NBS

Technical Note 304

BIBLIOGRAPHY ON TROPOSPHERIC PROPAGATION OF RADIO WAVES

WILHELM NUPEN

U. S. DEPARTMENT OF COMMERCE
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NATIONAL BUREAU OF STANDARDS

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BIBLIOGRAPHY ON TROPOSPHERIC PROPAGATION OF RADIO WAVES

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Central Radio Propagation Laboratory
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Boulder, Colorado

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DBS .... U. S. National Bureau of Standards, Washington, D. C.
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DLC ...... Library of Congress, Washington, D. C.
DWB ...... U. S. Weather Bureau, Suitland, Maryland
DN-HO .... U. S. Navy Hydrographic Office, Suitland, Maryland

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BIBLIOGRAPHY ON TROPOSPHERIC PROPAGATION OF RADIO WAVES

INTRODUCTION

This is the fifth in a series of bibliographies being prepared by the M&GA staff of the American Meteorological Society for the Boulder Laboratories of the National Bureau of Standards. The first four were:

(1) Bibliography on Ionospheric Propagation of Radio Waves (1923-1960). NBS Technical Note No. 84, Oct. 1960. (1404 items)

(2) Bibliography on Meteoric Radio Wave Propagation. NBS Technical Note No. 94, May 1961. (368 items)

(3) Bibliography on Auroral Radio Wave Propagation. NBS Technical Note No. 128, Jan. 1962. (297 items)

(4) Bibliography on Atmospheric Aspects of Radio Astronomy. NBS Technical Note No. 171, May 1963. (1013 items)

The present bibliography on Tropospheric Propagation of Radio Waves contains over a thousand abstracts or titles taken from the literature published between 1945 and 1964, incl., but the bulk of the literature comes after 1955.

The subject matter in this bibliography is confined to the effects of the Earth's atmosphere on radiofrequency radiation from 10 cps to 100,000 Mc.

Obviously not all of the vast amount of current and past literature on tropospheric propagation is included in this compilation, yet in spite of this fact, and in spite of gaps in the coverage of the world's literature in this field, the selection of material has been quite rigorous.

The following detailed subject outline shows the scope and the many facets of the material included herein. A geographical and an author index are also included.

We wish to express appreciation for guidance given by the staff of the NBS Boulder Laboratories, particularly to Mr. Bradford R. Bean, for valuable assistance in determining the scope and content of this and previous bibliographies on radio propagation. We also wish to thank Mrs. Doris Nickey for patient labor in typing and correcting the master copies of these five bibliographies; to Mr. Geza Thuronyi and Elemer Kiss for abstracting a large number of recent items; to Mrs. Susanne Manovill for preparing the Geographic Outline; and to other members of the M&GA staff for their contributions.

These bibliographies are available through the U. S. Department of Commerce, Office of Technical Services, Washington 25, D.C. This publication, NBS Technical Note No. , is available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

Any comments, criticisms, corrections, additions, or material for future radio propagation bibliographies should be addressed to:

Malcolm Rigby, Editor
Meteorological & Geoastrophysical Abstracts
P. O. Box 1736
Washington 13, D.C. - 20013

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BIBLIOGRAPHY ON PROPAGATION OF RADIO WAVES

THROUGH THE TROPOSPHERE

1902

E-1 Jackson, H.B., On some phenomena affecting the transmission of electric waves over the surface of the sea and earth. Royal Society of London, Proceedings, 70(462):254-272, July 8, 1902. 8 figs., 4 tables, ref. DLC--A pioneer study based on observations made from Naval vessels in the Mediterranean between 1895 and 1902. The effects of topography on radio transmission over land and sea and the reduction in distance of transmission caused by dust or salt particles in the atmosphere are first discussed. The conclusions regarding sferics are: they are more frequent in summer and autumn than in winter or spring, in mountainous regions than over open sea, in southerly than in northerly winds, in front of cyclone than in rear, with falling barometer than rising and (except for storm conditions) at 8-10 p.m. than between 9 a.m. and 1 p.m. A gale without lightning was preceded by sferics. It was noted that sferics produced signals in tape recorders similar to actual Morse code letters, so records of sferics were made possible by leaving the recorders operating. During approaching storms the radio reception distance was reduced 30-80% but during passage of sferics producing storm the reception distance would usually increase tremendously in spite of the frequent discharges. During sirocco winds the reception distance was markedly reduced. The author also noted effects such as skipping or zones of inaudibility of 20-40 mi and the remarkable fact that by using other transmission wave lengths the skipping did not occur. Thus he correctly interprets effects of lightning but not of tropospheric ducts or ionospheric reflection. (Met. Abs. 4K-5)--M.R.

1903

E-2 MacDonald, H.M., The bending of electric waves round a conducting obstacle. Royal Society of London, Proceedings, Ser. A, 71(472):251-258, 1903. Table, 6 foot-refs., 4 eqs. Comments by Lord J.W.S. Rayleigh and H. Pointcare, Ibid., 72(477):40-52, 1904. Eqs. Reply by MacDonald, Ibid., 72(477):59-68, 1904. Eqs. DLC--Assumes a Hertzian oscillator located outside a perfectly conducting sphere, in order to study theoretically the behavior of electric waves incident to the sphere. Some applications to the propagation of waves along the different surfaces of the Earth are discussed. (See ref. E-5)--W.N.

1907

E-3 Zenneck, J., Über die Fortpflantzung ebener elektromagnetischer Wellen langs einer ebenenen Leiterflache und ihre Beziehung zur drahtlosen Telegraphie. (Propagation of plain electromagnetic waves along a smooth conducting surface and its relation to wireless telegraphy.) Annalen der Physik, Ser. 4, 23(10): 846-866, 1907. 11 figs., foot-refs., 10 eqs. DLC--Starting with the directional transmission equation, the problem is discussed in terms of direction of the electric field, wave absorption in the direction of propagation, wave absorption by penetration into the conductor, state and propagation velocity of the electric and magnetic field intensity. The last part of the discussion is devoted to application of the results obtained to wireless telegraphy, taking into consideration ground and atmospheric conditions.--W.N.

1909

E-4 Sommerfield, A., Über die Ausbreitung der Wellen in der drahtlosen Telegraphie. (Wave propagation in wireless telegraphy.) Annalen der Physik, Ser. 4, 28(4): 665-736, 1909. 8 figs., footnote refs., 65 eqs. DLC--The purpose of this theoretical discussion is to prove the existence of the ground wave and to differentiate between the sky wave and the former, whose propagation and behavior over the Earth, under different conditions, is discussed. --W. N.

1911

E-5 MacDonald, H.M., The diffraction of waves round a perfectly reflecting obstacle. Royal Society of London, Philosophical Transactions, Ser. A, 210:113-144, Feb. 1911. 2 figs., table, foot-refs., eqs. DLC--An attempt "to find the effect at all points produced by a Hertzian oscillator placed outside a conducting sphere, whose radius is large compared with the wavelength of the oscillations". (See ref. E-2)--From text.

E-6 Nicholson, M.A., On the bending of electric waves round the earth, Pt. 1. Philosophical Magazine, London, 6th ser., 19(110):276-278, Feb. 1910. Foot-refs., 43 eqs. Pt. 2–4 have title On the bending of electric waves round a large sphere. Pt. 2, Ibid., 20(115):157-172, July 1910. Foot-refs., 57 eqs. Pt. 3, Ibid., 21(121):62-68, Jan. 1911. 5 tables, foot-refs., 7 eqs. Pt. 4, 21(123): 281-295, March 1911. Foot-refs., 45 eqs. DLC--Critisizes Poincare's results, then examines "the extent of the region between brightness and shadow when a radial oscillator is placed close to the surface of a perfectly conducting sphere". Pt. 2 deals with the nature of the transitional region and in Pt. 3 author determines β , the numerical coefficient to establish the intensity at any surface point. Since it is improbable that the estimated ratio 10^{-12} (if diffraction alone were the agent) could be recorded by any existing receiver, it is suggested that atmospheric layers reflect the transmitted energy back to the Earth's surface. Pt. 4 is an attempt to determine a higher approximation valid for points within "the region of brightness". --W. N.

1912

E-7 Eccles, W.H., On the diurnal variations of the electric waves occurring in nature, and on the propagation of electric waves round the bend of the Earth. Royal Society of London, Proceedings, Ser. A, 87(592):79-99, July 1912. 9 figs., refs. in foot notes. DLC--Discusses the influence of "strays" (i.e., sferics) and other twilight effects on propagation of wireless waves. Ionic refraction causes bending of radio waves around the Earth's surface. The observational results of signal transmission, Clifden-London, Jan. 1912, presented in curves, are indicative of the theory. --W. N.

E-8 March, H.W., Über die Ausbreitung der Wellen der drahtlosen Telegraphie auf der Erdkugel. (Propagation of radio waves over the terrestrial globe.) Annalen der Physik, Ser. 4, 37(1):29-50, 1912. 3 figs., foot-refs., 54 eqs. DLC--This excerpt of author's dissertation explains the results of overcoming the earth's curvature in radio communication. The first part of the paper gives the general integral solution and in the second part is the integral solution discussed in the case of complete conduction. --W. N.

1914

E-9 Macdonald, H. M., The transmission of electric waves around the Earth's surface. Royal Society of London, Proceedings, Ser. A, 90(615):50-61, April 1914. Table, refs. in footnotes, eqs. DLC--A series is obtained which represents the magnetic force at any point on the surface when the oscillator is also on the surface. Calculations of fall in amplitude with increased distance are shown for different wave lengths in the table presented. (See ref. E-5 and E-2)--From text.

E-10 Marriott, Robert H., Radio range variation. Institute of Radio Engineers, N.Y., Proceedings, 2(1):37-58, March 1914. 4 charts. Discussion p. 53-58. Ref. DLC--Discussion of statistical results (shown on very detailed charts) of experiments with distance of radio reception between ships at sea off Coney Island, in the Great Lakes, etc., and in the Denver, Colo. area as related to "atmospherics", temperature, humidity, vapor pressure, dew point, moonlight, daylight, etc. Atmospherics were related to temperature, being stronger in afternoon and in summer. The seasonal vapor pressure curve proved to be the inverse curve of distance of reception (vapor pressure in inches X 10) to the 5th power gave an index of strength of atmospherics above audibility. The question of whether the action of v. p. was in refracting, reflecting or absorbing power of the atmosphere at the station or between stations was not resolved. In the discussion Austin Curtis remarks on effect of local charges in thunder- or snow-storms on "noise" and on the "distant" effect of numerous lightning storms in the equatorial belt of calms which moves N and S with the sun. Thus in the northern summer sferics are almost constant in the North Atlantic, whereas in winter, when the belt is south of the equator, the radio reception is vastly improved. Julius Weinberger remarks on Kiebitz's paper discussing calculations of refractive index for moist air and the consequent bending of emission waves toward the earth. John Stone remarks on the ionizing effect of sunlight in upper atmosphere and consequences for radio propagation. Dr. De Forest remarks on reflecting layers of heated air reported by Tyndall and on similar reflecting of em waves. George H. Clark remarks on effect of a thunderstorm area between stations in cutting down signals until after it had passed the second station, when signals improved markedly. (Met. Abs. 4 K-12) --M. R.

1915

E-11 Love, A. E. H., The transmission of electrical waves over the surface of the Earth. Royal Society of London, Philosophical Transactions, Ser. A, 215:105-131, 1915. 4 figs., 4 tables, 18 refs., 56 eqs. DLC--The question of how radio waves penetrate the shadow region is critically surveyed. The purpose is to determine the electric and magnetic forces in the dielectric at points near the surface, but not near the sender, assuming the earth is a homogenous conductor in homogenous dielectric and the separating surface being a perfect sphere. The results, as far as daylight observations are concerned, appear to favor the diffraction theory although some other unaccounted forces are active, particularly at night. --W. N.

1927

E-12 Pedersen, Peder Oluf, Propagation of radio waves along the surface of the earth and in the atmosphere. Ingeniörvidenskabelige Skrifter, Ser. A, 15a, Copenhagen (issued by Danmarks Naturvidenskabelige Samfund udgivet ved Udvalget for Ingeniörvidenskabelige Forskning), 1927. 244 p. Numerous figs., 11 tables, foot-refs., eqs. Also: Appendix, Ibid., 15b, 1927. 19 p. Figs. DLC--

This is a pioneer text covering all the known theory and empirical knowledge of radio propagation in the troposphere and ionosphere. The physical and chemical properties of the atmosphere are discussed and illustrated with models and diagrams. Optical, as well as electrical properties, are considered. Effects of solar radiation and corpuscular emissions and ionization of rarified gasses, effects of wind, pressure, mean free path, number of collisions, lifetime of free electrons, recombination, cosmic rays, auroras, discontinuities, sunrise and sunset, wave length, magnetic fields, etc., are discussed. (Met. Abs. 8I-1) --M. R.

1929

E-13 Colwell, R.C., Fading curves and weather conditions. Institute of Radio Engineers, N.Y., Proceedings, 17(1):143-148, Jan. 1929. 11 figs. DLC--Brief report on observations at Morgantown with a Shaw recorder of station KDKA, April-May 1927. The sunset fading curves on fine days were more irregular than those on cloudy days. The signal strength was stronger in daylight hours. A falling curve indicated clearing weather and a rising curve cloudy weather or rain next day. (See ref. E-22). (Met. Abs. 8I-2)--W. N.

1931

E-14 Parkinson, T.; Kirby, S.S.; Arnold, P.N. et al., Bibliography on radio wave phenomena and measurement of radio field intensity. Institute of Radio Engineers, Proceedings, 19(6):1034-1084, June 1931. DLC--The bibliography contains 630 annotated entries classified under subject and related subdivisions in chronological order: radiation, radio wave phenomena, fading, daily and seasonal variations, direction variations; meteorological, geophysical and cosmic effects; eclipses, reflection, refraction, diffraction, absorption, polarization, K-H layer, wave front angle, transmission formulas, atmospheric disturbances, strays, directional properties, etc. (Met. Abs. 8I-4)--W. N.

1932

E-15 Eckersley, T.L., Studies in radio transmission. Institution of Electrical Engineers, London, Journal, 71(429):405-459, 1932. 33 figs., 7 tables, numerous refs., 109 eqs. DLC--With the advent of short wave telegraphy, a new technique of echo and facsimile measurement has been developed, facilitating signal intensity measurements in the wavelength range between 14 and 50 m. Pt. 1 of this paper deals with the adopted method of making facsimile measurements, and describes the results obtained, while in Pt. 2, the author discusses transmission problems in the light of these data and suggests the theoretical methods to be employed in solving such problems. Pt. 3 discusses the problem of scattering while in Pt. 4, the author deals with theory. --Author's abstract.

E-16 Marconi, Guglielmo, Radio communication by means of very short electrical waves. Royal Institution of Great Britain, Proceedings, 27(130):509-544, Dec. 1932. 10 figs., ref. DLC--Author describes construction and features of improved transmitters and receivers, methods used and results achieved, such as "beyond horizon" communication at 600,000 kc. This lecture, given before the Royal Institution Dec. 2, 1932, was accompanied by schematic diagrams and photographs which are reproduced here. (Met. Abs. 8I-5)--W. N.

1933

E-17 Schelleng, J.C.; Burrows, C.R. and Ferrell, E.B., Ultra short wave propagation. Institute of Radio Engineers, N.Y., Proceedings, 21(3):427-463, March 1933. 18 figs., 2 tables, numerous refs., 15 eqs. DLC--Pt. I contains some results of an experimental study of USW propagation in order to obtain quantitative data for the theoretical work in Pt. II where author analyzes experimental results in comparison with current theory. Such topics as reflection, diffraction and refraction are treated in relation to optical and nonoptical sea and land paths. Some characteristics of frequencies as a function of topography are considered. (Met. Abs. 8I-6)--W.N.

1935

E-18 Burrows, Charles R.; Decino, Alfred and Hund, Loyd E., Ultra-short-wave propagation over land. Institute of Radio Engineers, N.Y., Proceedings, 23(12):1507-1535, Dec. 1935. 21 figs., 11 tables, numerous refs., 25 eqs. DLC--Frequency characteristics at 100-200 Mc are discussed. Experimental confirmation both for an optical and nonoptical path involved in the approximate theory given, was established, and discrepancies between theoretical and practical results indicate absence in the formula of some element important to this propagation. (Met. Abs. 8I-7)--W.N.

1936

E-19 Handel, Paul von and Pfister, Wolfgang (Deutsche Versuchsanstalt f. Luftfahrt, Berlin), Die Ausbreitung der ultrakurzen Wellen (cm-, dm-, m-Wellen) längs der gekrümmten Erdoberfläche. (Propagation of ultrashort waves (cm, dm and m waves) along the curved surface of the earth.) Hochfrequenztechnik und Elektroakustik, Munich, 47(6):182-190, June 1936. 20 figs., 14 refs., eqs. DLC--USW propagation into the region beyond the horizon is dependent on diffraction and refraction. On the basis of optical analogy, diffraction is calculated by different methods. Calculations based on radiation received beyond the optical horizon are found to yield the best agreement with measurements. For practical use of the results, curves are presented which give values of field strength as a function of distance and altitude for all pertinent frequencies. The curves have been verified in flight. Measurements concerning the influence of refraction have been added. (See ref. E-27)--Transl. of Authors' abstract.

1937

E-20 Colwell, R.C. and Friend, A.W. (West Va. Univ., Dept. of Phys.), Tropospheric radio wave reflections. Science, Wash., D.C., 86(2238):473-474, Nov. 9, 1937. Fig., table, foot-refs.--During a brilliant auroral display tropospheric reflection from less than 1 km height was observed. The reflection was split into two parts. Details of the observation are presented in a table and the cathode ray oscillograph pattern is given.--G.T.

E-21 Friend, A.W. and Colwell, R.C., Measuring the reflection regions in the troposphere. Institute of Radio Engineers, N.Y., Proceedings, 25(12):1531-1541, Dec. 1937. 10 figs., 7 refs. DLC--The modified radio equipment at frequencies of 1614, 2398 and 3492.5 kc is graphically outlined. The equipment permitted determination of several stratified layers at 1-12 km altitude. It is suggested that the reduced velocities of waves, (as much as 50-85% that of the velocity in vacuum) observed over a 15 mi distance, are controlled by the reflecting lower atmosphere. (Met. Abs. 8I-9)--W.N.

1938

E-22 Colwell, R.C. and Friend, A.W., Studies of tropospheric changes and radio reception. American Meteorological Society, Bulletin, 19(7):317-319, Sept. 1938. Fig., 9 refs. DLC--Forecasting weather conditions one day ahead was done with 80% accuracy using the KDKA station signals, intensity of which was found to depend upon tropospheric layers (also designated as the C-region). Inversion conditions generally affect radio wave propagation and a cold front was always linked to a lower tropospheric reflectivity. The observations were made at W. Virginia Univ., Morgantown, about 100 km south of the KDKA radio station in Pittsburgh, Pa. (See ref. E-13) (Met. Abs. 8I-10)--W. N.

E-23 Englund, Carl Robert; Crawford, A.B. and Mumford, W.W., Ultra-short-wave transmission and atmospheric irregularities. Bell System Technical Journal, 17(4):489-519, Oct. 1938. 19 figs., tables, 13 refs. DLC--Mechanism of fading of 1.6 to 5.0 meter waves over a 70 mi ocean path was studied 106 days over a 2 yr period. Both horizontal and vertical polarization were used; when on different wavelengths, the shorter wave faded more. Presence of multiple signal components along the earth's surface are calculable (cf. WWEDENSKY, VAN DER POL and GRAY), these, and one or more air-mass-reflected components, may encompass the explanation for fading mechanism. Amplitude changes up to 40 db and fading rates up to 5 fades per minute were observed. Reflecting boundaries from 5.5 km down to 1.9 km were measured and lower ones are indicated. (Met. Abs. 8I-12)--W. N.

E-24 Englund, Carl Robert; Crawford, A.B. and Mumford, W.W., Ultra-short-wave radio transmission through the nonhomogeneous troposphere. American Meteorological Society, Bulletin, 19(8):356-360, Oct. 1938. 4 figs., 4 refs., eq. DLC--This is the first experimental proof of boundaries and layers as controlling tropospheric radio wave propagation, multiple paths of which is a function of discontinuities. The observations were conducted in the fall of 1933 from a simple surface station at Sea Bright, N.J., and over a 15 to 120 mi path to an aircraft at 1000-8000 ft altitude using 4.6 m and 1.58 m wavelengths. Experimental approach, results obtained and conclusions are given briefly. (Met. Abs. 8I-11)--W. N.

1939

E-25 Friend, A.W. and Colwell, R.C., The heights of the reflecting regions in the troposphere. Institute of Radio Engineers, N.Y., Proceedings, 27(10):626-634, Oct. 1939. 10 figs., 10 tables, 16 refs. DLC--This discussion is on the so-called C regions, a tropospheric layer at about 1.8 km but characterized by variation of altitude with change in weather, influenced perhaps by solar activity. The discovery of this region was made in the summer of 1938. The tropospheric reflection occurs generally below 2.0 km as a function of discontinuities, the reflection coefficient being about 10^{-3} to 10^{-5}. (Met. Abs. 8I-13)--W. N.

E-26 Maclean, K.G. and Wickizer, G.S., Notes on the random fading of 50 megacycle signals over nonoptical paths. Institute of Radio Engineers, N.Y., Proceedings, 27(8):501-506, Aug. 1939. 12 figs., 2 tables, 8 refs.--To obtain data on the variation of field strength beyond the horizon, simultaneous recordings were made at 3 locations, one within the optical path of the transmitter, one 700 ft below the line of sight, and one 11,400 ft below the line of sight. All three locations were on the same line from the transmitter. Recordings extended over a two week period, chosen at a time when atmospheric refraction was likely to be favorable. Analysis of the recorded data indicates several things of interest. The variation of field strength at each location was random and showed no correlation with any other location; the range of field strength variation exceeded 49 decibels at the most remote location, maximum fields generally occurred at night, and previous data on the rate of attenuation beyond the horizon were confirmed. --Authors' abstract.

E-27 Millington, G., The diffraction of wireless waves around the earth. (A summary of the diffraction analysis with a comparison between the various methods). Philosophical Magazine, London, 27(184):517-542, May 1939. 3 figs., 4 refs., 10 eqs. --The three independent methods (B. Vvedenskii; B. van der Pol and H. Bremmer; T.L. Eckersley and G. Millington) which try to answer the problem of the diffraction of wireless waves around the Earth are compared with the purpose to show that the differences involved are only a question of the approximations made in deriving the results, and that with one exception, they are not of any practical significance. (See ref. E-19)--E.K.

1940

E-28 Colwell, R.C., The troposphere and radio waves. Institute of Radio Engineers, N.Y., Proceedings, 28(6):299-302, June 1940. Fig., table, 8 refs., 3 eqs. DLC--The influence of weather on long and short waves is theoretically explained by changing cyclones and anticyclones that vary the height and the reflecting power of the inversion discontinuities. (Met. Abs. 8I-14)--W.N.

E-29 Friend, Albert W., Developments in meteorological sounding by radio waves. Journal of the Aeronautical Sciences, 7(8):347-350, June 1940. 6 figs., table, 3 refs. Discussion by Harry Diamond, Ibid., p. 350-351, and Reply by Friend, Ibid., p. 351-352. DLC--During late fall of 1939 experimental storm observations were made by West Virginia University with the aid of transmitted and reflected radio waves, and compared with the Blue Hill Observatory radiosonde data and aircraft data. The results, presented in curves, show good agreement.

1941

E-30 Norton, K.A., The calculation of ground wave field intensity over a finitely conducting spherical earth. Institute of Radio Engineers, N.Y., Proceedings, 29(12):623-639, Dec. 1941. 16 figs., 10 tables, numerous refs., 60 eqs. DLC--Earlier and present theoretical knowledge is here summarized into graphical methods along with equations so as to facilitate the work of calculation under discussion. (Met. Abs. 8I-16)--W.N.

E-31 Selvidge, H., Diffraction measurements at ultra-high frequencies. Institute of Radio Engineers, N.Y., Proceedings, 29(1):10-16, Jan. 1941. 12 figs., 7 refs., eq. DLC--A successful attempt to measure the diffraction alone was conducted over the natural knife edge of Mount Cadillac (1532 f. a. s.) of Mount Desert Island on the Atlantic coast near Harbor, Maine. The results of the tests at 55 and 110 Mc are presented in curves showing good agreement with theory. Horizontally polarized waves were diffracted more than the vertical. (Met. Abs. 8I-17)--W.N.

1942

E-32 McPetrie, J.S. and Saxton, J. A., Diffraction of ultrashort radio waves. Nature, London, 150(3801):292, Sept. 5, 1942. 2 figs., table, 3 refs.--Authors pointed out earlier that ultra short radio waves polarized with electric vector vertical are propagated into the shadow of hills more readily than horizontally polarized waves. Results of experiments are presented and discussed in which they observed the opposite effect for receiver positions beyond hills but just outside the shadow. --E.K.

1944

E-33 Katz, Isadore and Austin, J.M., Qualitative survey of meteorological factors affecting microwave propagation. Massachusetts Institute of Technology. Radiation Laboratory, Report No. 488, June 1, 1944. 50 p. 17 figs., 14 tables, 13 refs. MCM--An introduction to radio meteorology, stressing the forecasting of the distribution of the modified index of refraction. Dependence of modified index curve on vapor pressure and temperature gradient is discussed. The types of index curves, which are classified into six categories, are discussed in detail. (Met. Abs. 2H-16)

E-34 Leontovich, M., Ob odnom metode resheniia zadach o rasprostranenii elektromagnitnykh voln vdol' poverkhnosti zemli. (A method of solving problems of electromagnetic wave propagation along the Earth's surface.) Akademiia Nauk SSSR, Izvestiia, Ser. Fiz., 8(1):16-22, 1944. Refs., 19 eqs. DLC--The problem of electromagnetic wave propagation from a vertical dipole situated near the surface of a plane conducting earth is reduced to the solution of a differential equation of parabolic type with defined limiting conditions. The method may be extended to cases of variable ground conductivity and of electromagnetic wave propagation over a spherical earth. --G.T.

E-35 Smith, Dillon E.; Fletcher, Robert D. et al., Tropospheric weather factors likely to affect superrefraction of VHF-SHF radio propagation as applied to the Tropical Western Pacific. U.S. Weather Bureau, Report RP-1, July 1, 1944. 100 p. 53 figs., eqs. append. DWB--Meteorological characteristics of the tropical western Pacific, including the East Indies, are presented in this preliminary report as a guide to the radar meteorologist engaged in forecasting the atmospherically modified index of refraction, M curve. Meteorological characteristics of the area are discussed first, followed by general discussion of various types of normal inversions in the atmosphere and their associated modified refractive index. The meteorological factors which disrupt normal inversions are taken up. Finally, basic relations between weather factors and modified index curves noted. Methods of computing the M curve from aerological low level sounding data are presented. In general, theoretical aspects of the whole problem are not investigated. Numerous meteorological charts and diagrams are included. (Met. Abs. 8I-20)

E-36 Treloar, H.M., Radar meteorological report--probable radar ducts in September in region including north Australia and islands to the north and some general matters. Australia. Meteorological Services, Research Report, Ser. 10, No. 20, 1944. 21 p. 5 fold. charts, tables. DWB--Author considers the classes, distribution and intensity of warm, dry winds moving out over the sea and the heights of the resultant radar ducts. He states that in such air streams combined rapid vertical fall of humidity and some vertical increase of temperature make long range reception possible. His research is theoretical, and results tentative, but of use to practical researchers in this region. (Met. Abs. 8I-19)--H.P. Kramer.

1945

E-37 Friend, Albert W., A summary and interpretation of ultra high frequency wave propagation data collected by the late Ross A. Hull. Institute of Radio Engineers, N.Y., Proceedings, 33(6):358-373, June 1945. 24 figs., 5 refs., eq.--An analysis of portions of data recorded by Hull on the propagation of 60 megacycle waves indicates that, with certain extensions and minor variations, his theories were leading toward the now apparently correct solution of the ultra high frequency propagation problems. It was indicated that propagation far beyond the horizon was produced by refraction or reflection in the tropospheric strata. Calculations of radius of ray curvature have been made from data provided by the U.S. Weather Bureau, from stations near the propagation terminal points. It is indicated that radii of curvature less than the radius of the Earth are coincident with conditions favorable to the propagation of strong signals over this path extending far beyond the horizon. It is concluded that more accurate meteorological data with finer structure characteristics should make possible more precise calculation of propagation conditions. It also appears that certain meteorological conditions may be assumed when various propagation conditions are encountered.--Author's abstract.

1946

E-38 Bergmann, Peter G., Propagation of radiation in a medium with random inhomogeneities. Physical Reviews, N.Y., 70(7/8):486-492, Oct. 1946. 4 figs., 63 eqs. DLC--It is shown how approximate formulas, derived from geometrical optics, correlate statistical properties of inhomogeneities with fluctuations in signal level, and how a simplification of the formulas permits prediction of signal fluctuations dependent on range. (Met. Abs. 8I-21)--W. N.

E-39 Booker, H.G., Elements of radio meteorology: how weather and climate cause unorthodox radar vision beyond the geometrical horizon. Institution of Electrical Engineers, London, Journal, Pt. III A, 93(1):69-78, 1946. 13 figs. DLC--The object of this paper is to describe in broad outline the phenomenon of radio refraction in the lower atmosphere and to present the interdependence of radio propagation and meteorology in such a way that its implications for radio engineers are brought to light. Some examples of unorthodox radar vision; the ray theory and wave theory in connection with radio ducts; the meteorological requirements for super-refraction; the weather conditions involving super-refraction; and the climatic conditions involving super-refraction are discussed in detail.--E. K.

E-40 Craig, Richard A., Measurements of temperature and humidity in the lowest 1000 ft of the atmosphere over Massachusetts Bay. Papers in Physical Oceanography and Meteorology, Cambridge, Mass., 10(1), Nov. 1946. 47 p. 54 figs., 11 refs. DWB--There is a wealth of information in this exemplary presentation of temperature and humidity profiles. Of 500 aircraft soundings made over Massachusetts Bay in the summer and fall of 1944, 51 were selected which represent a wide variety of conditions for radio wave propagation. Profiles of temperature, dew point, and associated refractive index, based on psychrometric measurements at 50, 100, 150, 200, 300... and 1000 ft above the water surface, are shown for each of the 51 ascents, along with an analysis of the curves and a detailed summary of the synoptic situation. In the majority of cases, the curves exhibit temperature inversions and marked changes in the dew point lapse rate due to air mass modification by passage over cool water, to subsidence, or to the presence of cold or warm fronts. No summary of the climatological picture is attempted, but this can be had by careful examination, and comparison, of the individual profiles. (Met. Abs. 8I-22)--R.S. Quiroz

E-41 Crawford, A. B. and Sharpless, W. M., Further observations of the angle of arrival of microwaves. Institute of Radio Engineers, N. Y., Proceedings, 34(11):845-848, Nov. 1946. 3 figs., 5 refs. DLC--Observations in the summer of 1945 with a specially built antenna with about 2½ sharper beam operating at 1.25 cm are discussed here. Small abrupt changes in the refractive index such as may be present at the boundaries of inversion layers may be responsible for high angle components, rather than superrefraction in inversion layers. The multiple path transmission may be closer to its clarification if simultaneous measurements were made of angle-of-arrival in line paths of different lengths. (Met. Abs. 8I-23)--W. N.

E-42 Fok, Vladimir Aleksandrovich, Diffraktsiia radiovoln vokrug zemnoĭ poverkhnosti. (Diffraction of radio waves around the Earth's surface.) Moscow, Akademiia Nauk SSSR, 1946. 79 p. 6 figs., tables p. 62-79, 4 refs., numerous eqs. DLC--This is a theoretical study of radio wave propagation around a homogeneous surface of the earth, accounting for diffraction but not for ionospheric effects. The purpose is to develop formulas for wave amplitudes as a function of height of the source, its distance, wavelength and electrical properties of the ground. The most important result of the work is the development of a formula for the attenuation coefficient in the form of an integral. A detailed analysis shows that this formula is applicable to all situations encountered in practice. The results obtained are in agreement with other theories. Entirely new results were obtained in the half shadow zone (near the horizon). Formulas have been worked out, giving an uninterrupted transition from the light to the shadow zone. In all cases the numerical method of calculating the superimposed series and integrals are indicated. --Transl. of author's abstract.

E-43 McPetrie, J. S. and Ford, L. H., An experimental investigation on the propagation of radio waves over bare ridges in the wavelength range 10 cm to 10 m. Institution of Electrical Engineers, London, Journal, Pt. III A, 93(3):527-530, 1946. 10 figs., table, 6 refs. DLC--The variation in received field strength has been investigated as a receiver was moved over the crest and into the shadow of a bare ridge which approximated in contour to a cylinder. The rate of attenuation in the shadow of the ridge was found to agree, using horizontally polarized radiation, with values calculated from the formulae of Domb and Pryce over the whole range of wave lengths used, 9.2 cm to 11.15 m. --Authors' abstract.

E-44 McPetrie, J. S. and Ford, L. H., Some experiments on the propagation of radiation of 9.2 cm wavelength, especially on the effect of obstacles. Institution of Electrical Engineers, London, Journal, Pt. III A, 93(3):531-538, 1946. 9 figs., 6 tables. DLC--The salient results are brought together of a number of experiments on the propagation of radiation of a wavelength of 9.2 cm, carried out during 1943-44. All the measurements described were made over land, some over open country and some over transmission paths which were obstructed by various obstacles. The obstacles included trees, both leafless and in full leaf, brick walls, windows, and other parts of buildings. Many of the obstacles caused such large attenuation that they should generally be regarded as opaque objects round which diffraction takes place. Stone buildings, groups of trees so dense that the sky cannot be seen through them, and the trunks of trees come into this category. Semi transparent obstacles (causing a loss of signal of 10 db or less), include windows, tile or slate roofs, the sides of a light wooden hut, and thin screens of trees when the transmission path lies through the branches. --Authors' abstract.

E-45 Megaw, E.C.S., Experimental studies of the propagation of very short waves. Institution of Electrical Engineers, London, Journal, Pt. IIIA, 93(1):79-97, 1946. 23 figs., 3 tables, 4 eqs. DLC--The paper presents a survey of the experimental work on the propagation of very short waves, and especially of centimeter waves, carried out in England during World War II. Preliminary experimental studies over land and sea paths are described, with a summary of the tentative conclusion to which they led. The main experimental programme consisted of measurements of 3 cm, 9 cm, and 3½ m waves over sea path 57 mi and 200 mi in length; and of 9 cm waves over a single 38 mi land path. In a concluding Section, some investigations into special aspects of very short wave propagation are described; data on reflection from sea and land, and on the effect of obstacles are also included. --From author's abstract.

E-46 Radio Corporation of America. David Sarnoff Research Center, Princeton, N.J., Television: a bibliography of technical papers by RCA authors, 1929-1946. RCA Review, 1946. 10 p. DLC (Z7711.R3)--Several of the 275 technical papers, listed in chronological order 1929-1946, have a bearing on aspects of tropospheric propagation. --W. N.

1947

E-47 Bullington, Kenneth, Radio propagation at frequencies above 30 megacycles. Institute of Radio Engineers, N.Y., Proceedings, 35(10):1122-1136, Oct. 1947. 14 figs., 2 tables, 10 refs., 20 eqs. DLC--The results of this detailed study on factors influencing radio propagation (frequency, distance antenna heights, earth's curvature, atmospheric conditions, ground obstacles) are presented in a series of nomograms that quickly give an estimate of the received power and received field intensity for a given point-to-point transmission path. Comparison between empirical methods to estimate a.o., the effect of atmospheric refraction and other factors, with experimental data on shadow losses and fading ranges, is presented. (Met. Abs. 8I-25)--From author's abstract.

E-48 Domb, C. and Pryce, M.H.L., The calculation of field strengths over a spherical earth. Institution of Electrical Engineers, London, Journal, Pt. III, 94(30):325-339, July 1947. 16 figs., 44 eqs. DLC--Curves and formulas are given for the calculation of field strength at any height and distance from the transmitter for the case of horizontally polarized electromagnetic waves over a curved Earth or sea. Sufficiently within the optical range the field is calculated by ray theory, and appropriate quantities for calculating path difference and divergence of reflected ray are given. The case of vertically polarized waves is also briefly discussed, and curves and formulas are given for the reflection coefficient (including surface-wave term) where ray theory is applicable, and for one term of the diffraction formula in the region well beyond optical cutoff. --From authors' abstract.

E-49 Miller, G.A.; Halbert, H.W.; Doherty, L.H. and Swanson, D.A., Final report Suffield Tropospheric Project. Canadian Radio Wave Propagation Committee, Feb. 20, 1947. 39 sheets, numerous figs., numerous graphs, 10 refs. --This is the third of three reports and gives the (final) results of the tropospheric propagation experiments carried out at Suffield, Alberta from June 1, 1945 through April 1, 1946. Some results obtained from radar observations or echoes (spaced corner reflectors) are given. (Met. Abs. 8I-29)--W. N.

E-50 Norton, K. A. and Omberg, A., The maximum range of a radar set. Institute of Radio Engineers, N. Y., Proceedings, 35(1):4-24, Jan. 1947. 11 figs., 2 tables, 36 refs., 70 eqs. DLC--Formulas to calculate the maximum range of a radar set are demonstrated here along with several of the factors analyzed on which a given radar set depends for maximum range. In addition to electronics, etc., the meteorological elements involved in radio wave propagation are discussed. (Met. Abs. 8I-30)--W. N.

E-51 Physical Society of London and Royal Meteorological Society, Meteorological factors in radio wave propagation; report of a Conference held on April 8, 1946 at the Royal Institution, London. London 1947? 325 p. Figs., tables, refs. GB-MO. Review by H. Koschmieder in Zeitschrift für Flugwissenschaften, Brunswick, 2(6):156, June 1954. DLC--This report includes 21 papers describing various investigations concerned with the effect of the meteorological conditions of the lower atmosphere on the bending of very short radio waves transmitted through it. The list of contributions is as follows: APPLETON, SIR EDWARD, The influence of tropospheric conditions on ultra short wave propagation, p. 1-17. SMITH-ROSE, R.L. and STICKLAND, A.C., An experimental study of the effect of meteorological conditions upon the propagation of centimetric radio waves, p. 18-37. SHEPPARD, P.A., The structure and refractive index of the lower atmosphere, p. 37-79. BOOKER, H.G. and WALKINSHAW, W., The mode theory of tropospheric refraction and its relation to wave guides and diffraction, p. 80-127. HARTREE, D.R., MICHEL, J.G.L. and NICOLSON, PHYLLIS, Practical methods for the solution of the equations of tropospheric refraction, p. 127-168. RYDE, J.W., The attenuation and radar echoes produced at centimeter wavelengths by various meteorological phenomena, p. 169-189. WESTWATER, F.L., Radar storm detection I, p. 190. ROSS, R.G., Radar storm detection II, p. 190-193. DURST, C.S., Radio climatology, p. 193-212. JOHNSON, SIR NELSON K., Meteorological investigations in connection with radio propagation, p. 212-215. SAXTON, J.A., The dielectric properties of water vapor at very high radio frequencies, p. 215-238. RAMSAY, J.A., The vertical distribution of radar field strength over the sea under various conditions of atmospheric refraction, p. 238-242. ALEXANDER, F.E.S., Observations of unorthodox radar vision in the vicinity of New Zealand and Norfolk Island, p. 242-249. MACFARLANE, G.G., A method for deducing the refractive index profile of a stratified atmosphere from radio observations, p. 250-252. STICKLAND, A.C., Refraction in the lower atmosphere and its application to the propagation of radio waves, p. 253-267. BEST, A.C., A standard radio atmosphere for microwave propagation, p. 267-273. BULL, G.A., Note on errors in measurement of the refractive index of the air for high frequency radio waves consequent upon errors in meteorological measurements, p. 273-278. SAXTON, J.A. and LANE, J.A., The anomalous dispersion of water at very high radio frequencies. Pts. I-IV, p. 278-325. (Met. Abs. 8I-31)

E-52 Pickard, Greenleaf W. and Stetson, Harlan T., Tropospheric reception at 42.8 mc and meteorological conditions. Institute of Radio Engineers, N. Y., Proceedings, 35(12):1445-1450, Dec. 1947. 16 figs. DLC--Data of the alpine FM Station W2XMN transmissions over the 167 mi path to Needham, Mass., are analyzed and presented in diagrams. This purely tropospheric propagation as influenced by meteorological elements showed a distinct seasonal change, higher in summer because of surface refraction favored by maximum water vapor pressure. All frontal passage lowered transmission but in relation to angle of passage with the transmission path. Better transmission in calm weather may be due to favorable stratification otherwise reduced by turbulence. (Met. Abst. 8I-32)--W. N.

E-53 Smyth, J.B. and Trolese, L.G., Propagation of radio waves in the troposphere. Institute of Radio Engineers, N.Y., Proceedings, 35(1):1198-1202, Nov. 1947. 6 figs., 21 refs., 3 eqs. DLC--A theory based on three experimental types of index of refraction distribution is discussed here. The refracting stratum treated as a plane refracting layer, generally agrees with propagation experiments as conducted over a 90 mi nonoptical over water path at San Diego, records of which are shown and presented graphically for comparison with calculated results. (Met. Abs. 8I-33)--W. N.

E-54 Waynick, A.H., Ultra short wave propagation studies beyond the horizon. Institute of Radio Engineers, N.Y., Proceedings, 35(11):1334, Nov. 1947. 5 figs., 3 refs. --A brief presentation of data which are believed to: a) verify the statements of G.S. Wickizer and A.M. Braaten to the effect that atmospheric heights greater than about 100 ft are effective in returning signals back toward the Earth; and b) indicate that the portion of the atmosphere so effective is the region below about 1.5 km for the experimental conditions involved. --E.K.

E-55 Wickizer, G.S. and Braaten, A.M., Propagation studies on 45.1, 474 and 2800 megacycles within and beyond the horizon. Institute of Radio Engineers, N.Y., Proceedings, 35(7):670-680, July 1947. 20 figs., 3 tables, 8 refs., 3 eqs. DLC--Continuous recordings of field strength on 474 and 2800 megacycles, over a period of 13 months, revealed maximum values three to four times the free space field at distances of 42.5 and 70.1 mi from the transmitting site atop Empire State Building, N.Y.C. Recordings on 45.1 megacycles during the same period, on a reduced schedule, did not exhibit the large variation found on the higher frequencies. Refraction was found to be greater in summer time, the strongest periods occurring during night or early in the morning. Refraction greater than normal was not evident when the average wind velocity was above 13 mi per hr. A study of weather conditions during the periods of strongest refraction indicated that roughly 60% of the gradients were of the frontal type, involving different air masses, and approximately 60% of the gradients were higher than 100 ft above the earth's surface. (Met. Abs. 8I-34)--Authors' abstract.

1948

E-56 Booker, H.G., Some problems in radio meteorology. Royal Meteorological Society, Quarterly Journal, 74(321-322):277-315, July-Oct. 1948. 19 figs., 2 tables, 21 refs., 35 eqs. DWB, DAWS--Superrefraction of radio wavelengths less than about 10 m in the lower troposphere may occur with an inversion of temperature exceeding 5 F°/100 ft, or a lapse of humidity greater than 0.52 gm/kg/100 ft, or by a combination of these. The principal meteorological phenomena likely to cause radio refraction are nocturnal radiation inversions over land, advection of warm dry air over a cold surface, and low level subsidence inversions. Coastal and sea areas of the world found during World War II to be subject to superrefraction are listed. The conjugate power law theory of eddy diffusion is applied to ascertain the profiles of temperature and humidity associated with inversion phenomena, and a comparison is made with observed temperature and humidity profiles (M.I.T. data). The comparison suggests that lack of complete correspondence is attributable to the assumption that the coefficient of eddy diffusion is constant with height. (Met. Abs. 8I-35)--R.S.Quiroz.

E-57 Durkee, A.L., Results of microwave propagation tests on a 40 mi overland path. Institute of Radio Engineers, N.Y., Proceedings, 36(2):197-205, Feb. 1948. 15 figs. DLC--The 2 yr (July 1943-Feb. 1945) tests with 1.25 to 42 cm wavelengths over a 40 mi path from New York to Neshanic showed waves well above 3 cm to be preferred rather than lesser wavelengths. The influence of meteorological, as well as diurnal and seasonal, factors on propagation is shown graphically and discussed. (Met. Abs. 8I-36)--W. N.

E-58 Gerson, N. G., Variations in the index of refraction of the atmosphere. Geofisica Pura e Applicata, 13(3/4):88-101, Sept./Oct. 1948. 12 figs., 2 tables, 22 refs., 26 eqs. DLC (QC801. G37)--Several aspects of the refractive index variations are considered such as: (1) throughout the year at the earth's surface and (2) seasonally in several air masses, where monthly and seasonal values are employed. Graphical presentation of the variation of the refractive index with altitude is given for the more general air masses. Up to 6 km altitude, tropical and monsoon air masses had highest values, arctic air masses the lowest. Rate of decrease with altitude (up to 6 km) varies in accord with air masses, rate of decrease was more constant in upper air masses than in lower. (Met. Abs. 8I-38)--W. N.

E-59 Hamlin, E. W. and Gordon, W. E., Comparison of calculated and measured phase difference at 3.2 cm wavelength. Institute of Radio Engineers, N.Y., Proceedings, 36(10):1218-1223, Oct. 1948. 9 figs., 3 refs., 7 eqs. DLC--Radio propagation and associated meteorological measurements, made by the Electrical Engineering Research Laboratory of the University of Texas during April 1946, on a path from Gila Bend to Sentinel in the Arizona desert, show that, for meteorological conditions that could be represented by a linear M curve, the magnitude and phase of the field resulting from propagation over a 27 mi path on 3 cm could be calculated on the basis of a direct wave, and one reflected from a surface tangent to the actual profile at the point of reflection. Apparent reflection coefficients between 0.3 and 0.8 were found for desert sand on 3 cm for this path. (Met. Abs. 8I-39)--Authors' abstract.

E-60 Kerr, Donald E., Propagation of very short waves, Pt. 1. Electronics, 21(1):124-128, Jan. 1948. 6 figs., 2 refs., 26 eqs. Pt. 2, Ibid., 21(2):118-123, Feb. 1948. 5 figs., ref., 8 eqs. DLC--An excellent outline with new light on the subject, comprising the M.I.T. Radiation Laboratory experiments in summarized form. Also with those of many other investigators from various parts of the world. In the first part, author discusses the one way propagation in free space and over a spherical earth. Second part is devoted to surface reflection effects, radar type propagation, and finally, propagation caused by atmospheric refraction which is given particular consideration. The atmospheric index η depends on pressure temperature and humidity but is independent of wavelength down to about 1 cm (where absorption becomes important). The index gradient $d\eta/dz$ involves both the gradients of the atmospheric quantities and their values, resulting in the possibility of wide range of effects on the modified index profile of which the most important are: (1) In a completely vertically mixed atmosphere dN/dz is nearly constant (0.036 per ft defined as giving standard refraction). (2) Temperature inversions tend to make $dN/dz < 0.036$ and (3) Decrease of water vapor pressure or concentration with height trends to make $dN/dz < 0.036$. (4) Increase of humidity (the relative, not a conservative property of atmosphere, is considered a useless quantity here) with height, tends to make $dN/dz > 0.036$. (Met. Abs. 8I-40)--W. N.

E-61 Kerr, F.J., Radio superrefraction in the coastal regions of Australia. Australian Journal of Scientific Research, Ser. A, Physical Sciences, 1(4):443-463, Dec. 1948. 14 figs., 9 refs.--A study of the geographical and meteorological factors affecting superrefraction of radio or radar echoes in and near Australia. Based on reports from 112 RAAF radar warning stations (March 1944 to Aug. 1945), the study shows that: 1) seasonal and diurnal variations are marked, but opposite on the North and South coasts (maximum in summer in the South); 2) the most intense superrefraction occurs in the West Coast region and 3) the most favorable synoptic conditions is hot, dry air from interior above cool, moist sea air moving ashore. (Met. Abs. 2.3-173)--M.R.

E-62 Klinger, Hans Herbert, Erzeugung, Ausbreitung und Anwendung von Millimeterwellen. (Generation, propagation and application of millimeter waves.) Das Elektron, Munich, 2(10):213-214, Oct. 1948. DLC--Propagation of millimeter waves is characterized by scattering-absorption (scattering and refraction by water drops, absorption by water vapor and oxygen) increasing proportional with distance of transmission and reciprocal proportional to the fourth power of the wave length. The absorption is explained by certain quantum conditions of the molecules of oxygen and water vapor which frequencies do appear in these very short waves. (Oxygen has an absorption region at 2.5 mm and 5 mm waves, water vapor at 1.34 cm and some mm waves). Propagation experiments with 6 mm waves (beyond molecular absorption) show that in a nonturbulent atmosphere, transmission can be made over 30 km distance. (Met. Abs. 8I-42)--W.N.

E-63 Megaw, E.C.S., Some effects of obstacles on the propagation of very short radio waves. Institution of Electrical Engineers, London, Journal, Pt. III, 95(34):97-105, March 1948. 16 figs., table, 3 refs., 15 eqs. DLC--Experimentally observed effects of localized obstacles, reflection, and shadowing on dm and cm radio waves are discussed, and compared favorably with theoretical results.--W.N.

E-64 Norton, Kenneth A., Propagation in the FM broadcast band. Advances in Electronics, 1:381-423, 1948. 16 figs., table, 28 refs., 8 eqs. DLC--In his introduction author explains FM propagation generally and subsequently discusses the following topics: Interference due to long distance ionospheric propagation. Effects of radio noise on broadcast reception. Effects of antenna height and terrain on the effective transmission range over a smooth spherical earth. Effects of irregularities in the terrain. Systematic effects of terrain and tropospheric ducts. Tropospheric waves resulting from reflection at atmospheric boundary layers. Combined effects of ducts and random tropospheric waves. Calculated service and interference ranges of FM broadcast stations. The efficient allocation of facilities to FM broadcast stations. Optimum frequency for an FM broadcast service. (Met. Abs. 8I-43)--W.N.

