

ENGINEERING

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SECOND ANNUAL

NAB BROADCAST ENGINEERING CONFERENCE

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MAY 19-22, 1948

JUL 1948
JUL 1948

World Radio History

NATIONAL ASSOCIATION OF BROADCASTERS
26th ANNUAL CONVENTION

2nd ANNUAL BROADCAST ENGINEERING
CONFERENCE AGENDA
AND
PROGRAM SCHEDULE

TUESDAY, MAY 18, 1948

NAB Engineering Executive Committee Meeting
8:30 a.m., Biltmore Hotel

WEDNESDAY, MAY 19, 1948

REGISTRATION for Broadcast Engineering Conference
Galleria, Biltmore

EXHIBITS OPEN

NAB DEPARTMENT OF ENGINEERING

Royal V. Howard, Director
Neal McNaughten, Assistant Director

Engineering Office
2nd Floor, Biltmore Hotel

NAB ENGINEERING EXECUTIVE COMMITTEE

Chairman: Orrin W. Towner,
Technical Director, WHAS, Louisville

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Paul de Mars, Raymond M. Wilmotte, Inc.
A. James Ebel, WMBD
Oscar C. Hirsch, KFVS
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District 17—George A. Freeman, KRSC



J. R. (JACK) POPPELE, Member NAB Engineering Executive Committee, is Vice-President in Charge of Engineering of WOR and WOR-TV, New York, in addition to Bamberger's upcoming TV Station WOIC, Washington. Mr. Poppele is a Director of MBS, President of TBA, and is not only one of TV's outstanding figures but one of the nation's leading engineers. As Chief Engineer of Station WOR, he put its first program on the air in 1922. Mr. Poppele is a Director and Senior Member of IRE, a Director of VWOA, a Fellow of the RGA, and Member of the Acoustical Association, the SMPE, and the AIP.

THURSDAY, MAY 20, 1948

MORNING SESSION—9:30 A. M.

Presiding: J. R. Poppele

Vice President and Chief Engineer, WOR-Mutual
Member, NAB Engineering Executive Committee

COMPARATIVE FIELD MEASUREMENTS—COMPARISON OF PROPAGATION CHARACTERISTICS BETWEEN CHANNEL 4 AND CHANNEL 7 IN THE WASHINGTON METROPOLITAN AREA

E. C. Page, Consultant, Washington, D. C., for RCA Victor Corporation

TELEVISION AND FM TRANSMITTING PLANTS

Raymond F. Guy, Manager, Radio & Allocations, Engineering, National Broadcasting Company, New York, New York; and
John L. Seibert, Project Engineer, National Broadcasting Company, New York, New York

THE COMMUNITY TELEVISION STATION

James D. McLean, Commercial Mgr., Philco Television Broadcasting Corp., Philadelphia, Pennsylvania

TV STUDIO SYSTEMS

M. A. Trainer, Manager, Television Equipment, RCA-Victor, Camden, New Jersey

LIGHT SOURCES FOR TELEVISION STUDIO LIGHTING

F. E. Carlson, Illuminating Engineer, Lamp Department, General Electric Company, Cleveland, Ohio, presenting paper prepared by
Richard Blount, Engineer, Lamp Department, General Electric Company, Cleveland Ohio

REMOTE CONTROL TELEVISION LIGHTING

Captain W. C. Eddy, USN (Ret.), Director of Television, Balaban and Katz Station WBKB, Chicago, Illinois

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LUNCHEON—12:30-2:15 P. M.

Presiding: Royal V. Howard

Director, NAB Department of Engineering

THE ENGINEER'S ROLE IN BROADCASTING

A Message of Greeting—Judge Justin Miller, President, NAB

ROYAL V. HOWARD (B. Sc.) is Director of the NAB Department of Engineering. From 1934 to 1947 he was Vice-President, Engineering, of Associated Broadcasters, Inc., San Francisco. During the War he was a Member of the Board of War Communications and built international broadcast stations KWID and KWIX. He served with the Army in Europe as Director of a special ETOWSA headquarters staff for OSRD. Since joining NAB in 1947 he has been a U. S. Delegate at the International Telecommunications Conferences, Atlantic City, and the NARBA Engineering Conference, Havana. Mr. Howard is Chairman of the NAB Recording and Reproducing Standards Committee and is a Member of several RTPB, RMA and ASA standardization committees. He holds several letters patent on radio apparatus. He is a Senior Member of IRE and a Member of AIEE.



JUDGE JUSTIN MILLER
President
National Association of Broadcasters





FRANK L. MARX, Network Advisory Member of the NAB Engineering Executive Committee, is Vice-President in Charge of Engineering for American Broadcasting Company, NYC, and a pioneer in radio engineering. He entered the broadcasting field in 1925, and was associated in the construction of various radio stations throughout the United States. For 15 years he was Chief Engineer of WMCA, New York. In 1944 Mr. Marx became Technical Director of the Blue Network and, in 1945, was appointed Director of General Engineering of ABC. He has served on various RTPB panels and on the Committee on Sabotage of Radio Stations during the War. Mr. Marx is a Senior Member of the IRE.

THURSDAY, MAY 20, 1948

AFTERNOON SESSION—2:30 P. M.

Presiding: Frank Marx

Vice-President in Charge of Engineering, ABC
Network Advisory Member, NAB Engineering
Executive Committee

THE CBS GRAND CENTRAL TELEVISION STUDIOS

William B. Lodge, Director of General Engineering, Columbia Broadcasting System, New York, presenting paper prepared by
A. B. Chamberlain, Chief Engineer, CBS, New York

TELEVISION FIELD BROADCASTS, INCLUDING RADIO RELAY

Robert Clark, TV Operation Supervisor, National Broadcasting Company, New York

NETWORK FACILITIES FOR AUDIO AND VIDEO BROADCASTING

Ernest H. Schreiber, Engineer, The Pacific Telephone and Telegraph Company, Los Angeles, California

INSTALLATION AND MAINTENANCE OF TELEVISION RECEIVERS

Edward Edison, Field Engineer, Los Angeles Television Operation, RCA Service Company, Inc., Los Angeles, California

ABSOLUTE SPEED FOR MAGNETIC TAPE AND DEMONSTRATION OF TAPE REPRODUCTION AT 30" PER SECOND

R. H. Ranger, President, Rangertone, Inc., Newark, N. J.

MAGNETIC TAPE EDITING DEVICE

H. W. Pangborn, Assistant Chief Engineer, KNX-CBS, Hollywood, California, presenting paper prepared by
R. S. O'Brien, General Engineering Department, CBS, New York

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FRIDAY, MAY 21, 1948

MORNING SESSION—9:00 A. M.

Presiding: Paul A. de Mars,

Consultant, Raymond M. Wilmotte, Inc., Washington, D. C.
Member, NAB Engineering Executive Committee

THE ECONOMICS OF COVERAGE IN FM BROADCASTING

Everett Dillard, General Manager of WASH (Washington, D. C.) and KOZY (Kansas City, Missouri) and Member-Elect, NAB Board of Directors



PAUL A. deMARS (COMDR. USNR), Member NAB Engineering Executive Committee, received his B. Sc. from M.I.T., and is a Consultant with Raymond M. Wilmotte, Inc., Washington, D. C. During World War I he served with the AEF. From 1920 to 1926 he served as Engineer with the New England Telephone and Telegraph Company. From 1927 to 1930 Mr. deMars, as Head of the Electrical Engineering Department, Tufts College, conducted extensive research in ionospheric propagation. From 1931 to 1941 he planned and built the pioneer Paxton and Mt. Washington FM stations. During World War II he served with the Navy. Since then he has been associated with Raymond M. Wilmotte, Inc., directing its broadcast consulting, engineering, and construction projects.

NEAL McNAUGHTEN, Assistant Director, NAB Department of Engineering, joined NAB in January 1948. From 1934 to 1940 he was Chief Engineer, KRGV, Weslaco, Texas. In 1941 he entered the FCC and for two years was Assistant Supervisor of the Great Lakes Monitoring Area. In 1943 he was made Assistant Chief of the Treaty Section and represented FCC on IRAC and RTPB committees. In 1944 Mr. McNaughten became FCC's NARBA Administrator. In 1945 he was made Chief, Standard Broadcast Allocations Section. In 1946 he was Secretary-General of the Second NARBA Conference and, in 1946-47, coordinated NARBA activities with the clear channel proceedings, preparing proposals for the Third NARBA. He was a Delegate to the NARBA Engineering Conference in Havana. He is a Member of the IRE.



A STUDIO TO TRANSMITTER RELAY RADIO SYSTEM

W. G. Broughton, Assistant Sales Manager, Broadcast Equipment Division, General Electric Company, Schenectady, New York, and
D. J. Nigg, Engineer, Transmitter Division, General Electric Company, Schenectady, New York

MEASURING EQUIPMENT AND TECHNIQUES FOR FM AND AM BROADCAST TRANSMITTERS

David Packard, President, Hewlett-Packard Corporation, Palo Alto, California

FACTORS AFFECTING PERFORMANCE OF DIRECTIONAL ANTENNA SYSTEMS

A. Earl Cullum, Consultant, Dallas, Texas

A SYSTEM FOR MEASURING CO-CHANNEL INTERFERENCE

Robert A. Fox, General Engineering Department, WGAR, WJR, KMPC, Cleveland, Ohio

LUNCHEON—12:30-2:15 P. M.

