To: Tom
From: Susan
Re: International Radio Conferences

QUESTIONS

In the early 1900s, several international radio conferences were held to attempt to regulate radio consistently worldwide. What dates were these international radio conferences held? Did the U.S. participate in any? What motivated these conferences and what were the results? What consequence did the radio conferences have on the U.S.?

SHORT ANSWERS

(1) The conference dates were: 1903, 1906, 1912, 1927

(2) The U.S. participated in each conference.

(3) The first conference was motivated in part by signal interference and in part by the Marconi Company's refusal to interact with competing wireless systems. The second conference was called because the first conference didn't solve any problems. It is unclear precisely what instigated the third and fourth conferences.

(4) The first conference impacted the U.S. by raising its awareness of the strategic importance of wireless. The U.S. did not, however, adopt any new regulations because of it. After the second conference, the U.S. adopted the resulting treaty, although it only did so six years later due to U.S. distrust of government regulation and reluctance to regulate a still-developing technology. The U.S. incorporated the treaty of the third wireless conference in its Radio Act of August 13, 1912. And the U.S. hosted the fourth international wireless conference in 1927, the resolutions of which went into effect in 1929.

DISCUSSION

First international wireless conference – 1903

In 1903, Germany invited 7 nations to join it in an international wireless conference – the First International Radio Telegraphic Conference – Great Britain, France, Spain, Austria, Russia, Italy, and the U.S. Authors disagree about the main

impetus for the conference. Douglas says that it was spurred when a ship carrying the German Kaiser's brother couldn't communicate with Marconi stations in Europe or the U.S. because it used the radio equipment of a rival company, Telefunken and Manufacturing.[1] Bensman, however, claims that the Marconi Company's refusal to relay companies' radio signals was only one reason behind the First Convention.[2] And Archer claims that the "intolerable condition" of signal interference that potentially blocked life-saving and emergency transmissions motivated the first conference.[3]

According to Douglas, although the Kaiser's invitation to the conference proposed a number of potential topics to be discussed, the only real issue was the Marconi Company's refusal to communicate with other systems. The U.S. sent three delegates. All countries but Italy and Great Britain favored compelling the Marconi Company to communicate with other systems because an invention that could save lives and property shouldn't be monopolized by one company.[4]

Though the conference came to a resolution – that wireless coast stations must receive and transmit ship messages regardless of the ship's wireless system –it wasn't legally binding, and the Marconi Company continued its monopolistic behavior. Despite this, the conference did impact the U.S. by impressing on the American delegation "the advantages and international importance of a strong military presence in the airwaves." The Americans witnessed how greatly other countries' navies valued wireless. Because Roosevelt was preoccupied with other issues at the time, the U.S. military was unable to

---

[1] Susan J. Douglas, Inventing American Broadcasting, 119-24.
[2] Marvin R. Bensman, The Beginning of Broadcast Regulation in the Twentieth Century at 4 (". . . Germany called the First International Convention on wireless, stemming *partly* from the refusal of the Marconi Company to relay signals from a yacht belonging to a German prince on a visit to North America.") (emphasis added).
[3] Gleason L. Archer, History of Radio to 1926 at 64.
[4] Douglas 120-24.

act on this new awareness immediately. It wasn't until the Russo-Japanese War broke out in February 1904 that Roosevelt recognized the military importance of wireless and turned his attention to it.[5]

Second international wireless conference – 1906

In 1906, the Germans called for a second conference – the International Wireless Telegraph Convention – because nothing was solved at the first one and the Russo-Japanese War generated new diplomatic problems. Twenty-seven countries including the U.S. attended. According to Douglas, the same issue dominated the discussions – whether the Marconi Company should be able to communicate only with its own stations. Three of the four American delegates were in the military and had strong anti-Marconi feelings. When they arrived at the conference, they moved for compulsory ship-to-ship intercommunication and held fast to this position. All countries other than Britain, Italy, and Japan joined them. To demonstrate the consequences should the Marconi Company continue its behavior, several countries ignored Italy's delegates whenever they tried to speak on that or other issues. Ultimately, the countries worked out a compromise – every public shore station was required to exchange wireless communication with each wirelessly equipped ship regardless of the wireless systems used.

The countries set out other regulations, including: (1) that ship stations had to be licensed by the country whose flag they sailed under; (2) shipboard operators had to pass an exam on signaling and apparatus construction and operation to be licensed; (3) ships would have a three letter call sign designated by their government; (4) distress messages had priority over all others, as did government messages about navigation and weather conditions at sea; (5) wireless operators were bound by an oath of secrecy; (6) SOS

[5] Id.

would be the international distress code.[6] Also: (1) two wavelengths – 300 and 600 meters – were designated for public correspondence; (2) wavelengths over 1600 meters were for long distance communication with coastal stations; and (3) wavelengths between 600 and 1600 meters were for military and naval stations.[7]

Most governments ratified the treaty within a year and a half after the 1906 negotiations. The U.S., however, was not quick to ratify the treaty, waiting until 1912 to do so, despite that the American delegates had ardently favored many of the regulations. The country's reaction to the treaty was lukewarm because it was reluctant to hand over control of private industry to the government, particularly the military. The American press had a low opinion of the Kaiser, who sponsored the conference. And the treaty embodied solutions to European problems that didn't exist for the U.S., such as being surrounded by rival nations whose wireless transmissions posed interference problems and military vulnerability.

Moreover, wireless companies and amateurs successfully lobbied against wireless regulation in the U.S., objecting that the 1906 International Wireless Conference's treaty was premature, technically naïve and restrictive; exploitative of American inventors; and transformed wireless to a warfare instrument. Congress was not quick to regulate for several reasons: (1) it was preoccupied by other pressing legislation that was the heart of intense public scrutiny such as child labor laws, antitrust legislation, and the Pure Food and Drug Act; (2) wireless was a relatively undeveloped science that congressmen felt uncomfortable to act on without greater understanding; and (3) unlike in Europe, in the

[6] Douglas 137-43, 216-17.
[7] Bensman at 5.