E-65 Perlat, Andree, Meteorologie et radioelectricite. (Meteorology and radioelectricity.) L'Onde Electrique, 28:44-54, 1948. 18 figs. DLC--The first part of this article deals with the uses of radio and radar in meteorology. Pt. 2 describes with diagrams, the effect of meteorological phenomena on the propagation and refraction of waves of frequency exceeding 60 Mc/s. Factors considered are variation of refractive index with height, effect of turbulence, advection, nocturnal cooling, fog, subsidence, fronts and the formation of ducts. (Met. Abs. 8I-45)--C.E.P.B.

E-66 Price, W.L., Radio shadow effects produced in the atmosphere by inversions. Physical Society of London, Proceedings, 61(343):59-78, July 1, 1948. 9 figs., 10 refs., 32 eqs. DLC--For frequencies around 200 Mc/s it appears likely that certain predictable weather situations are associated with shadow zones (airplanes will not be detected). Author concludes with advice to those using high frequency sets in localities subject to strong inversion. At times, failure in system may occur due to meteorological conditions. (Met. Abs. 8I-46)--W. N.

E-67 Rydbeck, Olof E.H., On the propagation of waves in an inhomogeneous medium. Göteborg, Sweden. Chalmers Tekniska Högskola, Handlingar, No. 74; Reports from the Research Laboratory of Electronics, No. 7, 1948. 34 p. 7 figs., 18 refs., 137 eqs. DLC--The paper opens with a discussion of, and the connection between, the existing theoretical methods of propagation, both in slightly and strongly homogeneous media. Author proved that the reflection intensity as calculated by the good path method is correct. A complete, mathematical expression for the wave phase is presented. Finally, the circuit relation of the wave equation is demonstrated in the light of (1) ALFVEN's magneto hydrodynamic waves in the sun and (2) duct propagation of microwaves in the lower troposphere. (Met. Abs. 8I-47)--W. N.

E-68 Smith-Rose, R.L., Meteorology and the propagation of radio waves. Nature, London, 161(4082):145-146, Jan. 24, 1948.--Review of work done during the war, especially reports prepared for general distribution after the war, on determination of the effect of various weather conditions on radio and radar propagation. (Met. Abs. 1-176).

E-69 Straiton, A. W. and Gerhardt, J. R., Results of horizontal microwave angle-of-arrival measurements by the phase difference method. Institute of Radio Engineers, N.Y., Proceedings, 36(7):916-922, July 1948. 12 figs., 2 tables, eqs. DLC--Radio and meteorological equipment employed are described and results obtained are discussed. The observations were conducted at Corpus Christi, Texas. Sixty percent of the measurements showed angular deviation less than 0.03° and was found to be directly proportional to path length if constant gradient persists over the path. The angle of arrival as a function of gradient of index of refraction is considered. (Met. Abs. 8I-49)--W. N.

E-70 Thompson, Leland E., Microwave propagation experiments. Institute of Radio Engineers, N.Y., Proceedings, 36(5):671-676, May 1948. 5 figs., 13 refs. DLC--Propagation tests at frequencies between 3000 and 4000 Mc are described. The effect on the received signal of changes in the index of refraction of the atmosphere are discussed, and means are suggested for minimizing signal variations with particular regard to the application of microwave relay communication systems. Theoretical data is given on diffraction at these frequencies.--Author's abstract.

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E-71 Bremmer, H., Terrestrial radio waves: theory of propagation. New York, Elsevier Publ. Co., 1949. 343 p. 91 figs., numerous refs., eqs. DLC--The theoretical aspects of propagation are discussed. The classic papers of VAN DER POL and BREMMER (1930) on propagation over a curved earth are included. (Met. Abs. 8I-54)--W. N.

E-72 Dattan, W., Beitrag zur unnormalen Brechung ultrakurzer Wellen in der Atmosphäre. (Contribution to abnormal refraction of ultra short waves in the atmosphere.) Zeitschrift für Meteorologie, 3(1/2):50-51, Jan./Feb. 1949. Fig., ref. DWB--The 7.9 m wave was received at a distance of 180 km, due to reflection from a relatively low layer in the atmosphere. (Met. Abs. 8I-56)--C.E.P.B.

E-73 Davies, H., A preliminary study of some results from the radio-meteorological investigation conducted in Canterbury. Royal Society of New Zealand, Transactions, 77(5):78-85, Nov. 1949. 10 figs. DLC--The mechanics of orthodox propagation of cm waves in a well mixed atmosphere are discussed, including lobe distribution above the horizon due to interference of direct and reflected rays. Anomalous propagation in a duct is considered and the effect of a land-sea transition on the vertical structure of potential temperature, specific humidity, modified refractive index and duct shape in a typical NW advective duct are illustrated. These cause considerable superrefraction of wavelengths of 3 and 10 cm. (Met. Abs. 8I-57)--C.E.P.B.

E-74 Grün, Artur and Kleinsteuber, Werner, Der durch den Feuchtigkeits- und Temperaturgang der unteren atmosphärischen Schichten verursachte Interferenzschwund im Dezimetergebiet. (The interfering fading in the decimeter band, caused by the temperature and humidity variation of the lower layers of the atmosphere.) Archiv der Elektrischen Übertragung, 3(6):209-219, Sept. 1949. 18 figs., 10 refs., 20 eqs. DLC--Since the changeable curvature of a ray is due to the weather dependent gradient of the index of refraction, the difference in variation of both rays (i.e., the direct and the earth reflected) gives simple formulas for calculation of the field strength. Observational results evaluated by this method were found in good agreement with available meteorological observations. (Met. Abs. 8I-60)--W.N.

E-75 Harris, Donald B., A forward transmission echo ranging system. Institute of Radio Engineers, N.Y., Proceedings, 37(7):767-770, July 1949. 4 figs., 15 eqs. DLC--A new system using radar techniques is described. Receiver and transmitter are placed at separated locations. Range of target to receiving station being equal to difference in paths between direct and reflected waves divided by the versine of the angle of elevation of the receiving antenna, the radial waiting speed is made proportional permitting a PPI presentation of propagation path as seen from the side. Application of the system to propagation studies is promising. (Met. Abs. 8I-61)--W.N.

E-76 Herath, Fritz, Inversionsstudie auf Grund der Lindenberger Fesselaufstiege mit besonderer Berücksichtigung der Ultrakurzwellenausbreitung. (Inversion study based on the captive balloon ascent at Lindenberg Observatory, with special attention to the propagation of ultra short waves.) Germany. Deutscher Wetterdienst in der U.S. Zone, Berichte, No. 9, 1949. 41 p. 20 figs., 29 tables, 57 refs. DWB--In an extensive study of inversions $\geqq$ 3.0°C, which appeared between the ground surface and 2000 m, 17,586 captive balloon ascents and kite flights at Lindenberg Observatory (1903-1925) were analyzed. Annual variation, frequency and various characteristics of inversions are presented. The strongest inversion occurred in December when temperature on the ground was − 15.2° C, and at the altitude of 850 m + 1.9° C. The strong inversions $\geqq$ 10.0° C make 3.7% of all the cases. Temperature gradient in the free inversions is calculated in order to calculate the propagation of the ultra short waves. The observed maximal value was 71°/100 m. The maximal value of ideal inversions calculated after A. WEGENER was found to be approximately 43°. (Met. Abs. 8I-62)--W.N.

E-77 Israel, Hans and Sommermeyer, K., Über partielle Reflexion elektromagnetischer Wellen in der Troposphäre. (Partial reflection of electromagnetic waves in the troposphere.) Zeitschrift für Meteorologie, 3(1-2):32-39, Jan.-Feb. 1949. 2 figs., 12 refs., eqs. DLC--A marked partial reflection of electromagnetic waves by atmospheric formations can only occur if the dielectric constant at the reflecting surface changes considerably in a distance shorter than or at the most, of the same order as the wavelength. Most reflections at inversions, etc., are limited to waves of a few hundred meters or more. Decimeter waves can be reflected by water vapor discontinuities in transient turbulent eddies, mostly over the sea, and in thunderclouds and the space above them. Uniform ionization density in a thundercloud cannot explain reflection, and authors suggest local ionization in discharge channels. (Met. Abs. 11-175)--C.E.P.B.

E-78 Jones, R.F., Low level atmospheric ducts. Nature, London, 163(4147):639, April 23, 1949. 2 refs. Discussion by J.S. McPetrie and B. Starnecki, p. 639. DLC--Jones presents a plausible hypothesis for the formation of low level radio transmission ducts over the sea during strong wind conditions and during still air. Humidity lapse rates when strong winds come from cold areas, and temperature and humidity lapse rates when winds come from warm areas, create conditions favorable for these "ducts" in the lower 100 ft above the sea. Presence of spray also considered important during turbulent conditions (discussion). (Met. Abs. 8I-65)--M.R.

E-79 Jones, F.E. and Cornford, E.C., The measurement of the velocity of propagation of centimeter radio waves as a function of height above the earth. Pt. 2. Institution of Electrical Engineers, Proceedings, Pt. 3, 96(43):447-452, Sept. 1949. 8 figs., 7 tables, 5 refs., 6 eqs. DLC--Includes nomogram for computing variation of refraction index of atmosphere with height above earth. Velocities given for propagation between ground and 10, 20 and 30 thousand feet respectively (186,233; 186,246; and 186,256 mi/sec). (Met. Abs. 2.3-41)--M.R.

E-80 Kirke, H.L., Calculations of ground wave field strength over a composite land path. Institute of Radio Engineers, N.Y., Proceedings, 37(5):489-496, May 1949. 13 figs., foot-refs. DLC--A brief discussion of the problem is given, together with a description of the three proposed methods of solution. The results of a practical experiment are shown and curves calculated by the three methods are compared with the observed results. It is shown that the BBC method gives field strengths much nearer to the observed values than the P.P. Eckersley method, and that the method proposed by G. Millington, while somewhat more laborious to use, also gives results which agree well with observed values. The difference between the three methods is small at low frequencies and when the effect of the discontinuity is not large. --Author's abstract.

E-81 Krasil'nikov, V.A., O vliianii pul'satsiĭ koeffitsienta prelomleniia v atmosfere na rasprostranenie ul'trakorotkikh radiovoln. (Influence of pulsations of the index of refraction in the atmosphere on the propagation of ultrashort radio waves.) Akademiia Nauk SSSR, Izvestiia, Ser. Geogr. i Geofiz., 13(1):33-57, 1949. 7 figs., table, 16 refs., 60+ eqs. DWB, DLC--Fluctuations in the index of refraction of the atmosphere, due to temperature pulsations, causing fluctuations in signal strength, phase, etc., (fading) of high frequency radio waves, both up to and beyond the horizon. Comparison of theory with experimental results. (Met. Abs. 8I-66)

E-82 Lehfeldt, Wilhelm, Die Ausbreitung der Ultrakurzen (quasioptischen) Wellen. (Propagation of ultrashort (quasi-optical) waves.) Archiv der Elektrischen Übertragung, 3(4-9):137-142, 183-186, 221-228, 265-269, 305-312, 339-346, July-Dec. 1949. 44 figs., 8 tables, 49 refs, num. eqs. DLC--This detailed study contains two main parts. The first part discusses such problems as: (1) refraction of the ray in a homogeneous atmosphere, (2) refraction and reflection in an inhomogeneous atmosphere, (3) reflections and blurred boundaries, (4) influence of ions upon reflection and refraction, (5) suppression by scattering and absorption. Influence of the earth's surface. In the second part, devoted to discussion of the results obtained by measurement, the following topics are highlighted: (1) The technique of measurements, (2) Measurements of over-land propagation, (3) Statistical over-land results, (4) Measurements over the sea, and at 9 cm wavelength over plain lowland, (5) Ranges. (Met. Abs. 8I-67)--W. N.

E-83 Mcpetrie, J.S.; Starnecki, B.; Jarkowski, H. and Siscinski, L., Oversea propagation on wavelengths of 3 and 9 centimeters. Institute of Radio Engineers, N.Y., Proceedings, 37(3):243-257, March 1949. 16 figs., 2 tables, 10 refs., 5 eqs. DLC--Tests 1943-1946 to determine meteorological factors governing propagation of cm waves are discussed here. The results summarized cover continuous recordings of field strength at the over-sea paths 60 and 200 mi off the west coast of Great Britain. Radio results and meteorological parameters are considered in relation to current propagation theories. (Met. Abs. 8I-68)--W. N.

E-84 Millington, G., The reflection coefficient of a linearly graded layer. Marconi Review, London, 13(96):140-151, 1949. 23 figs.--The curves given in this paper refer to the specific problem of the reflection of a horizontally polarized plane wave incident obliquely on a layer in which there is a linear variation of dielectric constant, and hence, of the square of the refractive index, from some constant value on one side of the layer to some other constant value on the other side of the layer. They have a particular application to the propagation of ultra high frequency radio waves in the troposphere, and should, therefore, be a useful contribution to our knowledge of long distance transmission on these frequencies. The curves refer only to the case of horizontal polarization. The curves for horizontal polarization give also the numerical value of the reflection coefficient for vertical polarization to the accuracy to which they can be used. --From author's abstract.

E-85 Perlat, A., Effet des conditions meteorologiques sur la propagation des ondes radioélectriques a fréquence élevée. Note preliminaire. (Effect of meteorological conditions on the propagation of high frequency waves: preliminary note.) Journal Scientifique de la Météorologie, Paris, 1(4):131-138, 1949. 8 figs., tables. Cas des ondes de 150 Mc. (Case of waves of 150 Mc.) Ibid., 2(8):101-107, Oct.-Dec. 1950. 3 figs. French, English and Spanish summaries p. 131, 101. DWB--The first memorandum discusses the meteorological conditions for the existence of ducts giving abnormally large reception range of waves shorter than 10 m, making use of radiosonde ascents. In the second paper, several cases of very abnormal range (300-400 km) of 2 m waves in Western Europe are examined. They appear to require the presence of a subsidence area, pressure above 1013 mb and vapor pressure above 11 mb, and no fronts across the track. (Met. Abs. 8I-69).

E-86 Rocco, M. D. and Smyth, J. B., Diffraction of high frequency radio waves around the earth. Institute of Radio Engineers, N. Y., Proceedings, 37(10): 1195-1203, Oct. 1949. 14 figs., 17 refs. DLC--This paper reports non-optical height gain measurements on a remarkably uniform desert link at frequencies of 25, 63, 170, 520, 1000, 3000, and 9375 Mc using horizontal polarization. It has been shown that when the index of refraction of the atmosphere is a linear function of elevation, the problem of refraction and diffraction may be presented approximately by a problem in diffraction alone. Data taken under linear and slightly nonlinear index of refraction gradients are compared with fields predicted by standard diffraction theory. A mechanism other than diffraction is required to explain the higher frequency fields observed under standard meteorological conditions. (Met. Abs. 8I-70)--Authors' abstract.

E-87 U.S. Office of Scientific Research and Development. National Defense Research Committee, Radio wave propagation: consolidated summary technical report of the Committee on Propagation. Charles R. Burrows, Chairman. Stephen S. Attwood, editor. N. Y., Academic Press, 1949. 3 vol. in 1. 548 p. Figs., tables, bibliogs., eqs. "Reprinting, with some omissions of the 3 volumes pub. 1945? in a limited edition." Bibliog. p. 514-530. General bibliog. of reports on tropospheric propagation, Report WPG-14 (Columbia Univ. Wave Propagation Group) p. 530-548. Numerous figs., tables, bibliogs. and eqs. DLC (QC661.U63)--This comprehensive work on radio wave propagation through the troposphere comprises scientific information and reports of experiments. Vol. 1, entitled Technical survey, is largely a critical and general review of the technical developments of the tropospheric propagation problems. The general theory of standard and of nonstandard propagation with descriptions and results of transmissions, as well as the meteorological factors affecting propagation and attenuation, are treated. Vol. II, entitled Radio wave propagation, is devoted to meteorology. Such subjects as theory, equipment, development of forecasting techniques are dealt with in the first part; second part contains significant information and data on subjects such as reflection coefficients, dielectric constant, absorption, scattering (rain, drop size) echoes, targets, etc. Radar, in its relation to these factors, is given a detailed treatment. A consideration of angle-of-arrival is included. Vol. III, entitled The propagation of radiowaves through the standard atmosphere, is of particular interest to the (meteorological)radar operators. Propagation of waves above 30 Mc is discussed specifically here. Six transmission experiments at such different geographical locations as Massachusetts Bay, San Diego, Arizona, Antigua, West Indies and Great Britain are considered in detail in order to correlate practice with the theories discussed in Vol. I and the meteorological factors discussed in Vol. II. The comprehensive bibliographies consist of 450 entires for Vol. I and 123 + for Vol. II, and the general bibliography of reports (557 entries) includes the works from numerous service and civilian organizations in the U.S., Great Britain, Canada, New Zealand and Australia. (Met. Abs. 8I-71)--W. N.

E-88 Unwin, R.S., Some problems and techniques involved in the radiometeorological investigation conducted in Canterbury. Royal Society of New Zealand, Transactions, 77(5):85-91, Nov. 1949. 7 figs., 4 refs. DLC--Study of radar ducts made during late 1946 and 1947 during föhn (off shore) wind on coast of New Zealand – range 200 km from coast and 600 m above sea level. Isopleths of atmospheric factors and refraction index. (Met. Abs. 8I-72)--M.R.

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E-89 Aslakson, Carl I. and Fickeissen, Omar O., The effect of meteorological conditions on the measurement of long distances by electronics. American Geophysical Union, Transactions, 31(6):816-826, Dec. 1950. 6 figs., 3 tables, 6 refs., 10 eqs. DWB--Practical methods for correcting long distance electronic measurements, limited to frequencies peculiar to shoran or from about 220 to 250 megacycles per second for variations in meteorological conditions, are described. The following topics are considered: the technique of making meteorological observations by airplane; the empirical relationship expressing the index of refraction in terms of total pressure and water vapor pressure in millibars and absolute temperature (relationship used for U.S. Air Force projects); the manner in which curvature of the shoran ray affects geodetic distance; the methods of correcting for ray path curvature used by the U.S. Air Force, by Canada and by KROLL (U.S. Army Map Service); the effect of meteorological variations upon the velocity correction; the analysis of errors due to the uncertainty of the velocity of radio waves in a vacuum and to the uncertainty of the index of refraction of moist air. (Met. Abs. 8I-74)--I.L.D.

E-90 Birnbaum, George, A recording microwave refractometer. Review of Scientific Instruments, N.Y., 21(2):169-176, Feb. 1950. 7 figs., 9 eqs., 23 refs. DLC--An instrument designed to measure and record a small difference in frequency between two cavity resonators is described. A sweep frequency technique is used to generate the resonance responses of the cavities. These responses are sharpened and made to control the operating time of a trigger circuit, whose average output is metered. A sensitivity equal to 200 c.p.s. is obtained in the measurement of the frequency difference between two high Q cavities, whose resonance frequencies are equal to 9000 Mc. Applications of this instrument are discussed, especially those relating to measuring changes in dielectric constant. A simple extension of the present instrument is suggested for simultaneously recording changes in dielectric constant and loss. --Author's abstract.

E-91 Booker, H.G. and Gordon, W.E., Outline of a theory of radio scattering in the troposphere. Journal of Geophysical Research, Wash., D.C., 55(3):241-246, Sept. 1950. 2 figs., 7 refs., 9 eqs. DWB--Observations in Caribbean Sea and elsewhere showed that field strength well below the horizon decreased more slowly than on diffraction theory and suffered violent fading. This is explained by scattering from turbulence in the region of high field strength beyond the horizon. (Met. Abs. 2.5-51)--C.E.P.B.

E-92 Booker, H.G. and Gordon, W.E., A theory of radio scattering in the troposphere. Institute of Radio Engineers, N.Y., Proceedings, 38(4):401-412, April 1950. 3 figs., 12 refs., 7 eqs. DLC--The theory of scattering by a turbulent medium is applied to scattering of radio waves in the troposphere. Values of the scale of turbulence and of the departure of refractive index from mean expected on meteorological grounds are fully adequate to explain the scattered field strengths observed experimentally. (Met. Abs. 8I-75)--From authors' abstract.

E-93 Boyd, J. E. and Brown, F. B. (both, Ga. Inst. of Tech.), Propagation of 3, 10 and 23 cm waves over a 50 mile optical path. Georgia Institute of Technology. State Engineering Experiment Station, Contract W28-099-ac-175, Project 109-8, Technical Report No. 1, March 31, 1950. 69 p. 30 figs. (1 fold.), table, 11 refs. DWB--Experimental measurements of microwave propagation at X, S, and L bands were over 30-60 mi land path in 1947 and 1948 to obtain data on the effect of ducts, subsidence inversions and turbulence. The 100 day observations are analyzed and presented in statistical distribution curves. The results show that (1) signal strength fluctuations of 20-30 dcb are associated with atmospheric stratifications and that (2) substandard layers may cause strong diffraction. (3) Ray inversion in low level substandard layers may be a possible cause of some large signal fluctuations. (4) Soundings show that ground based superrefracting layers and ducts usually exist on radiation cooling nights, and that strong substandard layers may also develop during the early morning hours. (Met. Abs. 8I-77)--W. N.

E-94 Brandejs, Stanislav, Tabulky pro vypocet indexu lomu vzduchu v oboru ultrakrátkych radiovln. (Table for calculating the air refractive index in the ultrashort radio wave range.) Meteorologické Zprávy, 4(5-6):107-108, 1950. Table, 3 refs., 8 eqs. In Czech. MH-BH--Equations developed by H. G. BROKKER, A. FRIEND and A. PERLAT are explained and a table for calculating the air refraction (dielectric constant) from temperature, pressure and humidity presented. For a more detailed study of the subject the author refers to his article on abnormal propagation of ultrashort radio waves published in Meteorologické Zprávy, 1947, p. 105. (Met. Abs. 4.10-267)--G. T.

E-95 Bremmer, H., Voortplanting van radiogolven in de troposfeer. (Propagation of radio waves in the troposphere.) Nederlands Tijdschrift voor Natuurkunde, 16(11):275-280, Nov. 1950. 4 figs., 2 eqs. DLC--Discussion of superrefraction, radio ducts and other aspects of radio wave reflection and propagation in the troposphere is illustrated by schematic diagrams and examples. (Met. Abs. 8I-78) --M. R.

E-96 Bullington, K., Propagation of UHF and SHF waves beyond the horizon. Institute of Radio Engineers, N. Y., Proceedings, 38(10):1221-1222, Oct. 1950. Fig. DLC--Calculations by usual methods at above 200-500 Mc are severely limited by the uncertainty in choice of effective antenna heights. Clearance may be more important. A useful parameter is the actual clearing divided by the height of the first Fresnel zone. This ratio, as used to express diffraction loss over a knife edge and reflection from a plane surface, is graphically given. (Met. Abs. 8I-80)--W. N.

E-97 Bullington, K., Radio propagation variations at VHF and UHF. Institute of Radio Engineers, N. Y., Proceedings, 38(1):27-32, Jan. 1950. 5 figs., 8 refs. DLC--The variation of received signal with location (shadow losses) and with time (fading) greatly affect both the usable service area and the required geographical separation between co-channel stations. An empirical method is given for estimating the magnitude of these variations at VHF and UHF. These data indicate that the required separation between co-channel stations is from 3 to 10 times the average radius of the usable coverage, and depends on the type of service and on the degree of reliability required. The application of this method is illustrated by examples in the mobile radio-telephone field. (Met. Abs. 8I-79)--Author's abstract.

E-98 Cheydleur, Raymond D., A compilation of radio theses in American colleges and universities, 1918-1950. Huntington, W. Virginia. Marshall College, Educational Radio, 1950. --The 780 papers are listed alphabetically under 44 different subjects and include 150 papers on electrical engineering, 42 on engineering, 1 on engineering mechanics, 5 on engineering and physics, 8 on mathematics and electrical engineering, and 44 on physics. There are several papers related to the various aspects of tropospheric propagation. The multigraphed bibliography includes names of the 83 colleges and universities who responded with material and likewise, the 43 who did not. --W. N.

E-99 Cornell University. School of Electrical Engineering, Investigation of air-to-air and air-to-ground electromagnetic propagation. Contract AF 33(038)-1091, Interim Engineering Report No. 1-7, Dec. 27, 1948/Feb. 27, 1949 to April 27, 1950. Also: Addendum to Report No. 4, June 27, 1949, and Supplement to Report No. 6, Jan. 27, 1950. 9 pieces. Figs., refs., eqs. Several pieces typescript or photostat of typescript. DWB--The following papers are reviewed: Craig, R. A., The meteorology of ducts; Trolese, L. G., Tropospheric propagation characteristics; Brooks, F.E. and others, Dielectric constant measurements; Hastings, C.E., Variation in velocity of radio propagation; Boyd, J. E., Propagation of 3-10, and 25 cm waves over 50 mile optical and non-optical paths; Stratton, --- and La Grove, ---, Angle of arrival at low angle of incidence; and other papers. (Met. Abs. 8I-83)--M. R.

E-100 Crain, Cullen Malone, Apparatus for recording fluctuations in the refractive index of the atmosphere at 3.2 cm wavelength. Review of Scientific Instruments, N.Y., 21(5):456-457, May 1950. 2 figs., 4 refs. DLC--An apparatus for the study of microwave propagation is presented which will accurately record small changes in the refractive index of the atmosphere. The equipment is a modification of that previously used for measuring the dielectric constants of several gases under controlled conditions. --E. K.

E-101 Crain, C. M. and Gerhardt, J. R., Measurements of the parameters involved in the theory of radio scattering in the troposphere. Texas, University, Electrical Engineering Research Laboratory, Contract N5 ori-136, Report No. 47, Nov. 30, 1950. 22 p. 11 figs., table, 8 refs. DWB--Micrometeorological studies, using a recording refractometer and bead type thermistor, have been made since 1948 at the University of Texas to determine refractive index in lowest 50 ft of the atmosphere. Traces are presented to show simultaneous recording of refraction index (for microwave transmission at 1, 2, 3, 12 and 32 ft above dry and moist ground and with varying weather conditions and temperature fluctuations). Refractive index related to small scale turbulence, stability, etc. Future program outlined. (Met. Abs. 3.4-71)--M. R.

E-102 Crain, C. M. and Gerhardt, J. R., Some preliminary studies of the rapid variations in the index of refraction of atmospheric air at microwave frequencies. American Meteorological Society, Bulletin, 31(9):330-335, Nov. 1950. 7 figs., 11 refs., 2 eqs. MH-BH--Rapid moisture variations in the atmosphere are measured by the dielectric constant or index of refraction of atmospheric air at microwave frequencies. The theoretical basis for this procedure is discussed. The apparatus used to measure small changes in refractive index as a function of atmospheric moisture compares the resonant frequency of a cavity through which air is drawn with the constant resonant frequency of a sealed reference cavity. An auxiliary bead thermistor and heated platinum wire were used for comparing variations in refractive index with those of air temperature and wind speed. A comparison of simultaneously recorded fluctuations of microwave index of refraction and air temperature shows that air temperature and moisture variations are positively correlated. This positive correlation is shown to be a function of soil moisture, elevation and insolation. No immediate correlation was found between refractive index and wind speed. (Met. Abs. 2.6-145)--I.L.D.

E-103 Fok, V.A., Teoriia rasprostraneniia radiovoln v neodnorodnoĭ atmosfere dlia pripodniatogo istochnika. (Theory of radio wave propagation in inhomogeneous atmosphere for an elevated transmitter.) Akademiia Nauk SSSR, Ser. Fizicheskaia, 14(1):70-94, Jan/Feb. 1950. Fig., 4 refs., numerous eqs. DLC--In two earlier papers the author worked out the theories of radio wave propagation, a) in an atmosphere whose dielectric constant varies with height, for a transmitter on the ground, and b) for an elevated transmitter in a dielectrically homogeneous atmosphere, respectively. In the present paper the case of an elevated transmitter in an inhomogeneous atmosphere is considered. The theory is also applied to the problem of superrefraction. --G.T.

E-104 Gibson, Theodore W., Jr., Meteorological aspects of radio propagation. Weatherwise, Boston, 3(2):32-34, April 1950. 4 figs. DWB--Brief explanation of the effect of varying lapse rates of humidity and temperature on normal and anomalous propagation of microwaves (television and FM). (Met. Abs. 8I-85)--M.R.

E-105 Green, James W., On the deduction of the refractive index profile of a stratified atmosphere from radio field strength measurements. Institute of Radio Engineers, N.Y., Proceedings, 38(1):80-88, Jan. 1950. 9 figs., 8 refs., 7 eqs. DLC--This academic discussion on MACFARLANE's theory concludes that, except for the possible exception of a limited frequency range under linear lapse rate conditions, the method is too sensitive to permit application directly to experimental data. (Met. Abs. 9.11-169)--W.N.

E-106 Heightman, D.W., Propagation of metric waves beyond optical ranges. British Institution of Radio Engineers, London, Journal, 10:295-311, Oct. 1950. DLC--This paper was awarded the Clerk Maxwell Premium for 1950. It gives a qualitative survey of tropospheric and ionospheric propagation in the frequency band 30-200 Mc/s. Theoretical considerations are limited to explanations of the basic principles involved. A knowledge of the easily recognized meteorological conditions associated with variations in tropospheric propagation is shown to be useful in short term prediction of radio conditions. Long term observations over various land and sea paths, both tropospheric and ionospheric, are presented in graphical form and results discussed. --Brit.IRE abstract.

E-107 Jones, R.F., Low level atmospheric ducts. Nature, London, 165(4207):971, June 17, 1950. DLC--Short wave radio ducts across Cardigan Bay occurred in air which had travelled mostly over land. No signals in warm sector air from far to southwest. (Met. Abs. 8I-86)--C.E.P.B.

E-108 Karp, Samuel and Sollfrey, William, Diffraction by a dielectric wedge; with application to propagation through a cold front. New York Univ., Mathematics Research Group, Research Report No. EM-23, Oct. 1950. 45 leaves. 13 figs., 10 refs., 7 eqs. Mimeo. DWB--

The fields diffracted by a dielectric wedge whose dielectric constant differs but slightly from that of its surroundings have been obtained by an approximate method. The fields are expanded in powers of the difference in dielectric constant and only first powers are retained. The approximate fields are then represented as a superposition of plane waves of arbitrary complex direction of propagation, and the resulting integrals evaluated by stationary phase to obtain the asymptotic form of the scattered fields. The reflected and transmitted plane waves agree with those obtained by geometrical optics, and the angular pattern of the diffracted cylindrical waves is found. The results are applied to the propagation of plane waves through a cold front. (Met. Abs. 8I-87)--Authors' abstract.

E-109 Knighting, E., Elements of anomalous radio propagation. Meteorological Magazine, London, 79(933):74-81, March 1950. 4 figs., 6 photos, 5 refs., 4 eqs. DWB--The derivation of a "Modified Refractive Index" (MRI) is stated and it is shown that the conditions necessary to bend a short wave radio beam downward are a temperature inversion and/or a lapse rate of mixing ratio such that: Temperature gradient (°F per 1000 ft)/7+2 Humidity lapse (gm kg per 100 ft)/3 exceeds 1. Observations show that this condition frequently holds, especially over the sea, over a layer ("Duct") on or near the earth's surface. Illustrations of calculated MRI curves are given, and the tracks of beams through or under a duct. Application of electromagnetic wave theory shows why shorter wave lengths are the more affected by super-refraction. (Met. Abs. 8I-89)--C.E.P.B.

E-110 Megaw, E.C.S., Scattering of electromagnetic waves by atmospheric turbulence. Nature, London, 166(4235):1100-1104, Dec. 1950. Figs., 2 tables, 18 and 7 refs. DLC--In the first section of the paper the stellar scintillation and the spectrum of turbulence in the free atmosphere is discussed. The second section is the treatment of scattering of short radio waves by atmospheric turbulence. Experiments lead to the conclusion that, in spite of apparent discrepancies, the anomalous observations had a common cause, not in any exceptional condition of the atmosphere but in its permanently turbulent state and in the consequent fluctuation of refractive index. --E.K.

E-111 Millar, J.Z. and Byam, L.A., Jr., A microwave propagation test. Institute of Radio Engineers, N.Y., Proceedings, 38(6):619-626, June 1950. 13 figs., 2 tables. DLC--Description of a microwave test conducted for a year (1946-47) with simultaneous transmissions on 16.2-7.2 and 3.1 cm wavelengths over an unobstructed overland path (Neshanic to New York). Curves show relative field strength. Seasonal (summer and winter) and hourly variations in fading are shown and discussed in connection with weather conditions. (Met. Abs. 8I-91)--W.N.

E-112 Milnes, B. and Unwin, R.S., A radio meteorological investigation in the South Island of New Zealand. Physical Society of London, Proceedings, Ser. B, 63(8): 595-616, Aug. 1, 1950. 26 figs., 9 refs. DWB--The inversion that results when föhn winds blow out over the sea near Canterbury Bight has a pronounced effect on radio transmission. Meteorological factors and transmission measurements are analyzed. Some lapse rate and field strength contour charts are given. (Met. Abs. 8I-92).

E-113 Parke, Nathan Grier, III, Microwaves in an irregular atmosphere. Contract AF 19(122)-91, Interim Reports, No. 1-3, Sept. 30-July 15, 1950. 3 pieces. Tables, refs., eqs. (Third interim report has subtitle: Scattering by discrete distributions.) DWB--In the first phase of the project a survey of previous work on tropospheric propagation of microwaves was made. The author's theoretical work on Matrix optics was extended and adapted to the scattering problem for short waves. An approximation was developed for the quasi-stationary case. In the second phase, the algebra was worked out for relating the scattering of microwaves to the conditions existing in a turbulent atmosphere. Using dipoles as the basic elements, general expressions are derived for the power received from dipole distribution, and the results are applied to case of reception of radiation scattered by a cloud of fluctuating electric susceptibility. The formula $W(S,t)=(VK^4/\pi(4\sigma R)^2)W\ o\ (s,t)$, where W is the scattered power and σ is the Fourier transform of the space autocorrelation of the electric susceptibility, was obtained. In the last stage the problem of scattering by discrete distributions of scatterers was considered. Six models were analyzed, in which the scatterers were static, dielectric spheres. Then the problems of moving scatterers, and the theory tested against the specific problem of falling rain. The spectrum of radiation returned by rain when observed looking vertically upward is determined, illustrated and described. (Met. Abs. 8I-93)--From author's abstract.

E-114 Perlat, A., Effet des conditions météorologiques sur la propagation des ondes radioélectriques à fréquence élevée. (Effect of meteorological conditions on the propagation of radioelectric waves of high frequency.) Journal Scientifique de la Météorologie, Paris, 2(8):101-107, Oct./Dec. 1950. 3 figs. French, English and Spanish summaries p. 101. DWB--Test conducted in 1948 and 1949 between Paris and Clacton on Sea (Eng.) show that anomalous reception of 2 m radar signals depends on the presence of a subsidence inversion over the area and the absence of any fronts along the course. Best reception (at distance of 400 km) occurs when pressure is above 1013 mb and dew point above 9°C. Surface observations and radiosonde data were analyzed for 52 cases during the year when long distance reception was possible. (Met. Abs. 8I-94)--M.R.

E-115 Phillips, W. Eric, The permittivity of air at a wavelength of 10 centimeters. Institute of Radio Engineers, N.Y., Proceedings, 38(1):786-790, July 1950. 5 figs., 3 tables, 16 refs. DWB--Observed values of permittivity of moist air under various conditions of temperature, water vapor content and pressure are in agreement with theoretical static values and confirm belief that water vapor is very important in atmospheric refraction or anomalous propagation of centimeter-radio waves. Wavemeter and method of measurement described. Tables show results of measurement of dry air at sea level and at reduced pressure, of saturated air and of moist air. Work done is preliminary to long term program of correlating meteorological conditions with microwave propagation off the coast of Natal. (Met. Abs. 8I-95)--M.R.

E-116 Pickard, Greenleaf W. and Stetson, Harlan T., Comparison of tropospheric reception at 44.1 mc. and at 92.1 mc. over the 167 miles path, Alpine, New Jersey to Needham, Massachusetts 1947-1948. Journal of Atmospheric and Terrestrial Physics, London, 1(1):32-36, 1950. 4 figs., 2 refs. MH-BH--Daily and hourly field intensities of transmissions show close correlation with index of refraction of radio waves computed from pressure, temperature and humidity at Boston, Mass. Frequency distribution of reception in decibels is analyzed. Transmission is mainly due to refraction in the lower atmosphere. (Met. Abs. 3.2-201)--C.E.P.B.

E-117 Satow, P. G., Marine navigation, radar, meteorology and charts. Marine Observer, London, 20(149):158-167, July 1950. 2 figs., photo. DLC--Includes notes on sub-refraction and super-refraction due to meteorological causes. (Met. Abs. 10-7).

E-118 Saxton, J. A., Reflection coefficient of snow and ice at V.H.F. Wireless Engineer, 27(316):17-25, Jan. 1950. 13 figs., table, 10 refs., 22 eqs. 2 append. DLC--Discussion of the nature and composition of snow, the dielectric properties of snow, land and sea at 30, 300, 3000 and 30,000 Mc/s, and the effects of multiple reflection phenomena in changing the vertical coverage diagram of a very high frequency radio transmitter. Reflection coefficients for plane waves under the above conditions given in equations, tables and nomograms. (Met. Abs. 7-99)--M. R.

E-119 Smith-Rose, R.L., The speed of radio waves and its importance in some applications. Institute of Radio Engineers, N.Y., Proceedings, 38(1):16-20, Jan. 1950. 2 tables, 16 refs. DLC--The present knowledge of the subject is discussed and summarized. A table furnishes the measurements of type of waves, frequency, transmission, mean value in km/s accuracy, and the names of the workers. Influence of the refractive index upon speed of waves is considered. (Met. Abs. 8I-97)--W. N.

E-120 Straiton, A. W. and Smith, H. W., Progress of microwave radio scintillations at wind speed on an overwater path. Institute of Radio Engineers, N.Y., Proceedings, 38(7):825-826, July 1950. Fig., 2 tables, 3 refs. DLC--Brief report and results of a 2 way analysis of the experimental transmission of 3.2 cm wave over the 26 mi path in the Gulf of Mexico during June and July 1949 are given here. It is indicated that the scintillations were rather due to regions of different electric constant moving across the path, than to additional signals from scattering areas outside the duct. (Met. Abs. 8I-98)--W. N.

E-121 Stranz, Dietrich, Meteorologie und Mikrowellenausbreitung. (Meteorology and propagation of microwaves.) Meteorologische Rundschau, 3(9/10):199-202, Sept./Oct. 1950. 2 figs., 2 tables, 20 refs., eqs. DWB--After a historical introduction, author applies laws of optics to calculations of paths of radio beams for various refractive indices and degrees of absorption. The dimensions of the factors are of the same order as those of small discontinuities in the troposphere. Finally, a reference is made to "radioclimatology". (Met. Abs. 8I-99)--C.E.P.B.

E-122 Swingle, Donald M., Nomograms for the computation of tropospheric refractive index, its gradients and discontinuities. Harvard Univ. Cruft Lab., Contract N5ori-76, Task Order No. 28, Technical Report, No. 102, Feb. 25, 1950. 15 leaves. 3 figs., table, 24 refs., 28 eqs. MH-BH--Index of refraction n of moist air is given by

$$(n-1) \times 10^6 = \frac{74'4}{T} \quad \frac{(p + 4973\,e)}{T}$$

valid for electromagnetic waves down to 1.5 cm. Three sets of nomograms are given, designed for use with radiosonde ascents: (1) for refractive index in terms of density of atmospheric gases and dew point, (2) for discontinuities due to discontinuities of air temperature and dew point, and (3) for gradients of refractive index in terms of gradients of temperature and dew point. (Met. Abs. 8I-100) --C.E.P.B.

E-123 Yerg, Donald G., The importance of water vapor in microwave propagation at temperatures below freezing. American Meteorological Society, Bulletin, 31(5): 175-177, May 1950. 5 figs., table, 2 refs., 4 eqs. DWB--Nomograms show contribution of vapor pressure to refractive index at various temperatures (0° to -40° C), and to dn/dh (slope of the index curve) for temperature inversions in a saturated atmosphere. Modified index-of-refraction curves computed by neglecting and then by including vapor pressure as obtained from radiosonde flights at Fairbanks and Bethel. Conclusion is that vapor pressure cannot be neglected at temperatures above -35°C. (Met. Abs. 8I-101)--M.R.

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E-124 Baldinger, E. and Schaetti, N., 9. Generalversammlung der Union Radio-Scientifique Internationale (U.R.S.I.) in Zürich (vom 11.-22. September 1950). (Ninth general meeting of the International Scientific Radio Union (U.R.S.I.) in Zurich (Sept. 11-22, 1950).) Zeitschrift für Angewandte Mathematik und Physik, 2(3): 212-214, May 15, 1951. DLC--A brief report of the meeting including recommendations for further investigations to the following Commissions: II. Propagation in the troposphere (further investigation of influence of latitude, nature of ground and climate on refractive index, especially for short waves); III. Ionosphere and propagation of waves; IV., V. Radio noises of terrestrial origin. (Met. Abs. 8I-102)--C.E.P.B.

E-125 Birnbaum, George, Fluctuations in the refractive index of the atmosphere at microwave frequencies. Physical Review, N.Y., 82(1):110-111, April 1951. 2 figs., 6 refs., 3 eqs. DLC--Brief note on experimental observations as conducted with the aid of a refractometer developed and located at National Bureau of Standards, Wash., D.C. The difference in recording with one or both cavities of the instrument open to air is shown graphically. (Met. Abs. 8I-103)--W.N.

E-126 Booker, Henry George (Cornell Univ.), Meteorological aspects of propagation problems. (In: Compendium of meteorology. Boston, American Meteorological Society, 1951. p.1290-1296. 3 figs., 20 refs., 5 eqs.) DWB--The phenomenon of superrefraction or extra downward refraction in which the downward refraction of radio waves exceeds the curvature of the earth, as experienced at radar stations is described and the regions in which this phenomenon has been observed are listed. An explanation of the origin of superrefraction in terms of the temperature excess and of the humidity deficit of the appropriate air mass in relation to the earth's surface is presented. The problem of specifying accurately the temperature and humidity gradients and other meteorological data from generally available synoptic data and the meteorological factors responsible for these gradients are discussed. Some of the meteorological investigations made by R.A. CRAIG and H.G. BOOKER on the measurement of temperature and humidity at various heights and the explanation of their distribution by a theory of the modification in air mass by eddy diffusion, are summarized. (Met. Abs. 8I-104) --I.L.D.

E-127 Boyd, J. E. (Ga. Inst. of Tech.), The effect of atmospheric conditions on the propagation characteristics of electromagnetic waves in the microwave region. Georgia Institute of Technology. State Engineering Experiment Station, Contract W28-099-ac-175, Project 109-8, Technical Report, No. 4, Final Report on Project, June 30, 1951. 91 p. Diagr., graphs, 10 refs. DWB--During 1947, 1948 and 1949 the signal strength for optical and nonoptical links (at frequencies of 1310, 2860 and 9400 Mc) over highly varying and rough terrain were intensively studied, stressing the meteorological influence on microwave propagation, particularly the effects of ducts, inversions and turbulence. Data on refracting conditions were obtained by aircraft and balloon soundings and by radiosondes and modern electronic apparatus. Measurements up to 100 ft above the surface were taken with a meteorological tower sounding system. The valuable results are analyzed and discussed, concluding with the desirability of further intensive investigations of the important problem of the atmospheric structure within the first hundred feet above the earth's surface, and of the effect of irregular ground on signal stability. (Met. Abs. 8I-105)--W. N.

E-128 Brocks, Karl, Probleme der "Radiometeorologie". (Problems of radio-meteorology) Annalen der Meteorologie, 4(1/6):78-86, 1951. 2 figs., table, 17 refs., 4 eqs. Summaries in German and English p. 78. DWB--A discussion of the effect of the atmosphere on radio waves 1 cm to 10 m. The equations of the "relative beam-curvature" (negative gradient of refractive index times earth's radius) are set out and constants of pressure and vertical gradients of temperature and humidity tabulated. Other measures of refraction in use are defined. Diurnal variations at Quickborn are discussed. (Met. Abs. 8I-106)--C. E. P. B.

E-129 Cornell University. School of Electrical Engineering, Bibliography of report on tropospheric propagation. Contract AF 33(038)-1091, Final Report, Pt. 1, April 1, 1951. Each section renumbered. DLC--A thoroughly annotated bibliography of 867 reports on 17 phases of troposphere radio propagation from numerous American, British, Australian, Canadian and New Zealand sources from 1930 to 1949. The only sources other than those from the English language that have been abstracted are those which have been translated by such agencies as CADO and NACA. The abstracts are thorough and contain essential information and theory. A detailed subject and author index is provided. The meteorological theory and instrumentation, effect of temperature and humidity inversions, hills, trees, storms, polarization, etc., are all given proper emphasis. The term Radio climatology is introduced here. (Met. Abs. 4.7-226)--M. R.

E-130 Cornell Univ. School of Electrical Engineering, Summary report, air-to-air and air-to-ground electromagnetic propagation. Contract AF 33(038)-1091, Final Report, Pt. 2, June 1, 1951. 109 p. tables, figs., eqs. DWB--The present state of knowledge on propagation of electromagnetic waves above 30 Mc/s is reviewed and summarized under the following headings: 1) An evaluation of radio wave propagation problems with emphasis on air-to-air and air-go-ground transmission; 2) Standard and non-standard atmosphere propagation — pure theory; 3) Propagation experiments; 4) Meteorological theory, experiment and equipment; 5) Radar forecasting; 6) Absorption and scattering; 7) Dielectric constant and loss factor; 8) Reflection coefficient; 9) Horizontal and vertical polarization; 10) Effects of hills, trees and other obstacles; 11) Air-to-air and air-to-ground propagation. References to earlier work and definitions of the topics are included. (Met. Abs. 8I-108)--W. N.

E-131 Cornell Univ. School of Electrical Engineering, Investigation of air-to-air and air-to-ground experimental data. Contract AF 33(038)-1091, Final Report, Pt. 3, Dec. 10, 1951. 182 p. Numerous figs., tables, eqs. DWB--Attempts to obtain the true shape of the refractive index profile from a model of a horizontally stratified atmosphere and from radio data yield valuable information on characteristics without solving the problem. A wave structure is suggested and a theory of the elevated layers predicts satisfactorily the radio holes and to some degree the interference regions by means of statistical analysis. A method for computing the field strength in a standard atmosphere for communication (above 30 Mc/s) between two aircraft at the same altitude over land is presented. It is suggested that one plane should stay below 5000 ft because of the radio holes (24 of 27 runs above 5000 ft contained radio holes). (Met. Abs. 8I-109)--W. N.

E-132 Cornell Univ. School of Electrical Engineering, Air-to-air radio wave propagation data. Contract AF 33(038)-1091, Final Report, Pt. 4, Dec. 10, 1951. 139 p. Numerous graphs, 2 figs. DWB--The individual records and data of 22 flights are presented. The meteorological conditions for each flight are given, and a brief description of radio and meteorological instrumentation is included. The field strength (in most cases) was plotted as a function of distance, including the distance between two aircraft taking off from Wright-Patterson Air Force Base, meeting and then separating for a determined flight-distance at equal speed to keep the center point fixed at a constant altitude. The theoretical curves presented, involved geometrical optics to a stratified atmosphere. Reflection coefficients were compared to theoretical values for each flight. The use of the form for analysis and estimation of the refractive index is demonstrated. The results are summarized in Final Report, Pt. III. (Met. Abs. 8I-110)--W. N.

E-133 Feinstein, J., Tropospheric propagation beyond the horizon. Journal of Applied Physics, 22(10):1292-1293, Oct. 1951. Fig., 5 refs., eq. DWB--Since the atmosphere possesses a gradient of refractive index, a partial reflection of wave energy is delivered beyond the horizon of the transmitter. To estimate the magnitude of the field produced by that reflection, from a hybrid ray and wave theory, is the purpose of this paper. (Met. Abs. 4. 1-272)--W. N.

E-134 Friedman, Bernard, Propagation in a non-homogeneous atmosphere. Pure and Applied Mathematics, 4(2/3):317-350, Aug. 1951. 3 figs., 16 refs., 96 eqs. DWB--Two previous approaches to the problem of microwave propagation around the earth (that of WATSON, RYDBECK and others, and that of PRYCE, BOOKER, FURRY and PEKERIS) are reviewed. In this substantial theoretical paper, a third fundamental assumption is used as an approach. Starting with Maxwell's equations, the theory is developed for propagation in an inhomogeneous atmosphere where the dielectric constant is radially stratified. This allows treatment for a uniform and a non-uniform atmosphere, and results compare favorably with those obtained for a "flat earth" by the W. K. B. method, except where large distances exist between transmitter and receiver. Finally, the theory is applied to an atmosphere containing a duct, and a comparison made between the previous theory based on a magnetic dipole, and the corresponding equations for an electric dipole. (Met. Abs. 4. 7-227)--M. R.

E-135 Gerks, Irvin H., Propagation at 412 megacycles from a high power transmitter. Institute of Radio Engineers, N. Y., Proceedings, 39(11):1374-1382, Nov. 1951. 14 figs., table, 17 refs., eq. DLC--During the summer of 1948 and fall, winter and spring of 1949-1950, measurements taken over rolling midwestern terrain (about 100 mi distance) indicate: (1) the existence of pronounced nocturnal superrefraction during summer, and (2) of persistent scattering by atmospheric turbulence near the surface in all seasons. Graphs show the effect of distance, terrain, antenna height and time on field strength. Finally, the significance of the results in relation to electromagnetic wave communication is indicated. (Met. Abs. 8I-115)--W. N.

