



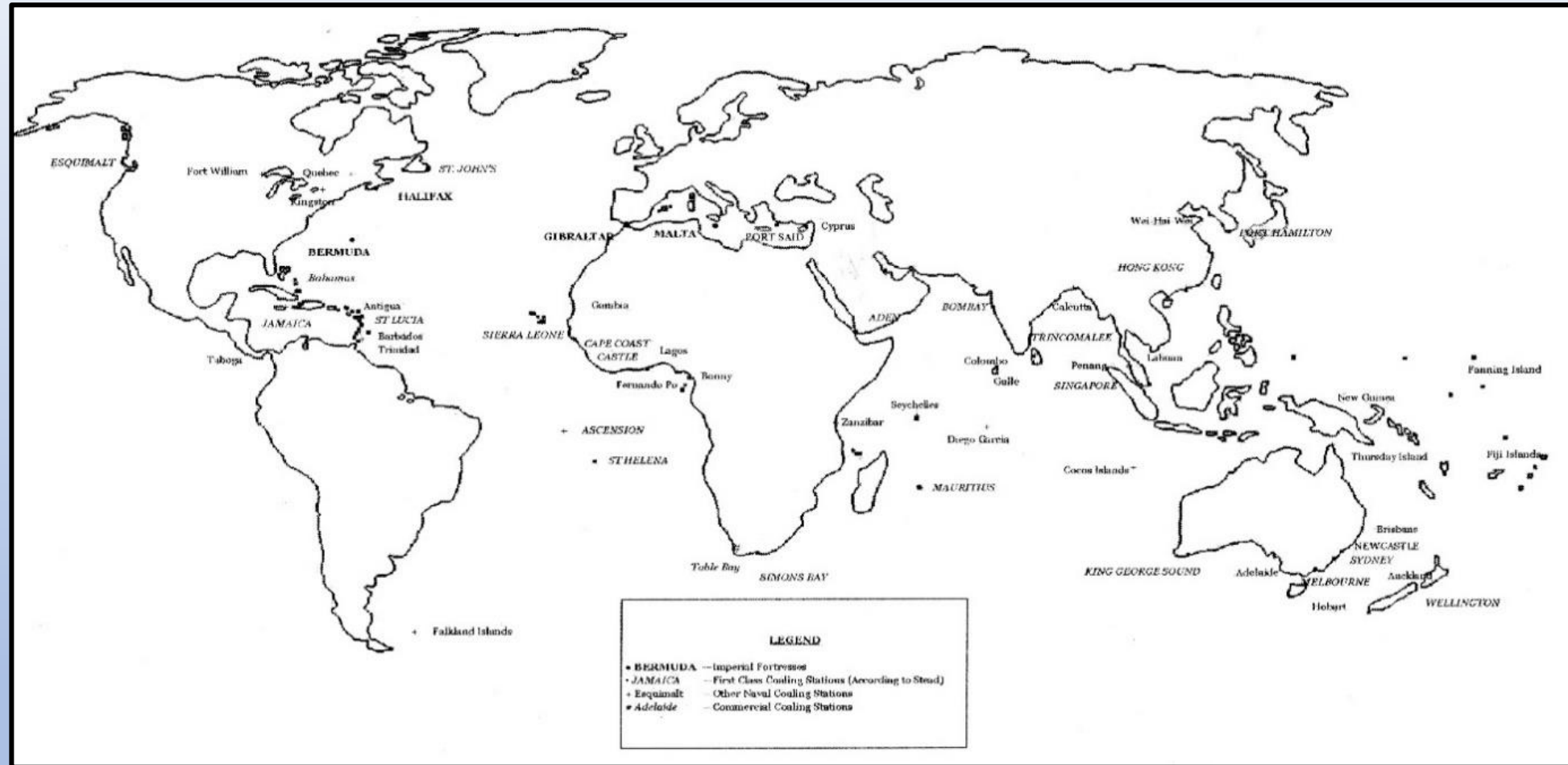
The Ionosphere: Undermining Britain's Imperial Power

Wireless and Its Impact on Geopolitics and Naval Operations (1919-1945)

Objectives Of Research

- To identify how Post World War 1 Political Priorities, Wireless Technology Decisions and Economic Realities in Britain and America contributed to the transfer of power between the Royal Navy and the United States Navy (USN).
 - **To show how the discovery of Short-Wave Radio came at a perfect time for the USN**
- To identify how wireless and short-wave in particular had a major impact on naval operations in the inter-war period
 - **How short-wave contributed to the creation of a major new art, Signals Intelligence (SIGINT)**

Strength from Steam and Submarine Cables



British Coaling Stations, 1879-1914

Britain's Early Lead in Submarine Cable Manufacture

714

Experiments on the communication of [SEPT.

ART. VI.—*Memoranda relative to experiments on the communication of Telegraphic Signals by induced Electricity.*—By W. B. O'SHAUGHNESSY, M. D. Assistant Surgeon ; Professor of Chemistry, Medical College, Calcutta ; and Officiating Joint-Secretary to the Asiatic Society of Bengal.

There are few projects which at first sight appear so visionary as those which promise practical benefit to mankind through the agency of electrical operations. From the dawning of knowledge in this science, pretenders of every grade have found it a free field for their speculations: and hence perhaps it arises that the sober and practical part of society generally regard with distrust, the multitudes of projects which electricians are constantly advancing.

***“The Journal of the Asiatic Society of Bengal
(September 1839).”***

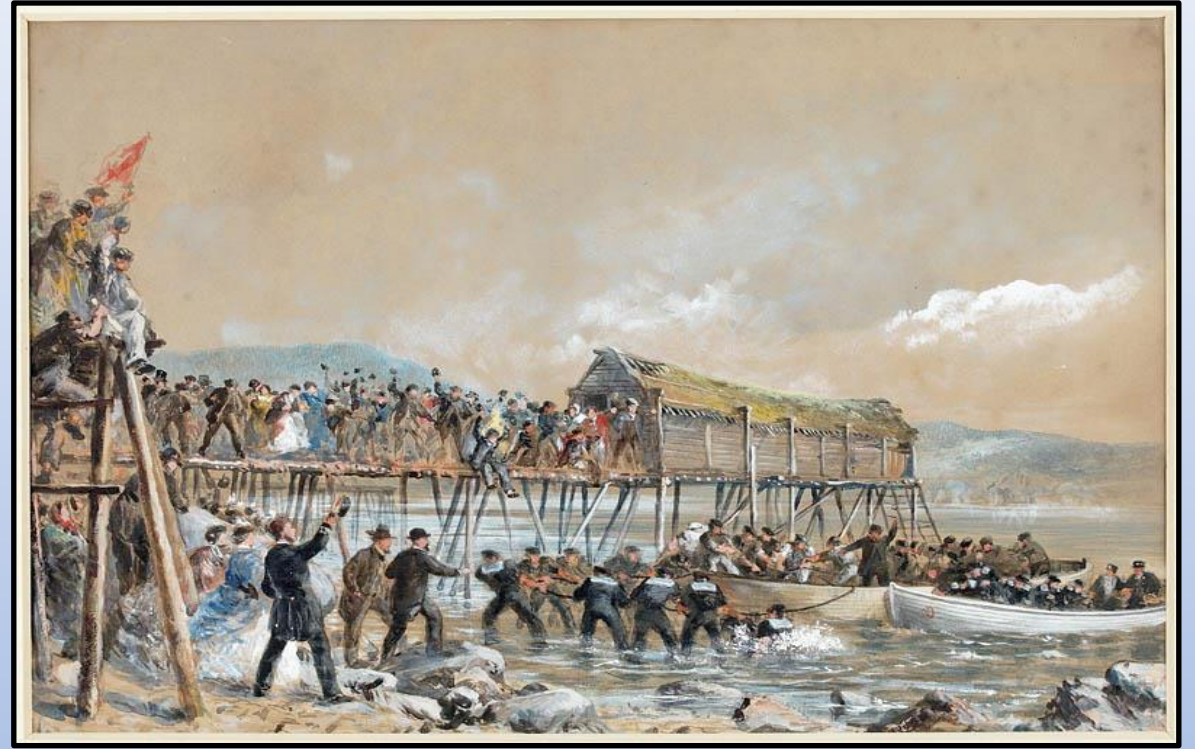


Goliath Laying Channel Cable - 1850

The Legacy of the Trans-Atlantic Cables



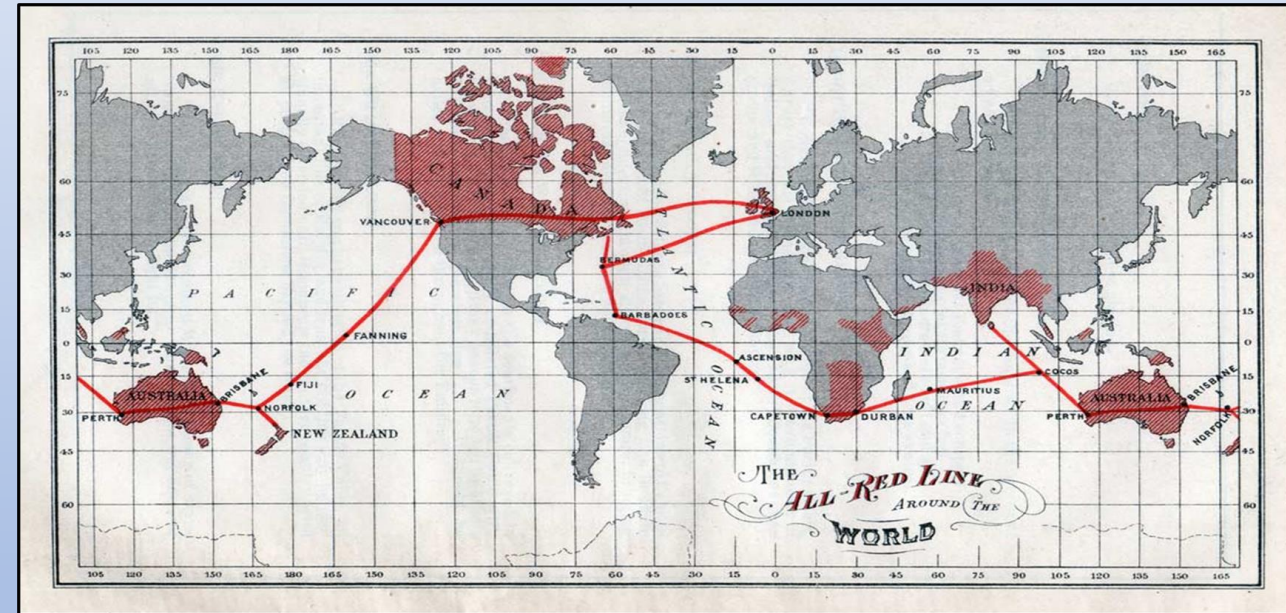
Agamemnon and Niagara laying the first Transatlantic Cable



Landing the Second Trans-Atlantic Cable at Hearts Content, Newfoundland.

The Imperial Connection and the “All Red Line”

Major Telegraph Companies in 1892		
	Length (kms)	Percentage of World Total
Eastern and Associated (GB)	112,711	45.5
Anglo-American (GB)	19,261	7.8
Western Union (USA)	14,340	5.8
Commercial Cable (USA)	12,849	5.2
Great Northern (Denmark)	12,838	5.2
Central & South American (USA)	8,977	3.6
West India & Panama (GB)	8,440	3.4
CFTSM (France)	6,952	2.8
CFT Paris-New York (France)	6,475	2.6
Direct United States (GB)	5,471	2.3



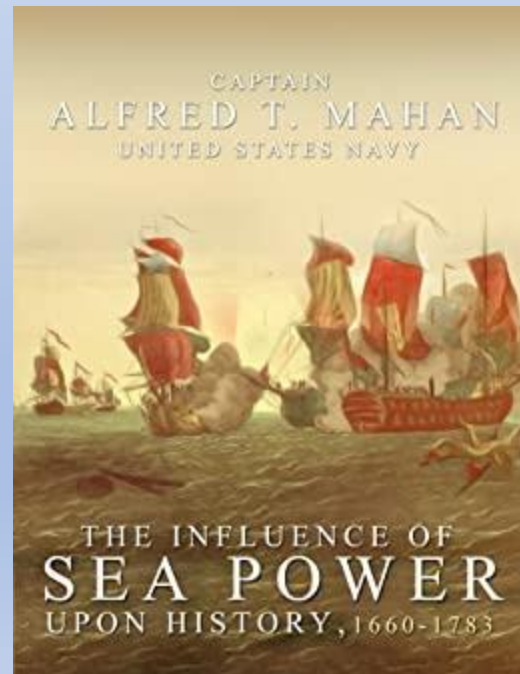
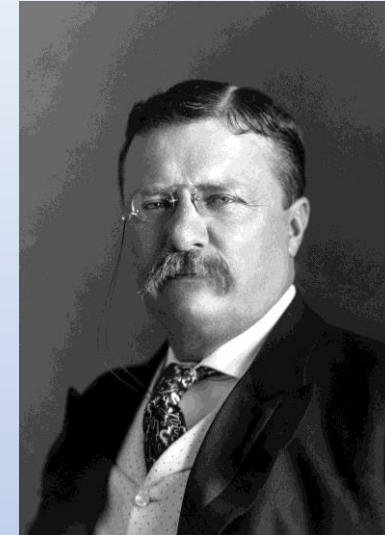
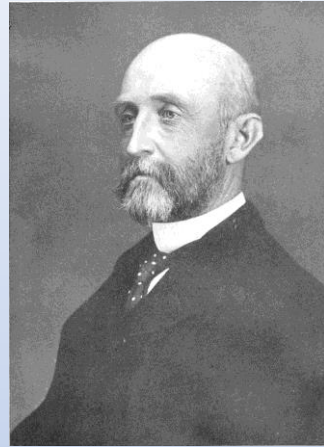