Presiding: Neal McNaughten,
Assistant Director, NAB Department of Engineering

THE DEVELOPMENT OF MAGNETIC RECORDING LEADING TO STEREOPHONIC SOUND and A DEMONSTRATION OF STEREOPHONIC SOUND

Dr. Haldon A. Leedy, Acting Director, Armour Research Foundation, Chicago, Illinois

FRIDAY, MAY 21, 1948

AFTERNOON SESSION—2:30 P. M.

Presiding: Orrin W. Towner,
Technical Director, WHAS, Louisville, Kentucky
Chairman, NAB Engineering Executive Committee

DEVELOPMENTS IN SOUND AND RELAY BROADCAST EQUIPMENT (Demonstrations)

J. L. Hathaway, Assistant Manager, Engineering Developments, National Broadcasting Company, New York

MODERN DESIGN FEATURES OF CBS STUDIO AUDIO FACILITIES

Lester H. Bowman, Manager, Technical Operations, Western Division of Columbia Broadcasting System, Hollywood, California, presenting paper prepared by

R. B. Monroe and

C. A. Palmquist, both of the General Engineering Department, Columbia Broadcasting System, New York

ORRIN W. TOWNER (E. E., University of Kansas), Chairman 1947-1948 of the NAB Engineering Executive Committee, is Technical Director of WHAS, Louisville, Kentucky. Mr. Towner was in charge of broadcast operation of Stations WREN and KFku in 1927. From 1927 to 1938 he served with Bell Telephone Laboratories in its Radio Development Department. Mr. Towner was Technical Director of WHAS from 1938 to 1942. During the War he served as Associate Director of Airborne Instruments Laboratory of Columbia University, Division of War Research (1942-1945). At the close of the War Mr. Towner returned to WHAS as Technical Director. He is a Member of IRE, AIEE, an Associate Member of SMPE and the Acoustical Society of America, and a Licensed Professional Engineer in both New York and Kentucky.



FCC-INDUSTRY ROUNDTABLE

Presiding: Royal V. Howard,
Director, NAB Department of Engineering

FOR THE COMMISSION

George E. Sterling, Commissioner
John A. Willoughby, Acting Chief Engineer
Cyril M. Braum, Chief, FM Broadcast Division
James A. Barr, Chief, Standard Broadcast Division
Hart S. Cowperthwait, Acting Chief, TV Broadcast Division

FOR INDUSTRY:

Neal McNaughten, NAB
Orrin W. Towner, WHAS
J. R. Poppele, WOR
Frank Marx, ABC
Paul A. deMars, Roymond M. Wilmotte, Inc.



GEORGE E. STERLING became Commissioner of the FCC January 1, 1940. As an amateur his radio experience dates from 1908. Mr. Sterling studied at Johns Hopkins University and Baltimore City College. After serving overseas in World War I, Lt. Sterling assisted in organizing the first radio intelligence section of the Signal Corps in France, receiving a special citation for his work. He entered the Federal Service in 1923 as a Radio Inspector. In 1942 he became Asst. Chief Engineer and Chief of the Radio Intelligence Division and, in 1945, he was placed in charge of the Field and Research Branch. On May 1, 1947, he was appointed Chief Engineer of the FCC. Mr. Sterling is a Senior Member of IRE.



JOHN A. WILLOUGHBY has been Acting Chief Engineer of the Federal Communications Commission since January 1948. He attended Clemson College, George Washington and Harvard Universities. In 1916 Mr. Willoughby started his long radio career with the Bureau of Standards, later working with the Post Office Department, the Army Air Corps, and the Naval Research Laboratory. He invented the submarine loop antenna, developed the interlocking "A" and "N" range system, and obtained patents on anti-fading systems. In 1930 he entered the Commission's Broadcast Division, being Assistant Chief of this Division from 1941 to 1944, when he was made Acting Chief, later becoming Assistant Chief Engineer in charge of Broadcast.



CYRIL M. BRAUM (Bach. E. E., University of Minnesota), Chief of FM Broadcast Division, Engineering Department, Federal Communications Commission, was Chief Engineer of WDGY in Minneapolis from January to December, 1929. During 1930 he was with Electrical Research Products, Inc., New York City. Mr. Braum was Radio Engineer with the Minneapolis Police Department from December, 1930, to October, 1937. From 1937 to 1940 he was Radio Inspector with the FCC in Chicago. From 1940 to date he has been in the Engineering Department of the FCC, having been Chief of FM Broadcast Division since 1942. He is a Voting Associate Member of IRE.



JAMES E. BARR is Chief, Standard Broadcast Division, Engineering Department, Federal Communications Commission. He attended Georgia School of Technology and Southern Methodist University. From 1929 to 1932 Mr. Barr was employed by Southwestern Bell Telephone Company on outside plant construction. He was with Southwest Broadcast Company, Fort Worth, Texas (KTAT, KOMA, K TSA, WACO and KNOW), from 1933 to 1938. From 1938 to 1940 Mr. Barr was Radio Inspector with the FCC with headquarters in New York City. Mr. Barr has been with the Standard Broadcast Division, FCC Engineering Department, from 1940 to date.



HART S. COWPERTHWAIT (Bach. E. E., University of Minnesota), Acting Chief, Television Broadcast Division, Engineering Department, Federal Communications Commission, was Engineer with the Northern States Power Company from 1933 to 1940. Joining the FCC in January, 1941, he has been Assistant Monitoring Officer at Grand Island, Nebraska, and San Juan, Puerto Rico. He was then Intercept Officer at Wilmington, N. C., following which he was made Chief of the Intercept Section in Washington. Joining the FCC Broadcast Division in 1944, he was Chief of the Television Allocations Section, and became Chief of Applications Section of the TV Division in 1945. He is an Associate Member of the IRE.



ESTERLY C. PAGE (Colonel, AUSR) is a Consulting Radio Engineer, Washington, D. C. A consultant in Washington before World War II, he served overseas with the Signal Corps in charge of Invasian Radio Planning for the North African, Sicilian, Italian and Southern France campaigns. He received the Legion of Merit in 1946. In 1945 Mr. Page joined the Mutual Broadcasting Company as Engineering Director and subsequently became Vice-President of the network. Since January 1, 1947, he has been a Member of the firm of E. C. Page, Consulting Radio Engineers in Washington. He is a Senior Member of the IRE.

COMPARATIVE FIELD MEASUREMENTS—COMPARISON OF PROPAGATION CHARACTERISTICS BETWEEN CHANNEL 4 AND CHANNEL 7 IN THE WASHINGTON METROPOLITAN AREA—

A comparative study and analysis of the coverage of two Television stations, operating on Channel 4 (66-72 Mc) and Channel 7 (174-180 Mc) is presented.

The technique employed consists of simultaneous mobile field intensity recordings of both stations, employing the method specified by the FCC. The recordings are analyzed to present the field intensities exceeded for 10, 50, and 90% of the sector distances. The measured results are compared to the calculated coverage. Associated problems are also treated.

RAYMOND F. GUY, Manager of Radio Allocation Engineering, NBC, New York, started out in radio as an amateur. In World War I he served with the U. S. Army Signal Corps in France. In 1921, after graduation from Pratt Institute in Electrical Engineering, Mr. Guy started his broadcasting career with WJZ. He served five years as Broadcasting Section Head of the RCA Research Laboratories, and for 19 years has directed NBC's radio allocations. He has played an important role in international broadcasting. To his credit are 20 years of Television and 11 years of FM experience. Mr. Guy is a Director and a Fellow of the IRE.

TELEVISION AND FM TRANSMITTING PLANTS—

This paper will deal with unique problems which arise in connection with the design, construction and operation of Television and FM transmitting plants. The subject matter will include layouts, novel design features, terminology, monitoring, test equipment and adjustments and synchronization control. The NBC plants in New York, Washington and Los Angeles will be briefly described.

JOHN L. SEIBERT (B. Sc. in E. E., University of Pennsylvania) is Project Engineer for NBC, NYC. After early experience with Westinghouse, he has been in NBC's Radio Allocations Division, designing and building radio facilities for AM, FM, TV and International Broadcasting. Mr. Seibert has built many AM, FM and TV plants, and is currently completing the company's station atop Mount Wilson. He has had wide experience in the field of transmitting plant design engineering and construction. He is an Associate Member of the IRE.



JAMES D. McLEAN (M. S. in E. E., M.I.T.) is not only an engineer of national standing, but is also the capable Commercial Manager of PHILCO's TV station WPTZ in Philadelphia. After graduation in 1938 he joined the General Electric Company, where he worked in Radio, TV and Radar for 9 years. In 1945 he was appointed Manager of Sales, Transmitter Division of GE, where he remained until he joined Philca in 1947.