U.S., the telegraph was not government owned and therefore provided no regulatory model Congress could use to formulate wireless regulation.[8]

Consequently, the U.S. did not ratify the 1906 International Wireless Convention treaty until April 3, 1912, when it was informed that it would not be welcome at the third convention scheduled for June 1912 unless it did so.[9]

Third international wireless conference – 1912

In 1912, London held the third international wireless conference – the International Radio Telegraph Convention of 1912 – and the U.S. attended. The sources don't explain the impetus behind the third conference, but the U.S.'s Radio Act of August 13, 1912 incorporated its regulations. The Radio Act primarily regulated wireless telegraphy in Morse code and prohibited commercial radio transmission without a federal license from the Secretary of Commerce. The purpose of licensing was to prevent or minimize interference between stations. Under the Act, the Secretary of Commerce maintained authority over radio broadcasting until 1926, when an Attorney General ruling and two lower federal court decisions eviscerated this authority. At that point, orderly regulation ceased and chaotic interference ensued, with stations jumping to different frequencies at will.[10] This confusion led to the Radio Act of 1927. The Radio Act of 1927 established the Federal Radio Commission and reimposed order on wireless communications by authorizing it to, among other duties, grant licenses of limited terms to broadcasters, assign frequencies, determine station locations, regulate apparatuses used, and classify radio stations.[11]

---

[8] Douglas 137-43, 216-17, 226.
[9] Douglas 226.
[10] Thomas Porter Robinson, Radio Networks and the Federal Government at 48-51.
[11] Id. at 53.

Fourth international communications conference – 1927

The fourth international conference was held in October 1927 when seventy-nine countries met in Washington, D.C. to revise the 1912 International Radio Telegraph Conference regulations. Secretary Hoover, conference chairman, explained in his closing statements that the Conference had agreed that, instead of dividing "the ether" into different channels for different countries, as had been previously proposed, the channels would be divided into groups, "each group being used for a particular variety in communication." Hoover explained that the Conference also agreed to prohibit future installation of "spark sets" because they caused great interference and to require replacement of existing spark sets with continuous wave sets or other modern equipment that minimized interference. The conference agreement went into effect January 1, 1929.[12]

The Conference adopted these frequency allocations:[13]

Kilocycles (later kHz)	Services
10-100	Fixed services
100-110	Fixed services and mobile services
110-125	Mobile services
125-150	Maritime mobile for public
150-160	Mobile services (a) Broadcasting (b) Fixed services (c) Mobile services
160-194	Regional differences allowed for all services within this range
194-285	Europe: air mobile services; Air fixed services
285-315	Radio beacons
315-350	Air mobile
350-360	Air mobile
360-390	Radio Compass
390-460	Mobile

[12] Bensman at 203-04
[13] Taken from Bensman at 204-205.

460-485	Mobile, except radio-telephony
485-515	Distress call and mobile
515-1,500	Broadcasting
1,500-1,715	Mobile
1,715-60,000	Mobile, amateur, experimental

It is possible that fourth international conference drew some of its allocations from the allocations set forth by the United States in its Third National Radio Conference,[14] though I have yet to find a definitive source on this issue. Similarities exist between the two tables, but notes from the U.S. Third National Radio Conference suggest that the international community may have already agreed how to allocate frequencies below 2000 kHz. The Third National Radio Conference subcommittee on frequency allocations specifically stated in its report that its allocation recommendation "must be considered to some extent temporary or experimental on account of the absence of an international agreement relative to frequencies above 2,000 kilocycles."[15] None of the earlier international conferences, however, set forth a detailed table of frequency allocations. By 1928, the U.S. had already designated 550 – 1500 kHz for broadcasting, but further research is needed to determine whether the international community had also already set aside these frequencies for broadcasting.[16] If this requires further follow up, the notes taken and reports made at the fourth international radio telegraph conference may demonstrate the extent to which the U.S. influenced the Conference's allocations table.

[14] Captain Linwood S. Howeth, USN, History of Communications-Electronics in the United States Navy (1963) at 501-512; Recommendations for Regulation of Radio adopted by the Third National Radio Confernece, Oct. 6-10, 1924.
[15] Recommendations for Regulation of Radio adopted by the Third National Radio Confernece, Oct. 6-10, 1924.
[16] See General Order 40.

For comparison, here are the frequency allocations set out by the U.S. Third National Radio Conference in 1927:

Kilocycles (later kHz)	Services
95-120	Government
120-157	Marine
157-190	Point-to-point and Marine
190-230	Government
230-235	University, college & experimental
235-250	Marine, phone
250	Government
250-275	Marine
275	Government
275-285	Marine
285-500	Marine & coastal (including 500 = distress calls & signals)
500-550	Aircraft
550-1500	Broadcasting, phone
1500-2000	Amateur, phone
2000-2250	Point-to-point
2250-2500	Aircraft
2500-2750	Mobile
2750-2850	Relay broadcasting
2850-3500	Public service
3500-4000	Amateur & army mobile
4000-4500	Public service & mobile
4500-5000	Relay broadcasting
5000-5500	Public service
5500-5700	Relay broadcasting
5700-7000	Public service
7000-8000	Amateur & army mobile
8000-9000	Public service & mobile
9000-10000	Relay broadcasting
10000-11000	Public service
11000-11400	Relay broadcasting
11400-14000	Public service
14000-18000	Amateur
16000-80000	Public service & mobile
18000-56000	Beam transmission
56000-64000	Amateur
64000-infinity	Beam transmission

*Highlighting shows which allocations designated by the Third National Radio Conference are similar to what was adopted by the Fourth International Radiotelegraph Conference. Comparison is difficult because the conferences use different categories.

From: Clay T. Whitehead
Sent: Wednesday, December 06, 2006 3:19 PM
To: Susan Burgess
Subject: RE: Significant wireless events that took place around Jan. 1, 1900

Any idea which got publicity?

-----Original Message-----
From: Susan Burgess
Sent: Wednesday, December 06, 2006 2:24 PM
To: Clay T. Whitehead
Subject: Significant wireless events that took place around Jan. 1, 1900

Tom,

I've reviewed most of the books and have found that these wireless developments took place around 1/1/1900. I will email you and additional
additional dates that I find:

Oct. 4, 1899 - Marconi reports America's Cup races by wireless -- Douglas 19-
22; Barnouw at 15.

