DEPARTMENT OF COMMERCE

RADIO SERVICE BULLETIN

ISSUED MONTHLY BY RADIO DIVISION

Washington, March 31, 1927—No. 120

CONTENTS

ABBREVIATIONS

The necessary corrections to the List of Radio Stations of the United States and to the International List of Radiotelegraph Stations, appearing in this bulletin under the heading "Alterations and corrections," are published after the stations affected in the following order:

Name	=Name of station.
Loc.	=Geographical location. O=west longitude. N=north latitude. S=south latitude.
Call	=Call letters assigned.
System	=Radio system used and sparks per second.
Range	=Normal range in nautical miles.
W. l.	=Wave lengths assigned: Normal wave lengths in italics.
Service	=Nature of service maintained: FX=Point-to-point (fixed service): PG=General public. PR=Limited public. RC=Radiocompass. AB=Aviation beacon. B=Beacon. P=Private. O=Government business exclusively.
Hours	=Hours of operation: N=Continuous service. X=No regular hours.
F. T. Co.	=Federal Telegraph Co.
I. R. T. Co.	=Intercity Radio Telegraph Co.
I. W. T. C.	=Independent Wireless Telegraph Co.
K. & C.	=Kilbourne & Clark Manufacturing Co.
R. C. A.	=Radio Corporation of America.
T. R. T. Co.	=Tropical Radio Telegraph Co.
U. R. Corp.	=Universal Radio Corp.
W. S. A. Co.	=Wireless Specialty Apparatus Co.
C. w.	=Continuous wave.
I. c. w.	=Interrupted continuous wave.
Kc.	=Kilocycles.
Fy.	=Frequency.
A. c.	=Alternating current.
V. t.	=Vacuum tube.
U. S. L.	=Applies only to the list of Commercial and Government Radio Stations of the United States.

38493°—27——1

NEW STATIONS

Commercial land stations, alphabetically, by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations published by the Berne bureau]

Station	Call signal	Wave lengths	Service	Hours	Station controlled by—
Snug Harbor, Alaska	KVC		P	X	Snug Harbor Packing Co.
Tyee, Alaska	KSR		P	X	Sebastian Stuart Fish Co.

Commercial ship stations, alphabetically, by names of vessels

[Additions to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations published by the Berne bureau]

Name of vessel	Call signal	Rates	Service	Hours	Owner of vessel	Station controlled by—
Chilsco	KDHU	8	PG	X	Chile S. S. Co.	R. C. A.
Chippewa [1]	KDJS		PG	X	Independent S. S. Co.	
Crusader	KGFC				Abram K. Macomber	
Gladysbe	KDEV	8	PG	X	United States-Mexico Oil Corp.	
Happy Days	WMBN				I. O. Copley	
Iroquois	KGFD	8	PG	N	New York & Miami S. S. Corp.	
James MacNaughton [1]	KFCN		PG	X	Wilson Transit Co.	
L. E. Block [1]	KGFE		PG	X	Inland S. S. Co.	
Pittsburgh Bridge (HC)	KUKL	8	PG	X	Matson Navigation Co.	
Robert Hobson [1]	WPBA		PG	X	Interlake S. S. Co.	
William McLaughlin [1]	WPBB		PG	X	do.	
William C. Atwater [1]	WPB		PG	X	Wilson Transit Co.	

[1] Great Lakes ship service 4 cents per word.

Commercial land and ship stations, alphabetically, by call signals

[b, ship station; c, land station]

Call signal	Name of station	Call signal	Name of station
KDEV	Gladysbe ... b	KSR	Tyee, Alaska ... c
KDHU	Chilsco ... b	KUKL	Pittsburgh Bridge ... b
KDJS	Chippewa ... b	KVC	Snug Harbor, Alaska ... c
KFCN	James MacNaughton ... b	WMBN	Happy Days ... b
KGFC	Crusader ... b	WPB	William C. Atwater ... b
KGFD	Iroquois ... b	WPBA	Robert Hobson ... b
KGFE	L. E. Block ... b	WPBB	William McLaughlin ... b

Government land stations, alphabetically, by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations published by the Berne bureau]

Station	Call signal	Wave length	Service	Hours	Station controlled by—
Aberdeen Proving Grounds, Md.	WUN		O	X	Signal Corps, U. S. Army.
Camp Custer, Mich.	WUAM		O	X	Do.
Camp Lewis, Wash.	WUAA		O	X	Do.
Camp McClellan, Ala.	WUR		O	X	Do.
Camp Meade, Md.	WUK		O	X	Do.
Curtis Bay, Md.	NGM		O	X	U. S. Coast Guard.
Fort Benning, Ga.	WUO		O	X	Signal Corps, U. S. Army.
Fort Brady, Mich.	WUAP		O	X	Do.
Fort Oglethorpe, Ga.	WUS		O	X	Do.
Fort Sheridan, Ill.	WUAN		O	X	Do.
Fort Thomas, Ky.	WUAF		O	X	Do.
Fort Wayne, Mich.	WUAO		O	X	Do.
Presidio of Monterey, Calif.	WUAB		O	X	Do.
Relief Lightship No. 79	WWAU	600, 731, 800.	O	X	Bureau of Lighthouses.
Vancouver Barracks, Wash.	WUAQ		O	X	Signal Corps, U. S. Army.

Government ship stations, alphabetically, by names of stations

[Additions to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations published by the Berne bureau]

Station	Call signal	Wave length	Service	Hours	Station controlled by—
AB-9	NISF	....	b	X	U. S. Coast Guard.

Government land and ship stations, alphabetically, by call signals

[b, ship station; c, land station]

Call signal	Name of station	Call signal	Name of station
NGM	Curtis Bay, Md. c	WUAP	Fort Brady, Mich. c
NISF	AB-9 ....b	WUAQ	Vancouver, Wash. c
WUAA	Camp Lewis, Wash. c	WUK	Camp Meade, Md. c
WUAB	Presidio of Monterey, Calif. c	WUN	Aberdeen Proving Grounds, Md. c
WUAF	Fort Thomas, Ky. c	WUO	Fort Benning, Ga. c
WUAM	Camp Custer, Mich. c	WUR	Camp McClellan, Ala. c
WUAN	Fort Sheridan, Ill. c	WUS	Fort Oglethorpe, Ga. c
WUAO	Fort Wayne, Mich. c	WWAU	Relief Lightship No. 79 c

ALTERATIONS AND CORRECTIONS

COMMERCIAL LAND STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

MANILA, P. I.—Rates, all ship service, 10 cents (52 centimes) per word.
ROCKY POINT, N. Y. (WNL).—Add the following as a footnote: "The telephone band used by this station extends from 4,875 to 5,125 meters.
Strike out all particulars of the following-named stations: Loring, Alaska (*Star of Greenland*—moored vessel); Wrangell, Alaska (*Star of England*—moored vessel).

COMMERCIAL SHIP STATIONS, ALPHABETICALLY, BY NAMES OF VESSELS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations, published by the Berne bureau]

ABSECON.—Station controlled by R. C. A.
ARLYN.—Station controlled by R. C. A.
AGWIMOON.—Owner of vessel, Standard Transportation Co.
AURORA.—Equipped by RC.
BARBARA.—Station controlled by R. C. A.
BRISTOL.—Equipped with RC.
BROAD ARROW.—Equipped with RC.
CABRILLE.—Name changed to Chilbar; station controlled by R. C. A.
CAPE ANN.—Name changed to Helen Olmsted.
CARL D. BRADLEY.—Name changed to John G. Munson.
CATAHOULA.—Equipped with RC.
CEDARHURST.—Owner of vessel, Steamer Cedarhurst Corporation.
CHARLES CHRISTENSON.—Owner of vessel, Christenson S. S. Co.
COVENA.—Station controlled by R. C. A.
CROWN CITY.—Station controlled by I. W. T. Co.
DARDEN.—Station controlled by I. W. T. Co.
DOROTHY.—Station controlled by R. C. A.
EASTERN MARINER.—Name changed to Willsipo.
EDWARD L. SHEA.—Station controlled by R. C. A.
ELIZABETH.—Station controlled by R. C. A.
HUMBOLDT.—Owner of vessel, Albert E. Gillespie.
ILLINOIS (KDSZ).—RC removed.

IPSWICH.—Owner of vessel, Ipswich S. S. Corporation; station controlled by I. W. T. Co.
IRENE.—Station controlled by R. C. A.
J. C. FITZSIMMONS.—Equipped with a Kolster v. t. (i. c. w.) mobile radiobeacon which transmits the following signal: 1 dash for 30 seconds, silent 30 seconds.
LAKE FAIRFORT.—Owner of vessel, Mobile, Miami & Gulf S. S. Co.
LILLIAN.—Station controlled by R. C. A.
MILLINOCKET.—Station controlled by R. C. A.
MYSTIC.—Station controlled by I. W. T. Co.
PERE MARQUETTE 18.—Equipped with RC.
ROYAL ARROW.—Equipped with RC.
SABANI.—Correct orthography, Sagami; owner of vessel, Sagami S. S. Co.
SAWOKLA.—Station controlled by I. W. T. Co.
VESTA.—Equipped with RC.
WAWALONA.—Station controlled by I. W. T. Co.
WEST CUSSETA.—Station controlled by I. W. T. Co.
WEST INSKIP.—Name changed to Charcas.
WILLIAM GREEN.—Equipped with RC.
WILLIAM H. DOHENY.—Equipped with RC.
Strike out all particulars of the following-named vessels: Carolinian, Elkton.

COMMERCIAL LAND AND SHIP STATIONS, ALPHABETICALLY, BY CALL SIGNALS

KDCB, *read* Helen Olmsted; KENS, *read* Chilbar; KFSI, *read* John G. Munson; KITZ, *read* Charcas; KUGB, *read* Willzipo; WNBB, *read* Sagami; strike out all particulars following the call signals, KJF, KNV, KOFK, KRI.

BROADCASTING STATIONS, BY CALL SIGNALS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1926, and list in Radio Service Bulletin No. 117, Dec. 31, 1926]

WNBI (PERU, ILL.).—Strike out all particulars.

