephone signals from the Bay Area, probably those of National Radiotelephone Company, successor to McCarty, and a company for which Doc Herrold worked as a consultant. In 1912 National was licensed as 6XE, experimental portable, license number 101. Doc Herrold connected San Francisco and San Jose by radio-telephone daily for eight months in 1912. About this time in San Francisco, another experimenter, H.D. Dwy-
er, tested his radiotelephone, with a receiver in the home of Haraden Pratt. Dwyer later tried to establish a commercial San Francisco to Fruitvale (Alameda County) circuit.\textsuperscript{123}

A typical high-quality nautical wireless outfit of 1911 is that of the good ship *Charles Nelson*, a bulk carrier of the Nelson Lumber Company. It employed a Marconi magnetic detector with a wind-up mechanism to move the wire through the silk covered litzen-draht coil. Another receiver used a Fleming valve diode detector with two valves connected to a loose coupler. Nighttime reception ranged to 200 miles. The operator listened on Brandes high impedance headphones. Then or soon after, a 240 cycle rotary spark transmitter from a new Seattle company, Killbourne and Clark handled outbound traffic. So reported its operator, R. S. (Russell) Ormsby, still at sea in 1954 (sine RQ) on his 26th ship.\textsuperscript{124} Lee de Forest’s former assistant in Canada, St. Louis and Denver, C.B. Cooper, was a principal at Killbourne and Clark. By 1915 Killbourne and Clark began to manufacture wireless state of the art transmitting equipment, and also its highly regarded Type E receiver.

State-of-the-Art in 1912, for those who could afford it, was Telefunken gear: a quenched sparkgap, a sharp-tuning receiver with litzendraht wire coils,\textsuperscript{125} and an electrolytic detector; most operators use galena crystal detectors irrespective of patent rights\textsuperscript{126} and some similarly used carborundum.\textsuperscript{127} Rule number one among wireless operators was: Don’t get caught by the company with your real detector.\textsuperscript{128}

In 1911 federal regulation had come to wireless. The Ship Act of 1911 required licenses of maritime wireless operators.\textsuperscript{129} In a typical success story, Sydney Fass, at 16 years-old in 1911, obtained his marine wireless telegrapher’s license. He then went to sea on schooners, crude oil tankers and liners. He also operated for United Wireless at station PM at Eureka, California. Fass was a friend of Haraden Pratt and Dick Johnstone.\textsuperscript{130} Fass was active in the San Francisco Radio Club as a young man. Fass was later to serve in the Navy in both wars. He retired as a Commander after 33 years in the Naval Reserve. Fass owned and operated one of San Francisco’s largest Radio and TV stores in the fifties.\textsuperscript{131}

Similarly, Edwin J. Lovejoy was licensed in 1911 and went on to become the Chief Operator and Manager of United Wireless station PJ in San Pedro at age 18. In 1914 he joined Federal Telegraph and operated KFS in San Francisco and KLS in Los Angeles, and arcs aboard ships as he installed them. After service in both wars in the Navy, he retired with the rank of Commander and had a distinguished career with the FCC.\textsuperscript{132}

In July of 1911 a new kind

![Image](image-url)
of scandal came to wireless. In Los Angeles, teenaged wireless amateur operators, trained at Los Angeles Polytechnic High School, intercepted and disclosed collusion over the Catalina wireless telegraph circuit. This involved the Hearst newspapers, with much attendant publicity from the rival press. The Hearst interests instituted a criminal prosecution but it was later dismissed.\textsuperscript{133} The affair garnered a great deal of publicity, and Hugo Gernsback’s Modern Electrics reported nationally on the prosecution and its dismissal. The Wireless Association of Southern California, over 200 young Los Angeles amateurs, formed as a result of the incident. It operated a two kilowatt spark transmitter using the callsign ALA.\textsuperscript{134}

Howard Seefred in Los Angeles in 1912 heard and logged several United Wireless stations and PH, (and he had also heard the first Pacific Wireless stations “A” in Avalon on Catalina Island and “G” in Los Angeles), all on the usual crystal set receiver of the day. He noted the Los Angeles Examiner newspaper as using the callsign EX. Seefred also monitored the new state-of-the-art Federal 12 kilowatt arc at Los Angeles, station PLA.

Seefred also logged Marconi-equipped vessels: IAA SS Lurline, IAB SS Wilhelmina, IAC SS Hyades, IAD SS Hilonian, IAE SS Enterprise, IAJ SS Jason, IAK SS Stanley Dollar, IAO SS Cuzco. And shore stations whose callsigns he recorded as: IAF San Francisco, CA, IAG Seattle, WA, IAH San Diego, CA. The “IA” callsigns suggest assignment for United/Marconi by Arthur Isbell before 1912.

Following in the spark technology lead of Malarin and Isbell, in May, 1912 the Federal Telegraph established the San Francisco and Hawaii circuit from South San Francisco using an arc.\textsuperscript{135} By December, Federal could communicate across country to Washington, DC and to Hawaii by its initial 35 kilowatt arc CW transmitters.\textsuperscript{136} This was a fraction of the power of much less effective spark stations. Federal arc stations included: POL Central Point, OR, PFW Fort Worth, TX, PNU Honolulu, HI, PNX Phoenix, AZ, PKC Kansas City, MO, PLA Los Angeles, CA, PSC South San Francisco, PSN Portland, OR, PSO El Paso, TX.

Federal alone could compete with the landline telegraph companies for domestic traffic. Some bigger companies also established their own wireless stations and circuits, especially where landlines were problematic. For example, in 1912 Phelps Dodge operated a wireless station at its main Arizona copper mine.\textsuperscript{137}

Federal operators and engineers in this period, including Lee de Forest and Lon Fuller at Federal, also first observed and analyzed ionospheric “skip” propagation. Differences in reception (due to selective fading) of the main wavelength and the back-wave, a higher frequency artifact of the arc keying method, suggested differential reflection of the higher and lower frequencies.\textsuperscript{138}

Labor issues arose for wireless in 1912. Some wireless operators called a strike, and harassed operating stations.\textsuperscript{139} One such station was PH in South San Francisco with Haraden Pratt at the key. He went out to see what the trouble was, with a revolver in his hand. It turned out to be an old acquaintance, Bill Larzelere.\textsuperscript{140} The strike was called by the Commercial Telegraphers Association of America, and resulted in gradually improved working conditions.\textsuperscript{141}

At the Hillcrest station, wire-
less telephone tests interfered with reception at station PH, prompting this log entry: 142

"...Recalling the days of 'Bugs' McCarthy [sic] the Wireless Telephone Capitalist [sic] in the Metropolis Bank Building. 9:55 p.m. 'Bugs' in with his fone, stronger than usual. Try to get GW but can't hear him through fone, CURSES!!!!"

The Federal arc station PSF, the Beach Station, earned a poem of similar disdain in the 1912 station PH logs:

There's a station way down on the Beach
The noise it turns out is surely a peach
The Opps tear their hair, They cuss and they swear
But Old Poulsen he sticks like a leach.

Arcs were notorious for parasitic and other interfering emissions. PSF/KSF wiped out reception at KPH in Daly City until special receiving antennas were devised, according to Dick Johnstone, an operator there.

The log also noted amateur operators on the weekend:

"8:30 a.m. The combined forces of 3,000 ham factories are bursting forth with their weird codes upon the quietude of this lovely rainy morning." 143 The term "ham" for amateur operators probably derives, at least in part, from the old landline telegraphers' description of badly sent traffic as "ham." Hence the description in the PH log of amateur stations a "ham factories." One of Doc Herrold's associates, many years later, closed a letter to Herrold along the lines of "one of your old ham factories." 144

PH operators could not resist poesy or at least doggerel verse:

The night was dark,
The static was bad
The power went off,

GEE, I was glad 145.