Early Challenges to British Communications Domination 1890-1914

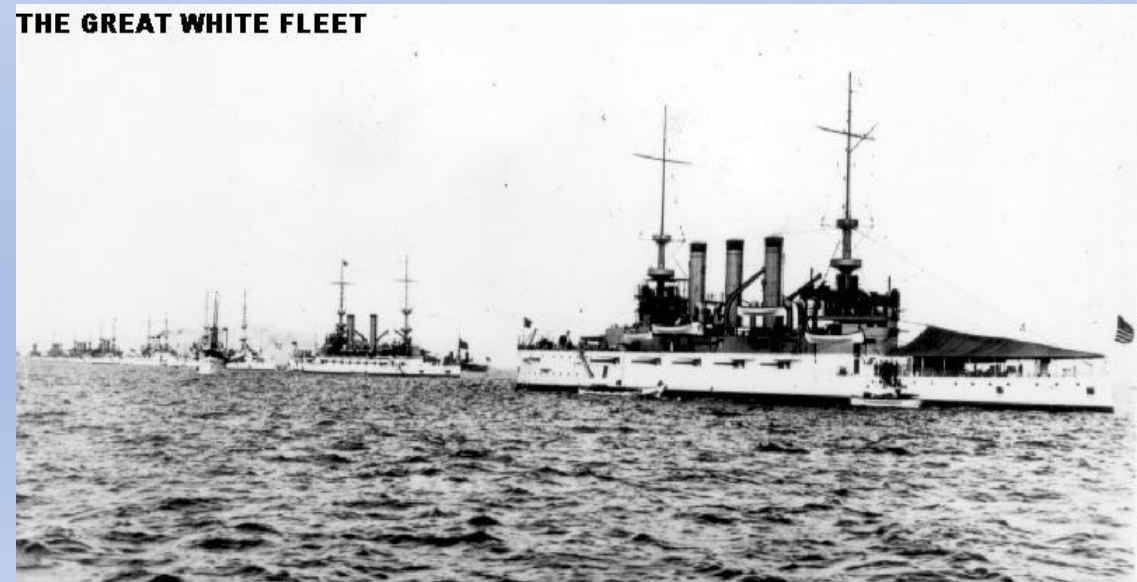
Germany



The United States



THE GREAT WHITE FLEET

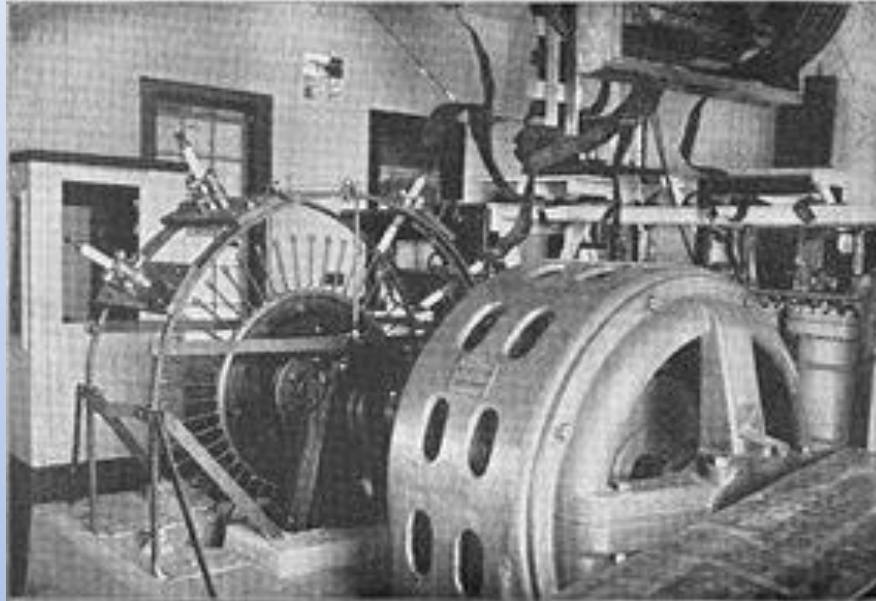
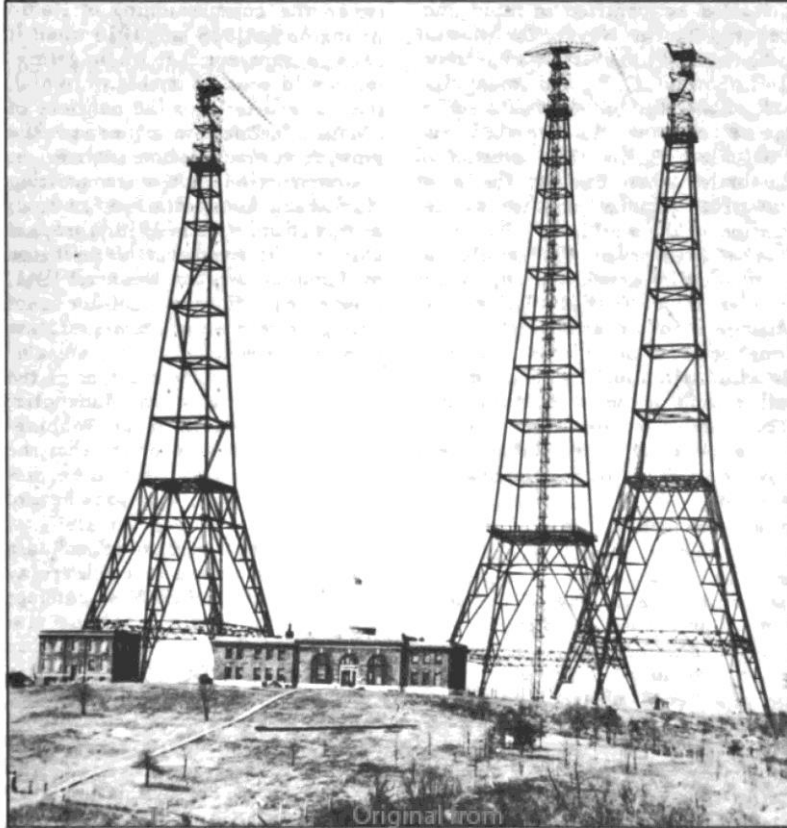


The USN and Early Friction with the Marconi Company

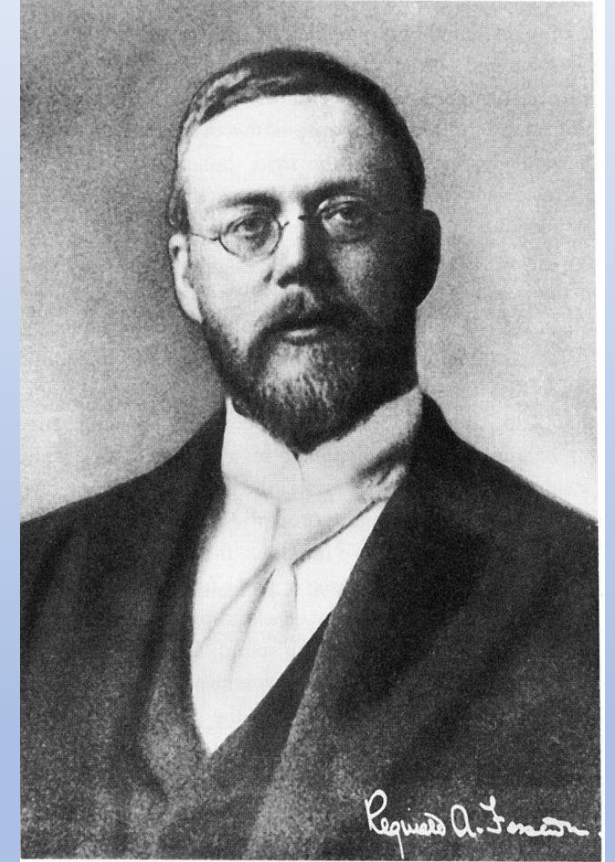


The USN and Continuous Wave

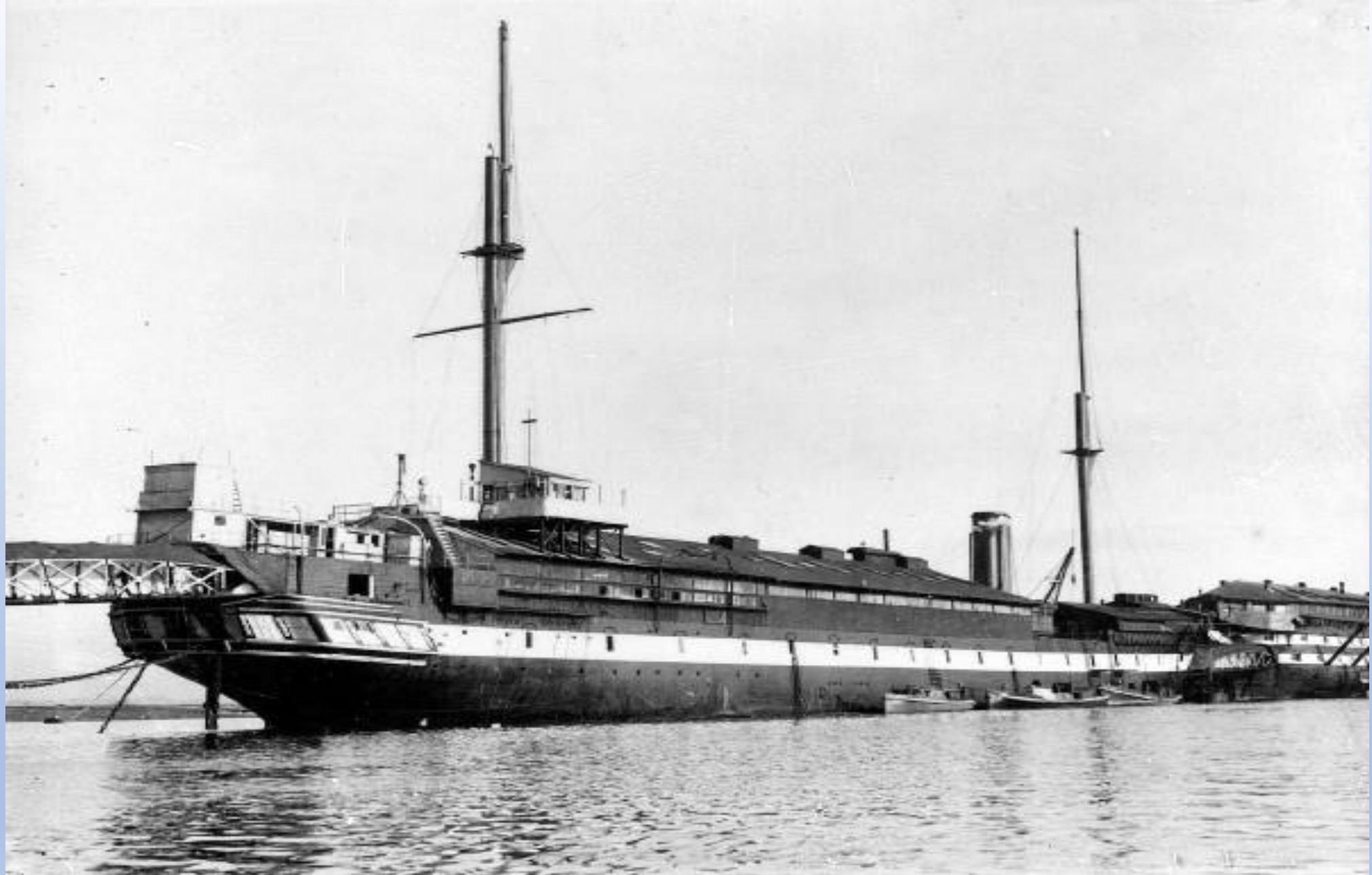
Early view of the three towers of Radio Arlington that became a hazard to aircraft in the Washington area.



NESCO Rotary Spark Discharger



Reginald Fessenden

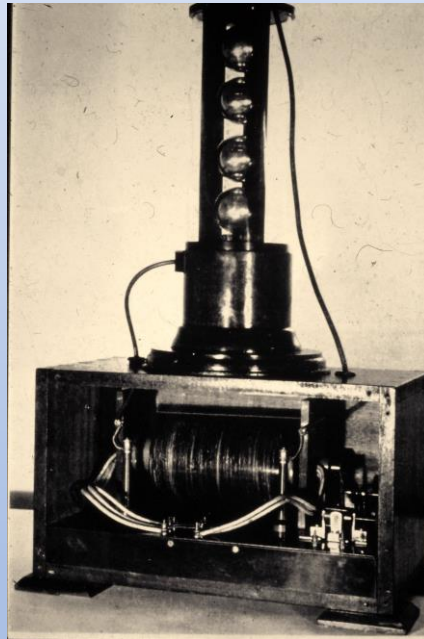


Early Wireless Telegraphy in the Royal Navy

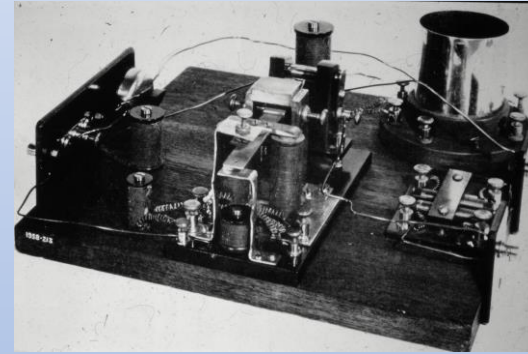
Henry Bradwardine Jackson (1855-1929)



Britannia Royal Navy College
Prior to moving on-shore in 1905



An Early Jackson
Transmitter



An Early Jackson Receiver

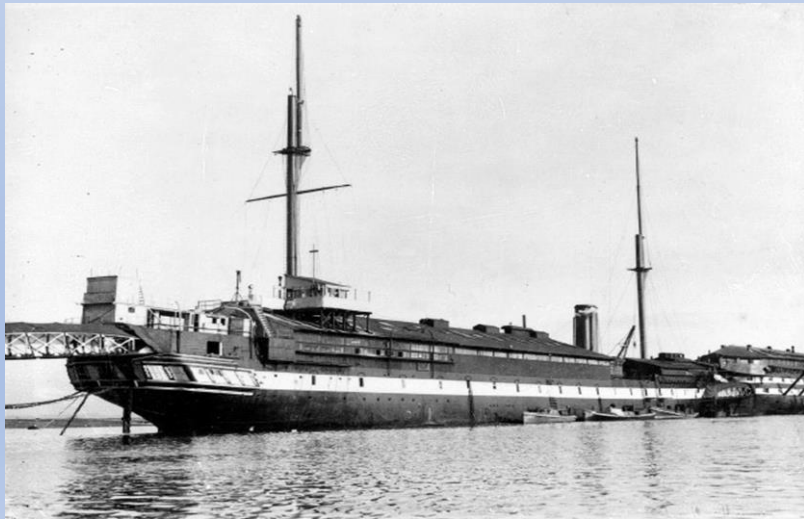


Admiral of the Fleet Sir Henry
Bradwardine Jackson,
GCB, KCVO, FRS

HMS Vernon



Main Gate and Guardhouse



HMS Vernon 1081



Current view of site of HMS Vernon

Jackson and Marconi



Captain Henry Jackson on board Defiance in 1897.