GOVERNMENT LAND STATIONS, ALPHABETICALLY, BY NAMES OF STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations, published by the Berne Bureau]

AMBROSE CHANNEL LIGHTSHIP, N. J.—*Read* Ambrose Channel Lightship, N. Y. W. l., *600*, 731, 800, 1000.
BLUNTS REEF LIGHTSHIP, CALIF.—W. l., *600*, 731, 800, 1,000.
BRUNSWICK LIGHTSHIP, GA.—W. l., *600*, 731, 800.
CAPE CHARLES LIGHTSHIP, VA.—W. l., *600*, 731, 800.
CAPE HENRY LIGHT STATION, N. J.—*Read* Cape Henry Light Station, Va. (U. S. L.).
CAPE LOOKOUT SHOALS LIGHTSHIP, VA.—W. l., *600*, 731, 800.
CAPE SARICHEF, ALASKA.—*Read* Cape Sarichef Light Station, Alaska.
CAPE SPENCER LIGHT STATION, ALASKA.—W. l., *600*, 800, 1,000.
COLUMBIA RIVER LIGHTSHIP, OREG.—W. l., *600*, 731, 800, 1,000.
CRESCENT CITY, CALIF.—*Read* Crescent City, Light Station, Calif., w. l., 400.
DIAMOND SHOALS LIGHTSHIP, VA.—W. l., *600*, 731, 800, 1,000.
DULUTH RANGE REAR LIGHT STATION, MINN.—W. l., 143.
FENWICK ISLAND SHOAL LIGHTSHIP, DEL.—W. l., *600*, 731, 800.
FIRE ISLAND LIGHTSHIP, N. Y.—W. l., *600*, 731, 800, 1,000.
FIVE FATHOM BANK LIGHTSHIP, N. J.—W. l., *600*, 731, 800, 1,000.
FRYING PAN SHOALS LIGHTSHIP, N. C.—W. l., *600*, 731, 800.
HEALD BANK LIGHTSHIP, TEX.—W. l., *600*, 731, 800.
HOG ISLAND, VA.—Call signal changed to NDV–NCZ remains the call signal for the group, Hog Island, Va., Virginia Beach, Va., and Poyners Hill, N. C. Changes should be made on pages 76, 91, and 116, list of Commercial and Government Radio Stations of the United States.
NANTUCKET SHOALS LIGHTSHIP, MASS.—W. l., *600*, 731, 800, 1,000.
NAVASSA ISLAND, WINDWARD PASSAGE, W. I.—*Read* Navassa Island Light Station, Windward Passage, W. I.; w. l., *600*, 731, 800.
NORTH EAST END LIGHTSHIP, N. J.—W. l., *600*, 731, 800.
POINT MONTARA, CALIF.—Correct call signal, NLH (U. S. L.).
POLLOCK RIP SLUE LIGHTSHIP, MASS.—W. l., *600*, 731, 800.

RELIEF LIGHTSHIP No. 72.—W. l., *600*, 731, 800, 1,000.
RELIEF LIGHTSHIP No. 76.—W. l., *600*, 731, 800, 1,000.
RELIEF LIGHTSHIP No. 78.—W. l., *600*, 731, 800, 1,000.
RELIEF LIGHTSHIP No. 85.—W. l., *600*, 731, 800, 1,000.
RELIEF LIGHTSHIP No. 92.—W. l., *600*, 731, 800, 1,000.
RELIEF LIGHTSHIP No. 109.—W. l., *600*, 731, 800.
SAN FRANCISCO LIGHTSHIP, CALIF.—W. l., *600*, 731, 800, 1,000.
SCOTCH CAP, ALASKA.—*Read* Scotch Cap Light Station, Alaska.
ST. GEORGE REEF, CALIF.—W. l., 400.
SUPERIOR ENTRY LIGHT STATION, WIS.—W. l., 143.
SWIFTSURE BANK LIGHTSHIP, WASH.—W. l., *600*, 731, 800, 1,000.
UMATILLA REEF LIGHTSHIP, WASH.—W. l., *600*, 731, 800, 1,000.
WINTER QUARTER SHOALS LIGHTSHIP, VA.—W. l., *600*, 731, 800.
Strike out all particulars of the following-named stations: Fort Du Pont, Del., Fort Morgan, Ala.; Fort Moultrie, S. C.; Fort Rosecrans, Calif.; Fort Stevens, Oreg. (WUK); Fort Washington, Md.; Fort Winfield Scott, Calif.; Fort Worden Wash.

GOVERNMENT SHIP STATIONS, APHABETICALLY BY NAMES OF STATIONS

[Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1926, and to the International List of Radiotelegraph Stations, published by the Berne Bureau]

ALDEBARAN.—W. l., add 1,100.
AMARANTH.—W. l., *715*, 875, 1,585.
ANEMONE.—W. l., *600*, 731, 800.
AZALEA.—W. l., *600*, 731, 800.
CEDAR.—W. l., 34.46, *600*, 731, 800.
COLUMBINE.—*Read* Accacia; w. l., *600*, 731, 800.
CYPRESS.—W. l., *600*, 731, 800.
FERN.—W. l., *600*, 731, 800.
GUIDE.—Equipped with RC.
HEATHER.—W. l., *600*, 731, 800.
HIBISCUS.—W. l., *600*, 731, 800.
HYACINTH.—W. l., *715*, 875, 1,585.
ILEX.—W. l., *600*, 731, 800.
INSPECTOR.—W. l., add 1,100.
IVY.—W. l., *600*, 731, 800.
KUKUI.—W. l., *600*, 731, 800.
LARKSPUR.—W. l., *600*, 731, 800.
LOTUS.—W. l., *600*, 731, 800.
MADRONO.—*Read* Lupine; w. l., *600*, 731, 800.
MAGNOLIA.—W. l., *600*, 731, 800.
MANGROVE.—W. l., *600*, 731, 800.
MANZANITA.—W. l., *600*, 731, 800.
MAPLE.—W. l., *600*, 731, 800.
MARIGOLD.—W. l., *715*, 875, 1,585.
MAYFLOWER (WWCP).—W. l., *600*, 731, 800.
ORCHID.—W. l., *600*, 731, 800.
ROSE.—W. l., *600*, 731, 800.
SEQUOIA.—W. l., *600*, 731, 800.
SPEEDWELL.—W. l., *600*, 731, 800.
SPRUCE.—W. l., *600*, 731, 800.
SUMAC.—W. l., *715*, 875, 1585.
SUNFLOWER.—W. l., *600*, 731, 800.
TULIP.—W. l., *600*, 731, 800.
Strike out all particulars of the following-named vessels: Arethusa, Wolverine.

GOVERNMENT LAND AND SHIP STATIONS, ALPHABETICALLY BY CALL SIGNALS

NDV, *read* Hog Island, Va.; WWAT, *read* Ambrose Channel Lightship, N. Y.; WWDC, *read* Accacia; WWDU, *read* Lupine; WWEA, *read* Navassa Island Light Station, Winward Passage, W. I.; WWEF, *read* Cape Sarichef Light Station, Alaska; WWEG, *read* Scotch Cap Light Station, Alaska; WWEJ, *read* Crescent City Light Station, Calif.; strike out all particulars following the call signals, NBU, NGW, WUAA, WUAB, WUAF, WUK, WUN, WUO, WUR, WUS.

CHANGES IN RADIOBEACON STATIONS

Portland Lightship, Me.—Operating period of radiobeacon to be changed about April 30, 1927, to sound every 180 seconds; groups of one dash and two dots for 60 seconds, silent 120 seconds, thus:

— . . — . . — . . etc.	Silent.
60 seconds.	120 seconds.

Radiobeacon will operate continuously during thick or foggy weather and during clear weather each day from 5.30 to 6 and 11.30 to 12 a. m. and from 5.30 to 6 and 11.30 to 12 p. m.

Boston Lightship, Mass.—Operating period to be changed about April 25, 1927, to sound every 180 seconds; groups of one dash and one dot for 60 seconds, silent 120 seconds, thus:

— . — . — . etc.	Silent.
60 seconds.	120 seconds.

Radiobeacon will be operated each day during clear weather from 2.30 to 3 and 8.30 to 9 a. m., and from 2.30 to 3 and 8.30 to 9 p. m.

Nantucket Shoals Lightship, Mass.—Operating period of radiobeacon to be changed about May 2, 1927, to sound every 180 seconds; groups of four dashes for 60 seconds, silent 120 seconds, thus:

— — — — — — — — etc.	Silent.
60 seconds.	120 seconds.

Stratford Shoal (Middle Ground) Light Station, Long Island Sound.—Radiobeacon established; to sound every 180 seconds; group of one dot, one dash and one dot, for 60 seconds, silent 120 seconds, thus:

. — . . — . . — . etc.	Silent.
60 seconds.	120 seconds.

To operate during clear weather each day from 1.30 to 2 and 7.30 to 8 a. m. and from 1.30 to 2 and 7.30 to 8 p. m. and continuously during thick or foggy weather. Location O 73° 06′ 06″, N. 41° 03′ 36″.

Fire Island Lightship, N. Y.—Radiobeacon to operate during clear weather from 5.30 to 6 and 11.30 to 12 a. m. and from 5.30 to 6 and 11.30 to 12 p. m.

Ambrose Channel Lightship, N. Y.—Radiobeacon to operate during clear weather from 3.30 to 4 and 9.30 to 10 a. m. and from 3.30 to 4 and 9.30 to 10 p. m.

Sea Girt Light Station, N. J.—Radiobeacon to operate during clear weather from 12.30 to 1 and 6.30 to 7 a. m. and from 12.30 to 1 and 6.30 to 7 p. m.

Five Fathom Bank Lightship, N. J.—Radiobeacon to operate during clear weather each day from 4.30 to 5 and 10.30 to 11 a. m. and from 4.30 to 5 and 10.30 to 11 p. m., effective about March 23, 1927.

Cape Henry Light Station, Va.—Radiobeacon to operate during clear weather from 2 to 2.30 and 8 to 8.30 a. m. and from 2 to 2.30 and 8 to 8.30 p. m., effective May 1, 1927.