Nor did manager Malarin or other operators escape versification; a problematic operator engendered this poem:

He worked Second at PH
One long month and a day
"LM" was tickled pink when he came,
Likewise when he went away.
'Twas he that smoked the cigarette
'Twas he that passed the "buck",
You'd thought he was the finest yet

Fig. 24. A.A. Isbell working for United in 1911 managed a direct wireless contact with Japan, anticipating the later high power Marconi circuit. Traffic with Japan was the prize sought by the commercial wireless companies because of the prices charged by the cable companies and the limited capacity of the cables. (Rachel Isbell Branch collection)
From the way he led you up.
Morse or Continental,
He left it to their whim,
The C.Q.D.'s of twenty ships
Could howl for all of him.146

Malarin's management style, and static – the bane of the long wave operators -- show up in the log:147 "5:30 a.m. Static very bad. "LM" made a remark at the office the other day to the effect that my nightly reports of static were all bunk. I'd give him my next pay check if he could do as much as clear NPH thru this static." NPH was the Navy station at Mare Island, 45 miles from PH.

The SS Titanic sank in 1912. The use of wireless in the rescue of the survivors was big news. Laws soon required more wireless installations and more wireless operators. The 1912 post-Titanic Radio Act required two operators on most ships. In Los Angeles in 1912 American Marconi operated a wireless school at the YMCA and used the callsign YM for its two kilowatt spark transmitter.148 Maritime and other demand for wireless operators created opportunities for such training schools. Doc Herrold's College of Wireless in San Jose also trained hundreds of operators in this period.

The Radio Act of 1912 also required licenses of all operators and consigned amateur operators to wavelengths of 200 meters and down, 1.5 MHz and up, thought to be useless short waves.149 Haraden Pratt made a point of obtaining one of the first new radio operator's licenses from Radio Inspector R.Y. Cadmus in San Francisco.150

In 1912 the terminology of the technology evolved: the Navy first employed the term "radio" rather than "wireless." Lee de Forest first used the term "radio" commercially in the De Forest Radio Telephone Company, organized in 1907.151 The term derived from the notion of radiating Hertzian waves. It caught the imagination.

The wireless telephone evolved into the radio-phone. As a telephone substitute, the wireless telephone faced the challenge of no privacy.152 With as little as a crystal set, any young man, Navy operator or business competitor could listen in. Then in about 1912 Doc Herrold in San Jose began to broadcast musical and other programs on a regular basis to a known audience, using an arc of his own design.153 The vice of the wireless telephone became the virtue of the radio-phone broadcaster: all could listen with as little as a crystal set. Herrold had started with a spark system in 1909, shortly after the visit of the great White Fleet to San Francisco and Meneratti's use of the de Forest Company arc to broadcast for the Navy. As one of the first radio stations as the technology is known now, ten years later in 1919 Herrold renewed his broadcasting activity soon after the end of the First World War, using DeForest vacuum tubes.154

THE TECHNOLOGY ABOUT TO DOMINATE THE 20TH CENTURY: 1913

In 1912, Lee de Forest in Palo Alto working at Federal Telegraph perfected the new vacuum tubes, his triode Audions. These eventually provided the catalyst by which "wireless" became "radio" as we know it. He built a two-stage and then a three-stage cascade audio amplifier at Federal. It provided a gain of 120. Federal demonstrated these amplifiers to the Navy in September, 1912.155 Soon thereafter de Forest and Charles Logwood (a brilliant engineer who had worked with McCarty) experimented with feedback circuits. This was short-
ly before Edwin Howard Armstrong, in New York, discovered regeneration. Armstrong had the benefit of the 1911 experiments of the United Fruit Company wireless operators with the de Forest Audion in the Wallace detector in a regenerative mode. De Forest's defeat in 1934 of Armstrong in the ensuing patent litigation turned on de Forest's work at Federal in Palo Alto. Hard feelings persist to this day among partisans.

Lee de Forest invented radio as we now it in 1913 in California: he got his new vacuum tube to oscillate at radio frequencies, proving it by heterodyning a transmitted Federal carrier wave. "On April 17, 1913, he received signals at SF from Palo Alto by oscillating audion" as George H. Clark put it. In ruling for de Forest over Armstrong in 1934, Justice Cardozo wrote for the Supreme Court:

"... on April 17, of [1913] at Palo Alto, California, he received a clear note, the true heterodyne beat note, from the radio signal station at San Francisco Beach... thereafter in 1914, de Forest recorded in his notebook... that he 'had full proof that the audion acts as a generator of high frequency currents.' The audion oscillating doomed both the primitive spark and the sophisticated arc.

It would, however, take a while for the new technology of the vacuum tube to triumph. In early 1913, the Navy operated 16 radiotelegraph stations on the West Coast (Pacific Ocean), ranging in power from two to ten kilowatts, including seven in Alaska. Call signs ranged from NPA through NPS, both on the Pribilof Islands. Mare Island used NPH. The Navy also operated stations in Hawaii (NPM), Guam (NPN), the Philippines (NPO, NPT) and China (NPP). The Navy's 27 East Coast and Caribbean stations (Atlantic Ocean) used callsigns in the NA series, from the flagship station, NAA at Arlington, Virginia at 100 kilowatts down to one kilowatt at NAY in Panama.

The Navy, however, also maintained its interest in the radiotelephone. In September of 1913 the Navy did radio-telephone tests between Point Arguello and Mare Island (300 miles). Doc Herrold did these tests with an arc. NAA in Virginia and Bremerton, Washington monitored these transmissions. Herrold's private music broadcasts were monitored off San Pedro and heard as far south as San Diego.

American Marconi aggressively pursued new spark stations, seemingly oblivious to new technologies such as the arc. For example, Marconi expanded its station in Eureka, California 280 miles up the Coast from San Francisco for marine work.

On September 24, 1914 American Marconi officially opened its Bolinas, California rotary spark station of about 300 kilowatts power, callsign KET, known as the "rock crusher." It was powerful and advanced for a spark system because it created almost a continuous wave. It provided the first leg of the San Francisco to Hawaii to Tokyo circuit. But the arc and the coming vacuum tube transmitters had already obsoleted it. In 1914 young Howard Armstrong in New York, when demonstrating his new vacuum tube regenerative Audion circuit, picked up a San Francisco wireless station. This was likely the KPH "rock crusher."

KET's receivers were somewhat isolated at Marshall across the Bolinas lagoon, where the operators lived. Its Marconi-standard operators' hotel at Marshall.
refurbished now as part of the Marconi Cove State Park, was known among the operators as the Hotel De Gink.167 “Gink” was an old landline telegraphers’ disparaging term for a bad operator.

The San Francisco Panama Pacific International Exposition of 1915 featured wireless. AT&T and Lee de Forest exhibited there, with AT&T trying to ignore de Forest’s contribution in the invention of the vacuum tube triode, so important to AT&T’s transcontinental longlines. At de Forest’s “Wireless Telephone Booth” he monitored Doc Herrold’s San Jose music broadcasts,168 made to San Francisco at Radio Inspector Lt. Ellery Stone’s request.169 This astonished the fairgoers.