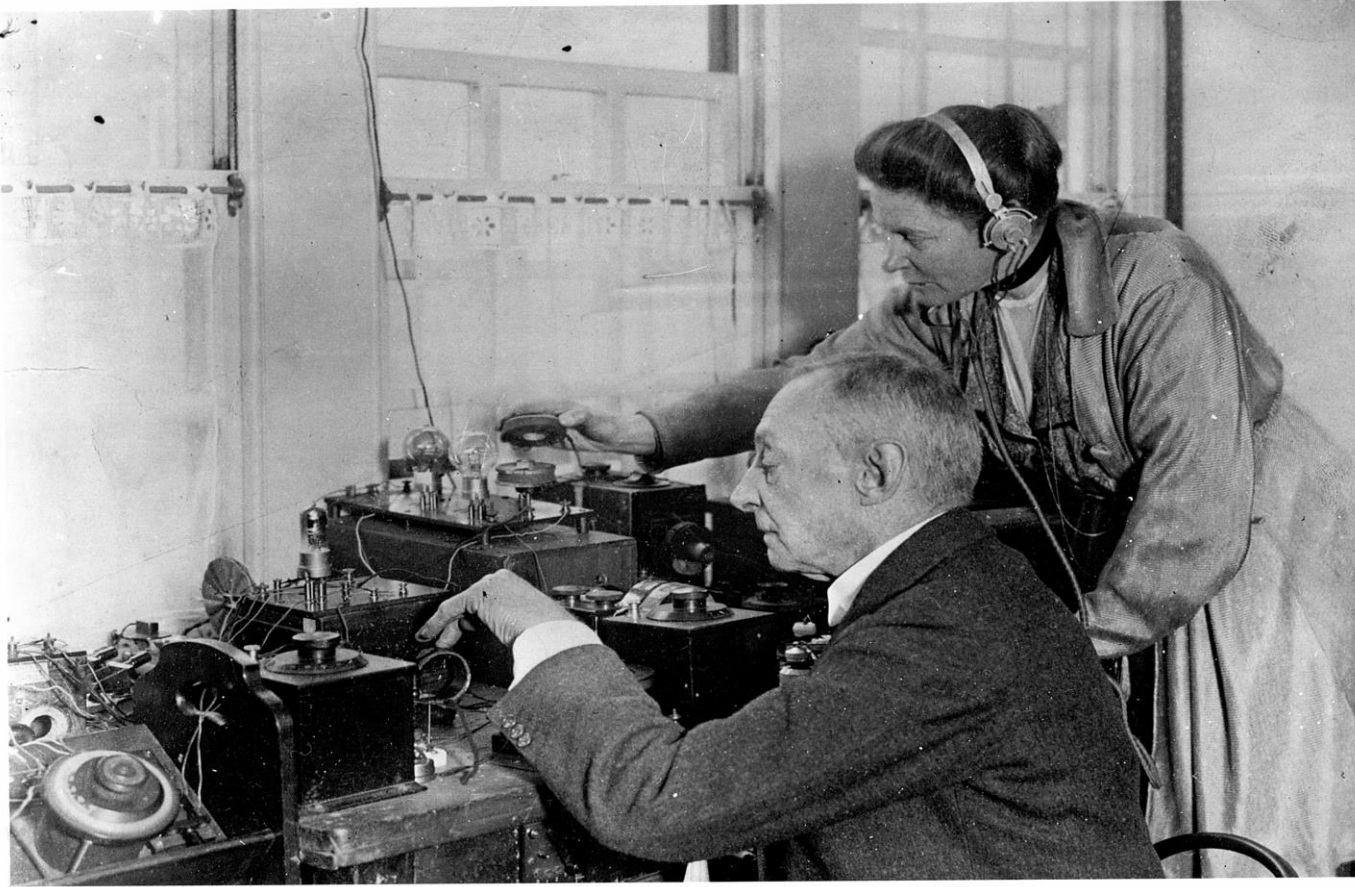


Guglielmo Marconi 1902

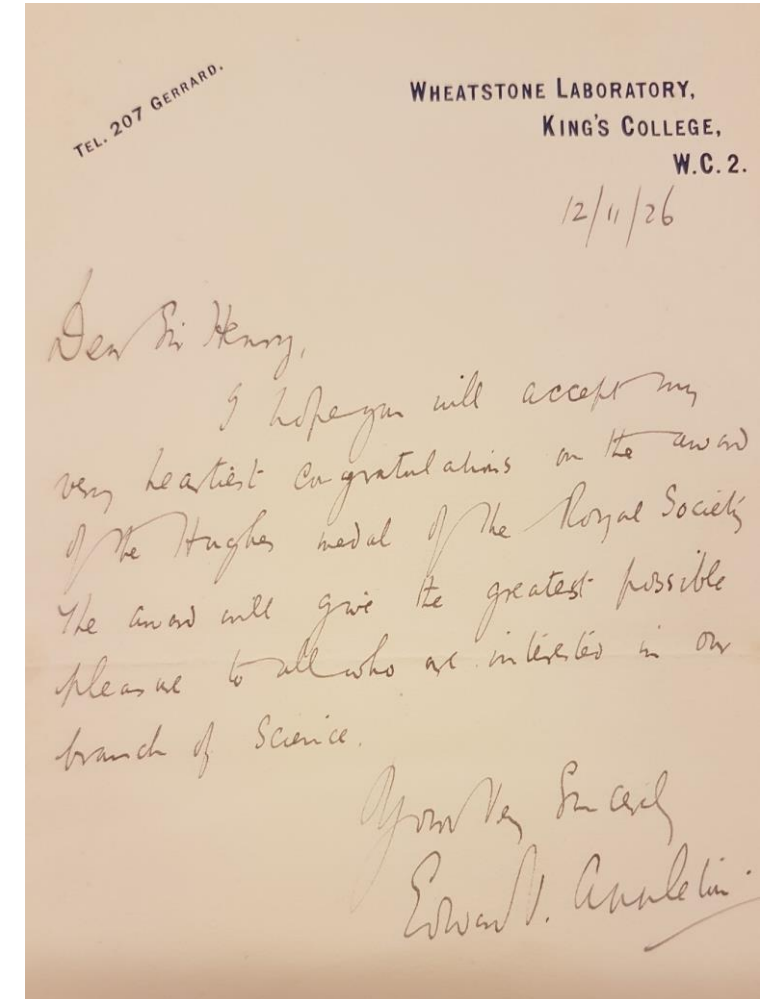


Post Office Engineers with Marconi Equipment- 1897

Admiral Jackson and the Radio Research Board



Admiral Sir Henry Jackson and Lady Jackson 1923

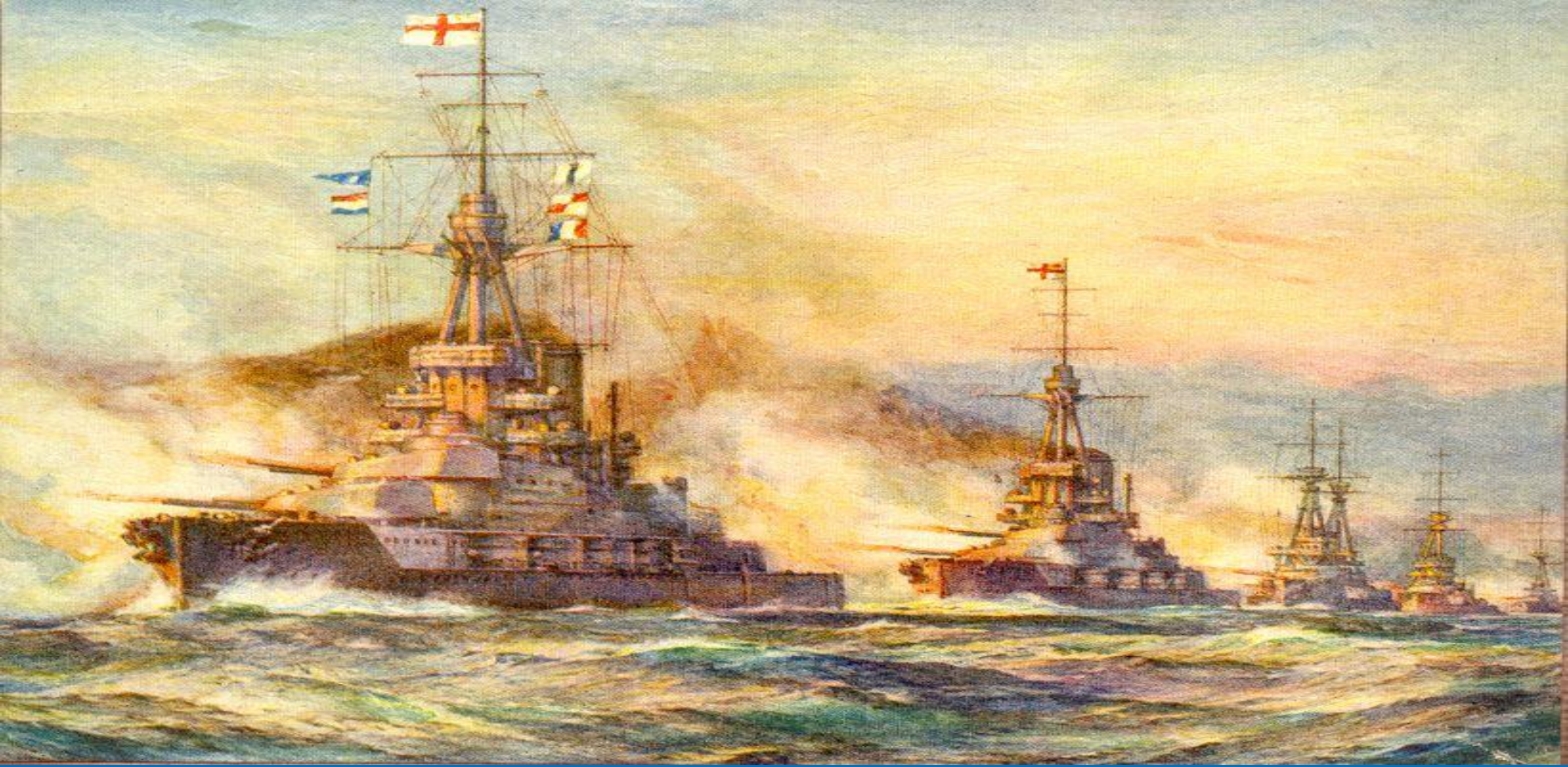


Edward Appleton Letter, Congratulating Admiral Jackson on Award of Hughes Medal, November 12, 1926

Early Royal Navy Wireless Telegraphy Deployments

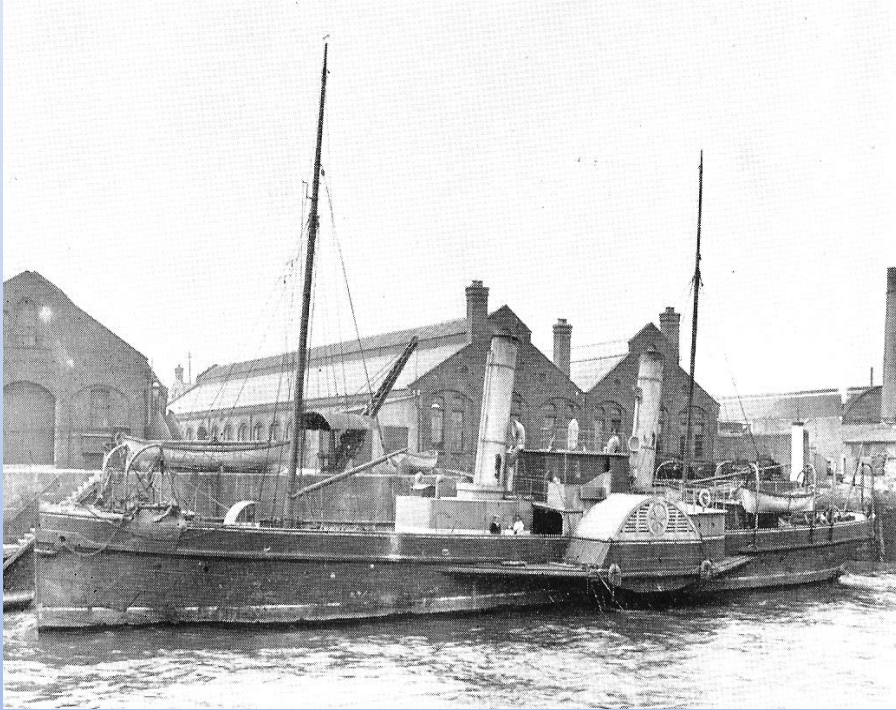
Station	Marconi Sets	Jackson Sets	Totals
Channel Squadron	6	7	13
Mediterranean Squadron	5	20	25
Reserve Squadron	3	8	11
Port Guard Ships	-	3	3
China Squadron	3	15	18
Cruiser Squadron	4	1	5
Shore Stations	8	4	12
Totals	29	58	87

Scheduled Royal Navy Deployment of Wireless Telegraphy Sets by December, 1901



World War 1

Germany's Fears Justified



Cable Ship Alert



The Zimmermann Telegram



PENDLETON, OREGON, THURSDAY, MARCH 1, 1917. NO. 9058

HAVE ING LLA

GERMANY PLOTS AGAINST THE U. S.