Nov. 2, 1899 -- Marconi tests his wireless systems on two U.S. naval ships 36
miles apart -- Archer at 59.

Nov. 15, 1899 -- American ship St. Paul communicates with a wireless station
on the Isle of Wight over 66 miles -- Archer at 60.

April, 1900 -- Marconi patents a tuner under English patent number 7777, a
crucial patent for him and one of the most frequently litigated claims in
wireless history -- Douglas at 38; Barnouw at 16.

June 1900 -- Fessenden asks GE to make 40 or 50 transmitters that he designed
using a dynamo as the transmitter itself -- Douglas at 47.

1900 -- US Weather Bureau appreaches Fessenden to experiment with wireless
telegraphy concerning its ability to predict floods and storms, especially
hurricanes -- Douglas at 45.

1900 -- Lee DeForest and Edward Smyth develop the responder or electrolytic
anticoherer -- Douglas at 50.

1900 -- John Stone Stone applies for patent for his inductive coupler months
before Marconi's American patent application -- Douglas 52.

1900 -- Marconi succeeds in sending waves covering 200 miles -- Archer at 60.

1900 -- the Marconi International Marine Communications Co. is set up --
Archer at 60.

1900 -- the Wireless Telegraph and Signal Company Limited, incorporated by
Marconi and associates in 1897, is renamed to Marconi's Wireless Telegraph
Co., Ltd. -- Archer at 57-58.

1900 -- Marconi retains John Ambrose Fleming as Consulting Engineer to lend
additional prestige to his company -- Douglas at 35.

From: Thomas H. White [whitetho@ipass.net]
Sent: Thursday, December 14, 2006 5:55 PM
To: Susan Burgess
Subject: Re: KDKA transmitter

There is not a lot of detailed information, but the KDKA transmitter
was a vaccuum-tube unit that was home-brewed by the local Westinghouse
engineers. One of these engineers, D. G. Little, wrote an article
for the October, 1922 Radio News that was titled "Radio Equipment
at KDKA". In this, he wrote "The power of KDKA was at first
relatively small, on the order of 100 watts being delivered to the
antenna. In August, 1921, the range of the station was increased
by improving the height of the antenna and raising the power output
first to 500 watts and subsequently to 1000 watts."

Thomas H. White == whitetho@ipass.net == Cary, NC

> ----- Original Message -----
> **From:** Susan Burgess
> **To:** whitetho@ipass.net
> **Sent:** Wednesday, December 13, 2006 19:33
> **Subject:** KDKA transmitter
>
> Dear Mr. Thomas,
>
> Your Early Radio History website is such a great resource - thanks for creating it!
>
> I'm assisting Clay T. Whitehead write a book about the evolution of telecommunications and am writing to you in hopes that you can help us answer a question. We'd like to know what type of transmitter was built to create KDKA. I checked your site, but didn't find the info there, and thought that you may know.
>
> Thanks in advance for your help,
> Susan Burgess

From: Clay T. Whitehead
Sent: Friday, February 16, 2007 3:30 PM
To: Susan Burgess
Subject: RE: more re role of telegraph in start of WWI

There is something specific on the diplomatic traffic before WW I , and I would like to track it down. Maybe we should discuss. Let's keep it open as a research item, but not time urgent.

-----Original Message-----
From: Susan Burgess
Sent: Friday, February 16, 2007 12:02 PM
To: tom@cwx.com
Subject: more re role of telegraph in start of WWI

Tom,

I finished reviewing our relevant books and didn't find any information showing that Germans and Austria-Hungary communicated by telegraph and got out of sync.

I did find, however, a few statements about the weaknesses of wireless and telegraph communications during the war and include them below. I also include another book's statement about how the Brits' interception of a significant German telegram to Mexico spurred the U.S. to join the war:

". . . American telegraph operators could scarcely believe it when they saw French telegraphers still receiving by watching the Morse Dots and dashes on a paper strip, instead of by ear." Alvin F. Harlow, Old Wires and New Waves at 491.

"When the United States entered the European war, certain nations over there had some eye-opening lessons in, for example, up-to-date telephony. Before our troops had begun to go across, French military authorities assured the American embassy in Paris that the French communications systems would

be
ample for the use of the American Army. . . . But when an American General at
St. Nazaire in the summer of 1917 wished to call General Pershing in Paris,
and learned that, what with European methods, plus the war emergency, it would
be four hours before he could get a call through, he stormed, "Cancel the
call! String four wires on the French poles from here to Paris!" and soon
demands came back across the sea that telephone equipment be rushed to
France." Alvin F. Harlow, Old Wires and New Waves at 488.

"It is said that the Battle of Jutland brought out in full the strength and
weakness of wireless telegraphy. Wireless was of tremendous value to the
commander of an embattled squadron while messages could be gotten to ships of
the fleet, but interference inevitably blanketed radio transmission and turned
everything into chaos." Gleason Archer, History of Radio to 1926 at 128.

German wireless broadcasts were "always in code which British agents could
readily decipher--world-wide intrigues that did much to align neutral nations
against her. It was, for example, a decoded wireless message to the
government of Mexico seeking to inflame her against the United States and thus
to induce her to enter the war on the side of Germany that did much to swerve
public opinion in the United States in favor of war with Germany." Gleason
Archer, History of Radio to 1926 at 128.

Let me know if you'd like me to look into this question in other sources --
i.e., online, other books -- otherwise, I'll move on to another research
question.

Susan

-----Original Message-----
From: Susan Burgess

Sent: Wednesday, February 14, 2007 5:58 PM
To: Clay T. Whitehead
Subject: role of telegraph in start of WWI

Tom,

You asked me to look into the role of the telegraph in the start of World War I. You believed that one of our books may have recounted how the Germans and Austria-Hungary communicated by telegraph and got out of sync.

I've reviewed five of our books, but so far haven't found anything on that specific issue. I'll check the remaining relevant books when I'm back in the office Friday.