Diamond Shoal Lightship, N. C.—Radiobeacon to operate during clear weather, third 15 minutes of each hour.

South Pass West Jetty Range Front Light Station, La.—Radiobeacon to operate continuously during thick or foggy weather and in clear weather daily from 10 to 10.30 a. m. and from 4 to 4.30 and 10 to 10.30 p. m.

Galveston Jetty Light Station, Tex.—Radiobeacon to operate continuously during thick or foggy weather and in clear weather from 12 to 12.30 and 6 to 6.30 a. m. and from 12 to 12.30 and 6 to 6.30 p. m.

Buffalo Light Station, N. Y.—Operating period of radiobeacon to be changed to sound every 180 seconds; single dashes for 60 seconds, silent 120 seconds, thus:

— — — — — — — — — — — — — — — etc.	Silent.
60 seconds.	120 seconds.

To operate during clear weather each day from 1 to 1.30 and 7 to 7.30 a. m. and from 1 to 1.30 and 7 to 7.30 p. m.

Detroit River Light Station, Mich.—Radiobeacon will be operated each day during clear weather from 3 to 3.30 and 9 to 9.30 a. m. and from 3 to 3.30 and 9 to 9.30 p. m.

Lake Huron Lightship, Mich.—Radiobeacon will be operated each day during clear weather from 12.30 to 1 and 6.30 to 7 a. m. and from 12.30 to 1 and 6.30 to 7 p. m.

Thunder Bay Island Light Station, Mich.—Radiobeacon operating period to be changed to sound every 180 seconds; groups of one dash, one dot, and one dash for 60 seconds, silent 120 seconds, thus:

— . — — . — — . — etc.	Silent.
60 seconds.	120 seconds.

Detour Light Station, Mich.—Radiobeacon will be operated each day during clear weather from 4.30 to 5 and 10.30 to 11 a. m. and from 4.30 to 5 and 10.30 to 11 p. m.

Whitefish Point Light Station, Mich.—Radiobeacon will be operated each day during clear weather from 1 to 1.30 and 7 to 7.30 a. m. and 1 to 1.30 and 7 to 7.30 p. m.

Point Betsie Light Station, Mich.—Radiobeacon established; to sound every 180 seconds; groups of one dot, two dashes, and one dot for 60 seconds, silent 120 seconds, thus:

. — — . . — — . etc.	Silent.
60 seconds.	120 seconds.

To operate during clear weather each day from 4 to 4.30 and 10 to 10.30 a. m. and from 4 to 4.30 and 10 to 10.30 p. m. Location, O 86° 15′ 18″, N. 44° 41′ 29″.

Manitou Light Station, Mich.—Operating period to be changed to sound every 180 seconds; groups of two dashes for 60 seconds, silent 120 seconds, thus:

— — — — — — etc.	Silent.
60 seconds.	120 seconds.

Radiobeacon will be operated each day during clear weather from 3.30 to 4 and 9.30 to 10 a. m. and from 3.30 to 4 and 9.30 to 10 p. m.

Milwaukee Breakwater Light Station, Wis.—Radiobeacon established; to sound every 180 seconds; groups of 2 dashes for 60 seconds, silent 120 seconds, thus:

— — — — — — etc.	Silent.
60 seconds.	120 seconds.

To operate during clear weather each day from 1.30 to 2 and 7.30 to 8 a. m. and from 1.30 to 2 and 7.30 to 8 p. m. Location, O 87° 52′ 56″, N. 43° 01′ 36″.

Devils Island Light Station, Wis.—Operating period to be changed to sound every 180 seconds; groups of 3 dashes for 60 seconds, silent 120 seconds, thus:

— — — — — — — — — etc.	Silent.
60 seconds.	120 seconds.

Radiobeacon will be operated each day during clear weather from 5 to 5.30 and 11 to 11.30 a. m. and from 5 to 5.30 and 11 to 11.30 p. m.

Lansing Shoal Lightship, Mich.—Radiobeacon established; to sound every 180 seconds; groups of one dash and two dots for 60 seconds, silent 120 seconds, thus:

— . . — . . — . . etc.	Silent.
60 seconds.	120 seconds.

Radiobeacon will be operated each day during clear weather from 5 to 5.30 and 11 to 11.30 a. m. and from 5 to 5.30 and 11 to 11.30 p. m. Location, O 85° 33′ 50″, N. 45° 54′ 18″.

Cape Blanco Light Station, Oreg.—Radiobeacon is operated each day during clear weather and from 10 to 10.30 a. m. and from 4 to 4.30 p. m. and the second 15 minutes of every even hour from 10.15 to 6.30 a. m.

Columbia River Lightship, Oreg.—Radiobeacon operating period to be changed about April 30, 1927, to sound every 180 seconds; 60 seconds on, silent for 120 seconds. No change in characteristic. Will be operated during clear weather from 8.30 to 9 a. m. and 2.30 to 3 p. m. and the first 15 minutes of every odd hour from 9 p. m. to 7.15 a. m.

Grays Harbor Light Station, Wash.—Radiobeacon is operated each day during clear weather from 7.30 to 8 a. m. and from 1.30 to 2 p. m. and the first 15 minutes of every even hour from 10 p. m. to 6.15 a. m. Operating period to be changed about April 15, 1927, to sound every 180 seconds; 60 seconds on, silent for 120 seconds. No change in characteristic.

Swiftsure Bank Lightship, Wash.—Radiobeacon operating period to be changed about April 30, 1927, to operate every 180 seconds; 60 seconds on, silent for 120 seconds. No change in characteristic. Will be operated in clear weather during the second 15 minutes of every hour.

NOTE.—All of the above-named beacons operate on 1,000 meters.

RADIO DIVISION FORMERLY IN THE BUREAU OF NAVIGATION NOW UNDER THE SUPERVISION OF THE SECRETARY OF COMMERCE

The radio division established in the Bureau of Navigation to assist the Secretary in the performance of the duties imposed by the acts of June 24, 1910, July 23, 1912, and February 23, 1927, relating to radio communication, in carrying out the International Radio Telegraphic Convention, and in the examination and settlement of international radio accounts, will hereafter be administered independently of the Bureau of Navigation, under the Secretary's immediate supervision, and such duties as have heretofore been performed by the Commissioner of Navigation with relation to the administration of the radio communication laws will be performed by the chief of the division. William D. Terrell, chief supervisor of radio, Bureau of Navigation, is designated chief of the radio division.

STATION LICENSES VALIDATED

The Federal Radio Commission, under authority of the act of February 23, 1927, extended the force and effect of all amateur and ship station licenses issued by the Department of Commerce until further orders from the commission. This extension to be of the same force and effect as though new licenses had been issued by the commission, subject to such general regulations as the commission may from time to time issue.—*General Order No. 1, March 15, 1927.*

All coastal, point to point, technical and training, and experimental station licenses in force on the 22d day of February, 1927, are extended until further order of the commission.—*General Order No. 3, March 27, 1927.*

NEW STATION LICENSE APPLICATION FORM

Triplicate application forms will be mailed shortly by the Federal Radio Commission to all present holders of broadcasting and point-to-point station licenses, as all of these must, under the radio act of 1927, file application for license with the commission. These applications are to be filled out in triplicate and forwarded by the applicant to the supervisor of radio in his district. All applications sent direct to the Federal Radio Commission will be immediately returned to the supervisor for his recommendation. All persons not at present holders of broadcasting or point-to-point station licenses who are desirous of securing such licenses should write to the Federal Radio Commission in Washington, or apply to the district supervisor of radio, requesting that application forms be forwarded.

RADIO OPERATOR LICENSES VALIDATED

All radio operator licenses valid at the passage of the radio act of 1927, approved February 23, are hereby extended for the unexpired period of such licenses.—*Order of the Secretary of Commerce, March 16, 1927.*

CHANGE IN HOG ISLAND (VA.), RADIOCOMPASS STATION

This station has a separate transmitter in the same geographical location as its receiving loop and has been assigned call signal NDV. The operation of the group in which it is located has not been changed in any manner; Virginia Beach controls as heretofore. The assignment of the new call signal does, however, make the Hog Island station available for furnishing independent bearings and for beacon service. Call signal NCZ still remains the group call for Hog Island, Va., Virginia Beach, Va., and Poyners Hill, N. C.

NORDERNEY LIGHT VESSEL (GERMANY) FOG SIGNAL HOURS CHANGED

Fog signals (radiobeacon) are now transmitted by this station daily in clear weather at the following times (G. M. T.): $8^h. 18^m. 45^s.-8^h. 59^m. 45^s.$; $12^h. 18^m. 45^s.-12^h. 59^m. 45^s.$; $17^h. 18^m. 45^s.-17^h. 59^m. 45^s.$

NAVIGATIONAL WARNINGS BY SWEDISH GOVERNMENT ICE BREAKER

The Swedish Government ice breaker, call signal SEE, sends out daily at 0800 and 1045, G. M. T., on week days and at 0800 and 1210, G. M. T., on Sundays on a wave length of 600 meters, spark and radiophone, during the time the vessel is employed on ice-breaking service, radio information concerning her position and the proposed area for ice breaking and rendering assistance during the ensuing 12 hours; also, important local information for mariners.

Method of transmission.—The message is, first of all, broadcast by radiotelegraph as follows: ——— CQ CQ CQ de SEE SEE SEE. Information in English giving the position of the ice breaker, the area proposed for ice breaking and rendering assistance, and important local information for mariners. Immediately after this transmission the message will be repeated by radiophone, in Swedish and English. This repetition is preceded by the words "Från Statisbrytaren" (from the State ice breaker).

REGULATION REGARDING THE USE OF RADIO BY FOREIGN STATIONS WHILE IN THE TERRITORIAL LIMITS OF FINLAND

According to a recent ordinance promulgated by the Director General of Telegraphs, Finland, foreign ships or airplanes are forbidden, except in case of distress, to transmit while in a port of within a distance less than 10 nautical miles of a coast station. The Director General of Telegraphs has the right, however, to authorize foreign ships to transmit within the circumscriptions of a port, upon request. This country adhered to the International Radiotelegraph Convention on February 5, 1927.