THE COMMUNITY TELEVISION STATION—

Development of community (small-city) television stations is economically necessary to obtain added coverage and revenues. Philca surveys indicate that a community television station may be constructed for a moderate investment. Two-way microwave relays connect this station to the nearest metropolitan station. Operation becomes economically feasible by utilizing network programs and gradually expanded local programming.





MERRILL A. TRAINER, Manager, TV Equipment Sales, RCA, Camden, has been intimately associated with major RCA TV developments since 1930. He assisted in the first successful TV relaying between Philadelphia and New York in 1932, and helped produce the first iconoscope cameras. In 1936 he helped build NBC's TV station, and, in 1937, he assisted in the design of TV equipment for Moscow. During the war, he supervised the Company's development of airborne TV equipment for guided missiles. He is an Associate Member of IRE.

TV STUDIO SYSTEMS—

Equipment layouts for television studios of small, medium and large size will be presented and discussed. Circuit arrangements for inter-connecting, switching and monitoring will be illustrated by diagrams. Various arrangements of the audio and video units in the studio control room, film control room and master control room will be shown on color slides.

FRANK E. CARLSON (B. Sc., University of Michigan) is an Illuminating Engineer of the Lamp Department of the General Electric Company in Nela Park, Cleveland. He and his associates are responsible for the application of light to the problem of picture projection, recording and reproducing sound on film in all phases of the lighting of photographic processes, including light for motion picture and television studios. He is a Member of SMPE, IES and the Photographic Society of America.

LIGHT SOURCES FOR TELEVISION STUDIO LIGHTING—

This paper describes the characteristics of several types of light sources in terms of the television studio lighting problem. Such factors as color quality, efficiency, and the degree to which the available light can be effectively utilized by reflectors or lenses are particularly emphasized. To the extent that fundamental data on pickup tube characteristics are available, an attempt is also made to evaluate each type of source in terms of pickup tube response.



WILLIAM C. EDDY (Captain, USN, Ret'd) is Director of Television for WBKB, Balaban and Kotz, Chicago. Following graduation from the Naval Academy in 1926, he served in the Submarine Service in China and Pacific waters. He joined Farnsworth Laboratories in 1932, and NBC New York in 1936. In 1940 he joined WBKB and in 1942 he returned to the Navy to command Radio Chicago. In 1947, with A. H. Broly, he designed WBKB's relay system. Captain Eddy holds over 100 radio and electronic patents and is a designer of lighting systems and lighting accessories for television.

REMOTE CONTROL TELEVISION LIGHTING—

With the novelty era of television fast disappearing, the audience now demands lighting and stage techniques comparable to motion pictures. Continuity of action in television and restricted staging areas prohibit using motion picture techniques. New equipment has been developed to solve this function of technical illumination. Remote controlled ceiling units, permitting complete flexibility and full utilization of new light sources, are fast becoming standard in television stations. A typical studio installation and the practical use of this new equipment will be the subject of this paper.

WILLIAM B. LODGE (M. S. in E. E., MIT), Network Advisory Member of the NAB Engineering Executive Committee, is Director of the General Engineering Department of CBS. Mr. Lodge joined CBS's engineering department in 1931, after two years experience in vacuum tube research at Bell Laboratories. From 1936 to 1942 he was CBS engineer in charge of their Radio Frequencies Division. From 1942 to 1944 he was Associate Director, Airborne Instrument Laboratory, Columbia University, for OSRD. In 1944 Mr. Lodge was appointed to his present position. He is Chairman of Panel 1, RTPB, and a Senior Member of the IRE.



THE CBS GRAND CENTRAL TELEVISION STUDIOS—

This paper describes the physical and technical facilities of the new WCBS-TV studios under construction in New York City. The video and audio systems design, meeting complex program production and technical operating requirements, will be enumerated. Emphasis has been placed on flexibility of operation. Consideration has been given to the importance of the audio system, continuity of service, and future expansion. Associated requirements including studio lighting and control, air conditioning, studio cues, and sound effects, as well as some major differences between these facilities and those required by average television stations, will be discussed.



ROBERT W. CLARK (E.E., Leland Stanford) is Television Operations Supervisor of NBC in New York City. In 1928 he joined RCA Communications at Balinas, California. In 1931 he joined NBC in San Francisco and, in 1932, was appointed their Assistant Chief Engineer at KNBC. In 1937 Mr. Clark was transferred to the NBC Television Development group, NYC, and cooperated in the development of the first portable TV equipment. From 1941 to 1944 he was engaged in war research projects. Returning to NBC in 1944 he was appointed to his present position. He is an Associate Member of IRE.

TELEVISION FIELD BROADCASTS, INCLUDING RADIO RELAY—

This will cover problems encountered in presenting television field programs in respect to preliminary surveys, equipment setup and program presentation. The relay portion of the talk will cover NBC's first experience in relay programs and will include recent information utilizing microwave relay equipment.

ERNEST H. SCHREIBER (M.A., Physics, University of California) is Engineer, Pacific Telephone and Telegraph Company, Los Angeles, having joined PT&T in 1923 at San Francisco. He has been located since 1929 in the Southern California Area office, where he is engaged in the engineering of audio and video network facilities. He is a Member of the IRE and Sigma Xi fraternity.



NETWORK FACILITIES FOR AUDIO AND VIDEO BROADCASTING—

This paper will describe the present methods for providing audio and video program channels for radio broadcasters and will tell of the mediums available now for transmission of audio and video signals: Regular cable pairs, coaxial conductors, special shielded pairs, and microwave radio systems. Present plans for providing service over principal intercity routes, types of facilities, band widths and general features will also be explained.



EDWARD EDISON (B. Sc., University of Nebraska) is Field Engineer attached to the Los Angeles Television Operation of RCA Service Company, Inc. In 1942 Mr. Edison joined the RCA Service Company. During the War years, as RCA Field Engineer, he was assigned to various Pacific Naval Bases in connection with radar installation and fleet instruction programs, in which connection he received a Navy Commendation. He is an Associate Member of the AIEE.

INSTALLATION AND MAINTENANCE OF TELEVISION RECEIVERS—

A brief history of RCA's growth in Television since 1936, leading up to the conception and launching of the RCA Service Plan for the consumer. A review of some related problems between the Television Broadcaster and the installation and service organization.

RICHARD H. RANGER, President of Rangertone, Inc., Newark, served with the Signal Corps in World War I. After the War, with RCA he worked on trans-oceanic telegraphy, broadcasting, and finally, facsimile. In 1930 he formed Rangertone, Inc., developing among other devices the first electronic organ in 1932. Working with the Signal Laboratories at Fort Monmouth prior to World War II, Mr. Ranger helped produce their first Radar. During the War, he was again with the Signal Corps, stationed first in the United States, and later with Technical Intelligence in Europe. He has adopted the German Magnetophone for use in the broadcasting field and has developed the professional magnetic tape recorder. He is a Member of the AIEE and Fellow of the IRE.

ABSOLUTE SPEED FOR MAGNETIC TAPE AND DEMONSTRATION OF TAPE REPRODUCTION AT 30" PER SECOND—

Factors determining the smoothness of the tape movement in a professional type magnetic recorder are the constancy of the tape pull of the three motors involved. First in importance is the synchronous motor. New hysteresis motors have proven particularly effective for these, and a particular adaptation will be described.



H. W. PANGBORN (B. Sc. EE, Pacific States University) is Assistant Chief Engineer of KNX-CBS, in Hollywood. Entering the broadcast field in 1932, Mr. Pangborn joined CBS Hollywood as Transmitter Engineer in 1936. He was made Transmitter Supervisor of KNX in 1943 and Facilities Engineer in September 1946. During the War Mr. Pangborn taught training courses in electronics at California Institute of Technology and graduate-level teaching at the University of Southern California.

MAGNETIC TAPE EDITING DEVICE—

A tape-editing machine which enables the precise location of particular words or portions of words is described. By means of a variable speed forward-reverse drive the tape may be quickly reeled to the desired section. A pickup head mounted on a drum is then rotated, scanning a 2-to-5 word section of tape repetitively. Aural and visual (oscilloscope) methods for locating an exact cutting point within the scanned section are described.

EVERETT L. DILLARD, Member-Elect, NAB Board of Directors, is General Manager of WASH, Washington, D. C., and KOZY, Kansas City, Mo. He entered radio in 1919 as an Amateur and in 1928 secured a license for (now) KCKN, Kansas City. In 1930 he organized the America Pezo Supply. He was later Chief Engineer of KXBY and experimental Television Station W9XAL. In 1933 he formed the well-known Commercial Radio Equipment Company. In 1936 Mr. Dillard became licensee of experimental FM Station W9XA, and later, K49KC, (now KOZY) which was placed in commercial operation in 1942. He established W3XL (now WASH) on 98.9 mc. Mr. Dillard organized the Continental FM network. He is a Member of the IRE, RTPB FM Panel, President of the FMA and a former Member of the FMBI.