Hold of
an Inter-
nal Fight.

OBTAINED

THE ZIMMERMAN LETTER JAPAN AND MEXICO SOUGHT AS ALLIES IN TEUTON SCHEME

Here is a copy of Zimmerman's instructions to Von Eckhardt, sent through Von Bernstorff, which is in possession of the United States government. It is as follows:

"Berlin, Jan. 19, 1917.—On the first of February we intend to begin submarine warfare unrestricted. In spite of this, it is our intention to endeavor to keep neutral the United States of America.

"If this attempt is not successful we propose an alliance on the following basis with Mexico. That we shall make war together and together make peace. We shall give general financial support, and it is understood that Mexico is to reconquer the lost territory in New Mexico, Texas and Arizona. The details are left to you for settlement.

JAPANESE AID IS SOLICITED.

"You are instructed to inform the President of Mexico of the above in confidence as soon as it is certain that there

Document Bearing Instructions to Von Eckhardt in Mexico City is Intercepted; Has Been in Possession of U.S. Government for Some Time; Sinister Sequence of Events Explained; Big Concessions

RECEIVED
Letter 1-8-58
Wm. L. Zimmerman, State Dept.
By Mack A. Eckhoff, Assistant
Date Oct. 22, 1917

FROM 2nd from London # 5747.

"We intend to begin on the first of February unrestricted submarine warfare. We shall endeavor in spite of this to keep the United States of America neutral. In the event of this not succeeding, we make Mexico a proposal of alliance on the following basis: make war together, make peace together, generous financial support and an understanding on our part that Mexico is to reconquer the lost territory in Texas, New Mexico, and

"All the News That's
Fit to Print."

The New York Times.

THE WEATHER
Forecast for New York City
and vicinity for the week ending
March 1, 1917.

NEW YORK, THURSDAY, MARCH 1, 1917.—TWENTY-TWO PAGES.

GERMANY SEEKS AN ALLIANCE AGAINST US; ASKS JAPAN AND MEXICO TO JOIN HER; FULL TEXT OF HER PROPOSAL MADE PUBLIC

CONGRESS TO BACK WILSON
Lacerte Tragely Adds
Strength to Pres.

No Ship Cash Exchanged
404,000 Tons Lost in February

Emancipation Again Against Neutral Ships With No Sank
Escape of the Orleans Only an Instance of Luck

JAPAN CALLS IT MONSTROUS

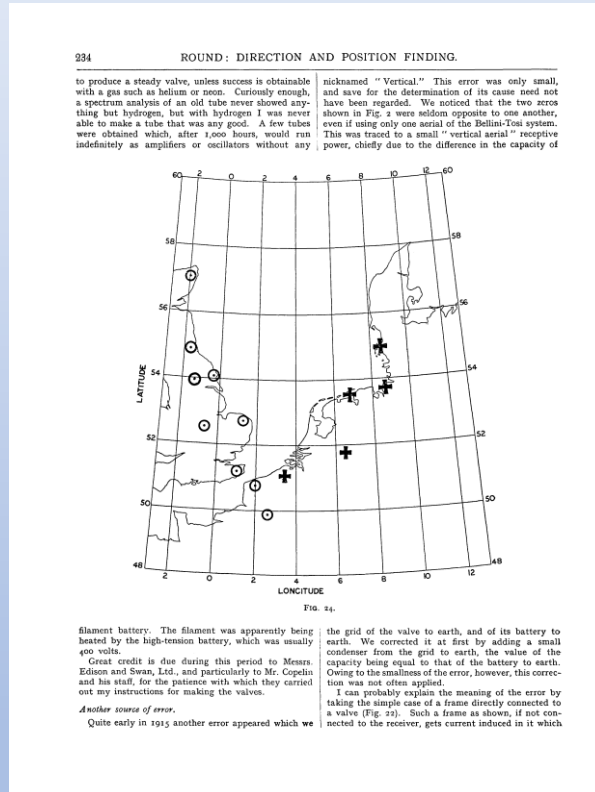
Text of Germany's Proposal to Form an Alliance
With Mexico and Japan Against the United States

WASHINGTON EXPOSES PLOT
Our Government Has
Zimmermann's Note

Radio Location and the Battle of Jutland



H.J. Round



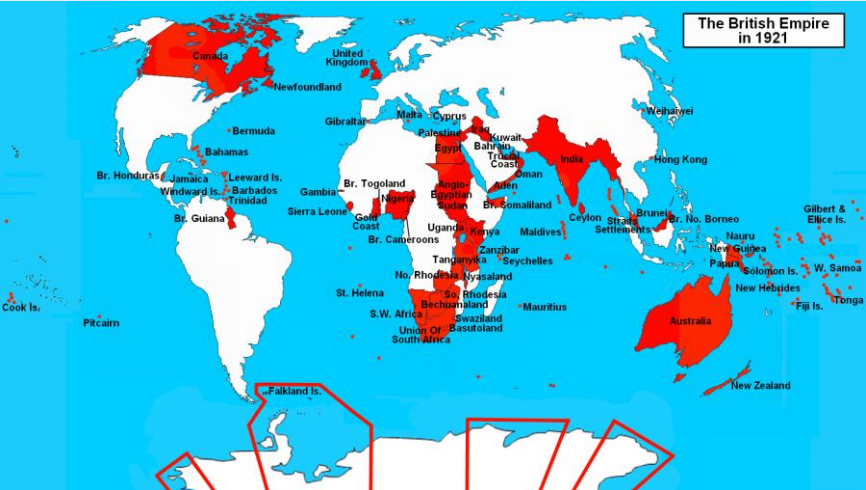
Admiral John Jellicoe





Post-War Austerity, Wireless Debates and Conflicts

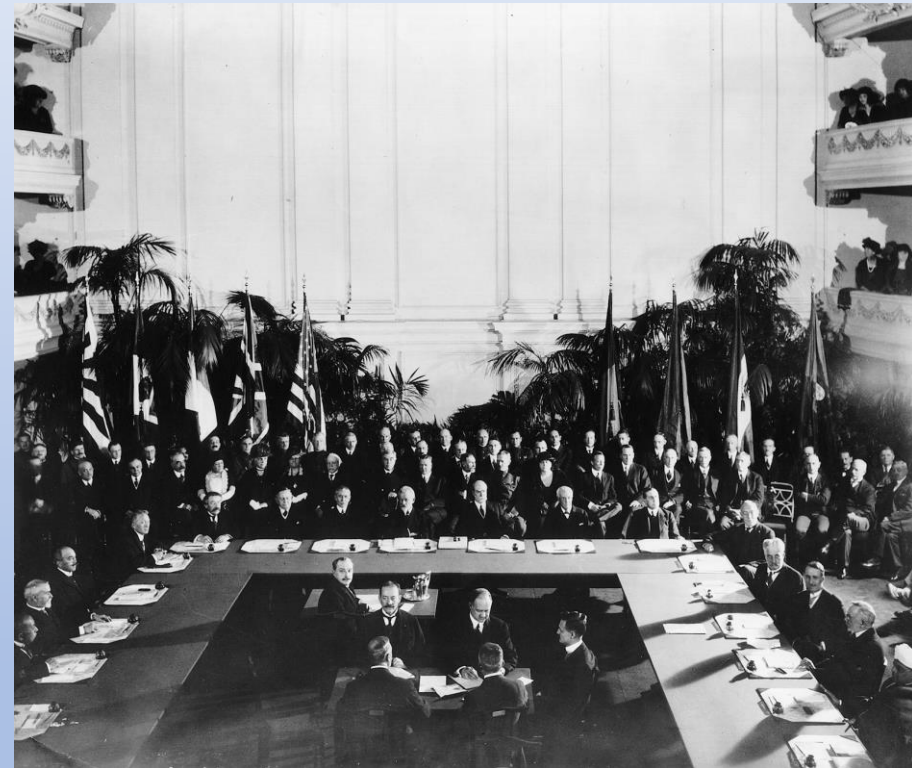
Post-War Austerity In Britain



Allied Expenditures and Total Mobilized Forces, 1914-1919.		
	War Expenditure at 1913 Prices (billions of dollars)	Total Mobilized Forces (millions)
British Empire	23.0	9.5
France	9.3	8.2
Russia	5.4	13.0
Italy	3.2	5.6
United States	17.1	3.8
Other Allies	-0.3	2.6
Totals	57.7	40.7



A Post–War Navy

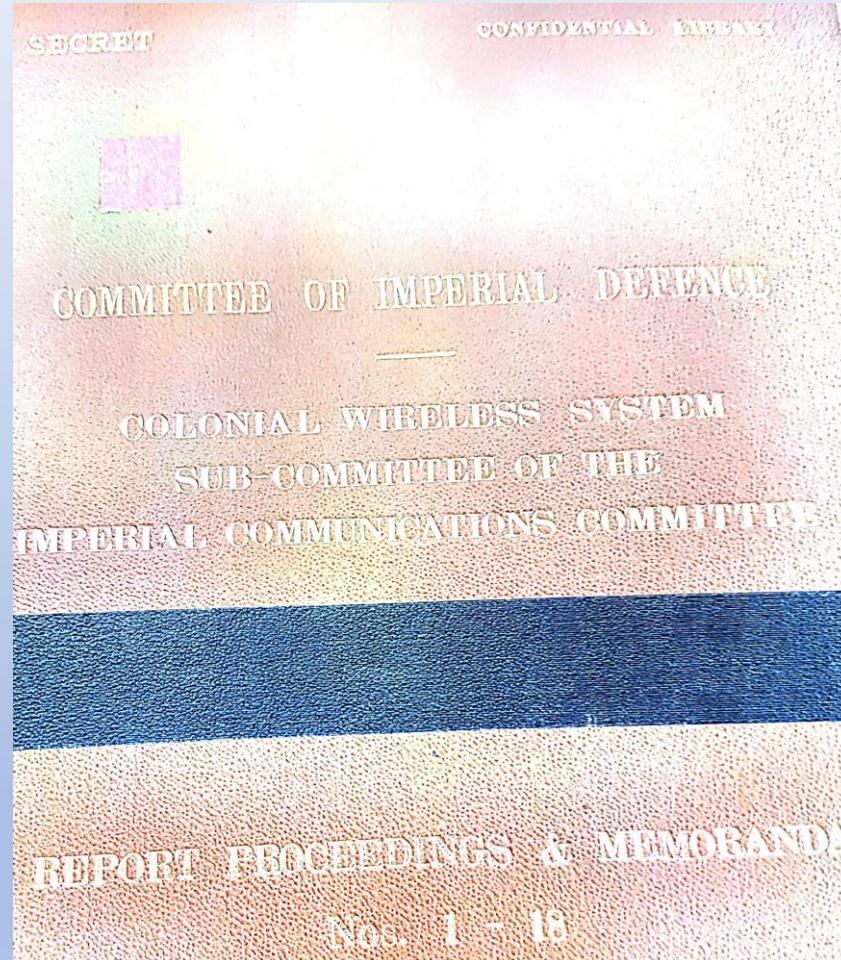


Washington Naval Conference
Nov 1921 – Feb 1922

The Imperial Network Debate

The Governments of Australia, India (and probably the Union of South Africa) desire to establish direct communication with the United Kingdom instead of by 2,000 miles steps as proposed in the scheme of the Imperial Wireless Chain now approved

Winston Churchill, Secretary of State for the Colonies



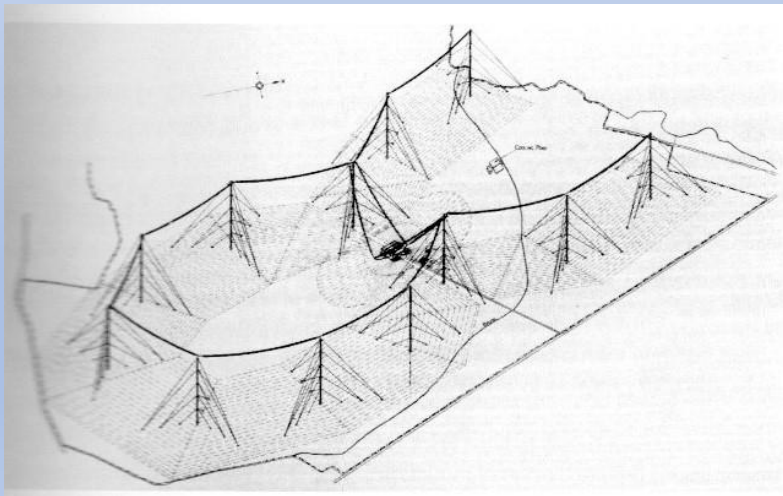
We will put up a plant in Australia which will communicate directly with you, and every other dominion can do the same