NO RELAY CHARGE FOR CERTAIN RADIOGRAMS DESTINED TO UNITED STATES STATIONS OF THE TROPICAL RADIO TELEGRAPH CO.

The Tropical Radio Telegraph Co., under date of March 25, 1927, advised this office that there is no relay charge for radiograms destined to its coast stations in the United States when retransmitted by its ships or coast stations in Central America; the only tolls are those of the coast station in the United States and those of the telegraph companies beyond this point.

WEATHER REPORTS TRANSMITTED BY PRATAS ISLAND (CHINA), STATION

A daily weather forecast, based on 2200 and 0600 observations from about 90 stations in the Far East, is issued by Pratas meteorological station at 0400 and 1000, respectively.

The weather report and forecast are broadcast in plain English, first on 600 meters, spark, at 0600 and 1100, and repeated on 1,450 meters, c. w., at 0610 and 1110. The message, which is preceded by QST QST QST de XPI XPI XPI (call signal of the station), is sent twice and will contain the following information:

Part I.—Synopsis of general atmospheric pressure distribution, including the location of high and low pressure areas.

Part II.—Location and expected direction of movement of depression or typhoon, affecting the China Sea, Eastern Sea, Yellow Sea, Japan Sea (including the Pacific Ocean to the eastward), or southeast of the Philippine Islands extending northward from Guam and adjacent islands to northern Japan.

Part III.—Wind and weather forecast for Formosa Channel, China Sea, and neighboring areas.

Part IV.—Wind direction and force, and state of the weather at Pratas Island.

Weather reports are also transmitted on request, free of charge. The approximate location of this station is latitude 20° 42′ N., longitude 116° 43′ E.

53403°—27——2

Typhoon warnings for the China Sea are broadcast in plain English on 600 meters, spark, as frequently as changes are observed or at such intervals as may be found most expedient.

SOME EXPERIMENTAL RADIO FIELD INTENSITY MEASUREMENTS AND OBSERVATIONS

The measurement of radio field intensities from a transmitting station is not a subject which is especially new, but it is believed to be one which has been neglected in the past, although more interest is being shown at the present time.

Measurements of this kind were attempted by various experimenters as early as 1905, their attempts being largely limited to the lower frequencies. As a matter of fact until the advent of radio broadcasting no great need existed for such measurements, since very few stations desired to radiate strongly in all directions, it being rather preferred to radiate in one general direction only. With the arrival of broadcasting a new condition came into existence; that is, the desire to radiate signals of equal intensity in all directions. Up to the present time all attempts in radio broadcasting have been in the nature of the development of transmitters and receivers, the medium through which the signals passed and the conditions appropriate to best passage through this medium having been entirely neglected. Although serious thought may have been given to antenna construction and location of stations, apparently sufficient reliable data on this subject was not available on which prospective broadcasters might determine whether or not the design of their antenna was correct or that the location of their station was desirable.

It is generally conceded that broadcasting is moving along on the road toward perfection, so far as the apparatus used in transmission and reception is concerned. The problem which now arises is that of securing the best results possible out of the medium of transmission. This medium being an uncontrollable one can best be mastered by learning something about it and instead of fighting the laws which may be found to govern it, work with them, and thereby solve one of the major problems which radio broadcasting faces. By making field strength measurements the vagaries of radio transmission have become less mysterious, and we are now able to state positively in many cases why a station radiates well in one direction and is not heard in another, whereas before such a statement was a matter of conjecture. The value of these measurements can not be overestimated in the securing of the best possible service and efficiency from a radio broadcast station, for by these measurements the area the station reliably serves and its value to the public can be determined. It is a remarkable thing that there are to-day a large number of broadcast stations in operation which were intended to serve a certain area but are serving other areas much better than the one they were intended to cover. This condition has in some cases been determined by actual field strength measurements made by this office. A very important need, therefore, exists for a means of determining what happens to a signal when it leaves a transmitting station, and with this in view this office has been conducting experiments to determine what does happen and what apparatus should be used in making this determination.

There are several different methods and types of apparatus now existing by means of which field intensity measurements may be made. The main requirement of such apparatus is that it be capable of producing results which can be duplicated and resulting in values of standard units which are comparable. The unit of measurement of radio field intensities now in general use is the volt per meter. The unit "volt per meter" is a large one, and for ordinary purposes it is more convenient to use either millivolts per meter or mircovolts per meter. The unit "microvolt per meter" is a derived term expressing the strength of an electric field at various frequencies used by radio stations in such a manner that they are similar and therefore comparable.

The objective in view at the start of field strength measurements made by this office were (*a*) the distribution of the field of radio broadcast stations, (*b*) the reliable service areas of broadcast stations, (*c*) the effects produced by locating stations in cities on or near large steel structures, and (*d*) the effects produced by locating stations in the open country away from steel structures or electrical down net-works.

Methods and apparatus

The field strength set used in these measurements was a portable set developed for use aboard the Department of Commerce radio test car. This set permanently installed aboard the car is capable of making measurements on frequencies between 1,500 kilocycle-seconds and 500 kilocycle-seconds and is calibrated for field intensities ranging from slightly below 5 millivolts per meter to 50 millivolts per meter.

The measurement of the field strength of a radio station must be made in a definite orderly fashion and in accordance with a predetermined method in order that the conclusions drawn may be based on actual measured values rather than on estimates. All the surveys made thus far have been made using the same method, and as a result all of them are comparable and of the same accuracy. When it is decided to determine the field disbution of a radio station, a map of the area surrounding the station is obtained showing in detail all the roads and streets in the area under consideration. Directions are then selected which lead radially from the station in all directions, and roads corresponding to these directions are chosen on which actual measurements are to be made. These roads should not be too widely separated from each other. Measurements are then made on the chosen routes at intervals of approximately three-tenths of a mile, and measurements are continued until the readings indicate that the limit of the reliable service area has been reached. By making the individual measurements frequently, so that there are relatively short distances between, it is possible to accurately determine the values of signal intensity for the entire distance over which the measurements are made. From the data obtained the various levels are noted on curves which have the field strengths as ordinates and the distance as abscissæ, which shows the falling off of field strength with increasing distance. The curve will also show any effects produced on the strength of the signal by steel buildings or electrical networks. One of the curves is obtained for each direction in which measurements were made. These curves furnish data for to those employed in making topographical survey maps. Usually it is desired to transfer to a contour map. The contour maps are made using methods similar show the location of certain contour lines, such as the 50, 40, 30, 20, 10, and 5 millivolt per meter lines. The data for these contours is obtained from the curves. It is very necessary that the data obtained be represented in graphic form in order that the general distribution of energy after it leaves the antenna, as well as the various strengths of field at various points may be seen at a glance. Each of the six field strength surveys conducted by this office were made using the procedure described above.

Accomplishments

When a radio broadcast station is placed in operation, its first purpose is presumably to serve a certain area with reliable signals. In general, this means, at the present development of the art, that it is desired to propagate signals of equal intensity in all directions. It is desired to achieve as far as possible the perfect field which is a circle, the transmitter being its center. How far actual installations in operation in the broadcast spectrum to-day deviate from this condition can be seen by reference to the illustrations accompanying this article. The results obtained in the several surveys which this office has made show that a realization of the ideal field or anything approaching it is an exception. That this condition should prevail is largely a result of the locations in which broadcast stations have been placed. The majority of broadcast stations to-day are located on buildings in cities of varying sizes and within their metropolitan limits. Further, most of them are located on buildings which contain steel frameworks and are generally near electrical networks. That these conditions in the majority of cases produce undesirable effects on radio transmission has been fairly well demonstrated in the measurements made by this office and discussed in this paper. These surveys were made on stations in widely separated parts of the United States east of the Mississippi River on wave lengths from 270 meters (1,110 kilocycle-seconds) to 469 meters (640 kilocycle-seconds). These stations were some of the best in this area. Some of these stations were located on buildings of steel construction and others were located in the country and they used power from 750 watts to 3,500 watts. One station was surveyed twice in order to ascertain whether or not a radical change in antenna system changed the distribution of the field where absorptive conditions were known to exist.

Any body capable of conducting electricity has a natural period of oscillation. Therefore, if a radio station be located in a large city there can not help but be certain conditions which develop due to the location of the station with regard to conductive bodies. Two of the most serious factors occurring are absorption and shadowing. In the case of absorption the radiated energy is conducted to ground and therefore lost as far as being of any practical use is concerned, and in the case of shadowing a reduction of good service area in the departure from a perfect radio field will be realized. This condition of shadowing in a radio field is analogous to shadowing as found when an opaque object is held near a source of light. Of the two, the phenomenon of absorption has been found to be more common and is clearly seen by reference to Figures 1, 2, 4, and 5. Shadowing may not necessarily result in a loss of energy but absorption does, and usually in such a fashion as to be extremely detrimental. How serious this condition may be can best be appreciated when it is stated that signals from a transmitter