Meanwhile, you may be interested to know that the Brits' interception of a significant German telegram to Mexico was one factor that spurred the U.S. to join the war:

"Germany lacked secure channels of its own for military and diplomatic messages and needed to originate cables from such officially neutral countries as Sweden, exposing them to British interception. In 1917, in one of the war's greatest intelligence coups, the British decoded a telegram from German Foreign Secretary Arthur Zimmermann to the president of Mexico offering the return of Texas, Arizona, and New Mexico if Mexico would enter the war on Germany's side. Disclosure of the Zimmermann telegram in March 1917 helped to bring the United States into the war against Gemany the next month." See Paul Starr, "The Creation of the Media" at 224.

Susan

From: Adam Greenfield [AGreenfield@playwrightshorizons.org]
Sent: Tuesday, January 08, 2008 10:31 AM
To: Susan Burgess
Subject: RE: question for Adam Greenfield
Attachments: Table of Contents.doc; TIMELINE OF WORLD EVENTS (FINAL!).doc

Hi Susan—

As far as a bibliography goes, I never created one large all-encompassing document—rather, I assembled a rather extensive notebook geared specifically towards the content of the play. I have attached to this email a copy of the Table of Contents that accompanied the two large notebooks of research I compiled for the production at La Jolla Playhouse, and then again for Broadway. Each section of the notebook corresponds to a section of the play, wherein I included sections of various books that helped unpack the (rather dense amount of) personal, cultural, and business histories the play references. On the Table of Contents you'll find the book titles and authors I used, as well as a brief description of what each of these passages includes.

I also included a timeline I compiled which really came in handy for us, and which I hope is helpful to you and Tom.

In addition to the books listed on the Table of Contents, the following were helpful in my understanding of the greater story…

Abramson, Albert; The History of Television 1880-1941
Cook, Curtis; Patents, Profits and Power (2002)
Dershowitz, Alan; The Vanishing American Jew
Ellmore, Terry R; The Illustrated Dictionary of Broadcast-CATV-Telecommunications
Himmelberg, Robert F.; The Great Depression and the New Deal (2001)
Lewis, Tom; Empire of the Air
McElvaine, Robert S.; The Great Depression: America 1929-1941 (1993)
Niz, Ellen Sturn and Keith Tucker (illus.); Philo Farnsworth and The Television (2007)
Ritchie, Michael; Please Stand By: A Pre-History of Television (1994)
Schatzkin, Paul; The Boy Who Invented Television (2002)
Sobel, Robert; RCA (1986)
Waldrop and Borkin; History of Broadcasting: Radio and Television (1971)
Webb, Richard; Televisionaries: The People Behind the Invention of Television

If there's anything you see in my table of contents that you'd like a copy of, please don't hesitate to ask. Happy to help however I can.

All the best,
Adam Greenfield

From: Adam Greenfield
Sent: Monday, January 07, 2008 1:16 PM
To: susan@cwx.com
Cc: Adam Greenfield
Subject: RE: question for Adam Greenfield

Hi Susan—

Thanks for your email, which was forwarded along to me. I will send the bibliography along to you as soon as I can. It's on my laptop computer, which is (of course) currently on the fritz and in repairs… I'll get it back in a few days, however, and am happy to send along as much info as you and/or Tom would like.

All best,
Adam Greenfield

From: Literary Resident
Sent: Monday, January 07, 2008 12:27 PM
To: Adam Greenfield
Subject: FW: question for Adam Greenfield

From: Susan Burgess [mailto:susan@cwx.com]
Posted At: Monday, January 07, 2008 11:44 AM
Posted To: Literary
Conversation: question for Adam Greenfield
Subject: question for Adam Greenfield

To Whom It May Concern:

First, my apologies if this email is misdirected. I am writing to contact Literary Manager Adam Greenfield in hopes that this is the same Adam Greenfield who worked as Production Dramaturg on The Farnsworth Invention. If so, I'm writing to ask Mr. Greenfield if he would consider sharing his bibliography of sources for Farnsworth. I am assisting Tom Whitehead write a book on the history of telecommunications in the 21st century, and the creation of radio and television is one piece of this history. My professional background is academic - I have absolutely no experience with the world of dramaturgy - so please forgive me if this seems to be an unusual or unthinkable request in your professional circles. My boss, however, urged me to contact you after he saw the play in New York a few weeks ago and was impressed with the accuracy of the story line.

Many thanks in advance,
Susan Burgess

Susan K. Burgess
Researcher for Clay T. Whitehead
P.O. Box 8090
McLean VA 22106

susan@cwx.com
703-761-2807

THE FARNSWORTH INVENTION
Dramaturgy Notebooks
Table Of Contents (Act One)

**** denotes the segments that have been included in actor-packets.*
Notebooks contain fuller versions of all segments.

- "The Russian Jews Arrive," from Jews in America by Arthur Hertzberg. ***
  This chapter discusses who the Russian Jewish immigrants were and what brought them to America. We also see see the hopes, fears and realities of this massive migration.

- "Invention of the Jewish Mother," from Jews in America by Arthur Hertzberg ***
  Secular Jews in an alien land

- from David Sarnoff: A Biography, by Eugene Lyons ***
  Sarnoff's childhood in Uzlian, his family's move to New York, and his fascination with electronics.

- from The Last Lone Inventor by Evan Schwartz ***
  The Titanic and the Sarnoff Myth

- from The Vanishing American Jew by Alan Dershowitz
  Thoughts on the success of secular Jews in America

4. Pages 14-30 in script
   - "Dame Fortune Smiles" from Distant Vision by Pem Farnsworth ***
     Pem's accounts of Everson's and Gorrell's growing support and her wedding day.

   - from The Story of Television by George Everson ***
     Everson's account of his growing partnership with Farnsworth

   - "The Other Woman," from Distant Vision by Pem Farnsworth ***
     Alone on her wedding night, Pem remembers falling in love with Philo.

   - from The Last Lone Inventor by Evan Schwartz ***
     A particularly romantic night out with young Pem and Philo

   - from The Boy Genius and the Mogul by Daniel Stashauer ***
     A brief description of Farnsworth's first (failed) experiments in Los Angeles.