THE ECONOMICS OF COVERAGE IN FM BROADCASTING—

The engineering considerations contributing to the best coverage consistent with economy and operation, and the required service area by FM Stations will be discussed. Advantages in coverage of FM; engineering aspects of single-site FM-AM operation; engineering aspects of a site selected exclusively for FM; the relation of transmitter power, antenna height, and antenna gain; planning for future FM expansion; effects of topography on coverage; site factors to be avoided; multipath distortion problems; allocation of the Class A FM Station; discussion of FCC standards for FM; and the use of FM by Radio Relay in FM Networking, will be discussed.



WILLIAM G. BROUGHTON (E. E., Cornell) is Sales Engineer of the Transmitter Division of General Electric Company. Joining GE in 1924, Mr. Broughton entered the radio field in 1930 and was engaged in aircraft radio development, participating in long-distance communication tests in the Caribbean with the U. S. Navy. In 1936 Mr. Broughton was appointed Supervisor of the Radio Engineering Section of the GE Advanced Course in Engineering. Since 1937 he has worked on special assignments dealing with emergency communication systems and application engineering on new-type radio equipment. He is an Associate Member of IRE.

A STUDIO-TO-TRANSMITTER RADIO RELAY SYSTEM—

A new 920-960 mc ST system for FM Broadcast service is described. Photographs, specifications, performance, and propagation characteristics are given. Application engineering and economic considerations are discussed. It is shown that a radio link between studio and transmitter is advantageous, especially where high-fidelity wire circuits are not already available, where the transmitter site is located in terrain difficult of access, or where severe climatic conditions are encountered.



DONALD J. NIGG (B. Sc. in EE, University of Kansas), Engineer, Broadcast Engineering Section of General Electric's Transmitter Division at Syracuse, has been engaged in the development and design of FM Broadcast equipment for the past three years. Employed by GE in the Test Department at Bridgeport, Conn., in June 1943 Mr. Nigg later worked on equipment for the armed forces. During 1944 he handled special radar assignments for the company at MIT's Radiation Laboratories. He is an Associate Member of IRE and a member of Tau Beta Pi.



DAVID PACKARD (E. E., Stanford) is President of Hewlett-Packard, Inc., of Palo Alto, California. From 1935 to 1938 he was with General Electric at Schenectady as an engineer in vacuum tube engineering. In 1939 with William H. Hewlett, he organized the Hewlett-Packard Company. During his work at the Hewlett-Packard Company he has been especially interested in development and application of measuring instruments. Most recently his work has included supervision of the development of monitoring and measuring equipment for broadcast applications. He is a Fellow of the IRE, Member of AIEE (now serving on the AIEE Committee on Electronic Instruments) and a Member of Phi Beta Kappa and Sigma Xi.

MEASURING EQUIPMENT AND TECHNIQUES FOR FM AND AM BROADCAST TRANSMITTERS—

Techniques and equipment involved in making gain, distortion, intermodulation, noise and residual hum measurements of AF channels in broadcasting transmitters are described, as well as the relative merits of measurements, precautions, and interpretations necessary to obtain reliable information.

Measurements of overall performance with emphasis on FM equipment; means of demodulating the carrier to provide the necessary measuring signals; the problem of measuring carrier deviation and modulation swing in FM transmitters; the application of monitoring equipment to measure residual AM modulation on FM transmitters, together with normal measurements, are described.

A. EARL CULLUM (B. Sc. in Communications Engineering, MIT) is a Consulting Radio Engineer of Dallas, Texas. In 1931 he became Communications Engineer with American Airlines. In 1934 and 1935 he was Vice President and Chief Engineer of the Southwest Broadcasting Company, Fort Worth. Since 1936 he has headed the firm of Consulting Radio Engineers in Dallas, Texas. In 1942 he was appointed Research Associate at the Radio Research Laboratory, Harvard, and in 1943-1945 was Associate Director of the Laboratory. Mr. Cullum is a Fellow and Director of the IRE.



FACTORS AFFECTING PERFORMANCE OF DIRECTIONAL ANTENNAS—

A brief review will be made of the technical aspects that must be considered in designing directional antennas. This review will bring out not only the problems of protection and coverage, but will also bring out the aspects that affect the stability and efficiency of directional antennas. A review will then be made of the modern methods used to calculate, adjust, and maintain directional antennas.



ROBERT A. FOX is Engineer, General Engineering Department for the Richards Stations (WGAR-WJR-KMPC) Cleveland, Ohio. While attending Ashland College and the University of Illinois he worked as a Plant Engineer for the Star Telephone Company, becoming an engineer there from 1926 to 1928. In 1928 Mr. Fox was appointed Chief Engineer of the Lorain Telephone Company where in 1931 he established its ship-to-shore telephone service on the Great Lakes. In 1936 he joined UBC in Cleveland and in 1941 he joined WGAR. On leave of absence in 1942, he conducted war research at Columbia University. In 1943 the RFC placed him in charge of their communications in the South American area. From 1944 to 1945 he was a Combat Scientist with OSRD, serving with distinction with the Army in both European and Pacific theaters as an Operational Analyst. He is a Senior Member of IRE.

A SYSTEM FOR MEASURING CO-CHANNEL INTERFERENCE—

This paper describes a system for continuously recording the ratio of desired to undesired signal for stations operating on the same channel. The system employs a receiver having constant output over a wide range of input voltage followed by a selective amplifier which isolates the heterodyne voltage when an undesired signal is present. The selective amplifier operates a graphic recorder whose reading is proportional to the ratio of desired to undesired signal.

HALDON A. LEEDY (Ph. D., University of Illinois) is Acting Director of Armour Research Foundation, Chicago, Illinois. From 1933 to 1938 Dr. Leedy held the post of Assistant in Physics at the University of Illinois. In 1938 he joined the Armour Research Foundation as Physicist, and in 1944 became Chairman of Physics Research, which position he held until 1948. He is a member of Sigma Xi, Physics Club of Chicago, the Acoustical Society of America, the ASA, the American Society for Testing Materials, the American Institute of Physics, the AIEE, and the Illinois State Academy of Science, and a Senior Member of IRE.



THE DEVELOPMENT OF MAGNETIC RECORDING LEADING TO STEREOPHONIC SOUND and A DEMONSTRATION OF STEREOPHONIC SOUND—

Recent improvements in the design of recording heads, the use of high frequency bias, and improved magnetic materials have resulted in a remarkable increase in the quality of magnetic sound. The talk will be illustrated by a demonstration of the basic principles of magnetic recording and a demonstration of a stereophonic sound reproduction system, with sound recorded on three magnetic tracks, simultaneously, on a single paper tape corresponding to three microphones placed in the sound field. Reproduction is obtained by placing loudspeakers in positions corresponding to those of the original sound source.

J. L. HATHAWAY (B. Sc. in E. E., University of Colorado) is Assistant Manager of Engineering Developments, NBC, New York. In 1929 he joined NBC where, as a member of the development group, he has since engaged in all fields of NBC's engineering activities. While on leave of absence from 1941 to 1943 he served as Special Research Associate of Harvard University, performing underwater sound developments work for the U. S. Navy. In October 1947 he was appointed to his present position. He is a Senior Member of the IRE.

DEVELOPMENTS IN SOUND AND RELAY BROADCAST EQUIPMENT—

A newly designed pocket-type transmitter and a miniature field pick-up amplifier are described. These are highly effective, incorporating several new and useful facilities. The transmitter represents a great improvement over similar prewar transmitters, and the field amplifier fulfills the need for a high-quality easily-operated unit which can be carried in a standard briefcase.

LESTER H. BOWMAN is Manager of Technical Operations, Western Division of CBS with headquarters in Hollywood. He attended the College of the City of New York and Valparaiso University in Indiana. Mr. Bowman, a veteran wireless operator, joined CBS Engineering Department in New York City in 1929. In 1931 he was appointed Chief Engineer of CBS Washington Station WTOP (then WJSV), in 1936 transferring to his present position with CBS-KNX. Mr. Bowman is a Member of IRE.



MODERN DESIGN FEATURES OF THE CBS STUDIO AUDIO FACILITIES—

The design of a recently completed broadcasting studio audio-control console, with facilities capable of handling the production of the largest and most elaborate radio productions, is described. This unit, although comparable in size to a standard office desk, contains as much equipment as formerly required three or more standard equipment racks. Many new and novel features are included, and the performance is well within requirements set forth for AM, FM and Television audio facilities. Although designed primarily for broadcasting, the fundamental ideas and methods are applicable to other services.



MUTUAL-DON LEE BROADCASTING SYSTEM BUILDING

CLIFF E. HALLMAN, ARCHITECT
 HERMAN HUNTER, ARCHITECT
 W. W. WILSON, ARCHITECT, CHICAGO, ILL.

FRIDAY, MAY 21, 1948 EVENING INSPECTION TOUR—6:30-8:30 P. M.