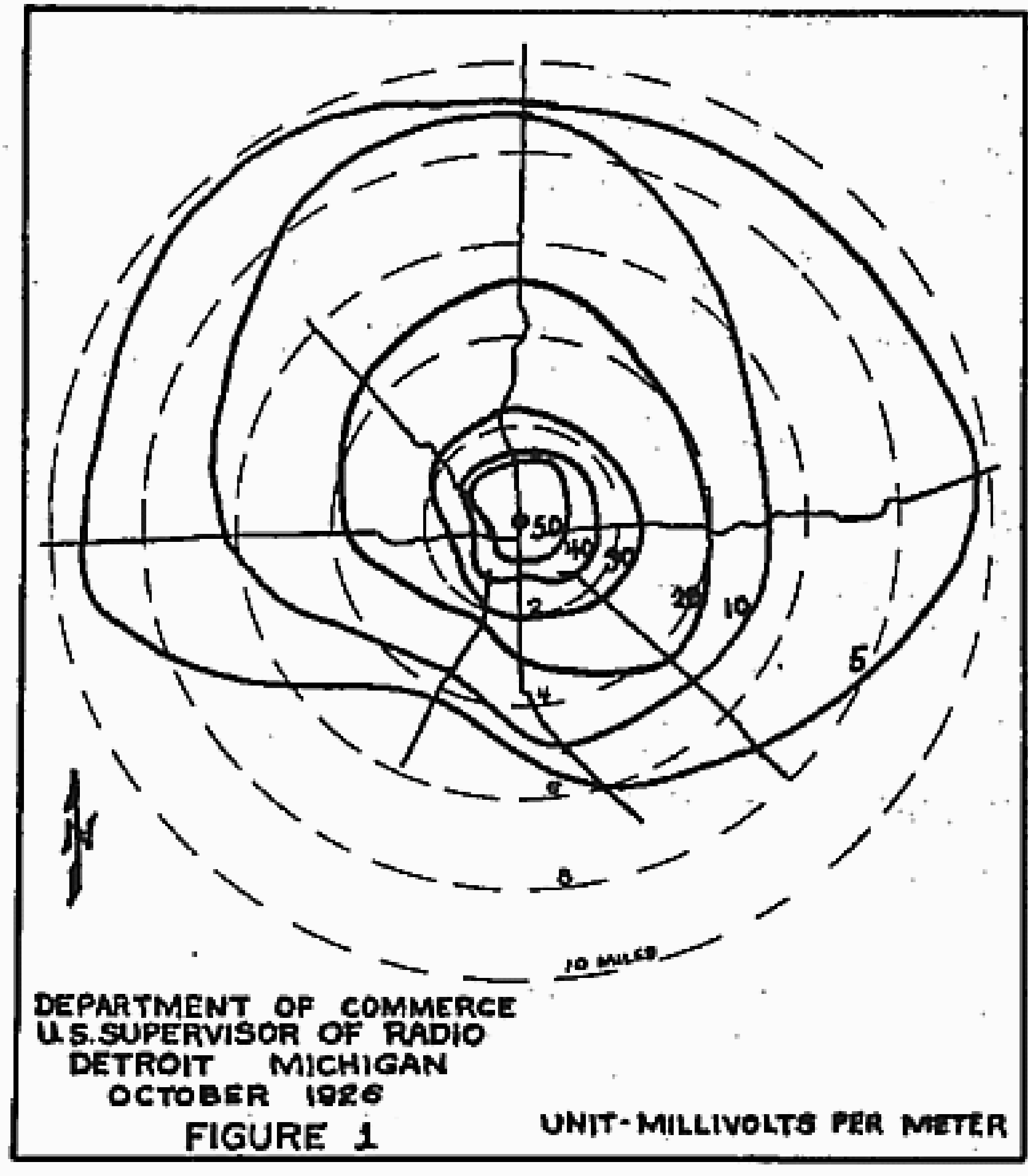


FIGURE 1

whose radio field is shown in Figure 1 are rarely heard 75 miles away in the direction in which absorption takes place, while in other directions this range is very much increased, and signals are consistently received. It is quite evident that the location of a radio station in a metropolitan district desiring to serve a large area is, with the exception of a few instances, a mistake in so far as securing maximum proprogation of signal energy in all directions is concerned. These conditions may not only be due to steel structures in the city surrounding the station but may be caused by absorption in the building on which the station itself is located. Figure 2 shows the field of a broadcast station located on a large steel building. This building has the ability to absorb energy from the transmitter on its normal wave length and to radiate very strongly on another and higher wave length to a degree that it was audible more than 75 miles away. This double emission has been corrected.

The conditions outlined above, as determined by actual measurements, represent an average situation in radio broadcasting at the present time and have two effects: One of them is the low efficiency realized by the station in its transmission and the other is the somewhat inferior service given to the listeners whom the station is intended to serve.

Some typical examples pertaining to the two conditions described above will be given. In the first place, there are to-day certain cities in which there are located two or more stations using the same power and the same wave length, both located in the metropolitan area, and sometimes both stations use the same type of apparatus. In certain directions one of these stations gives much better signal strength than the other. In some cases the signals from one station

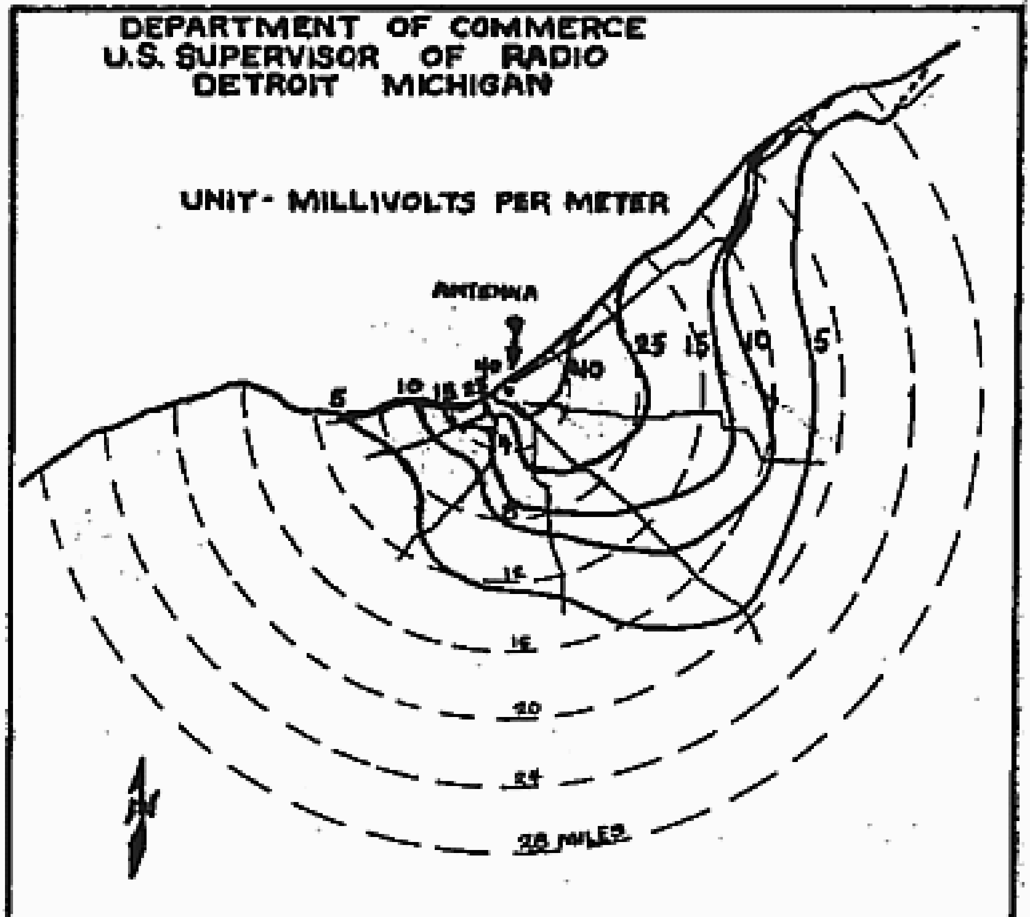
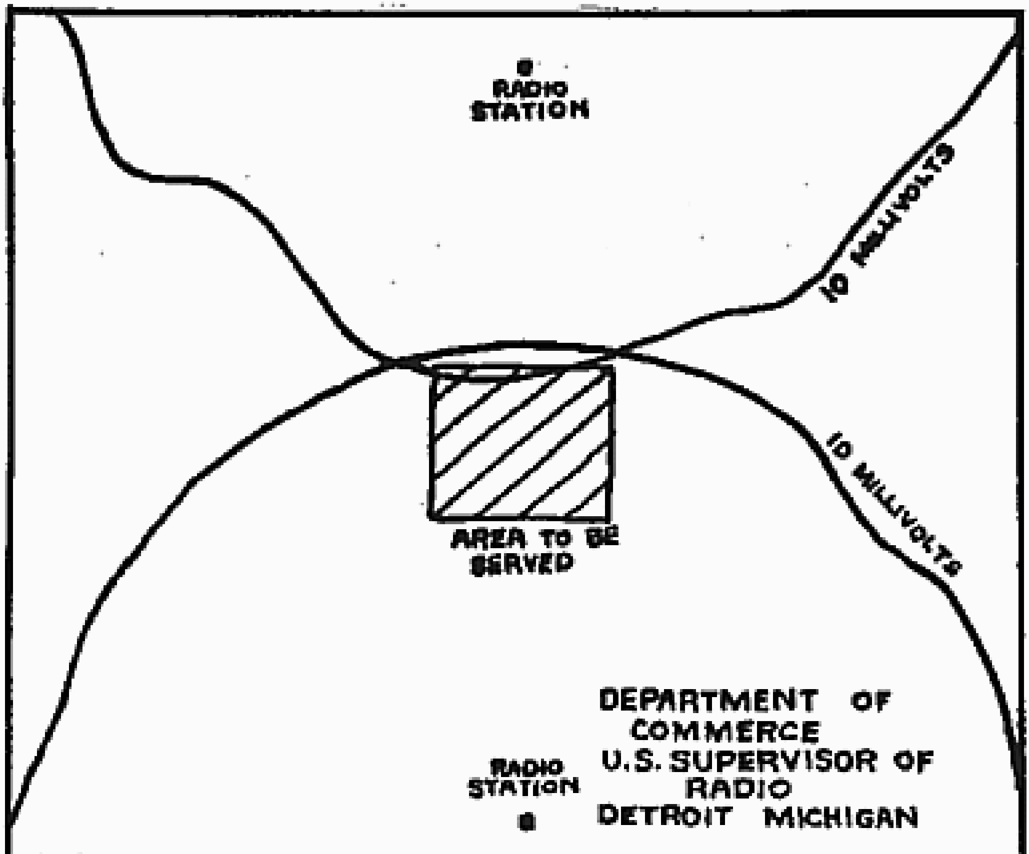


FIGURE 2

are much stronger than they are from the other. Assuming that both transmitters are operated efficiently, any radical difference in results obtained is probably due largely to the location—whether on or near large metallic bodies. Almost universally if one of the stations is in the country it is far superior in the public service it renders than that given by the station located in the city. These two exemplar stations may desire to serve the same area, and, if such is the case, it is readily seen that in order to produce the same signal voltage over the service area desired the station in the city must of necessity use a higher power input than the one in the country. Quite obviously, then, the rating of the power input to the transmitting apparatus is unfair to the listening public, since similar powers will not produce similar results. This condition may be observed by reference to Figure 3. The measurement of a station's transmission in microvolts or similar units per meter is the only basis on which the transmission can be so regulated that both the broadcast listener and the competing stations can receive fair and equitable results from their respective investments. At the same time these field intensity measurements will show whether or not the broadcasting station is using too much or too little power to serve the area desired.