   - from The Last Lone Inventor by Evan Schwartz ***
     Enter Crocker National Bank

   - from Distant Vision by Pem Farnsworth
     Pem's account of Philo's pitch to Crocker

   - from Tube, by David E. and Marshall J. Fisher
     The parallel path of Vladmir Zworykin

   - Images: Young Pem, and Philo; Everson and Gorrell.

5. Pages 30-35 in script
   - from The Boy Genius and the Mogul by Daniel Stashauer ***
     Dempsey vs. Carpentier, the rise of Sarnoff, and Sarnoff's vision for TV

   - from The Last Lone Inventor by Evan Schwartz ***
     Enter Harbord; Sarnoff's patent plans

- from David Sarnoff: A Biography by Eugene Lyons ***
  Enter Lizette

- from Empire of the Air by Tom Lewis ***
  Walter Gifford and the birth of radio advertising

6. Pages 35-49 in script
   - "Life On Green Street" from The Last Lone Inventor by Evan Schwartz ***
     This chapter describes Philo's lab on Green Street, Cliff Gardner's glassblowing training, the filing of Patent 1-773-980, the use of cesium oxide, and the general hooplah surrounding Farnsworth's success at achieving an image. Schwartz also includes a somewhat extended comparison between Farnsworth and Albert Einstein.

   - from Distant Vision by Pem Farnsworth
     Pem's account of Farnsworth's success at achieving a image. Includes her anecdote about seeing cigarette smoke on the television receiver.

   - Farnsworth's Patent 1-773-980

   - Images: Cliff and Agnes; The Green Street lab; components used to invent electronic television; press and publicity.

7. Pages 49-62 in script
   - "Networking," from The Last Lone Inventor by Evan Schwartz ***
     This chapter discusses Sarnoff's vision for the future of radio programming, his battle with Walter Gifford, Harbord's temporary departure, the formation of NBC, and RCA's acquisition of Victor Talking Machines Company

   - "Prophet with Honor," from David Sarnoff: A Biography by Eugene Lyons ***
     Sarnoff's vision for the future of broadcasting and his strength as a public speaker.

   - An Overview of anti-semitism in the United States ***

   - Images: Sarnoff

8. Pages 62-68 in script
   - from The Last Lone Inventor ***
     Various selections from this book which describe, in order:
     1) *Sarnoff's agreement with Zworykin;*
     2) *warning signs of the stock market crash;*
     3) *the first anti-trust lawsuit against RCA, and how it necessitated RCA's ownership of television; creation of the "Get Around Farnsworth" department*
     4) *a lovely passage about the changing identity of inventors;*
     5) *the threat Farnsworth posed to Sarnoff*
     6) *the threat Farnsworth posed to RCA*
     7) *RCA's paltry offer to Farnsworth*

   - Causes of the stock market crash

THE FARNSWORTH INVENTION
Dramaturgy
Table Of Contents (Act Two + Appendices)

Act Two

- "A Beautiful Instrument" (cont'd)
  Zwoykin's use of his visit to the lab

- Images: Zworykin, iconoscope, kinescope

13. Pages 24-26 in script
    - from The Last Lone Inventor ***
      Kenny Farnsworth's death

    - from Distant Vision ***
      Kenny Farnsworth's death

14. Pages 26-36 in script
    - Brief excerpt from The Last Lone Inventor ***
      On RCA sending employees out on spy missions

    - "All's Fair, World's Fair" from The Last Lone Inventor ***
      Sarnoff becomes Father of Television

    - "Post-War," from The Last Lone Inventor ***
      Zworykin becomes Inventor of Television

    - Images: Sarnoff as emperor; Zworykin as Father of Television; Farnsworth struggles on.

15. Pages 36-46 in script
    - "Who Owns What?" from The Last Lone Inventor ***
      A play-by-play of the first RCA/Farnsworth legal battle; meanwhile Philo and Pem struggle in their relationship.

    - "Dashing of Hopes" from Distant Vision by Pem Farnsworth
      Philo's breakdown and decline

    - Another brief excerpt from The Last Lone Inventor
      A few more notes on Farnsworth's decline.

16. Pages 46-54 in script

    - "The Lawyer Wept," from The Boy Genius and the Mogul ***
      A quick overview of the rest of Farnsworth's and Sarnoff's lives.

    - "The Electromagnetic Spectrum Blues: An Elegy for Dr. Philo Taylor Farnsworth II," by Max Crosley
      A free-verse poem by written a family friend on the occasion of Philo's death

    - "Teen Creates Nuclear Fusion in his Michigan Basement" from the Detroit Free Press
      Thiago Olson, a Detroit teenager, is being called a young Farnsworth these days.

    - Images: Sarnoff and Farnsworth in their later years

Appendices

A. Glossary of terms
B. Glossary of people
C. Chronology of Television's Invention, Technology, and the Play in general history

D. Money equivalents
E. An overview of RCA, NBC, CBS, and AT&T
F. Patent law
G. Quotations about television
H. Sarrnoff's public speeches
I. NY Times articles
J. Images of early televisions
K. Bibliography

TIMELINE:

World events, Technology milestones, Events in *The Farnsworth Invention*

1752 Benjamin Franklin's electricity experiments lead to application of the lightning rod; when placed at the apex of barn or church steeple, conducts lightening bolts harmlessly into the ground.

1790 William Pollard of Philadelphia is issued US patent for his machine that roves and spins cotton.

1844 Samuel F.B. Morse demonstrates telegraph.

1872 **Joseph May discovers selenium's conductance of electricity is enhanced by light.**

1876 Alexander Graham Bell patents telephone built with assistance of Thomas A. Watson.

1877 Thomas Alva Edison perfects system of sound recording and transmission Menlo Park, New Jersey laboratories.

1878 Senelq proposes facsimile transmission using selenium scanner and telegraphy.

1879 Thomas Edison perfects an incandescent light bulb with $30,000 of research funds provided by J.P. Morgan.

1880 First articles in *Nature, English Mechanic* and *Scientific American* are published about early television models.

1884 **Paul Nipkov patents first television scanning disk.**

1885 William Le Baron Jenny is first to use steel-grinder in construction and completes first sky scraper; the 10-story Home Insurance Company Building in Chicago.