**INSPECTION OF MUTUAL-DON LEE BROADCASTING SYSTEM STUDIOS
 1313 VINE STREET, HOLLYWOOD, CALIFORNIA**

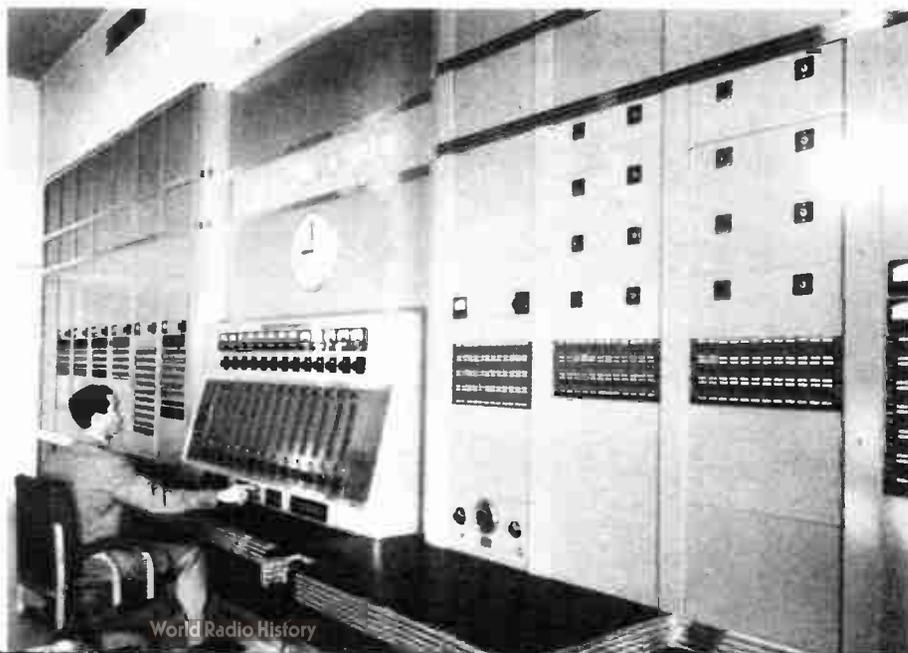
by special invitation of Lewis Allen Weiss and in co-operation with the Western Electric Company. These most modern studios will be open especially for NAB Broadcast Engineering Conference Registrants.

LADIES ARE INVITED TO ATTEND

HOSTS:

Walter Carruthers, Chief Engineer, Studio Operations
 Harry Lubcke, Technical Television Director
 Frank Kennedy, Chief Engineer, Transmitter & FM Operations

Busses Leave Biltmore Hotel at 5:30, 6:00 and 6:30 P.M.



SATURDAY, MAY 22, 1948

**INSPECTION TRIP TO FAMED
MILE-HIGH-PLUS MOUNT WILSON**

In charge of Arrangements: L. H. Bowman, CBS-KNX,
Hollywood

Special Busses, each seating 35 passengers, will leave from the Biltmore Hotel, Los Angeles, at approximately 10-minute intervals from 9:30 to 10:00 Saturday morning, May 22nd.

The scenic trip over the new "high gear" Angeles Crest Highway will require about two hours.

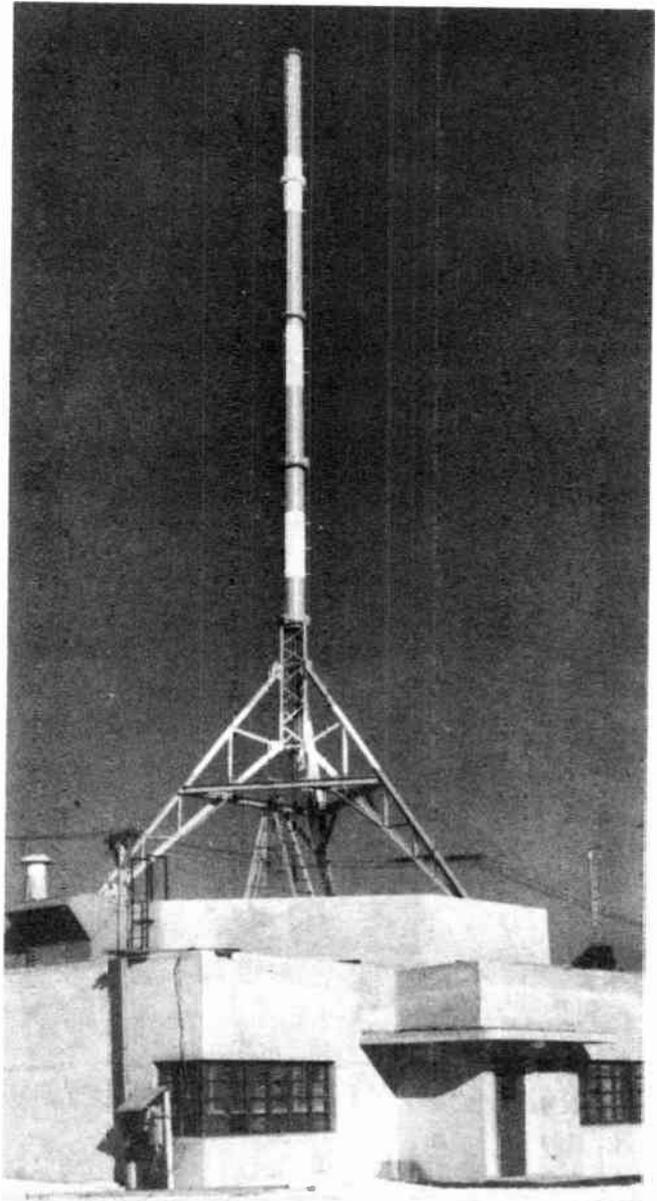
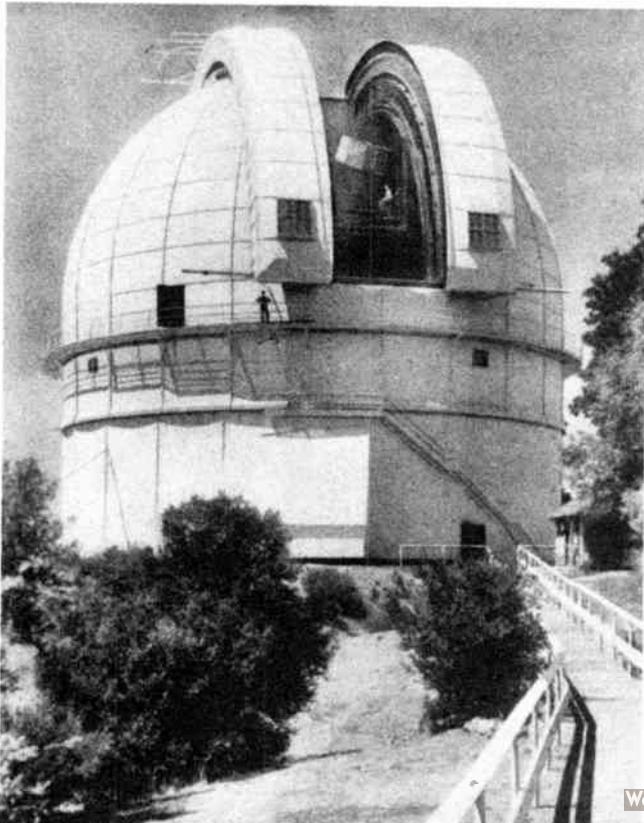
Those making the trip will see the many FM and TV stations now in operation and under construction, and PT&T TV and Communications Plant. Additionally, a visit has been arranged to see the famed Mount Wilson 100" reflecting telescope (the world's second largest telescope). Visitors will also be able to see the 150' sun tower, other observatories, and the astronomical museum. On clear days, the view from Mount Wilson's 5,714' elevation, overlooking 70 cities and fifty miles of coastline, is one of the world's greatest sights.

A light lunch will be obtainable at the Inn.

Returning busses will start back about 3:00 p.m. for arrival at the Biltmore at around 5:00-5:30 p.m.