Our observations would seem to indicate that in cases where transmission is difficult from a station located on a steel building conditions of transmission from that station may be greatly improved by a proper selection of frequency so as to avoid the resonant effects of the building.

Measurements made by this office and by others indicate that at the present time signal strengths on the order of 10,000 or more microvolts per meter furnish excellent radio reception. Values of radio intensities below this figure may give excellent reception under some conditions. Where reproduction of clarity on the order of that secured from a musical instrument is desired, the signal must be of such a level that ordinary noises encountered in reception will be overridden.



THEORETICAL RADIO FIELDS OF TWO STATIONS ATTEMPTING TO SERVE SAME AREA USING SAME POWER. STATIONS EQUI-DISTANT FROM AREA. FIGURE 3

These noises are power leaks, turning on of switches in the electrical circuits, and tube and set noises, as well as those caused by the making and breaking of electrical circuits. A signal of 10,000 microvolts per meter is generally sufficient to override most of these interference conditions except in very severe cases. With lower values of signal energy, less satisfactory reception will occur; therefore, a station must not be located at too great a distance from the area which it should serve or it will not secure the desired results. Signals above 10,000 microvolts per meter intensity bring into existence the question of interference with other stations due to the spreading of energy over too broad a band of frequencies on the average radio receiver. The question, therefore, becomes a matter of balance between furnishing ample signal to the listener, too great a signal or a signal not strong enough. A determination of this balance is practical only through the measurement of signal intensity and it is by this means alone that the ideal relation between broadcaster and broadcast listener can be secured.

Having considered the peculiarities of radio transmission and the requirements of good service to the broadcast audiences, a few examples of actual conditions will be cited. The remarks are based on observations on a number of broadcast stations. The contour maps of field distribution of these stations are shown in Figures 1, 2, 4, 5, and 6, respectively.

The transmitter whose field is represented in Figure 4 is a 1 kilowatt transmitter of modern design located approximately one-quarter mile west of the business district of a large city. This business district consists of many steel structures, some of which are 30 to 40 stories in height. The effect of the business district on the field of the station will be plainly seen by reference to the contour map. There is a decided falling off of signal strength to the east of transmitter. At the time these measurements were made the antenna used by this station was supported on one end by a steel building and on the other by a steel mast. Subsequently, the antenna system was radically changed. Steel towers were erected on the building in which the transmitter is located and a higher antenna erected.

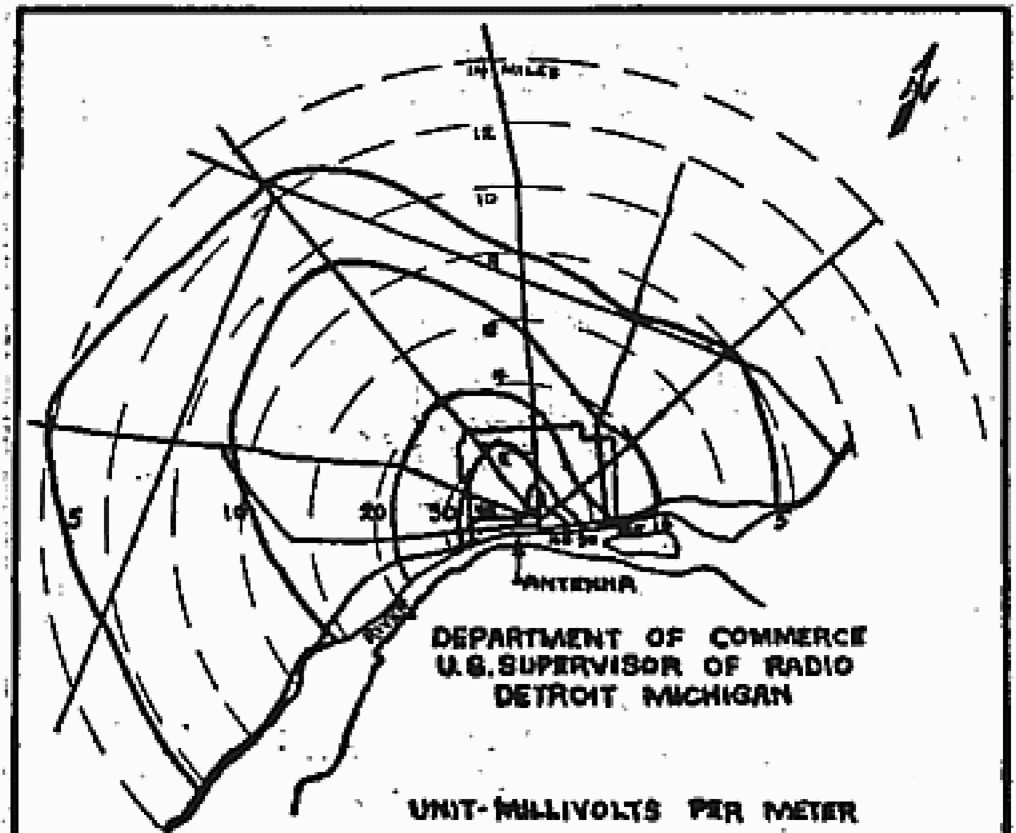


FIGURE 4

A counterpoise system was also installed. Field strength measurements on this station after the change of antenna system was made indicated that the general shape of the field of the station remained unchanged, which would tend to indicate that the field distortion was entirely due to the near-by steel buildings. However, by a happy circumstance this broadcast station serves very well the area in which the station is located and the city limits are fairly well within the 10-millivolt contour line. It may be remarked that at the time these measuremenst were made, reception 150 miles east or northeast of the station was difficult, while reception 150 miles south, southwest, or west was consistent.

Another example of the effects of business districts on broadcast stations is shown by the contour map in Figure 1. This transmitter whose field is here represented is located 1 mile northeast of the steel building area. The station itself is located on a 10-story steel building, and in addition to the detrimental effects on the station's transmission caused by the steel area of the city in which the transmitter is located the building itself materially decreases the output of the transmitter. While this station is frequently heard north or northwest of the transmitter, it is seldom heard in a southerly or southwest direction.

Figure 6 shows the field of a 750-watt transmitter located at a considerable distance from any steel buildings of appreciable size. The field of this station very nearly approaches the shape of a circle and may be considered very good. The field has a tendency to be slightly stronger in three directions which lies over three river beds showing the apparent tendency to good transmission over water in this locality.

The field depicted in Figure 2 represents that set up by a station located on a 20-story building on the easterly fringe of a tall steel building area. The pronounced attenuation in a westerly direction is at once apparent, and it appears that transmission is exceptionally good along the lake shore, in an easterly direction from the transmitter. This condition is a good example of what a radio station in a business district of a large city is liable to encounter.

The field shown in Figure 5 is that of a 1,500-watt transmitter located in the open country approximately 15 miles from large steel buildings and quite well