In September, 1915 AT&T via the Navy station at Arlington, Virginia (NAA) conversed over radiotelephone with Mare Island using a vacuum tube transmitter. Wireless pioneer Lloyd Espenscheid monitored this traffic in Hawaii. This test provided a preliminary success leading to the successful transatlantic radio-telephone tests in October.170 The transmitter used massively parallel triodes for maximum carrier power.

In this period, Amateur radio continued to call out to the young and technically adept. In 1915 Charles V. Litton, then 11 years old and the later founder of Litton Industries, operated his own amateur radio station in Redwood City.171 The official callbook of 1913 listed just over 300 amateur operators in the Sixth District (California, Nevada, Utah, Arizona and Hawaii) perhaps 10% fewer than the Second District (southern and central New York and northern New Jersey); Seattle’s Seventh District had about 75 licensees for Washington, Oregon, Alaska, Idaho, Montana and Wyoming.172 In 1914 an amateur radio station at the University of California at Berkeley began to operate, with Haraden Pratt as the principal.173 Somewhat later, in 1917 Frederick E. Terman, later the Vice President of Stanford University and the father of electronics development in what became Silicon Valley, as a teenager operated an amateur radio station in Palo Alto.174 Amateurs quickly heard the virtues of Lee de Forest’s audions. He wrote: “By 1915, the cult of radio ‘hams’ was growing rapidly...” making demands on de Forest’s first manufacturer, McCandless. Westinghouse put McCandless out of the vacuum tube business. As a
result, wrote de Forest: “several bootleggers sprang up over the country, chief and most mischievous of whom was Moorehead of San Francisco.” He referred to O.B. (Otis) Moorehead, manufacturer of the “audiotron” triode.

Broadcasting also began to appeal in 1915, although the audience was limited to wireless operators, both professional and amateur. A student of Herrold’s, Robert J. Stull, set up a radio-telephone broadcasting station at the University of California at Berkeley. De Forest in New York put the oscillating triode vacuum tube to work in 1916, notably in broadcasting the 1916 early election results.

Seasoned operators pushed the limits of old technology. In 1916 Dick Johnstone, as a Marconi operator at KPH on Hillcrest, and Tom Lambert on the tanker J.A. Moffett, callsign WRE, communicated for the whole voyage to China, 5,000 miles, each using only a galena crystal set for a receiver. KPH handled much of the Marconi company’s marine work but did not use a vacuum tube receiver until 1917. While KPH ran five kilowatts power, the wireless on the J.A Moffett cannot have been more than a few kilowatts. Johnstone was a popular operator at KPH. Other well known KPH operators were Haraden Pratt, Frank Shaw dating from PH days and “Pop” Hyde, who like LM was an old landline telegrapher and a very early associate of Lee de Forest. In 1916 Howard Seefred also used a Galena crystal set for transpacific reception. He logged Funabashi, Japan, some 6,000 miles away. The ether was likely a whole lot quieter in those days, with little man-made noise and favorable geomagnetic conditions.

In October, 1916, Electrical Experimenter magazine featured a young woman wireless operator on its cover in full color. The magazine declared Miss Kathleen Parkin of San Rafael, California to be an “Expert Radio Operator at Fifteen Years of Age.” She held a First Grade Commercial license and the amateur callsign 6SO. She made all of her own instruments including her ¼ kilowatt spark transmitter.

In November, 1916 the Navy’s transpacific radio telegraph circuit opened to commercial traffic. In January, 1917 San Diego’s Navy 200 kilowatt arc station first went on the air (S.N. Hooper, the early
West Coast Wireless

Navy wireless manager for San Francisco Earthquake traffic and now a high officer, worked the silver key. Hawaii and Canal Zone transmitters followed at the end of the year. These arc stations as the Navy's transpacific chain provided the backbone of the Navy's Pacific communications.

In late 1916 Henry Dickow founded the magazine Pacific Radio News in San Francisco, the first issue of which was published in January 1917. He started as an amateur in 1907 and went to sea as a newly licensed teenager in 1914, after LM told him to wear long pants. Dickow also helped, in 1909, to found the San Francisco Radio Club and was an officer in 1921. Pacific Radio News evolved into the monthly Radio. Radio and Television News in the 1950s ran a series honoring early wireless operators such as Dickow, mentioned in this note. The ARRL's QST magazine from 1915, Gernsback's publications, and Dickow's publications, and many others, all popularized radio developments and enthused thousands of young men (and a few women) about the new art both before and after World War One.

In April, 1916 Kilbourne and Clark's manufacture of wireless gear in Seattle led to litigation with American Marconi. Lee de Forest's old assistant C.B. Cooper acted as a principal in the trial. Killbourne and Clark won in 1917. Marconi as a British company faced disadvantages in the United States. Only its absorption as part of the Navy-created RCA "naturalized" it as American.

The technology was changing rapidly. In San Francisco in 1916 Otis B. Moorehead established what became his vacuum tube manufacturing company in San Francisco, with backing from Elmer T. Cunningham. He manufactured the earliest high vacuum tubes. Irving Langmuir at AT&T had discovered that high vacuum improved triode performance, contrary to Lee de Forest's expectations. But de Forest explains Moorehead's post 1918 success as a result of a complex patent deal to make audions as the only manufacturer. Thousands of Moorehead tubes were produced for use in the First World War during the domestic patent-war truce, notably the Type B on a four-pin base, and the tubular "Electron Relay."

Cunningham and George Haller formed Haller-Cunningham Company in San Francisco to manufacture wireless gear, primarily the Impulse Excitation transmitter and also the HALCUN Type B receiver. Haller was the first to suggest a cylindrical plate for the triode audions that he and others were bootlegging in San Francisco very early. Cunningham later made a deal with RCA, using the
leverage of a defect in an RCA-owned patent, that gave him the right to cherrypick its vacuum tube production as his own product[^1]. (e.g., the type 301 tube; RCA made the 201, de Forest made the 401, all the same triode). Cunningham was known as a hard-nosed businessman who later went to work for RCA.[^2] Cunningham founded the Remler Radio Company ("Elmer" backwards with a couple of "r" letters for "radio") in San Francisco, which used the Scotty dog logo, and which lasted until about 1972.

The West Coast saw much other manufacturing activity. For example, in Los Angeles, A.J. Edgecomb opened The Wireless Shop as a successor to Edgecomb-Pyle of Pennsylvania. The Wireless Shop produced elegant "Audiotron" receivers.[^3]

**WORLD WAR ONE'S RADIO SILENCE**

In early 1917 the war in Europe...
had been waged for almost three years. America joined in April, 1917. Interception by British Intelligence of the wireless Zimmerman telegram from Germany to Mexico triggered the declaration of war. Haraden Pratt was in charge of wireless on the West Coast for the Navy. Working from San Diego and Los Angeles, and Texas, he triangulated the location of a German wireless station transmitting from Mexico.194

America’s entry into the Great War shut down all radio stations after April, 1917, especially amateur stations. There was great and justified fear of German espionage and sabotage at the time. The war shut down even commercial radio in the United States, except that of the armed forces or stations operated by them. Widespread wireless and radio experimentation stopped dead, but corporate improvement and manufacturing of radio equipment and components such as vacuum tubes flourished. So too did schools. In 1917 and 1918 Doc Herrold at his school in San Jose trained a thousand wireless operators for the Navy and Army in World War One. His College of Wireless earlier had earlier trained 1,200 maritime and commercial operators. 195

Circa 1919 after the war the U.S. Navy was the largest user of wireless, with over a dozen stations in California (11th & 12th Districts), more than 20 in Oregon, Washington and Alaska (13th District) and three in Hawaii (14th District), as well as a large station at Darien in the Canal Zone in Panama.196 In this period as many as 400 vessels equipped with wireless plied the Pacific Coast.197 American Marconi, like the British Marconi company, enjoyed a near monopoly in commercial maritime wireless. The Navy-created Radio Corporation of America (RCA; initially 80% General Electric, 20% Marconi) soon swallowed American Marconi, as a result of the Navy’s discomfort with such a facility being owned by foreign interests. American Marconi’s operations provided the

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**Fig. 31.** A Los Angeles 1916 Audion bootlegger, Harry Roome. Roome had been one of the boy wireless interceptors of the Catalina circuit in 1911. Whatever the patent situation, the flood of triode vacuum tubes before and after World War One made the technology available to everyone with an interest in communications and its advancement, from RCA to every young man wanting to graduate from a crystal set.