E-136 Germany. Deutscher Wetterdienst in der US-Zone. Wetterdienstbibliothek, Literatur-Ausstellung über Fragen auf dem Gebiet der Ausbreitung elektrischer Wellen vom Standpunkt der Meteorologie aus. (Presentation of literature on problems in the field of electrical wave propagation from a meteorological point of view.) (1951?) 3 p. Mimeo. DWB--Four brief bibliographies are included, covering the following subjects applicable to the general subject of electromagnetic propagation: 1) The influence of the atmosphere on electric waves (17 items); 2) Thunderstorms (13 items); 3) Temperature and humidity in the lowest kilometer of the atmosphere (16 items); and 4) Pertinent German works on various fields of meteorology and forestry (10 items). (Met. Abs. 8I-116)--M. R.

E-137 Gough, M. V., Propagazione delle onde metriche (VHF) e decimetriche (UHF) entro il campo ottico. (Propagation of meter (VHF) waves and decimeter (UHF) waves within the optical range.) Marconi, Rome, 2(3/4):21-32, July/Dec. 1951. DLC--Ground reflection and its dominant influences on VHF and UHF propagation in the optical range is treated in some detail here. Other influencing factors such as atmospheric refraction, ionospheric and tropospheric reflections and diffraction are noted briefly. (Met. Abs. 8I-117)--W. N.

E-138 Grosskopf, J., Ultrakurzwellenausbreitung im Bereich von 30 bis 100 MHz. I. (USW propagation in the 30-100 Mc/s range, Pt. 1.) NTZ: Nachrichtentechnische Zeitschrift, Berlin, 4(9):411-414, Sept. 1951. Pt. 2, Ibid., 4(10):441-451, Oct. 1951. 30 figs., 46 eqs., 2 refs. DLC--Field strength measurements made by the German Post Office over distances within the range of vision are analyzed. Factors investigated include the influence of ground reflections near transmitter or receiver on the shape of the field, the influence of undulations or hilliness on attenuation, and the diffracting effect of obstacles. Irregularities in the field strength/distance curves are traced to relatively simple causes such as double reflections. Diffraction measurements indicate that in general the classical diffraction formulas are inapplicable, and that the analysis of the propagation process must take account of the nature of the terrain.

E-139 Hauer, A., Meteorologische aspecten van de voorplanting in de atmosfeer van zeer korte golven. (Meteorological aspects of very short wave propagation in the atmosphere.) Tijdschrift van het Nederlandsch Radiogenootschap, Baarn, 16(1):39-52, Jan. 1951. 6 figs., 4 refs., eqs.--This lecture, which deals with some practical measurements held against the theory of refraction and scattering related to meteorological factors, was delivered before the Nederlandsch Radiogenootschap, Oct. 1950.--W. N.

E-140 Hay, H. G. and Unwin, R. S., Extension of the mode theory of tropospheric refraction to cover variations in the refractive index profile along a transmission path. Great Gritain. Telecommunications Research Establishment, T. R. E. Technical Note, No. 124, Aug. 1951. 13 p. 6 figs., 3 refs., 37 eqs. Mimeo. GB-MO--The method is to divide the transmission path into zones in each of which variations in the profile are small. The duct height and lapse rate of modified refractive index at infinite height are found by the half-power law and used with a set of curves to evaluate the distribution of radio field strength beyond the horizon of the transmitter. (Met. Abs. 6. 5-102)--C. E. P. B.

E-141 Hines, C. O., Wave packets, the Poynting vector, and energy flow, Pt. 1, Non-dissipative (anisotropic) homogeneous media. Pt. 2, Group propagation through dissipative isotropic media. Pt. 3, Packet propagation through dissipative anisotropic media. Journal of Geophysical Research, 56(1, 2):63-72; 197-220, March, June, 1951. 15 refs., 131 eqs. DWB--An attempt to correlate the results of electromagnetic propagation energy velocities cbtained by the wave packet and the POYNTING vector by the energy density does not equal the speed obtained by the packet method. The first paper deals with nondissipative method in which the effective permittivity matrix is Hermitian. When plane homogeneous waves are propagated through a homogeneous, nonabsorbing media, agreement is good for direction in which energy flows. In the second paper, the expression for velocity of a wave packet or group speed in a dissipative isotropic medium was found to be $U = c/(dkn_2/dk)$ where n_1 is the real part of the refractive index at frequency $kc/2\pi$. Expressions are also obtained which apply to transmissions of pulses through slabs of material. In the third paper formulas are proposed for expressing the velocity of a packet in an anisotropic dissipative medium. One expression is given for homogeneous waves and one for inhomogeneous waves. In the case of nondissipative media, the two are shown to be equal. (Met. Abs. 8I-118)--M. R.

E-142 Jones, E. H., Propagation of VHF radio waves. Nature, London, 168(4281):870-871, Nov. 17, 1951. 2 figs. DLC, DWB--Note on some field strength measurements on frequencies of 280 and 387 Mc/s over distances up to 250 mi, the transmitter being airborne at 40,000 ft and the receiver near the ground. Some discrepancies between observed and calculated values are noted.

E-143 Kerr, Donald E. (ed.), Propagation of short radio waves. 1st ed. Prepared under the supervision of the Office of the Scientific Research and Development, National Defense Research Committee. N. Y., McGraw-Hill, 1951. 728 p. 299 figs. (Massachusetts Institute of Technology, Radiation Laboratory Series, No. 13). DLC--The book discusses and treats radio meteorology with many experiments of correlating radio meteorological patterns, and will be found handy as a reference on tropospheric propagation. The chapters are: Elements of the problem; Theory of propagation in a horizontally stratified atmosphere; Meteorology of the refraction problem; Experimental studies of refraction; Reflections from the earth's surface; Radar targets and echoes and Meteorological echoes and atmospheric attenuation. (Met. Abs. 8I-119)--W. N.

E-144 Knighting, E., Some meteorological aspects of radio duct formation. Physical Society of London, Proceedings, Sec. B, 64(373):21-30, Jan. 1951. DLC--Theoretical discussion of three problems of meteorological interest concerning formation of radio ducts in the atmosphere, which occurs when variation of height of modified refractive index obeys certain conditions: 1) considerations of growth rate of ducts over sea, 2) duct formation during nocturnal cooling, and 3) duct widths associated with power law profile of modified refractive index. (Met. Abs. 8I-120)--Author's abstract.

E-145 New Zealand. Dept. of Scientific and Industrial Research, Report of the factual data from the Canterbury Project, a radio-meteorological investigation in the South Island of New Zealand. London, pub. by the Dept., 1951. 3 vol. (857 + 187 p.) Figs., tables, graphs, refs. V. 2-3 oversize. DWB--These three large volumes comprise the final report, including all of the data, charts and analyses of a joint scientific investigation conducted between Sept. 1946 and Dec. 1947 by the Dept. of Scientific and Industrial Research of the United Kingdom and of New Zealand. The "Canterbury Project" was planned in 1944 to provide information on the formation and behavior of low level atmospheric ducts caused by advection of warm dry continental air over the neighboring sea. An area in Canterbury Province of South Island, New Zealand was considered the most suitable. Vol. 1, Descriptive and numerical data, contains an analysis of all of the meteorological and radio data collected during this period and all of the detailed surface, upper air, synoptic and oceanographic data for the entire area around New Zealand. Airplane, radar, balloon, radiosonde and ship observations were used intensively and extensively. Each separate situation is described and analyzed. Surface (coded) synoptic observations are given for 00, 03, 06, 09, 12, 15 and 18 h for a score of stations. The observational, operational and theoretical considerations are also treated at great length and in detail. Vol. 2, Meteorological data, consists of a large "atlas" type presentation of graphs and charts prepared from the meteorological data collected during this survey. A detailed topographical map of the region and a cross section showing the relief in relation to observation stations is followed by detailed isopleth and sounding diagrams of potential temperature, specific humidity, temperature and upper air winds for levels from the sea level to 2000 ft height. Actual anemograph traces for the 50 ft level are reproduced for several stations for each of the 50 or so situations studied. Synoptic charts are presented for 1200 h local time for the Australasian region for all of the periods when data were obtained. Isopleth cross sections of potential temperature and specific humidity are given in great detail for a range of 25 mi of land and 120 mi at sea (to 1000 ft). Soundings are given for both land and sea. Vol. 3, Radiowave propagation data, also consists of large detailed graphs and isopleth cross sections of modified refractive index, height gain curves, etc., from aircraft and ship soundings from 0 to 1000 or 2000 ft height. About 50 separate situations are thoroughly analyzed in this fashion. (Met. Abs. 8I-121)--M.R.

E-146 Overcash, Frank J. (Aircraft Radiation Lab., Wright Air Dev. Center), Index of refraction measurement with an airplane psychrograph. U.S. Air Force, A.F. Technical Report, No. 6621, Aug. 1951. 38 p. 33 figs., 10 refs. DWB--An airplane psychrograph was used by the Aircraft Radiation Laboratory of Wright Air Development Center to obtain accurately the atmospheric index of refraction up to 10,000 ft in the Dayton, Ohio, area. Complete details of its use are given, with curves of experimental results. This instrument makes a continuous recording of the fine detail of the wet bulb and dry bulb temperature above freezing, which is used with pressure to calculate index of refraction. These data show that the index profile follows closely the wet bulb temperature profile in the Dayton, Ohio, area in the summer months. Index lapse rates greater than $30(n-1)10^6$ units per 100 ft were recorded at 7000 ft. Actual index curves that conform approximately to what has been considered the standard were found to be the exception rather than the rule. (Met. Abs. 8I-122)--Author's abstract.

E-147 Perers, Olaf F.; Stjernberg, Bo. K.E. and Forsgren, K.H., Microwave propagation in the optical range. Göteborg, Sweden. Chalmers Tekniska Högskola, Handlingar, No. 108, 1951. 19 p. Graphs, photos, refs. Price: Kroner 3-. DWB--In 1946 when these propagation tests betan in the vicinity of Göteborg, Sweden, access to reports on similar works by foreign scientists was not possible. The results presented are nevertheless valuable for studying the influence of local weather and consist of: transmission field strength, attenuation, refraction, fading and diurnal variation of 10, 3, and 1 cm wavelengths. Equipment, sites of installations and records are shown in photographs. (Met. Abs. 8I-124)--W. N.

E-148 Phillips, W. Eric; Ashwell, P.C. and Browne, L.C. (all, Univ. of Natal, Durban), Atmospheric super-refraction and the anomalous propagation of radio waves off the coast of Natal. South African Journal of Science, 48(5):163-166, Dec. 1951. 2 figs., 7 refs. DWB--Correlated meteorological observations with microwave phenomena on the Natal coast of Wentworth and Durban, showed that super-refraction is present during the autumn and winter months. Some ducts were transitory. The K-H layer plays no role in such propagation. Some data are given. (Met. Abs. 4.5-241)--W. N.

E-149 Saxton, J. A., The propagation of meter radio waves beyond the normal horizon. Pt. 1, Some theoretical considerations with particular reference to propagation over land. Institution of Electrical Engineers, N.Y., Proceedings, Pt. III. 98(55):360-369, Sept. 1951. 15 figs., table, 14 refs., 13 eqs. Also: Saxton, J. A.; Luscombe, G. W. and Bazzard, G.H., Pt. 2, Experimental investigations at frequencies of 90 and 45 Mc/s. Ibid., 98(55):370-378, Sept. 1951. 12 figs., table, 5 refs. DLC--In Pt. 1, the relative importance of abnormally high refraction near the surface of the earth, and of reflection from high level inversion layers, is investigated and illustrated by examples. Of the two mechanisms, the latter is the more likely to give abnormally high field strength at ranges of a few hundred kilometers, especially for low terminal heights. Consideration is also given to the effects of scattering by turbulent eddies in the atmosphere. This is of less importance than other mechanisms of propagation up to distances of 250 km. The statistical distribution of quasi peak field strength as a function of the time was determined for propagation over two paths of respective lengths 110 and 270 km, at 90 mc, and over one of length 160 km at 45 mc, for a period of two years. The observed field strengths often considerably exceeded the refraction. Some degree of correlation was found with meteorological data obtained from routine radiosonde ascents. Use of the results in planning vhf broadcasting services is outlined. --Authors' abstract.

E-150 Schachenmeier, Richard, Untersuchungen uber den Einfluss der Troposphare auf die Ausbreitung ultrakurzer Wellen. (Investigations of the influence of troposphere on propagation of ultrashort waves.) Archiv der Elektrischen Übertragung, 5(1):1-9, Jan. 1951. 9 figs., 8 refs., 46 eqs. DLC--A method for reliable calculation of field strength is demonstrated. The method is based on the physical principles of propagation: (1) the combined effects of atmospheric refraction, and (2) diffraction due to the curvature of the earth. Values from meteorological observations are compared and found in satisfactory agreement with measured field strength at meter and decimeter wavelengths for different land and sea paths. Propagation within and beyond the optical range is treated separately. (Met. Abs. 8I-126)--W. N.

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E-151 Abild, Bruno; Wensien, H.; Arnold, E. and Schikorski, W. (Aerologische Station, Flensburg, N. W. Germany), Über die Ausbreitung ultrakurzer Wellen jenseits des Horizontes unter besonderer Berücksichtigung der meteorologischen Einwirkungen. (Propagation of ultrashort waves beyond the horizon with special consideration of meteorological influences.) Hamburg. Nordwestdeutscher Rundfunk, Technische Hausmitteilungen, 4(5/6):85-100, May/June 1952. 25 figs., 7 tables, 7 refs., 43 eqs. Abstracted from reprint. DWB--After a detailed theoretical analysis of ultrashort wave propagation, in which the effect of various conditions in the deflection and the interference zones is investigated and illustrated by numerous diagrams, tables and graphs, the authors report field intensity measurements conducted in N. W. Germany. General conclusions are deduced from observed high field intensities and corresponding synoptic situations. Data on the correlation between field intensities and height and thickness of inversions, pressure and temperature are presented. Seasonal variations of inversions, of anomalous field intensities, etc., are shown in tables and graphs. The authors conclude that both ground level inversions and those above 3000 m increase field intensities. A few situations in which the effect of inversions was particularly noticeable are described. (Met. Abs. 8I-130)--G. T.

E-152 Abild, Bruno, Überreichweiten bei ultrakurzen Wellen und ihre meteorologischen Ursachen. (Extended ranges of ultrashort waves and their meteorological causes.) Germany. Deutscher Wetterdienst in the US-Zone, Berichte, No. 35: 227-228, 1952. Also issued as Hamburg. Norwestdeutscher Rundfunk, Technische Hausmitteilungen, 4:4-11, 1952. 20 figs., 10 refs. DWB--Experimental transmissions of 3 m waves were carried out by the Nordwestdeutscher Rundfunk (1951) over a 150 km overland path. The receiving site (200 m transmission height) was about 100 km beyond the normal horizon. The field strength observations agreed well with the 6 hourly radiosonde and surface observations. The cause of the extended range (beyond the horizon) is explained by heavy inversions, but the obvious close correlation between propagation and the meteorological factors as a function has not been explained. A statistical evaluation might be possible, hence charts based on meteorological observations will be made in an attempt to forecast time of the day and the month when the phenomenon might occur. (Met. Abs. 8I-129)--W. N.

E-153 Anderson, L. J. (Res. Div. U.S. Navy Electronics Lab.), Calculator for atmospheric refractive index. U.S. Navy Electronics Laboratory, Report, 279, March 18, 1952. 7 p. 4 figs. (fold.). DWB--The calculator, developed at NEL, provides a simple and accurate method of obtaining true and modified refractive index values from temperature, humidity, and altitude data. Its principal advantage over other refractive index calculators is that only one setting is required per value. Base diagrams are provided for humidity expressed as either dewpoint or wet bulb temperature. Rotor diagrams are supplied for calculation of either true or modified refractive index. (Met. Abs. 4.9-247)--Author's abstract.

E-154 Beckmann, B., Die ionosphärische und troposphärische Steuerung der Funkwellenausbreitung. (Ionospheric and tropospheric steering of wireless broadcasts.) Zeitschrift für Meteorologie, 6(4):112-117, April 1952. 4 figs., 10 refs., 8 eqs. MH-BH--The transmitting frequency (UFB) of the space wave from a broadcasting station lies between the limits of reflection and damping in the ionosphere. Its distribution, diurnal and annual variations are illustrated and discussed. Refraction in the troposphere (normally at about 8000 m) plays an important part in extending the range only of ultrashort and decimeter waves in inversions. It is much less regular than ionospheric steering. The index of refraction, which depends on moisture content, is small and only becomes effective with wave inclination under 1°. (Met. Abs. 3.9-235) --C.E.P.B.

E-155 Brocks, Karl, Die Lichtstrahlkrümmung in den unteren 500 m der Atmosphäre. (Tabellen des Refraktions-koeffizienten, II, Für Höhenmessung und Radiometeorologie). (The curvature of light rays near the earth's surface. (Tables of the refraction coefficient, Pt. 2, For height measurements and radiometeorology).) Annalen der Meteorologie, 5(1-2):47-57, 1952. 3 figs., 7 tables, 16 refs. German and English summaries p. 47. DWB--This part of a two part article gives bi-hourly mean values of refraction in central and west Europe from 0.5-500 m above level plains. These are calculated from mean temperatures ignoring humidity, but the effect of humidity is discussed. Subsidiary tables for June and December give values for clear and overcast days and effect of sun's altitude. Special cases are discussed. A formula is given for refraction of ultrashort radio waves in terms of pressure, temperature and vapor pressure. Pt. 1 deals mainly with optical rays (Met. Abs. 2.1-178). (Met. Abs. 4.5-221)--C.E.P.B.

E-156 Christall, F.I. and Cubitt, J.D., Unusual radar performance, Red Sea. Marine Observer, 22(55):14-15, Jan. 1952. DWB--March 1, 1951. Pronounced echoes at 50,000-60,000 yards separated by a gap from normal echoes at 30,000 yards. Example of superrefraction. (Met. Abs. 3.9-236).

E-157 Cornell Univ. School of Electrical Engineering, Investigation of air-to-air and air-to-ground electromagnetic propagation. Contract AF 33(038)-1091, Interim Engineering Report, No. 15, June 10, 1952. 23 p. 2 figs., 2 tables, eqs. DWB--Various forms of the correlation functions were discussed, the importance of which were demonstrated by deriving their corresponding scattering coefficients. The theoretical results showed that if the average signal power and noise power are constant, the correlation functions are related by a constant factor. The small value of the signal to noise ratio must be attributed to "noise". Some results of variation of scale intensity with height were given. (Met. Abs. 8I-134)--W.N.

E-158 Crain, C.M. and Deam, A.P., An airborne microwave refractometer. Review of Scientific Instruments, N.Y., 23(4):149-151, April 1952. 2 figs., 4 refs. DLC--A device for measuring directly tropospheric index of refraction fluctuations and profiles is described. The change in resonant frequency of a cavity resonator exposed to atmospheric air is recorded continuously, thus giving a continuous recording of atmospheric index of refraction relative to an arbitrary reference. The method used for sampling the air and the measured errors involved are described. A typical segment of recorded data is shown.--Authors' abstract.

E-159 Crain, C. M. and Gerhardt, J. R., Measurements of the parameters involved in the theory of radio scattering in the troposphere. Institute of Radio Engineers, N. Y., Proceedings, 40(1):50-54, Jan. 1952. 5 figs., table, 6 refs., 2 eqs. DLC--Preliminary measures of the scale and the intensity of turbulence were obtained by direct measurements of the variation of the index of refraction and the associated temperature fluctuations from 10 in. to 50 ft above the ground. The observations have been carried out by the Electrical Engineering Research Laboratory of the University of Texas since 1948-49. It is shown that the instantaneous patterns of temperature, moisture or refractive index generally have a magnitude significantly greater than zero. Observations to 300 ft above the ground will be made. (Met. Abs. 8I-135)--W. N.

E-160 Crawford, A. B. and Jakes, W. C., Jr., Selective fading of microwaves. Bell System Technical Journal, 31(1):68-90, Jan. 1952. 14 figs., table, 4 refs. DLC--The results of an extended survey of microwave propagation over two line-of-sight paths in New Jersey are described. Angle-of-arrival measurements at 1.25 cm wavelength and selective fading observations in a 450 Mc frequency band centered at 2950 Mc show that the severe fading can be explained in terms of multiple path transmission. A computer of the analogue type was built to stimulate the more complicated selective fading patterns. (Met. Abs. 8I-136) --Authors' abstract.

E-161 Dolukhanov, M. P., Rasprostranenie radiovoln. (Radiowave propagation.) Moscow, Gosud. Izdatvo Literatury po Voprosam Sviazi i Radio, 1952. 490 p. Refs., numerous figs., tables, eqs. DLC (QC661.D6)--A textbook on radio propagation, going quite extensively into surface propagation, ionospheric propagation, long wave, short wave, and ultrashort wave propagation and, finally, atmospherics and cosmic noise. Tropospheric meteorological factors are discussed on p. 436-461, in the chapter on ultrashort wave propagation. Theory, curves, etc., are given for humidity and temperature effects, channels and turbulent dispersion, absorption and beyond-the-horizon propagation. (Met. Abs. 10.9-12)--M. R.

E-162 Fine, H., Variation of field intensities over irregular terrain within line of sight of the UHF band. Institute of Radio Engineers, N. Y., Transactions, No. PGAP-4:53-65, Dec. 1952. 11 figs., table, 3 refs. DLC--Statistical analysis of available data from field strength surveys enabled empirical propagation formulas to be deduced for the whole UHF television band from 300 to 900 Mc to assist the Federal Communications Commission in the problem of frequency allocation for UHF television broadcasting stations.

E-163 Fukushima, M.; Tao, K.; Uyesugi, Y. et al., Ultrashort wave propagation and mirage. Journal of Geomagnetism and Geoelectricity, Tokyo, 4(3/4):141-146, Dec. 1952. 6 figs., table, 4 refs. DLC--Observations of field intensity at 472, 153 and 60 Mc and of vertical distribution of meteorological elements in the lower atmosphere were carried out to make clearer the anomalous propagation of VHF and UHF waves at the coast of Toyama Bay during a month in which mirages appeared. On the days when mirage appeared, the field intensities of shorter waves increased considerably, especially at 472 Mc. Radio ducts were observed on these days and they were so intense as to transmit the 472 Mc wave. From this consideration, the mirage and the radio duct are thought to be due to the same meteorological conditions. The results of this study are applicable to forecasting the anomalous propagation of ultrashort wave in the neighborhood of the coastline. --Authors' abstract.

E-164 Gast, E.; Essen, L. and Froome, K. D., The refractive indices and dielectric constants of air and its principal constituents at 24,000 Mc/s. Archiv der Elektrischen Übertragung, 6(12):532-534, Dec. 1952. Fig., 2 tables. DLC--The oscillator, the accuracy of which is comparative to that of the optical range, is briefly described and outlined in a diagram. Results of measurements of air, nitrogen, oxygen and argon free from carbon dioxide are presented in tables, featuring a number of results at various frequencies by other workers. For the refractive index of humid air under different atmospheric conditions formulas were deduced that can be reduced to normal atmospheric conditions by:

$$(nt, P - 1) . 10^6 = \frac{103,49}{T} . P_1 + \frac{177,4}{T} . P_2 + \frac{86,26}{T} . P_3 (1 + \frac{57,48}{T}),$$

where P_1, P_2 and P_3 stand for the part pressure of dry air, carbon dioxide and water vapor; t = the temperature in $^{\circ}C$; T = t + 273 the absolute temperature. The value for the dipole moment of the water vapor molecule was deduced as $1.839 \pm 0.002 \cdot 10^{18}$. (Met. Abs. 8I-137)--W. N.

E-165 Grant, Arthur S. G. (Met. Serv., Canada), Some meteorological problems of electronic surveying. Royal Meteorological Society, Canadian Branch, (Publications), 3(3), 1952. 9 p. Fig., 9 refs. DWB--The technique of electronic surveying is described. Distances are measured by radar from aircraft with a known elevation and values obtained are then reduced to map distances. The author briefly discusses the effect of atmospheric conditions on the determination of aircraft elevation, and on the atmospheric refraction of radio signals. (Met. Abs. 4.11-37)--G. T.

E-166 Hay, H. G. and Unwin, R. S., Tropospheric wave propagation in a duct of non-uniform height. Physical Society of London, Proceedings, Ser. B, 65(12):981-989, Dec. 1, 1952. 3 figs., 4 refs., 26 eqs. DWB--The simple mode theory of tropospheric refraction (H. G. BOOKER and W. WALKINSHAW, 1947) is extended to cover situations where refractive index profile varies, e.g., with distance offshore. The expression for field strength in decibel form is applied to experimental data on radio ducts off New Zealand, duct width increasing from 100 ft near coast to 350 ft at 55 km, and gave values of field strength of the right order at long ranges. A more general expression for field strength is also given. (Met. Abs. 4.5-238)--C. E. P. B.

E-167 Hirao, Kunio; Uyesugi, Y. and Tao, K., Propagation characteristics of VHF over a distance of 125 km. Journal of Geomagnetism and Geoelectricity, Tokyo, 4(3/4):131-140, Dec. 1952. 15 figs., 4 tables, 7 refs. DLC--A statistical study of the field intensity of VHF wave over a distance of 125 km was made by using mainly the observed data of 150 Mc and partly those of 65 Mc. For this purpose, the weather maps, the aerological data obtained at Tateno Aerological Observatory and the meteorological elements observed at Kokubunji and Hiraiso were fully investigated. The field intensity and the range of its diurnal variation are large in summer and spring, and small in winter and on days with precipitation. Abnormally high field intensity which appears frequently, and its severe variation, are considered to be caused by the complicated distribution of meteorological elements in the lower atmosphere. The effect of front is recognized and it seems to be more remarkable at night than in daytime. --Authors' abstract.

E-168 Hund, August, Short wave radiation phenomena. N.Y., McGraw-Hill, 1952. 2 vol. 1382 p. 394 figs., 97 tables, 1009 eqs., bibliog. p.1288-1301. DLC (QC661.H83)--This valuable work covers theoretical and experimental contributions from the discovery of electromagnetic waves to their applications in radio communication and in guided missiles. The nine chapters are as follows: Ch. 1, Fundamental concepts and relations of currents and electromagnetic fields; 2, Space electromagnetic fields of elementary electric and magnetic dipoles; 3, Fundamental methods used in electromagnetic theory; 4, Propagation characteristics; 5, Transmission lines and radiation; 6, Unobstructed space radiation; 7, Space radiation in the presence of electromagnetic obstruction; 8, Electromagnetic diffraction, and 9, Wave guides and cavities. Cross references are provided. The last three chapters deal particularly with radiometeorology. The appendix provides a list of the symbols used and an extensive bibliography. Met. Abs. 8I-139)--W.N.

E-169 Institute of Radio Engineers--International Scientific Radio Union, Wash.,D.C., April 21-24, 1952. Proceedings. Institute of Radio Engineers, N.Y., Proceedings, 40(6):738-748, June 1952.--Contains the summaries of 71 technical papers presented at meeting, including 6 on tropospheric propagation (papers 5 and 20-25).--E.K.

E-170 Kirby, Robert S.; Herbstreit, J.W. and Norton, K.A., Service range for air-to-ground and air-to-air communication above 50 Mc/s. Institute of Radio Engineers, N.Y., Proceedings, 40(5):525-536, May 1952. 17 figs., 3 tables, 10 refs., 10 eqs. DLC--Propagation aspects of air-to-ground and air-to-air communications are analyzed. Contours of constant received signal strength are shown in the form of lobes for various frequencies. It is shown that for systems with equivalent transmitted power, ground antenna height, and transmitting and receiving antenna gain the service range decreases as the frequency is increased. This is due primarily to a decrease in the absorbing area of the receiving antenna and to a larger number of nulls in the lobe structure arising from interference between direct and ground reflected waves. Ground station antenna height diversity and tilted array ground antenna systems are discussed as a means of improving coverage as the operating frequency is increased. --Authors' abstract.

E-171 LaGrone, Alfred H., Volume integration of scattered radio waves. Institute of Radio Engineers, N.Y., Proceedings, 40(1):54, Jan. 1952. Fig., 3 refs., eq.--The general equation for radio scattering developed by Booker and Gordon is extended to a volume integral equation, which gives the total scattered power density per unit cped at a receiver point relative to the power radiated per unit solid angle by an isotropic source.--Author's abstract.

E-172 Lauter, Ernst A. and Bartels, G. (Met.Obs., Kuhlungsborn, Germany), Optische Refraktion and Ultrakurzwellenausbreitung im Ostseeraum im Frühjahr 1952. (Optical refraction and propagation of ultrashort waves in the Baltic Sea area spring 1952.) Zeitschrift für Meteorologie, 6(7):215-220, July 1952. 7 figs., 2 refs. DWB--Unusually strong refraction phenomena observed at the Met.Obs. Kühlungsborn, N.Germany, March 14, April 17 and May 2, 1952, are described in detail and compared with the synoptic situation and with ultrashort wave propagation investigated at the same time. It was found that variations in optical refraction index are not always in a direct relationship to variations in ultrashort wave reception field intensity. The considerable effect of horizontal atmospheric heterogeneity on the propagation of ultrashort waves is stressed. (Met. Abs. 4.9-250)--G.T.

E-173 Neumann, J., Diurnal variation of the subsidence inversion and associated radio wave propagation phenomena over the coastal area of Israel. Israel. Meteorological Service, Ser. A, Meteorological Notes, No. 6, 1952. 16 p. 5 figs., table, 10 refs., 20 eqs. MH-BH--Mean height, pressure, temperature and humidity of base and top subsidence inversion at Lydda Airport at 1, 7, 13 and 19 h were found for July 1945 and diurnal variations computed. Inversion base-top varied from 678-1101 m at 7 h to 486-781 m at 19 h and is probably lowest at 17 h. Main rises (1-7 h) and falls (13-17 h) are associated with convergent land and divergent sea breezes. The modified refractive index profiles for radio waves are calculated; the lowest level of the elevated duct and greatest hydrolapse account for the observed optimum propagation in the evening. (Met. Abs. 8I-141)--C.E.P.B.

E-174 Northover, F.H., The anomalous propagation of radio waves in the 1-10m band. Journal of Atmospheric and Terrestrial Physics, 2(2):106-129, 1952. Fig., 12 refs., 109 eqs. DWB--Anomalous propagation of meter waves is discussed mathematically and results applied to an observed dry bulb inversion from 41-51°F at 3900 ft above Cardington, England. Wet bulb 40°F. It is found that such an upper inversion, sharp enough to act as a discontinuity, can cause considerable anomalous propagation in waves of 3-1/2 and 7 m. (Met. Abs. 3.9-237)--C.E.P.B.

E-175 Schulkin, M., Average radio-ray refraction in the lower atmosphere. Institute of Radio Engineers, N.Y., Proceedings, 40(5):554-561, May 1952. 7 figs., 2 tables. DLC--Presents empirical results (accompanied by many useful curves) of computations for a range of climatological conditions in North America, of the bending of rays that pass entirely through the atmosphere and arrive or depart tangentially to the earth's surface. Ninety percent of the ray bending occurs in the lowest 10 km of the atmosphere. The results are compared with the standard refraction approximation and it is found that although in the average case there is fairly good agreement, the deviation from the true refraction is large, both as a function of altitude and of geographical location. Most of the curves are based on data for Washington, D.C. (Met. Abs. 4.7-231) --W.N.

E-176 Spencer, C.W., Radiowave propagation at 89 Mc/s in relation to synoptic conditions. Meteorological Magazine, London, 81(961):206-212, July 1952. Fig., 4 tables, 5 refs. DWB--Superrefraction of 3.4 m waves over a distance of 257 km was recorded daily at Slough, Eng. It was compared with isobaric curvature; greatest relative frequency with cols, easterly and southerly types, least with cyclonic and northerly types. Nearly always with elevated (below 700 mb) or less often surface inversions, especially 950-900 mb. (Met. Abs. 8I-145)--C.E.P.B.

E-177 U.S. Air Force, Third Air Weather Group, Ent Air Force Base, Colorado Springs, Computing the index of refraction of the atmosphere. Its Technical Paper, No. 1, May 1952. 14 p. 5 figs., 6 refs. DWB--In this practical guide, the equation for refractive index is stated and orders of magnitude of temperature and moisture gradients which result in nonstandard radar propagation are given. Superrefraction may be due to a strong temperature inversion (about 3°C/100 ft), a strong lapse in moisture (1/2 gm/kg/100 ft), or a combination of these factors. (Met. Abs. 8I-146)--R.S. Quiroz.

E-178 Vassy, Arlette and Vassy, Etienne, Interpretation d'un type particular d'echo de radar. (Interpretation of a special type of radar echo.) Academie des Sciences, Paris, Comptes Rendus, 235(20):1240-1242, Nov. 17, 1952. 2 refs. DWB--The peculiar radar echo from a cloudless sky (first observed by J.BROCH on a 3.2 cm radar over the ocean) was again observed in the summer of 1952. This paper is an attempt to interpret the phenomenon as a coincidence of meteorological factors favoring superrefraction. (Met. Abs. 8I-147)--W.N.

E-179 Wickizer, G.S. and Braaten, A.M., Field strengths recorded on adjacent FM channels at 93 Mc over distances from 40 to 150 miles. Institute of Radio Engineers, N.Y., Proceedings, 40(12):1694-1699, Dec. 1952. 14 figs., table, ref. DLC--Field strengths of KE2Xcc (93.1 Mc, Alpine, N.J.) and WBZ-FM (92.9 Mc, Boston, Mass.) have been recorded for more than a year at two locations (Hauppauge and Riverhead) on Long Island. Statistical analysis of data for the evening hours reveals a broad seasonal trend toward higher intensities in the summer, with larger over-all variation on the longer transmission paths. Based on analysis of one summer month, refraction effects appeared to vary independently in two directions. During periods of rapid and violent fading, hourly median field strengths of WBZ-FM varied over a range of 32 db at Riverhead and 25 db at Hauppage. Furthermore, for the above mentioned fading conditions, it was observed that on the 150 mi path, the hourly curves of field strength distribution with time approached a log normal distribution when the median field was less than 10 db above 1 μv per meter, and a Rayleigh distribution when the median field was greater than 15 db above 1 μv per meter. (Met. Abs. 8I-148)--Authors' abstract.

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E-180 Aden, Arthur L., Feasibility of detecting atmospheric inversions by electromagnetic probing. U.S. Air Force. Cambridge Research Center, Air Force Surveys in Geophysics, No.34, March 1953. 9 p. 7 refs., 19 eqs. DWB--An outline is given of the theory of standard and nonstandard propagation characteristics of electromagnetic waves, dependent on discontinuity of the refractive index. Vertical incidence atmospheric probing with standard L-band radar equipment should not give reflections from temperature and humidity inversions. There is only a remote possibility that proper equipment could be developed. (Met. Abs. 8J-2)--A.A.

E-181 Al'pert, Ia.L.; Ginzburg, V.L. and Feinberg, E.L., Rasprostranenie radiovoln. (Radiowave propagation.) Moscow, Gos.Izdat.Tekhniko-Teoreticheskoi Literatury, 1953. 883 p. 128 figs., 124 tables, 373 refs. DLC. Translations of several chapters into English available Special Libraries Association, Translation Center (John Crerar Library, Chicago) as its R-1929 to R-1937.--The most advanced text on theoretical and empirical aspects of radio wave propagation in all bands from microwaves to long waves, and in the troposphere and ionosphere. First, there is a historical sketch of progress in radio science since POPOV (1845), especially in Russia. Then in Pt.I, the general theory of radio propagation; Pt.II, theory of propagation in ionosphere (p.278-546); Pt.III, structure of ionosphere and experimental data on formation; regular and irregular processes in ionosphere (p.547-680); Pt.IV, experimental investigations on propagation and comparison with calculated data by various methods (p.681-870). The first part of this voluminous text is mainly theory; the last part is practical data, tables, recorder records and interpretations, nomograms, etc. All of the layers of the ionosphere are treated, as well as the troposphere, in relation to long distance propagation. Radar and impulse propagation are also considered. The extensive bibliography in 5 parts consist of about half Russian and half foreign literature through 1952. (Met. Abs. 8J-3)--M.R.

E-182 Ament, W.S., Toward a theory of reflection by a rough surface. Institute of Radio Engineers, N.Y., Proceedings, 41(1):142-146, Jan. 1953. Fig., 3 refs., 19 eqs.--A rough, perfectly reflecting surface is first specified by the statistics of noise theory. If illuminated by a plane electromagnetic wave, such a surface would reflect statistically predictable fields. An attempt is made to formulate the problem of predicting the fields in terms of the statistics of the surface with particular applicability to predicting theoretically the effect of oceanic swell and chop on the propagation of microwaves. The result is a series of integral expressions in which averages of the currents induced in the surface appear as unknown functions. Owing to mathematical complexities, these expressions are not solved for the average currents; however, a qualitative discussion is given of a known formula for the specular reflection coefficient of a gently rolling surface.--Author's abstract.

E-183 Anderson, L.J. and Gossard, E.E., The effect of the oceanic duct on microwave propagation. American Geophysical Union, Transactions, 34(5):695-700, Oct. 1953. 7 figs., 8 refs., 3 eqs. DLC--A body of experimental radio and meteorological data taken over Cardigan Bay, on the British west coast, is examined to ascertain how radar propagation is affected by the microwave duct lying next to the sea surface. The boundary layer meteorological profiles are analyzed in terms of semi-empirical relation due to E.L. DEACON, and propagation is predicted according to a method of S.A.SCHELKUNOFF. At 3 cm wavelengths, it is found that the agreement between observation and theory becomes steadily better as wind speed increases, until at speeds above 15 mi/hr (7m/s) the consistency is truly striking. At lower wind speeds there is a definite tendency to follow the theoretical pattern, but a great deal of scatter is noted. Possible explanations for this scatter are offered. More scatter is observed at 9 cm than at 3 cm, and the transition to trapping conditions is less definite. The 9 cm waves appear to "feel" the effects of the duct some time before trapping occurs. An interpretation is offered of the fact noted by MCPETRIE and STARNECKI that, in general, high signals are associated with large positive air-sea temperature differences, while low signals are accompanied by large negative differences. Also, Jones' observation that under unstable conditions high winds are accompanied by high signals is nicely explained. (Met. Abs. 8J-5)--Authors' abstract.

E-184 Anderson, L.J. and Gossard, E.E., Oceanic duct and its effect on microwave propagation. Nature, London, 172(4372):298-300, Aug. 15, 1953. 4 figs., 4 refs., eqs. DWB--A criterion for trapping in a surface duct is derived in terms of index of refraction at level at which meteorological observations are taken and at sea surface, profile index of potential refractive index, and surface roughness. This is checked against field strength observations over Cardigan Bay with fairly good results. (Met. Abs. 5.6-283)--C.E.P.B.

E-185 Anderson, L. J. and Gossard, E. E., Prediction of the nocturnal duct and its effect on UHF. Institute of Radio Engineers, N. Y., Proceedings, 41(1):135-139, Jan. 1953. 6 figs., 4 refs., 7 eqs. DLC--A method is described for predicting diurnal variation in UHF field strengths, which is based on the micrometeorology governing the nighttime refractive index profiles. Using surface meteorological data from past years, predictions are made of the probability distribution of the diurnal field variations to be expected on 100 and 1000 Mc over CRPL links in Colorado. The predictions are compared with field strength observations taken in 1952, and the agreement is encouraging. (Met. Abs. 8 J-4)--Authors' abstract.

E-186 Bean, Bradford R., The geographical and height distribution of the gradient of refractive index. Institute of Radio Engineers, N. Y., Proceedings, 41(4):549-550, April 1953. 3 charts, 4 refs., eq. DLC. Also issued as U. S. National Bureau of Standards, NBS Report, No. 1720. --Very brief text accompanying two charts featuring the Feb. and Aug. distribution of the effective earth's radius factor over the U. S. Another chart shows the distribution of refractive index for warm, temperate and cold climates. (Met. Abs. 8 J-6)--W. N.

E-187 Bellaire, F. R. and Arvola, W. A. (both, U. S. Navy Electronics Lab., San Diego), Prediction of diurnal field strength patterns by synoptic methods. (In: Conference on Radio Meteorology, Univ. of Texas, Austin, Nov. 9-12, 1953, Proceedings, Vol. (1):III-4, pub. 1953. 7 p. 4 figs.) DLC, DWB--Best VHF-UHF propagation to a point beyond the horizon occurs when a shallow layer of moist air lies under a dry layer and the worst conditions occur when air is dry or moist (unstable) to great heights. Southerly flow from Gulf of Mexico, weak pressure gradient, clear skies, varring winds, laminar structure (from Raob data), large diurnal temperature range, fog at night, and light winds give highest signals. Seven flow or air mass classes were designated for correlation with signal strength. Large diurnal variations in signal strength is characteristic of high intensity signals (at night) and low variations with low intensity. Air mass changes are apt to produce greatest deviations of actual from predicted values of diurnal curve. (Met. Abs. 8 J-7)--M. R.

E-188 Bremmer, H., The troposphere as a medium for the propagation of radio waves -I, II. Philips Technical Review, Eindhoven, Netherlands, 15(5, 6):148-159; 175-181, Nov., Dec. 1953. 10 figs., 24 refs., eqs. DLC--For microwave ($<$ 10 m) propagation the troposphere below 10 km (or the refraction index in the troposphere), not the ionosphere, has proven to be the most critical region of the atmosphere. Knowledge of this troposphere propagation and of the physical characteristics of the troposphere which affect microwaves is reviewed. Six methods by which microwaves are transmitted are examined: a) along 2 normal paths, one direct and one reflected; b) along a few rays via a transition layer; c) super-refraction (along many rays as in a wave guide with the troposphere as the wave guide; d) via reflection due to (temperature and humidity) gradient changes; e) by diffraction and f) by scattering. The last named method is discussed in great detail as it is responsible for interference from distant transmitter and hence, is the most important factor in assigning wave lengths and spacing of transmitters in order to avoid interference. (Met. Abs. 6. 6-156)--M. R.

E-189 Browne, Ian C., Radar echoes at vertical incidence from a horizontally stratified atmosphere. Royal Meteorological Society, Quarterly Journal, 79(339):157-160, Jan. 1953. 2 figs., 8 refs., 4 eqs. DWB--On July 12, 1949, on 3.2 cm radar at Cambridge, Eng., an echo (angel) was received from a horizontal layer 300 ft thick at 4560 ft, attributed to a humidity discontinuity of 40% at an anticyclonic inversion. (Met. Abs. 8J-9)--C.E.P.B.

E-190 Bullington, Kenneth, Radio transmission beyond the horizon in the 40 to 4000 Mc band. Institute of Radio Engineers, N.Y., Proceedings, 41(1):146-152, Jan. 1953. Fig., 16 refs., 21 eqs. DLC--After defining and calculating the transmission loss, author discusses the subject as related to ionospheric and tropospheric propagation, involving Rayleigh's theory. Latter part of the paper is devoted to the maximum range of a radio system along with noise problems caused by other radios. (Met. Abs. 8J-10)--W.N.

E-191 Byam, L.A. and Miller, J.Z., Notes on propagation. Institute of Radio Engineers, N.Y., IRE Convention Record, Pt. 2. Antennas and Communications, p.68-76, 1953. 11 figs., 5 refs. DLC--A brief discussion of the fading which occurred during an extended microwave propagation experiment, operated at a frequency of 4000 Mc. Attention was directed primarily to those fades which dropped 15 db or more from the normal signal level. For each such fade, the essential data were extracted and tabulated, including information with respect to the corresponding level of the diversity (or main) signal. --E.K.

E-192 Clemmow, P.C., Radio propagation over a flat earth across a boundary separating two different media. Royal Society of London, Philosophical Transactions, Ser. A, 246:1-55, 1953. 16 figs., 252 eqs., bibliog. p.54-55. DLC--A theoretical investigation is given of the phenomena arising when vertically polarized radio waves are propagated across a boundary between two homogeneous sections of the Earth's surface which have different complex permittivities. Then an analytical treatment is given of a suitable simplified problem which is fundamental in the theory of radio propagation over an inhomogeneous Earth. This purpose is achieved by establishing formulas from which any example could be largely worked out. Finally, some ramifications of the theory are outlined. --E.K.

E-193 Conference on Radio Meteorology, Univ. of Texas, Austin, Nov. 9-12, 1953, Proceedings, (v.1). Conference sponsored by The American Meteorological Society, The Institute of Radio Engineers; The Radar Weather Conference; The International Scientific Radio Union; The Joint Commission on Radio Meteorology of the International Scientific Unions. Austin, Bureau of Engineering Research, Univ. of Texas, 1953. Each section repaged. Supplement (i.e. Vol. 2), pub. 1954. Also: Saxton, J.A., Radiometeorology: Conference in Texas. Nature, London, 173(4408):761-764, April 24, 1954. DWB--In Vol. 1, short versions or summaries of 61 papers on Tropospheric propagation; Refractive index; Atmospheric scattering and turbulence; Thunderstorm and tornado atmospherics; Cloud and precipitation physics and Use of weather radar, as presented at the sessions on those topics during the Conference on Radio Meteorology Nov. 9-12, 1953 at Austin, Tex. The remaining papers and supplementary material, discussions, etc., comprise the Supplement (i.e. Vol. 2) which contains 17 papers on the various aspects of Radio propagation, Radar meteorology, Turbulence, Cloud and thunderstorm physics and 11 pages of discussion on the various subjects covered in the conference, corrections on papers in Vol. I, and a list of names and addresses of the participants. The article by Saxton is an account of the Conference which mentions the papers and discussions. (Met. Abs. 8J-11; 6.5-352)--

E-194 Cowan, Leslie W., Forecasting refractive index profiles in the atmosphere. U.S. Air Force. 3rd Weather Group, Ent Air Force Base, Colorado Springs, Technical Paper, No. 2, Sept. 1953. 80 p. 51 figs., 7 tables, 15 refs., 2 eqs. DWB--Meteorological factors affecting radar propagation in the troposphere are analyzed and methods of forecasting refractive indexes or superrefraction (or the opposite) conditions set forth. Seasonal air mass and regional variations in nonstandard conditions are treated in detail with profiles, tables, schematic diagrams, nomograms, etc. Limitations of radiosonde observations and effects of radiation or of sea or lake surface in modifying conditions are emphasized. Radio climatological (inversion frequency) data for cities in the U.S. and for the W. Atlantic are included on charts and frequency diagrams. (Met. Abs. 8J-12) --M.R.

E-195 Cowan, Leslie W., Interpreting refractive index profiles in terms of radar coverage. U.S. Air Force. 3rd Weather Group, Ent Air Force Base, Colorado Springs, Technical Paper, No. 3, Oct. 1953. 99 p. 13 figs., 61 cases, table, 6 refs. DWB--A manual giving information and nomograms necessary for calculating refractive index profiles, radio holes and other radar parameters involved in tropospheric propagation with transmitters 2000 ft, 1000 ft above and at base of layer, or 500 ft or 1000 ft below layer or in surface duct, and for different thicknesses of layer (50 ft to 1000 ft). Special cases of a radar on a coastal peak 3000 ft above the sea, and with targets 10,000 ft and 20,000 ft above transmitter, are considered. (Met. Abs. 8J-13)--M.R.

E-196 Crain, Cullen M.; Deam, A.P. and Gerhardt, J.R., Measurement of tropospheric index-of-refraction fluctuations and profiles. Institute of Radio Engineers, N.Y., Proceedings, 41(2):284-290, Feb. 1953. 8 figs. DLC--Simultaneous records of index-of-refraction and of temperature fluctuations over the sea and over coastal areas near Lakehurst, N.J., are presented. They were obtained in April 1951 by means of a microwave refractometer and a bead-type thermistor carried by a Navy Type M airship up to 5000 ft. Index of refraction fluctuations appear to be primarily due to fluctuations in air moisture content. Records showing refractive index profiles and fluctuations are also presented for Dayton, Ohio. These were obtained in June 1951 with a refractometer carried up to 11,000 ft in a Type C-46 aircraft. Some details of the meteorological conditions prevailing during the flights are mentioned, like the fact that whenever rough air was encountered, the index of refraction showed rapid variations of large amplitude, the reverse not being necessarily the case. In general, tropospheric index of refraction fluctuations are found to vary greatly with time and space. (Met. Abs. 4.8-266)--G.T.

E-197 Crain, Cullen M., Refractometer measured tropospheric index-of-refraction profiles, Vol. 1. Texas. Univ. Electrical Engineering Research Laboratory, Contracts AF 18(600)-113 and AF 19(604)-494, Report No. 6-02, Feb. 27, 1953. 27 X 40 cm. 7 p. 10 + 42 + 31 graphs. DWB--Refractometer sounding curves are shown on large sheets of graph paper for airplane soundings made in 1952 to 12,000 ft altitude over SW Ohio, off the West Coast of Washington State and west from San Francisco over the Pacific. The peculiarities of the curves are explained in terms of surface stratus layers in marine air off the West Coast, upper layers of super refractive or sub-refractive air or steep gradients caused by air mass discontinuities; either on individual days or as a general seasonal condition. On the whole, conditions were more steady off the West Coast (Aug.-Oct.) than in Ohio (Aug. 1952). (Met. Abs. 5.11-213)--M. R.

E-198 Crain, C. M.; Straiton, A. W. and von Rosenberg, C. E., A statistical survey of atmospheric index-of-refraction variation. Institute of Radio Engineers, Transactions, Vol. AP-1, No. 2:43-46, Oct. 1953. 8 figs., 2 refs., eqs. DBS--This paper presents a statistical survey of index of refraction variations as recorded by an airborne microwave refractometer. Scales and intensities of the index variations are given, as well as the parameters $\Delta N^2/l$, for data taken over southwest Ohio during summer months and over the Pacific Ocean off the west coast of Washington in Aug. and of California in October. Heights from 2000 and 12,000 ft msl were considered with most of the data taken between 2000 and 12,000 ft. Approximately, 1200 samples taken on 34 flights were analyzed. The composite of the data gave the following median values:

Index scale = 130 ft

Index intensity = 0.3 N

$$\frac{\Delta N^2}{l} = 7 \times 10^{-4}\ N^2/\text{ft}$$

(Met. Abs. 8J-15)--Authors' abstract.