Prime Minister of Australia (Billy Hughes)

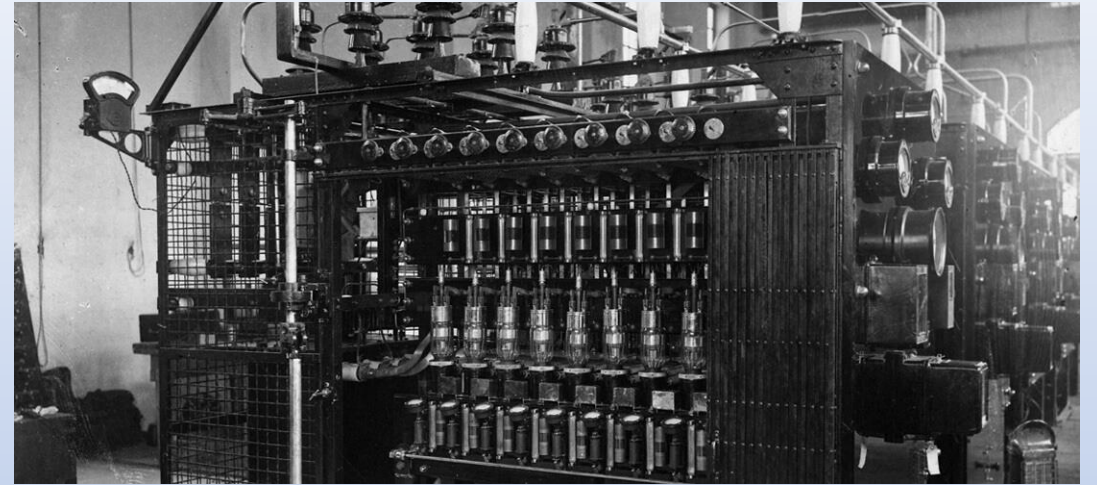
Rugby Radio Station



Burying Earth Wires - November 1924



Aerial and Buried Earth Mat (dotted) -1926



Rugby Long Wave Transmitter



Tuning Inductor

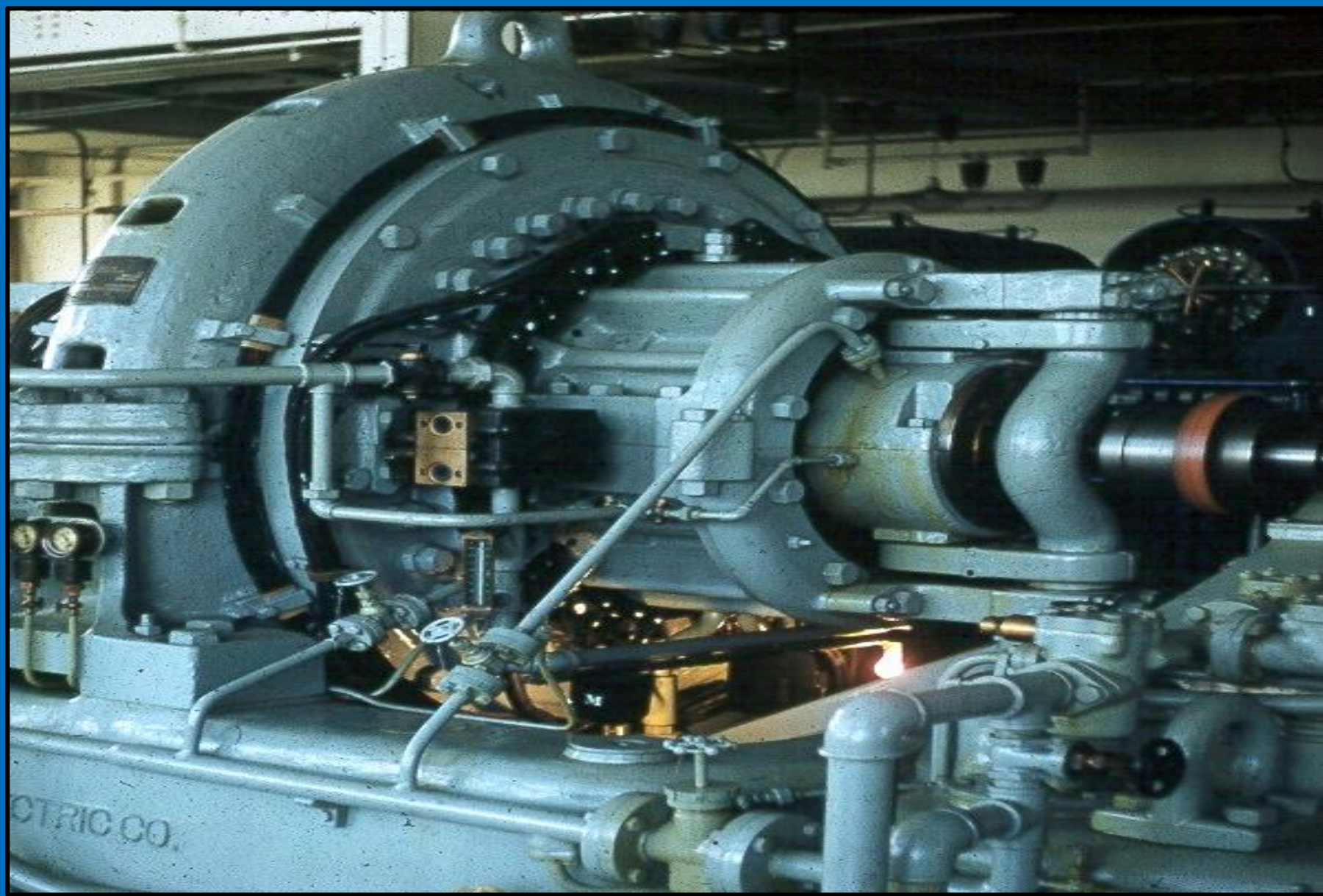
United States Post-War Prosperity and Political Will

It is a matter of common knowledge that the highly efficient cable system of Great Britain is so closely co-ordinated with the diplomatic and commercial interests of that country that no message which might be of value to either the British Foreign Office or the British Board of Trade is assured of secrecy if at any point in its journey it passes over a British line

Elihu Root Jr, Senator and attorney for Western Union

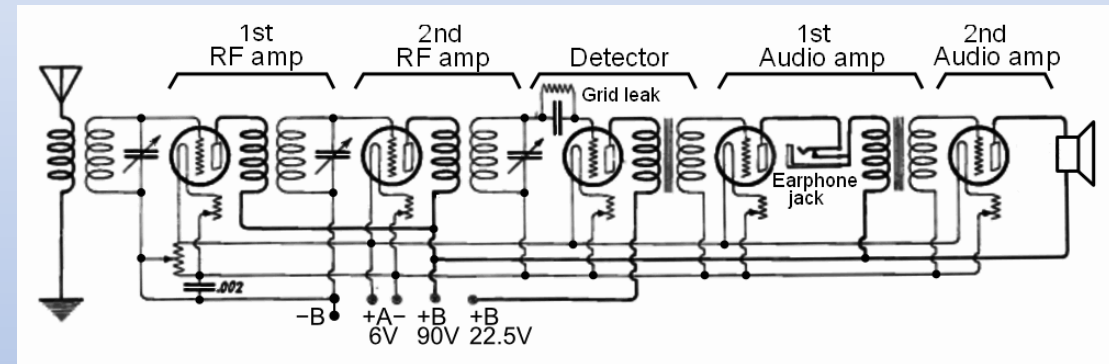
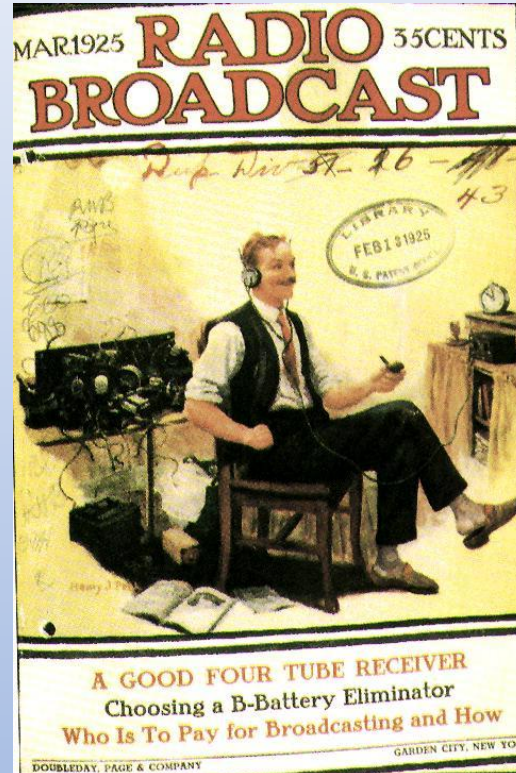
Our ships and merchant marine now have to depend upon the courtesy of foreign controlled means of communication to get home connections.....The United States is connected on one side only. A new system should be developed with the United States at the centre

U.S. Postmaster General, A.S. Burleson



Divergent Technology Paths
Continuous Wave Vs Spark Gap

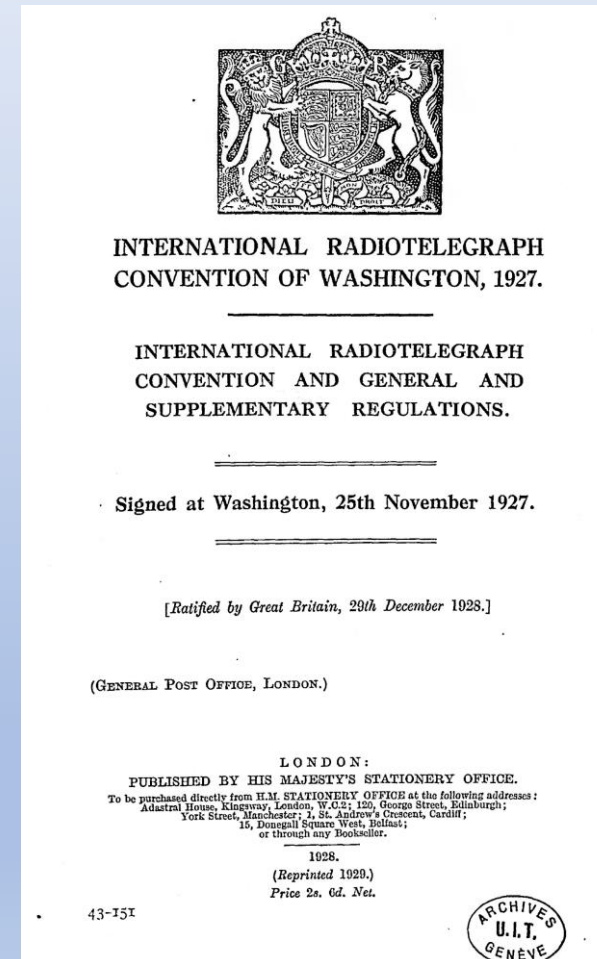
Continuous Wave and Broadcasting

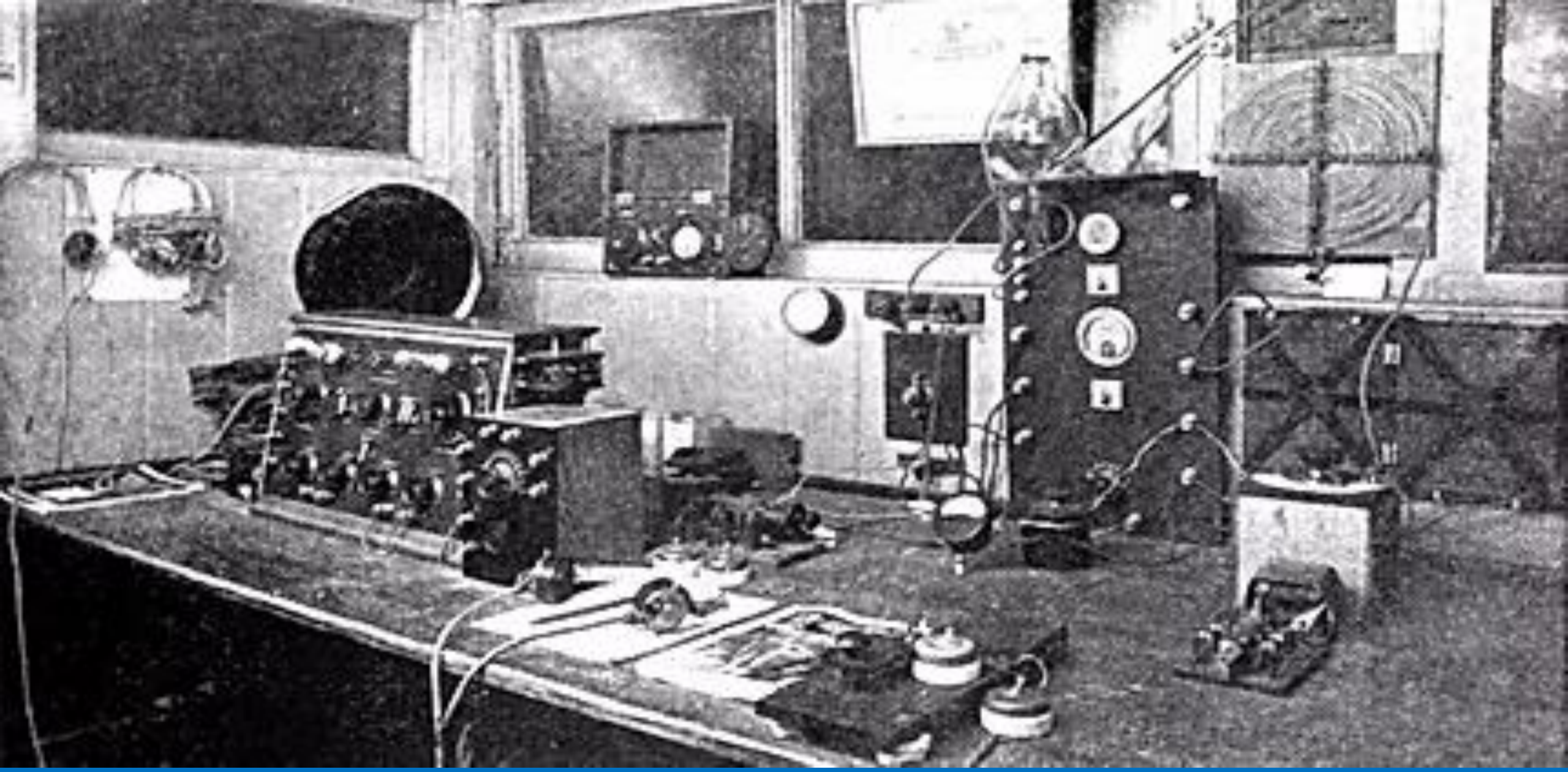


Post-War Radio Spectrum Regulation

We have witnessed in the last four or five months one of the most astounding things that has come under my observation of American life. This department estimates that today more than 600,000 persons possess wireless telephone receiving sets, whereas there were less than 50,000 such sets a year ago