LADIES ARE ESPECIALLY INVITED TO MAKE THIS TRIP

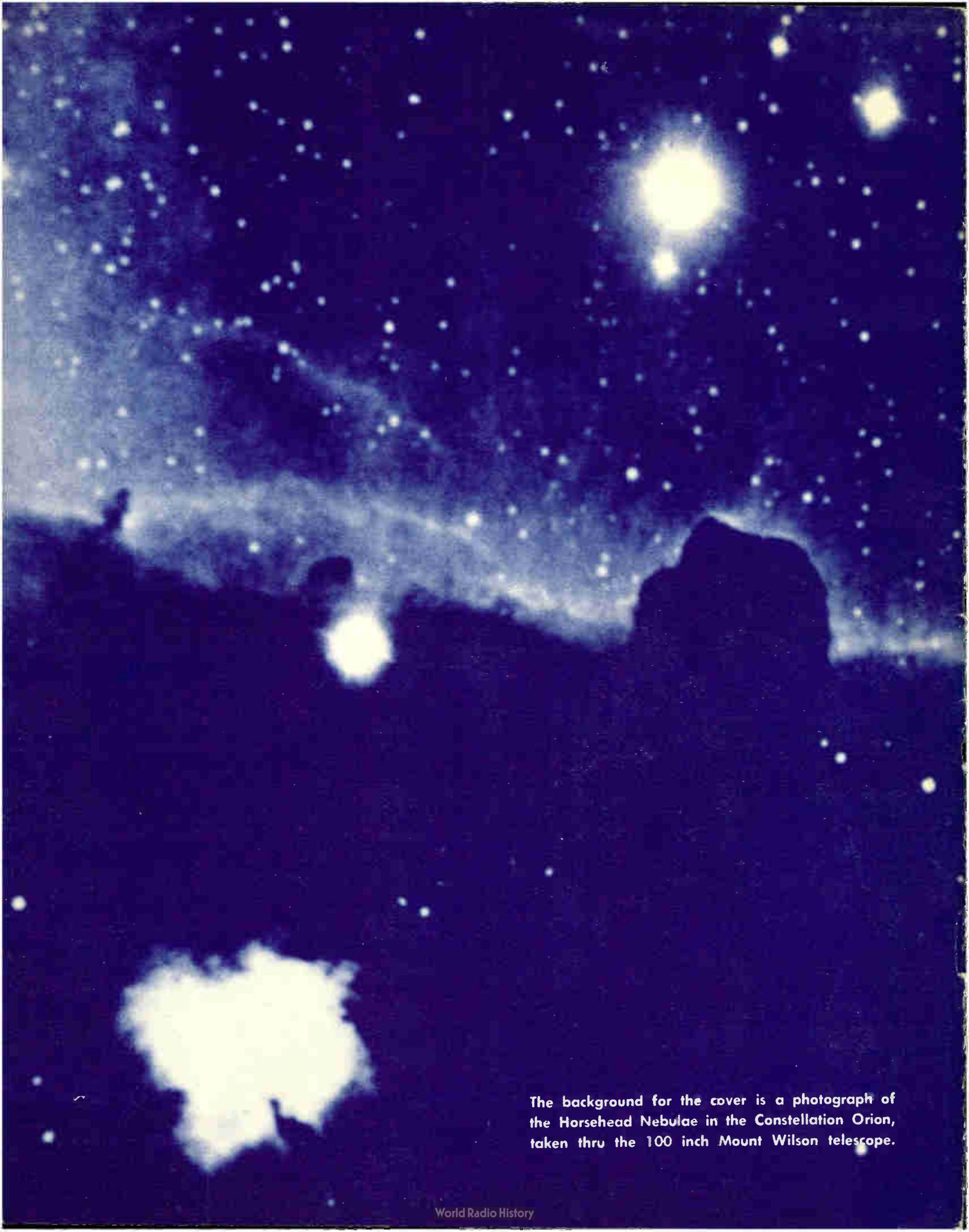
Mount Wilson Observatory



CBS-KNX, FM

PT&T TV and Communications Plant





The background for the cover is a photograph of the Horsehead Nebulae in the Constellation Orion, taken thru the 100 inch Mount Wilson telescope.

NAB LIBRARY

NATIONAL ASSOCIATION of BROADCASTERS

26th Annual Convention

ENGINEERING CONFERENCE

MAY 20 - 21 - 22, 1948

BILTMORE HOTEL . . . LOS ANGELES, CALIFORNIA

DAILY REGISTRATION LIST

No. 2

Friday, May 21, 1948

Name—Station or Firm—City	Hotel	Room	Name—Station or Firm—City	Hotel	Room
Abbott, Mrs. Jean, Pacific Palisades, Calif.	Biltmore	7358	Campbell, Alan T., KNOB, Long Beach, Calif.		
Adair, George P., Washington, D. C.	Biltmore	9321	Carrick, Jack, L. A. Times, Los Angeles, Calif.		
Adams, Val, Radio Daily, New York, N. Y.	Biltmore	3229	Case, Myron D., ABC/KGO, San Leandro, Calif.		
Akerman, Ben, WGST, Atlanta, Ga.	Town House	1105	Chandler, George C., CJOR LIMITED, Vancouver, B. C., Canada	Clark	1030
Albertson, Fred W., Washington, D. C.	Biltmore	11323	Chandler, H. J., KFLW, Klamath Falls, Ore.	Clark	553
Allen, W. H., KALB, KALB-FM, Alexandria, La.	Biltmore	4328	Chatfield, Blake, NBC, Los Angeles, Calif.		
Amoo, Lloyd R., KIOA, Des Moines, Iowa	Biltmore	8217	Chapin, Wells R., KWGD, St. Louis, Mo.		
Anderson, Arthur C., KTAR, Phoenix, Arizona	Biltmore	817	Clark, Plez S., KFH, Wichita 2, Kansas		
Anderson, H. Vernon, KLOU, Lake Charles, La.	Alexandria	959	Clark, Robert W., WNBT, New York 20, N. Y.		
Antony, W. E., KWKH, Shreveport, La.	Biltmore	6327	Clay, Henry B., Gen. Mgr., KWKH, Shreveport, La.		
Anzjon, Arne, KXLF, Butte, Mont.	Biltmore	5208	Clayton, Vincent E., KSL, Salt Lake City, Utah		
Arney, C. E., Jr., NAB, Washington, D. C.	Mayfair		Clough, Reginald, Tide, New York, N. Y.		
Arnard, Juan P., Standard Electric Argentine, Buenos Aires, Argentina	Alexandria	985	Coghshall, P. C., Federal Tel. & Radio Corp., Clifton, N. J.		
Arnold, George, Jr., WTAD—WTAD-FM, Quincy, Ill.	Biltmore	2117	Cole, Burt R., Graybar Electric Co., Inc., San Francisco, Calif.		
Arnou, Bud, UAW, Detroit, Mich.	Biltmore	2117	Cole, H. J., Federal Tel. & Radio Corp., Clifton, N. J.		
Austin, Allan S., The Austin Company	Ambassador	210	Collins, C. B., Broadcast Service Bureau, Washington, D. C.		
			Compton, Robin D., Television Consulting Engineer, Norristown, Pa.		
Bailey, Bill, FMA, Washington, D. C.	Biltmore	9230	Conn, Joseph W., KTML, KTTV, Los Angeles, Calif.		
Baker, Kenneth, NAB, Washington, D. C.	Biltmore	7235	Cormack, Allan N., KQW, San Francisco, Calif.		
Baldwin, John M., KDYL, Salt Lake City, Utah	Biltmore	10323	Cosman, J. W., Fed. Tel. & Radio Corp., Clifton, N. J.	Knickerbocker	315
Barnes, Bertram B., WAPO, Chattanooga, Tenn.	Biltmore	7234	Cowperthwait, Hart, FCC, Washington, D. C.		
Barr, James, FCC, Washington, D. C.	Biltmore	11319	Crain, G. D., Jr., Advertising Age	Town House	
Basnigh, Jessie, NAB, Washington, D. C.	Biltmore	524	Crater, Rufus, Broadcasting		
Bassett, John A., Televiser Magazine, Los Angeles, Calif.	Biltmore	1205	Craven, T. A. M., WOL, Washington 6, D. C.		
Bauriedel, John, KIEM, Eureka, Calif.	Biltmore	10331	Crissey, Howard, Raytheon Mfg. Co., Dallas 8, Texas		
Beatty, J. Frank, Broadcasting Magazine, New York, N. Y.	Biltmore	319	Crumbaugh, Luther, KGER, Long Beach, Calif.		
Belle Isle, A. G., WSYR, Syracuse, N. Y.	Biltmore	10331	Cullum, A. Earl, Jr., Consulting Radio Engineer, Dallas, Tex.		
Benedict, E. J., Federal Tel. & Radio Corp., Clifton, N. J.	Biltmore	319	Curran, George, KFI, Los Angeles, Calif.		
Beranek, J. A., KNX-FM, Los Angeles, Calif.	Biltmore	319	Curtis, James R., KFRO, Longview, Texas		
Berlin, Charles V., KSCO, Santa Cruz, Calif.	Biltmore	1409			
Bernice, J. J., KOMA, Oklahoma City, Okla.	Biltmore	4301	Dabadie, J. Roy, WJBO, Baton Rouge, La.		
Bice, Max H., KTNT, Tacoma 1, Wash.	Biltmore	853	Davidson, Herb, KWIL, Albany, Oregon		
Bickett, Harold, KTAR, Phoenix, Ariz.	Alexandria	675	Davis, George C., Consulting Radio Engineer, Washington, D. C.	Clark	853
Binns, F. D., WLAC, Nashville, Tenn.	Alexandria	675	Dawson, James, NAB, Washington, D. C.	Biltmore	
Bird, William, Pasadena Independent, Pasadena, Calif.	Clark	836	De Ryder, Herbert, WAAT, WAAT-FM, WATV, Newark, N. J.		
Birkenhead, Warren, Capitol Records, Inc., Hollywood, Calif.	Clark	836	Dewing, Harold, WCVS, Springfield, Ill.		
Bishop, J. Dige, WCTA, Andalusia, Alabama	Clark	836	Dickinson, Irvin, McClatchy Broadcasting Co., Sacramento, Calif.		
Black, H. Neil, KSMO, San Mateo, Calif.	Clark	836	Dieringer, Frank A., WFMI, Youngstown, Ohio		
Blatterman, H. L., KFI, Los Angeles 54, Calif.	Clark	836	Doherty, Richard P., NAB, Washington, D. C.		
Blaylock, L. B., Federal Telephone and Radio Corporation, Clifton, N. J.	Town House		Doolittle, Franklin, WDRG, Hartford, Conn.		
			Downey, C. E. "Bud", KROW, Oakland, Calif.		
Bloom, J. D., Jr., WWL, New Orleans, La.	Hollywood Plaza	304	Dumm, Wesley I., KSFO, San Francisco, Calif.		
Blumenthal, Les, Sponsor Mag.	Biltmore	4133	Dunn, Frank, KPAS, Banning, Calif.	Savoy	407
Boatright, B. C., KWTC, Barstow, Calif.	Biltmore	4133			
Boerner, T. J., RCA, Collingswood, N. J.	Clark	931	Ebel, A. James, WMBD, Peoria, Illinois	Ambassador	561
Bolen, Murray, Ward Wheelock Agency, Hollywood, Calif.			Eddy, W. C., WBKB, Chicago, Ill.	Biltmore	9201
Bookwalter, Louis S., KOIN, Portland, Oregon	Alexandria		Edison, E., RCA Service Co., Inc., Lynwood, Calif.		
Born, Leo W., WTAD, Mason City, Iowa	Clark	622	Edmunds, Fred, City Wire, Long Beach, Calif.		
Boundy, Glenn G., Fort Industry Co., Detroit, Mich.	Biltmore	4105	Eisenminger, Dick, NBC, Los Angeles, Calif.		
Bowman, Les., KNX, Los Angeles, Calif.	Biltmore	5339	Eitel, W. W., KSBR, San Bruno, Calif.		
Boyd, Gerald F., WPAV, Portsmouth, Ohio	Alexandria	1068	Emm, Ted, KBMT, San Bernardino, Calif.		
Braum, Cyril, F.C.C., Washington, D. C.	Alexandria	1068	Engelwood, Arthur, Hollywood Reporter, Hollywood, Calif.		
Breed, Lewis B., WSPR, Longmeadow, Mass.	Biltmore		Eriksen, J. W., The Austin Company, New York 6, N. Y.		
Breeding, Charles S., KRUX, Phoenix, Ariz.	Biltmore		Evans, A. E., KGO, San Francisco, Calif.		
Bremer, Frank V., WAAT, WAAT-FM, WATV, Newark, N. J.	Biltmore	7356	Ewing, George W., KPXM, San Bernardino, Calif.		
Brenner, Joseph, FCC, San Francisco, Calif.	Biltmore	2126			
Briggs, M. R., Westinghouse Electric Corp., Baltimore, Md.	Biltmore	2126	Fair, Harold, NAB, Washington, D. C.		
Broadhead, D. K., Allied Record Mfg. Co., Inc., Hollywood, Calif.	Biltmore	2126	Faithorn, Nathaniel, KSFO, San Francisco, Calif.		
Brock, George, KRNO, San Bernardino, Calif.	Rosslyn	1034	Farver, Don, NAB, Washington, D. C.		
Brott, Francis J., KOMO, Seattle, Wash.			Fehlman, Robert C., WHBC, Canton, Ohio		
Broughton, Wm. G., General Electric Co., Syracuse, N. Y.	Biltmore	3354	Felthousen, Arthur Q., C. P. MacGregor Company, Hollywood, Calif.		
Brown, Harold R., KFRE, Fresno 2, Calif.	Biltmore	11123			
Brown, J. S., Andrew Corp., Chicago, Ill.	Biltmore	6321	Fetzer, John E., WKZO, Kalamazoo, Mich.	Ambassador	228
Brown, Orrin H., KSBR, San Bruno, Calif.	Biltmore	3107	Findley, L. K., Collins Radio Co., Cedar Rapids, Iowa	Biltmore	11127
Brumbach, Eleanor, Broadcasting, Washington, D. C.	Biltmore	2237	Fishler, Alan, Billboard, Hollywood, Calif.		
Caesar, George P. E. Jr., KCBC, Milwaukee, Wis.	Chapman Park	501			
Callen, Rob't J., Standard Radio, Los Angeles, Calif.	Biltmore	2215			