E-199 Dickson, F. H.; Egli, J. J.; Herbstreit, J. W. and Wickizer, G. S., Large reductions of VHF transmission loss and fading by the presence of a mountain obstacle in beyond-line-of-sight paths. Institute of Radio Engineers, N. Y., Proceedings, 41(8):967-969, Aug. 1953. 2 figs., 4 refs. DLC--Demonstrates how high mountain ridges can be utilized to reduce both transmission loss and tropospheric fading. Experimental verification of principles involved is given here. (Met. Abs. 8J-16)--W. N.

E-200 Doherty, L. H., Effect of atmospheric ducts on line-of-sight transmission. U.S. Navy Electronics Laboratory, San Diego, Report, No. 409:51-55, 1953. 2 figs. DWB, DLC--It is shown that the ray theory may yield satisfactory answers to problems of tropospheric duct propagation. Some meteorological conditions as mechanisms for specific propagation phenomena are discussed. (Met. Abs. 8J-17)--W. N.

E-201 Epstein, Jess and Peterson, Donald W., An experimental study of wave propagation at 850 Mc. Institute of Radio Engineers, N. Y., Proceedings, 41(5): 595-611, May 1953. 34 figs., 7 tables, 10 refs., eqs. DLC--The prediction of area coverage of a broadcast station is of prime importance. To do this requires evaluation of the effect of such factors as wave refraction, earth reflection, diffraction and attenuation. The following paper describes an experiment conducted at 850 Mc which was undertaken to solve this problem. We have concluded that useful predictions of wave propagation can be made with free space theoretical field strength reduced by theoretical knife edge diffraction shadow loss and by suitable empirical experience factors. (Met. Abe. 8J-18) --Authors' abstract.

E-202 Fine, H., Some notes on theory of radio scattering in a randomly inhomogenous atmosphere. Institute of Radio Engineers, N. Y., Proceedings, 41(2):294, Feb. 1953. Eqs. DLC--A time-space correlation function is offered. Brief reference to BOOKER and GORDON's space correlation and STARAS' time correlation is given. (Met. Abs. 8J-176)--W. N.

E-203 Herbstreit, J. W.; Norton, K. A.; Rice, P. L. and Schafer, G. E., Radio wave scattering in tropospheric propagation. Institute of Radio Engineers, N. Y., Convention Record, Pt. 2:85-93, 1953. 6 figs., table, 10 refs., 26 eqs. DLC (TK6541.I5)--The scattering theory of BOOKER and GORDON has been developed, assuming the correlation function $C(r)=C(O)\exp(-r/l)$, so as to be suitable for easy numerical calculation of the transmission loss expected with this mode of transmission; C(O) denotes the variance with time of the refractive index of the atmosphere and l denotes the scale of turbulence. In this development, the parameter $C(O)/l$ emerges as a direct measure of the radio wave power transmitted by this mode of propagation. The theory is used to calculate the transmission loss to be expected on the transmission paths involved in the NBS Cheyenne Mountain experiment which cover the transmitting antenna height range from 30 to 7,800 ft, distance range 223 to 628 mi, and frequency range 100-1,046 Mc. The dependence of $C(O)/l$ on height above the earth's surface which must be assumed in these predictions to obtain agreement with the experimental transmission loss data is in qualitative agreement with the meager meteorological data which are now available for estimating this parameter. (Met. Abs. 8J-19) --Authors' abstract.

E-204 Hood, A. D. and Doherty, L. H. (both, Radio and Elec. Engr. Div., Nat'l. Res. Council, Ottawa), Radar forecasting on Lake Ontario. (In: Conference on Radio Meteorology, Univ. of Texas, Austin, Nov. 9-12, 1953, Proceedings. Vol. 1: III-6, pub. 1953. 7 p. 4 figs. (incl. photos), ref.) DLC, DWB--Correlation with duct height as predicted by the power law was compared with the duct height observed at 1830 or 1930 EST, and presented graphically for Aug. and Sept. 1952. The results, excluding days of frontal passage and/or no surface ducts, indicate a maximum value of duct height. No echoes were visible during standard propagation conditions. The diurnal variation is distinct during summer. The 3 cm radar used scanned a 180° sector and gave a vertical view of every 8 ft to a height of 220 ft every 30 sec. (Met. Abs. 8J-20)--W. N.

E-205 Institute of Radio Engineers. Committee on Wave Propagation, Tropospheric propagation: a selected guide to the literature. Institute of Radio Engineers, N. Y., Proceedings, 41(5):588-594, May 1953. Numerous refs. DWB--This bibliography is mainly for the non-specialist seeking information on details of tropospheric propagation. The subject arrangement of the contributions reviewed is as follows: Books; general discussions; diffraction; refraction (rays, modes and ducts, elevated layers, angle of arrival); lobe structure; time and space variations of field strength, attenuation by atmospheric gases and precipitation; ground and sea roughness; meteorological echoes; velocity of propagation. The review is based on American and British sources. (Met. Abs. 6B-152)--G. T.

E-206 Jehn, K. H. and Staley, R. C., Correlations of 100 Mc radio propagation with certain meteorological variables. Journal of Atmospheric and Terrestrial Physics, 3(3):163-171, April 1953. 9 figs., 6 refs. DWB--Signal strengths of 100 Mc (3 m) waves received at Austin, Texas, from San Antonio (78 mi) and Dallas

(175 mi), are compared with meteorological data. It is found that high signal strength is associated with maritime tropical and low with polar continental air. Some relations were found with height of base of refracting layer but it is suggested that these were due to the presence of multiple refracting layers. A time-height turbulence plot is shown for San Antonio up to 25,000 ft and some relation is found to signal propagation. (Met. Abs. 8J-22)--C.E.P.B.

E-207 Johnson, Walter E., Analogue computer for the solution of the radio refractive index equation. U.S. National Bureau of Standards, Journal of Research, 51(6): 335-342, Dec. 1953. 7 figs., table, 5 refs. DWB--The solution to the radio refractive index equation provides information necessary to the research worker studying tropospheric radio propagation in the very high and ultrahigh regions. Present means of computation are either time consuming or of low accuracy. An analogue computer is developed to solve this equation by utilizing basic computation circuits incorporated into a null balance bridge circuit. A unique feature of this computer is the modification of a linear 10 turn potentiometer so that its output to input voltage ratio versus rotation closely approximates the exponential type curve of the saturated water vapor term in the refractive index equation. This computer is now in use at the Central Radio Propagation Laboratory of the National Bureau of Standards, Boulder, Colo., and has superseded other methods of calculating the radio refractive index. (Met. Abs. 5.8-96) --Author's abstract.

E-208 Kiely, D.G., Some measurements of fading at a wavelength of 8 mm over a very short sea path. Baldock, Hertfordshire, Services Electronics Research Laboratory, S.E.R.L. Technical Journal, 3(1):15-18, March 1953. 2 figs., table, 3 refs. Mimeo. GB-MO--A one-way link one mile long was set up across Loch Goil, Scotland, transmitter 15 ft above MSL, receiver 100 ft, to investigate superrefraction on 8 mm wavelength. Very large fluctuations of signal strength were associated with weather changes and attributed to a surface or elevated duct. (Met. Abs. 4.11-18)--C.E.P.B.

E-209 Lowell, P.D.; Hakkarinen, W. and Randall, D.L., National Bureau of Standards mobile low level sounding system. U.S. National Bureau of Standards, Journal of Research, 50(1):7-17, Jan. 1953. 6 tables, 14 figs., 12 refs. DWB--Details of component parts, calibration procedure, flight computations and tests, etc., are given in text, tables, wiring and other schematic diagrams and photographs. The equipment is designed to measure pressure, temperature and moisture distribution and gradients from the surface up to 2000 ft over different types of terrain. It is a combination of an improved wired sonde and Army SGM-1A Mobile Meteorological Station. For obtaining refraction index gradients used in tropospheric radiowave propagation measurements, this system has several advantages over radiosondes (too fast ascent), towers (300-400 ft maximum height) or wired sondes (uncertain height and low ceiling). (Met. Abs. 8J-24)--M.R.

E-210 Megaw, E.C.S., Waves and fluctuations. Institution of Electrical Engineers, London, Proceedings, Pt. 3, 100(63):1-8, Jan. 1953. 9 figs., 14 refs., 2 eqs. DLC--This interesting lecture includes sections on turbulence and fluctuations of refractive index, wave propagation through slightly inhomogeneous media, intensity fluctuations or scintillation, and long range propagation of radio waves by atmospheric scattering. Agreement between theoretical calculation and observations is good. (Met. Abs. 8J-25)--C.E.P.B.

E-211 Naito, K., On the scattering of the plane electromagnetic wave by a continuous inhomogeneity with spherical symmetry in a homogeneous medium. Papers in Meteorology and Geophysics, Tokyo, 3(4):313-319, March 1953. 3 refs., 28 eqs. DWB--The effect of atmospheric turbulence on microwave propagation is investigated theoretically. After integrating a vector wave equation for a plane wave encountering a continuous inhomogeneity with a spherical symmetry in a homogeneous medium, the author defines the total scattering cross section (i. e. the ratio of the total scattered energy per unit time to the energy density of the incident wave) and finds it to be proportional to the square of a qualitative magnitude of inhomogeneity. (Met. Abs. 8J-26)--G.T.

E-212 Naito, K. (Met. Res. Inst.), On the influence of waterdrops in the air upon the atmospheric radio refractive index. Papers in Meteorology and Geophysics, 4(34):109-114, Dec. 1953. Summary p. 109. 2 figs., 3 refs., 11 eqs. DWB--Radio refractive index is computed assuming Rayleigh scattering for a single drop and approximate reactions between scattered waves. Relation to visibility is shown. The resulting effect cannot always be disregarded as it is done in the conventional formula, considering only pressure, temperature and vapor pressure. (Met. Abs. 8J-27)--A. A.

E-213 Norton, Kenneth A., Transmission loss in radio propagation. Institute of Radio Engineers, N.Y., Proceedings, 146-152, Jan. 1953. Fig., 19 refs., 21 eqs. DLC--Ionospheric and tropospheric aspects of the problem are considered. Basis for the discussion is author's definition of transmission loss to the ratio of the power radiated from the transmitting antenna to the resulting signal power available from a loss-free receiving antenna. (Met. Abs. 8J-28)--W. N.

E-214 Perlat, A. and Voge, J., Attenuation des ondes centimétriques et millimétriques dans l'atmosphère. (Attenuation of centimeter and millimeter waves in the atmosphere.) Annales des Télécommunications, Paris, 8(12):395-405, Dec. 1953. 7 figs., 15 tables, 9 refs. DLC--The authors delineate the effects of the atmosphere on very short waves and the importance of atmospheric attenuation. In the first section results obtained by American and English research workers are surveyed in connection with absorption by rain, snow, hail, fog and clouds. Attenuation by atmospheric ozone and by water vapor is also considered, taking into consideration the effects of altitude and temperature. The second section is a statistical study presenting precipitation, fog, water vapor and temperature data of France and North Africa. In the third section a method is worked out for calculating atmospheric attenuation over a given path for specified percentages of given time periods. --Transl. of authors' abstract-E. K.

E-215 Reen, J.H., Summary of A.P.O. microwave propagation measurements on the Sydney-Melbourne route (Aug. 1949-Oct. 1950). U.S. Navy Electronics Laboratory, San Diego, Report, No. 409:72, 1953. 2 tables, ref. --A tabulated summary is given of the comparative fading results over the radio propagation paths of Sydney-New Madden, New Madden-Bowral, and Bowral-Goulburn, at frequencies of 160, 3300 and 9400 Mc, respectively. Disturbed weather conditions were prevalent on all paths. --N. N.

E-216 Rice, S.O., Radio field strength statistical fluctuations beyond the horizon. Institute of Radio Engineers, N.Y., Proceedings, 41(2):274-281, Feb. 1953. 4 figs., table, 8 refs., 33 eqs. DLC--When a sinusoidal radio wave of extremely high frequency is sent out by a transmitter, the wave received far beyond the horizon is often observed to fluctuate. Here some of the statistical properties of this fluctuation are derived on the Booker-Gordon assumption; namely, that the received wave is the sum of many little waves produced when the transmitter beam strikes "scatterers" distributed in the troposphere. Expressions are obtained for the periods of the fluctuations in time, in space, and in frequency. These expressions extend closely related results obtained by BOOKER, RATCLIFFE and others. (Met. Abs. 8J-29)--Author's abstract.

E-217 Rider, G.C., Some VHF experiments upon the diffraction effects of hills. Marconi Review, London, 16(109):96-106, 1953. 7 figs. DLC--Experiments at 160.2 Mc on propagation over steep hills show that the signal increase obtained when passive repeater antennas are used may be satisfactorily predicted by the method normally used for calculating the field in the shadow of a knife edge. Passive repeaters are expected to be most useful in the UHF band. For prediction of field strength across a valley, when transmitter and/or receiver are close to the hill, the spherical diffraction treatment gives results in closer agreement with experiment than the knife-edge method. A preliminary survey of the polarization and direction of arrival of radio waves at receiver positions round the hill was also made.

E-218 Robbins, R.L. (Bell Telephone Labs., Inc., N.Y.), Measurement of path loss between Miami and Key West at 3675 Mc. Institute of Radio Engineers, Transactions, Vol. AP-1, No.1:5-8, July 1953. 6 figs., ref. DBS--Experimental results over five 130 mi paths are discussed here. The path losses observed, especially over water in semi-tropical areas, were in agreement with those observed in other areas by BULLINGTON. Foreground terrains in relation to overland, over water paths and elevation of paths showed no difference; likewise, diurnal and short term signal variations were similar to those observed elsewhere. (Met. Abs. 8J-30)--W.N.

E-219 Sadoun, B., Propagation des ondes metriques a grande distance. (Long distance propagation of meter waves.) Annales des Telecommunications, Paris, 8(8-9): 299-308, Aug./Sept. 1953. 19 figs., 14 refs., 2 eqs. DLC--Since Nov. 1952 the National Laboratory of Radioelectricity has been conducting long distance recordings (300-700 km) of FM field strength at 88-100 Mc/s. It is found that in addition to sporadic anomalous propagation phenomena there is, at long distance, a permanent fluctuating field whose mean level becomes more and more stable with increasing distance. This field is far stronger than that obtained by calculating the diffraction of waves around the earth. An explanation for the phenomenon may be found by assuming a tropospheric scattering of radio waves. --Transl. of author's abstract.

E-220 Schachenmeier, Richard, Die Erhöhung der UKW-Empfangsfeldstärke durch eine brechende Schicht. Inversion der Troposphäre. (The increase in USW field intensity due to a tropospheric inversion layer.) Archiv der Elektrischen Übertragung, 7(10):485-491, Oct. 1953. 5 figs., refs., 41 eqs. DLC--Refraction in an inversion layer is considered in terms of an apparent increase in the effective height of the sender. Calculations are made for different elevations of the receiver and sender relative to the inversion layer. The influence of focusing of the radiation in increasing the received field intensity is also considered. (Met. Abs. 8J-31) --Electrical Engr. Abstract.

E-221 Smith, Ernest K., Jr. and Weintraub, Stanley, Constants in the equation for atmospheric refractive index at radio frequencies. U.S. National Bureau of Standards, Journal of Research, 50(1):39-41, Jan. 1953. 2 tables, 21 refs., eqs. DWB. Also in: Institute of Radio Engineers, N.Y., Proceedings, 41(8):1035-1037, Aug. 1953. 21 refs., 11 eqs. DLC--Several radio propagation laboratories have made improvements in microwave techniques and hence in the sets of constants used in calculations of atmospheric refraction of radio waves. It is suggested that a compromise set of constants such as are proposed in this article, be adopted universally to avoid confusion hereafter. The expression to be used in Radio meteorology is $N = (77.6/T) \quad P + 4810 (e/T)$, where P = total pressure (mb), e = partial pressure of water vapor (mb), T = absolute temperature. This is considered accurate to 0.5% up to 30,000 megacycles at normal atmospheric temperature, pressure and humidity ranges. Values of E-1, N, K_1, K_2, and K_3 obtained by various authors (1931-1952) are tabulated. (Met. Abs. 8J-32)--M.R.

E-222 Strand, Kaj G., Investigation of atmospheric refraction at low altitudes. U.S. Arctic, Desert, Tropic Information Center, ADTIC Publication, No. A-102, Feb. 1953. 36 p. 3 figs., 13 tables, 4 refs. DWB--Refractive indexes are computed from observations made in 1951 and 1952 at Dearborn Observatory about 60 ft from the west shore of Lake Michigan near Chicago, supplemented by Joliet radiosonde data for selected days in 1951 and 1952. It is realized that the air over Joliet is not the same as over Lake Michigan, yet conditions at 3000 ft are not so much different that data cannot be used interchangeably. Observations of the Pleiades and Moon were used to determine refraction effect. Techniques are described in detail and illustrated, and meteorological, as well as astronomical data presented in full. Pressure, temperature and dew point are used for surface and up to 24,000 ft and tabulated and measured values are compared, indicating that on individual nights observed values may differ by as much as 8% from computed values, when corrections for surface pressure and temperature are applied. (Met. Abs. 8J-33)--M.R.

E-223 Swarm, H.M.; Ghose, R.N. and Keitel, G.H., Tropospheric propagation in horizontally stratified media over rough terrain. Institute of Radio Engineers, N.Y., IRE Convention Record, Pt. 2 - Antennas and Communications, p. 77-84, 1953. 12 figs., 3 refs., 6 eqs. --The correlation of fields calculated on the basis of the mode theory with measured signals for a 150 mi path is studied. For the path considered with the assumption of linear index of refraction in the atmosphere between 3000 and 10,000 ft heights, the field strength may be predicted within 15 db for 90% of the time. The predicted field strength is based on first mode propagation in which the gradient of the refractive index is the primary variable. The atmosphere is assumed to be stratified vertically, but homogeneous horizontally. The roughness of the terrain affects the heights at which the refraction is important at the middle of the path and is of particular importance near the receiving site. The calculated field strength was always lower than the measured field strength by a median value of 11.5 db. Thus apparently other mechanisms of propagation contribute to the increased field strength by this median value. --Authors' abstract.

E-224 Swingle, Donald M., Nomograms for the computation of tropospheric refractive index. Institute of Radio Engineers, N. Y., Proceedings, 41(3):385-391, March 1953. 3 figs., refs., 5 eqs. DLC--Three sets of nomograms permitting calculation of tropospheric refractive index gradient are presented. So far as is known, no similar charts have been made for discontinuity and gradient calculations. All three have been designed about the standard radiosonde transmission, which gives temperature, dew point temperature, and pressure at points where discontinuities occur in the vertical gradients of temperature or dew point temperature. These nomograms are valid for all wavelengths greater than 1.5 cm. (Met. Abs. 8J-34)--Author's abstract.

E-225 Swingle, Donald M. (Signal Corps Eng. Lab., Fort Monmouth, N. J.), Reflections on electromagnetic waves from media of continuously variable refractive index. (In: Conference on Radio Meteorology, Univ. of Texas, Austin, Nov. 9-12, 1953, Proceedings, Vol. 1 :IV-2, pub. 1953. 7 p. 3 figs., 6 refs., 17 eqs. DLC, DWB--The theoretical analysis presented is based on the assumption of small change in the refractive index and gives a good approximation of the lower atmosphere where the maximum possible change is of the order of 0.3%. Extension of the analysis may permit inclusion of both large changes of index and spherical waves. The method may be applicable to situations where no direct discontinuity of the refractive index occurs. It is shown that a plane wave pulse containing an integral number of cycles, propagating through a region of constant refractive index gradients, produces no reflection. (Met. Abs. 8J-35)--W. N.

E-226 U.S. Army, Antennas and radio propagation. Its Technical Manual TM 11-666, Feb. 1953. 225 p. 197 figs., tables. DWB (M08 U58t)--The basic principles of radio propagation are clearly presented, with many lucid schematic diagrams, in Ch. 2 of this comprehensive manual. Ground wave propagation, the ionosphere, and sky wave propagation are taken up in 3 sections of Ch. 2, and scores of definitions and questions appended in a fourth section. The various types of tropospheric propagation (temp. inversions, humidity lapses, etc.) and ionospheric reflection from O, E & F layers, day and night and with solar flares, 11 yr and 27 day cycles, sporadic E, etc., are outlined. (Met. Abs. 8J-36)--M. R.

E-227 U.S. Navy Electronics Laboratory, San Diego, Calif., Symposium on tropospheric wave propagation within the horizon, March 30-April 2, 1953. Its Report, 409, Sept. 3, 1953. 72 p. Figs., tables, refs., eqs. DLC--The symposium was divided into 3 sessions during which 14 papers were delivered as follows: (1) Terrain effects (5 papers); (2) Refraction effects (6 papers); (3) Combined and other effects (3 papers). These papers are reproduced in full or in abstract in this report which also includes a list of names of all participants. (Met. Abs. 8J-37)--W. N.

E-228 Unwin, R.S., Ultrashort wave field strength in a ground based radio duct. Nature, London, 172(4384):856-857, Nov. 7, 1953. Fig., 8 refs. DWB--Data from New Zealand Canterbury Project show that duct width is the most important parameter in field strength beyond the horizon. Examples reproduced show that as duct width increases from zero, field strength increases from a low value up to a certain level (where first node goes from a leaky to a trapped state) after which it increases very slowly or remains constant. The critical duct width increases from 27 m on 3 cm wavelength to 90 m on 60 cm but scatter is large. (Met. Abs. 5.3-324)--C. E. P. B.

E-229 Voge, Jean, Fadings et pertes de contact en ondes ultra-courtes, dus à la présence de couches d'inversion. (Fadings and disruptions of contact in ultrashort wave communication, due to inversion layers.) Académie des Sciences, Paris, Comptes Rendus, 237(9):491-493, Aug. 31, 1953. 3 refs. DWB--Results of a theoretical investigation of direct (standard) radio communication conditions associated with inversions are summed up for various cases involving different relative positions of the communicating stations and of inversion layers. (Met. Abs. 8 J-39)--G. T.

E-230 Voge, Jean, Fluctuations du champ électromagnétique dues a la turbulence, à l'extrémité d'un trajet de propagation en visibilité directe. (Fluctuations of the electromagnetic field due to turbulence on the end of a propagation trajectory with direct visibility.) Académie des Sciences, Paris, Comptes Rendus, 237 (4):351-353, July 27, 1953. 3 refs. DWB--Theoretical discussion for ultrashort waves and light waves, applying the TAYLOR spectrum of turbulence, which gives simpler solutions than proposed by MEGAW, who used KOLMOGOROV's spectrum. (Met. Abs. 6. 3-161)--A. A.

E-231 Voge, J., Note relative a la bande de fréquences utilisable pour des transmissions a grande distance en ondes ultra courtes. (Note on the frequency band usable for long distance USW transmission.) Annales des Telecommunications, 8(8-9):308-311, Aug. /Sept., 1953. 2 figs., 5 refs., 22 eqs. DLC--The theory of S. O. Rice, according to which the field received over great distances depends on scattering from a level directly visible from both the transmitter and receiver, is applied to data of the Wrotham-Bagneux path. It is found that usable frequency is independent and is in inverse proportion to distance, being of the order of 100 kc/s for a distance of 300 km. These figures have not yet been checked experimentally. --Transl. of author's abstract.

E-232 Weintraub, Stanley, Slide rule computes radio refractive index of air. Electronics, 26(1):182, 186, 190, 194, 196, 198, 200, Jan. 1953. 3 figs., 2 refs., eqs. DLC--The slide rule described and illustrated is claimed to have a precision of $\pm$ 0.5 N-units under almost any conditions encountered in the troposphere. The slide rule was developed by the U. S. National Bureau of Standards and facilitates tropospheric propagation studies. (Met. Abs. 8 J-40)--W. N.

E-233 Wickizer, G.S., Field strength of KC"XAK, 534.75 Mc recorded at Riverhead, N.Y. Institute of Radio Engineers, N.Y., Proceedings, 41(1):140-141, Jan. 1953. 6 figs., 2 refs. --Field strength was recorded for 22 months over a non-optical path at a distance of 33 mi. Overall variation was approximately 12 db in winter and 33 db in summer, with relatively small variation in the median level. On this transmission path, falling 10 db or more below the median occurred during the summer months and was about evenly divided between daylight and darkness for the normal hours of operation. --Author's abstract.

E-234 Wolin, Samuel (U.S. Naval Air Dev. Center, Pa., Johnsville, Pa.), Ray deflection through a medium having a continuously varying refractive index. Optical Society of America, Journal, 43(5):373-375, May 1953. 2 figs., foot-refs., 28 eqs. DLC--A method is outlined for computing the ray deflection through a medium having a continuously varying refractive index. General equations are developed by applying the calculus of variations to Fermat's principle of optics. These equations are applied to the case of a dielectric material having a linear variation with distance in its refractive index and also to the case of a foam dielectric having a linear variation in density. A set of universal curves is presented for the case of a plane dielectric sheet having a linearly varying dielectric constant. The general equations presented here can also be applied to the design of lenses and optical devices having a continuously varying refractive index. (Met. Abs. 8.6-370)--Author's abstract.

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E-235 Barsis, A.P., Comparative 100 Mc measurements at distances far beyond the radio horizon. Institute of Radio Engineers, N.Y., Convention Record, Pt. 1: 98-107, 1954. 10 figs., 5 refs. DLC (TK6541.I5)--Results of 100 Mc measurements are evaluated in terms of distributions of hourly medians of transmission loss. Transmitters were located at elevations of approximately 6200, 8800 and 14,100 f.a.m.s.l. on the eastern slope of the Rocky Mountains. Receiving sites were located at distances of 230 and 400 mi from the transmitters. Various types of antennas were employed for transmitting and receiving. The results of studies of fading rate and fading range are reported for the 400 mi site by comparing signals received simultaneously on two different antennas. These results are compared to those expected from the application of the tropospheric scattering theory. (Met. Abs. 8J-41)--Author's abstract.

E-236 Bean, Bradford R. and Meaney, Frances M. (both, National Bureau of Standards, Boulder, Colo.), The monthly refractivity gradient for the United States and its application to predicting the geographical and annual trend of VHF transmission loss. (In: Conference on Radio Meteorology, Nov. 9-12, 1953, Univ. of Texas, Supplement to the Proceedings, III-2, pub. 1954. 11 p. 5 figs., table, 4 refs., 2 eqs.) DWB (M94.7 C748p Sup.)--Climatological studies of VHF propagation conditions all over the U.S. are under way, using the simple parameter Δ N (refractivity gradient from surface to K km above the surface) to correlate with the transmission loss over the propagation path whose midpoint is over the weather station in question. Other causes must be taken into account (roughness, distance, height of antenna, etc.). The present method reduces the month-to-month and station-to-station uncertainty by taking out the average climatic effect. Tables and curves based on 1950-52 data show effectiveness of method and amount of variation. (Met. Abs. 8J-42)--M.R.

E-237 Bean, Bradford R., Prolonged space-wave fadeouts at 1,046 Mc observed in Cheyenne Mountain propagation program. Institute of Radio Engineers, N.Y., Proceedings, 42(5):848-853, May 1954. 8 figs., table, 3 refs., eq. DLC--During the first year of continuous operation of the Cheyenne Mountain propagation program, recordings of 1,046 Mc fields at receiving locations within the radio horizon have exhibited "fadeouts" or prolonged periods of attenuation often in excess of 20 db below the monthly meridian level and lasting from a minute up to several hours. The occurrence of these fadeouts has been found to coincide with widespread superrefraction as evidenced by enhanced signals beyond the radio horizon and ground modification of the refractive index profile. (Met. Abs. 8J-43)--Author's abstract.

E-238 Bremmer, H., The extension of Sommerfield's formula for the propagation of radio waves over a flat earth, to different conductivities of the soil. Physica, Amsterdam, 20(8):441-460, Aug. 1954. 4 figs., 6 refs., 54 eqs. DLC (QC1.P38)--The influence of non-homogeneous soil conditions on the propagation of radio waves over a flat earth is investigated with the aid of an integral equation based on Green's theorem. This equation applies to all types of distributions (also continuous) of the conductivity and of the dielectric constant of the earth; it is essentially identical with the integral equation considered by HUFFORD for the propagation over irregular terrain. (Met. Abs. 8J-44) --From author's abstract.

E-239 Carroll, Thomas J., Overcoming the line-of-sight Shibboleth with the air and high power. Institute of Radio Engineers, N.Y., Convention Record, Pt. 1: 121-125, 1954. 3 refs. Also: Institute of Radio Engineers (Australia), Proceedings, 16:107-112, April 1955. DLC--Gives a simple account of the reasons for both VHF and UHF trans-horizontal propagation and includes some probable implications for the UHF television. The role of the troposphere has been grossly neglected in the earlier tropospheric propagation theory. The crux is not in the shape of the index profile, but rather in making proper distinction in the mathematics between the inhomogeneous air layer and the homogeneous void beyond. --W. N.

E-240 Carroll, Thomas J. (M.I.T.), Tropospheric propagation well beyond the horizon: a review. (In: Conference on Radio Meteorology, Nov. 9-12, 1953, Univ. of Texas, Supplement to the Proceedings, I-1, pub. 1954. 7 p. Fig., 2 refs.) DWB (M94.7 C748p Sup.)--The author reviews the basic discoveries that radio waves would propagate well beyond the horizon or the theoretical distance calculated by mathematical formulas. The 4/3 (earth's radius) law did not explain atmospheric effects produced by anomalous temperature and humidity structure. Superrefraction, effect of turbulence in scattering rays into the twilight zone, the duct theory (modes in the dielectric layer), and effect of roughness of earth are considered. The mode theory operates well enough except when turbulent layers exist over the midpoint of the path, then an even greater degree of propagation (though erratic) to distances can exist. Typical propagation measurements for 93, 410 and 3000 Mc are shown on curves for distances up to 400 km. Isolated measurements at 1047, 3700 and 9375 Mc are also shown on chart and all are compared with the theoretical curves for geometrical horizon, the 4/3 radius for 300 Mc, the 4 1/3 radius for 50 Mc and free space (vacuum), respectively. (Met. Abs. 8J-46)--M.R.

E-241 Crain, Cullen M.; Gerhardt, J.R. and Williams, C.E. (all, Univ. of Texas, Austin), A preliminary survey of tropospheric refractive index measurements for U.S. interior and coastal regions. Institute of Radio Engineers, N.Y., Transactions, Vol. AP-2, No. 1:15-22, Jan. 1954. 9 figs., 5 refs. DBS--This paper summarizes the results of approximately 700 tropospheric refractive index soundings carried out between July 1952 and Dec. 1952, using aircraft mounted direct reading refractometers. Extensive observations up to heights as great as 25,000 ft have been made in the Southern Ohio region and off the U.S. east and west coasts. Preliminary statistical analyses on the occurrence of standard and non-standard average gradients are presented together with qualitative meteorological correlations. The existence of large scale index variations near certain cloud boundaries is confirmed and these are tentatively explained in terms of the contrast between the free air refractive index and that of a vertically moving air current having a refractive index representative of some lower atmospheric level. (Met. Abs. 8J-47)--Authors' abstract.

E-242 Deppermann, K. and Franz, W., Theorie der Beugung an der Kugel unter Berücksichtigung der Kriechwelle. (Theory of diffraction over a sphere with particular consideration to the creeping wave.) Annalen der Physik, Ser. 6, 14(6/8):253-264, 1954. 5 figs., 6 refs., 5 eqs.--This theoretical paper is based upon excerpts from Deppermann's dissertation, and deals with refraction of acoustical and electromagnetic waves of an ideal reflecting sphere, as discussed in terms of the integral equations of the refraction theory. The interference of the creeping wave (skin effect) on the geometrically reflected wave manifests itself as intensity maxima and minima which is demonstrated graphically.--W. N.

E-243 Feinstein, J., Some information theory aspects of propagation through time varying media. Institute of Radio Engineers, N. Y., Convention Record, Pt. 1: 87-97, 1954. 3 figs., 9 refs., 69 eqs. DLC--The channel capacity of a communications system which utilizes wave propagation through a time varying medium such as the ionosphere or troposphere is evaluated in terms of the statistical properties of the medium and of the noise. The signal fading in such a system reduces the capacity. Information theory concepts are broadened to include the possibility of multiple reception at spaced receiving sites, and the consequent increase in theoretical channel capacity is computed as a function of the number of such sites. Current practices in the use of diversity reception and directional antennas are examined in the light of these results. (Met. Abs. 8J-48)--Author's abstract.

E-244 Feinstein, Joseph (U.S. Nat'l. Bureau of Standards), Some stochastic problems in wave propagation, Pt. 1. Institute of Radio Engineers, N. Y., Transactions, Vol. AP-2, No. 1:23-30, Jan. 1954. Pt. 2. Ibid., Vol. AP-2, No. 2:63-70, April 1954. 6 figs., 87 eqs. DBS--This theoretical discussion deals first with some effects of random height variations over a conductive surface upon reflected wave energy, using methods of physical optics. Several aspects are determined. Next, the author treats the effects of the refractive index fluctuations on an emergent front within volume and subsequently generalized to a continuous medium. The effects upon properties of traversing waves are discussed in Pt. 2. The results as applied to some tropospheric and ionospheric problems are then discussed and found indicative and applicable. (Met. Abs. 8J-49) --W. N.

E-245 Fine, Harry, An effective ground conductivity map for continental U.S. Institute of Radio Engineers, N. Y., Proceedings, 42(9):1405-1408, Sept. 1954. Fig., table. DLC--Derivation and accuracy of the map adopted by the Federal Communications Commission for use as of April 1954, is discussed here. The map, designed on a 1 to 2,500,000 scale, features not less than 7000 paths throughout the country. The true effective median path conductivity for distances less than 25 mi from transmitter is within 0.59 and 1.7 of the values plotted. The map is available from the Govt. Print. Off., Wash., D.C. for $3.50 a copy. (Met. Abs. 8J-50)--W. N.

E-246 Franz, Walter, Uber die Greenschen Funktionen des Zylinders und der Kugel. (Green's functions of cylinders and spheres.) Zeitschrift fur Naturforschung, 9a(9):705-716, Sept. 1954. 7 figs., 6 tables, 8 refs., 39 eqs.--This theoretical discussion has bearing on the propagation of radio waves through the troposphere. Reference is made to works by WATSON and VAN DER POL-BREMMER.--W. N.

E-247 Frundt, H. J., Betriebsbereitschaft einer weit hinter den Horizont reichenden UKW–Richtverbindung. (Reliability of USW radio link extending far beyond the horizon.) Telefunken Zeitung, 27(103):41-43, March 1954. 5 figs., 6 refs. --Some exercises and results obtained on the non-optical radio link Berlin-Harr at 41 and 68 Mc/s are discussed. --W. N.

E-248 Ghose, Rabindra Nath and Albright, W. G., VHF field intensities in the diffraction zone. Institute of Radio Engineers, Transactions, AP-2(1):35-38, Jan. 1954. 3 figs., 8 refs., 20 eqs. --Signal strengths are calculated and compared with measured values. This analysis departs from others in the variation of form of obtaining a solution to the wave equation. An exponential form of refractive index distribution with height is presented. --W. N.

E-249 Gibbs, W. J., Meteorological aspects of microwave propagation in Australia. Australia. Meteorological Branch, Meteorological Study, No. 1, June 1954. 14 p. 13 figs., 6 refs., 12 eqs. DWB--Superrefraction will occur in the lowest layers of the atmosphere where there is a strong temperature inversion ($> 0.14°$ C/m), a moderate temperature inversion and lapse of humidity, or a strong lapse of humidity (vapor pressure gradient > -0.3 mb/m). In Australia, superrefraction is likely to be associated with the "coastal front" (continental air overlying denser marine air), subsidence inversions, inversions in continental air modified over the sea, and nocturnal radiation inversions. Typical profiles of temperature, vapor pressure, and refractive index gradient are shown. (Met. Abs. 8 J-51) --R. S. Quiroz.

E-250 Grant, Arthur S. G. (Met. Service of Canada, Ottawa), Notes on the atmospheric refractive index in Canada from aircraft meteorological soundings. American Geophysical Union, Transactions, 35(3):508-510, June 1954. 3 figs., 4 refs. MH-BH--Calculations of the atmospheric refractive index for radio waves were made from aircraft soundings over a large area of northern Canada in connection with the 1952 season of the shoran survey. A comparison is made between the results and the NACA 60% relative humidity standard atmosphere. (Met. Abs. 6. 2-327)--Author's abstract.

E-251 Jasinski, W. and Berry, J. A., Measurement of refractive indices of air, nitrogen, oxygen, carbon dioxide and water vapor at 3360 Mc/s. Institution of Electrical Engineers, London, Proceedings, Pt. 3, 101(73):337-343, Sept. 1954. 3 figs., 2 tables, 19 refs., 8 eqs. DWB--Refractive indexes n were measured by resonant frequency of a cavity filled with the gas, checked by a crystal-controlled frequency standard. Values of $(n - 1) \times 10^6$ at 0°C, 760 mm, correct to about ± 0.2 were: Dry air free of CO_2, 288.3; Nitrogen 294.5; Oxygen 266.2: CO_2 494.6. Water vapor at 20°C and 10 mm gave 61.3 ± 0.1. The permanent electric moment of the water molecule was calculated as $(1.845) \times 10^{18}$ e. s. u. (Met. Abs. 6. 5-350)--C. E. P. B.

E-252 Kazanský, B., Vliv povětrnostních poměrů na televisní příjem. (Influence of weather conditions on television reception.) Meteorologické Zprávy, Prague, 7(2):53-55, 1954. DLC. From the Russian original by M. DOLUKHANOV in Radio, No. 9:41-44, 1952. --Sums up knowledge on ultrashort radio wave propagation beyond the horizon and its meteorological causes. Television reception beyond the normal range is attributed mainly to abnormal refraction and sudden drops in temperature. (Met. Abs. 8J-53)--G.T.

E-253 Kirby, R.S.; Harman, J.C.; Capps, F.M. and Jones, R.N., Effective radio ground conductivity measurements in the United States. U.S. National Bureau of Standards, Circular 546, Feb. 26, 1954. 87 p. almost entirely maps. DLC--Maps are presented showing the results of effective ground conductivity measurements made by various broadcasters and consulting engineers throughout the United States. Over 7000 radials are shown on the maps, and provisions have been made for entering new measurements, as the results become available. Due to the complexity of ground wave propagation over an inhomogeneous earth, the determination of effective ground conductivity over a given radial strictly applies only at the frequency at which the measurements were made. (Met. Abs. 8J-54) --From authors' abstract.

E-254 Lauter, E.A. and Klinker, L., Long distance U.S.W. reception. Nachrichtentechnik, 4(6):242-247, June 1954. --Records of field strength measurements made at Kühlungsborn since 1951 are analyzed in respect of diurnal variations of mean level, sudden changes in level, and rapid fluctuations. Data cover transmissions in the 87.5-100 Mc band over two 200 km land paths and one 180 km sea path, and hourly records of some 30 transmissions over distances 50-500 km. Refraction theory accounts satisfactorily for propagation over distances up to three times the optical range; partial reflections can give field strengths below the horizon only 20-30 db below the level for free space propagation; relatively high mean field strength at great distances during unstable atmospheric conditions is ascribed to scattering process. (Met. Abs. 8J-55)--Abstract from Wireless Engineer.

E-255 Peterson, D.W., Bibliography of non-contract literature on tropospheric propagation. Radio Corporation of America. Engineering Products Div., Camden, N.J., Contract DA-36-039-Sc-5663, Study of Army Television Problems, Vol. 3, May 15, 1954. 146 p.--The bibliography contains about 500 entries comprising IRE abstracts, and other American symposium, reports and dissertations during the period 1949 and well into 1953. It may be regarded as a supplement to the Cornell Univ. Final Report, Pt. I, April 1951, Bibliography of reports on tropospheric propagation. The annotated references are listed in chronological order, cross referenced by the author index and an excellent subject index. (Met. Abs. 8J-56)--W.N.

E-256 Randall, D.L. (National Bureau of Standards, Wash., D.C.), A study of some of the meteorological effects on radio propagation at 96.3 Mc between Richmond, Va. and Washington, D.C. American Meteorological Society, Bulletin, 35(2): 56-59, Feb. 1954. 4 figs., 4 refs. DWB--This study was made to investigate the relationship of surface meteorological data and corresponding surface refractive indices to radio field strengths in the FM frequency band. For meteorological observations during which the wind speeds were equal to or greater than 10 mph, and when fronts, low overcast clouds (less than 5000 ft), rain, thunderstorms and fogs were excluded, a 0.70 correlation coefficient was found between hourly surface refractive index and hourly median field strength over a Washington-Richmond path at a frequency of 96.3 Mc. (Met. Abs. 8J-57) --Author's abstract.

E-257 Riddle, R.L. and Ammerman, C.R. (both, Penna. State Univ., Dept. of Elec. Engr.), A preliminary study of fading of 100 Megacycle FM signals. Institute of Radio Engineers, Transactions, Vol. AP-2, No. 1:30-34, Jan. 1954. 7 figs., 9 refs., eqs. DBS--This analytical study includes experimental transmission data from the mountainous path between Pittsburgh, Pa. and State College, Pa. The tropospheric scatter volume in this path is about 39 mi west of State College and at about 3800 ft altitude. BOOKER and GORDON's troposphere model is strengthened. It is indicated that this study is an embryonal method of continuous measurements of wind velocities and/or to determine the extent to which turbulence is present. (Met. Abs. 8 J-58)--W. N.

E-258 Saxton, J. A., Basic ground wave propagation characteristics in the frequency band 50-800 Mc/s. Institution of Electrical Engineers, London, Proceedings, Pt. III, 101(72):211-214, July 1954. 4 figs., 22 refs., 3 eqs. Discussion p. 221-224. DLC--The relation between existing experimental data on transmission at very high frequencies, at distances such that variations in atmospheric refractive index are of little significance, and fundamental propagation theory is discussed. An empirical correction for the difference between the field strengths observed over irregular terrain and theoretical values is given, and basic ground wave characteristics for the frequency band 50-800 Mc/s are suggested which should be applicable except in very mountainous country or in densely built-up areas. Over this frequency band, and for distances inside the normal horizon, it appears that there is very little variation of median field strength with frequency for a given effective radiated power. --Author's abstract.

E-259 Saxton, J. A. and Harden, B. N., Ground wave field strength surveys at 100 and 600 Mc/s. Institution of Electrical Engineers, London, Proceedings, Pt. III, 101(72):215-221, July 1954. 5 figs., 15 refs. Discussion p. 221-224. DLC--The paper gives the results of an experimental investigation of the effects of irregular terrain on ground wave propagation at frequencies near 100 and 600 Mc/s, particular attention being paid to propagation characteristics at the higher frequency. Together with other work, these results clearly show that as the frequency increases so also does the amount by which the median observed field strength for any distance falls below the smooth earth theoretical value. --Authors' abstract.

E-260 Silverman, Richard A. and Balzer, Martin, Statistics of electromagnetic radiation scattered by a turbulent medium. Physical Review, N. Y., 96(3):560-563, Nov. 1, 1954. 6 eqs. --Univariate and bivariate amplitude distributions are calculated employing Villars and Weisskopf's theory, and compared with experiment. The univariate distribution is Raleigh, and the bivariate is used to derive a relation between the amplitude correlation function and the velocity correlation function as appearing in von Weizsacker-Heisenberg's statistical theory of turbulence. --W. N.

E-261 Straiton, A. W.; Gerhardt, J. R. and Tolbert, C. W., Propagation of millimeter radio waves in low level overwater ducts. Texas. Univ. Electrical Engineering Research Lab., Contract Nonr 375(01), Report, No. 74, Oct. 15, 1954. 19 p. 12+8 figs. (incl. photos), table, 14 refs. DWB--Radio signal strength measurements are reported for propagation tests in a low level overwater duct. A wavelength of 4.3 mm was used on a 7 mi path, a wavelength of 8.6 mm on paths up to 24 mi and a wavelength of 3.2 cm on paths up to 44 mi. All transmitter and receiver heights used were less than 15 ft. The signal level was found to be less than the free space value with decay rates per mile given approximately as follows:

Wavelength	Decay Rate in db per Mile Relative to Free Space	Theoretical Oxygen and Water Vapor Loss in db per Mile
4.3 mm	3	2.0
8.6 mm	0.7	0.4
3.2 mm	0.3	0.0

The fluctuation range increased sharply as the wavelength decreased from 3.2 cm to 8.6 mm and increased still more as the wavelength decreased to 4.3 mm. The range of the fluctuation also increased approximately in proportion to distance. (Met. Abs. 8J-59)--Authors' abstract.

E-262 Suda, K., Field strength calculations--New Method for mixed paths. Wireless Engineer, 31(9):249-251, Sept. 1954. 2 figs., 4 refs., 4 eqs. DLC--A simple method for the calculation of field strength over mixed paths is explained with the aid of a comparison with measured values of field strength. An equivalent conductivity is obtained from the "numerical distance" and field strength is calculated easily by conventional curves. --Author's abstract.

E-263 Tao, Kazuhiko (Radio Res. Labs., Tokyo), On the propagation of ultra short waves beyond the horizon. Japanese Journal of Geophysics, Tokyo, 1(1):27-79, May 1954. 41 figs., 2 tables (1 fold.), 42 refs., numerous eqs. DWB--A long and thorough paper covering in the first part, the theory of tropospheric propagation of high frequency radio waves beyond the horizon, considering 3 types of propagation conditions: diffraction by a discontinuity, reflection from a nocturnal inversion (at 150-300 m height, as a rule), and double reflection from an inversion and the ground. Field strength distance curves are given in 4 elaborate nomograms, and schematic models presented to illustrate relation of field strength to various vertical profiles. In the second part the observed variations of field strength between Kokubunji and Hiraiso, crossing Tateno Geological Observatory, are analyzed to find seasonal, diurnal, and meteorological variations of 150 and 60 Mc/s waves. Examples are described and illustrated. Daily aerological soundings at Tateno furnished refractive index data for noontime, and captive balloons were used on Nov. 17, 18, 20 and 22, 1952 to obtain diurnal variations in refractive index gradient up to 200 m. The conclusion was that thin layers (20, 40 or 60 m thick, for instance) do not carry the maximum signal strength, but that layers about 160 m thick are optimum. Signal strength is usually weakest about noon and reaches a remarkably high value at night. This latter cannot be explained by a linear refraction-diffraction theory, so a bilinear theory is proposed. Signals are stable when atmosphere is stable and vice versa. Conditions during different types of air masses and during passage of fronts are discussed and illustrated by 3 hourly synoptic charts for Nov. 17, 18 and 20, 1952, and time cross sections of mixing ratio and potential temperature as well as hourly refractive index profiles and Δn, ΔT, $\Delta \theta$, and other parameter curves. (Met. Abs. 8J-60)--M.R.

E-264 Tolbert, C. W.; Britt, C. O.; Tipton, C. D. and Straiton, A. W., Propagation of 4.3 millimeter radio waves on 3.5 and 7 mile paths. Texas. Univ. Electrical Engineering Research Laboratory, Contract Nonr 375(01), Contract Nonr 071 032, Report No. 73, Aug. 6, 1954. 15 p. 8 figs., 5 refs. Available ASTIA, AD 38950. --Propagation measurements are reported for frequencies of 69.5 and 70.1 kilomegacycles per second over 3.5 and 7 mi paths in the vicinity of Austin, Texas. These measurements indicate that the oxygen absorption is somewhat less than that predicted by VAN VLECK (1) whereas the water vapor absorption is several times that predicted. The magnetron transmitter, the crystal video receiver, and the associated equipment used for the test are described in the report. (Met. Abs. 8J-61)--Authors' abstract.

E-265 Villars, F. and Weisskopf, V. F., Scattering of electromagnetic waves by turbulent atmospheric fluctuations. Physical Review, N. Y., 94(2):232-240, April 15, 1954. 2 figs., 7 refs., 54 eqs. --Application of the statistical theory to tropospheric and ionospheric density fluctuations. The dominant role of humidity fluctuation in tropospheric scattering is demonstrated. --W. N.

E-266 Wait, James R., Radiation from a vertical electric dipole over a stratified ground. Pt. 1. Institute of Radio Engineers, N. Y., Transactions, AP-1(1):9-11, July 1953. 2 figs., 11 eqs., 6 refs. Also: Wait, J. R. and Fraser, C. G., Pt. 2. Ibid., AP-3:144-146, Oct. 1954. 2 figs., table, 5 refs., 7 eqs. DLC--Pt. 1, expressions for the radiation fields at low frequencies of a vertical electric dipole situated on a horizontally stratified ground are derived. It is indicated that the well known numerical results for the homogeneous ground can also be employed for ground wave propagation over a plane conductor composed of any number of parallel layers by suitably defining an effective numerical distance. In Pt. 2, further results are given for the problem of a vertical electric dipole situated over a horizontally stratified conductor. It is pointed out that under certain conditions the surface wave field intensity for a stratified conducting ground is greater than the corresponding case for a perfectly conducting ground. Numerical values for the attenuation factor are also given. (See ref. E-428) --Author's abstract.

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E-267 Ames, L. A.; Newman, P. and Rogers, T. F. (all, Air Force Cambridge Res. Center, Mass.), VHF tropospheric overwater measurements far beyond the radio horizon. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1369-1373, Oct. 1955. 6 figs., 13 refs. DLC--Using a high power radar type transmitter near Boston, Mass., point-to-point measurements have been made at a frequency of 220 mcps on 200 and 400 statute-mi overwater paths extending along the east coast. Comparisons are made with similar data available for overland paths. Correlations between the shorter path field strength data and sea echo back scatter near the transmitter site are indicated. Airborne field strength measurements have also been made out across the North Atlantic Ocean to a distance in excess of 400 mi; the variation of field strength with distance is graphically displayed by this technique. (Met. Abs. 8J-63) --Authors' abstract.