**Fig. 32.** An Audiotron receiver made by the Edgecomb Wireless Shop in Los Angeles, a successor to Edgecomb-Pyle back east. (Photo from Adam Schoolsky, CHRS collection)
foundations for RCA's worldwide communications networks, including the Radiomarine Corporation of America as of 1927.

In September of 1919 amateur radio operators came back on the air after World War One's prohibitions. The San Francisco Radio Club was incorporated in May, 1919 in anticipation of the lifting of the wartime ban. It had been active well before World War One as well but went dormant in 1917 along with all other radio amateur enterprise. The club operates today as it has continuously for over one hundred years since 1909; it is now known as the San Francisco Amateur Radio Club.

In the twenty years since the 1899 message "Sherman in sight" wireless on the West Coast had evolved into major international communications circuits, reliable ship to shore messaging, and the beginnings of broadcasting. Almost everyone involved had enjoyed amateur radio operation as his introduction to the art. At the November, 1920 Pacific Coast Radio Convention, a hundred or more men sat for a group portrait. Several clubs help up placards including: "SF Radio Club," the "Bay Counties Radio Club" and the "Polytechnic Radio Club S.F." (Dick Johnstone had attended Polytechnic High School).

Typical of the new companies coming to the fore in the maturing technology of radio, Colin B. Kennedy founded his radio company in San Francisco in 1919. Wireless pioneer R.S. Ormsby was one of his engineers. Kennedy made custom as well as production models and was known as the "wireless tailor" for his custom work.

After World War One, vacuum tube receiver technology dominated. Commercial stations often used a one-tube receiver; regeneration could make for high sensitivity. For example, the Daly City, California station on Radio Ridge, known as the Hillcrest Station, used a tubular audion detector in 1919.

THE BEGINNING OF BROADCASTING

In March of 1920 Lee deForest established a broadcasting station, callsign 6XA, at the California Theatre in San Francisco with a vacuum tube transmitter he developed in 1915 and used in New York in 1916. He moved the station to Berkeley in the Fall.
Doc Herrold and Ray Newby took out a license for broadcasting as 6XF (and 6FE portable) in San Jose. They also now used vacuum tubes. Broadcast radio as we know it had come to the West Coast, 21 years after the San Francisco 1899 demonstration of the potentials of wireless.

De Forest and Herrold in Northern California provided the leading edge of what was soon to be the national radio broadcasting mania of the prosperous post-war 1920s. It was facilitated by the triode vacuum tube circuits derived from Lee de Forest’s Audion invention of 1906. Cheap reliable receivers (and transmitters) could now be constructed and then mass-produced, benefiting from the advances in production during the war. “Radio” took off as an American institution of culture, news and entertainment.

At the same time, alternative means of generating continuous waves as carriers or as signals by interruption (such as Morse code) fell by the wayside. Federal’s massive arcs of World War One could not compete with advancing vacuum tube technology, especially as shorter wavelengths and high frequencies were found so useful for distance work in the early 1920s. The Alexanderson alternators of the early decades (first conceived by Reginald Fessenden around 1904 and built at G.E. by Ernst Alexanderson) also went obsolete. In the 1920s they were, however, for a while the backbone of RCA’s high power long wave transpacific service from Bolinas to Hawaii and Tokyo, installed at KET in 1920 and 1921, operating at 13.1 KHz and 15.6 KHz. That very low frequency technology re-appeared in World War Two for communications from Hawaii to submarines.

A typical early radio broadcasting station of 1922 brings the story back to Telegraph Hill in San Francisco. Ralph Heintz (having formed his own radio company in 1921) established an AM Broadcasting station, KFDB, on the North side of Telegraph Hill.

“Two [50] foot wooden towers and several smaller buildings appeared on the [Lombard and Kearny] corner in 1922. One building contained electronic gear, the other a well-padded studio, and all were for the radio station built by Ralph M. Heintz for the Mercantile Trust Company (now the Wells Fargo Bank). With its permit dated August 23, 1922 in hand, KFDB began broadcasting from its [1,000] watt transmitter (then considered the most powerful on the Pacific Coast) and under favorable conditions [it] could be heard as far away as Honolulu or Atlanta. Broadcasting time was brief: only one hour each morning, afternoon and evening during weekdays, while on Sunday the station was silent. The life of KFDB was short; by August 18, 1923 it was off the air. The towers and

Fig. 34. The American Marconi soon to be RCA KPH Hillcrest, Daly City station in 1919, with its vacuum tube receiver. (Hal Layer, CHRS photo). KPH got its first triode receiver in 1917. KPH handled most of the marine traffic while KEI in Bolinas handled the long distance Hawaii-Japan circuit. KPH eventually relocated to Bolinas.

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the buildings were removed and in their place six flats were completed in the summer of 1925."

The KFBD site was within blocks of the site of the first wireless experimentation in April, 1899 from the Call building to the South side of Telegraph Hill. KFDB looked out over the San Francisco Bay as had PH on Russian Hill more than a dozen years earlier.

Heintz recalled his 1922 radio station sixty years later in 1982:207

"The Mercantile Trust Company wanted to be able to broadcast produce, market quotations for advertising purposes, so I built them a transmitter. It was on Telegraph Hill, with the call letters KFDB. They put out the stock market and beef quotations: so much for prime, so much for something else, and so much for baloney bulls. Apparently, bulls were used for baloney in those days. And then eggs and all that, all the commodities, they did that, and then they put on a program in the evening of phonograph records, mostly. They gingerly tried studio broadcasts. This was in an old residence up on top of Telegraph Hill. It turned out pretty well as the first American broadcast station, as far as I know, that had been heard in Australia."

The Age of Radio Broadcasting had dawned with stations in California as well as the rest of America and the world.

ACKNOWLEDGEMENT

Many people have helped me with the research for this note. I am especially indebted to the late James Maxwell, ARRL, for his encouragement and sources from his collection and library, and I dedicate this note to his memory. I have tried to acknowledge particular people in the notes, especially photos and clippings and the like from Hal Layer and Paul Bourbin of CHRS. But I thank all those who have helped me, especially those I may have inadvertently omitted from the references, gathered over more than 20 years. It is an honor to belong to this community of scholars, historians and collectors.

NOTES AND SOURCES

1 Thorn L. Mayes, Wireless Communication in the United States (New England Wireless and Steam Museum, East Greenwich, R.I., 1989) is the definitive text with respect to commercial operations. Arthur Goodnow, and Robert W. and Nancy A. Merriam of the Museum prepared it for publication.


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developments in two magisterial volumes. Richard Johnstone (Commander, USN, Ret.), My San Francisco Story of the Waterfront and the Wireless (Privately printed, Sebastopol, California, 1965) charms with color and detail from 1899 forward, but Commander Johnstone’s recollections after as many as 65 years fuzzed some of that detail; I am indebted to Diana Osborne, daughter of early wireless amateur Butler (Bert) Osborne, later W6US, for my copy as annotated by her father for greater accuracy.