Secretary of Commerce: Herbert Hoover opening address to the First National Radio Conference (Washington 1921)



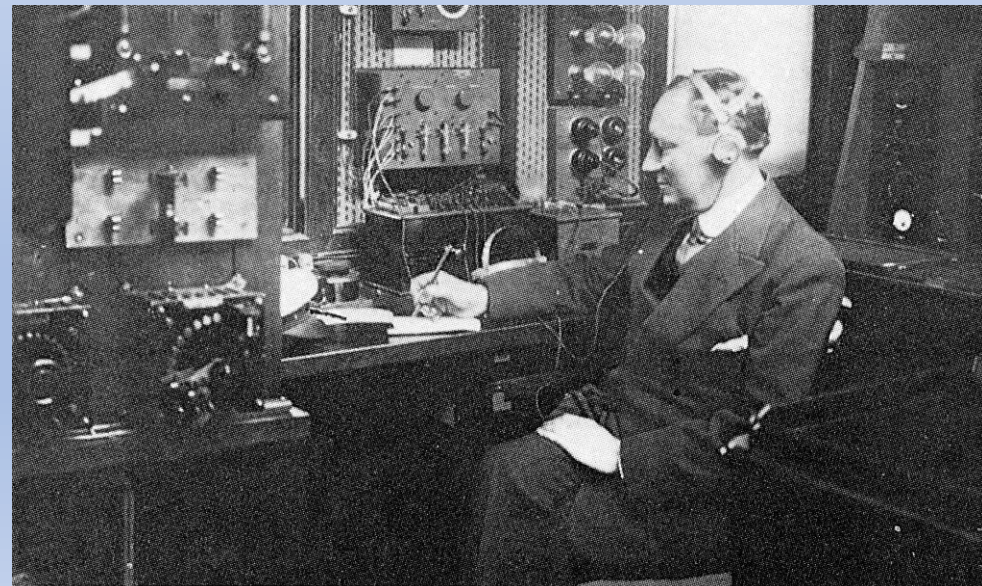
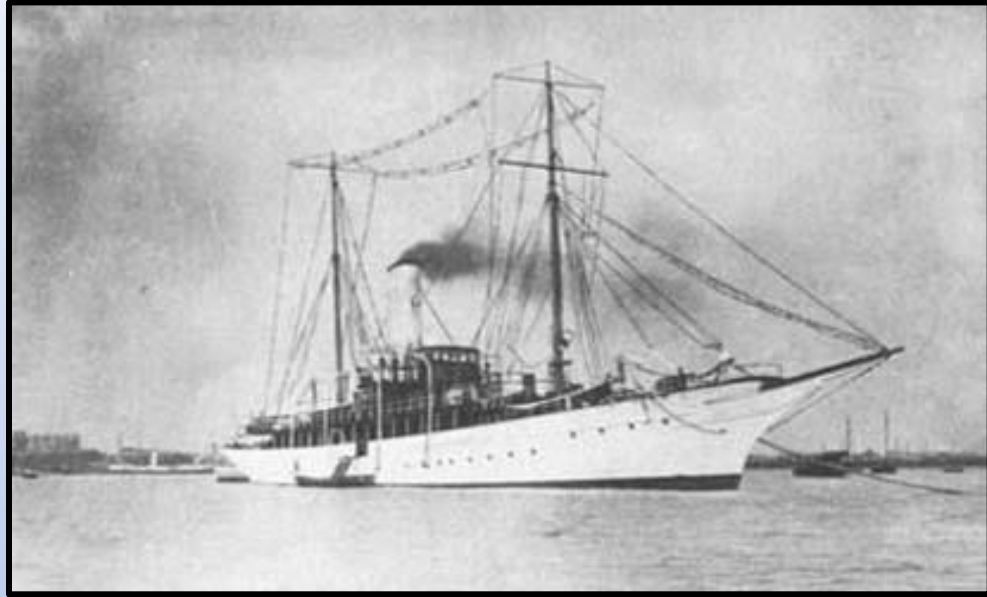


The Discovery of the Potential of Short Waves

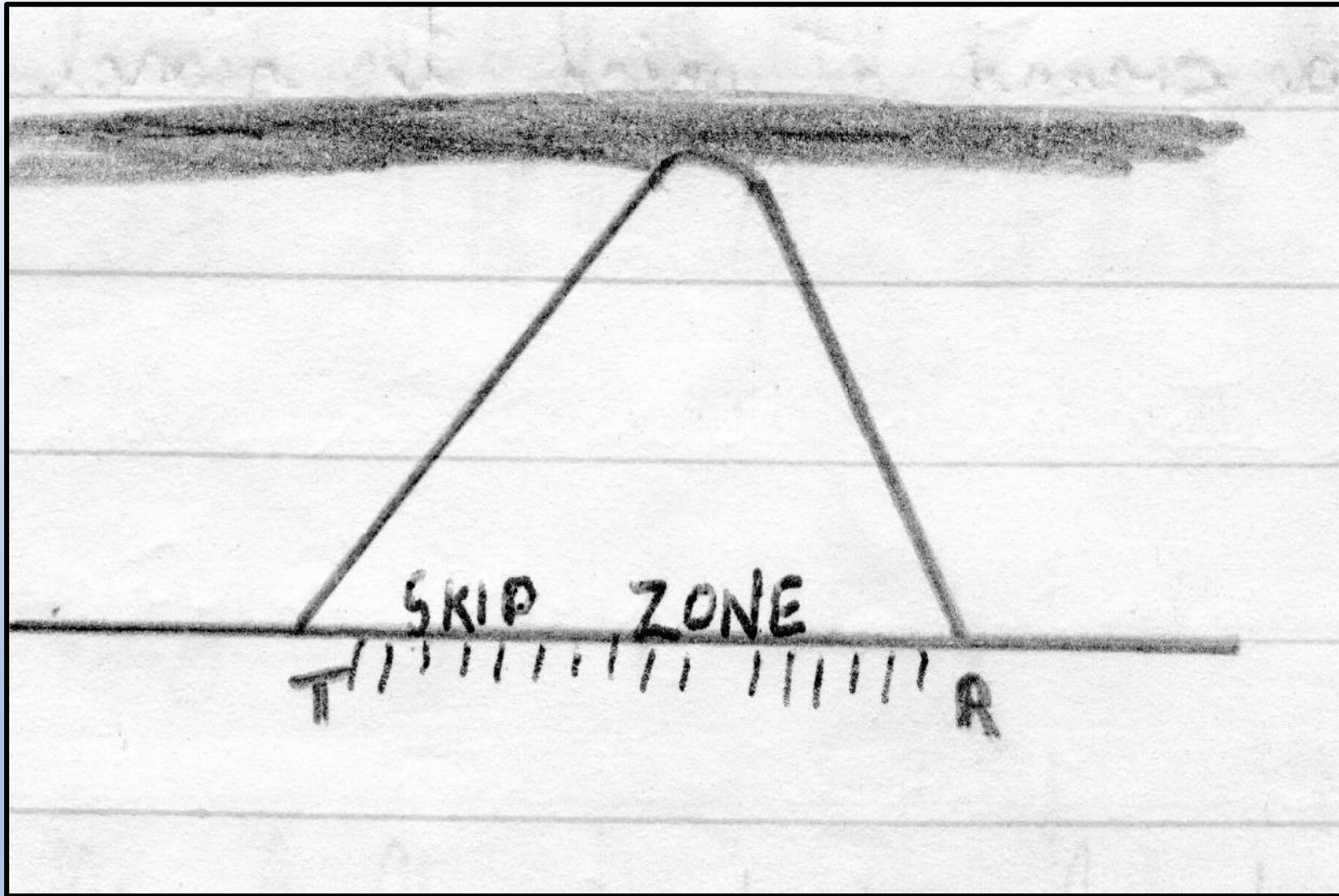
Marconi and Early Work on Short Waves



C.S. Franklin

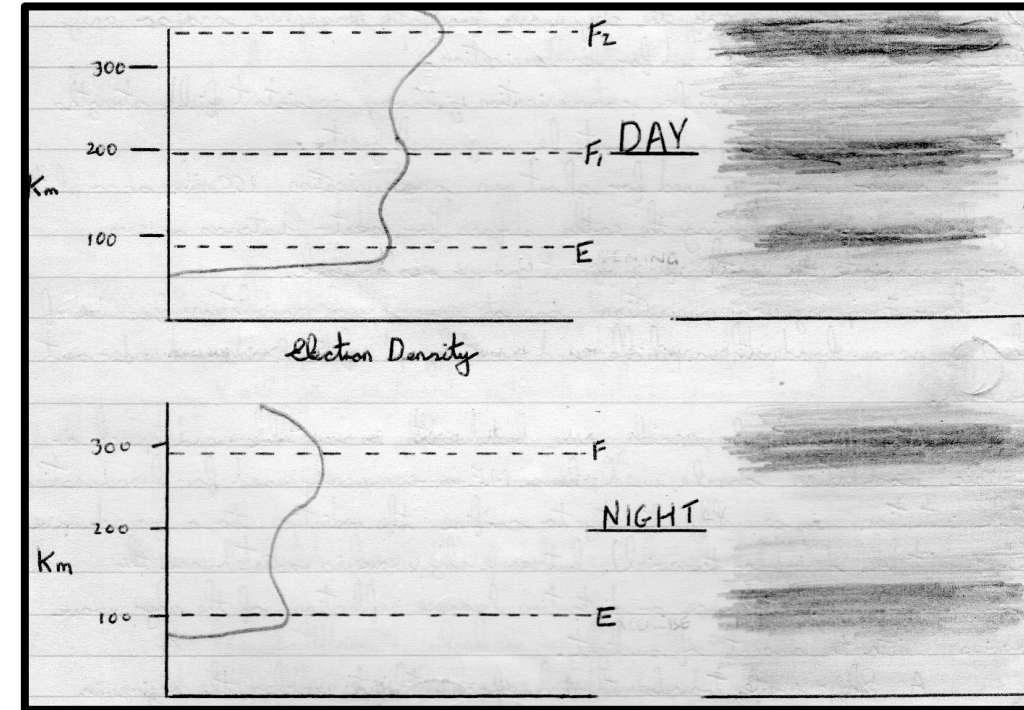
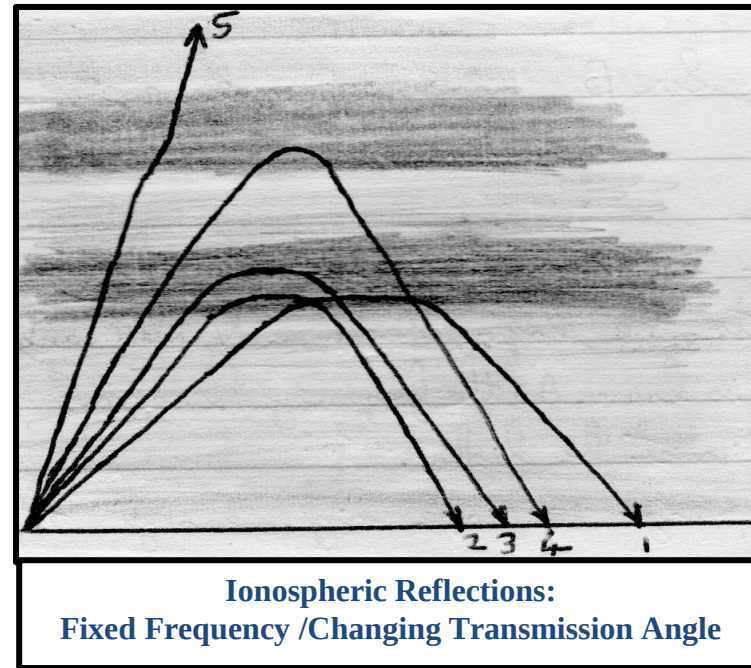
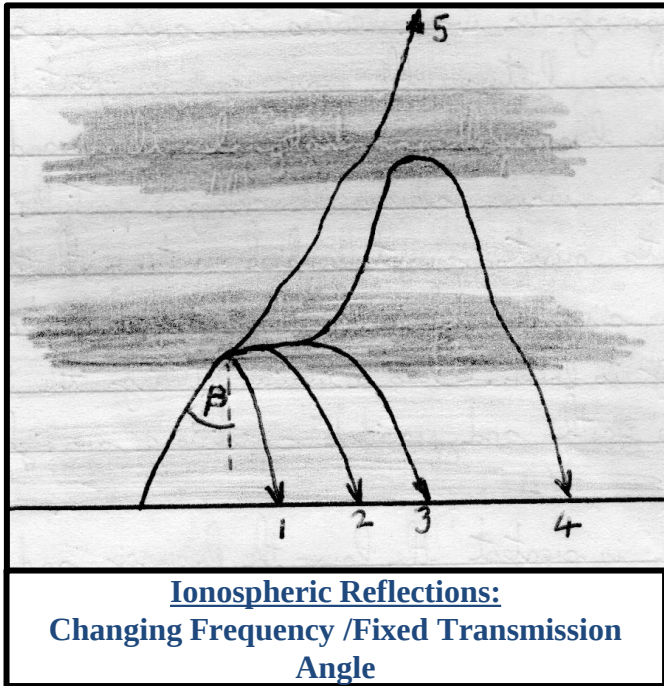