E-268 Ames, L. A. and Rogers, T. F., Available bandwidth in 200 mi VHF tropospheric propagation. Institute of Radio Engineers, Transactions, AP-3(4):217-218, Oct. 1955. Fig., 8 refs. DBS--Television signals radiated from the Empire State Building, New York, over the frequency range 210-216 mcps were received 196 mi away in Scituate, Mass. A study of the signals received leads to the conclusion that the propagation medium allows an effective bandwidth of some 3-4 mcps at vhf for 200 mi even during the weaker signal level periods predominantly characterized by the extra diffraction type propagation mode. This is in agreement with tropospheric scatter propagation theory. --G. T.

E-269 Anderson, L. J. and Gossard, E. E., Prediction of oceanic duct propagation from climatological data. Institute of Radio Engineers, N. Y., Professional Group on Antennas and Propagation, Transactions, Vol. AP-3, No. 4:163-167, Oct. 1955. 5 figs., foot-refs. DLC. Also issued as: U.S. Navy Electronics Laboratory, San Diego, Calif., Research and Development Report, No. 654, Dec. 14, 1955. DWB--Techniques are described for predicting the effect of the "oceanic duct" in increasing the coverage of low sited microwave radars. Prediction is made on a monthly basis using statistical data on sea temperature, air temperature, humidity, and wind speed. A large area in the northwest Pacific is used to illustrate the methods used. The basic prediction approach is to deduce refractive index profiles from available data parameters and to use SCHELKUNOFF's ducting criteria to predict radar propagation effects. Monthly contours are then drawn over the area for each radar band showing the probability of extended coverage. (Met. Abs. 8. 1-393)--Authors' abstract.

E-270 Aono, Yuichiro and Muramatsu, Kinya, Measurement of field intensity of ground wave over mixed paths. Japan. Radio Research Laboratories, Tokyo, Journal, 2(7):51-58, Jan. 1955. 10 figs., 2 tables, 13 refs. DWB--This paper describes the results of the measurement carried out near Tokyo of the field intensity of ground wave on the frequencies 1.85, 2.5 and 4 Mc. The measured values are compared with the calculated values after the methods developed by a number of workers. From this comparison it is derived that the new theory which has been developed theoretically by K. FURUTSU, a member of our Laboratories in cooperation with the experiments, can give the most reasonable explanation to the propagation characteristics of ground wave. (Met. Abs. 8 J-64)--Authors' abstract.

E-271 Barghausen, A. F.; Decker, M. T. and Maloney, L. J., Measurements of correlation, height gain, and path antenna gain at 1046 megacycles on spaced antennas far beyond the radio horizon. Institute of Radio Engineers, N. Y., Convention Record, Pt. 1:78-81, 1955. 5 figs. DLC (RK 6541.I5)--Studies made and reported by the National Bureau of Standards in 1953 on the correlation of 1046 Mc radio fields on spaced antennas at distances far beyond the radio horizon are supplemented by more recent measurements. Measurements were made on the NBS Cheyenne Mountain transmission path in Colorado and Kansas at a frequency of 1046 Mc, the receiving location being at an angular distance of 27 milliradians (for standard atmosphere), i. e. approximately 150 mi beyond the transmitter radio horizon. In addition to the correlation of instantaneous fields, the correlation of hourly median fields and the diurnal variation of the received signal are shown. (Met. Abs. 8 J-65)--From authors' abstract.

E-272 Barsis, A. P.; Herbstreit, J. W. and Hornberg, K. O., Cheyenne mountain tropospheric propagation experiments. U.S. National Bureau of Standards, Circular No. 554, Jan. 3, 1955. 39 p. 46 figs., 2 tables, 18 refs., eqs. --Measurements at five frequencies from 92 to 1046 Mc/s were conducted over 393 and 617 mi paths. The studies include effects of rough terrain, dependence on transmission loss on refractive index profiles, height gain functions and application of relative theories, e.g. the new theory of propagation embodying BOOKER-GORDON's scattering principles as extended by STARAS. --W. N.

E-273 Bean, Bradford R. (Central Radio Propagation Lab., National Bureau of Standards, Boulder, Colo.) and Meaney, F.M. (formerly of same Lab.), Some applications of the monthly median refractivity gradient in tropospheric propagation. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1419-1431, Oct. 1955. 9 figs., 6 tables, 12 refs., numerous eqs. DLC--A consistent correlation has been found between the monthly median values of 100 Mc transmission loss and an atmospheric parameter ΔN which is determined from standard radiosonde observations. ΔN is defined as the difference between the refractivity at the earth's surface and at one kilometer above the earth's surface. ΔN is determined from the mid-point of the propagation path and is taken to represent an effective gradient of the refractive index. It is found to yield correlation coefficients with transmission loss of about 0.7 even in the far scattering region. This correlation is also used to derive estimates of the annual, geographic, and terrain variances of the transmission loss. Six year average values of ΔN are presented for the United States and can be used as an aid in the prediction of the annual cycle of 100 Mc transmission loss. The possibility of using surface observations of N for times of day other than the radiosonde observation hours is examined and found to be encouraging. One of the major conclusions is that the observed dependence of transmission loss upon ΔN is five times greater than that indicated by standard propagation theory. (Met. Abs. 8 J-67)--Authors' abstract.

E-274 Birnbaum, George and Bussey, H.E. (both, Nat'l. Bureau of Standards, Boulder, Colo.), Amplitude, scale, and spectrum of refractive index inhomogeneities in the first 125 meters of the atmosphere. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1412-1418, Oct. 1955. 3 figs., 2 tables, 13 refs., eqs. DLC--An extensive series of observations was obtained with two refractometers and meteorological equipment installed on various levels of a 128 m tower at the Brookhaven National Laboratory, Long Island, New York. One of the refractometers was equipped with a multiple cavity unit for the study of correlation between two positions in the horizontal direction. The errors arising from the exposure of the cavity to the atmosphere and its ventilation were investigated. The amplitude of the refractive index variations could be correlated with various meteorological conditions. From the experimentally determined cross correlation coefficient, and assuming that its variation with distance is given by the exponential (Taylor) form, scales in the neighborhood of 60 m were obtained. A crude analysis of the data indicated that the intensity of the refractive index inhomogeneities varied, on the average, as the 1.6 power of their size. (Met. Abs. 8 J-68)--Authors' abstract.

E-275 Booker, H.G. and de Bettencourt, J.T. (both, M.I.T.), Theory of radio transmission by tropospheric scattering using very narrow beams. Institute of Radio Engineers, N.Y., Proceedings, 43(3):281-290, March 1955. 16 figs., 8 refs., 36 eqs. DWB--Calculations have been made for communication over a 300 km path between antennas, each consisting of a paraboloid of diameter 100 λ. It is assumed that, under normal atmospheric conditions, transmission over this distance is due to scattering by atmospheric irregularities and that the scattering phenomena are described by the formula used by BOOKER and GORDON. Over this path, the effect of spread in the direction of arrival of scattered power should become noticeable for beamwidths less than about 1.5 degrees. For the 0.73 degree beams assumed, spread in the angle of arrival should show up quite markedly for synchronized beam swinging--that is, when the beams at both transmitter and receiver are swung simultaneously so that their axes continue to intersect, When the beams are swung 1 degree to one side of the great circle path, the reduction in power received should be about 7 db, as compared with more than 40 db that would occur for propagation purely in the vertical plane containing transmitter and receiver. Narrowing the antenna beams to very small values is an important key to increasing circuit radio frequency bandwidth capability, although at the expense of increasing antenna "aperture-medium coupling loss" (so-called "gain loss"). For the assumed circuit average bandwidth should be about 6 mcp, the loss being of the order of 10 db. For beams much larger than 1.5 degrees, the bandwidth should be limited by the medium to about 3 mcp, with negligible loss. General formulas are given from which the important characteristics of any such communication link can be predicted. (Met. Abs. 8 J-69)--Authors' abstract.

E-276 Bray, W. J.; Hopkins, H. G.; Kitchen, F. A. and Saxton, J. A., Review of long distance of radio wave propagation above 30 Mc/s. Institution of Electrical Engineers, London, Proceedings, Pt. B, 102(1):87-95, Jan. 1955. 3 tables, 61 refs. DLC--The purpose of the paper is to summarize the present state of knowledge concerning the factors affecting long distance radio wave propagation at frequencies above 30 Mc/s. Attention is drawn to various ionospheric and tropospheric propagation mechanisms and their broad characteristics. The account of these special processes is preceded by Sections dealing with selected aspects of "normal" propagation. A comprehensive bibliography is included. (Met. Abs. 6 D-277)--Authors' abstract.

E-277 British Institution of Radio Engineers, London, Abstracts of papers which have appeared in the Journal over the past 15 years (v. I-15, 1939-1955). London, Pub. by the Institution, 1955. 48 p. 395 abstracts in Decimal Classification order.--The abstracts cover the principal papers published in the past 15 yrs in this journal which, prior to 1939, was referred to as "The Proceedings". The sections of radio meteorology including propagation and instrumentation are listed under Radio Communication (621.396) and subdivided according to the latest amendments to the U.D.C. system. (Met. Abs. 14.7-112)--W. N.

E-278 Brocks, Karl, Der Brechungsindexgradient für elektromagnetische Wellen (Cm- bis M-Band) in der maritimen Grenzschicht der Atmosphäre, I. (The gradient of refractive index for electromagnetic waves (cm- to m-band) in the maritime boundary layer of the atmosphere, Pt. 1.) Deutsche Hydrographische Zeitschrift, 8(5): 186-194, 1955. 4 figs., 3 tables, 9 refs., 18 eqs. German, English and French summaries p. 186-187. Also: Brocks, Karl and Hasse, Lutz, Pt. 2 (Summary, diagrams and tables). Ibid., 9(5):217-221, 1956. 3 fold plates, 2 tables, 5 refs., 8 eqs. German, English and French summaries p. 217. DWB--The vertical gradient of the modified refractive index is correlated with the air-water temperature difference and the vertical stratification of water vapor. These correlations enable the mean vertical gradient of refractive index in the duct in the lower decameter above the surface to be calculated. Tables and diagrams are given for practical application, with values for summer and winter at Weather Ship "D" as an example. In Pt. 2, further aids are given for computing the refractive index above the sea. These are: vapor pressure (mb) from dry and wet bulb temperatures, saturation vapor pressure and relative humidity from vapor pressure and dry bulb temperature, and $N = (n - 1) 10^6$ (n = refractive index) from dry bulb and wet bulb or water temperature (salinity 35%). A short method is described for computing curves of refractive index from air temperature, water content, wind velocity, sea temperature and salinity. (Met. Abs. 8 J-122)--C. E. P. B.

E-279 Bullington, Kenneth (Bell Telephone Labs., N.Y.), Characteristics of beyond-the-horizon radio transmission. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1175-1180, Oct. 1955. 5 figs., 35 refs. DLC--This paper summarizes the principal characteristics of tropospheric transmission beyond the horizon and compares them with some of the properties of ionospheric scatter transmission. Quantitative results are given on the dependence of the average signal level on distance and frequency, fading phenomena, band width capabilities and realizable antenna gain. A short historical summary of beyond horizon tropospheric transmission is also included. (Met. Abs. 8J-71)--Author's abstract.

E-280 Bullington, K.; Inkster, W.J. and Durkee, A.L., Results of propagation tests at 505 Mc and 4090 Mc on beyond horizon paths. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1306-1316, Oct. 1955. 18 figs., 3 tables, 2 refs. DLC--This paper gives the results of some radio propagation tests which were made on two beyond horizon paths in Newfoundland. During these tests simultaneous transmissions at 505 Mc and 4090 Mc over a 150 nautical mile path were measured for a full year, and transmission at 505 Mc over a 255 mi path was measured for a period of 5 months. Both of these paths were partly over land and partly over water. Long term median signal levels and fading statistics for the two paths are given, as well as the results of some measurements of the improvement obtained from space diversity reception and the gain realized from large (28 ft) antennas on the 150 mi path. The test results provide further evidence of the feasibility of using UHF beyond horizon links in communication systems. (Met. Abs. 8J-70)--Authors' abstract.

E-281 Campen, Charles F. and Cole, Allen E., Tropospheric variations of refractive index at microwave frequencies. U.S. Air Force. Cambridge Research Center, Air Force Surveys in Geophysics, No. 79, Oct. 1955. 76 p. 46 figs., 4 tables, 44 refs., 13+19 eqs. DWB, DLC--The effect of gross variations in tropospheric refractive index on the accuracy of radio guidance systems for high altitude vehicles is discussed. Refractive index profiles prepared from radiosonde observations taken for 3 summer and 3 winter days at stations in different geographical locations in North America and representing various types of air masses are compared with a standard index of refraction curve derived from the ICAO Standard Atmosphere. Variations of the index at the ground, at 20 kilofeet, the average of the index from the ground to 25 kilofeet and the differences between these and the standard index are given. It was found that the index varied by 135 N units at the ground, by 21 N units at 20 kilofeet, and that the average index from the ground to 25 kilofeet varied by 35 N units. When categorized by air mass type, by location, or by time intervals, variations within any of these categories were much smaller. Differences between the computed indices and the Standard Index ranged from +71 to −64 N units at the ground, from +17 to −4 N units at 20 kilofeet. The differences between the averages of the index from the ground to 25 kilofeet and the average of the standard index ranged from +23 to −12 N units. Correlation of these average index data with surface index data was found to be very good. A correlation coefficient of 0.98 was obtained. For the scattergram a regression curve was drawn which showed a standard estimate of error of only 5 N units. Sample calculations of refraction errors were made which show use of the index data for correction of these errors. (Met. Abs. 8J-72)--Authors' abstract.

E-282 Carroll, T. J. and Ring, R. M. (both, MIT, Lincoln Lab., Lexington, Mass.), Propagation of short radio waves in normally stratified troposphere. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1384-1390, Oct. 1955. 3 figs., 24 refs., eqs. DLC--Experiments of the past decade give stronger fields well beyond the horizon than are calculated by the 4/3 airless earth approximation. Post war work on the theory of the WKB approximation for wave propagation in slowly varying inhomogeneous media, and the peculiar results for eigenvalues of the bilinear refractive index profile offer valuable clues in the search for an oversight in conventional propagation theory. If the absolute value, as well as the gradient of the refractive index at the earth's surface be specified, with a refractive index profile which tapers to vacuum at some arbitrarily large height, then allowed modes of the wave equation permit the field to be calculated within, just beyond, and well beyond the horizon, in agreement with many vhf and microwave experiments. Modes thus calculated are supported by ordinary coherent molecular scattering in normal air dielectric layer. At times, superrefraction and macroscopic turbulence are additional mechanisms for propagation deep into the shadow of the earth bulge. (Met. Abs. 8.3-343)--Authors' abstract.

E-283 Chisholm, J. H.; Portmann, P. A.; de Bettencourt, J. T. and Roche, J. F. (all, M.I.T. Lincoln Lab., Lexington, Mass.), Investigations of angular scattering and multipath properties of tropospheric propagation of short radio waves beyond the horizon. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1317-1335, Oct. 1955. 28 figs. (incl. photos), table, 23 foot-refs., eqs. DLC--Experiments designed to investigate the potential communications capacity of UHF and SHF tropospheric propagation beyond the radio horizon were conducted by the MIT Lincoln Laboratory on circuits from 161 to 188 mi in length along the coastal regions of the northeastern United States. Some of these tests were made in cooperation with the Bell Telephone Laboratories and the late E. H. ARMSTRONG. A study of the following aspects of tropospheric propagation was considered necessary in order to gain a better understanding of the factors involved in design of communications systems: 1) the extent of useful communication bandwidths; 2) variation of UHF and SHF median signal levels over a full seasonal cycle; 3) the range and rates of fading; 4) the effective gain of highly directional antenna systems; 5) the effect of multipath propagation on modulated signals; 6) the polarization properties of scattered fields and 7) the angular dependence of scattered fields. Such experiments made from 1953 to 1955 have confirmed the utility of tropospheric circuits for wideband communication systems and have provided information useful in the evaluation of tropospheric propagation mechanisms. (Met. Abs. 8 J-75)--Authors' abstract.

E-284 Collier, James S. (57 Chapel Ave., Buffalo, N. Y.), Upper air conditions for two meter DX: temperature and water vapor content soundings for some famous dates. QST, West Hartford, Conn., 39(9):16-18, Sept. 1955. 7 figs., ref. DLC--Synoptic weather maps give good clues to the conditions ideal for superrefraction of VHF (2 m) radio waves, but upper air soundings are the only sure indicators since they show existence and location of steep humidity gradients. An example of normal (nonsuperrefractive) temperature and humidity sounding, and 6 other soundings (Joliet, Albany, Pittsburgh, Toledo and Charleston, etc.) show conditions which give two meter DX. The Charleston sounding indicates no humidity gradient (July 23, 1949) at a time when Toledo shows a marked gradient, indicating cause of nonreception at Charleston when conditions in the Northern States were good. (Met. Abs. 8 J-76)--M. R.

E-285 Crain, C.M. (Electrical Engrg. Res. Lab., Univ. of Texas), Survey of airborne microwave refractometer measurements. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1405-1411, Oct. 1955. 12 figs., 13 refs. DLC--This paper presents a summary of airborne refractive index measurements which have been made at many locations in the United States both over land and off the east and west coasts, by several organizations. Included are the results of studies of the mean vertical structure of the index of refraction of the atmosphere as a function of such factors as location, season, horizontal distance, and time. Included also are the results of measurements of the fine detail variations of refractive index about its mean value at several locations for altitudes up to 20,000 ft mean sea level. (Met. Abs. 8.3-345)--Author's abstract.

E-286 Crysdale, J.H.; Dickson, F.H.; Egli, J.J. et al., Large reduction of VHF transmission loss and fading by presence of a mountain obstacle in beyond-line-of-sight paths. Institute of Radio Engineers, N.Y., Proceedings, 43(5): 627-628, May 1955. 2 figs., foot-refs., 3 eqs. DLC--Calculations for the Mt. Fairweather circuit are revised. The Mt. Fairweather circuit predicts a transmission loss 50 db in excess of the free space transmission loss. Since smooth earth diffraction theory predicts a loss of 105 db relative to free space, it follows that the revised theoretical value of the "obstacle gain" is 55 db, which is 25 db less than the previously predicted value and 18 db less than the measured value. A number of explanations is given to account for this discrepancy between theory and experiment. --E.K.

E-287 Davidson, David and Pote, Alfred J., Designing over horizon communication links. Electronics, N.Y., 28(12):126-131, Dec. 1955. 8 figs., 4 tables, 17 refs., 11 eqs. --Long distance, wide band circuits are usable in tropospheric propagation provided high transmitter power and diversity receiving equipment are used. Design considerations, including antenna gain and order of diversity, show how to set up a working system with a given percentage of reliability. --Authors' abstract.

E-288 Deam, A.P. and Fannin, B.M., Phase difference variations in 9350 megacycle radio signals arriving at spaced antennas. Institute of Radio Engineers, Proceedings, 43(10):1402-1404, Oct. 1955. 4 figs., ref. DLC--The phase difference between 9350 megacycle per second radio signals received from a common transmitter at two horizontally spaced antennas was measured by the Electrical Engineering Research Lab. of the Univ. of Texas during March 1955. The transmitter was located on Cheyenne Mountain in Colorado and the site of the receiver was at Fort Carson, 3.5 mi distant. The elevation angle of the transmitter as seen from the receivers was 9°. This paper presents and discusses the results of these measurements. (Met. Abs. 8J-78)--Authors' abstract.

E-289 Eckart, Gottfried, Statistische Beschreibung der dielektrischen Turbulenz in der Troposphäre. Erster teil einer Theorie der Streuung elektrischer Wellen in Turbulenter Atmosphäre. (Statistical presentation of dielectric turbulence in the troposphere. Pt. 1 of a Theory of the scattering of electric waves in the turbulent atmosphere.) Akademie der Wissenschaften, Munich. Math.-Naturwiss. Klasse, Abhandlungen, New Ser., No. 74, 1955. 34 p. Fig., 26 refs., 112 eqs. Pt. 2, Über die Streuung elektrischer Wellen an Zonen dielektrischer Turbulenz. (Scattering of electric waves at zones of dielectric turbulence.) Ibid., No. 76, 1956. 36 p. 7 refs., 107 eqs. Pt. 3, Die Analyse der Storungen der Dielektrizitätskonstanten dielektrisch turbulenter Zonen mittels Streufelbeobachtungen. (Analysis of disturbances of the dielectric constant of dielectric turbulent zones by means of observations of the field of scattering.) Ibid., No. 77, 1956. 18 p. 9 refs., 44 eqs. DWB--Statistical theory of turbulence is developed and presented in detail and applied to the propagation (or scattering) of ultrahigh frequency waves in the troposphere. The first part of this series of 3 papers covers in 7 chapters: 1) the definition of dielectric turbulence; 2) mathematical definition in form of Fourier series in space and time, and in the form of a Fourier integral; 3) the variation of the dielectric constant (DK) in space and time as a random process; 4) the relation between the frequency of function of the processes and that of the Fourier coefficients; 5) the representation of the moments and solution of the moment problem by means of Mellin (two sided Laplace) transformations; 6) homogeneous stationary space-time intervals; 7) criteria for introduction of homogeneous stationary intervals and related problems. Pt. 2 and 3 continue with the theoretical or statistical treatment and its application to radar scattering or fading, under the assumption that empirically derived data from attenuation of short waves in a turbulent atmosphere are not comprehensive enough to give a true picture of the quantitative effects of turbulent media on the radiation passing through such a medium. (Met. Abs. 12.10-135)--M.R.

E-290 Feinstein, Joseph (Bell Telephone Labs., New Jersey), Information theory aspects of propagation through time varying media. Journal of Applied Physics, N.Y., 26(2):219-229, Feb. 1955. 3 figs., table, 45 eqs. DLC--The channel capacity of a communications system which utilizes wave propagation through a time varying medium such as the ionosphere or troposphere is evaluated in terms of the statistical properties of the medium and of the noise. The signal fading in such a system reduces the capacity. Rayleigh fading is found to give rise to an equivalent signal to noise ratio of .172, while shallow fading of the Gaussian type augments the noise in the channel by a fraction of the signal power proportional to the fading depth. An optimum manner of band width subdivision is shown to exist when selective fading is present. Information theory concepts are broadened to include the possibility of multiple reception at spaced receiving sites, and the consequent increase in theoretical channel capacity is computed as a function of the number of such sites and the signal statistics. The method of maximum likelihood is utilized to obtain optimum combinatorial laws for the multiple signals. The commonly employed maximum signal selection diversity system is shown to perform as well as the optimum system in the presence of Rayleigh fading, for a small number of receiving sites. (Met. Abs. 14.4-117) --Author's abstract.

E-291 Florman, Edwin F., A measurement of the velocity of propagation of very high frequency radio waves at the surface of the earth. U.S. National Bureau of Standards, Journal of Research, 54(6):335-345, June 1955. 12 figs., 4 tables, 24 refs., eqs. DLC--The velocity of propagation of electromagnetic waves was measured at the surface of the earth, using a radio wave interferometer operating at a frequency of 172.8 Mc. The measured phase velocity, converted to velocity in vacuum, or the "free space" value, was found to be 299795 ± 31 km/sec. The uncertainty of ± 3.1 km/sec includes a 95% confidence interval for the mean, plus an estimated limit to the systematic error of ± 0.7 km/sec. Based on a 50% confidence interval (probable error of the mean), the uncertainty, including the estimated limit to the systematic error of ± 0.7 km/sec, becomes ± 1.4 km/sec. The accuracy with which the free space velocity of radio waves could be measured was limited primarily by the accuracy to which the refractive index of air could be obtained from measured values of pressure, temperature and relative humidity. (Met. Abs. 8J-79)--Author's abstract.

E-292 Froome, K. D., The refractive indices of water vapor, air, oxygen, nitrogen, and argon at 72 kmc/s. Physical Society of London, Proceedings, Pt. B, 68(11): 833-835, Nov. 1, 1955. 2 figs., 2 refs. --Cavity resonator measurements at 72 kMc/s compared with those at lower frequency show that nitrogen and argon did not change all the other components as much as expected from the dipole theory. --W. N.

E-293 Furutsu, Koichi, Propagation of electromagnetic waves over a flat earth across a boundary separating different media and coastal refraction. Japan. Radio Research Laboratories, Tokyo, Journal, 2(7):1-49, Jan. 1955. Figs., numerous eqs. Also his: Propagation of electromagnetic waves over a flat earth across two boundaries separating three different media. Ibid., 2(9):239-279, July 1955. Figs., numerous eqs. And his: Propagation of electromagnetic waves over the spherical earth across boundaries separating different earth media. Ibid., 2(10): 345-398, Oct. 1955. Figs., numerous eqs. DBS--This 140 page tripartite mathematical work is an impressively elaborate treatment of the problems specified in the titles. --G. T.

E-294 Gerks, I. H., Factors affecting spacing of radio terminals in a UHF link. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1290-1297, Oct. 1955. 12 figs., 7 refs., 18 eqs. DLC--Measurements made by the Central Radio Propagation Laboratory and others have established the feasibility of producing UHF fields at long distances which are sufficiently strong and consistent to be usable for communication purposes. This paper assembles the results of several investigators of the field strength-distance relationship and shows that these results are in reasonable agreement in a range of about 75 to 250 mi. Statistical variations from the median due to fading are discussed. Graphical means are developed to facilitate the determination of the signal-to-noise ratio at the receiver for various ranges of distance, antenna gain, frequency, transmitter power, bandwidth, and receiver noise figure. Diversity systems are explored briefly. Estimates are made of the effect of the medium upon the antenna gain and the maximum bandwidth. (Met. Abs. 8 J-81)--Author's abstract.

E-295 Gordon, William E., Radio scattering in the troposphere. Institute of Radio Engineers, N. Y., Proceedings, 43(1):23-28, Jan. 1955. 8 figs., 11 refs., 19 eqs. DWB--The theory of radio scattering in the troposphere is modified in the light of recent observations of the fluctuations in refractive index. The theory is applied to the communication problem and yields some characteristics which are peculiar to the scattering mechanism. One characteristic imposes a limit on the maximum size of an antenna which yields its full theoretical gain. This characteristic is deduced from the prediction of diversity distance. Height gain is also deduced from diversity distance. Other characteristics are derived pertinent to the communication problem, including fading rates and frequency bandwidth of the scattering mechanism. (Met. Abs. 8 J-82)--Author's abstract.

E-296 Gough, M. W., Some features of VHF tropospheric propagation. Institution of Electrical Engineers, London, Proceedings, Pt. B, 102(1):43-58, Jan. 1955. 24 figs., 6 tables, 20 refs. Condensed version in: Institution of Electrical Engineers, London, Journal, New Series, 1(1):34-36, Jan. 1955. 6 figs. DLC--Widespread v. h. f. continuous signal strength measurements made in tropical and Mediterranean regions over the last four years have exemplified and thrown into relief many of the well known mechanisms of tropospheric propagation. Although these mechanisms are broadly familiar to many engineers and physicists, the practical magnitudes, as exemplified throughout the paper, are perhaps less widely appreciated despite their great importance to the communication engineers. It is the purpose of the paper to present and analyze new v. h. f. data from the sources indicated, so as to show (a) that observed v. h. f. signal patterns are consistent with tropospheric structures known commonly to occur, and (b) that sufficient information is now available to enable the communication engineer to forecast to a useful accuracy the statistical behavior of projected v. h. f. radio paths in certain parts of the world. (Met. Abs. 6. 8-147) --Author's abstract.

E-297 Gudmandsen, P., Notes on statistical analyses with special reference to the distribution of fade durations. Akademiet for de Tekniske Videnskaber. Mikrobőlge Laboratoriet, Copenhagen (Report) P 1312/1507/1525, June 24, 1955. 33 diagr., 4 tables. --Data obtained on sea paths under varying weather conditions using 3. 2, 6. 4, and 17 cm wavelengths are analyzed and discussed here. Statistical consideration is given in particular to sampling procedures employed, found adequate in representing propagation conditions in terms of distribution of field strengths. Distribution of fade distribution was found very sensitive to sampling procedure, influence of which is governed by wavelength employed, perhaps type of path and weather encountered; recording method and strength, however, seems independent upon length of sampling interval. (Met. Abs. 8J-84)--From author's abstract.

E-298 Hay, D. R., Some measurements on VHF and UHF signals at ranges between 50 and 235 miles. Ottawa. Defence Research Telecommunications Establishment. Radio Physics Laboratory, Project Report, 22-0-4, Jan. 6, 1955. 24 p. 10 figs., tables, 7 refs.--Signal transmissions at 49, 91, 173 and 492 Mc/s have been recorded for 48 hr periods at ranges of 50, 89, 152, 199 and 234 mi. These signals were transmitted over rolling terrain between moderately low antennas. Information has been obtained from these records on the relative attenuation with distance and the rates of fading of the four frequencies. Records have been made also of thunderstorm signals at these frequencies. (Met. Abs. 8J-85)--Author's abstract.

E-299 Hay, D. R. and Langille, R. C., VHF and UHF signals in central Canada. Institute of Radio Engineers, N. Y., Proceedings, 43(9):1136, Sept. 1955. 2 figs., 5 refs. DLC--Results of an experiment are presented which was carried out over several different paths in central Canada. Graph shows a comparison between median measured signals and theoretical signals for diffraction around smooth spherical Earth with atmosphere. Another graph shows the median of the random component of the signals at range beyond 80 mi. Examination of the data proves that the signal power varies approximately as the inverse cubed power of distance from the transmitter. --E. K.

E-300 Heer, O., Zur tropospharischen Brechung ultrakurzer Wellen (Tagesgang der Feldstarke). (Tropospheric refraction of ultrashort waves (diurnal variations of field strength).) FTZ: Fernmeldetechnische Zeitschrift, Brunswick, 8(3): 129-138, March 1955. 19 figs., 30 refs. DLC--Following a review of the reasons of tropospheric refraction of ultrashort waves, the microstructure of the low atmosphere is more precisely studied and the diffraction of rays is calculated by means of meteorological data. Recordings of a VHF radio line observed during one year are compared with meteorological observations. --Author's abstract.

E-301 Herbstreit, J. W. and Thompson, M.C. (both, Central Radio Propagation Lab., Nat'l. Bureau of Standards, Boulder, Colo.), Measurements of the phase of radio waves received over transmission paths with electric lengths varying as a result of atmospheric turbulence. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1391-1401, Oct. 1955. 14 figs., table, 12 refs., eqs. DLC--A system for the measurement of the variations in electrical lengths of radio propagation paths is described. The observed path length instabilities are considered to be caused by the same atmospheric turbulence responsible for the existence of very high frequency and ultra high frequency fields far beyond the radio horizon. Results obtained on 172.8 Mc and 1046 Mc along 3 1/2, 10, and 60 mi paths are reported. It is pointed out that measurements of this type provide a powerful tool for the study of the size and intensity of the refractivity variations of the atmosphere giving rise to the observed phenomenon. (Met. Abs. 8J-86)--Authors' abstract.

E-302 Hirao, Kunio and Maruyama, Hiroyuki, Special instruments for observations and analysis of VHF fading. Japan. Radio Research Laboratories, Tokyo, Journal, 2(8):207-216, April 1955. 12 figs., 2 refs., 5 eqs. DWB--An auto-correlation analysis has been carried out for the examination of fading of VHF waves. The recording system which is linear in voltage in its recorded fluctuation, and the relay computer for Δxy were both designed and constructed especially for this analysis. A few examples of the results are introduced in the present paper. The necessary duration of observation and intervals of reading are also discussed in order to avoid misunderstanding about the statistical quantities of fading. (Met. Abs. 8J-87)--Authors' abstract.

E-303 International Radio Consultative Committee, Atlas of ground wave propagation curves for frequencies between 30 Mc/s and 300 Mc/s (C.C.I.R. Resolution No. 11). Geneva, Union Internationale des Telecommunications, 1955. XXXV p. of text. 174 p. of charts. 10 refs. 3 column pages of French, English (original) and Spanish text. DLC (QC973.I55)--This atlas is composed of 168 main diagrams for direct practical application, plus 24 diagrams featuring typical physical properties. The earth is considered as smooth and spherical, homogeneous as far as electrical properties are concerned. The troposphere is stratified, while the gradient of the refractive index near the ground is based upon 4/3 times the actual value of the effective radius of the earth.--W. N.

E-304 Janes, H.B., An analysis of within-the-hour fading in 100 to 1000 Mc transmissions. U.S. National Bureau of Standards, Journal of Research, 54(4):231-250, April 1955. 23 figs., table, 4 refs. DLC--An analysis is made of the fading range of 100 to 1000 Mc transmissions received both within and beyond the radio horizon. The measurements were made during Aug. 1952 over various Cheyenne Mountain Field Station paths and over the Cedar Rapids, Iowa — Quincy, Ill. path. Fading range is defined as the ratio in decibels of the signal levels exceeded 10 and 90% of an hour. For each of the four frequencies studied, the extent to which median fading range and median signal level depend on the angular distance and time of day is shown in the form of graphs and sample recordings. The data show that beyond the region where diffraction is considered to be the dominant mechanism, the signal level distributions closely resemble the Rayleigh distribution in both fading range and general shape. (Met. Abs. 8J-89)--From author's abstract.

E-305 Janes, H.B. and Wells, P.I. (both, Central Radio Propagation Lab., Nat'l. Bureau of Standards, Boulder, Colo.), Some tropospheric scatter propagation measurements near the radio horizon. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1336-1340, Oct. 1955. 4 figs., 7 foot-refs., 2 eqs. DLC--Measurements of small variations in 100 Mc field intensity within and just beyond the radio horizon are reported. The measured fields are assumed to be the resultant of two field components, one having a constant amplitude and the other being a rapidly fading scattered component. The fading range of the resultant field intensity over a 10 minute period is used to determine K. Here, K is the ratio in decibels of the root-mean-square amplitude of the scattered component to the amplitude of the constant vector. Curves showing the measured median values of basic transmission loss, fading rate, and K plotted vs hour of the day are included for three of the Cheyenne Mountain transmission paths. Diurnal variation of these quantities is also discussed. The average basic transmission loss of the scattered component, L_{bas}, can be found if K and the resultant basic transmission loss, L_{bm}, are known. Median values of L_{bas} and L_{bm} are plotted vs the angular path distance, θ Measurement of the correlation of the resultant field strengths received on two horizontally spaced antennas within the radio horizon is reported. When the spacing was varied from 1/2 to 20 wavelengths and the correlation compared to other characteristics of the field, the correlation was found to be as much a function of L_{bas} and fading rate as it was of antenna spacing. (Met. Abs. 8J-90) --Authors' abstract.

E-306 Japan. Radio Research Laboratories, Tokyo, Seventh Semi-Annual Meeting on Researches Conducted in the Laboratories. Its Journal, 2(7):107-109, Jan. 1955. Listing of papers presented (with English titles). DWB--Lists 16 papers read on Oct. 26, and 33 on Oct. 27, 1954 on many aspects of ionospheric and tropospheric propagation. Meeting was held at the Hall of the Radio Research Laboratories, Tokyo. (Met. Abs. 8.3-346)--M.R.

E-307 Jones, R.F., Abnormal radio propagation Dec. 3, 1954. Meteorological Magazine, London, 84(997):225-226, July 1955. DWB--Abnormal propagation on 180.4 Mc/s over 147 mi in England, is discussed. On Dec. 3, 1954, the field strength was 100 times normal. This is attributed to very dry air as low as 2200 ft with inversion below. (Met. Abs. 8J-92)--C.E.P.B.

E-308 Kirby, R.S.; Dougherty, H.T. and McQuate, P.L., Obstacle gain measurements over Pikes Peak at 60 to 1046 Mc. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1467-1472, Oct. 1955. 11 figs., 3 tables, 13 refs., eq. DLC--Radio transmission loss measurements made over four propagation paths approximately 100 mi in length show the effect of a large mountain obstacle on VHF and UHF ground-to-ground propagation. Recordings of transmission loss were obtained at four sites as a function of receiving antenna height and by mobile measurements along a route normal to the propagation path. Measurements for propagation directly over Pikes Peak exhibit the well defined lobing associated with four ray path diffraction theory. Theoretical approximations based on the FRESNEL-KIRCHHOFF scalar knife edge diffraction theory predicts values of transmission loss and lobe structures which are in good agreement with those observed. Measurements for propagation to the east and west of Pikes Peak are characterized by lower fields at all frequencies and large fading ranges. (Met. Abs. 8J-93)--Authors' abstract.

E-309 Klinker, L., Beitrag zum Tagesgang der Feldstärken im Ultrakurzwellenbereich. (Daily variation of field strength in the ultrashort region.) Zeitschrift für Meteorologie, 9(6):178-191, June 1955. 7 figs., 2 tables, 12 refs., 13 eqs. MH-BH-- The frequent formation of a nocturnal inversion and its dissipation by day leads to a diurnal variation of the field strength of ultrashort wave transmissions from a distance. Ranges up to double can be traced to the changing atmospheric refraction. Using measurements of vertical temperature and vapor pressure gradients near the ground this diurnal variation is calculated from the field strength formula. For mean range over a long period the temperature gradient by itself gives agreement with observed values. At greater distances, however, there is a discrepancy increasing with distance. The cause is that the importance of refraction for ultrashort wave transmission decreases compared with other transmission mechanisms due to meteorological causes. Especially the scattering processes at turbulence elements of the atmosphere should lead to their own form of the diurnal variation. (Met. Abs. 6.11-233)--Transl. of author's abstract.

E-310 Klinker, Ludwig, UKW-Fernempfangsbeobachtungen: Ihre Bedeutung für Meteorologie und Funktechnik. (Ultrashort wave distant reception observations: their significance for meteorology and radio technology.) Germany. (Democratic Republic). Meteorologischer und Hydrologischer Dienst, Abhandlungen, 4, i.e. 5?(35), 1955. 66 p. 36 figs., 3 tables, 37 refs. DWB--Pt. 1 "The effect of meteorological conditions upon ultrashort wave propagation over the German plain and the Baltic" covers a mathematical treatment of the theory of ultrashort wave propagation including the influence of refraction upon the range of the ultrashort wave ray, field strength variations beyond the ultrashort wave horizon, reflections from the free atmospheric inversions and scattering processes at the turbulence elements of the atmosphere; the apparatus arrangement for making measurements in specified ultrashort wave ranges in the 3 m band and the evaluation of the propagation measurements; analysis of ultrashort wave propagation during free inversions with advection; the relationship between nocturnal radiation ground inversion and the daily variation of ultrashort wave propagation over land, etc.; The annual variation of ultrashort wave propagation; the influence of frontal processes, of low pressure areas, lows aloft, unstable stratified cold air, upon ultrashort wave propagation; large scale weather situations and mean field strength intensity, etc. Pt. 2 deals with the climatology of ultrashort wave propagation in Central Europe. It contains statistical data for a land area of 200 sq km and a sea area of 175 sq km, data on temporal field strength intensity distribution for six ultrashort wave measurement distances 100 to 500 km apart on a basis of five months of observations, decline of field intensity with distance and daily variation of the ultrashort wave field intensity. (Met. Abs. 8.3-20) --I.L.D.

E-311 Kono, Tetsuo; Nishikori, Kiyoshi; Fukushima, Madoka; Ikeda, Masao and Yoshida, Noriaki, Experimental studies on diffracted waves from a mountain at 3000 Mc/s. Japan. Radio Research Laboratories, Tokyo, Journal, 2(8): 163-180, April 1955. 21 figs., 4 tables, 8 refs. DWB--Radio transmission experiments were made at the frequency of 3000 Mc/s over the 243 km path between Kawaguchi and Ryozen in Sept. and over the 166 km path between Kawaguchi and Izumi in Dec. 1954. Mt. Yamizo lies in the midway of these paths. Transmission loss and fading characteristics obtained in this experiment are much different from that of a VHF radio wave experiment over a mountain. In the first experiment, the median value of the field intensity agreed approximately with that calculated by FRESNEL's knife edge diffraction theory, but in the second experiment it was about 10 db below the calculated value. (Met. Abs. 8J-94)--Authors' abstract.

E-312 Kurihara, Yoshitaka (Radio Research Labs., Tokyo), Trans-horizon microwave propagation over hilly terrain. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1362-1368, Oct. 1955. 13 figs., 3 tables, 3 foot-refs., eqs. DLC--By introducing three path parameters into the geometry of scattered signal transmission, the spherical earth formulas of W. E. GORDON were extended to the nonspherical earth case. This paper describes the result of analysis. The nonspherical earth formulas were applied to the prediction of the signal power and characteristics of tropospheric scattered fields on the hilly 93 mi path between Ithaca and Wethersfield-Springs, N. Y., and on the 119 mi path between Ithaca and Buffalo, N. Y. The transmission experiments over these two paths were conducted at Cornell Univ., at frequencies of 2780 Mc and 9150 Mc. The results of the experiments are presented together with the predictions in this paper. (Met. Abs. 8 J-95)--Author's abstract.

E-313 LaGrone, A. H.; Straiton, A. W. and Smith, H. W., Synthesis of radio signals on over water paths. Institute of Radio Engineers, Transactions, AP-3(2):48-52, April 1955. 7 figs., 5 refs., 20 eqs. DBS--The fluctuations of radio signals at microwave frequencies on overwater paths are explained on the basis of a periodic rise and fall of the water level. From this study, it is seen that the variations in the radio signal strength will contain the frequency of the water level cycles and also the second and third harmonics of the water level cycles. This same model predicts that the cross correlation function of the fluctuations of the radio signal at two vertically spaced antennas will drop from unity to zero as the separation distance is changed from zero to one-half of a lobe width of a height gain interference pattern. Although the model assumes reflection from a plane surface, the results of the study successfully explain most of the features of the observed fluctuations of the radio signals on two overwater paths. --Authors' abstract.

E-314 Laver, F. J. M., Introduction to some technical factors affecting point-to-point radiocommunication systems. Institution of Electrical Engineers, London, Proceedings, Pt. B, 102(6):733-743, Nov. 1955. 8 figs., 100 refs., 11 eqs. DLC--An extensive review of literature on point-to-point radio transmission and factors affecting it. Noise, distortion, attenuation, signal strength, fading, interference, etc., are treated in separate sections. Ionospheric and tropospheric propagation factors are considered, for both long and short range, high and low frequency transmission. (Met. Abs. 8 J-96)--M. R.

E-315 Mack, C. L., Diversity reception in UHF long range communications. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1281-1289, Oct. 1955. 14 figs., 5 refs., 20 eqs. DLC--Several diversity techniques employed in UHF beyond the horizon systems are discussed. Filed experience is evaluated in terms of equivalent reliability, flexibility and performance. A nonswitching parallel combiner has become the standard military diversity circuit for UHF long range receivers. The circuit is described and analyzed. --Author's abstract.

E-316 Mellen, G. L.; Morrow, W. E.; Pote, A. I.; Radford, W. H. and Wiesner, J. B., UHF long range communication systems. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1269-1281, Oct. 1955. 23 figs., 9 refs., 25 eqs. DLC--Recent discoveries about long range propagation of UHF radio waves, together with careful utilization of high powered transmitters and large antennas, have made possible reliable multichannel point-to-point radio communication systems which operate over distances of 200 mi or more beyond the horizon. Measurements by various investigators have shown that transmission losses on such path have median values of the order of 80 db below free space levels. A program of investigation at Lincoln Laboratory, MIT, has yielded detailed propagation data necessary for the design of long distance multichannel UHF radio communication circuits. This also led to the design of specialized equipment for this application. These circuits employ antennas having transmitting and receiving gains of 25-40 db; high power FM transmitters of up to 10 kw output; sensitive FM receivers having low noise input circuits, and excellent selectivity; and space diversity reception. A procedure for system design is outlined. --Authors' abstract.

E-317 Muchmore, R.B. and Wheelon, A.D. (both, Guided Missile Research Div., Ramo-Wooldridge Corp., L.A.), Line-of-sight propagation phenomena, Pt. 1, Ray treatment. Institute of Radio Engineers, N.Y., Proceedings, 43(10): 1437-1449, Oct. 1955. 9 figs., numerous refs., 55 eqs. Pt. 2, Scattered components. Ibid., p. 1450-1458. 10 figs., refs., 55 eqs. DLC--The effect of variations in index of refraction on line-of-sight propagation of electromagnetic waves in the troposphere is investigated using, in Pt. 1, a ray theory approach. Mean square variations in phase delay and phase correlation between two paths are calculated. It is shown that these quantities are relatively insensitive to the form of space correlation function assumed for the index of refraction. The mean square phase is proportional to $\Delta N^2 lo$ where lo is scale length and ΔN^2 the mean square variation in index of refraction, whereas in beyond line-of-sight propagation the received power is proportional to $\Delta N^2/lo$. Variations in angle of arrival are also calculated and it is shown that here the assumed space correlation of index of refraction is critical in determining the angle of arrival characteristics. It is shown, however, that a certain portion of the angle-of-arrival spectrum is insensitive to the choice. In Pt. 2 the foregoing investigation of line-of-sight propagation through a turbulent atmosphere is continued and enlarged. Generalizations of the ray calculation to include scattering contributions by off axis blobs are given. It is found that the previous expressions for rms phase errors are substantially maintained. The dependence of these fluctuations on receiving antenna beamwidth is adduced. These techniques are then applied to estimate phase scintillation for transmission through a rainstorm. Meteorological data are used to relate such errors to rainstorm. Meteorological data are used to relate such errors to rainfall intensity and infer scintillation frequency spectra. Numerical values for these effects are given for representative atmospheric conditions. (Met. Abs. 8.6-369)--Authors' abstract.

E-318 Northover, Francis H., Long distance V.H.F. fields, Pt. 1, Partial reflection from a standard atmosphere. Canadian Journal of Physics, Ottawa, 33(5):241-256, May 1955. 13 refs., numerous eqs. Also his: Pt. 2, Refractivity profiles containing "sharp layers". Ibid., 33(6):316-346, June 1955. Fig., 2 tables, 13 refs., numerous eqs. Also his: Pt. 3, The case of two elevated layers. Ibid., p. 347-349. Eqs. DWB--Reliable propagation of VHF waves and microwaves from high power transmitters to distances of several hundred miles beyond optical range has been demonstrated by an ever increasing number of experiments during the last ten years. The fields which have been observed have consistently been many times greater than the field strengths predicted by the "effective radius" theory. The present paper will be published in three parts. In Pt. I the theory that the phenomenon can be explained solely in terms of "partial internal reflection" from elementary layers of a dielectric distribution where the rate of decrease of $(\mu - 1)$ with height is everywhere continuous and of the same order of magnitude as in a "standard" atmosphere is carefully examined and found to be untenable. In Pt. II, the case where the distribution contains "sharp layers" (i. e., local regions where ($\mu - 1$) changes relatively rapidly with height) is examined and it is found that these could cause the phenomenon. However, in view of the other characteristics of the observed field, it is concluded that the effect in question is probably more usually due to scattering of the electromagnetic waves from atmospheric turbulence. In Pt. 2, the general solution developed in Pt. 1 is applied to the case in which the refractivity profile contains sharp layers (i. e. local regions where μ and $d\mu/dh$ change very rapidly compared with their rate of variation in a "standard" type atmosphere). It is found that such layers, when well developed, can cause distant fields of the order of magnitude of those which have been observed, but present experimental evidence seems to indicate that scattering from atmospheric turbulence is usually the important factor. An attempt is made to work out a physical interpretation of the field formation below the elevated layer. In Pt. 3, the general theory developed in Pt. 1 and in the beginning of Pt. 2 is applied to derive an equation for the eigenvalues of the propagation for the case of two sharp elevated layers. This equation is very briefly discussed and some special cases noted. (Met. Abs. 8 J-99)--Author's abstract.

E-319 Norton, Kenneth A.; Rice, P.L.; Janes, H.B. and Barsis, A.P. (all, Central Radio Propagation Lab., Nat'l. Bureau of Standards, Boulder, Colo.), Rate of fading in propagation through a turbulent atmosphere. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1341-1353, Oct. 1955. 13 figs., table, 22 refs., numerous eqs. DLC--Fading rate is defined to be the number of times per minute that the envelope of the received field crosses its median level with a positive slope. This definition of fading rate is equally useful for ionospheric or tropospheric propagation studies. Furthermore, it may be used with equal facility on short transmission paths where the ground wave component of the received field predominates and on the longer transmission paths where the scattered component of the received field predominates. It is shown that this definition of fading rate provides a quantity which is numerically related to the parameters of the propagation medium under certain conditions which are normally satisfied in either ionospheric or tropospheric propagation studies. The pertinent parameters of the propagation medium in beyond-the-horizon transmission are the location and shape of the scattering volume and the turbulent and drift velocities of the scatterers. An extensive discussion is given of the shape of the tropospheric scattering volume for beyond-the-horizon transmission. An analysis is then given of some fading rate data obtained in the National Bureau of Standards tropospheric propagation program in the 92 to 1046 Mc range of frequencies on transmission paths, 70, 97, 226, and 394 mi in length. Finally, an analysis is given for within-the-horizon propagation. In this case it is advantageous to define fading rate as the number of times per minute that the phase of the received field crosses its median level with a positive slope. (Met. Abs. 8 J-101)--Authors' abstract.

E-320 Norton, K. A.; Vogler, L. E.; Mansfield, W. V. and Short, P. J., The probability distribution of the amplitude of a constant vector plus a Raleigh distributed vector. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1354-1361, Oct. 1955. 4 figs., 2 tables, 10 refs., 41 eqs. DLC--The discussion is accompanied by formulas, tables and graphs. Distribution of: 1) amplitude of a constant vector and of 2) of the Rayleigh distributed vector along with physical requirements involved are treated. The paper ends with a discussion on two other random vectors as encountered in tropospheric propagation studies. (Met. Abs. 8 J-103)--W. N.