2 Lee de Forest, Father of Radio, (Self-published, Chicago, 1950) introduction at 4. De Forest provides a wealth of detail about early wireless and radio but his agenda to promote Lee de Forest is clear and leads to omissions; nonetheless de Forest may deserve even more historical honors than he was willing to bestow on himself.

3 San Francisco Call, August 24, 1899, front page; also Morgan, Ch. 1, Wireless Waves and a Wild Welcome, at 7. According to a sidebar in the Call, Charles M. Fisher was the telegrapher on board Lightship 70. Ashore, Lewis McKisick and H.J. Wolters at the Cliff House managed the receiver. The actual message as reported then was: “Sherman in sight.” They had suggested the experiment.

4 Cleveland Moffett, Marconi’s Wireless Telegraph, McClure’s Magazine (New York and London, June, 1899) at 99 (a thorough technical exposition); Lightship East Goodwin with antenna (and story of use) at 108-09. This issue of McClure’s is archived in the Maxwell Memorial Library at the California Historical Radio Society. On April 28, 1899 the Goodwin suffered a collision and used its wireless to summon help, which was widely reported in the newspapers of the day. See http://www.ramsgatelifeboat.org.uk/first-radio-distress-call.htm


6 Mayes, supra; the index provides 21 references, all favorable, to Shoemaker. He was widely respected then and now.

7 Johnstone, supra, at 86; SWP (see infra); Tom Kneitel, Radio Station Treasury, 1900-1946 (CRB Research, Cormack, N.Y.).

8 Clark Radioana Collection, Smithsonian, SRM 101 052 p. 1, -101 017 (“daily schedule”). George H. Clark (USN, Ret.) devoted his working life to documenting radio history and gave his files, in hundreds of boxes, to the Smithsonian in the 1930s as the Radioana Collection. The equipment had first been tested in New York in August 1899 to communicate with a lightship. This experiment was also likely stimulated by the McClure’s Magazine report of Marconi and newspaper reports regarding the Lightship Goodwin. Regarding Alcatraz, Dick Dillman, W6AWO, now a principal in the Maritime Radio Historical Society at the KPH site in Bolinas, has reported a substantiating interview recording.
archived at the San Francisco Maritime Museum.

9 Society of Wireless Pioneers publication(s) especially Spark Gap Times (California) -- hereinafter SWP – this published archive primarily of reproductions and reminiscences is also voluminous but random and scattered. Much of the information relevant here appears to come from Richard Johnstone (see note 1, supra).


11 See, e.g., the solicitation of investment in the Atlantic Radio Company, Modern Electrics (March, 1909) at 419: $100 invested in Bell became $200,000.


13 In 1920, The San Francisco Chamber of Commerce noted: “...the National Radio Company has purchased property at Twentieth St., ... having a frontage of 245 feet by a depth of 95 feet. A modern factory building will be erected containing 48,000 square feet of floor space which will be devoted to the manufacture and perfection of wireless and radio equipment of all kinds. San Francisco Chamber of Commerce Activities, (Vol. 7 No. 14, April 2, 1920), accessible at www.archive.org/stream/san franciscoc hathalmar20sanf/san franciscoc hathalmar20sanf.djvu.txt.

14 Robert H. Marriott, “As it Was in the Beginning” [his quotes in title] – A Personal Narrative ... Radio Broadcast (May, 1924) at 51; see also Radio Pioneers, (Institute of Radio Engineers (IRE), New York, 1945), Marriott was an IRE founder. See also Radio-Craft (March, 1938, reprinted Vestal press, 1987 as Jubilee Souvenir Number) at 559 along with reminiscences of many other early radiomen. See also Orrin E. Dunlap, Jr. Radio’s 100 Men of Science (new York, 1944, reprint 1970). Norwood Teague and Joe Knight, The 1902 Wireless Connection – Santa Catalina Island to San Pedro, California, 20 AWA Review 97 (2007) tells the story in detail relying in part on Marriott’s account, which is, however, somewhat more colorful in Radio-Craft (March, 1938) supra, at 560. Lee de Forest also quotes Marriott in the more colorful version in Pioneer Radio Operators, CQ – The Commercial Radio Magazine (Vol. II, No. 8, April 1933) at 21, 27.

15 Mayes, supra, at 27ff.

16 See, e.g., photo of George S. Corpe, later W6LM, operating the Long Beach Station circa 1912 (from the collection of Paul Bourbin, CHRS).


18 SWP.

19 Haraden Pratt, Sixty Years of Wireless and Radio Reminiscenses (typescript in the Perham Collections now at History San Jose, circa 1968). I am indebted to Will Jensby, WØEOM, CHRS, for my copy. Both Mayes and Morgan,
supra note 1, rely in part on Pratt.
20 Signals photo showing the Mare island installation as of 1904 and a radioman.
21 Howeth, supra at 555; time from Mare Island at 109.
22 Ed Marriner, Wireless Point Loma, Ham Radio magazine, (April, 1969) at 54.
23 Furlong had been a San Francisco amateur wireless experimenter as early as 1903 according to Haraden Pratt, supra, at 2, getting five miles out a spark set and a detector of “two carbons and a needle.”
24 By December 12, 1901, John Ambrose Fleming, although he designed the Poldhu station, had been sent back to London at the time of the test. Accounts claiming he worked the key are wrong.
25 Father of Radio, Ch. 15: Overland Wireless, at 163.
26 SWP, and C.B. Cooper sources and photos.
27 San Francisco Examiner, January 2, 1905, front page (I am indebted to George Patterson, CHRS, for this original newspaper); Hugo Gernsback, Editorial: Tree Wireless, Electrical Experimenter, (Vol. VII, No. 74, June, 1919) at 98: wartime tree transmitter and receiver circuits worked for three miles, and trees as antennae permitted reception of European stations, all of which General Squire reported to the Physical Society, according to Gernsback.
28 Johnstone, supra, at 5.
29 SWP.
30 SWP.
31 Tom Kneitel, Radio Station Treasury supra; SWP.
32 Denver Post, March 30, 1906, DeForest Wireless Telegraph Company advertisement: “DeForest Wireless Telegraph Company Comes to the Rescue of the Western Union Telegraph Co., The Postal Telegraph Co., the Telephone Co., Businessmen and Citizens of Los Angeles and San Diego” noting the service at the request of the landline companies, and reproducing newspaper stories about the event. Early wireless man E. N. (Elmo) Pickerill was the 1905 De Forest operator at Colorado Springs. He preserved this article in a remarkable scrapbook. The large scrapbook, full of contemporary published accounts of wireless success, is in the Clark Radioana Collection at the Smithsonian, Box 43.
33 Howeth, supra, at 113, quoting S.N. Hooper.
34 McCarty articles, supra.
35 Herrold papers.
36 SWP and photos.
37 SWP.
38 Pratt, supra, at 2.
39 Photograph of PH radioshack circa 1915 looking to the West from Hillcrest; from George S. Corpe via the Paul Bourbin collection. Johnstone, supra, at 54, reports: two antenna poles, 250 feet high, a 500 foot long antenna between them, the shack in the middle, a galvanized wire groundscreen, and a 5 kilowatt rotary soak gap at 240 cycles.
40 KPH still operates (as KSM and also as K6KPH) at Bolinas under the aegis of the National Park Service, as a historical site, administered by the Maritime Historical Radio Society and its principal Dick Dillman, W6AWO. See generally MHRS at www.radiomarine.org for KPH history.
41 Radio Station Treasury, supra; Mayes, supra, at 75 for Pacific’s station SF.
42 Richmond Banner [San Francisco newspaper], (August, 1908), from the Osborne family records courtesy of Diana Osborne.
43 Conversation with Diana Osborne, Sonoma, California.
44 Pratt supra; SWP.
45 SWP.
47 Johnstone, supra, e.g., at 11, 21, 67, 75-76. Malarin, despite or perhaps because of his seniority, later found himself abused by RCA company politics (connectedness over competence) and went back to sea, after warning his friend Johnstone. Soon Johnstone suffered the same sort of RCA company abuse, so he
rejoined the Navy in 1946.
48 North Adams Herald, [Mass.], Arthur Isbell Gets Wireless, (October 23, 1906), tells the story; the clipping comes from the Rachel Isbell Branch collection of family records, in the possession of Ms. Branch, their curator, who has made a video about her great uncle Arthur A. Isbell’s career and archives: KeySpark (Privately produced, 2010, with support from Robert Merriam’s New England Wireless and Steam Museum, which holds the first Massie station). Isbell asserted himself to be the fourth wireless operator in the history of the art, going back to August, 1902 with Lee de Forest.