The Voyage of Elettra



The Sky Wave and Skip Distance for Short Wave Propagation

The Science of the Ionosphere



Layers of the Ionosphere – Electron Density

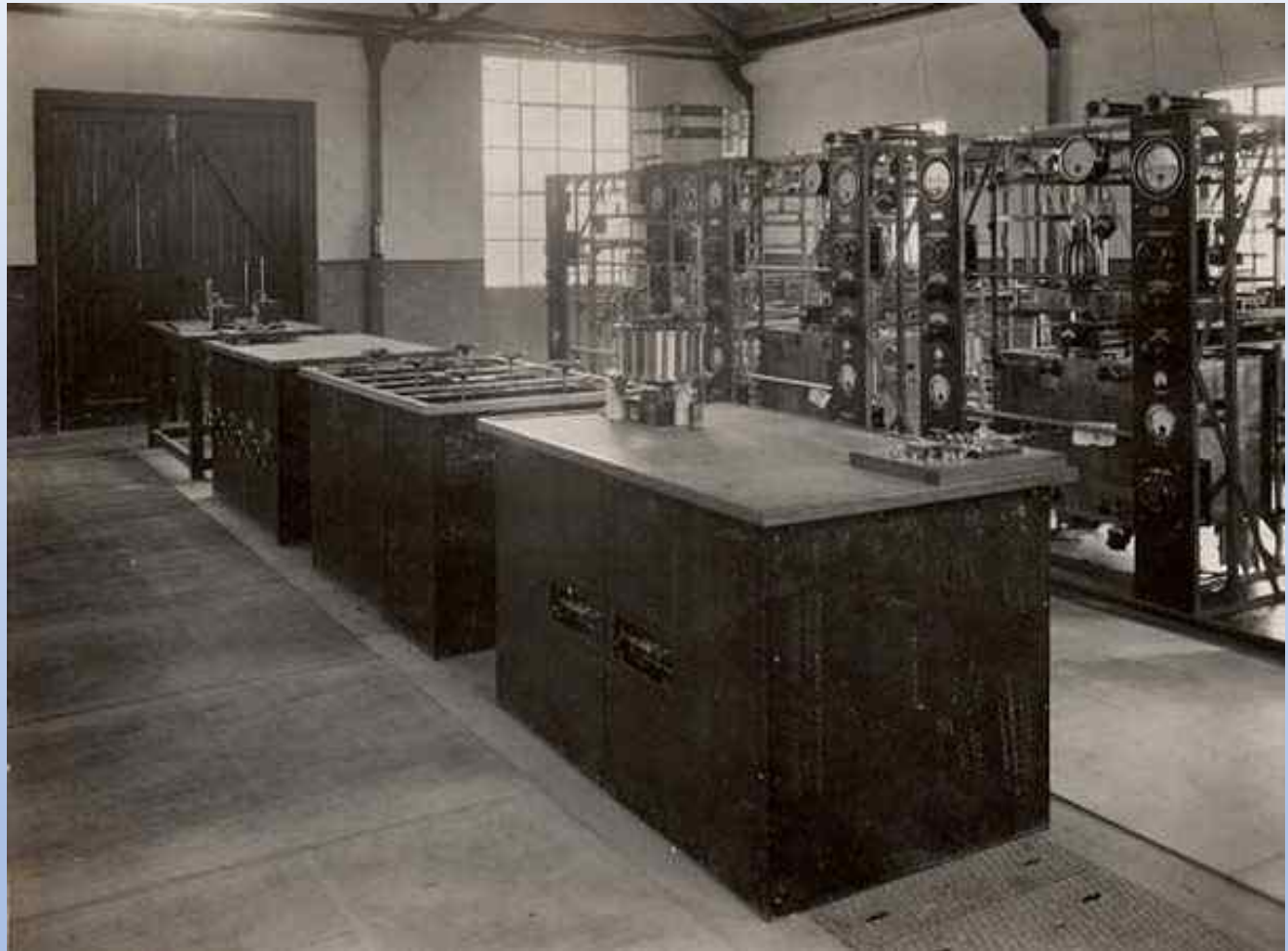
The Imperial Beam System

THE MARCONI SHORT WAVE BEAM SYSTEM

Pamphlet No. 242

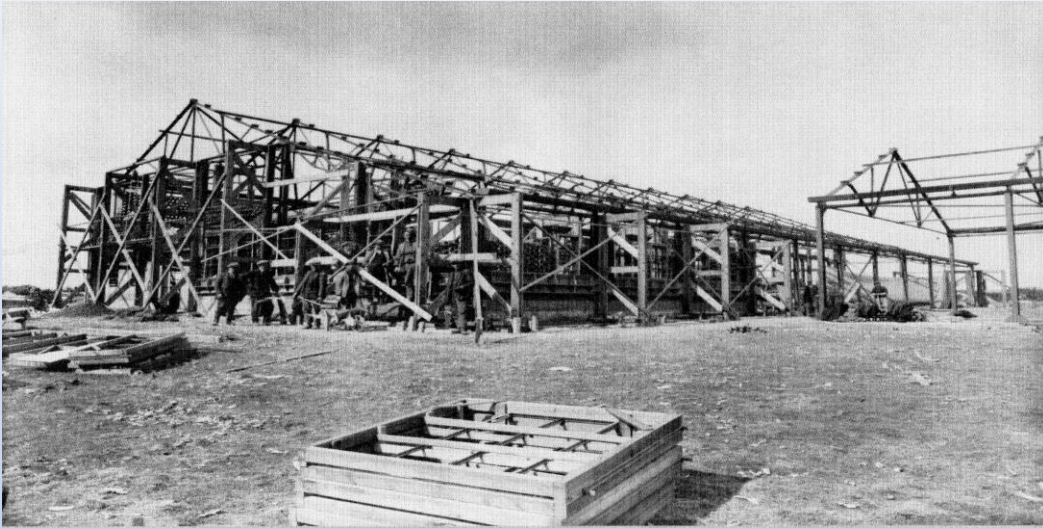
MARCONI'S WIRELESS
TELEGRAPH COMPANY, LTD.
MARCONI HOUSE, STRAND, LONDON, W.C. 2
Telephone No. : CITY 8710.
Telegraphic Address : "EXPANSE, ESTRAND, LONDON"
Codes :
Marconi, Western Union, Bentley's, A.B.C. 4th & 5th editions

34025-790



Bodmin Transmitter

Marconi's Risk with the Imperial System



Beam Station Construction



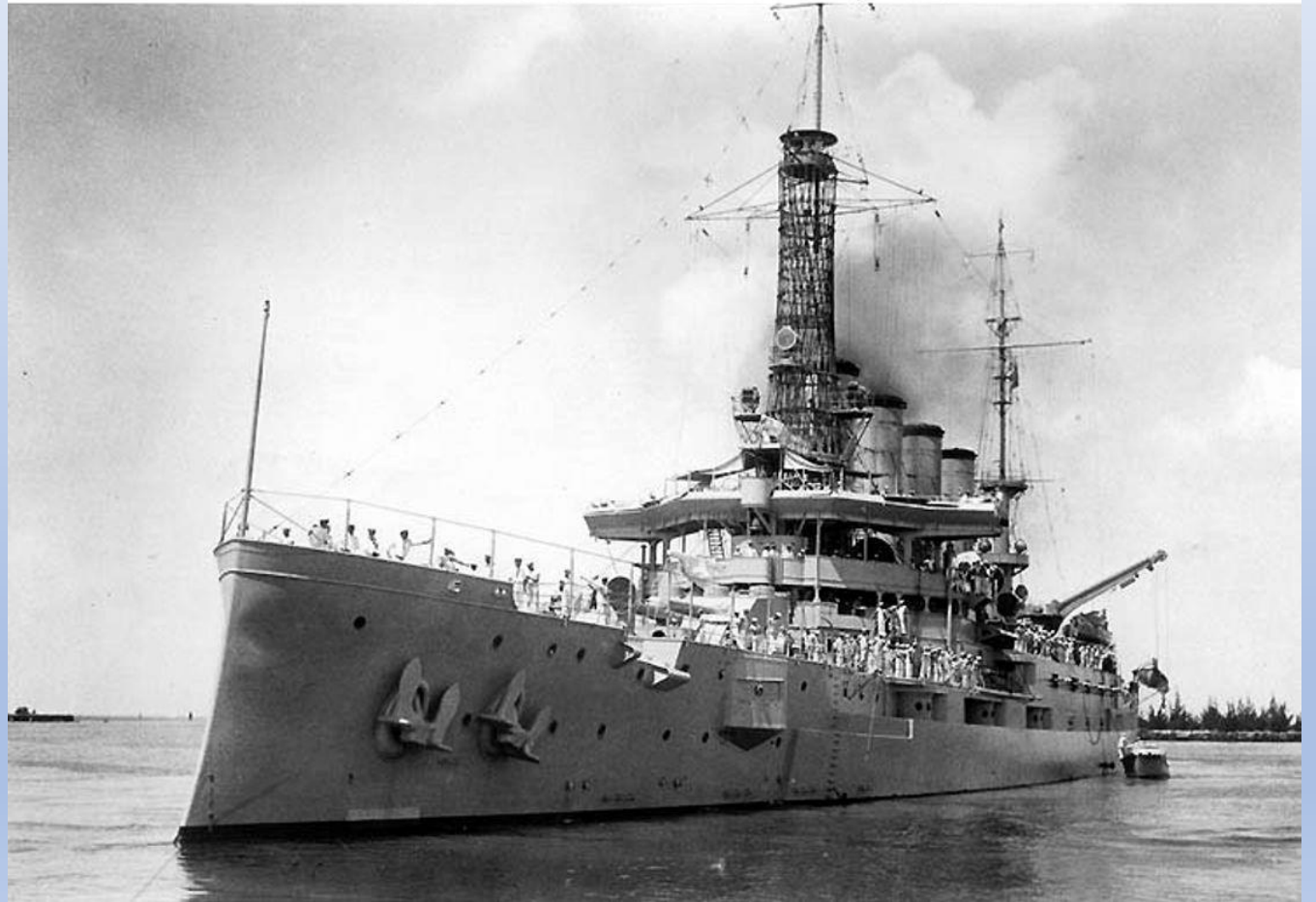
**Franklin Designed Beam Antenna Array at Dorchester Radio Station (UK)-
1928
New York Service**

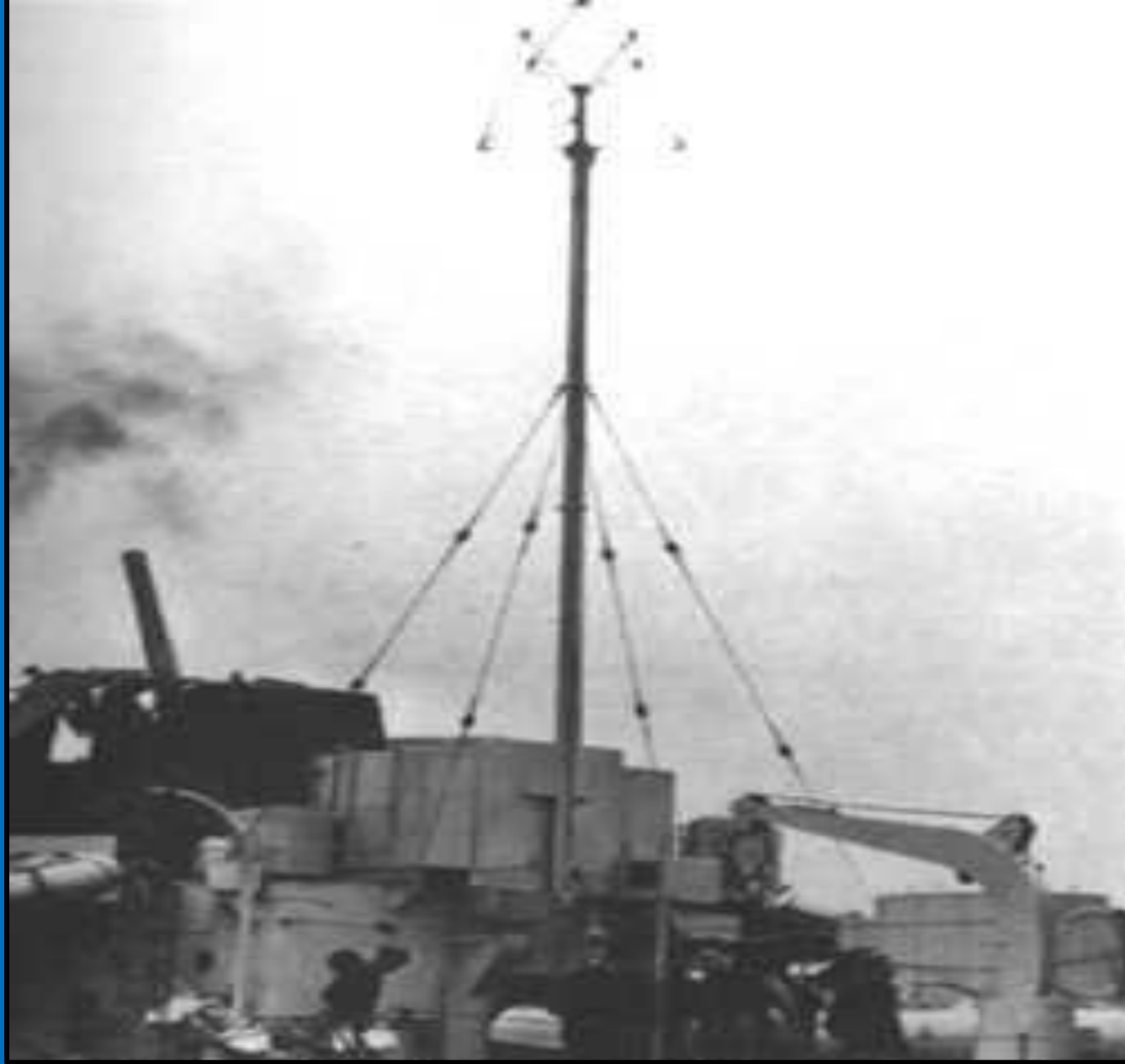
Royal Navy & US Navy Different Attitudes to Short Wave