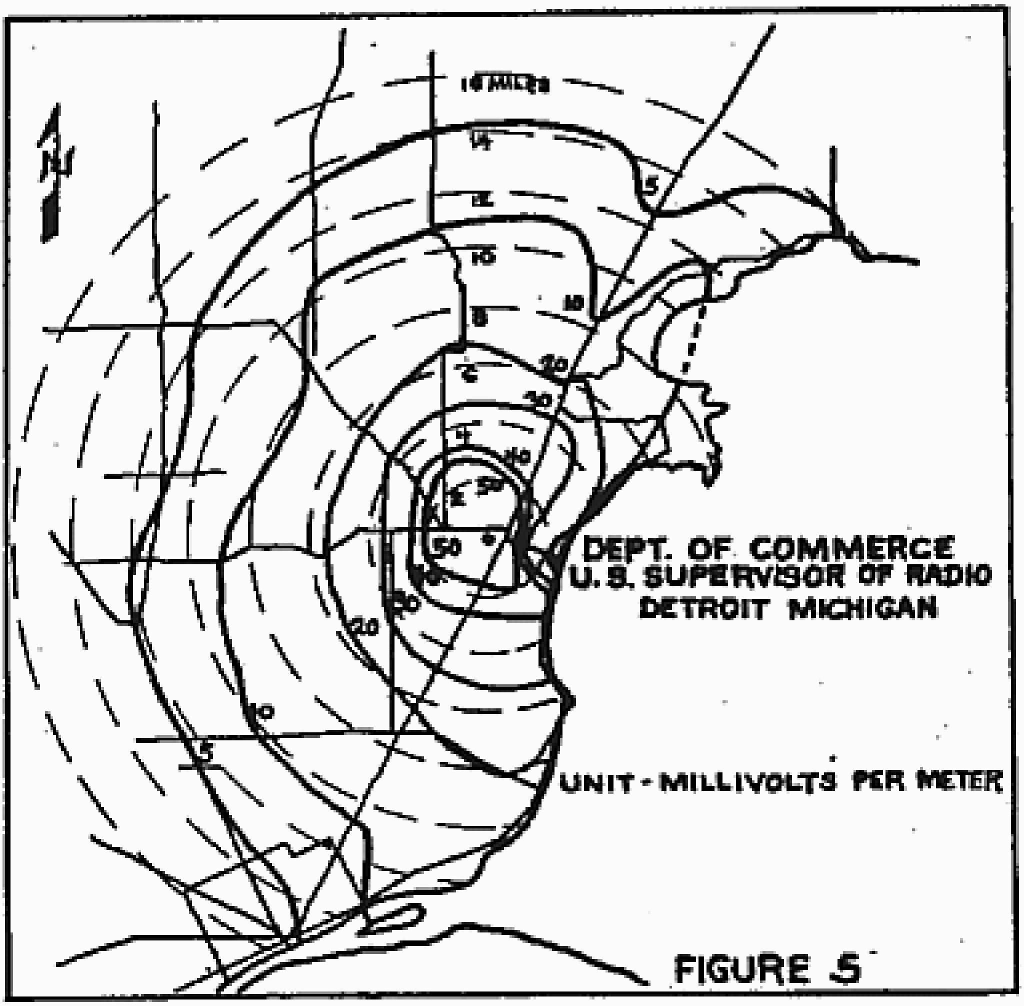


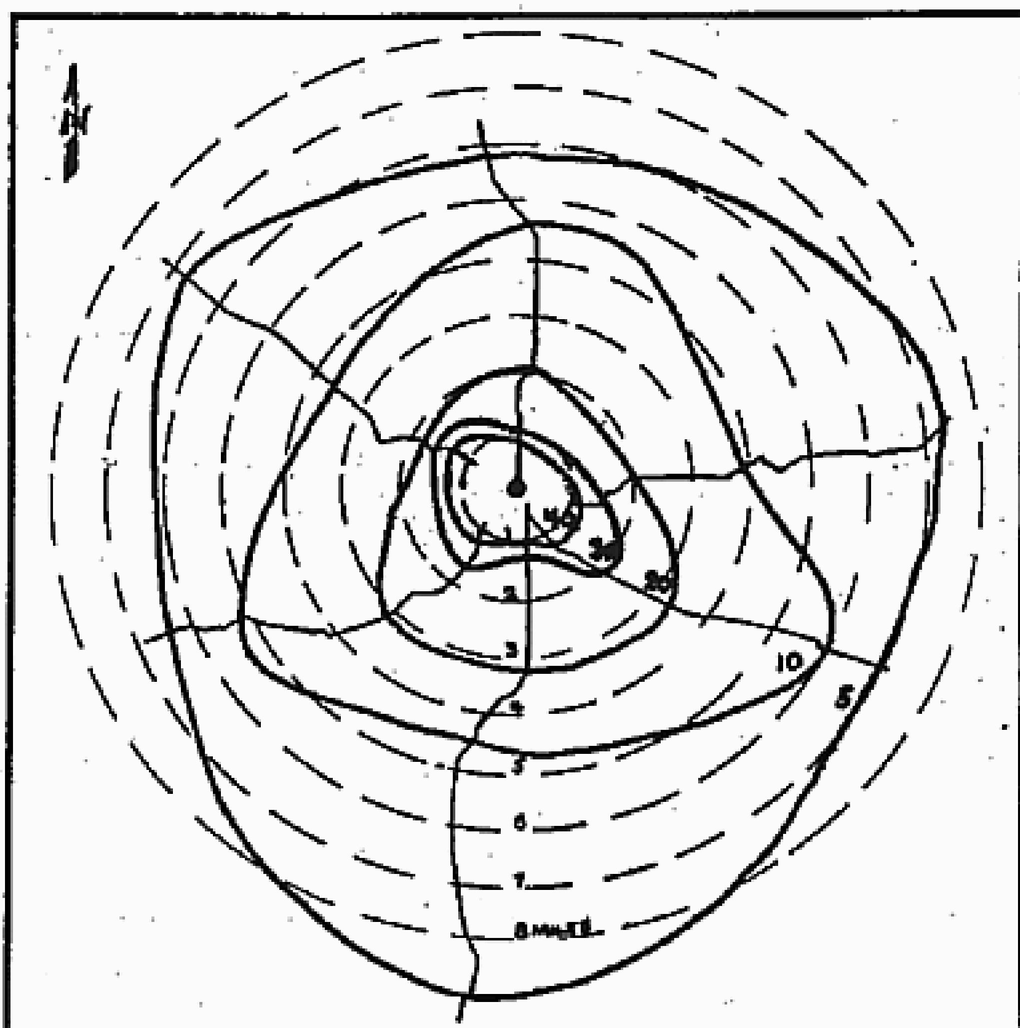
FIGURE 5

removed from populous areas. Due to the location of the station it would be expected that the field intensities would be reasonably uniform, and this expectation is realized to a certain extent. The coverage obtained here considering the power used is greater than other stations measured. The noticeable indentations on the curves in a north by east direction from the transmitter are due to absorption by a number of power telephone and telegraph lines closely grouped.

Figure 7 represents two signal strength curves. Curve No. 1 is an actual curve drawn from measurements made on the station. No. 2 indicates a curve whose values were computed from one good value on signal curve No. 1. No. 1 shows the actual variation of signal voltage while No. 2 shows what would be the ideal signal curve.

As a result of the surveys which this office has conducted there are evidently two conditions which a radio broadcast station must meet before it can operate with a maximum efficiency and serve the greatest possible area and number of listeners with a given power input to the antenna. The first of these conditions is the design of the transmitting apparatus and its associated antenna to radiate properly. The two conditions that must here be met are that maximum effective antenna height with a maximum antenna current be secured. The second condition is the proper location of the transmitter. For equally effective service in all directions the station must be located a reasonable distance away from all electrical networks and from any steel buildings of any great size. Unless these two conditions are met the field obtained will probably not be uniform.

There are a number of possibilities that the use of field-strength measurements in connection with radio transmission create. A leading possibility is



DEPARTMENT OF COMMERCE
U. S. SUPERVISOR OF RADIO
DETROIT MICHIGAN
NOVEMBER 1926

FIGURE 6
UNIT - MILLIVOLTS PER METER

that of rating stations in terms of microvolts per meter at a specified distance rather than in watts input to antenna. In itself the term "microvolts per meter" indicates the service which a radio transmitter is giving in actual reception, whereas the power input to antenna indicates in no manner what the strength of the received signal is or will be and therefore what its usefulness may be. Where we have two transmitters both trying to serve the same area and one of which is hampered by absorptive conditions, the only fair method of power rating is that of field strength at a certain distance.

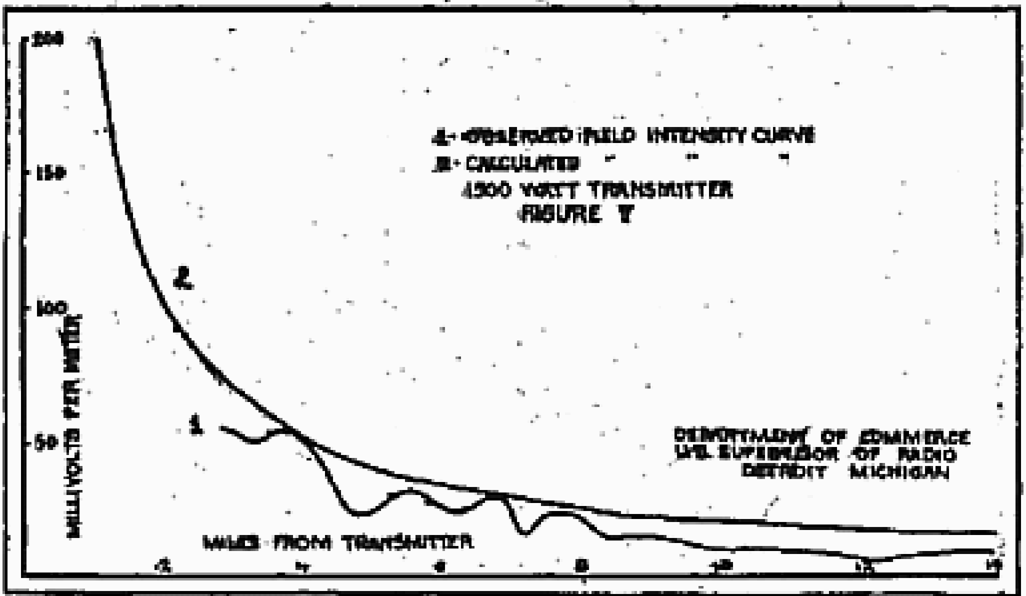
It has long been known that certain broadcast stations radiated well in one direction and very poorly in another. Whether this was a consistent condition or not was never determined until field-strength measurements had been made. In the case where such a condition may be found to exist there does not seem to be any sound reason why another station can not be operated on the same frequency at a considerable distance away in the direction of poorest radiation without causing interference. This duplication would, no doubt, prove very helpful in the allocation of frequencies to broadcast stations.

The use of a field-strength measuring device in connection with a portable transmitter makes possible the determination of the best location of a proposed radio transmitter. Heretofore the location of any transmitter has been a matter of opinion with no actual working data obtainable. The preliminary making of field-strength measurements insures that the investment in the proposed station will not be wasted by an unfortunate choice of location.

In conclusion, the surveys and experiments which have been conducted indicate that the use of field-strength measuring apparatus should prove of very great value to a broadcast-station owner and to the broadcast listener by making possible much better service for all concerned.

FORMULAS AND TABLES FOR THE CALCULATION OF ANTENNA CAPACITY

The Bureau of Standards has just issued Letter Circular 224, which gives formulas and tables for the calculation of antenna capacity. The capacity of



the common forms of antennas used in radio transmission and reception may be calculated from the formulas given in this letter circular. In addition to the formulas, tables are given by which capacities may be obtained directly without calculation for three kinds of antennas; otherwise the single-wire horizontal, the single-wire vertical, and the 2-wire horizontal.

This letter circular is a mimeographed document, not obtainable by purchase. A copy may, however, be obtained by persons having actual use for it upon application addressed to the Bureau of Standards, Department of Commerce, Washington, D. C.

RADIO-SIGNAL TRANSMISSIONS OF STANDARD FREQUENCY, APRIL TO OCTOBER

The Bureau of Standards announces a new schedule of radio signals of standard frequencies, for use by the public in standardizing frequency meters (wave meters) and transmitting and receiving apparatus. The signals are transmitted from the bureau's station WWV, Washington, D. C. It is to be noted that a number of the individual frequencies differ somewhat from those used in previous transmissions.