1887 Emile Berliner, German immigrant living in Washington, invents process for recording sound on a horizontal disk. The "platter record" is born.

1888 George Eastman introduces a hand-held box camera with 100 exposures, for portable use.

1890 Victorian Trade Card predicts a device that can transmit picture and sound.

1891 **David Sarnoff Born in Uzlian**

William Dickson and Thomas Edison, perfect the kinetoscope. It is the forerunner of the movie projector.

1892 Frank and Charles Duryea fabricate the first gasoline-powered automobile built in the U.S.

1900 Max Planck Formulates Quantum Theory

Sigmund Freud Publishes *The Interpretation of Dreams*

Sarnoff Family arrives in New York

First use of term "television" by Perskyi at International Electricity Congress; part of 1900 Paris Exhibition.

1901 First Nobel Prizes Awarded

First Trans-Atlantic Radio Signal

Queen Victoria Dies

U.S. President McKinley Assassinated

1902 Mount Pelée Erupts

The Teddy Bear is Introduced

U.S. Passes the Chinese Exclusion Act

1903 First Flight at Kitty Hawk

First Message to Travel Around the World

First Silent Movie, *The Great Train Robbery*

First World Series

Orville and Wilbur Wright break the powered flight barrier by piloting "Flyer I" for 12 seconds.

1904 First Popular American Film

Ground Broken on Panama Canal

New York City Subway Opens

Trans-Siberian Railway Completed

1905 Einstein Proposes His Theory of Relativity

Freud Publishes His Theory of Sexuality

1906 Finland First European Country to Give Women the Right to Vote

Kellogg's Starts Selling Corn Flakes

Birth of Philo T. Farnsworth

San Francisco Earthquake

Upton Sinclair Writes *The Jungle*

David Sarnoff lands a job at Commercial Cable Company

Max Dieckmann builds rudimentary fax machine using cathode-ray tube

1907 First Electric Washing Machine

Picasso Introduces Cubism

Boris Rosing designs mechanical scanner with cathode-ray-tube receiver.

1908 Ford Introduces the Model-T

Allan A. Campbell Swinton proposes cathode-ray tube for both scanning and receiving.

1909 NAACP Is Founded

Plastic Is Invented

Robert Peary Becomes the First to Reach the North Pole

1910 Boy Scouts Established in U.S.

Halley's Comet Makes an Appearance

The Tango Catches On

1911 The Chinese Revolution

Ernest Rutherford Discovers the Structure of an Atom

Greenwich Mean Time Adopted

The Incan City of Machu Picchu Discovered

Roald Amundsen Reaches the South Pole

Charles F. Kettering sells his automobile starters to Cadillac and increases popularity of gasoline-powered cars over hand-crank model cars.

Boris Rosing receives patent for synchronization and achieves first distant transmission of images with assistant Zworykin.

***Scientific American* article discusses future uses of television; entertainment is not mentioned.**

1912 Oreo Cookies First Introduced

Parachutes Invented

The *Titanic* Sinks

1913 First Crossword Puzzle

Henry Ford Creates Assembly Line

Personal Income Tax Introduced in U.S.

1914 Charlie Chaplin First Appeared as the Little Tramp

First Traffic Light

Panama Canal Officially Opened

World War I Begins

1915 D.W. Griffith's *The Birth of a Nation* Released

1917 First Pulitzer Prizes Awarded

Russian Revolution

David Sarnoff marries Lizette Hermant

U.S. Enters World War I

1918 Daylight Saving Time Introduced

Influenza Epidemic

1919 Prohibition Begins in the U.S.

David Sarnoff joins RCA

Treaty of Versailles Ends World War I

RCA becomes subsidiary of GE. A 28 year old David Sarnoff is named manager.

1920 Bubonic Plague in India

First Commercial Radio Broadcast Aired

Harlem Renaissance Begins

League of Nations Established

Women Granted the Right to Vote in U.S.

First radio station broadcast begin with AM station KDKA of Pittsburg covering Harding-Cox election.

1921 "Fatty" Arbuckle Scandal

Lie Detector Invented

Heavyweight boxing match between Jack Dempsey and Georges Carpentier

First electronically transmitted photograph (wire photo) sent by Western Union.

Philo T. Farnsworth, at age 14, has a vision of electronic TV scanning while plowing hay.

1922 Mussolini Marches on Rome

Farnsworth explains his electronic TV system to his high school teacher.

C. Francis Jenkins transmits still pictures by wireless with a mechanical system.

1923 Charleston Dance Becomes Popular

Talking Movies Invented

Time Magazine Founded

As Westinghouse employee, Zworykin files patent application for all-electronic system. He is not able to build or demonstrate it at this time.

1924 First Olympic Winter Games

Kenjiro Takayanagi starts his television work in Japan.

1925 Flapper Dresses in Style

Hitler Publishes *Mein Kampf*

The Scopes (Monkey) Trial

Baird demonstrates his mechanical television system at Selfridge's Store in London

Jenkins transmits "moving objects" -- (a windmill) in Washington, D.C.

Zworykin demonstrates a working system to his bosses at Westinghouse.

1926 A.A. Milne Publishes *Winnie-the-Pooh*

Robert Goddard Fires His First Liquid-Fuel Rocket

Baird gets his first license to transmit television in London.

Farnsworth gets $6000 advance from George Everson in Salt Lake City.

Philo Farnsworth marries Elma Gardner, and moves to San Francisco.

Alexanderson is proclaimed the "Inventor of Television" by the press in St. Louis.

1927 Babe Ruth Makes Home-Run Record

BBC Founded

The First Talking Movie, *The Jazz Singer*

Lindbergh Flies Solo Across the Atlantic

January: **Alexanderson demonstrates mechanical TV to Radio Engineers.**

April: **AT&T demos mechanical system - Herbert Hoover televised.**

September**: Philo Farnsworth transmits a straight line via his electronic TV system; later, he demonstrates first electronic television for potential investors by broadcasting image of a dollar sign.**

The *New York World* newspaper exclaims "Television Now Fact!"