E-321 Norton, Kenneth A. and Wiesner, Jerome B., The scatter propagation issue. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1174-1526, Oct. 1955. DLC--This large issue of the Proceedings is devoted to about 35 papers on various aspects of tropospheric or ionospheric propagation of short radio waves beyond the horizon. The introduction by NORTON and WIESNER explains the phenomenon in terms of two contrasting theories, one that irregular "blobs" in the troposphere or cosmic dust clouds in the ionosphere are responsible for this anomalous propagation, the other that regular discontinuities could accomplish the same results (inversions or gradients producing refraction). (Met. Abs. 8J-100)--M. R.

E-322 Norton, K. A.; Rice, P. L. and Vogler, L. E. (all, Central Radio Propagation Lab., National Bureau of Standards, Boulder, Colo.), Use of angular distance in estimating transmission loss and fading range for propagation through a turbulent atmosphere over irregular terrain. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1488-1526, Oct. 1955. 40 figs., 56 foot-refs., 71 eqs. DLC--A discussion is given of the transmission loss expected in free space with various types of antennas, followed by a description of theoretical prediction curves for the transmission loss expected in tropospheric propagation on overland paths. The Bremmer-van der Pol theory of diffraction and the Booker-Gordon and Weisskopf-Villars theories of tropospheric forward scattering are then developed in terms of angular distance as a parameter. Angular distance is the angle in the great circle plane between the radio horizon rays from the transmitting and receiving antennas. It is shown that this parameter replaces, to a first order of approximation, both the transmission path length and the antenna heights. Angular distance is shown to be useful for predicting the short term within the hour fading range as well as the median transmission loss. Illustrations are presented of the theoretical dependence of transmission loss on the angular distance, transmission path length, antenna height, radio frequency, and a parameter ΔN which is a measure of the vertical gradient of atmospheric refractive index. Most of the long term variations of the scattered field intensities with time, as well as the climatological variations, are attributed to changes in ΔN. A new theory of obstacle gain is developed, and it is shown that this is particularly useful for explaining some of the unusually strong fields which have been observed just beyond the horizon in overland propagation. The diffraction and scattering theories are compared with extensive data on radio transmission loss involving 136,000 hourly median values recorded over 122 propagation paths at frequencies between 66 and 1046 megacycles. Estimates of the Booker-Gordon scattering parameter $[\overline{(\Delta n/n)^2}/l_0]$ and of the Weisskopf-Villars scattering parameter $\{[\overline{(dn/dh)^2}] - [\overline{dn/dh}]\}^2$, determined from our median radio data and normalized to a height of one kilometer above the surface, are considered to be correlated with the gradient of refractivity, ΔN. The radio data indicate that the magnitude of the scattering cross section decreases in inverse proportion to the radio frequency in the range we have studied. This provides strong evidence in favor of the Weisskopf-Villars tropospheric forward scattering theory presented elsewhere in this issue of the Proceedings. Theoretical curves of the average value of the path antenna gain to be expected in tropospheric forward scatter propagation are presented as a function of the angular distance, the asymmetry factor, and the free space gains of the transmitting and receiving antennas. (Met. Abs. 8.5-340)--Authors' abstract.

E-323 Poeverlein, Hermann, Field strength near the skip distance. U.S. Air Force. Cambridge Research Center, AFCRC-TR-54-104, Jan. 1955. 13 p. 3 figs., 20 refs., 26 eqs. DWB (M94 P745f)--The field strength in an interval of a few hundred km beyond the skip distance is derived from theoretic-optical considerations as proportional to $(X - X_s + \Delta X_c)^{-1/4}$ where $X - X_s$ is the distance from the skip distance. The small correction term ΔX_c provides the correct skip distance value of the field strength. The focusing which occurs at the skip distance itself increases the field strength under certain regular conditions to about eight times the unfocused free propagation field strength. At short skip distances, however, this focusing becomes weaker and another much broader field strength maximum appears at a distance from the transmitter approximately proportional to the layer thickness. (Met. Abs. 8 J-104)--Author's abstract.

E-324 Prokott, Ernst, Übertragungsversuche bei 530 MHz mit Reichweiten jenseits der optischen Sicht. (Transmission tests at 530 Mc/s at ranges beyond the optical horizon.) FTZ: Fernmeldetechnische Zeitschrift, Brunswick, 8(8):430-437, Aug. 1955. 18 figs., 2 tables, 2 eqs. DLC--Propagation tests were performed over two radio lines in central Germany on 533.5 Mc/s. The aim of these experiments was to find out the required amount of technical experiments for satisfactory communication. --Author's abstract.

E-325 Roessler, E., Erklärungen für die beständigen Feldstärken unter 10 m. Wellenlänge weit hinter dem Horizont. (Explanation of the prevailing field strengths below 10 m wavelengths far beyond the horizon.) Elektronische Rundschau, 9(4):151-155, 1955. 4 figs., 56 refs. --This is a concise survey of various theories and works on beyond-the-horizon propagation originating in the USA, United Kingdom and Germany. --W. N.

E-326 Rogers, T.F., VHF field strength far beyond the radio horizon. Institute of Radio Engineers, N.Y., Proceedings, 43(5):623, May 1955. Fig. DLC--Brief report on experimental transmission of 1.4 m waves over a 420 statute mile flight path over the North Atlantic Ocean eastward from Boston, Mass. It is shown that 1.4 m field strength decreases less rapidly than MEGAW's observations with 10 cm waves. This may indicate a dependency upon wavelengths so far as attenuation is concerned, however, with the reservation that weather conditions and seasons differed in these transmissions. (Met. Abs. 8 J-105) --W. N.

E-327 Sacco, Luigi, Il collegamento radio in regime di superrifrazione atmosferica. (Radio link during atmospheric superrefraction.) Alta Frequenza, Milan, 24(6): 436-469, Dec. 1955. 10 figs., refs., numerous eqs. DLC--Meteorological research conducted in Italy during the last few years has shown that superrefraction at heights below 500 m occurs with some frequency, both during the day and at night. In this article the geometrical parameters (reflection point, path and angle of incidence of reflected waves, convergence coefficient) of radio links during such conditions are studied, values of these parameters are determined and their application to calculation of the received field is shown. The formation of tropospheric ducts is not considered, but possibilities of focusing and reflection are discussed. --Transl. of author's abstract.

E-328 Saxton, J. A. and Lane, J. A., VHF and UHF reception effects of trees and other obstacles. Wireless World, London, 61(5):229-232, May 1955. 3 figs., 4 refs., 2 eqs. DLC--Some experiments to determine the attenuation caused by screens of trees and thick woods at frequencies of 100, 540 and 1200 Mc/s are described, and these and other data are used to estimate the attenuation over the frequency range 30 - 3000 Mc/s. This work was carried out as part of the program of the Radic Research Board. The nature of the diffraction loss and variation of field strength behind opaque obstacles of various kinds for the same frequency band is examined on the basis of the Fresnel theory of diffraction. --Authors' abstract.

E-329 Silleni, Stelio, Su alcuni fattori geofisici nelle radiocommunicazioni. (Some geophysical facts in radiocommunication.) Annali di Geofisica, Rome, 8(1): 135-148, Jan. 1955. 4 figs., 14 refs., eqs. Italian and English summaries p. 146-147. DLC--A review of ionospheric and tropospheric propagation theory and the latest empirical data on effects of time of day, temperature, humidity and magnetic disturbances which affect radio propagation in the various wave bands (including short wave radio telephone circuits). (Met. Abs. 8 J-106) --M. R.

E-330 Silverman, Richard A. (N. Y. Univ.), Some remarks on scattering from eddies. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1253-1254, Oct. 1955. 8 foot-refs., 2 eqs. DLC--The Gaussian character of electromagnetic radiation scattered from turbulent atmosphere fluctuations is shown to follow from the Central Limit Theorem, even when the scattering is from only one macro-eddy and there is coupling between eddy motions of different sizes. It is suggested that including the effects of eddy coupling may increase the calculated average scattered power enough to give agreement with experiment. (Met. Abs. 8 J-107) --Author's abstract.

E-331 Simon, J. C., Quelques problèmes de fluctuations en radioélectricité. (Some radioelectric fluctuation problems.) Annales de Radioélectricité, Paris, 10(39): 3-19, Jan. 1955. 9 figs., 10 refs., 49 eqs. DLC--The statistical approach enables simple solutions to be given to a great number of problems in the field of radioelectricity. Many of these are related to the study of the sum of vectors, the phase angles of which are random. This study is undertaken in a first theoretical part. The correlation function concept applied to this problem is studied in detail. The second part gives different practical applications such as multiple reflections on a transmission line, propagation problems, influence of scattered echoes, radiation of a great number of sources, fluctuations of a radar echo, and effect of phase error on antenna performance. --Author's abstract.

E-332 Smith-Rose, R. L., Radio communication by wave scattering. Wireless Engineers, 32(11):287-290, Nov. 1955. --Tropospheric and ionospheric works are discussed briefly, including experiments in the United Kingdom. --W. N.

E-333 Smith-Rose, R. L. and Saxton, J. A., UHF television broadcasting: study of propagation conditions: geographical separation of stations using common frequencies. Wireless World, London, 61(7):343-346, July 1955. 2 figs., 2 tables, 13 refs. DLC--Possibilities of the ultra high frequencies (UHF) for broadcasting purposes with special reference to television transmission in

Bands IV and V (470 to 585 and 610 to 960 Mc/s respectively), are considered. It is already appreciated that a single UHF transmitter cannot serve as large an area as a radio or television transmitter in the VHF bands. The discussion includes a comparison of the relative usefulness of UHF and VHF for television transmissions. --E. K.

E-334 Stack-Forsyth, E. F., An experimental study of the propagation of 10 cm radio waves over a short non-optical sea path. Institution of Electrical Engineers, London, Proceedings, Sec. B, 102(2):231-236, March 1955. 8 figs., table, 5 refs., 5 eqs. DWB--Tests of 10 cm radio propagation over sea paths up to 21.1 mi (1.14 times optical horizon) were made near Durban in April-Aug. 1953. Temperature and humidity up to 600 ft were obtained by balloon or kite. A duct of average depth 120 ft was present for a large proportion of the time, especially night and early morning with a secondary maximum at midday; it was caused by a high lapse of vapor pressure. (Met. Abs. 8 J-108)--C. E. P. B.

E-335 Staras, Harold (Engineering Products Div., RCA, Camden, N. J.), Forward scattering of radio waves by anisotropic turbulence. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1374-1380, Oct. 1955. 12 figs., 9 foot-refs., numerous eqs. DLC--This paper extends the theory of tropospheric scatter by deriving the appropriate formulas for the important radio system parameters under the assumption that the turbulence is anisotropic, i. e., that the scale of turbulence in the horizontal dimension is different from the scale of turbulence in the vertical dimension. The frequency dependence of the scattered radiation is the same for anisotropic large-scale turbulence as for isotropic. Furthermore, those radio systems parameters which depend only on the rate of decrease of scattered energy with elevation angle (such as the vertical correlation function and height gain) remain unchanged under the assumption of anisotropy while those parameters which depend on the energy coming out of the great circle plane (such as the horizontal correlation function) can be influenced quite substantially by anisotropy. Several other parameters such as the longitudinal correlation function, bandwidth of the medium and effective antenna gain may also be influenced by anisotropy but generally to a lesser extent. A comparison is made between our theory and some recent NBS data -- indicating that anisotropy does exist. (Met. Abs. 8 J-109)--Author's abstract.

E-336 Tao, Kazuhiko, On the relationship between the hourly variation of field strength and the structure of the lower atmosphere. Japan. Radio Research Laboratories, Tokyo, Journal, 2(8):181-191, April 1955. 13 figs., table, 10 refs. DWB--It is clear that the relationship between the hourly variation of field strength and the distribution of the refractive index in the lower atmosphere is ascertained by the actual data from captive balloon observations, i. e., the high level of field strength corresponds to the abnormal distribution of the refractive index. Moreover, it is clear that the abnormal distribution of the refractive index can be explained from the viewpoint of synoptic meteorology. (Met. Abs. 8 J-110)--Author's abstract.

E-337 Texas. Univ. Electrical Engineering Research Lab., Bibliography of Reports, Memoranda, Technical Publications, Papers and Theses, 1945-1955. Contract Nonr 375(01), Report No. 75, March 31, 1955. 45 p. --The material is arranged as follows: (1) Reports to the sponsoring agencies: U. S. Navy, U. S. Air Force, U. S. Army, U. S. Nat. Bur. of Standards, and industrial organizations; (2) Technical publications; (3) Papers by staff members of the University and (4) theses. (See ref. E-1083). (Met. Abs. 8 J-111)--W. N.

E-338 Tidd, W.H. (Bell Telephone Labs., N.Y.), Demonstration of bandwidth capabilities of beyond horizon tropospheric radio propagation. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1297-1299, Oct. 1955. 8 figs. (incl. photos). DLC--Tropospheric radio transmission beyond the horizon is characterized by rapid and selective fading, which suggests a possible limitation on the useful bandwidth. The tests discussed were made to explore the bandwidth capabilities of this medium. Bell Telephone Laboratories conducted these tests in cooperation with the M.I.T. Lincoln Laboratory on a 188 mi path at 5050 Mc with a power of 300w and 28 ft paraboloidal antennas. Two types of tests were made. First a 12 voice channel multiplex system for intermodulation crosstalk. IF band was 1.3 Mc. Then television tests were made with a deviation of ± 4 Mc and IF bandwidth of 30 Mc. No significant impairment in system quality could be attributed to distortion in transmission medium in either test. (Met. Abs. 8.5-342)--Author's abstract.

E-339 Tohsha, M., On the superrefraction of microwave in Kanto District. Journal of Meteorological Research, Tokyo, 7(7):446-454, Oct. 1955. 12 figs., 3 tables, 8 refs., 7 eqs. In Japanese; English summary p.446. DWB--Radar echoes accompanying superrefraction which is anomalous propagation of radar wave were observed before sunset on Aug. 5, 1954 in Kanto district. Whether the phenomenon depends on the K type refraction in which the effective radius of the earth increases, or on the duct type in which the distribution of refractive index N or M decreases with height in the surface layer of the atmosphere, is discussed. From the judgment of observational data at Tateno and Tsukuba, it is found that K type anomalous propagation had not occurred. It is considered that the phenomenon of superrefraction occurred as the duct type, from the minute analysis of aerological sounding at Tateno. Also, the formation of duct was discussed synoptically, using the data observed in the networks of meteorological stations in Kanto district, and the condition that the two air flows were mixed in the surface layer was found to be necessary for the formation. The 4000 Mc receiving and its recording of one way transmission between Mitaka and Tsukuba were operated by the Electric Communication Laboratory, and the attenuation of duct layer was observed in the period of the anomalous echoes, the value of which attained to about 10 db. On the other hand, a condition that air flows were not mixed was investigated, in which case such superrefraction as the above mentioned was not found. (Met. Abs. 8J-113)--Author's abstract.

E-340 Trolese, L.G. (Smythe Res. Associates, S. Diego, Calif.), Characteristics of tropospheric scattered fields. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1300-1305, Oct. 1955. 12 figs., table, 6 refs., eqs. DLC--Experimental results obtained with transmissions at wavelengths of 3.2, 9.3 and 24 cms over a 46.3 mi path are presented. With low terminal heights the scattered field was dominant on this path. Tests with a narrow beam antenna indicate that the scattered field arrives at the receiver spread over an appreciable angle. This angle is some five to seven times as large as the Booker-Gordon theory predicts on the assumption that the scale of turbulence is large compared to the wavelength. Loss in ability to receive power in proportion to antenna gain was encountered for antennas with aperture diameters greater than about 20 wavelengths. This loss occurs for aperture sizes considerably smaller than the Booker-Gordon theory predicts. The speed of fading of the scattered field signal increases almost linearly with frequency. This agrees fairly well with the concept (due to Ratcliffe and applied to tropospheric scattering by Booker and Gordon) that fading is due to beating between various scattered field components whose frequencies differ by a fractional Doppler shift due to motion of the scatterers. The speed of fading always increases, during the day, with time of day and does not correlate with mean upper wind speed. This increase with time of day is probably connected with the repetitive diurnal meteorological cycle prevalent in Arizona. (Met. Abs. 8.3-349)--Author's abstract.

E-341 U.S. Office of Naval Operations, U.S. Navy Marine Climatic Atlas of the World, Vol. 1, North Atlantic Ocean. Its NAVAER 50-1C-528, Nov. 1, 1955. xvii p. 275 charts (in color), 31 refs. Vol. 2, North Pacific Ocean. Ibid., 50-1C-529, July 1, 1956. xvii p. 275 charts (in color). both 50 X 34 cm. DWB (M82.3 U585m)--Each of these carefully compiled atlases contains among many other charts useful for naval air and sea operations, four charts covering the "Modified Refractive Index" or "B" Index for the respective seasons (Dec.-Mar. to Sept.-Nov.). The data are presented in frequency distribution paste-ups for the 60 or more upper air stations in all parts of the Atlantic or Pacific (including Weather Ships). The values presented are for 25% and 75% of all B Values (quartets) for each of 5 levels (surface, 950, 900, 850 and 800 mb). The data are derived from 0300Z observation for varying lengths of record (1946-1955). Charts of frequency of inversions and of annual temperature and humidity are also included. (Met. Abs. 8J-116)--M.R.

E-342 Villars, F. and Weisskopf, V.F., On the scattering of radio waves by turbulent fluctuations of the atmosphere. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1232-1239, Oct. 1955. 5 figs., 2 tables, 20 refs., numerous eqs. DLC--This paper presents a theoretical analysis of the mechanism that enables transmission of VHF signals over distances of the order of 10^3 km. It is found that turbulent mixing, operating at the lower edge of the E layer (h = 80-90 km) produces fluctuations in electron density of sufficient intensity to account for the observed signals. The basic assumptions are the existence of a sufficiently strong gradient of electron density (dN/dh 10^3 cm^{-3}/km) and a reasonable level of turbulent activity. (Met. Abs. 8J-117)--Authors' abstract.

E-343 Waterman, Alan T., Jr., Radio power received via tropospheric scattering. Stanford Univ. Applied Electronics Laboratory, Contract DA 36-039-Sc-63189, Contract Nonr 225(10), Technical Report, No. 461-1, July 18, 1955. 7 p. 9 refs., eqs. (U.S. ASTIA, AD 66502)--UHF and SHF beyond horizon propagation as a function of atmospheric turbulence is treated theoretically here. Integration of the scattered power involved can be performed exactly as is demonstrated. (Met. Abs. 8J-118)--W.N.

E-344 Muchmore, R.B. and Wheelon, A.D., Line-of-sight propagation phenomena--I. Ray treatment. Institute of Radio Engineers, N.Y., Proceedings, 43(10):1437-1449, Oct. 1955. 9 figs., 22 refs., 55 eqs. Also, Wheelon, A.D. and Muchmore, R.B., Line-of-sight propagation phenomena--II. Scattered components. Ibid., 43(10):1450-1458, Oct. 1955. 10 figs., table, 19 refs., 55 eqs. Also: Wheelon, A.D., Near-field corrections to line-of-sight propagation. Ibid., 43(10):1459-1466, Oct. 1955. 3 figs., 9 refs., 53 eqs. DLC--In Pt. 1, the effect of variations in index of refraction on line-of-sight propagation of electromagnetic waves in the troposphere is investigated using a ray theory approach. Mean square variations in phase delay and phase correlation between two paths are calculated. It is shown that these quantities are relatively insensitive to the form of space correlation function assumed for the index of refraction. The mean square phase is proportional to $\Delta N^2 {}_o$, where ℓ_o is scale length and ΔN^2 the mean square variation in index of refraction, whereas in beyond line-of-sight propagation the received power is proportional to $\Delta N^2/\ell_0$. Variations in angle of arrival are also calculated and it is shown that here the assumed space correlation of index of refraction is critical in determining the angle of arrival characteristics. It is shown, however, that a certain portion of the angle-of-arrival spectrum is insensitive to the choice. In Pt. 2, the foregoing investigation of line-of-sight propagation through a turbulent atmosphere is continued and enlarged. Generalizations of the ray calculation to include scattering contributions by off-axis blobs are given. It is found that the previous expressions for tms phase errors are substantially maintained. The dependence of these fluctuations on receiving antenna beamwidth is reduced. These techniques are then applied to estimate phase scintillation for transmission through a rainstorm. Meteorological data are used to relate such errors to rainfall intensity and to infer scintillation frequency spectra. Numerical values for these effects are given for representative atmospheric conditions. In the last article, the line-of-sight propagation of electromagnetic waves in a turbulent medium is considered. The field equation describing propagation through a region characterized by random dielectric fluctuations is first developed. Solutions of this equation which represents the scattered field are derived with ordinary perturbation theory. These solutions are next used to calculate the rms phase error for an arbitrary path in the troposphere. This approach includes both a three dimensional and near field description for the multipath, scattered amplitudes; thereby overcoming the limitations of previous treatments. The phase correlation between signals received on two parallel transmission paths is derived last to illustrate the role of overlapping antennae beams. (Met. Abs. 8J-98)--From authors' abstract.

E-345 Wheelon, A. D. (Ramo-Wooldridge Corp., Los Angeles, Calif.), Note on scatter propagation with a modified exponential correlation. Institute of Radio Engineers, N. Y., Proceedings, 43(10):1381-1383, Oct. 1955. 14 refs., numerous eqs. DLC--A phenomenological exponential space correlation of dielectric fluctuations is normally used to predict scatter field strengths beyond the horizon. This paper introduces a modified exponential model which includes effects of the smallest blob cutoff in the turbulent spectrum and rectifies the correlation's cusp at the origin. It is found that the present agreement of troposphere scatter experiments with the exponential function does not depend on this cusp. It is suggested that frequency dependent tropospheric fields recently measured below 25 cm may indicate the influence of the correlation's fine structure. The same model is then applied to the ionosphere, where the extended range VHF scatter wavelengths just straddle the smallest blob size ($\sim$3 m) in the E layer. The turbulence fine structure is most important for this propagation and gives a qualitative explanation of the curious dualism in frequency scaling laws observed at opposite ends of the VHF band. Satisfactory variation of signal strength with scattering angle is also predicted by this model. It is shown that scatter measurements can provide valuable estimates of the atmosphere's fine structure at various heights. (Met. Abs. 8.5-344)--Author's abstract.

E-346 Yamada, Ryozo, On the radio wave propagation in a stratified atmosphere. Physical Society of Japan, Journal, 10(1):71-77, Jan. 1955. Table, 6 figs., 7 refs., numerous eqs. DWB--In the present paper certain approximate methods concerning operators H of Hilbert space which can be expressed in the form $H = T * T$ are developed. Some theorems are formulated with remarks and examples. They give a method of obtaining upper and lower bounds of the value of the solution, at each preassigned point, of a boundary value problem. As a numerical example we consider the following Poisson equation $\Delta u = 1$ in D, u = 0 on C, where D denotes the square domain in the xy plane with vertices at (1, - 1), (1, 1), (-1, 1), (-1, -1) and C is the boundary of this square. Upper and lower bounds of the value of the solution u at the origin are calculated. The result of the second approximation is $0.2939 \leq u(0.0) \leq 0.2953$. In order to show that the results are applicable to many problems, several differential operators familiar in mathematical physics, for instance, Laplace's differential operators with different boundary conditions are reduced to the form $T^* T$. (Met. Abs. 8 J-120)--Author's abstract.

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E-347 Abild, B., UKW-Feldstärke als meteorologisches Element. (USW field strength as a meteorological element.) Fernmelde - Praxis, 33(1/2):25-32, Jan. 1956. (Unchecked)--From the well established functional correlation between weather and field strength is it not merely possible to derive the origin of the field strength fluctuation, but also to determine the state of the atmospheric layers from the characteristics of field strength? Field strength recordings will complement the random tests conducted by way of radiosonde ascents, thus constituting an integral of the weather in time and space, particularly distinct when fronts cross the path under measurements. Uniquely determined results of simultaneous observations over several lengths of paths are thus obtainable. Individual examples of weather analysis by means of field strength characteristics of the logs Schleswig-Hamburg and Schleswig-Hannover (117 and 242 km, 88.5 and 97.8 Mc respectively) are given. It is concluded that a network of meter waves will provide a detailed picture of humidity and other conditions in the lower layers of the atmosphere over a large region. --N. T. G.

E-348 Altman, Frederick J. (Int. Teleph. & Telegraph Corp.), Configurations for beyond-the-horizon diversity systems. Electrical Communication, N.Y., 33(2): 161-164, June 1956. 2 figs., 3 foot-refs. DLC--The recent application of the dual polarization method of exciting antennas to beyond-the-horizon systems has provided a hitherto unexplored parameter to provide many configurations as yet unused. A systematic classification and nomenclature is described, and 26 systems, including those already well known, are derived from the elementary forms shown. (Met. Abs. 14.5-127)--From author's text.

E-349 Altman, F. J. (Int. Teleph. & Telegraph Corp.), Design chart for tropospheric beyond-the-horizon propagation. Electrical Communication, N.Y., 33(2):165-167, June 1956. Fig., table.--This chart represents a summary of propagation data presently available and facilitates choice of equipment and the computation of carrier-to-noise ratio. The practical applicability of the curves is demonstrated by three sample computations tabulated. (Met. Abs. 14.7-101)--W. N.

E-350 Altman, F. J.; Gray, Richard K.; Kandoian, Armig G. and Sichak, William (all, Int. Tel. & Tel. Corp.), 900 megacycle pulse-time-modulation beyond the horizon radio link. Electrical Communication, N.Y., 33(2):143-150, June 1956. 12 figs. (incl. photos).--Some results obtained with pulse-time equipment for the study of this propagation to multi channel transmissions, are discussed. The experiments are conducted over a 2 way link, Nutley, N.J.-Southampton, Long Island, N.Y. It is concluded that pulse-time-modulation (ptm) retains its known properties when applied to trans-horizontal propagation. The ptm equipment used is described and illustrated. (Met. Abs. 14.4-126)--W. N.

E-351 Altman, F.J. and Sichak, Wm. (both, Int. Teleph. & Telegraph Corp.), Simplified diversity communication system for beyond-the-horizon links. Electrical Communication, N.Y., 33(2):151-160, June 1956. 15 figs., photo, 2 foot-refs., eqs.--The 900 Mc nonoptical path transmission experiments as conducted between Nutley, N.J. and Southampton, Long Island, N.Y., by means of frequency modulation, frequency division multiplex, and diversity reception is reported on here. Since the emphasis is on equipment economics and the analysis of diversity combining methods, the system is described in detail. (Met. Abs. 14.5-128) --W.N.

E-352 Ament, W.S., Forward and back scattering from certain rough surfaces. IRE Transactions on Antennas and Propagation, N.Y., 4(3):369-373, July 1956. 3 figs., 3 refs., 12 eqs. DLC--Heuristic relations are derived between the specular reflection coefficient, R, and the radar echoing power of rough surfaces in which induced current elements are constrained to radiate equal powers in the reflected ray's direction and back toward the radar. To the extent that currents in the surface and fields scattered by it are calculable through a self consistent formulation, a simple Fresnel zone computation of R shows that σ_0, the radar area per unit area of mean plane, is proportional to $[R^2] \sin^2 \theta$, where θ is the angle incident rays make with the mean plane. It is plausibly assumed that large scatterers on the surface cast shadows with beamwidth proportional to radar wavelength λ; here the argument leads to $\sigma_0 \propto ([R^2] \sin^2 \theta/\lambda$. In two appendices the law $\sigma_0 = 4 \sin^2 \theta$ is derived for a lossless surface obeying Lambert's law, and a known self consistent solution of a rough surface problem is examined by three generally applicable criteria.--Author's abstract.

E-353 Ames, Leon A.; Martin, Edward J. and Rogers, Thomas F., Long distance VHF - UHF tropospheric field strength and certain of their implications for radio communications. IRE, Transactions on Communications Systems, N.Y., CS-4 (1):102-103, March 1956. 2 figs. DBS--Data available from long path length measurements have been subjected to analysis and comparison. As a result, it appears that a good estimate of temporate latitude transmission loss can now be made within the 100-500 Mcps region to distances of 400 mi, and usable estimates to 600 mi.--From authors' abstract.

E-354 Barsis, A.P., Some aspects of tropospheric radio wave propagation. IRE transactions on Broadcast Transmission Systems, N.Y., PGBTS-6:1-10, Oct. 1956. 10 figs., table, 13 refs. DBS--The Tropospheric Propagation Research Section of the Radio Propagation Engineering Division, National Bureau of Standards, has conducted extensive measurements of programs in the 100-1000 Mc frequency range. A variety of transmitting and receiving antenna heights was used, and long term recordings are available over distances ranging from well within to far beyond the radio horizon. Some results of this measurement program are evaluated to provide estimates for power requirements and interference problems concerning broadcasting services in this frequency range.--Author's abstract.

E-355 Barsis, A.P. and MacGavin, R.E., Report on comparative 100 Mc measurements for three transmitting antenna heights. IRE Transactions on Antennas and Propagation, N.Y., 4(2):168-174, April 1956. 17 figs., 6 tables, 7 refs. DBS--This report evaluates measurements taken during Aug. 1952 at a frequency of 100 Mc as transmitted from three transmitting sites at elevations ranging from

6220 ft to 14, 110 ft above msl. Six receiving sites were used, ranging in distance from approximately 50 mi to 620 mi from the transmitter sites. Results are presented in terms of hourly medians of recorded field intensity and their distributions, as well as the over-all median values and deviations derived from these distributions. (Met. Abs. 8 J-121)--Authors' abstract.

E-356 Bean, B. R., Some meteorological effects on scattered radio waves. Institute of Radio Engineers, IRE Transactions on Communications Systems, N. Y., CS-4(1): 32-38, March 1956. 12 figs., 9 refs., 4 eqs. DLC--The long term variations of received scattered fields due to atmospheric effects are estimated for frequencies of 100 to 50, 000 Mc and over propagation paths of 100 to 1000 mi. The long term variations are presented in two parts: (1) empirically derived variations excluding absorption and (2) theoretically derived variations due to gaseous atmospheric absorption. The absorption effects are obtained by following a scattered radio wave through an actual atmosphere. (Met. Abs. 8 J-178)--Author's abstract.

E-357 Beard, C. I.; Katz, I. and Spetner, L. M., Phenomenological vector model of microwave reflections from the ocean. IRE Transactions on Antennas and Propagation, N. Y., 4(4):162-167, April 1956. 4 figs., 2 tables, 15 refs., eqs. DLC--The model is based on experimental data and fills a gap in the study of microwave reflection from water surfaces. --W. N.

E-358 Bolljahn, J. T. and Lucke, W. S., Some relationships between total scattered power and the scattered field in the shadow zone. IRE Transactions on Antennas and Propagation, N. Y., 4(1):69-71, Jan. 1956. Fig., 19 eqs. --Equations are derived which relate the far-zone scattered field, as measured in the shadow zone of an electromagnetic scatterer, to the total energy scattered and absorbed by the scatterer, the energy stored in the fields about the scatterer is also related to the far-zone scattered field in the shadow zone. --Authors' abstract.

E-359 Carl, Helmut (C. Lorenz A. G., Stuttgart), Range of multichannel radio links between 30 and 10, 000 megacycles. Electrical Communication, N. Y., 33(2): 168-173, June 1956. 8 figs. (incl. photo), 5 foot-refs. --This paper was published in SEG-Nachrichten, 3(4):185-187, 1955 and is the English version of the original title: "Die Grenzen der Reichweite von Richtfunkstrecken fur Vielkanalubertragung im Freguenzgebiet von 30-10, 000 MHz". It reviews the 10 yr evolution of communication from 30 to 10, 000 Mc. It is concluded that the optical and the transhorizontal will continue to supplement one another for some time. --W. N.

E-360 Carr, T. R., Tropospheric propagation study progress report for 1955: countermeasures program. U. S. Naval Air Missile Test Center, Point Mugu, Calif., Technical Memorandum Report, No. 102, July 1, 1956. 21 p. 25 p. of charts (33). 11 figs., 18 refs. Also: Carr, T. R. and Appel, John, Tropospheric propagation study progress report for 1956. Ibid., No. 106, May 1, 1957. 95 p. 95 figs. (incl. photos), 12 refs., eqs. DWB (M(055) U5842uni)--Strong refractive index gradients associated with temperature inversions along the Southern Calif. coast result in radio holes and ducts that interfere with missile tests at the Naval Air Missile Test Center (Point Mugu, Calif.). Two airborne microwave refractometers from the University of Texas were used in 1955 and 1956 to obtain refractive index profiles over the sea and these were compared with profiles calculated from radiosonde data at shore stations. Anomalous propagation data uses, terrain, meteorology of area, instrumentation, sounding procedures, methods of calculating and comments on individual soundings, plus a large number of the soundings made in Jan. 1955 - Dec. 1956 are described, illustrated or presented in graphical form in these reports. Flight paths are also shown. (Met. Abs. 12.3-102)--M. R.

E-361 Carroll, Thomas J. (M.I.T.Lincoln Lab., Lexington), Marconi's last paper "On the propagation of microwaves over considerable distances". Institute of Radio Engineers, N.Y., Proceedings, 44(8):1056-1057, Aug. 1956. DLC. Includes translation by R.M.Fans into English of the original Italian: Marconi, G., Sulla propagazione di micro-onde a notevole distanza (originally published 1933, and included in the Scritti di Guglielmo Marconi, pub. Rome 1941. --The two important last papers published by Marconi in 1932 and 1933 did not attract much attention in the scientific world, but now it is evident that the great inventor was well ahead of his time in this respect, just as he was regarding trans-Atlantic propagation of long radio waves. A translation of the 13 sentence paper, which was published in 1933, reveals that MARCONI did not believe high frequency radio waves were limited to the optical horizon, and that results of tests made from Santa Margherita Ligure and a receiver on a yacht (Elettra) along the coast of Tirreno (Aug. 2-6, 1933) at 60 cm (500 mc) indicated that good reception was to be had at 150 km, or 5 times the distance to the optical horizon. The year before (July and Aug. 1932) he had obtained poorer reception — only twice the optical distance. Signals could be detected at 258 km or 8 times the optical distance, and across high hills to boot. The author intended to publish more complete results, but his health was poor and he died soon after (1937). (Met. Abs. 8J-123)--M. R.

E-362 Chisholm, James H. (M.I.T.Lincoln Lab.), Progress of tropospheric propagation research related to communications beyond the horizon. IRE Transactions on Communications Systems, 4(1):6-16, March 1956. 14 figs., 12 refs.--The simplified presentation of theoretical models and discussion of selected experimental results given in this paper is intended to convey a general picture of tropospheric scattering. The results of experimental measurements show that reliable communications with useful bandwidths can be obtained at UHF and SHF over paths 150 to 300 mi in length, utilizing radio waves of several kw, scattered by the troposphere. Angular measurements of pulse signals indicate that the mechanism of scattering is highly directive and that multipath delays are less serious than originally anticipated. --Author's abstract.

E-363 Chu, C.M. and Churchill, S.W., Multiple scattering by randomly distributed obstacles — Methods of solution. IRE Transactions on Antennas and Propagation, N.Y., 4(2):142-148, April 1956. 2 figs., 13 refs. --Known methods are reviewed generally. Multiple scattering is considered from the Lagrangian and the Eulerian viewpoints. Solution for several geometrics by way of representing the intensity of components is shown. More accurate results than those obtained by way of the diffusion theory for anisotropic scattering are those yielded by the two-flux model developed. A six-flux model will increase accuracy but requires machine computations. --W. N.

E-364 Clara, Jose Maria (Nat'l. Telephone Co. of Spain) and Antinori, Albino (Ministry of Post Office and Telecommunications, Rome, Italy), Investigation of very-high-frequency nonoptical propagation between Sardinia and Minorca. Electrical Communication, N. Y., 33(2):133-142, June 1956. 10 figs. (incl. photo), foot-ref. --The experiments with frequencies from 238 to 297 Mc show that operational telephony is feasible in spite of the not too optimistic results discussed. On this 240 mi path only 1% or 88 hrs of the year the performance will be worse than 46 db adjusted, however, new techniques and instrumental improvement encourage further tests in process. The results are presented in graphs. --W. N.

E-365 Clarke, Robert F. (Meteorologist, Army Electronic Proving Ground, Fort Huachuca, Ariz.), The relation of physical conditions in the atmosphere to microwave propagation. (1956). 29 p. 7 figs., 6 refs., 6 eqs. DWB (M94.7 C599r)--A method of forecasting microwave trapping or superrefraction in "ducts" at low levels in the troposphere, was developed by the author at Fort Huachuca, Ariz. since assignment there in Aug. 1955. The method involves forecasting the longest wavelength that will be trapped on the following morning and this depends on forecasts of humidity, temperature, pressure and wind. In desert areas humidity varies slightly. Observational and research program, as well as equipment and theoretical basis for forecasting, is treated. No forecasts have been verified as yet, although daily forecasts have been issued since Sept. 15, 1955. (Met. Abs. 8 J-124)--M. R.

E-366 Clavier, Andre G. (Int. Teleph. & Telegraph Corp.), Microwave communication beyond the horizon. Electrical Communication, N. Y., 33(2):108-116, June 1956. 6 figs., 18 refs. --Some of the major facts contributing to reliable transhorizontal communication, including design of equipment, are discussed here. Basic attenuation curves of practical value are given and transmission levels within and beyond the horizon as a function of frequency, are presented in graphs. Fading margins in db related to wavelength from 6-300 cm are tabulated. --W. N.

E-367 Clavier, Andre G. and Altovsky, V. (both, Central Lab. of Communications, Paris), Beyond-the-horizon 3000 megacycle propagation tests in 1941. Electrical Communication, N. Y., 33(2):117-132, June 1956. 20 figs. (incl. photos), 2 foot-refs. --The series of over land-sea experiments with 10 cm waves were conducted around Toulouse, France, from May - Dec. 1941 with equipment developed during the war and described here. Two different types of propagation were encountered, viz: (1) the normal, in turbulent atmosphere resulting in steady and rapid attenuation beyond the horizon; (2) the abnormal, characterized by substantial increase of range beyond the horizon and large amplitude variations. The latter observation disagreed with propagation theory in isotropic media. --W. N.

E-368 Crain, C. M. and Williams, C. E., Microwave refractometer predicts propagation. Electronics, 29(12):150-154, Dec. 1956. 6 figs., 8 refs. --Changes in radiowave propagation at the higher frequencies have been correlated with changes in refractive index of the atmosphere. Earlier investigations depended upon meteorological data collection and evaluation. The airborne microwave refractometer directly measuring refractive index profiles has become a powerful tool in propagation studies. --Authors' abstract.

E-369 Cunningham, Robert; Plank, Vernon G. and Campen, Charles M., Cloud refractive index studies. U.S. Air Force. Cambridge Research Center, Geophysical Research Papers, No. 51, Oct. 1956. 105 p. 65 figs. (some fold., some photos), 29 refs., 5 tables. DLC, DWB--An analysis of data obtained by various methods in and around cumulus clouds is presented in detail in order to obtain a rough idea of the variations in refractive index between clouds and free air or within clouds or cloudy regions. Radiosonde data, cloud photographs, and aircraft refractometer and cloud physics measurements near Tucson, Ariz.; Ft. Banks, Mass.; Denver, Colo.; Yuma, Ariz.; Rantoul, Ill. and Mt. Clements, Mich. in June and July 1955 with a B-29 equipped with a U. of Texas model refractometer are reproduced. Soundings, cross sections, statistical graphs, cloud photos, refractive index traces, etc., are reproduced in extenso and the methods, equipment and discussion of each day's flight treated in text. More knowledge of convective cells in clouds is needed. (Met. Abs. 8J-125)--M.R.

E-370 Epstein, J. and Peterson, D. W., A method of predicting the coverage of a television station. Radio Corporation of America, Review, 17(4):571-582, Dec. 1956. 8 figs., foot-refs. DLC--A method is described for estimating television broadcast station field strength coverage for such uses as spectrum utilization studies. The method is simple enough to be applied to studies involving a large number of station locations; an estimate along an entire radial line can be prepared in a few hours. Practical confirmation of the validity of the method is shown in an example of its use. --Authors' abstract.

E-371 Fannin, Bob M., Line-of-sight wave propagation in a randomly inhomogeneous medium. IRE Transactions on Antennas and Propagation, N.Y., 4(4):661-665, Oct. 1956. 5 figs., 15 eqs.--Single scattering approximation is used in this study, embodying the statistical quantities of variance, correlation function, power spectrum, with stress on transition of ray treatment results to the scattering cross section results. The time and space dependency of the correlation function for the refractive index facilities computation of the power spectrum. --W. N.

E-372 Fok, V.A., Priblizhennaia formula dlia dal'nosti gorizonta pri nalichii sverkhrefraktsii. (Approximate formula for horizon distance in the presence of superrefraction.) Radiotekhnika i Elektronika, Moscow, 1(5):560-574, May 1956. 117 refs. DLC--A formula is derived for the range of radio wave propagation (horizon distance) in the presence of superrefraction. The formula obtained is applicable to atmospheric ducts near the ground, in which the refractive index is in a hyperbolic relationship with height. --Transl. of author's abstract.

E-373 Furutsu, Koichi, Field strength in the vicinity of the line of sight in diffraction by a spherical surface. Japan. Radio Research Laboratories, Journal, 3(11):55-76, Jan. 1956. 12 figs., eqs. DWB--The convergence of the series of the ordinary Watson formula used for diffraction by a spherical surface becomes very bad in the vicinity of the line of sight, and the formula is scarcely applicable for practical use in this domain. The problem of convergence of this kind can be solved by suitable choice of the integration path. According to this method the formula is divided into two parts, one of which has the same expression as obtained in the case of a flat earth or obtained by the method of geometrical optics or KIRCHOFF's approximation. The other part is expressed in the integral form which is rather adapted to the numerical calculation. The latter thus explicitly expresses the effect of diffraction or correction to the former. The method is applied to several cases, and the results are displayed in figures in a useful range of parameters. Some of these figures are especially convenient for calculation of field strength in diffraction by a spherical mountain or any mountain having sufficiently large radius of curvature as compared with the wave length. (Met. Abs. 8 J-126)--Author's abstract.

E-374 Gerhardt, J. R.; Crain, C. M. and Chapman, H. (all, Univ. of Texas), Microwave refractive index fluctuations associated with convective activity in the atmosphere. American Meteorological Society, Bulletin, 37(6):251-262, June 1956. 10 figs., 8 refs., eq. DWB. Also Gerhardt, J. R. and Crain, C. M., Recent measurements of tropospheric microwave refractive index fluctuations (Shorter version). Weather Radar Conference, 5th, Asbury Park, Sept. 1955, Proceedings, pub. 1956. p. 43-44. DWB--This study deals with the results of a series of refractive index measurements made while flying at various constant levels in the lower troposphere in and around Colorado and Florida. The refractometers used were sufficiently sensitive "to observe refractive index or equivalent moisture content variations having frequencies up to 100 cycles per second and amplitudes as small as 0.01 N-unit". The response, operation, installation of the refractometer and the measurement program are described and recordings of measurements under different atmospheric conditions are given. The observed pattern of refractive index variations was found to be associated with the moisture changes in air masses "in which convective heat transfer from the ground is contributing to the formation of rising warm, moist air thermals and cumulus clouds". An indirect use of the refractometer is its value in the analysis of these atmospheric processes either contributing to or producing tropospheric mixing. (Met. Abs. 8 J-127)--I. L. D.

E-375 Gerks, I. H. and Svien, A. J., Wave propagation over a 350 mi path at 960 Mc. Institute of Radio Engineers, N. Y., Convention Record, Pt. 1:3-8, 1956. 10 figs., 4 refs. DLC--The object of this paper is to present some of the propagation results observed at 960 Mc over a 350 mi path. The path on which the greater portion of the data was obtained extends from Lamar, Mo. to the Collins Engineering Building at Cedar Rapids. Some results of tests made at intermediate points are also included. (Met. Abs. 8 J-128)--From authors' abstract.

E-376 Gorelik, G. S., K teorii rasseianiia radiovoln na bluzhdaiushchikh neodnorodnostiiakh. (Theory of radio wave scattering by random inhomogeneities.) Radiotekhnika i Elektronika, Moscow, 1(6):695-703, May 1956. 5 refs., 36 eqs. --The scattering of radio waves by random inhomogeneities is considered from the point of view of turbulent diffusion theory, treating the velocities of inhomogeneities as stationary stochastic processes. A correlation is established between the time correlation function of the scattered field and some statistical characteristics of random motions of inhomogeneities. --Transl. of author's abstract.

E-377 Gossard, E. E., Gravity waves in the lower troposphere over Southern California. U.S. Navy Electronics Laboratory, San Diego Research and Development Report; NEL/Report, No. 709, Aug. 9, 1956. 47 p. 30 figs., 2 tables, 20 refs., 26 eqs. DWB--Micro-oscillations of pressure of 5 to 20 min in the atmosphere at sea level (sometimes associated with sea surface fluctuations called Tsunamis), are often noted at the meteorological station at Scripps Institute at La Jolla.

These may affect the refractive index and radio propagation. The detailed analyses of Pibal, radiosonde data and surface wind, pressure, solar radiation, temperature, etc., show that the oscillations are internal gravity waves associated with temperature inversion surfaces. The waves can sometimes be seen and photographed (examples included) and may affect several stations, thus showing contiguity over an expanse of 100 mi. The correspondence of the oscillations in wind direction, speed and pressure are illustrated by a number of automatic traces superimposed on the same time scale. The regular short duration oscillations are never associated with storms, but usually with a "Santa Ana" situation. Erratic, long duration oscillations are often associated with cyclones or fronts. (Met. Abs. 11.2-179)--M.R.

E-378 Gossard, E.E. and Anderson, L.J., The effect of superrefractive layers on 50-5000 Mc nonoptical fields. U.S. Navy Electronics Laboratory, San Diego, Calif., Research Report, No. 684, April 3, 1956. p.175-178. 8 figs., 4 refs. DWB. Also issued in IRE Transactions on Antennas and Propagation, N.Y., 4(2):175-178, April 1956. DBS--Radio propagation data taken over 82 naut. mi of water between San Diego and San Pedro, Calif. on 52, 100, 547 and 5000 Mc are analyzed and compared with the atmospheric structure. Attenuation coefficients calculated from the Furry model agree quite well with observational results at 100 Mc but not for lower or higher frequencies. Conclusion is that for a given height of the top of the superrefractive layer there is an optimum frequency for which attenuation is a minimum. (Met. Abs. 8J-129)--M.R.

E-379 Grønlund, M. and Lund, C.O., An electronic computer for statistical analysis of radio propagation data. Akademiet for de Tekniske Videnskaber, Copenhagen, Mikrobölgelaboratoriet, (Report) P 1992, Sept. 13, 1956. --The equipment in use at the laboratory is described in some detail along with future improvements. Pen recordings of the field strength are transferred into a five digit binary code (by a manually operated curve converter) and stored as perforated punched teletype tape, from which the statistical analysis is made by electronic equipment permitting reading of data at 1000 numbers per sec. Distribution curves, single set as well as for a diversity system, are handled. (Met. Abs. 8J-130)--From authors' abstract.

E-380 Grosskopf, J., Uber den augenblicklichen Stand der Forschung auf dem Gebiet der troposphärischen Streustrahlung, Teil 1. (Present state of research on tropospheric scatter propagation, Pt. 1.) NTZ: Nachrichtentechnische Zeitschrift, Brunswick, 9(6):272-279, June 1956. Pt. 2, Ibid., 9(7):315-329, July 1956. 49 figs., 25 refs., 69 eqs. DLC--The purpose of this paper is to summarize current outstanding contributions, particularly the American works in the October 1956 issue of the Institute of Radio Engineers, Proceedings. --W. N.

E-381 Grosskopf, J. and Vogt, K., Der Einfluss von Bodeninhomogenitäten auf die Funkbeschickung. (The influence of surface inhomogeneity on radio coverage.) NTZ: Nachriochtentechnische Zeitschrift, Brunswick, 9(8):349-355, Aug. 1956. 13 figs., table, 6 refs. DLC--The surface properties of a site of radio receiver and transmission installations may affect the efficiency and the radiative distribution of the antennas and cause bearing errors of direction finding stations. Comparative measurements conducted within the circumference of a direction finder station of conductivity and of bearing errors yielded a linear relation between the maximum conductivity variation δ max/ δ min and the mean bearing error δ(δmax/ δmin = 4 yields $\delta = 1^{o}$). Exterior reflectors, such as cables and power lines, showed bearing errors of 0.5°, 10°, and 20°, caused by (1) an uncharged cable ending right below the station, (2) charged with counter balance, and (3) a traversing cable respectively. Discontinuity points of conductivity yielded a maximum of 2°. However, determination of the azimuthal distribution of conductivity measurements is only feasible under simple surface conditions. --G.T.

E-382 Hirao, Kunio, Fading of the ultra short wave and its relation to the meteorological conditions. Japan. Radio Research Laboratories, Tokyo, Journal, 3(13):191-255, July 1956. 47 figs., table, 33 refs. DBS--Data on 65.82 Mc wave reception at various localities (transmitted from Hiraiso Observatory) are compared with meteorological data (temperature and wind fluctuations, refractive index, etc.) by means of autocorrelation analysis. The techniques used, including the meteorological equipment at Tateno Aerological Observatory, and the statistical method are described in detail. Fading is found to be composed of three parts due to scintillation, scatter and interference between the diffracted and reflected wave, respectively. The period of scintillation fading is nearly equal to the duration of refractive index irregularity or its turbulence; scatter fading is inversely proportional to turbulent velocity. A complete schematic model of fading is worked out and applied to a number of different propagation conditions. --G.T.

E-383 Hooper, A.H., Abnormal VHF propagation: determination of radio refractive index structures from weather data. Wireless World, London, 62(6):295-298, June 1956. 3 figs., 3 tables. DLC--V.H.F. propagation is related to vertical structure of radio refractive index. A method is given of plotting this variation with height up to 8000 ft from pressure and "refraction temperature" T_r based on observed temperature and humidity. A graph of T_r against air temperature and dew point, and instructions for preparing and using a plotting chart, are given. (Met. Abs. 8.4-83)--C.E.P.B.