IMPORTANT FINAL AGENDA

**NAB Broadcast Engineering Conference
Biltmore Hotel, Los Angeles • 1948**

TIMES, DATES and LOCATIONS

of
ALL SESSIONS, LUNCHEONS

ENTERTAINMENT

and
INSPECTION TOURS

(Note especially changes in meeting and luncheon places)

Thursday, May 20

- 9:30 a.m.** Morning Session
Music Room, Galeria, Biltmore
- 12:30 p.m.** Luncheon
Biltmore Bowl
- 2:15 p.m.** Afternoon Session
Music Room, Galeria, Biltmore
(Note: There will be a meeting in the Music Room immediately following this session which will be of interest to IRE Members)

Friday, May 21

- 9:00 a.m.** Morning Session
Biltmore Theater
- 12:30 p.m.** Luncheon
Music Room, Galeria, Biltmore
- 2:15 p.m.** Afternoon Session
Biltmore Theater
- 5:00 p.m.** Sessions close promptly
- 6:30 p.m.** Buses, through courtesy of Western Electric, depart **Grand Street Entrance**, Biltmore, for Mutual-Don Lee Studios. Ladies invited.
- 8:30 p.m.** Buses, through courtesy of RCA, depart Mutual-Don Lee Studios **promptly** for Large Screen Television Demonstration at Warner Brothers Studios, Burbank. Ladies invited.

(See Special Event Announcement)

Note: Special tickets are necessary for entrance to Warner Bros. Studios. Extra tickets for entrance to Warner Brothers and buses to Mutual-Don Lee Studios may be obtained at Registration and Information Desks. No tickets required for buses from Mutual-Don Lee to Warner Brothers.

Saturday, May 22

- 9:30 a.m.** Buses leave from **Grand Street** side of Biltmore to for Mount Wilson Inspection Tour. You are urged to obtain tickets for this tour **early** to insure sufficient Bus facilities. Ladies are invited. Walking shoes suggested. Bring your camera.
- 10:00 a.m.** Buses, through courtesy of RCA, depart Mutual-Don Lee Studios **promptly** for Large Screen Television Demonstration at Warner Brothers Studios, Burbank. Ladies invited.
- Note: Those desiring to stay at Mount Wilson for the special astronomy tour beginning at 4:30 p.m. will not arrive back at Biltmore until about 8:00 p.m.
- Free theater tickets for Ladies are available at Registration Desk.