49 Isbell kept a photograph of the window with the bullet hole; Rachel Isbell Branch collection, supra.

50 Howeth, supra, at 109; Mayes, supra, at 79 ff; see A.A. Isbell letter in Mayes at 221.

51 Johnstone, supra, at 22 in 1912; before 1912 Isbell “covered the waterfront in those days by horse and buggy.”

52 San Francisco Call, April 3, 1912 in the Rachel Isbell Branch collection, supra: the bride’s picture as it appeared in the newspaper appears in Ms. Branch’s KeySpark video.

53 Pratt, supra at 8.

54 SWP.

55 The late Jim Maxwell, W6CF, ARRL, CHRS, maintained an extensive library of radio history publications and archives. He assisted in the research for this note over the years; sources he provided are denoted “Maxwell papers.” I am especially indebted to him for providing me with materials from Pacific Radio News as well as the archives from the Bay Counties Wireless Association and other specific research assistance. Much of his library is now housed at the California Historical Radio Society (CHRS) museum in the KRE building in Berkeley. Maxwell’s copies of many early BCWTA documents apparently came from the estate of Kenneth V. Laird, who used callsign SAL running 5 kilowatts on 975 meters before 1912.

56 Pratt, supra.


58 Maxwell papers, BCWTA archives, Constitution and By Laws, Art. III, Sec. II.

59 Edward D. Stevens, They Used to Call it Wireless, San Diego Historical Society Quarterly, (Vol. IX, 1963) reprinted SWP, Society of Wireless Pioneers, Year Book 1971, at 23. Stevens asserted himself to have been the second amateur wireless operator in San Francisco after Larzelere.

60 Pratt, supra and Maxwell papers: BCWTA archives 1907 membership list.

61 Maxwell papers: BCWTA archives, Minutes, January 3, 1913 (74th meeting). By March of 1913, the club had held 76 meetings over more than five years.

62 Johnstone, supra.

63 SWP.


65 Glorious Day at Old “PH,” Pacific Radio News, (Vol. I, No. 2, February, 1917), at 58. Pacific Radio News, which became a Radio Magazine, and similar publications, played an important role in interesting young men and the public in general in the radio arts. This was foundational to the broadcast radio craze of the early 1920s.

66 SWP.

67 Johnstone, supra, at 8, and a $10 premium for tanker service (at 32); KPH operators got $90 a month, with a $10 premium for the third trick, Midnight to 8 AM (at 57).

68 Modern Electrics (Vol. I, No. 1, April, 1908; reprinted 1958) at 18 and map.

69 Herrold papers.

70 Pratt, supra at 5; SWP. The Bay Counties Wireless Association membership list circa 1908 shows Ralph Wiley with the callsign SRW at 5 KW and C. Kellogg with the...
callsign SCM at 2 KW, both in San Francisco operating spark sets (Maxwell papers).

71 Wireless Telegraph Contest [monthly], Modern Electrics (Vol. II, No. 8, November, 1909) at 377.

72 Gap to Hawaii Bridged by Wireless Men, San Francisco Call, Oct 12, 1908; this clipping comes from the Rachel Isbell Branch collection, supra.

73 SWP, Pratt, supra, at 7.

74 Howeth, supra, at 171.

75 SWP & photos.

76 Pratt, supra, at 15.

77 SWP.

78 George H. Clark Radioana Collection. Meneratti's recollections and his log from the 1908 period are indexed as SRM 134-469A and pages following. I thank Mike Adams of CHRS for retrieving these materials. Haraden Pratt also heard Meneratti's music, but not well; Pratt, supra at 5.

79 Clark Radioana, SRM 134-469A at paragraph 15.

80 Rough Log of Herbert J. Meneratti ... 1908, Clark Radioana SRM 134 517 p:1 [ff] at May 26 [1908].

81 Clark Radioana, SRM 134-469A at paragraph 19.

82 Clark Radioana, near 1345-469A but unnumbered.

83 Johnstone, supra, at 10-11.

84 Herrold papers.


86 SWP.

87 Johnstone, supra, at 62.

88 The Sinking of the Roanoke, Wireless Age (July, 1916) at 691, poem at 692; stories of rescues follow at 695ff.

89 For example, San Francisco (Fort Miley) Massie station operator Duncan died from a lightning strike, electrocuted while transmitting, according to Bert Osborne's notes on Johnstone, supra, note 1. Cf. All Radio Heroes are Not Found at Sea, Electrical Experimenter, (Vol. IV, No. 42, October, 1916) at 413; Astoria, Oregon operator severely burned manning his post in a storm. Dick Johnstone at KPH was blown out of the shack and stunned by a lightning strike in 1916, coming "to out in the rain"; Johnstone, supra, at 55. KPH was destroyed and operated for a while at the Army Presidio station WVV.

90 List of Wireless-Telegraph Stations of the World, 1907, supra.

91 Pratt, supra, at 7; CH took over for PH when it discontinued at Russian Hill and moved to Hillcrest in Daly City; photo from Mayes.

92 Johnstone, supra, at 11.

93 Glorious Day at Old "PH," supra, at 58.

94 Radio News (September, 1931).

95 Morgan, supra, at 23.

96 Ross G. Miller, Youthful Wireless Operators in San Francisco, San Francisco Chronicle, December 26, 1909 at 3. The story appears to be generic, into which San Francisco details have been inserted.

97 Morgan, supra, at 42.

98 See Federal Telegraph Company pamphlet for the Pacific Radio Exposition, circa 1920, with a photograph of the Beach Station. Federal calls itself: "Builders of the world's largest radio stations." It offered radio-telegraph service between Seattle and San Diego and cities in between at "15 words for the usual price of 10." For communications with ships at sea, it listed its stations KFS San Francisco, KEK Portland and KOK Los Angeles.

99 SWP.

100 Morgan, supra, at 32.


102 Herrold papers, EI affidavits.

103 Modern Electrics (Vol. III, No. 5, August, 1910) at 274, photo.

104 San Jose Mercury News interview, Herrold papers. Johnstone notes Newby's service on eleven vessels to 1925, at KPH at Hillcrest, and at TK in Nak Nek, Alaska in 1911; Johnstone, supra, at 136.