The transmissions are by continuous-wave radiotelegraphy. The signals have a slight modulation of high pitch which aids in their identification. A complete frequency transmission includes a "general call" and "standard frequency signal" and "announcements." The "general call" is given at the beginning of the 8-minute period and continues for about 2 minutes. This includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letter (WWV) intervening. This signal continues for about 4 minutes. The "announcements" are on the same frequency as the "standard frequency signal" just transmitted and contain a statement of the frequency. An announcement of the next frequency to be transmitted is then given. There is then a 4-minute interval while the transmitting set is adjusted for the next frequency.

The signals can be heard and utilized by stations equipped for continuous-wave reception at distances up to about 500 to 1,000 miles from the transmitting station. Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 171, which may be obtained on application from the Bureau of Standards, Washington, D. C. Even though only a few frequency points are received, persons can obtain as complete a frequency meter calibration as desired by the method of generator harmonics, information on which is given in the letter circular. The schedule of standard frequency signals is as follows:

Schedules of frequencies in kilocycles

[Approximate wave lengths in meters in parentheses]

Eastern standard time	Apr. 20	May 20	June 20	July 20	Aug. 22	Sept. 20	Oct. 20
10 to 10.08 p. m.	550 (545)	1,500 (200)	3,000 (100)	125 (2,400)	250 (1,199)	3,000 (100)	550 (545)
10.12 to 10.20 p. m.	630 (476)	1,650 (182)	3,300 (91)	140 (2,142)	283.3 (1,058)	3,300 (91)	633.3 (473)
10.24 to 10.32 p. m.	730 (411)	1,825 (164)	3,600 (83)	160 (1,874)	320 (937)	3,600 (83)	733.3 (409)
10.36 to 10.44 p. m.	850 (353)	2,025 (148)	4,000 (75)	180 (1,666)	358.7 (836)	4,000 (75)	850 (353)
10.48 to 10.56 p. m.	980 (306)	2,225 (135)	4,400 (68)	206.2 (1,454)	410 (731)	4,400 (68)	975 (308)
11 to 11.08 p. m.	1,150 (261)	2,450 (122)	4,900 (61)	231.2 (1,298)	465.7 (643)	4,900 (61)	1,125 (267)
11.12 to 11.20 p. m.	1,300 (231)	2,700 (111)	5,400 (56)	258.7 (1,159)	525 (571)	5,400 (56)	1,300 (231)
11.24 to 11.32 p. m.	1,500 (200)	3,000 (100)	6,000 (50)	300 (999)	600 (500)	6,000 (50)	1,500 (200)

STANDARD FREQUENCY STATIONS

As a result of measurements by the Bureau of Standards upon the transmitted waves of a limited number of radio transmitting stations, data are given in each month's RADIO SERVICE BULLETIN on such of these stations as have been found to maintain a sufficiently constant frequency to be useful as standards.

As shown by the list of "Constant frequency stations," there may be many other stations not measured in the bureau's laboratory which maintain their frequencies just as constant as the stations listed below. There is, of course, no actual guaranty that these stations will maintain the constancy shown, but the data indicate the high degree of confidence that can be placed in them. The transmitted frequencies from the standard frequency stations can be utilized for calibrating frequency meters and other apparatus by the procedure given in Bureau of Standards Letter Circular No. 171, which may be obtained by a person having actual use for it upon application to the Bureau of Standards, Department of Commerce, Washington, D. C.

Station	Owner	Location	Assigned frequency	Period covered by measurements	Number of times measured	Deviations from assigned frequencies noted in measurements	
						Average	Greatest since Feb. 25, 1927
			Kilocycles	*Months*		*Per cent*	*Per cent*
NSS	United States Navy	Annapolis, Md.	[1] 17.50	10	50	0.1	0.1
WCI	Radio Corporation of America.	Tuckerton, N. J.	17.95	24	106	.1	[2]
WSS	do	Rocky Point, N. Y.	18.60	6	22	.1	.4
WGG	do	Tuckerton (No. 1), N. J.	18.86	43	282	.2	.3
WII	do	New Brunswick, N. J.	21.60	23	132	.1	.1
WVA	United States Army	Annapolis, Md.	100	24	154	.2	.4
NAA	United States Navy	Arlington, Va.	112	17	87	.2	.4
WEAF	National Broadcasting Co.	New York, N. Y.	610	27	156	.0	.0
WRC	Radio Corporation of America.	Washington, D. C.	640	39	169	.1	.0
WJZ	do	Bound Brook, N. J.	660	10	40	.2	.3
WGY	General Electric Co.	Schenectady, N. Y.	790	45	199	.1	.0
WBZ	Westinghouse Electric & Manufacturing Co.	Springfield, Mass.	900	23	93	.1	.1
KDKA	do	East Pittsburgh, Pa.	970	10	44	.1	.1

[1] Changed to 17.60 kilocycles on Mar. 25. [2] Not measured since Feb. 25.

CONSTANT FREQUENCY STATIONS

The list of "Constant frequency stations" given below supplements the list of "Standard frequency stations." The transmitted waves from the stations in either list should be of value to the public as frequency standards because of their constancy and close adherence to the licensed values. The Bureau of Standards makes regular measurements of the transmitted frequencies of the standard frequency stations only. The constant frequency stations in the following supplementary list do not carry the same assurance of reliability as if the transmitted waves were regularly measured by the Bureau of Standards, but it is probable that if measurement data were available many of them would show the same constancy as the standard frequency stations.

The fundamental requirement of a broadcasting station for inclusion in the following list is the employment of a special device for controlling or checking the frequency, the calibration of such a device being in agreement with the bureau's frequency standards. The special device may be automatic piezocontrol, a piezooscillator, piezoresonator, or frequency indicator. Stations not included in this list nor in the list of standard frequency stations, which use one of the special devices for frequency regulation, are invited to communicate with the Bureau of Standards requesting a copy of Letter Circular 214, Requirements of Constant Frequency Stations.

Station	Owner	Location	Frequency	Wave length	Apparatus for frequency regulation
			Kilocycles	*Meters*	
WHO	Bankers Life Co.	Des Moines, Iowa	570	526	Piezooscillator.
KFRU	Stephens College	Columbia, Mo.	600	499.7	Frequency indicator and piezoscillator.
WOC	Palmer School of Chiropractic.	Davenport, Iowa	620	483.6	Piezooscillator.
WTIC	Traveler's Insurance Co.	Hartford, Conn.	630	475.9	Do.
WMAQ	Chicago Daily News	Chicago, Ill.	670	447.5	Frequency indicator, type B, and piezooscillator.
KPO	Hale Bros. and the Chronicle.	San Francisco, Calif.	700	428.3	Frequency indicator.
WLW	Crosley Radio Corporation.	Harrison, Ohio	710	422.3	Frequency indicator and piezooscillator.
WCCO	Washburn-Crosby Co.	St. Paul-Minneapolis, Minn.	720	416.4	Piezooscillator.
WTAM, WEAR	Willard Storage Battery Co.	Cleveland, Ohio	770	389.4	Do.

Station	Owner	Location	Frequency	Wave length	Apparatus for frequency regulation
			Kilocycles	*Meters*	
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	800	374.8	Frequency indicator, type B.
WJJD	Loyal Order of Moose	Mooseheart, Ill.	810	370.2	Piezooscillator.
KGO	General Electric Co.	Oakland, Calif.	830	361.2	Automatic piezocontrol and piezooscillator.
WJAD	Frank P. Jackson	Waco, Tex.	850	352.7	Frequency indicator, type B.
WWJ	Detroit News	Detroit, Mich.	850	352.7	Do.
WLS	Sears, Roebuck & Co.	Crete, Ill.	870	344.6	Piezooscillator.
KFAB	Nebraska Buick Motor Co.	Lincoln, Nebr.	880	340.7	Frequency indicator, type B.
WKAQ	Radio Corporation of Porto Rico.	San Juan, P. R.	880	340.7	Do.
KOA	General Electric Co.	Denver, Colo.	930	322.4	Piezooscillator.
WEAO	Ohio State University	Columbus, Ohio	1,020	293.9	Frequency indicator, type B.
WMBI	Moody Bible Institute of Chicago.	Chicago, Ill.	1,040	288.3	Piezooscillator.
WFBG	William F. Gable Co.	Altoona, Pa.	1,080	277.6	Frequency indicator.
KFKA	Colorado State Teachers' College.	Greeley, Colo.	1,100	272.6	Piezooscillator.
WBAA	Purdue University	W. Lafayette, Ind.	1,100	272.6	Do.
WOI	Iowa State College	Ames, Iowa	1,110	270.1	Automatic piezocontrol (checked with type B frequency indicator).
KFH	Hotel Lassen	Wichita, Kans.	1,120	267.7	Frequency indicator, type B.
WCAD	St. Lawrence University	Canton, N. Y.	1,140	263	Frequency indicator.
WAAM	I. R. Nelson	Newark, N. J.	1,140	263	Piezooscillator.
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	1,320	227.1	Do.
WBBM	Atlass Investment Co.	Chicago, Ill.	1,330	225.4	Do.
WEBQ	Tate Radio Co.	Harrisburg, Ill.	1,330	225.4	Piezooscillator, type N.
KFVS	Hirsch Battery & Radio Co.	Cape Girardeau, Mo.	1,340	223.7	Frequency indicator, type B.
WPDQ	Hiram L. Turner	Buffalo, N. Y.	1,460	205.4	Do.

REFERENCES TO CURRENT RADIO LITERATURE

This is a montly list of references prepared by the radio laboratory of the Bureau of Standards and is intended to cover the more important papers of interest to professional radio engineers which have recently appeared in periodicals, books, etc. The number at the left of each reference classifies the reference by subject, in accordance with the scheme presented in A Decimal Classification of Radio Subjects—An Extension of the Dewey System, Bureau of Standards Circular No. 138, a copy of which may be obtained for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C. The various articles listed below are not obtainable from the Bureau of Standards. The various periodicals can be consulted at large public libraries.

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