1928 Bubble Gum Invented

First Mickey Mouse Cartoon

First *Oxford English Dictionary* Published

Penicillin Discovered

Baird transmits from London to New York, using his mechanical system.

Takayanagi gives a demonstration of his CRT system in Japan.

Farnsworth demonstrates his CRT system to the press in San Francisco.

Station WLEX, Lexington, Mass., (about 15 miles NW of Boston) begins broadcasting via mechanical system.

1929 Byrd and Bennett Fly Over South Pole

Car Radio Invented

First Academy Awards

New York Stock Market Crashes

January**: Zworykin meets with Sarnoff at RCA in NY. Predicts 2 years and 100K to produce electronic television. Sarnoff agrees to fund his work.**

April: W1WX (which would eventually become W1XAV), the Shortwave and Television mechanical station, goes on the air.

***Summer*: Farnsworth team replaces motor generator with vacuum tube generator, generating the first all-electric system with no moving parts.**

***November*: Zworykin announces development of the Kinescope, his cathode-ray receiver.**

1930 Gandhi's Salt March

Pluto Discovered

United Artists visits Farnsworth's lab in San Francisco

Sliced Bread Available

Baird begins telecasting three nights a week on BBC in London, Berlin, Paris and Stockholm.

***January*: David Sarnoff becomes RCA president at age 38.**

***April*: Zworykin visits Farnsworth's San Francisco lab and praises the Image Dissector camera tube. In Camden laboratories, Zworykin tries to develop a camera tube as good as Farnsworth to go with Kinescope.**

1931 Empire State Building Completed

U.S. Officially Gets National Anthem

Thomas Edison dies

Karl Guthe Jansky of Bell Laboratories, accidentally discovers radio waves emanating from stars in outer space.

***April:* Sarnoff visits Farnsworth lab, makes $100,000 offer, which is rejected.**

***May:* Zworykin turns toward using one-sided camera tubes.**

***Summer:* Sanford Essig bakes photoelectric mosaic too long, accidentally creating mosaic of insulated globules – the "final key"**

***June:* Farnsworth signs contract with *Philco* and moves lab to Philadelphia.**

***August:* Berlin Radio Exhibition features Manfred von Ardenne's cathode-ray system; called "the world premiere of electronic television"**

October: **Zworykin names his new tube the Iconoscope.**

November 9**: First successful Iconoscope tested. In theory, Zworykin has first all-electronic system.**

1932 Air Conditioning Invented

Scientists Split the Atom

Zippo Lighters Introduced

Kenny Farnsworth dies

Sarnoff demonstrates RCA system in New York, then drapes curtain of secrecy over lab. It is the last RCA demo for 4 years.

March**: Philco denies Farnsworth time to travel to Utah to bury his young son Kenny.**

1933 Adolf Hitler Becomes Chancellor of Germany

FDR Launches New Deal

First Nazi Concentration Camp Established

Loch Ness Monster First Spotted

Prohibition Ends in the U.S.

Wiley Post Flies Around the World in 8 1/2 Days

Radio City is built.

Philco **drops Farnsworth due to pressure from RCA. Farnsworth sets up own lab in Philadelphia.**

April: **Farnsworth applies for patent on first low-velocity storage camera tube.**

June 26: **Zworykin announces his Iconoscope (without demonstration) and finally perfects his all-electronic system performance in the lab.**

1934 Cheeseburger Created

The Dust Bowl

Mao Zedong Begins the Long March

Parker Brothers Sells the Game "Monopoly"

Zworykin is reqwarded the Morris Liebmann Memorial Prize for his pioneering work

August: **Farnsworth demonstrates at the Franklin Institute's new museum in Philadelphia.**

1935 Alcoholics Anonymous Founded

Germany Issues the Anti-Jewish Nuremberg Laws

Social Security Enacted in U.S.

Patent interference between Zworykin and Farnsworth declared in 1932, finally ruled in favor of Farnsworth; decision prevents RCA from gaining total patent control of television.

June: **Pressured by EMI's success in London, Sarnoff announces million-dollar research and testing plan for television; evicting Armstrong from the Empire State building for lab space.**

March **- Germany begins what they call the "first television broadcasting service in the world". Low resolution, few receivers.**

1936 Carnegie Publishes *How to Win Friends and Influence People*

Hoover Dam Completed

Nazi Olympics in Berlin

Spanish Civil War Begins

April: **First RCA demonstration in 4 years using all electronic system; they transmit pictures of 343 lines at 30 frames per second.**

Farnsworth transmits entertainment programs from Wyndmoor, Pennsylvania, station, also at 343 lines at 30 frames per second.

Summer: **Berlin Olympics televised by Telefunken and Fernseh, using RCA and Farnsworth equipment, respectively.**

1937 Amelia Earhart Vanishes

Golden Gate Bridge Opened

The Hindenberg Disaster

Japan Invades China

Philo and wife take an unsuccessful trip to Germany to collect royalties on his television technology used during the Berlin, Olympics in a meeting with Paul Görz, the president of Fernseh; one of two main television companies in Germany at the time.

18 Experimental Television Stations are operating in the United States.

1938 Radio broadcast of "The War of the Worlds" causes panic

Chamberlain Announces "Peace in Our Time"

Hitler Annexes Austria

The Night of Broken Glass (Kristallnacht)

The Farnsworth's buy farm in Maine to ease Philo's growing depressions and alcoholism.

June: **RCA announces Images Iconoscope; a camera 6 to 10 times more sensitive than Iconoscope.**

The RMA (*Radio Manufacturer's Association*) recommends to the FCC that commercial television be launched with standards of 441 lines and 30 frames per second (RCA's standards). Philco and Zenith argue against it.

October: **Sarnoff announces RCA will inaugurate regular broadcasting at the World's Fair next April.**

1939 First Commercial Flight Over the Atlantic

German-Soviet Non-Aggression Pact Signed

Helicopter Invented

Refugees on the *St. Louis* Refused Entry Everywhere

World War II Begins

John Atanasoff and Clifford Berry complete the prototype for the first digital computer.