105 SWP; Johnstone, supra, at 83;

106 Fong Yee, the Wireless Expert, Popular Electricity (Vol. IV, No. 2, June, 1911), reprinted as High Power Wireless Equipment (Lindsay Publications, Bradley, IL, 1988) at 94. His exploits gave rise to the legend of "Dragonwings" in
the Bay Area Chinese community, including a book, Laurence Yep, Dragonwings (Harper Collins, New York, 1975) and a play by Yep of the same title at the Berkeley Repetory Theater in 1992. San Francisco Chronicle, December 17, 1992 at C-3. Fong Yee's name is also reported as Fong Joe Guey, Feng Ru, Feng Yue and variants.


108 Radio's 100 Men of Science, supra, provides a biography at 231.

109 SWP.

110 C. Howard Bowers, Wireless Operators of Old, Radio and Television News, 1953-54: “Carbon Copy,” March, 1953 -- Bowers as the 1915 operator on the “Yankee Mail Boat” Sonoma between San Francisco and Sydney; “Mr. Wireless” Edwin W. Lovejoy, December, 1953 at 173; John O. Ashton, of Palo Alto, sine JO, who enjoyed a distinguished career and who was a member of the IRE, and who claimed to have heard Marconi's “S” from Poldhu in 1901, March, 1954; R.S. Ormsby, since 1911, who also recalled the strike of wireless operators, April, 1954 at 83; Ralph L. Hazelton, since 1910 in Santa Cruz, starting with gear from the 1910 EI catalog, later a high official of the Civil Aeronautics Board, April, 1954; Sydney J. Fass, since 1909 with Haraden Pratt and Dick Johnstone, June, 1954 (with photos); John M. Boyle, who recalled checking in with Lawrence Malarin (LM) at the Merchant’s Exchange Building in San Francisco for assignments circa 1912, June, 1954. This series is cited herein as TVRN.

111 SWP; TVRN.

112 Mayes, supra, at 67. In 1912 Marconi took over 70 United Stations.

113 Howard Seefred log, in the Perham Collections, now archived at History San Jose.

114 Mayes, supra, at 67.

115 Cf. Mayes, supra, at 55.

116 Mayes, supra, at 69.

117 TVRN.

118 SWP, Pratt, supra.

119 Perham Collections, now archived at History San Jose. Mayes, supra, at 113.

120 Perham Collections, now archived at History San Jose.

121 Herrold papers, License.

122 Herrold papers.

123 Pratt, supra.

124 TVRN, SWP.

125 Photo from the collection of Hal Layer, CHRS

126 SWP, Pratt supra.

127 See Bartholomew Lee, How Dunwoody's Chunk of 'Coal' Saved Marconi and De Forest, 22 AWA Review 135 (2008).

128 Johnstone, supra, at 45ff; Rule number two prohibited unnecessary talk between operators at sea.

129 SWP, Pratt, supra.

130 Johnstone, supra.

131 TVRN.

132 TVRN.

133 Seefred log, supra, newspaper clippings; Modern Electrics (September and December, 1911); see Bartholomew Lee, Radio Spies, 15 AWA Review 7, 9 ff.

134 Seefred log, supra.

135 Mayes, supra, at 145; Federal charged two cents a word vs. 16 cents a word by the cable companies.

136 SWP.

137 Mayes, supra; as of 1915, the Marconi company operated station KDC at the Cooper Queen mine in Douglas, Arizona with a range of 75 miles. The Yearbook of Wireless Telegraphy and Telephony – 1915 (Marconi Publishing Corporation, New York, 1915) at 347.

138 Father of Radio at 277 ff. De Forest for this circuit also invented what we call frequency division multiplex transmission, which he called “diplex,” using a fast switch alternately to provide two operators of one arc with
two different frequencies for simultaneous operation.
139 SWP.
140 Pratt, supra.
141 TVRN.
142 Glorious Day at Old "PH," supra, at 58.
143 Glorious Day at Old "PH," supra, at 60.
144 Herrold papers.
145 Glorious Day at Old "PH," supra, at 58.
146 Glorious Day at Old "PH," supra, at 58.
147 Glorious Day at Old "PH," supra, 58; cartoons in the log illustrated static and caricatured the operators.
148 Seefred log, supra.
150 SWP, Pratt, supra.
151 Howeth, supra, 150: De Forest Radio telephone Company, 1907.
152 Experimentation continued.
In December, 1912 successors to McCarty (probably National) conducted wireless telephone tests between Los Angeles and Point Loma, San Diego, 135 miles. Herrold papers.
153 Herrold put the arcs into liquid hydrocarbons, which permitted a sustained arc. Herrold (like de Forest and especially early wireless pioneer John Stone Stone) was also quite mathematical in his approach to many problems. Herrold papers.
154 Herrold papers.
156 Radio's 100 Men of Science, supra, provides a biography at 250.
157 Father of Radio, at 375, Ch. 40: Historic Litigation, regarding the dispute with Armstrong.
159 And rightly proud of it he was; Father of Radio, at 293ff: "... a discovery which was destined a few years later to completely revolutionize the entire art of radio transmission." See also 303ff, recording his notebook entry: "This day I obtained the long-sought-for beat note phenomenon." It was on this entry that the dispute with Armstrong turned.
160 George H. Clark typescript "About DeForest 1924 +-", Radioana Collection, unnumbered, near SRM 124-973A. This event persuaded the Supreme Court of the United States (Justice Benjamin N. Cardozo writing for the Court) to give de Forest patent priority over Edwin Howard Armstrong because oscillation was primary and earlier invented and regeneration but an application of it, as next set forth.
161 Radio Corporation of America vs. Radio Engineering Laboratories, 293 U.S. 1-14 (1934), i.e., volume 293 of the United States Reports of Supreme Court cases at pages 1 through 14; the quotes comes from 293 U.S. at 14.
162 Electrician and Mechanic Magazine data reported in Mayes, supra, at 19.
163 Herrold papers.
164 New Wireless Plant is Being Installed Here, The Humboldt Times, October 29, 1913, front page: "... a duplicate of the Hillcrest station in San Francisco." I am indebted to Sterling K. Jensen for this story. See photo, "Radio Eureka Cali – 1913 – " from the collection of Hal Layer, CHRS.
165 Marconi companies Yearbook ... – 1915, supra, at 33, 346.
166 Marconi Conference Center, Marshall, California advertisement and photograph of the refurbished hotel.
167 Conversation with pioneer wireless operator William Brenniman, a principal of SWP. "Gink" was a 19th century term for a hobo as well.
168 Morgan, supra, at 64.
169 Herrold papers. Ellery Stone had been a member of the Bay Cities club as of 1912. His personal amateur callsign was LM. (Another later San Francisco Radio Inspector in the club was Bernard Linden, callsign HP). BCWTA, Minutes, April 12, 1912 in Maxwell papers. True to form,
de Forest in his autobiography does not mention this 1915 event, but rather concentrates on how he had to claim credit for the vacuum tube amplifiers that made transcontinental telephony possible because AT&T did not mention his contribution. Father of Radio at 328ff. Similarly he risked death on the wartime high seas to travel to Paris to claim due credit for the transatlantic radio-telephone tests of 1916. Father of Radio at 333ff. Lee de Forest was not one to keep his candle (or audion) under a bushel, cf. Matthew 5:15: "Neither do men light a candle and put it under a bushel, but on a candlestick; and it giveth light unto all that are in the house." (King James version).