Naval Research Laboratory
1923

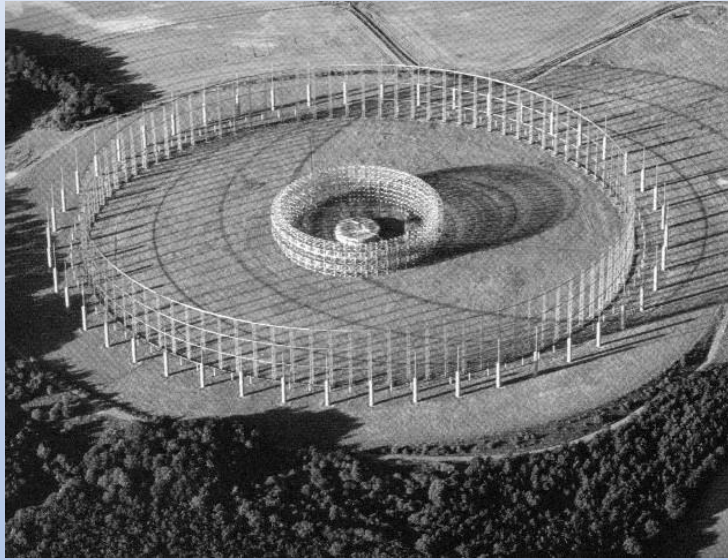
Photo # NH 83086 USS Seattle in Hawaiian waters, circa 1923



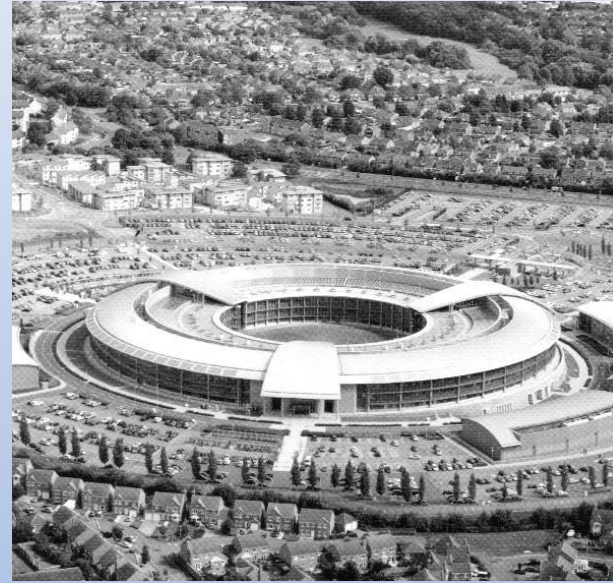


Short Wave and Naval Operations in World War 2

The Y Service



Y Service Aerial in England



Modern Day GCHQ HQs in Cheltenham

SIGINT in the North Atlantic U Boat War



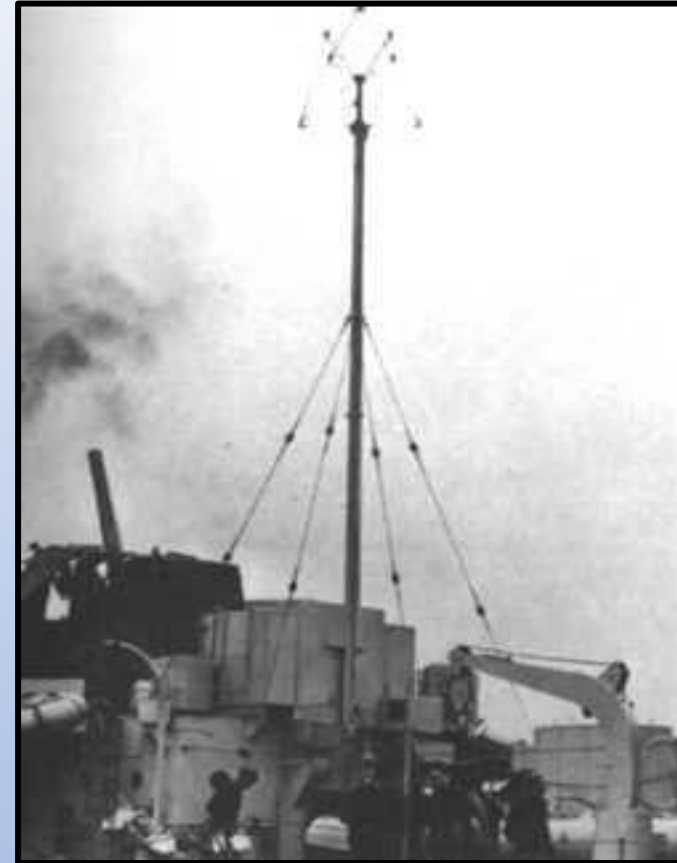
Admiral Karl Donitz

HF/DF

52. U-Boat Situation. Week ending 7/12/42

	30.11.42	7.12.42	Ir
<i>North Norway</i>			
(Based on Z information up to 5.12.42)			
Narvik	4	3	
Trondheim	3	4	
Bergen	7	9	
Spitzbergen-Bear Island	9	6	
Unlocated	1	1	
Total	24	23	
<i>North Atlantic</i>			
(S/M Tracking Room estimate)			
On passage northabout	1	-	
NE Area (Iceland-Ireland)	-	3	
NW Area			
(Iceland-Newfoundland)	11	12	
SE Area (Azores-Cape Verdes)	5	6	
SW Area			
(Azores-Antilles-Bermuda)	3	7	
Canadian coast (Cape Race-Cape Sable)	4	13	
American coast (Cape Sable-Florida)	1	1	
Caribbean (Gulf of Mexico-Guiana)	5	4	
Biscay-Azores-Madeira-Gibraltar	45	36	
Biscay Ports	91	82	
Total	166	164	
<i>South Atlantic</i>			
(S/M Tracking Room estimate)			
N and E of Brazil	4	6	
Cape Verdes Islands-Cape Palmas	2	2	
S Atlantic (return passage)	1	2	
Cape Town area	1	-	
Takoradi area	-	1	
Total	8	11	
<i>Indian Ocean</i>			
(S/M Tracking Room estimate)			
	1	1	

Partial List from Admiralty Tracking
Room 7 December 1942



HF/DF Antenna on a Corvette

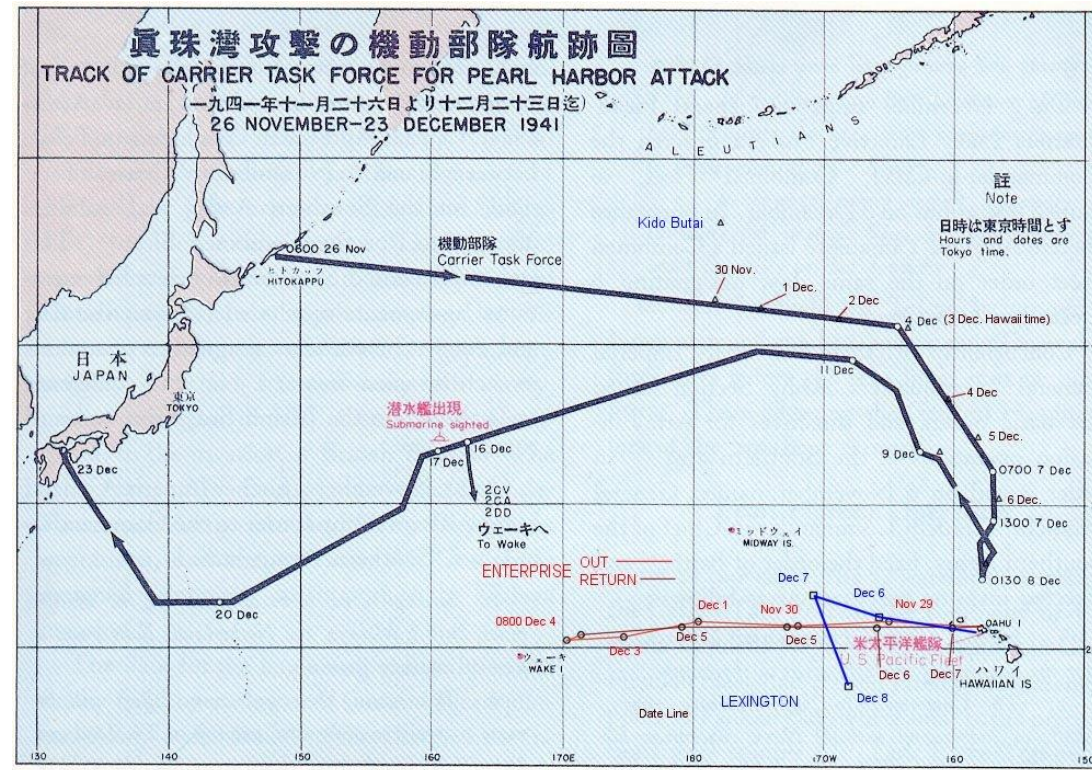


Wireless in a Global War

Finding the Bismarck



Wireless Deception





Summary and Conclusions

Four Main Factors in the Transfer of Sea Power

Geography

Britain

- Imperial Responsibilities
 - Focused on Point to Point Long Distance Wireless
 - Royal Navy considered telegraphy and wide area coverage key
 - Hobbled by conflicting demands of Colonies and Colonial Administrations

United States

- Territorial and Broadcast Focus
 - Demands of Wide Spread National Population
 - Focus on Broadcast Radio
 - Demands for Audio and Voice
 - Need for spectrum efficiency
 - Contribution of rural populations and radio amateurs
 - Equivalent contribution to that of Barnstormers to US Aviation

Technology Path

Britain

- Undue Marconi Influence
 - Telegraphy focus
 - Focus on spark techniques and a “Brute Force” approach
 - Patent focus and loss of innovation

United States

- Open to alternative influences (Fessenden, Poulsen, Alexanderson, DeForest)
- Early adoption of Continuous Wave (Broadcast, Voice)
- Drive for Spectrum Efficiency
- Regulatory influence

Political Will

Britain

- Conflicts between state ownership (Post Office) and Commercialism (Marconi Company)
 - Created a huge barrier often based on personal egos
- Conflicts with newly independent minded Colonies

United States

- Strong Presidential Mandate
- Growing Nationalism coming out of WW1
 - Example was attitude to American Marconi

Austerity and Social Change

Britain

- Highly indebted pressure on budgets
- Changing social priorities towards social programs (Health, Housing and Education)
- A strong lobby against military expenditure and a belief in the absence of any near term conflict
- The Navy forced into disarmament treaties rather than arms expenditures

United States

- A rise in Nationalism and the gaining of a virtual empire based on culture and trade
- An enhanced manufacturing capability built upon war effort
- The realisation of the importance of sea power for global trade leadership
- A secret plan to benefit from the Royal Navies need to base their strategies on Anglo-US co operation

Major Factors in the Transfer of Sea Power

The research revealed two major factors that had been understated regarding the inter-war transfer of power between the Royal Navy and the US Navy

- **Britain's adherence to the Marconi way**
 - The fact that between his introduction of wireless (1900-1905) and his recognition of Short Wave (1924) he rather strategy and internal development to the Marconi Company which based its strategy on his original patents and a telegraphy focus

Marconi's twenty year absence from innovation

- **US Political Will and Britain's flawed assumption that the United States was in all matters a reliable and complete Ally with no aggressive agenda**
 - US focus on trade dominance and openness to wireless innovation from several sources
 - A President who understood the connection between communications and sea power

Thinking the unthinkable

Thank You

Recommended further reading:

Winseck, Dwayne R., and Robert M. Pike. *Communication and Empire: Media, Markets and Globalization, 1860-1930*. Durham & London: Duke University Press, 2007.

Headrick, Daniel R. *The Invisible Weapon: Telecommunications and International Politics, 1851-1945*. Oxford: Oxford University Press, 1991.

Aitken, Hugh G.J. *The Continuous Wave: Technology and American Radio, 1900-1932*. Princeton: Princeton University Press, 1985.

Other Peter Garland Naval Material

HMS Vernon Memorial: The Development of Wireless at HMS Vernon, <https://www.vernonlink.uk/hms-Vernon>.

Ports Towns & Urban Cultures: Why Maritime History Matters: Maritime Highways- A Personal Journey.

<http://porttowns.port.ac.uk/author/garlandp/>