Farnsworth sells his television patents to RCA Victor for $1 million

March 31: **Farnsworth Television and Radio is incorporated; operations begin in Fort Wayne, Indiana.**

April 20: **In broadcast from the World's Fair in Flushing, Queens, Sarnoff announces "Now we add sight to sound" 10 days later, FDR is first president to be televised. Television sets go on sale the next day. RCA (NBC) begins regular broadcasts.**

June 7: **RCA announces its Orthicon low-velocity camera tube; 10 to 20 times more sensitive model.**

October 2: **Farnsworth signs patent-licensing agreement with RCA. First time RCA agreed to pay royalties to another company.**

1940 Hitler invades Norway, Denmark, the Netherlands, Belgium, Luxembourg, and France

Churchill becomes Britain's prime minister.

Trotsky assassinated in Mexico

Estonia, Latvia, and Lithuania annexed by USSR

The first official network television broadcast is put out by NBC.

June: **RCA and Philco televise the Republican convention from Philadelphia.**

There were 23 experimental television broadcasting stations operating in the United States.

1941 Germany attacks the Balkans and Russia.

Japanese surprise attack on U.S. fleet at Pearl Harbor brings U.S. into World War II;

U.S. and Britain declare war on Japan.

Orson Welles's *Citizen Kane.*

Manhattan Project (atomic bomb research) begins.

March: **The NTSC announces recommendation standards for USA of 525 lines and 30 fps**

FCC authorizes commercial broadcasting to begin July 1.

December 7: Pearl Harbor is attacked.

1942 Declaration of United Nations signed in Washington.

Enrico Fermi achieves nuclear chain reaction.

Japanese Internment

Coconut Grove nightclub fire in Boston kills 492.

Enrico Fermi manages team who produces the first controlled, self-sustaining nuclear chain reaction at University of Chicago.

Commercial production of TV equipment banned for duration of war.

NBC's commercial TV is cancelled.

1943 Mussolini deposed.

1944 Allies invade Normandy on D-Day

U.S., British Commonwealth, and USSR propose establishment of United Nations.

Battle of the Bulge

1945 Yalta Conference (Roosevelt, Churchill, Stalin) plans final defeat of Germany

FDR dies

Hitler commits suicide

Germany surrenders

U.S. drops atomic bombs on Japanese cities of Hiroshima and Nagasaki

United Nations established

First electronic computer, ENIAC, built.

1946 First meeting of UN General Assembly opens in London

Winston Churchill's "Iron Curtain" speech warns of Soviet expansion

Juan Perón becomes president of Argentina.

Benjamin Spock's childcare classic published.

CBS holds color demonstration to the FCC at Nyack, New York.

CBS is publicity praised as having "reached the perfection of black and white" in television quality images

1947 Air Force pilot Chuck Yeager becomes first person to break the sound barrier

Jackie Robinson the Brooklyn Dodgers.

Anne Frank's *The Diary of a Young Girl* published.

1948 Gandhi assassinated in New Delhi by Hindu fanatic

Burma and Ceylon granted independence by Britain.

Communists seize power in Czechoslovakia

Nation of Israel proclaimed.

Independent Republic of Korea is proclaimed

Alger Hiss, former U.S. State Department official, indicted on perjury charges.

Truman ends racial segregation in military.

Alfred Kinsey publishes *Sexual Behavior in the American Male.*

Tennessee Williams's *A Streetcar Named Desire* wins Pulitzer.

1949 Cease-fire in Palestine

Start of North Atlantic Treaty Organization (NATO).

Federal Republic of Germany (West Germany) established

First successful Soviet atomic test

Communist People's Republic of China formally proclaimed by Chairman Mao Zedong

German Democratic Republic (East Germany) established under Soviet rule

South Africa institutionalizes apartheid.

RCA steps up development of all-electronic color system.

Farnsworth Radio and Television sold to ITT.

Philo Farnsworth leaves television and radio business at age 43; continues to suffer from depression and alcoholism.

1951 **RCA demonstrates its new electronic color system.**

1954 **Zworykin retires as Vice President from RCA at age 65 to became director of Rockefeller University's Medical Electronics Center in New York, where he developed the "endosonde," an FM radio transmitter-in-a-pill that, once swallowed, broadcasts data from the remoter regions of the patient's gastrointestinal tract**

1960 Theodore H. Maiman creates first laser.

After more than $130 million spent in development and marketing, RCA records first profit from color television. Profits jump to a million dollars the following year.

1964 IBM rolls out OS/360m first mass-produced operating system.

1965 **RCA profits surpass 100 million from color television.**

1969 NASA's Apollo 11 spacecraft and Neil Armstrong touches down on the moon's surface.

1970 Coring Glass announces creation of glass fiber so clear; it can communicate pulses of light.

1971 **Philo Farnsworth dies at 64 in Salt Lake City, Utah.**

The New York Times **obituary gives Philo sole credit for television's invention; scores of other sources either ignore or give him second or co-billing with Zworykin.**

1972 First video game *Pong*, invented by Nolan Bushnell, is the rage.

1977 ***September:*** **Philo III, supervises the enormous task of recreating the exact experiment that his father's "lab gang" had demonstrated in 1927 for the Sept. 7 celebration at Foothill Electronics Museum near Palo Alto. Displays included the first tube had been blown 50 years earlier, to manufacture the image dissector. Crowd of nearly 100 that included Pem, Cliff, Tobe Rutherford and TV crews from NBC, CBS, and local San Francisco TV stations. Ironically, the NBC Nightly News aired Philo as inventor of TV, with the network built by RCA's David Sarnoff.**

1982 **Zworykin dies at age 93 with multi-national recognition and founder of television. Once shared his thoughts on television in later years: "I hate what they've done to my child…I would never let my own children watch it."**

From: Susan Burgess
Sent: Tuesday, May 15, 2007 11:08 AM
To: 'tom@cwx.com'
Cc: 'Wendell J Bartnick'
Subject: Table of allocations data

Tom,

Friday you asked Wendell about the allocation data he used to compile his spreadsheets. You can find the chart at this link starting on scanned page 170 (which is appendix G(1)):
http://www.fcc.gov/fcc-bin/assemble?docno=2810264

Susan