171 Morgan, supra, at 68, 95, 145.

172 Callbook of 1913 and Supplements 1, 2 & 3, reprint Old Old Timers' Club (circa 1960s), from Maxwell papers.

173 Morgan, supra, at 58

174 Morgan, supra, at 68, 89.

175 Father of Radio at 332.

176 Herrold papers.

177 Father of Radio at 338


181 Howeth, supra, at 224.

182 Howeth, supra, at 224.

183 TVRN.

184 Pacific Radio News (Vol. III, No. 3, October, 1921) at 103.

185 SWP.


187 Moorehead had been a wireless operator working for A.A Isbell on Alaska stations that Isbell put into service with the lower forty-eight, before Moorehead got into the vacuum tube bootlegging business. Pratt, supra, at 19.

188 Father of Radio at 326, 354; before this deal the "mischievous" Moorehead bootlegged triodes (at 332). Articles with photos of the factory appear in Radio Age (Vol. 16, June & September, 1991) and cover.


190 Conversation with Thorn Mayes, Jr.

191 SWP, Pratt, supra, at 20.

192 Pratt, supra, at 20.

193 I am indebted to Adam Schoolsky of CHRS for providing me with a large series of photographs that tell the story of Edgecomb.

194 Pratt, supra, at 18.

195 Herrold papers.

196 Howeth, supra.

197 SWP.

198 De Soto, supra at 55, Ch. 9: Back on the Air.

199 Incorporation document from the archives of the California Secretary of State, 1919.


201 SWP Sparks Journal (Vol. 8, No. 1, Sept. 20, 1985) at 20-21.

202 SWP.

203 Photo from the collection of Hal Layer, CHRS.

204 Father of Radio, at 354ff.

205 Herrold papers; the vacuum tubes were made in San Francisco, likely by Moorehead.

206 David Myrick, San Francisco’s Telegraph Hill (Howell-North Books, Berkeley California, 1972) at 201.

207 Ralph M. Heintz: Technical Innovation and Business in the Bay Area, 1982 interview by Art L. Norberg, Bancroft Library, University of California, Berkeley, History of Science and Technology Program; I am indebted to the late Hank Olson, W6GXN, CHRS, for the Heintz quote and source.

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ABOUT THE AUTHOR

Bartholomew (Bart) Lee, K6VK, xKV6LEE, WPE2DLT, is a long time member of AWA and the California Historical Radio Society, for whom he serves as General Counsel Emeritus. He has enjoyed radio and radio-related activities in many parts of the world, in the last year in Italy and Sicily (radio from North Africa is fascinating even though it’s mostly in Arabic). Radio technology and history have fascinated him since he made his first crystal set with a razor blade and pencil lead more than 50 years ago. He is especially fond of those sets of which it is said: 'Real Radios Glow in the Dark.' Bart is a widely published author on legal subjects and most recently on the history of radio. He has, in many forums, including most recently the annual meeting of the American Vacuum Society, written about and lectured on early radio technology, radio intelligence activities ('episodes in the ether wars') from 1901 into the latter 20th Century, wireless telegraphy especially Marconi’s early work, wireless developments in California and the West Coast since 1899, short wave radio, radio ephemera including radio stamps, and radio in emergency and disaster response. Since 1989 he has made some 20 presentations to the AWA conferences on his research interests including the development of television in San Francisco in the 1920s. The AWA presented its Houck Award for documentation to him in 2003 and the California Historical Radio Society made its 1991 ‘Doc’ Herrold Award to him in connection with his work for the Perham Foundation Electronics Museum. In 2001, during disaster recovery operations in New York after the ‘9/11’ terrorist enormity, he served as the Red Cross deputy communications lead from September 12 to September 21, (the ‘night shift trick chief’). He has served as the Liaison Officer for the San Francisco Auxiliary Communications System (ACS – RACES) and as an ARES Emergency Coordinator. He presently serves as an ARRL Government Liaison and Volunteer Counsel. Bart is a litigator by trade, having prosecuted and defended cases in both state and federal court. He also taught Law & Economics for 20 years, including the economic history of telecommunications. He is a graduate of St. John’s College (the ‘Great Books School’) and the University of Chicago Law School. Bart’s son Christoffer Lee is also a licensed amateur radio operator and is now finishing law school. Bart invites correspondence at: KV6LEE@gmail.com

Bart Lee. Photo by Paula Carmody taken in Indonesia; copyright Bart Lee 2009.
Letters to the Editor

DEFOREST’S CREDIBILITY

I was delighted with the last Review from cover to cover, and especially happy when I got to the back to see Eric’s letter.

I had found it hard to believe that deForest could have saved his company with a new detector that did not work. Eric (as would I) gave credence to Pickard’s views on Dunwoody’s carborundum detector implementation. Upon reflection, I thought that perhaps Pickard had an ax to grind, or perhaps deForest initially used a mechanical pressure implementation as also shown in Dunwoody’s patent. Eric deserves great praise for then investigating the physical reality of Dunwoody’s firecracker, despite Pickard’s denigration of it (and for finding that photo of it!). Pickard had said that carborundum was the one mineral he did not investigate, so maybe he had some regrets about that. (At least he went on to great success as a principal of Wireless Speciality Apparatus). The firecracker could indeed work, as Eric demonstrated, thus resolving the matter (much to the distress of many, no doubt) in favor of deForest’s credibility.

Bart Lee

EARLY ORIGINS OF THE BC14/A

Shortly after my article entitled “SCR-54/A (BC-14/A) Radio Receiver Sets for Artillery Spotting” was published in the 2010 issue of the AWA Review, I came into possession of the French military crystal set shown in Fig. 1. My fellow collector and historian from France, Eric Verdier, believes this to be the predecessor of the French A1 receiver—the prototype used

Fig. 1. This French military crystal set dates from 1912 or earlier.
Letters to the Editor

by the US Army to develop the BC14/A. According to Eric Verdier, this early French crystal set can be traced back to at least 1912.

That this crystal set was manufactured for or by the French military can be confirmed by the name tag shown in Fig. 2 which contains the following inscription “Licences du Ministère de la Guerre [Licenses of the Ministry of War].” The detector on this crystal set is virtually identical to the one found on both the French A1 and the American BC-14/A, and the unusual headphone jack is similar to (and compatible with) the one used on the A1.

Here is what Eric Verdier wrote me about this set:

“A long time ago I saw a 1912 military book marked “secret defense” in which this set was pictured. What I know now is that at that time the military sets were made by the laboratory of the “Télégraphie Militaire” directed by Gustave Ferrié, then a Colonel in the French army. They produced only a small quantity of radios. They started to give orders for radios to French manufacturers after the war [WWI] began because the need for radio sets increased dramatically. The design of this set was clearly earlier than 1912.”

Eric Verdier sent me a photograph of a French military radio operator using this set in the field (see Fig. 3) along with a schematic diagram reproduced here as Fig. 4. The schematic reveals a single-circuit tuner with an Oudin coil versus the two-circuit tuner with a variometer used on the A1, a design change which was needed to increase selectivity for distinguishing among the numerous transmitters

Fig. 2. The name tag on the crystal set indicates that it was made by the French military.

Fig. 3. This crystal set was used in the field by a French military radio operator.

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in close proximity used at the front during WWI. Because this breadboard set would have been far too fragile for use in trench warfare during WWI, the follow-on A1 was enclosed in a sturdy hardwood box with lid for protection.

Eric Verdier went on to write:


With the exception of the detector, this crystal set with its Oudin coil is indeed strikingly similar to the bread board portion of the electrolytic detector set pictured in the Biraud book, which is reproduced here as Fig. 5. Thus, the pedigree of the BC-14/A can actually be traced back a French electrolytic receiver manufactured circa 1908.

Eric Wenaas