Engineering Department Headquarters
Room 2324, Biltmore
Michigan 1011

Name—Station or Firm—City

Hotel Room

Flaherty, Joseph A., WDAF, Kansas City, Mo.....	Biltmore—10261
Florance, Herbert C., KDFC, Sausalito, Calif.....	Clark—825
Flynn, R. M., KRDL, Dallas, Texas.....	Beverly Hills—B16A
Fox, Robert A., WGAR, Cleveland, Ohio.....	Biltmore—2338
Franken, Jerry, Billboard, New York, N. Y.....	Biltmore—5303
Freitag, Willis O., KRKD, Los Angeles, Calif.....	Biltmore—5303
Fritschel, E. H., WRGB, Schenectady, N. Y.....	Biltmore—5303
Frost, E. "Jack", RCA, Los Angeles, Calif.....	Biltmore—5303
Fruth, Helen, NAB, Washington, D. C.....	Biltmore—5303
Ganzenhuber, J. H., Western Electric Co., Inc., New York, N. Y.....	Biltmore—4350
Gaskill, Marvin L., RCA Exhibit, Marlton, N. J.....	Biltmore—9124
Gihring, H. E., RCA, Camden, N. J.....	Clark—7-6
Gillett, Glenn D., Glenn D. Gillett & Assoc., Washington, D. C.....	Biltmore—2237
Glickman, David, Broadcasting, Hollywood, Calif.....	Biltmore—2237
Grater, Vincent M., KHJ, Los Angeles, Calif.....	Biltmore—8355
Gray, William A., Raytheon Manufacturing Co., Waltham 54, Mass.....	Biltmore—3132
Green, John A., Collins Radio Co., Cedar Rapids, Iowa.....	Biltmore—3132
Gresham, Stokes, Jr., WISH, Indianapolis, Ind.....	Biltmore—5121
Griffith, Pat, NAB, Washington, D. C.....	Alexandria—1173
Grove, Wm. C., KFBC, Cheyenne, Wyo.....	Biltmore—2111
Gundy, P. L., Graybar Electric Co., Detroit, Mich.....	Beverly Hills—321
Gunther, Frank A., Radio Engineering Laboratories, Inc., L. I. City, N. Y.....	Beverly Hills—321
Guy, Raymond, NBC, New York, N. Y.....	Beverly Hills—321
Haas, C. Harvey, KFSG-KKLA-FM, Los Angeles, Calif.....	Biltmore—4304
Hall, Gladys, NAB, Washington, D. C.....	Mayfair
Halstead, Charles E., Diamond H Ranch Broadcasters, Auburn, Calif.....	Town House—1007
Hamann, Gerard Peter, WBRC, Birmingham, Ala.....	Biltmore—4104
Hampton, C. A., Federal Tel. & Radio Corp., Clifton, N. J.....	Beverly Hills—321
Hannay, Jack, INS.....	Baltimore—6127
Hanna, Eloise H., WBRC, Birmingham, Ala.....	Biltmore—5217
Hanson, O. B., NBC, New York, N. Y.....	Alexandria—968
Harmon, R. N., Westinghouse Electric Corp., Baltimore, Md.....	Ambassador—306
Harrison, C. J., Federal Tel. & Radio Corp., Clifton, N. J.....	Alexandria
Hartenbower, E. K., KCMO, Kansas City, Mo.....	Alexandria—677
Hartmann, R. T., L. A. Times, Los Angeles, Calif.....	Los Angeles, Calif.....
Haselman, Albert, Communication Products Company, Inc., Keyport, N. J.....	Los Angeles, Calif.....
Hassett, Vern, KSRO, Santa Rosa, Calif.....	Los Angeles, Calif.....
Hathaway, Jarrett L., NBC, New York, N. Y.....	Los Angeles, Calif.....
Hellman, Jack, Variety, Hollywood, Calif.....	Los Angeles, Calif.....
Herold, Joseph, WOW, Omaha, Neb.....	Los Angeles, Calif.....
Heyn, Howard, Associated Press, Los Angeles, Calif.....	Los Angeles, Calif.....
Hill, Gladwin, New York Times, Los Angeles, Calif.....	Los Angeles, Calif.....
Hilliard, John, Capitol Transcriptions.....	Los Angeles, Calif.....
Hirsch, Oscar C., KFVS, Cape Girardeau, Mo.....	Los Angeles, Calif.....
Hochstrasser, L. B., Wall Street Journal, Los Angeles, Calif.....	Los Angeles, Calif.....
Hodgson, Richard, Paramount Pictures, Inc., New York, N. Y.....	Los Angeles, Calif.....
Hoffman, Edward, Federal Tel. & Radio Corp., Clifton, N. J.....	Los Angeles, Calif.....
Holsclaw, Ray, KVOA, Tucson, Ariz.....	Los Angeles, Calif.....
Hood, Paul C., Daily Oklahoman, Oklahoma City, Okla.....	Los Angeles, Calif.....
Hopkins, Floyd, Printers Ink, Los Angeles, Calif.....	Los Angeles, Calif.....
Hoskins, Cecil B., WWNC, Asheville, N. C.....	Los Angeles, Calif.....
Howard, Royal V., NAB, Washington, D. C.....	Los Angeles, Calif.....
Howell, Rex, KFJ, Grand Junction, Colo.....	Los Angeles, Calif.....
Hurd, Freeman L., IBEW, Washington, D. C.....	Los Angeles, Calif.....
Hurley, John, Hollywood Reporter, Hollywood, Calif.....	Los Angeles, Calif.....
Hurt, Edward P., KFXD & KFXD-FM, Nampa, Idaho.....	Los Angeles, Calif.....
Ing, George W., KONO & KONO-FM, San Antonio, Texas.....	Alexandria—504
Isberg, R. A., KRON-FM, KRON-TV, San Francisco, Calif.....	Alexandria—1157
Jackson, A. H., Blaw Knox Co., Pittsburgh, Pa.....	Biltmore—4319
Jarvis, Leo P., KPNC, Bakersfield, Calif.....	Town House
Jeffers, Charles L., WOAI, San Antonio, Texas.....	Biltmore—8203
Johnson, Albert D., KOY, Phoenix, Ariz.....	Biltmore—11208
Johnson, E. M., Mutual Broadcasting System, New York.....	Biltmore—11208
Johnson, F. M., KBUC, Corona, Calif.....	Town House—912
Johnson, Seymour F., KFI, Los Angeles, Calif.....	Biltmore—4355
Johnson, Leslie C., WHBF, WHBF-FM, Rock Island, Ill.....	Alexandria—1185
Johnston, Col. George C., WDBO, Orlando, Fla.....	Biltmore—8339
Jones, Donald L., KCIL, Houma, La.....	Biltmore—7110
Josephsen, A., RCA, New York, N. Y.....	Hayward—939
Kahle, Douglas D., KCOL, Fort Collins, Colo.....	Clark—1002
Karpisek, Wm. J., KCNA, Tucson, Ariz.....	Clark—931
Keachie, Jas. H., Radio Corp. of Am., Cleveland, Ohio.....	Clark—931
Kean, W. F., Andrew Corporation, Chicago, Ill.....	Biltmore—11318
Kearney, Lt. Col. Robt. E., GSC USA, A.F.R.S., Los Angeles, Calif.....	Biltmore—10101
Kentner, C. D., W3XEP-TV, Camden, N. J.....	Biltmore—4330
Kerner, Sam, KWIK, Burbank, Calif.....	Beverly Hills
King, Art, Broadcasting, New York, N. Y.....	Beverly Hills
Kirsch, Marvin, Radio Daily, New York, N. Y.....	Beverly Hills
Kreiger, Herman, KHUZ, Borger, Texas.....	Beverly Hills
Kugel, Frederick A., Television, New York, N. Y.....	Beverly Hills
La Marque, J. W., Graybar Elec. Co., Inc., New York 17, N. Y.....	Biltmore—2119
Lamons, Robert, Federal Tel. & Radio Corp., Clifton, N. J.....	Savoy—704
Landsberg, Klaus, KTLA, Los Angeles, Calif.....	Biltmore—3227
Lavery, Harry J., RCA Victor Division, Millville, N. J.....	Clark—827
Lawrence, Waller L., RCA Victor Division, Camden, N. J.....	Clark—827
Layne, C. N., KID, Idaho Falls, Idaho.....	Clark—827
Leake, Paul E., Consultant, Sacramento, Calif.....	Clark—827
Lee, Robert E., KFMB, San Diego, Calif.....	Clark—827

PROGRAM

Friday, May 21, 1948

MORNING SESSION — 9:00 A. M.

Presiding: James Ebel, WMBD, Peoria, Ill.

Member, NAB Engineering Executive Committee

THE ECONOMICS OF COVERAGE IN FM BROADCASTING

Everett Dillard, General Manager of WASH (Washington, D. C.) and KOZY (Kansas City, Missouri) and Member-Elect, NAB Board of Directors

A STUDIO TO TRANSMITTER RELAY RADIO SYSTEM

W. G. Broughton, Assistant Sales Manager, Broadcast Equipment Division, General Electric Company, Schenectady, New York, and
D. J. Nigg, Engineer, Transmitter Division, General Electric Company, Schenectady, New York

MEASURING EQUIPMENT AND TECHNIQUES FOR FM AND AM BROADCAST TRANSMITTERS

David Packard, President, Hewlett-Packard Corporation, Palo Alto, California

FACTORS AFFECTING PERFORMANCE OF DIRECTIONAL ANTENNA SYSTEMS

A. Earl Cullum, Consultant, Dallas, Texas

A SYSTEM FOR MEASURING CO-CHANNEL INTERFERENCE

Robert A. Fox, General Engineering Department, WGAR, WJR, KMPC, Cleveland, Ohio

LUNCHEON — 12:30 - 2:15 P. M.

Presiding: Neal McNaughten,

Assistant Director, NAB Department of Engineering

THE DEVELOPMENT OF MAGNETIC RECORDING LEADING TO STEREOPHONIC SOUND and A DEMONSTRATION OF STEREOPHONIC SOUND

Dr. Haldon A. Leedy, Acting Director, Armour Research Foundation, Chicago, Illinois.

AFTERNOON SESSION — 2:30 P. M.

Presiding: Orrin W. Towner,

Technical Director, WHAS, Louisville, Kentucky
Chairman, NAB Engineering Executive Committee

DEVELOPMENTS IN SOUND AND RELAY BROADCAST EQUIPMENT (Demonstrations)

J. L. Hathaway, Assistant Manager, Engineering Developments, National Broadcasting Company, New York

MODERN DESIGN FEATURES OF CBS STUDIO AUDIO FACILITIES

Lester H. Bowman, Manager, Technical Operations, Western Division of Columbia Broadcasting System, Hollywood, California, presenting paper prepared by R. B. Monroe and

C. A. Palmquist, both of the General Engineering Department, Columbia Broadcasting System, New York

FCC - INDUSTRY ROUNDTABLE

Presiding: Royal V. Howard,

Director, NAB Department of Engineering

FOR THE COMMISSION

George E. Sterling, Commissioner
John A. Willoughby, Acting Chief Engineer
Cyril M. Braum, Chief, FM Broadcast Division
James A. Barr, Chief, Standard Broadcast Division
Hart S. Cowperthwait, Acting Chief, TV Broadcast Division

FOR INDUSTRY:

Neal McNaughten, NAB
Orrin W. Towner, WHAS
J. R. Poppele, WOR
Frank Marx, ABC
Paul A. deMars, Raymond M. Wilmotte, Inc.