E-384 Hooper, A.H. and Taylor, A.P., Radio refraction in the free atmosphere. Great Britain. Meteorological Research Committee, M.R.Papers, 1021, Dec. 31, 1956. 6 p. 2 figs., 4 tables, ref., 5 eqs. Mimeo. DWB--The theory of refraction, and the refractive index structure of the atmosphere, are set out. The refraction correction of radar heights is calculated for I.C.A.N. moist atmosphere. Further corrections are considered for I.C.A.N. dry atmosphere, and for low level European and sub-tropical moisture discontinuities. (Met. Abs. 8J-131)--C.E.P.B.

E-385 Hopkins, R.U.F.; Smyth, J.B. and Trolese, L.G., The effect of superrefraction on the high altitude coverage of ground based radar. U.S. Navy Electronics Laboratory, San Diego, Calif., NEL Report 741, Dec. 12, 1956. 19 p. 12 figs. (incl. photos), 11 refs. DWB (MO55 U585r, No. 741)--The effects of a standard atmosphere and of ducts and elevated layers on propagation (reflection, refraction and ducts) of 218, 418 and 1089 Mc coverage at distances up to 150 mi and heights up to 60,000 ft are discussed, and nomograms are presented showing characteristics of propagation. The details of the experimental procedures used to test the effects of index of refraction anomalies on high angle propagation, using high flying jet planes, between Jan. 1953 and June 1955 over the Pacific Ocean west of Los Angeles, are set forth. It was found that both by theoretical and experimental means, the distribution of field strength at angles 1° above the horizon is not appreciably affected by inversions or other atmospheric inhomogeneities at 218, 418 or 1089 Mc. A series of diagrams show index of refracting profiles and variations of field strength with distance for vertically and for horizontally polarized radiation at frequencies of 218, 418 and 1089 Mc for distances up to 300 mi for altitudes of 28,000-39,000 ft. The presence of strong temperature inversions or ducts at low altitude results in loss of energy in region from the horizon to 1° or so above the horizon. Normally there are large "lobes" of field strength intensity but these may be broken up into fine "spikes" if low altitude index of refraction changes are large. (Met. Abs. 8J-132)--M.R.

E-386 Iakovlev, O.I., Uchet vysot antenn v teorii troposfernogo rasseianiia metrovykh radiovoln. (Taking antenna height into account in the theory of tropospheric scattering of meter waves.) Radiotekhnika i Elektronika, Moscow, 1(3):309-312, 1956. 3 figs., 3 refs., 12 eqs. DLC. English translation available from Morris D. Friedman, Inc., Needham Heights, Mass., as their MDF I-112. --The dependence of field strength well beyond the horizon on antenna height is investigated on the basis of tropospheric scatter propagation theory. It is shown that interference in the region of scattering has to be taken into account in calculating the scatter field. By accounting for interference between the direct waves and those reflected from the ground it is possible to determine the dependence of the received signal intensity on antenna height. (Met. Abs. 8J-179)--Transl. of author's abstract.

E-387 Jones, D.E., A critique of the variational method in scattering problems. IRE Transactions on Antennas and Propagation, N.Y., 4(3):297-301, July 1956. 6 refs., 24 eqs. --The equivalence of the variational method and Galerkin's method is presented. The reciprocity theorem is complied with in terms of it, rather than introducing the variational principle. --W.N.

E-388 Kalinin, A.I., Dal'nee rasprostranenie ul'trakorotkikh voln za schet rasseianiia v troposfere. (Distant propagation of US waves by means of tropospheric scatter.) Elektrosviaz', Moscow, No. 5:37-44, May 1956. 11 figs., 7 refs., 4 eqs. DLC--Foreign (non-Russian) literature on tropospheric scatter propagation of ultrashort waves over great distances is reviewed. --Transl. of author's abstract.

E-389 Kamen, Ira and Doundoulakis, George (both, General Bronze Corp., Electronic Div., N.Y.), Scatter propagation, theory and practice. Indianapolis, Howard W. Sams & Co., Oct. 1956. 197 p. 141 figs. (incl. tables), eqs. DLC--This book, written by design engineers, deals with design problems of tropospheric equipment. The general theory on scatter propagation of radio waves is given and discussed in relation to the ionosphere and troposphere. Several meteorological aspects influencing reliability, range and maintenance of tropospheric equipment for transhorizontal, local and/or worldwide radio communication are discussed. Tabulated and graphical presentation, as well as excellent photographs, enhance the value of the work. (Met. Abs. 8J-133)--W.N.

E-390 Kirby, R.S. and Capps, F.M. (both, U.S. Nat'l. Bureau of Standards, Central Radio Prop. Lab., Boulder, Colo.), Correlation in VHF propagation over irregular terrain. IRE Transactions on Antennas and Propagation, N.Y., 4(1):77-85, Jan. 1956. 10 figs., 6 refs. DBS--A study has been made of the correlation in transmission loss observed over irregular terrain paths. Simultaneous mobile measurements were made of two pairs of VHF broadcasting stations in the Wash., D.C. - Baltimore, Md. area. The correlations coefficients derived from sample sets of transmission loss data indicate that when reception is from opposite directions, no significant correlation is evident, and when the paths of propagation are the same, even though the frequencies are separated considerably, the correlation appears to be significantly high. (Met. Abs. 8J-134)--Authors' abstract.

E-391 Kirby, R.S.; Dougherty, H.T. and McQuate, P.L., VHF propagation measurements in the Rocky Mountain region. IRE Transactions on Vehicular Communications, N.Y., Vol.PGUC 6:13-19, July 1956. 6 figs., 5 refs. NBS--Mobile measurements of VHF propagation over various irregular terrain paths have been made by the National Bureau of Standards in the Colorado Rocky Mountain region in an effort to evaluate terrain effects upon broadcast and point-to-point communications at very high frequencies. Mobile measurements of the varying path transmission loss were obtained in a continuous manner, while driving along selected routes with a mobile field strength recording unit, which consists of a modified house trailer equipped with a telescoping mast and pulled by a pick-up truck. The paths used ranged from relatively smooth to very rough. The results of the measurements are considered in the light of current irregular terrain theory. The correlation of sector median transmission loss for different frequencies over irregular terrain tends to be high when the paths are nearly the same, becoming significantly less when the paths diverge. This would indicate that the frequency selectivity of an irregular terrain path is small. --Authors' abstract.

E-392 Klinker, L., Fernempfangsbeobachtungen im 3-m Rundfunkband. (Observations of distant reception at 3 m wavelength.) Hochfrequenztechnik und Elektroakustik, Leipzig, 65(3):77-86, Nov. 1956. 16 figs., 2 tables, 20 refs. DLC--A study of several years of ultrashort wave (3 m) propagation data supports the validity of the CCIR curves as far as the Central European area is concerned. The long distance field fluctuations are found to be closely related to weather conditions. --Transl. of author's abstract.

E-393 Klinker, L. (Kuhlungsborn Met. Obs., East Germany), Meteorologiai befolyasok a rovid periodusu elhalkulasok kialakulasara az ultrarovid hullamu tavolsagi forgalomban. (Meteorological influences on the production of fadings of short duration in VHF long distance communication.) Időjaras, Budapest, 60(4):212-221, July/Aug. 1956. 7 figs., 12 refs. Russian and English summaries p. 212. German version p. V-X. DLC--By observations of wave propagation made during special synoptic situations, the author has been led to the assumption that two peculiar types of VHF fadings are produced by atmospheric dispersion and by partial reflections on free inversion surfaces. (Met. Abs. 8J-135)--Author's abstract.

E-394 Krasil'nikov, V.A. and Obukhov, A.M., Propagation of waves in a medium with random inhomogeneities of the index of refraction (Survey). Soviet Physics: Acoustics, N.Y., 2(2):103-110, 1956. 2 figs., 23 refs., 26 eqs. Transl. of original Russian in Akusticheskii Zhurnal, Moscow, 1956. DLC--The survey is devoted to the problem of "waves and fluctuations" which in recent years has been developed in connection with a number of problems of atmospheric acoustics, hydroacoustics, atmospheric optics and the propagation of radio waves in the troposphere. More particularly, the authors discuss the study of phenomena arising during the propagation of waves in a medium with weak random inhomogeneities caused by turbulence. The authors have written a number of papers on this subject; certain results of these papers are briefly discussed along with the results of a number of other authors (mostly Russian). (Met. Abs. 10G-81)--From authors' abstract.

E-395 Lucy, R.E. and Sharp, C.E., Radar-type propagation survey experiments for communication systems. Institute of Radio Engineers, N.Y., Convention Record, Pt. 1:20-27, 1956. 9 figs. DLC--A technique for conducting rapid UHF and microwave propagation surveys is described. Experiments have been made using the terrain backscatter patterns of a radar PPI scope. The results are discussed and illustrated with photographs. (Met. Abs. 8J-136)--From authors' abstract.

E-396 Maenhout, A., Gunstige voortplantingsvoorwaarden voor zeer korte golven. (Favorable propagation conditions for very short waves.) Hemel en Dampkring, The Hague, 54(2):40-41, Feb. 1956. Fig. DWB, DLC--The propagation of very short wave radiation as a function of atmospheric refraction which is influenced by atmospheric conditions is outlined and the unusually favorable propagation of very short waves on Jan. 6, 1956 is explained by the magnitude of the refractive index at Uccle which increased the propagation of the 3 m band by 32%. (Met. Abs. 8J-137)--I.L.D.

E-397 Millman, George H. (General Electric Co., Syracuse, N.Y.), Analysis of tropospheric, ionospheric and extraterrestrial effects on VHF and UHF propagation. General Electric Co. Electronics Div., Technical Information Series, R56EMH31, Oct. 6, 1956. 138 p. 68 figs., tables, 50 refs., numerous eqs. Photostat copy. DWB (M94.7 M655an)--Effects of the atmosphere and extraterrestrial noise sources on the propagation of VHF and UHF radio waves are discussed. Relationships are derived for calculating refraction effects, time delays, Doppler errors, polarization changes and attenuation of radio waves traversing the atmosphere. These conclusions were reached. Refraction and time delay effects in the troposphere are independent of frequency and are a direct function of relative humidity in the air. In the ionosphere refraction and time delay errors, polarization shift and attenuation are inversely proportional to the square of frequency. The Doppler frequency error in the troposphere is directly proportional to frequency while in the ionosphere is inversely proportional to frequency. The theoretical total radiation from the quiet sun, in the radio frequency spectrum, is directly proportional to frequency raised to about the 0.755 power. The total flux density emanating from radio stars, Cassiopea and Cygnus, is inversely proportional to the frequency raised to the 0.81 power. (Met. Abs. 11E-99)--Author's abstract.

E-398 Misenheimer, Harvey N., "Over-the-horizon" radio tests. Telephony, 151(5): 22-24, 38, Aug. 4, 1956. 7 figs.--This is an account of a full year, 1953-54, investigations conducted in Newfoundland over land-sea paths under different weather and transmission conditions, at frequencies of 505 and 4090 Mc. The results are presented graphically and include the influence of weather, snow and fog on transmission.--W.N.

E-399 Misme, P., Methode de mesure thermodynamique de l'indice de refraction de l'air. Déscription de la radiosonde MD1. (Thermodynamic method of atmospheric refractive index measurements. Déscription of the MD1 radiosonde.) Annales des Telecommunications, Paris, 11(4):81-84, April 1956. 6 figs.--A radiosonde is described, which measures temperature, pressure and humidity, from which refractive index values can then be calculated. The instrument is described and shown in detailed diagrams. A sample sounding record is presented; it shows that refractive index variation with height shows a pattern similar to that of the humidity variation. This fact would have gone unnoticed if the refractive index had been determined with a radio method. Thus the thermodynamic method of refractive index determination is better suited for relating propagation anomalies to meteorological phenomena.--G.T.

E-400 Moler, W.F. and Arvola, W.A., Vertical motion in the atmosphere and its effect on VHF radio signal strength. American Geophysical Union, Transactions, 37(4): 399-409, Aug. 1956. 10 figs., 5 refs., 6 eqs. DWB, DLC--The hypothesis is proposed that the vertical gradient of the refractive index is strongly affected by the vertical motion in the atmosphere. It is shown that changes in this gradient are due principally to changes in the moisture stratification and temperature lapse rate resulting from the vertical velocity and its horizontal gradient within the air mass. Mean radio signal strengths are plotted against the time position of 500 mb troughs and ridges relative to the radio link. A series of 500 mb charts is given, with the vertical velocity field obtained by the Sawyer-Bushby method. The vertical velocity over two radio links is compared with the signal strength. Cross sections taken through several of the troughs illustrate the stratification changes on the forward and rear sides of the troughs due to vertical motion. (Met. Abs. 8.4-247)--Authors' abstract.

E-401 Morrow, W.E., Jr.; Mack, C.L., Jr.; Nichols, B.E. and Leonhard J., Single-sideband techniques in UHF long range communications. Institute of Radio Engineers, N.Y., Proceedings, 44(12):1854-1873, Dec. 1956. 31 figs., 5 tables, 25 refs., 9 eqs.--Several factors relevant to the design of UHF long range communication systems are analyzed. In particular, single sideband amplitude modulation is evaluated and compared to frequency modulation, with special regard to a) spectrum conservation; b) performance in the presence of multipath; and c) realized channel signal to noise ratio vs total transmitted rf power. It is shown that 1) SSB requires one sixth to one tenth of the spectrum width required by fm, 2) the useful bandwidth of the transmission medium in the presence of multipath is at least four times as great for SSB as for fm, 3) the average power required for a 24 channel SSB system is about 20 decibels less than that required for an equivalent fm system, providing equal usable communications. System design considerations are discussed for UHF single sideband, as well as the design parameters of a particular set of equipment operating in the 300 to 400 megacycle band. The linearity of high power klystrons is discussed and a promising technique for achieving highly efficient operation of such devices is described. --Authors' abstract.

E-402 Moyer, Vance E., Preliminary synoptic analyses of the atmospheric refractive index climatology of Alaska and the Western United States coastal waters. Weather Radar Conference, 5th, Asbury Park, N.J., Sept. 1955, Proceedings, pub. 1956. p.45-61. 12 figs. DWB--The synoptic climatological approach is used in the study of the microwave refractive index conditions in Alaska, the Aleutians and Northwest Canada. Radiosonde data from a fairly dense network of stations are used to obtain daily maps showing the regional distribution of the vertical gradient of refractive index (1000 - 850 mb) and of the absolute value of this parameter at 850 mb. A few of the maps for Sept. 1953 which were prepared in this study are reproduced and discussed. Another study of the horizontal and vertical variations of the low level refractive index profiles off the California coast was made on the basis of airborne refractometer measurements made between Aug. 4 and Oct. 29, 1954. (Met. Abs. 8J-138)--M.R.

E-403 Norton, Kenneth A., Point-to-point radio relaying via the scatter mode of tropospheric propagation. Institute of Radio Engineers. IRE Transactions on Communications Systems, N.Y., 4(1):39-49, March 1956. 7 figs., table, 32 refs., 29 eqs. DLC--Formulas are given for determining the transmitter power required to provide a specified grade of service in point-to-point radio relaying of the following types of signals: television, frequency modulation high fidelity music, frequency modulation voice, frequency shift telegraph, and a just measurable signal. Allowance is made for the antenna gains, the carrier frequency, the system bandwidth, distance, the antenna heights above the ground and the effects of the terrain and the atmosphere along the transmission path. The formula for the transmission loss allows separately for the effects of the actual distance, the angular distance and the antenna heights, and this separation of the influence of these variables provides the basis for the development of rules for the efficient siting of the terminals of a tropospheric forward scatter relay circuit. (Met. Abs. 8J-180)--Author's abstract.

E-404 Plank, Vernon G., A meteorological study of radar angels. U.S. Air Force. Cambridge Research Center, Geophysical Research Papers, No. 52, July 1956. 117 p. 29 figs., 4 tables, 113 refs., 24 eqs. DWB, DLC--Three different types of angels are recognized: 1) layer angels; 2) localized source angels, and 3) erratic angels. Their nature, size, meteorological conditions favoring each type, other sources (insects and birds or dust), refractive index inhomogeneities, the history of angels of each type, and a thorough bibliography are presented in this monograph. A tremendous amount of theoretical, graphical and tabular data are analyzed and incorporated in the text. Work is based on radar soundings at Round Hill, Mass. in 1951-53 and on work of others in this field. Of all the possible sources, refractive index inhomogeneities are found to be the most common. Activity is the greatest with high temperature, moisture content and light winds, and with pronounced convective activity. (Met. Abs. 8J-141)--M. R.

E-405 Poeverlein, H., Eine einfache Theorie der Beugung von Radiowellen jenseits des optischen Horizonts. (A simple theory of radiowave diffraction beyond the horizon.) Zeitschrift fur Angewandte Physik, 8(2):90-95, 1956. Transl. into English (15 p.) issued by U.S. Air Force Cambridge Research Center, as its AFCR-TR-116, Sept. 1957. (ASTIA Document, No. AD 1337 II). 2 figs., 3 tables, 15 refs., 9 eqs.--Repeated application of Huygen's principle leads to a field strength formula for waves diffracted around the curved earth which is identical with the approximation of the Van der Pol-Bremmer theory. The ground constants enter through the consideration of the reflected waves, especially the reflected Huygens elementary waves. The influence of the ground can be expressed by a parameter which appears in the properly written Fresnel reflection coefficient of the ground. In order to have the diffraction theory valid, certain assumptions have to be fulfilled. Irregular inclination of the earth's surface of inhomogeneities of the atmosphere can make the theory more or less useless for the shorter wavelengths.--Author's abstract.

E-406 Poeverlein, H., Grosse Reichweiten von m-, dm- und cm-Wellen. (Long ranges of VHF, UHF, and SHF.) Zeitschrift für Angewandte Physik, 8(5):244-254, 1956. Transl. into English (30 p.) issued by U.S. Air Force Cambridge Research Center, as its AFCR-TR-57-117, Sept. 1957. (ASTIA Document, No. AD 133712). 8 figs., table, 63 refs., 24 eqs.--This paper was dedicated to Geheimrat Zenneck on his 85th birthday. The main topics discussed are the diffraction around the earth and the refraction in the troposphere as causative agents for reception just beyond the horizon and its irregularities, typical for waves shorter than 10 m. It is shown that the scattering cross section depends mainly on the vertical extension of the scattering centers. The integration would remain unchanged by horizontal extension, however, increase the field strength at reception point in direction of specular reflection, otherwise decrease.--N. T. G.

E-407 Potts, D.H.; Rempel, R.W. and Goss, R.N., A summary of the symposium on normal mode theory, July 5-7, 1955. U.S. Navy Electronics Laboratory, San Diego, Research Report; NEL Report, No. 718, Oct. 9, 1956. 26 p. 8 figs., 13 refs., eqs. DWB--The symposium, held at the Navy Electronics Laboratory, San Diego, Calif., on July 5, 6 and 7, 1955, under the chairmanship of S.A. SCHELKUNOFF of Bell Telephone Laboratories, and jointly sponsored by the Office of Naval Research, Navy Engineering Laboratory, and Ryan Aeronautical Company, consisted of a round table discussion of theoretical knowledge of wave propagation through stratified media, methods of solution of problems, and outstanding problems yet to be solved. No formal papers were presented. The subjects discussed were ray theory, Huygens' principle, normal modes, Sommerfield surface wave, and propagation beyond the horizon. Appended is a paper by FRIEDMAN on Normal modes in tropospheric propagation. (Met. Abs. 8 J-142)--Partly from summary and M.R.

E-408 Pressey, B.G.; Ashwell, G.E. and Fowler, C.S., Change of phase with distance of a low frequency ground wave propagated across a coast line. Institution of Electrical Engineers, London, Proceedings, Pt. B, 103(10):527-534, July 1956. 14 figs., 4 refs. DLC--Observations of the change of phase with distance have been made on frequency of 127.5 kc/s along a number of path radiating from a transmitter near Lewes and crossing the south coast between Pevensey and Littlehampton. The nature of the ground adjacent to the coast, the angle of crossing the coast line and the length of the land and sea sections covered varied from path to path; the greatest distance covered out to sea was 22 km. Measurements were also made over path at right angles to the radials, and phase changes in the area off Worthing, where the path was tangential to the coast, were examined in detail. The results confirm the existence of a phase recovery effect which, as theoretical considerations have shown, should be experienced by a wave passing from low conductivity ground to sea water and which was indicated by previous measurements over geological boundaries on land. The detail of the measurements at sea shows also that, in addition to this general behavior of the phase, there are superimposed systematic variations whose magnitudes decay from about 4^o of phase near the coast to a negligible amount at 6λ out to sea and on some paths are comparable to the recovery. A very marked phase disturbance within $\lambda/2$ of the coast on the landward side is also evident; it is similar to that previously observed over geological boundaries on land. --Authors' abstract.

E-409 Rivet, Pierre, Essais de diversité et étude de l'effet de focalisation sur des liaisons longues en visibilite. (Diversity experiments and study of the effect of focusing on communication over long optical paths.) L'Onde Electrique, Paris, 36(346):23-31, Jan. 1956. 6 figs., 2 tables. DBS--Results of propagation experiments over a 230 km overwater path (Mt. Agel, France, elev. 1140 m, La Punta, Corsica, elev. 750 m) are reported. The experiments involved simultaneous use of diversity in height and frequency. It is found that the multiple path hypothesis cannot account for the field variations observed. --G.T.

E-410 Saxton, J.A., Tropospheric scatter propagation. Wireless World, London, 62(12):587-590, Dec. 1956. 2 figs. DLC--Latest theories concerning the possibilities of extending communication beyond the horizon by means of microwaves are reviewed. It has been found that links operating on the scatter principle are capable of carrying wide banded information and are suitable for relaying multichannel telephony over paths of a few hundred miles. The reliable transmission of television signals will follow probably as the technique develops, though, in view of the bandwidth required, the length of a link for this purpose will generally be less than is possible for telephony and telegraphy. --E.K.

E-411 Saxton, J. A. and Harden, B. N., Polarization discrimination in VHF reception. Institution of Electrical Engineers, London, Proceedings, Pt. B, 103(12):757-760, Nov. 1956. 5 figs., table, foot-ref. DLC--An account is given of measurements in the band 40-200 Mc/s of the discrimination likely to be achievable between common frequency transmissions by the use of orthogonal polarizations. It is shown that the discrimination is determined primarily by the topographical nature of the receiving site, that it is substantially independent of distance from the transmitter and of frequency in the band under consideration, and that the median value is about 18 db. The perturbing effects of pick up on the feeder and of receiving aerial misalignment are discussed. --Authors' abstract.

E-412 Schachenmeier, Richard, Einige Forschungsarbeiten uber die Ausbreitung ultrakurzer Wellen. (Investigations on the propagation of ultra short waves.) Akademie der Wissenschaften, Berlin, Wissenschaftliche Annalen, 5(7):589-603, July 1956. 10 figs., 10 refs., 8 foot-refs., 14 eqs. DWB, DLC--The author reviews several investigations in which it was attempted to measure and calculate the tropospheric conditions influencing the reception intensity of ultrashort radiation in the case of relatively short distances and low antennae heights. (Met. Abs. 8J-143)--I. L. D.

E-413 Schensted, C. E., Approximate method for scattering problems. IRE Transactions on Antennas and Propagation, N. Y., 4(3):240-242, July 1956. 3 figs., 16 eqs.--Two examples of the method are given, viz: scattering by (1) a half-plane and (2) by a circular disk. The solution of satisfying certain boundary conditions, which was the purpose, is given. --W. N.

E-414 Schmelovsky, Karl-Heinz, Partielle Reflektionen in schwachen troposphärischen Wellenleitern. (Partial reflections in weak tropospheric wave-ducts.) Zeitschrift für Meteorologie, 10(8):239-243, Aug. 1956. 2 figs., 6 refs., 8 eqs. DLC--This work describes an approximation process for obtaining the propagation constants in weak ducts. A diagram collects the results for some special height relations of the modified refraction index. (Met. Abs. 8.4-343)--Transl. of author's abstract.

E-415 Shabel'nikov, A. V., Vliianiia vida funktsii raspredeleniia dielektricheskoĭ pronitsaemosti vozdukha s vysotoĭ na refraktsiiu radiovoln v nizhnikh sloiakh atmosfery. (Influence of the form of the vertical distribution function for dielectric permeability of the air on the refraction of radio waves in the lower layers of the atmosphere.) Radiotekhnika i Elektronika, Moscow, 1(3):277-280, 1956. Fig., 5 refs., 13 eqs. DLC--The dependence of the angle of refraction on the vertical distribution of atmospheric dielectric permeability is analyzed theoretically by means of a method of variation calculation. It is shown that no such dependence exists at zenith angles comprised between 0° and 80°. (Met. Abs. 8J-181) --Transl. of author's abstract.

E-416 Silverman, Richard A. (Inst. of Math. Sciences, N. Y. Univ.), Turbulent mixing theory applied to radio scattering. Journal of Applied Physics, 27(7):699-705, July 1956. 2 tables, 18 refs., eqs. DLC--OBUKHOFF's statistical theory of turbulent mixing is proposed as a replacement for the heuristic theories of GALLET and VILLARS-WEISSKOPF, and is applied to the problem of the scattering of radio waves by refractive index fluctuations. In the case of ionospheric scattering, order of magnitude agreement with the observed scattered power is obtained if the refractive index fluctuations are attributed to electron density fluctuations produced by turbulent mixing in the lower edge of the E layer. In the case of tropospheric scattering, it appears that order-of-magnitude agreement with the observed scattered power can be obtained, except during the summer months, by attributing the refractive index fluctuations to temperature fluctuations. During the summer months and at low scattering heights, humidity and its fluctuations are expected to play a prominent role. Experimental and theoretical evidence is cited in favor of perennial fractional degree temperature fluctuations in the troposphere. A comparison of the Obukhoff, Villars-Weisskopf, and Booker-Gordon models is given, and it is found that the Obukhoff model predicts the most scattered power. (Met. Abs. 8J-144)--Author's abstract.

E-417 Staras, Harold, Scattering of electromagnetic energy in randomly inhomogeneous atmosphere. Journal of Applied Physics, 23(10):1152-1156, Oct. 1956. 15 eqs. DLC--It is demonstrated that the integral expressions as used by PEKERIS, BOOKER and GORDON are not appropriate to use as a space correlation function of refractive index. Here is introduced a time correlation instead which permits direct measurement of.the time correlation function and formal evaluation of the time average scattered power, which is shown to depend but little on any particular model of turbulence. However, in its large scale turbulence condition it is affected greatly by the time correlation chosen or by the assumption that scattering is a result of randomly located spheres. (Met. Abs. 8J-145)--From author's abstract.

E-418 Starkey, B. J., Some aircraft measurements of beyond-the-horizon propagation phenomena at 91.3 Mc/s. Farnborough, England. Royal Aircraft Establishment, Technical Note, No: RAD. 638, March 1956. 4 p. 4 figs., 7 refs. Mimeo. GB-MO. Also in: Institution of Electrical Engineers, Proceedings, Pt. B, 103(12): 761-763, Nov. 1956. 4 figs., 8 refs., eq. DLC--Field strength measurements on an aircraft at 10,000 ft 150-430 mi from source (Wrotham) showed an initial decrease slower than expected from diffraction theory, maxima at about 250 and 300 mi, deep and regular fades beyond 350 mi and a rapid drop to noise level at 420 mi. Horizon was about 175 mi. The extended range is attributed to specular reflection from a tropopause discontinuity of refractive index at 38,000 ft shown by radiosonde at Lerwick. The fluctuations are explained by interference between various rays. (Met. Abs. 8.1-396)--C.E.P.B.

E-419 Straiton, A. W. and Tolbert, C. W., Measurement and analysis of instantaneous radio height gain curves at 8.6 millimeters over rough surfaces. IRE Transactions on Antennas and Propagation, N.Y., 4(3):346-351, July 1956. 13 figs., 4 refs. --The data analyzed and discussed were taken on a radio path over Lake Austin, Nov. 1954, A specific antenna system was constructed for obtaining proportional height gain curves in a very short time interval. The vector sum of the direct, a constant reflected, and a varying reflected wave may represent the fluctuation of the radio signal measured. --W. N.

E-420 Suzuki, Michiya and Hasegawa, Taro (both, Yamagata Univ. Faculty of Engineering), Vertical distribution of radio meteorological M-curve for near the snow covered terrain. Seppyo (Snow and Ice), Tokyo, 18(2):48-55, Aug. 1956. 8 figs., 7 refs. In Japanese; English summary p. 48. DWB--The variation of the equivalent reflection coefficient (Pe) is one of the most important factors which determine the properties of K Type Fading at microwave propagation over snow covered terrain.

And Pe's physical meaning is somewhat complicated by the reason that it contains many factors (surface deposited snow's dielectric properties, radio meteorology, etc.). So we observed Pe's daily variation at the model propagation test (at very short distance 100 m, 4000 Mc/s) and annexed the radio meteorological condition's measurements. This paper shows the method of this experiment and the analytic results on the radio meteorological M curve (M profile lies on the very low layer near upon the model test's reflection point). The vertical profiles of measured atmospheric temperature and M curve are represented in Fig. 4 and Δ M (M - inversion) in Fig. 6, respectively. In general, the variation of Δ M is smaller than over the land and sea, especially at night time. So it is found that the dielectric properties of deposited snow at reflection surface had probably a pretty large influence on the variation of Pe. (Met. Abs. 8 J-147)--Authors' abstract.

E-421 Symposium on electromagnetic wave theory, Univ. of Michigan, June 20-25, 1955, Report of conference. IRE Transactions on Antennas and Propagation, 4(3):191-586, July 1956. --This issue is devoted entirely to the symposium and contains: boundary value problems of diffraction and scattering theory (19 papers). Forward and multiple scattering (9 papers). Antenna theory and microwave optics (10 papers). Propagation in doubly refracting media (7 papers). Summaries of the panel discussions (5 papers). Appendix: Abstracts of the contributed papers. A-1, Scattering, diffraction and general mathematical papers (17 abstracts). A-2, Multiple scattering, scattering from rough surfaces, and transmission and reflection problems (10 abstracts). A-3, Wave guides, propagation, and slow waves and surface waves (10 abstracts). A-4, Ferrities, plasma oscillations and anisotropic media (8 abstracts). A-5, Antennas and microwave optics (8 abstracts). Author index. --W. N.

E-422 Tao, Kazuhiko, Some consideration for the field strength of ultra short waves at night. Japan. Radio Research Laboratories, Journal, 3(11):77-99, Jan. 1956. 15 figs., 15 refs. DWB--This analytical study is based on two years of transmission experiments conducted at the Radio Research Laboratories of Japan. Frequencies at 150 and 60 Mc were used over the 125 km path from Kokubunjii to Hiraiso, the latter located in diffraction region. It is shown that super high field strength at night is a function of a tropospheric M layer formed by abnormal water vapor distribution and associated with temperature inversion. This formation is discussed in terms of synoptic meteorology. It is suggested that prediction of hourly median field strength of USW is greatly facilitated by these analyses. (Met. Abs. 8 J-148)--W. N.

E-423 Tatarskii, V.I., O pul'satsii amplitudy i fazy volny, rasprostraniaiushcheĭsia v slaboneodnorodnoĭ atmosfere. (The pulsations of amplitude and the phases of waves propagated in a moderately heterogeneous atmosphere.) Akademiia Nauk SSSR, Doklady, 107(2):245-248, March 11, 1956. 4 refs., 23 eqs. DLC--The problem of the propagation of waves in a medium with a moderately heterogeneous coefficient of refraction is treated theoretically and a more simple and practical solution than that of A. M. OBUKHOV is obtained. The coefficient of refraction is assumed to be $n = n_1 + 1 + (r)$, where $n_1 (r)$ is the deviation of the coefficient of refraction from the mean value (unity) and that $n_1 \leq 1$. Equations for calculating the scintillation of stars and analogous phenomena are presented. (Met. Abs. 8.9-204)--I. L. D.

E-424 Troitskii, V. N., O vozmozhnoĭ polose peredachi v sluchae dal'nego troposfernogo rasprostraneniia. (Possible transmission band for long range tropospheric propagation.) Radiotekhnika, Moscow, 11(9):3-7, Sept. 1956. 3 figs., 2 refs. DLC--This paper contains a discussion of the problem of transmission distortions in which it is assumed that the atmosphere is anisotropic and that horizontal irregularities in the dielectric constant are smaller than the vertical irregularities. Formulas are given for determining the band width for the transmission of a message without distortions. The effect of antenna directivity on a possible bandwidth is also analyzed. --R. M.

E-425 Troitskii, V. N., Otrazhenie ul'trakorotkikh voln ot sloistykh neodnorodnostei troposfery. (Ultrashort wave reflection from stratified inhomogeneities of the troposphere.) Radiotekhnika, Moscow, 11(1):7-16, Jan. 1956. English transl. issued by Special Libraries Association Translation Center as its No. R-975. 20 p. Available John Crerar Library, Chicago. DLC--A theoretical treatment of reflection of oblique incident ultrashort radio waves falling on stratified discontinuities in the troposphere and the determination of the coefficient of refraction from various forms of superrefractive layers. The basic formula used is

$$\Delta e . 10^6 = \frac{155}{+2} P - \Delta T + 4800 \frac{\Delta e}{P}$$

where P = pressure in mb, T = absolute temperature, e = absolute humidity. (Met. Abs. 8 J-149)--M. R.

E-426 Troitskii, V. N., Rasprostranenie ul'trakorotkikh voln na bol'shikh rasstoianiiakh za predelami gorizonta. (Propagation of ultrashort waves far beyond the horizon.) Radiotekhnika, Moscow, 11(5):3-20, May 1956. 13 figs., 31 refs., 32 eqs. DLC--After briefly reviewing theories of field strength in the far zone and the mechanism of tropospheric scatter, the author examines the problem of extended range propagation of ultrashort waves on the assumption that this phenomenon is due to dielectric constant irregularities which can be laminar as well as turbulent in nature. The mean value and stability of field strength of a tropospheric wave are determined. The problem of fading and distortion of waves in tropospheric scattering is briefly considered and experimental and theoretical data are compared. A supplement deals with the problem of the validity of the two-thirds law for tropospheric irregularities. The supplement also contains a survey of experimental data on irregularities in the dielectric constants obtained by different authors. --R. M.

E-427 Wait, J. R., Currents excited on a conducting surface of large radius of curvature. IRE Transactions on Microwave Theory and Techniques, N. Y., 4(3):143-145, July 1956. Fig., 5 refs., 15 eqs. DBS--The nature of the electromagnetic field of an antenna in the vicinity of a surface of large radius of curvature is discussed. Assuming a spherical surface, the solution for a dipole source in the form of the Watson residue series is transformed to a more rapidly converging series which is preferable at short distances. Using this result, numerical data is presented in graphical form for the currents induced on the spherical surface. The curves are applicable to both a stub and slot antenna mounted on the conducting surface. --Author's abstract.

E-428 Wait, J. R., Effect of the ground screen on the field radiated from a monopole. IRE Transactions on Antennas and Propagation, N. Y., 4(2):179-181, April 1956. Fig., table, foot-refs., 10 eqs. DLC--In this brief note an attempt has been made to show that quantitative results can be obtained which support the author's earlier contention that the ground screen has only a small effect on the ground wave field intensity for a special current on the antenna. (See ref. E-266) --E. K.

E-429 Wait, J. R., Mixed path ground wave propagation, Pt. 1, Short distances. U.S. National Bureau of Standards, N. Y., Journal of Research, 57(1):1-15, July 1956. 12 figs., 10 refs., 23 eqs. Also: J. R. Wait and J. Householder, Pt. 2, Large distances, Ibid., 59(1):19-26, July 1959. 9 figs., 10 refs., 16 eqs. DLC--In Pt. 1, an expression is derived for the mutual impedance between two short vertical antennas on a flat earth with a straight boundary separating two media of differing electrical constants. After making some approximations that are valid at low and medium frequencies and where the antennas are not near the boundary, the integral formula for the field is evaluated for a wide range of parameters. The numerical results computed in this paper are shown to be in reasonably good agreement with experiment. Finally, the effect of the obliqueness of the boundary is considered by a refinement of the stationary phase evaluation of the integrals. In Pt. 2, the theoretical results for ground wave propagation over a mixed path on a flat earth are generalized to a spherical earth. The problem is formulated in terms of the natural impedance between two vertical dipoles which are located on either side of the boundary separation. Extensive numerical results are given in graphical form for a mixed land-sea path at frequencies of 10, 20, 50, 100 and 200 kilocycles per sec. --Authors' abstract.

E-430 Wait, J. R., Radiation from a vertical antenna over a curved stratified ground. U.S. National Bureau of Standards, Journal of Research, 56(4):237-244, April 1956. 5 figs., 13 refs., 63 eqs. DLC--The problem of a radial electric dipole outside a concentrically stratified spherical conductor, such as the Earth, is formulated. The solution is facilitated by considering the analogous nonuniform transmission line for the radial modes. The general result is then transformed to a Watson type residue or azimuthal mode series, which reduces to the well known result for the homogeneous Earth as a special case. Following a method introduced recently by Brenner, the residue series is converted to an alternative expansion, which is more suitable at short distances. The leading term of this new expansion corresponds to the case of the transmitter and receiver over a plane stratified conducting earth. --Author's abstract.

E-431 Wait, J. R., Transient fields of a vertical dipole over a homogeneous ground. Canadian Journal of Physics, Ottawa, 34(1):27-35, Jan. 1956. 3 figs., 9 refs. DLC--Expressions are derived for the transient fields of a short vertical antenna, situated on a smooth spherical conducting earth, and energized by a current which is discontinuous in time. When the antenna current is a linear function of time, the radiation field on a flat perfectly conducting earth is of step function form. The departure from the step shape of the field is shown to be due to the finite conductivity and dielectric constant of the ground, the induction and static fields of the antenna, and curvature of the Earth. --Author's abstract.

E-432 Wait, J. R. and Howe, Herbert H., Amplitude and phase curves for ground wave propagation in the band 200 c/s to 500 kc/s. U.S. National Bureau of Standards, Circular, No. 574. 17 p. May 21, 1956. 12 figs., 2 tables, 13 refs., 11 eqs. DLC--After making several extensions to the formulas of Van der Pol and Bremmer, field strength and phase values of the very low frequency ground wave from a short vertical antenna are computed. The ground conductivity values chosen are 4, 0.01, and 0.001 mho per meter. The distances considered range from 1 to 1500 mi. --Authors' abstract.

E-433 Vysokovskii, D. M., Nekotorye osobennosti rascheta radiorefraktsii. (Some peculiarities in radio refractivity calculation.) Radiotekhnika i Elektronika, Moscow, 1(3):274-276, 1956. 3 refs., 14 eqs. DLC--Expressions of radio refraction, in the form of an integral and of a progression, and their applications to computation problems are discussed. Conditions are determined, under which refraction is independent of the form of the vertical distribution function of the index of refraction. (Met. Abs. 8 J-183)--Transl. of author's abstract.

E-434 Wheelon, A. D., Near field corrections to line-of-sight propagation. IRE Transactions on Antennas and Propagation, N.Y., 4(3):322-329, July 1956. Fig., 7 refs., 53 eqs. --This study deals with the restrictions imposed on trans-horizontal propagation by the turbulent fluctuations of the troposphere's dielectric constant. The field equation describing the propagation is developed and the subsequent solutions are then used to calculate the rms phase error for an arbitrary path in the troposphere, including dimensional descriptions for the multipath, scattered amplitudes. The phase correlation between signals on two parallel paths show the role of overlapping antenna beams. --W. N.

E-435 World Meteorological Organization, International Geophysical Year, 1957-1958, Meteorological programme: general survey. Its WMO (Publication), No. 55, IGY. 1, 1956. 111 p. forms. DWB, DLC--In a systematic review of the IGY, its purposes, programs of investigations and observations, networks, communications, codes, data collection, etc., a section is devoted to the observation program for tropospheric propagation. The resolutions made in 1952, 1954 and 1956 by ICSU Joint Commission on Radio meteorology, URSI, etc., the work to be carried out by National Committees during IGY, and other details, are outlined. The program calls for publication of radiosonde data up to 700 mb. Captive balloon observations, refractometer measurements of refractive index, humidity gradient measurements near cloud tops, study of humidity discontinuities and of diurnal, seasonal, geographic and cloud type variations in relative humidity gradient. (Met. Abs. 8 J-151)--M. R.

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E-436 Arenberg, A. G., Rasprostranenie detsimetrovkyh i santimetrovykh voln. (Propagation of decimeter and centimeter waves.) Izd-vo "Sovetskoe Radio" Moscow, 1957. 303 p. Figs., tables, eqs., bibliog. p. 293-300. DLC (TK6553. A64)--The author presents a survey of experimental and theoretical work up to 1957. A separate chapter is devoted both to tropospheric scattering and ionospheric scattering of ultrashort waves. The book contains an extensive bibliography. --R. M.

E-437 Arvola, William A. (U.S. Navy Electron. Lab., San Diego, Calif.), Refractive index profiles and associated synoptic patterns. American Meteorological Society, Bulletin, 38(4):212-220, April 1957. 12 figs., eqs. Also reprinted as U.S. Navy Electronics Laboratory, Research Report, NEL Report, No. 793, May 23, 1957. DWB--A study is made of meteorological conditions associated with synoptic patterns passing over the Middle West leading to super-refractive index profiles. The signal strength for a 71.75 Mc TV link in Illinois is related to the refractive index profiles. (Met. Abs. 8J-152)--Author's abstract.

E-438 Basu, A. (Director General of Obs., India), A brief note on the weather radar studies undertaken in the India Meteorological Department. Weather Radar Conference, 6th, Cambridge, Mass., March 26-28, 1957. p. 363-364. DWB (M01.81 R124pc)--Low power storm detection radar sets are in operation at New Delhi and Poona, and a long range set at Calcutta. Equipment is described and their present and future use outlined. Studies of cloud and squall structure during thunderstorms, cyclonic and monsoon storms and for studies of conditions of superrefraction.--M. R.

E-439 Bauer, L. H. and Flood, W. A., UHF forward scatter from lightning strokes. Institute of Radio Engineers, N.Y., Proceedings, 45(12):1743, Dec. 1957. Fig., 3 refs.--Sample recordings of "spikes" rising from thunderstorms near the midpoint of a propagation path are briefly discussed. This propagation is distinct from sferics, and may rather offer evidence of forward scatter from ionized regions caused by cloud-to-cloud discharges.--W. N.

E-440 Baur, K., Phasenverzerrung durch Bodeninhomogenitäten. (Phase distortion due to surface inhomogeneities.) NTZ: Nachrichtentechnische Zeitschrift, Brunswick, 10(8):385-389, Aug. 1957. 4 figs., 11 refs., 26 eqs. DLC--In preparatory work for the establishment of a direction finder station it is imperative to survey the immediate locality. Attention, in particular, should be paid to the surface since it will affect the dielectric constant as a function of the local variation of the surface conductivity. This fact causes a local phase deviation from the normal value and contributes to a distorted result of the direction findings. Formulas are developed to permit a definition of the property of the surface, hence, the criteria for selection of a location suitable for a direction finder station is given.--Transl. of author's abstract.

E-441 Bean, B. R. and Abbott, R. (both, Nat'l. Bur. of Stand., Boulder, Colo.), Oxygen and water vapor absorption of radio waves in the atmosphere. Geofisica Pura e Applicata, Rome, 37:127-144, 1957. 12 figs., 4 tables, 22 refs., 5 eqs. DLC--Calculated values of the gaseous atmospheric absorption are presented for frequency range 100 to 50,000 Mc at elevations above ground up to at least 130,000 ft, for average conditions during Feb. and Aug. at Bismarck, N.D. and Washington, D.C. Total radio path absorptions are presented for tropospheric forward scatter communication links for distances of 100, 300 and 1000 mi. A correlation of total path absorption with the surface value of absolute humidity is developed, thus providing estimates of the range of absorption values in different geographic areas. Maps of average absolute humidity for the world are presented. Previous work on rain absorption is then combined with the present study to provide estimates of the radio power loss due to absorption expected to be exceeded 1% of the time. (Met. Abs. 8J-153)--From authors' abstract.

E-442 Bean, B.R. and Cahoon, B.A. (Nat'l. Bureau of Stand., Boulder, Colo.), A note on the climatic variation of absolute humidity. American Meteorological Society, Bulletin, 38(7):395-398, Sept. 1957. 5 figs., table, 8 refs. DWB--Maps of the variation of absolute humidity over the U.S. are presented for the values exceeded 1, 50 and 99% of the time during the months of Feb. and Aug. Cumulative distributions of absolute humidity are presented for nine climatologically diverse locations for the four seasons of the year. In addition, regression equations have been derived to enable one to estimate the values of absolute humidity exceeded 1 and 99% of the time at any location for which average values are available. Graphs show cumulative distributions for Tatoosh, Bismarck, Ely and Miami. The charts are intended for use in radio refractive index or propagation studies. (Met. Abs. 8J-155)--From authors' abstract.

E-443 Bean, B.R., and Cahoon, B.A., The use of surface weather observations to predict the total atmospheric bending of radio rays at small elevation angles. Institute of Radio Engineers, N.Y., Proceedings, 45(11):1545-1546, Nov. 1957. 3 figs., table, 8 refs. DLC--The purpose of this study is to evaluate any possible effects of commonly observed marked departures of the actual refractive index profile from the smoothed profiles so obtained. It is shown that the surface value of the refractivity alone may be used to predict the total bending with useful accuracy even for elevation angles of arrival or departure as small as 10 milliradians. --E.K.

E-444 Beard, C.I. and Katz, I., The dependence of microwave radio signal spectra on ocean roughness and wave spectra. IRE Transactions on Antennas and Propagation, N.Y., 5(2):183-191, April 1957. 12 figs., 2 tables, foot-refs. DBS--This paper is an extension of previous work on reflection of microwaves from an ocean surface. Present analysis is based on data obtained in a one way X-band propagation experiment performed across the Golden Gate, San Francisco. Two paths of 9000 and 15,000 ft were used. To describe the ocean surface, wave gages were mounted on a piling driven into the Golden Gate channel. Radio signal spectra are found to be broader than the ocean wave spectra and the spectral breadth a function of ocean roughness. The important result of this analysis is the establishment of a linear relationship between ocean roughness and the spectral breadth of the radio signals. Ocean roughness is measured by the product of the standard deviation of the wave height and the grazing angle divided by the radio wave length. Radio spectral breadths are determined by the frequencies at which each spectrum drops to the 0.9, 0.8, 0.7, 0.5, 0.25 and 0.1 power points. The breadth are then expressed as ratios of these frequencies to the frequency of the peak in the simultaneous ocean wave spectrum. The analysis now enables one to predict the approximate shape of the spectrum of the radio signal received in a one way transmission path given only a knowledge of the geometry, radio wavelength, ocean wave height, and the peak frequency in the ocean spectrum. --Authors' abstract.

E-445 Beckmann, P., A new approach to the problem of reflection from a rough surface. Ceskoslovenska Akademie Ved, Acta technica, 2(4):311-355, 1957. 17 figs., 41 refs., eqs. DLC--This is an attempt to develop a statistical theory of the scattering of a plane wave by a surface consisting of plane elements of random slope. The profile of such a surface is given as a model of a stochastic process, namely a Markoff chain with a finite number of states and discrete moments of transition. The following assumption serve as the basis for the calculation of the scattered field: a) Every element reflects the beam incident upon it with the Fresnel reflection coefficient in the direction prescribed by geometrical optics;

b) The elementary waves reflected in the same direction are summed with respect to their phases to form one resultant scattered wave in that direction. These assumptions are not strictly true but they afford a reasonable approximation. The author derives the probability distribution of the amplitude of unit vectors with random phases uniformly distributed between -a and +a for arbitrary values of a. (Rayleigh derived this distribution only for a =). Each realization of a rough surface with prescribed statistical properties will in general result in a different scattering coefficient and the distribution of these individual values about the mean value is the Rayleigh distribution. The author distinguishes two cases for scattering in the principle direction: a) distribution of the horizontal elements with height is not uniform; b) distribution of the horizontal elements with height is uniform. The theory is in agreement with accessible statistical measurements of reflection coefficients of rough surfaces and, moreover, explains "polarization effect". The application of the theory to tropospheric propagation will be the subject of further work. Here the author notes that when an irregular layer moves through the region in the troposphere where radio waves are reflected toward the receiver far beyond the horizon of the transmitter, this is equivalent to different models of rough surfaces at different times. If the total time considered is not too long, all these surfaces will have equal statistical properties. The distribution of the scattering coefficient will of course be the same as that of the received field strength. This field over short periods of time is Rayleigh distribution. --R. M.

E-446 Berg, Eduard (Lwiro, Belg. Congo), Phasenverhaltnisse im Beugungsschatten in geschichteter Troposphare. (Phase relationships in the diffraction shadow of a stratified troposphere.) Archiv der Elektrischen Ubertragung, Stuttgart, 11(9): 366-378, Sept. 1957. 10 figs., 14 refs., eqs. DLC. Transl. into English by A. P. Barsis issued as U. S. National Bureau of Standards, NBS Translation, No. 5567, July 1958. 37 p. 10 figs., 14 refs., eqs. DWB (M10.52 B493ph)--The solution of the wave equation for a troposphere with over critical refraction is given for a magnetic dipole with the aid of WHITTACKER functions in a form from which the solution for a homogeneous or nearly homogeneous atmosphere is found as a special case by equating certain constants to zero. The obtained series expansion of GREEN's function is converted with the aid of WATSON's transformation. For the special case of infinite ground conductivity it is shown that for tropospheric ducts it is requisite to have at least one real zero of the denominator of the reflection coefficient supplying the residues in WATSON's transformation. An approximation shows the dependence of the cutoff wave length of the index of refraction and the height of the tropospheric duct. Besides, the phase surfaces and their displacement at the ground are compared with conditions in a homogeneous atmosphere. (Met. Abs. 10.11-255)--Author's abstract.

E-447 Beyers, Norman J., Airborne refractometer installation. U.S. White Sands Signal Corps Agency, Electromagnetic Radiation through the Atmosphere, Progress Report, No. 2, Jan. 11, 1957. 9 p. 5 figs., ref. --The air-borne Type VI Microwave Refractometer developed by the Electrical Engineering Research Laboratory at the University of Texas is briefly described and shown in photographs and diagrams. The instrument measures atmospheric index of refraction at a frequency of approximately 9400 Mc, providing a continuous record of the index of refraction versus altitude. Its main parts are 1) the refractometer proper, 2) the power supply, and 3) the recording meter. (Met. Abs. 8 J-186)--G. T.

E-448 Booker, H. G. and Gordon, W. E., The role of stratospheric scattering in radio communication. Institute of Radio Engineers, N. Y., Proceedings, 45(9):1223-1227, Sept. 1957. 2 figs., table, 9 refs., 37 eqs. DLC--On the mixing-in-gradient hypothesis of incoherent scattering of radio waves in a dry atmosphere, the intensity of the irregularities in dielectric constant depends on the excess of the temperature gradient above that appropriate to an adiabatic atmosphere. In going from the upper troposphere to the stratosphere, there is a significant increase in this gradient excess and consequently, a significant increase in the intensity of irregularities in dielectric constant. The decrease in intensity with increase of height measured by Crain in the troposphere does not, therefore, indicate reliably the intensity to be expected above the tropopause. Calculations have been made concerning the effect of stratospheric, as distinct from tropospheric, scattering. Stratospheric scattering is expected to predominate over tropospheric scattering at ranges greater than about 600 km. At a range of 1000 km, the calculated transmission loss, due to stratospheric scattering, is a few decibels greater than is indicated by observations. The effect of stratospheric scattering at a frequency of 108 Mc is such that the minimum signal observed at this frequency over the path from Cedar Rapids, Iowa, to Sterling, Va., could conceivably have been stratospheric origin, with ionospheric scattering being predominant at certain times, for example, during SID's. (Met. Abs. 8J-157)--Authors' abstract.

E-449 Boudouris, G., Propagation troposphérique. (Tropospheric propagation.) Paris, Centre de Documentation Universitaire, 1957. 463 p. numerous figs., eqs., bibl. p. 459-463. Mimeo. --The author presents in this work a synthesis of present knowledge concerning the propagation of radioelectric waves. The work is composed of 7 parts which deal successively with: 1. Propagation of plane waves; 2. Theorems and general notions. Specific waves; 3. and 4. Propagation over a level continent; 5. Propagation over the spherical earth; 6. Propagation over a nonhomogeneous world. Influence of irregularities of the ground and obstacles; 7. Propagation in real troposphere (nonhomogeneous). (Met. Abs. 10.5-28) --A. V.

E-450 Bullington, K., Radio propagation fundamentals. Bell System Technical Journal, N. Y., 36(3):593-626, May 1957. 19 figs., table, 34 refs., 11 eqs. DLC--The engineering of radio systems requires an estimate of the power loss between the transmitter and the receiver. Such estimates are affected by many factors, including reflections, fading, refraction in the atmosphere, and diffraction over the Earth's surface. In this paper, radio transmission theory and experiment in all frequency bands of current interest are summarized. Ground wave and sky wave transmission are included, and both line of sight and beyond horizon transmission are considered. The principal emphasis is placed on quantitative charts that are useful for engineering purposes. --Author's abstract.

E-451 Chapman, J. H.; Heikkila, W. J. and Hogarth, J. E., A new technique for the study of scatter propagation in the troposphere. Canadian Journal of Physics, Ottawa, 35(8):823-830, Aug. 1957. 4 figs., 16 refs., 7 eqs. DLC--The power spectrum of the fluctuations in received signal strength on a near optical UHF circuit has been measured. The sidebands associated with these fluctuations can overlap the information carrying sidebands of a communication system. When this happens, these sidebands must be taken into account in determining the signal to noise ratio of the system. In other words, the fluctuations then have the characteristics of noise and, therefore, they are called propagation noise in the paper. Experiments at a carrier frequency of 500 Mc have shown that the propagation noise power density usually varies with sideband frequency f (measured from the carrier) as $1/f^2$, for f in the range 0.1 to 10 c.p.s. Departures from this law have been observed in the regions near 0.1 c.p.s. and 10 c.p.s. The measurement of the power spectrum directly offers several advantages over the conventional signal strength recording method, and these are discussed herein. --Authors' abstract.

E-452 Colloque International sur les Problèmes d'Actualité dans la Propagation des Ondes Radioélectriques, Paris, Sept. 17-21, 1956, Communications. L'Onde Electrique, Paris, 37(362):411-542, May 1957. And: Annales des Télécommunications, Paris, 12(5):135-216, May 1957. Numerous figs., tables, refs., eqs. Review in Nature, London, 179(4555):354-356, Feb. 16, 1957. DLC--Eighty papers were presented at the International Symposium on Radio Wave Propagation in Paris (Sept. 1956). Of these 27 are included in Onde Electrique (covering the fields of scatter propagation, theory, fluctuations, whistlers and meteors) and 23 in Annales des Télécommunications (ionospheric propagation, radio meteorology, effect of irregular surface, and antennas), while the remaining 30 are listed in both journals by title only. The following papers bear direct relationship to the subject of this bibliography: Bean, B.R. (NBS, Boulder, Colo.), Sur l'utilisation des observations meteorologiques courantes en propagation radioélectrique, (On the use of available meteorological data in radio wave propagation), l'Onde Electrique, p. 411-415. The use of meteorological data in climatological studies of atmospheric refractivity is discussed with special reference to work done by the U.S. National Bureau of Standards. It is reported that 2½ million complete sets of data have been recorded on punched cards, representing 10 yrs of surface observations made every 2 hrs at 54 stations throughout the United States. A study of the global distribution of refractivity index has also been undertaken. World charts showing mean values of surface refractivity in Feb. and in Aug. are presented. Beckmann, B. (Darmstadt, Germany), Observations de diffusion vers l'arriere avec des signaux télégraphiques, (Observation of back scattering with telegraph signals), p. 416-420. Describes new "annular" method developed in Germany. Carroll, Thomas J. (M.I.T. Lincoln Lab.), La propagation des ondes ultra-courtes au delà de l'horizon de Marconi a nos jours, (Propagation of ultrashort waves beyond the horizon from Marconi to the present), p. 421-426. Short history including 38 references. Chisholm, James H. (M.I.T. Lincoln Lab.), Recherches experimentales sur la diffusion angulaire et sur les possibilities d'utilisation de la propagation tropospherique pour les communications bien au delà de l'horizon, (Experimental investigation of angular scattering and possibilities of the use of tropospheric propagation for communication well beyond the horizon), p. 427-434. Describes installation used at Lincoln Laboratories for measuring attenuation of shortwave radio signals over long tropospheric paths (up to 830 mi). Clavier, P. (Compagnie Francaise Thomson, Houston), Calcul d'une liaison par diffusion tropospherique optimum du point de vue economique, (Calculation of optimum tropospheric scatter communication from an economic point of view), p. 435-440. Considers performance characteristics of the various components of scatter propagation equipment and indicates best choice of apparatus for operation at reduced cost. Crain, C.M. (Texas Univ., Austin), Les refractomètres et leurs applications à la propagation radioélectrique et à d'autres problèmes, (Refractometers and their applications to radio wave propagation and to other problems), p. 441-443. Discusses airborne refractometers and results obtained with them in the measurement of atmospheric refractivity variations with height and with atmospheric conditions. Morrow, W.E., Jr. (M.I.T. Lincoln Lab.), Etude de systèmes de radiocommunication troposphérique U.H.F. a longue distance, (A study of methods of tropospheric UHF radio communication over long distances),

p. 444-449. Includes schematic diagrams of equipment used in scatter propagation studies and graphical presentation of results. Wiesner, J.B. (M.I.T.) and Pote, A.J. (Hycon Eastern), Liaisons radioélectriques au moyen de la propagation par diffusion troposphérique. (Radio communication by means of tropospheric scatter propagation), p. 456-461. General review of tropospheric propagation beyond the horizon and of work conducted at Lincoln Laboratories. Bochenek, K. (Warsaw, Poland), Sur certaines methodes d'analyse des relations obtenues a l'aide de la méthode W.K.B., (On certain methods of analysis of the relations obtained by means of the W.K.B. method), p. 462-464. Mathematical analysis of the possible application of geometrical optics to radio wave propagation. Boudouris, Georges (Paris), Le probleme de propagation au dessus de la terre spherique (terre et atmosphere homogenes) est-il definitivement résolu? (Is a final solution available on the problem of propagation over a spherical earth (homogeneous earth and atmosphere)), p. 465-470. Reviews classical and recent theories of radio wave propagation and concludes that while the theoretical problems have been solved satisfactorily, no adequate method has been developed for quick and complete field calculations. Carroll, Thomas J. and Ring, R.M. (M.I.T. Lincoln Lab.), Propagation des micro-ondes dans la zone d'ombre a travers une couche d'air dont l'indice décroit de façon monotone, Microwave propagation in the shadow zone through a layer of air whose index decreases uniformly), p. 471-479. Treating the troposphere as a dielectric layer stratified by gravity, the authors show that excessive field strengths observed in the shadow zone can be explained by an atmospheric wave guide effect without any additional effect of turbulence or unusual stratification. Fock, V.A. (Moscow, U.S.S.R.), Application des integrales complexes à certains problèmes de diffraction, (Application of complex integrals to certain problems of diffraction), p. 480-481. Author briefly sums up his own work on the theory of radio wave propagation and refers to 13 papers published by him since 1945. Goubau, Georg (Signal Corps Eng. Lab.), Rapport entre l'onde de surface et l'onde d'espace, (Relation between the ground wave and the sky wave), p. 482-484. Considers theoretically the problem of separating the field due to the ground wave from that due to the sky wave. Smyth, J.B. and Anderson, L.J. (San Diego, Calif.), L'Importance du processus de réflexion dans les communications au-delà de l'horizon, (Importance of reflection in communication beyond the horizon), p. 485-490. Reports results of airborne refractometer measurements throughout the U.S. and discusses mechanisms of radio wave reflection from tropospheric layers. Wong, Ming S. (Wright Aeron. Develop. Center, Ohio), Méthode des caustiques dans la propagation troposphérique, (The method of caustic in tropospheric propagation), p. 491-494. Shows that anomalies observed in air-to-air propagation can be explained by stable horizontal layers, and anomalies of ground-to-air propagation by fragments of layers, and layers moving horizontally. Arsac, J. (Meudon Obs., France) and Simon, J.C. (Paris), Problèmes de fluctuation en propagation lointaine, (Problems of fluctuation in long distance propagation), p. 495-497. Discusses possibilities of an application of radio field measurement to the study of atmospheric irregularities. Bremmer, H. (Philips Res. Lab., Netherlands), Comparison des fluctuations de l'amplitude et de la phase des champs engendrés par diffusion (champs de turbulence), (Comparison of the amplitude and the phase variations of fields due to scattering (turbulence fields)), p. 498-500. The statistical theories developed by RICE for the study of noise and by BOOKER, RATCLIFFE and SHINN for the study of ionospheric propagation are extended and applied to the study of field strength and phase variations in scatter propagation. Du Castel, F. (Lab. Nat. de Radioelectricite, France), Divers types de fluctuations de champs tropospheriques et leur interpretation physique, (Different types of tropospheric field variations and their physical interpretation), p. 501-506. Reports results of work done at the French

Telecommunications Research Center and presents graphs of field strength variations as functions of various meteorological and technical factors. Tukizi, Osamu (Tokyo, Japan), Theorie du fading de scintillation en micro-ondes, (Theory of scintillation fading of microwaves), p. 512-519. Suggests that scintillation fading may be interpreted as being due to interference between direct and scattered waves. Anastassiades, M. and Carapiperis, L. (Athens, Greece), Influence des facteurs météorologiques sur la propagation des hyperfrequences (Données sur la Mer Egee du sud), (Effect of meteorological factors on UHF propagation (Data for the southern Aegean Sea)), Annales des Telecommunications, p. 177-180. From field measurements over a 120 km maritime path (Thera Heraklion) it is concluded that propagation conditions may be predicted correctly in simple weather situations such as frequently prevail in the region investigated. Battaglia, A. (Pisa), Boudouris, G. (Paris) and Gozzini, A. (Pisa), Sur l'indice de refraction de l'air humide en microondes, (Index of refraction of humid air for microwaves), p. 181-184. Reports laboratory measurements made at the Institute of Physics at Pisa University, by means of a spectrometer. Beckmann, Petr (Czechoslovakia), La reflection des ondes VHF par les variations brusques d'humidité dans la troposphère, (Reflection of VHF waves by abrupt humidity variations in the troposphere), p. 50-52. Sharp discontinuities of humidity at the boundaries of clouds show high correlation with propagation beyond the horizon. Mevel, J. (Rennes, France), Etude sur l'interaction de deux spheres voisines placees dans un champ electromagnetique. (Interaction of two adjacent spheres in an electromagnetic field), p. 186-188. Considers the theory of diffraction of radio waves by cloud particles. Misme, Pierre (Paris), Influence des discontinuites frontales sur la propagation des ondes decimetriques et centimétriques, (Effect of frontal discontinuities on the propagation of decimeter and centimeter waves), p. 189-194. Analysis of field measurements over a 50 km maritime path during a frontal passage, and of measurements made during a shower. In addition to these papers printed in full, there are also several on tropospheric propagation among those listed by title only. (Met. Abs. 8 J-187) --G. T.

E-453 Coroniti, S. C. and Gerson, N. C., Scatter-field strengths and large ion concentration. Journal of Atmospheric and Terrestrial Physics, London, 10(4):237-239, 1957. Fig., 5 refs. DWB--Field strength well beyond horizon at 100-4000 Mc/s varies only slightly with distance. To explain this, the concentration of large ions N_+ was compared with modified refractive N. From 2000-10,000 ft N = 210 + 0.13 N_+. (Met. Abs. 10.2-336)--C. E. P. B.

E-454 De, A. C.; Das, P. M. and Gangopadhayaya, M., Super-refraction conditions at Dum Dum Airport. Indian Journal of Meteorology and Geophysics, Delhi, 8(4): 418-426, Oct. 1957. 5 figs., table, 8 refs. DWB, DLC--Conditions for super-refraction have been studied at Dum Dum Airport (Calcutta) with a 3 cm radar. There appears to exist some correspondence between the occurrence of ground fog and mist on the one hand, and the appearance of super standard echoes on the other. (Met. Abs. 8 J-188)--Authors' abstract.

E-455 Dolukhanov, M. P., Issledovaniia rasprostraneniia radiovoln vdol' poverkhnosti Zemli v SSSR. (Investigations of radio wave propagation along the Earth's surface in the U.S.S.R.) Radiotekhnika i Elektronika, Moscow, 2(11):1344-1359, Nov. 1957. 10 figs., 43 refs., 11 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 2(11):39-61, 1957. DLC--After a historical review, the author discusses briefly the cases of the propagation of radio waves by diffraction, reflection, and scattering. The structure of the troposphere is also briefly discussed. The final sections are devoted to the propagation of ultrashort waves in tropospheric ducts and by tropospheric scattering. --R. M.

E-456 Egli, John J., Radio propagation above 40 Mc over irregular terrain. Institute of Radio Engineers, N. Y., Proceedings, 45(10):1383-1391, Oct. 1957. 15 figs., 15 refs., 5 eqs. DLC--Radio transmissions in the VHF and UHF frequency region over land areas always content with the irregularities of the terrain and the presence thereon of dispersed quantities of trees, buildings, and other man made structures, or wave propagation incumbrances. The determination of path attenuation is not easily satisfied by simple, curved, or plane earth calculations. However, quantitative wave propagation data are available in varying degrees which take into account conditions experienced by fixed to fixed and fixed to moving transmissions over irregular terrain. This available statistical wave propagation information on terrain effects vs frequency, antenna height, polarization, and distance is analyzed, expressed by empirical formulas, and presented in the form of nomographs and correction curves amenable for use by the systems engineer. --Author's abstract.

E-457 Fannin, B. M. and Jehn, K. H., A study of radar elevation-angle errors due to atmospheric refraction. IRE Transactions on Antennas and Propagation, N. Y., 5(1):71-77, Jan. 1957. 6 figs., 2 tables, foot-refs. DBS--Refractive index variations in the atmosphere cause errors in radar measurements. This paper presents the results of a theoretical study of the elevation angle error due to the refraction of electromagnetic waves in the troposphere. The study is based upon ray theory, using standard meteorological data reported by the U. S. Weather Bureau for the surface and the standard pressure levels. Computed errors are tabulated for 34 monthly mean refractive index profiles selected as being representative of various type air masses for different seasons and latitudes. In order to get an indication of the spread in propagation errors to be expected during a particular season for fixed locations, computations have been carried out based on the 0300Z soundings for the odd days of Jan. (1950-1954) and July (1950-1953) for nine U. S. locations. The diurnal influence is investigated by analyzing the variations in surface refractive index for Jan. and July 1953, and also for nine U. S. locations. --Authors' abstract.

E-458 Friis, H. T.; Crawford, A. B. and Hogg, D. C., A reflection theory for propagation beyond the horizon. Bell System Technical Journal, N. Y., 36(3):627-644, May 1957. 11 figs., 10 refs., 25 eqs. DLC--Propagation of short radio waves beyond the horizon is discussed in terms of reflection from layers in the atmosphere formed by relatively sharp gradients of refractive index. The atmosphere is assumed to contain many such layers of limited dimensions with random position and orientation. On this basis, the dependence of the propagation on path length, antenna size and wavelength is obtained. --Authors' abstract.

E-459 Furutsu, Koichi, Wave propagation over an irregular terrain, Pt. 1. Japan. Radio Research Laboratories, Journal, 4(16):135-153, April 1957. Pt. 2, Ibid., 4(18): 349-392, Oct. 1957. Figs., numerous eqs. DBS--A formula of field strength over an irregular terrain is obtained on the condition that both the radius and electrical properties of the earth's surface discontinuously change several times along the wave path. The formula is expressed in a unified form and is valid for the entire range of frequencies. It is considered to be more general than those for mixed paths of the homogeneous earth, since the latter can be derived from the former as special cases. The first paper of this series is mainly concerned with the equation formulation and the derivation of the formula of field strength on the general condition; the second paper is devoted to the derivation of supplemental formulas for several cases of bad convergence of series of the obtained formula, and also for several applications to diffraction by hills or mountains. --Author's abstract.

E-460 Gossard, Earl E. (U.S. Navy Electronics Lab.), Air-sea refractive index difference charts for the Mediterranean-Southeast Asia areas. American Meteorological Society, Bulletin, 38(5):274-278, May 1957. 8 figs., 4 refs. Reprinted as U.S. Navy Electronics Laboratory, San Diego, Calif., NEL Research Report, No. 794, May 23, 1957. DWB--Data for 350,000 ship observations (on punched cards at Asheville, N.C.) were used to calculate frequencies (for 5° squares) in terms of median difference and standard deviation of sea-air refractive index ($B_s - B_b$) for March-May, June-Aug., Aug-Oct. and Nov.-Jan. for the Eastern Mediterranean, Persian Gulf, Bay of Bengal and South China Sea. The data are presented on charts and the theory and techniques explained. (Met. Abs. 8 J-160) --M. R.

E-461 Gray, R.E., The refractive index of the atmosphere as a factor in tropospheric propagation far beyond the horizon. IRE Convention Record, N.Y., Pt. 1, 1957. p. 3-11. 10 figs., 15 refs. DLC--In order to plan a tropospheric beyond the horizon radio link, it is at present necessary to make transmission tests to establish the median path loss and to determine the magnitude and duration of the path loss variations. Recent measurements indicate, however, that the relation existing between transmission loss and the refractive index of the atmosphere may enable estimates to be made, from climatic data alone, of the transmission characteristics of any particular path. Extreme values of transmission loss are believed to be chiefly due to exceptional variations with height of the refractive index, while the monthly median values of path loss have been found to be a function of the average surface values of the refractive index of the atmosphere on the transmission path. Curves are given showing the relation found on various path between radio transmission loss and the refractive index. --Author's abstract.

E-462 Gudmandsen, P., A design chart for tropospheric scatter. Akademiet for de Tekniske Videnskaber, Copenhagen (Danish Academy of Technical Sciences), Microwave Laboratory Report, P 1625, Jan. 6, 1957. --The chart developed comprises frequencies 100 to 10,000 Mc and distances 100 to 500 km and incorporates transmission power, antennae dimension, bandwidth, effective noise figure, fading margin and signal-to-noise ratio. Its procedure is given along with experimental measurements for comparison showing that the transmission loss perhaps is over estimated. Final conclusions necessitates further measurements. If the minimum values at 400 - 800 Mc are not usable, higher, rather than lower frequencies are preferred. (Met. Abs. 8 J-161)--From author's abstract.

E-463 Hirai, Masaichi, Notes on phase incoherence in tropospheric propagation and its effects on scattered field. Japan. Radio Research Laboratories, Journal, 4(17):255-266, July 1957. 3 figs., 6 refs., 25 eqs. DBS--Assuming a Gaussian form for the correlation function of the distribution of capacitivity in the atmosphere, the following is found: 1) Within the line-of-sight path, the time mean-square value of the random phase difference at spaced points at the same distances from the transmitter is roughly proportional to the scale of turbulence, to the propagation distance, and to the square of the frequency, but it is independent of the separation between the spaced points, except in the case of an extremely short propagation path and a close separation. 2) Beyond the horizon the effect of the phase incoherence on the scattered field is considered to be negligible so far as the time average value of the received power is concerned, within the range of interest and on frequencies below UHF, inclusive. --Author's abstract.

E-464 Hirao, Kunio and Akita, Kin-Ichiro, A new type refractive index variometer. Japan. Radio Research Laboratories, Tokyo, Journal, 4(18):423-437, Oct. 1957. 12 figs., 8 refs. --Atmospheric refractive index variation in the frequency range of radio waves can be expressed as the linear combination of both dry and wet bulb temperature variations. A new type refractive index variometer based on this principle, has been designed and constructed. In the present paper this variometer is described in detail. Some observational data are shown with radio meteorological considerations. --Authors' abstract.

E-465 IRE - URSI Symposium, April 30, May 1-3, 1956, Wash., D.C. and Oct. 11-12, 1956, Berkeley, Calif., Abstracts of papers. IRE Transactions on Antennas and Propagation, N.Y., 5(1):148-168, Jan. 1957. Foot-refs. DBS--In connection with the first symposium, more than 100 papers, in connection with the second, 29 papers are summarized. Various aspects of radio wave propagation were discussed. Both symposia include papers treating the propagation of radio waves in the troposphere. --E.K.

E-466 Johler, J.R. (Nat'l. Bur. of Stands., Boulder, Colo.), Propagation of the radio frequency ground wave transient over a finitely conducting plane earth. Geofisica Pura e Applicata, Rome, 37:116-126, 1957. 6 figs., 10 refs., 22 eqs. DLC--The theory of the propagation of a transient radio frequency ground wave over a finitely conducting plane earth is presented for the particular case of the NORTON surface wave by a consideration of a wave interrupted abruptly at one point in time ($t = O, T_2$) and a wave interrupted at one point in time followed by an exponential decay. The first case is illustrated by several numerical examples of a cosine current wave applied to an electric dipole source. It is apparent that the method of the inverse Laplace transform for the particular cases considered yields some simple mathematical formulas. (Met. Abs. 8J-162)--From author's abstract.

E-467 Kirby, R.S., Measurement of service area for television broadcasting. IRE Transactions on Broadcast Transmission Systems, N.Y., 7:23-30, Feb. 1957. 6 figs., 5 refs. DBS--It is proposed that the present definition of television service in terms of iso-probability contours, be abandoned. A new definition of service area, first proposed by Norton and Gainen in 1950, is recommended in its place. This provides a much more useful measure of service and makes the estimating techniques more tractable. A method of estimating the service area is described. This method consists of sampling the field strength at specified random locations along circular routes around the transmitter using portable field strength measuring equipment and an antenna height of 30 ft. The estimate of the service area expressed in square miles is arrived at by a simple integration process based on the probability distributions of field strength levels as a function of distance from the transmitter. --Author's abstract.

E-468 Kitchen, F. A. and Richmond, I. J., Some characteristics of long distance scatter transmission. Pt. 1, Transmission via ionospheric scatter. British Communications and Electronics, London, 4(2):74-78, Feb. 1957. 4 figs., 14 refs. Also Pt. 2, Transmission via tropospheric scatter. Ibid., 4(3):146-148, March 1957. 2 figs., 15 refs. DLC--Some of the characteristics of ionospheric and tropospheric scatter mechanisms of beyond the horizon transmission are reviewed. Pt. 1 is concerned with the characteristics of ionospheric scatter propagation. Ionospheric scatter communication systems were found to be relatively inflexible in terms of operating frequency, and are suitable for operation between defined limits of distance. Pt. 2 is the treatment of tropospheric scatter communications systems, which are extremely flexible from the point of view of choice of operating frequency. For practical purposes, 400 mi may be taken as the upper limit of distance for transmission. The bandwidth capabilities of this mechanism are high, and may be possibly exploited for television relays on a point-to-point basis over moderate distances. --E. K.

E-469 Klinker, Ludwig, Aufschlusse uber den Fernausbreitungsmechanismus im Meterwellenbereich durch troposphärische Driftmessungen. (Distant propagation mechanism in the meter wave region by tropospheric drift measurements.) Zeitschrift für Meteorologie, 11(2):43-49, Feb. 1957. 6 figs., table, 11 refs. DLC--The question is discussed whether propagation of ultrashort waves to great distances is due to scattering by tropospheric turbulence elements or to partial reflection at free inversions. Fading at antennas 50-300 m apart shows systematic time differences. In many cases the drift measurements coincided with wind discontinuities at the lower limit of free inversions between 500 and 3000 m shown by upper air ascents; examples are described. About two-thirds of the observations agree with aerological data and support the occurrence of partial reflection. (Met. Abs. 8 J-163)--C. E. P. B.

E-470 Klinker, L., Experimentelle Untersuchungen zur Frage des Fernausbreitungsmechanismus im Meterwellenbereich. (Experimental investigations into the mechanism of the long range propagation in the meter wave region.) Nachrichtentechnik, Berlin, 7(5):210-215, May 1957. 5 figs., 7 tables, 20 refs., 3 eqs. --Observations of USW fading over 50 km to 400 km distances were conducted in the period of a year. It is shown that the fading ridges do not change significantly with the length of paths. No dependency of the fading ridges on the average velocity of tropospheric turbulence was found, whereas a close correlation was found with the vertical components of movement of the tropospheric inhomogeneities. The diversity distance is dependent on the corresponding period of fading and fluctuates between 85 m to well beyond 400 m on a 180 km long path. During tropospheric drift measurements it was by far the wind discontinuities present at the lower border of the free inversions that were detected, These results are not interpretable in light of the scattering theory. In the meter wave region it may well be that it is the partial reflection from layer inhomogeneities to transmission distances of not less than 400 km which makes up the dominant mechanism of propagation. --N. T. G.

E-471 Klinker, L., Weitere Ergebnisse von tropospharischen Driftbeobachtungen zur Frage des Fernausbreitungsmechanismus im Meterwellenbereich. (Further results on tropospheric drift observations on the subject of radio propagation mechanism in the meter wave range.) Zeitschrift für Meteorologie, Berlin, 11(10/11):339-344, Oct./Nov. 1957. 5 figs., 3 tables, 5 refs. DWB, DLC--In order to investigate the propagation conditions in the ultrashort wave region, 160 observations on tropospheric drift made with short waves were carried out at the Kühlungsborn Observatory. Of these observations, 130 could be compared with simultaneous aerological measurements at the Copenhagen-Castrup Station. The results of the study indicate that the partial reflections in the meter wave region constitute the exclusive propagation mechanism up to a distance of 500 km from the sender. Ultrashort wave propagation observations prove to be a good aid in continuous control by large geographic areas over the intensity of vertical transposition processes in the lower troposphere, in particular of the ground layer, since the intensification or attenuation of strata inhomogeneities become immediately visible in the intensity of the reflected field. Specific examples of drift observations accompanied by aerological observations are presented. (Met. Abs. 13.4-164) --I.L.D.

E-472 Knopfel, W., Einige Vergleichsuntersuchungen der Wellenausbreitungsverhaltnisse in Band II und IV. (Some comparative investigations of propagation conditions in the II band and in the IV band.) NTZ: Nachrichtentechnische Zeitschrift, Brunswick, 10(5):233-235, May 1957. 9 figs., 3 refs. DLC--In order to secure basic data pertinent in the planning of radio transmission networks, damping measurements in the IV band were conducted beyond diffractive ridges and locations. The IV band results show an average of 6 db position damping and of 12 db diffraction damping greater than those in the II band. A greater transmission density and a considerably pitched radiation output will produce adequate supply. --N.T.G.

E-473 Kuhn, Udo, Ein Beitrag zur Kenntnis der Ausbreitungsbedingungen bei 1.3 GHz nach Messungen an einer Übertragungsstrecke mit optischer Sicht. (Propagation conditions at 1.3 GHz over an optical path.) BRF, Technische Mitteilungen, Vol. 1, p.4, 1957. (Unchecked)--The powerful field strength interference as observed in a year over a 82 km long Dezi relay line at 1.3 GHz featured daily and annually variation. The results are compared with meteorological parameters and show certain correlations between frequency of the fading and the intermixing of the lower atmosphere and the vapor pressure. --N.T.G.

E-474 Kuhn, U., Einjahrige Feldstärkemessungen im UKW-Rundfunkband in Kolberg bei Berlin. (One year field strength measurements in the ultrashort wave radio band at Kolberg near Berlin.) Geofisica Pura e Applicata, Rome, 38:157-168, 1957. 13 figs., 12 refs. German and English summaries. DLC--The results of field strength measurements over some propagation paths in the frequency range from 88-100 Mc are presented. On the average, the lowest field strength could be observed in June and Dec. There was found a correlation between the temperature gradient at inversions and the field strength when using the average values of field strength and the single values. The correlation coefficient between the field strength and the temperature gradient at the inversions is a function of the length of the propagation path. In the same way the amplitude of the daily variation of field strength depends on the length of the propagation path; the values being a maximum at a distance of 200 to 300 km. With a coefficient of 0.49 there was found a good correlation between the field strength and the air pressure variation at ground level. As there also exists a correlation between the field strength and the temperature variations in the lower part of the troposphere, a better correlation coefficient of 0.58 was found when comparing the field strength with the air pressure variation and the variation of the temperature at the 700 mb level. There are given some diagrams of the field strength dependent upon the available air mass, the height of the 700 mb level a.o. Some diagrams present the field strength variation with varying temperature gradient on inversions. As to the field strength variation with distance there was found a curve which for more than 300 km is somewhat below this curve that was measured by the Kühlungsborn Meteorological Observatory. The curve showed somewhat higher values compared with one curve which was published in a document of the U.S. presented at the CCIR Assembly in Warsaw in 1956. (Met. Abs. 9.11-170)--Author's abstract.

E-475 Long, William G. and Weeks, Ray R., Quadruple diversity tropospheric scatter systems. IRE Transactions on Communications Systems, N.Y., 5(3):8-19, Dec. 1957. 16 figs., 12 refs., 12 eqs. DLC--The need for highly reliable, multichannel systems for relatively long distances without repeating is pointed out. It has been found that with the use of present operational equipment, with the exception of high power bipolarized feed systems, quadruple diversity reception can be employed with only two parabolic reflectors per terminal. The quadruple diversity system utilizes the operational spare concept to advantage. This system yields reliable multichannel communications for circuits well over 300 mi in length.--E.K.

E-476 Mc Craken, Leslie G., Ray theory vs normal mode theory in wave propagation problems. IRE Transactions on Antennas and Propagation, N.Y., 5(1):137-140, Jan. 1957. 2 figs., 7 refs., 24 eqs. DBS--A set of universal curves is presented by which the approximate magnitude and phase of the reflection coefficient for vertical polarization can be determined at any grazing angle with relatively little computation. The approximation, which is almost always suffidiently accurate for engineering purposes, is excellent if the relative impedance of the reflecting medium is high and still quite good even if the impedance ratio is only moderately greater than unity.--Author's abstract.

E-477 Megaw, E.C.S., Fundamental radio scatter propagation theory. Institution of Electrical Engineers, London, Proceedings, Pt.C, 104(6):441-455, Sept. 1957. 2 figs., 5 tables, 29 refs., 83 eqs. DLC--The text and the arrangement of the extensive notes and analytical material left by the late author were prepared by F.A. KITCHEN and M.A. JOHNSON. The detailed theoretical treatment of the problem of beyond horizon scatter propagation includes a full analysis of the influence of the geometry of the scatter volume on the received field strength. The form for the spectral density of refractive index fluctuation, assumed congruent with velocity fluctuation, is derived from the universal equilibrium theory of turbulence. It is here used to predict several aspects of stellar nature and radio signal field strength fluctuation. Theoretical and experimental comparisons support the theoretical form of the refractive index fluctuation spectrum. (Met. Abs. 8J-164)--From author's abstract.

E-478 Merkulov, V.V., K teorii rasprostraneniia elektromagnitnykh voln v sredakh so sluchaĭnymi neodnorodnostiami pokazatelia prelomleniia. (Contribution to the theory of the propagation of electromagnetic waves in media with random irregularities in the refractive index.) Zhurnal tekhnicheskoi fiziki, Moscow, 27(5):1051-1055, May 1957. 5 refs., 18 eqs. DLC--The author introduces a new characteristic of a field in a medium with random irregularities, the correlation function of the scattered field, which includes the relationship of field fluctuations of amplitude and phase. By means of this function, a solution is found for the problem of the diffraction of electromagnetic waves with random amplitude and phase at the aperture of the receiving apparatus.--R.M.

E-479 Millington, G., Concept of the equivalent radius of the earth in tropospheric propagation. Marconi Review, London, 20(126):79-93, 1957. 5 figs., 5 refs., 73 eqs. DLC--The concept of the equivalent radius of the earth to take account of a linear variation of refractive index with height in tropospheric refraction is re-examined. It is shown that the transformation is not limited to nearly horizontal rays, but that essentially it reduces the curvature of the earth by that of a ray traveling horizontally and the curvature of the rays by the amount required to straighten them at whatever angle to the horizontal they may be going. The results obtained geometrically in a previous paper for the angle of elevation at the refraction point, the optical path difference between the direct and indirect rays and the divergence factor are derived by simple analysis, affording a useful check on the method. --Author's abstract.

E-480 Moyer, V.E. and Gerhardt, J.R., A survey of microwave refractive index analysis and forecasting techniques. Texas. Univ. Electrical Engineering Research Laboratory, Report No. 6-18, Contract AF 19(604)-494, March 25, 1957. 16 p. 30 refs. DWB--The present knowledge, techniques, instrumentation and analysis in relation to the accuracy of forecasting both vertical and lateral refractive index gradients are summarized and discussed in some detail. A balloon-borne refractometer would seem to be the ideal instrument, particularly for the meteorologist. However, such an instrument remains to be invented. Author sums up suggestions and recommendations pertinent to refractometry. (Met. Abs. 8 J-165)--W. N.

E-481 Niwa, Shuntaro et al., Results of experiments on the VHF overland propagation beyond the radio horizon. Japan. Radio Research Laboratories, Journal, 4(16): 111-122, April 1957. 10 figs., 3 tables. DBS--This paper gives the results of experiments carried out from March to Aug. 1956 on VHF overland propagation between Inubo and Kokubunji (123 km). The mean levels of field intensity, fading, etc., are analyzed statistically and effects of frequencies used and location of receiving points are discussed. --Authors' abstract.

E-482 Onoue, Michio et al., Microwave propagation over the sea beyond the line of sight. Japan. Radio Research Laboratories, Journal, 4(18):395-406, Oct. 1957. 19 figs., 5 refs. --Experiments on microwave propagation over the sea beyond the line of sight were carried out on the frequency 9375 Mc/s along the Sea of Kashima over a period of two years (1955-1957), the waves being transmitted at Inubo and received at Hiraiso Radio Wave Observatories. From the results so far obtained, it is concluded that there is a qualitative correlation between meteorological elements and the variation in field strength, and that the duct contributes, in a large proportion, to the propagation beyond the line of sight through the lower atmosphere along the coastline. --From authors' abstract.

E-483 Phillpot, H.R., Effects of meteorological conditions on ultra high frequency radio transmission over two water paths in Australia. Australia. Bureau of Meteorology, Meteorological Study, No. 11, July 1957. 27 p. 10 figs., 6 tables, 18 refs., eqs. DWB--The effects of atmospheric refraction on electromagnetic waves of various frequencies are discussed, and the basic theory of the effect of variations in the atmospheric parameters on the refractive index of the lower troposphere is reviewed. Results of earlier investigations made over sea paths in the United Kingdom, United States of America and New Zealand are considered, and the current work in Australia for two links, at Mt. Bonython - Yorketown (South Australia) and Melbourne - Arthur's Seat, Victoria is outlined.

A technique is developed whereby it is possible to approximately assess the percentage occurrence of fading which might be expected on any proposed over water microwave link, the significant parameters being the temperature difference between the air and the underlying sea surface and the geostrophic wind speed. (Met. Abs. 8J-189)--Author's abstract.

E-484 Plank, Vernon G.; Cunningham, Robert M. and Campen, Charles F., Jr., (all, G.R.D., AFCRC), The refractive index structure of a cumulus boundary and implications concerning radio wave reflection. Weather Radar Conference, 6th, Cambridge, Mass., March 26-28, 1957, Proceedings, pub. 1957. p.273-280. 5 figs., 3 tables, 4 refs., 3 eqs. DWB (M01.81 R124pc)--Refractive index measurements made during an aircraft pass through cumulus have been analyzed for the details of index fluctuation at the cloud boundary. The microstructure is described and an explanation suggested. A restrictive estimate of boundary region reflectivity is obtained, using current theory. (Met. Abs. 9.11-171) --Authors' abstract.

E-485 Rogers, G.L., An experimental verification of diffraction microscopy, using radio waves. Journal of Atmospheric and Terrestrial Physics, 11(1):51-53, 1957. 6 refs. DWB--A DC-3 airplane was flown over 3 spaced radio receivers at 4000 and 8000 ft and fading of 125 m radio wavelength was recorded photographically. The amplitude of the main wave fluctuated from 97-103% of undisturbed amplitude, equivalent to a scatter of 0.09% of energy, but projected area of DC-3 is only 0.028% of Fresnel half period zone. The 3 fold increase in effective projected area is attributed to conduction. (Met. Abs. 10.2-178)--C.E.P.B.

E-486 Rogers, T.F.; Ames, L.A. and Martin, E.J., The possibility of extending air-ground UHF voice communications to distances far beyond the radio horizon. IRE Transactions on Communications Systems, 5(1):106-121, March 1957. 9 figs., table, 6 refs. DLC--Certain of the results of a detailed research investigation of 220 Mcps tropospheric scatter field strengths at long distances and high altitudes carried out at the Air Force Cambridge Research Center are reviewed in some detail. On the basis of the air-borne data obtained to date, supplemented by fading statistics, reasonable initial estimates can be made of the UHF radio wave path loss expected to obtain for various percentages of the time out to distances of several hundreds of miles and up to altitudes of several tens of thousands of feet. It is concluded, upon the basis of these path loss estimates, and initial air-borne voice reception tests, that the scatter mode of propagation will permit the extension of reliable good quality air ground UHF voice communication to distances far beyond the radio horizon. --Authors' abstract.

E-487 Rowden, R.A. and Stark, J.W. (both, B.B.C. Research Dept.), Long distance propagation at 94.35 Mc/s over the North Sea. Institution of Electrical Engineers, London, Proceedings, Pt.B, 104(15):210-212, May 1957. 3 figs., table. DLC--A number of VHF (94.35 Mc) propagation tests were made between Scheveningen, Holland (52°06' 04°16'E) and 4 points in England, Scotland and the Shetlands (123 to 591 mi) to determine over sea characteristics compared with previous over land propagation data. The over sea paths gave higher field strengths at the 1% and 10% levels than the over land paths. In every case when relatively strong signals were received it was found that anticyclones and inversions existed over the North Sea. (Met. Abs. 8J-167)--M.R.

E-488 Ryzko, Stanislaw, Radiokomunikacja na falach rozproszonych. (Radio communication using scattered waves.) Tele-Radio, Warsaw, 2(12):559-566, Dec. 1957. 7 figs., 5 refs. DLC--A general survey of ionospheric and tropospheric scatter propagation based on English language sources. Following a brief historical review, the phenomenon of scattering and the characteristics and use of scattered waves are discussed. Some basic equipment is pictured and briefly described. A final section covers the possibility of establishing communication systems based on the reflection of signals from meteor trails. --R.M.

E-489 Sapporo District, Japan. Central Meteorological Observatory, On the lower temperature inversion layer and the curvature of microwave propagation at Sapporo. Journal of Meteorological Research, Tokyo, 9(8):575-582, Aug. 1957. 5 figs., 9 tables, 7 refs., 7 eqs. DWB--The lower temperature inversion layer has an important role for the propagation of microwaves. In this report, some statistical features of the inversion layer at Sapporo during 1952 and 1953 are examined, that is: (1) height of the bottom of the layer, (2) height of the top of the layer, (3) thickness of the layer, (4) temperature difference between the bottom and the top of the layer, etc. Next, the curvature of microwave propagation in the inversion layer is examined by use of radiosonde data. (Met. Abs. 9.7-198) --Author's abstract.

E-490 Saxton, J. A., Scatter propagation and its application to television. Television Society, London, Journal, 8(7):273-284, July-Sept. 1957. 6 figs., 33 refs.--The fundamental aspects of radio wave scattering at VHF in the ionosphere, and at VHF and UHF in the troposphere are described; and a discussion is given of the possible application of both mechanisms for communication purposes. Scatter transmission is useful only for point to point links; and the manner in which the performance of these links depends on such parameters as frequency, bandwidth and aerial characteristics, is considered. Although ionospheric scattering may be used at frequencies of 25 to 60 Mc/s over paths of 1000 to 2000 km, the bandwidth capabilities are such that links operating in this manner are useful primarily for telegraphy, and to some extent for telephony; and, without a revolution in existing techniques, there is very little likehood that television signals will be relayed by this means. UHF tropospheric scatter links on the other hand, although in general much shorter than ionospheric links, are capable of transmitting much greater bandwidth, and there appear to be reasonable prospects for their ultimate use in relaying television over paths of a few hundred km as the technique develops. --Author's abstract.

E-491 Saxton, J. A.; Kreielsheimer, K. S. and Luscombe, G. W., Measurement of height gain at meter wavelengths. Electronic and Radio Engineer, London, 34:89-95, 1957. 7 figs., 12 refs.--A method has been derived, using lightweight, balloon-borne equipment incorporating a system of telemetry, for the measurement of height gain at meter wavelengths. The equipment has been designed primarily to operate at frequencies in the television B and I. Preliminary measurements made on the sound channel of the Sutton Coldfield transmitter of the BBC (frequency 58.25 Mc/s) have shown that, under conditions of standard atmospheric refraction, the observed height gain is very similar to that predicted by diffraction theory; but divergencies from this theory occur with non-standard modes of propagation. --Authors' abstract.

E-492 Schunemann, R., Uber den Ausbreitungsmechanismus ultrakurzer Wellen bei grossen Entfernungen. (Propagation mechanism of ultra short waves at great distances.) Hochfrequenztechnik und Elektroakustik, Leipzig, 66(2):52-61, Sept. 1957. 6 figs., 18 refs., 11 eqs. DLC--It has been hitherto assumed that ultrashort wave propagation over great distances is dependent on atmospheric turbulence. The author shows theoretically that refractive index fluctuations and the resulting partial reflections may also significantly contribute to the tropospheric propagation mechanism. --G.T.

E-493 Schunemann, R., Uber den Mechanismus der Ultrakurzwellenausbreitung jenseits des Horizonts. (Mechanism of USW propagation beyond the horizon.) Ilmenau. Hochschule für Elektrotechnik, Wissenschaftliche Zeitschrift, 3(1):59-62, 1957. (Unchecked)--Field strengths up to 100 km distances are mainly controlled by refraction, whereas scattering is responsible for the daily variation and which was experimentally evidenced through the 68 Mc transmissions over 76 km discussed here. The results are presented in graphs. The tropospheric scattering is largely responsible for the 100 - 800 km propagation from where ionospheric scattering takes place up to about 2000 km. Experimental propagation curves for different frequencies are accompanying the explanation of the tropospheric and ionospheric scattering held in a simple non-mathematical language. The origin of scattering are largely due to atmospheric inhomogeneities in the form of layers and cells. --N.T.G.

E-494 Silverman, Richard A., Fading of radio waves scattered by dielectric turbulence. Journal of Applied Physics, N.Y., 28(4):506-511, April 1957. 2 figs., numerous foot-refs., 21 eqs. DLC--The fading of radio waves scattered by dielectric turbulence is shown to be the result of two effects. The first is time variation of the scattering eddies as seen in a coordinate system moving with the local wind velocity. The second is Doppler shifting produced by the convection of the scattering eddies by the mean wind and by the macro-eddies. In the troposphere, the scattering eddies lie in the inertial range of statistical turbulence theory. This makes it possible to find the envelope fading rate of the received scattered signal to within a constant of proportionality by using dimensionality and similarity arguments. The result is an expression for the fading rate as a function of carrier frequency which departs significantly from that found with "scattering blob" models. (Met. Abs. 8 J-168)--Author's abstract.

E-495 Staras, H., Antenna to medium coupling loss. IRE Transactions on Antennas and Propagation, N.Y., 5(2):228-231, April 1957. 4 figs., 6 refs., 10 eqs. DBS--This paper presents an improved estimate of one of the more important systems parameters on a scatter circuit, namely, the antenna to medium coupling loss. The work presented in this paper differs from the earlier work of Booker and de Bettencourt, in that it permits evaluating the coupling loss even when nonconical, nonidentical antennas are used at either end of the scatter circuit, and it also permits taking the anisotropy of atmospheric turbulence into account. An important conclusion is reached that the coupling loss is not shared equally by the two antennas (i.e., transmitting and receiving) even if they are identical. This is a phenomenon which should be fully appreciated by engineers designing a scatter circuit or when measuring the coupling loss experimentally. --Author's abstract.

E-496 Takahashi, Kozo, On the scattering of radio waves in the troposphere, stratosphere and ionosphere. Japan. Radio Research Laboratories, Journal, 4(17):333-340, July 1957. 5 figs., 15 refs., 23 eqs. DBS--This paper explains the mechanism of the scattering of radio waves in the troposphere, stratosphere and ionosphere, and introduces new formulas for the scattering of radio waves by the use of the theory of partial reflection. The basic assumption is that the fluctuations of refractive index are chaotic. --Author's abstract.

E-497 Tao, Kazuhiko, Meteorological influences on the hourly median field strength of ultrashort waves in the diffraction region. Japan. Radio Research Laboratories, Journal, 4(16):155-254, April 1957. Numerous figs., tables, refs., eqs. DBS--After a brief historical review, a statistical investigation of seasonal variations of the vertical gradient of refractive index, calculated from radiosonde observations at several stations in Japan, and of nocturnal inversions is reported. Monthly charts of refractive index are included. The propagation theory of US waves is dealt with and curves of field strength vs distance are shown for various values of vertical gradient of refractive index. The correlation between observed refractive index profiles and field strength variations is analyzed and meteorological parameters involved are discussed in detail with the help of numerous sample records. Seasonal and diurnal variations of field strength are found to be closely associated with meteorological conditions. --G. T.

E-498 Tao, Kazuhiko, On the relationship between the scattering of radio waves and the statistical theory of turbulence. Japan. Radio Research Laboratories, Journal, 4(15):15-24, Jan. 1957. 20 refs., 48 eqs. DBS--In Pt. 1 of this paper, the reduction of the scattering cross section derived semi-intuitively by VILLARS and WEISKOPF (1954, 1955) is discussed more vigorously from the mathematical model of turbulent element. In Pt. 2, the scattering cross section is expressed in terms of the energy spectrum of the turbulence which is equivalent to the TAYLOR - KARMAN correlation function whose physical meaning is clear from the viewpoint of the statistical theory of turbulence. --Author's abstract.

E-499 Taumer, F. and Muller, K., Die Ausbreitung der Bodenwellen uber inhomogenen Untergrund. (Propagation of ground waves over inhomogenous surfaces.) BRF Technische Mitteilungen, 1(2):21, 1957. (Unchecked)--Exact analyses of the ground wave propagation over a homogenous plain or spherical earth have been made by several workers, but in practice this prerequisite is rarely met. Hence, further development in relation to the practical application of empirical methods for determination of the ground wave propagation over inhomogenous surfaces have become imperative in the last years. The evaluation of the different methods here discussed insures a technical interpretation of the area of radio coverage.

E-500 Telford, M., Communications potentialities of tropospheric scatter. Point to point telecommunications, Chelmsford, England, Communications Division, Marconi's Wireless Telegraph Co., 1(2):29-49, Feb. 1957. 9 figs., photos. DLC--After a short historical introduction, the various factors used in evaluating the communications potentialities of tropospheric scatter are discussed. Particular attention is paid to methods of calculating path attenuation, the most reliable of which appears to be that based on the angular distance concept. The calculation of received signal level and the more important parameters of FDM/FM scatter systems is then described. So called "optimum utilization" charts are introduced, useful for the quick assessment of system range, etc. Similar methods are applied to the consideration of SSB amplitude modulation and a comparison is made between the two types of modulation. Reference is made throughout to the necessity for diversity operation and a section is devoted to diversity techniques. The possibility of relaying television signals over tropospheric scatter circuits is critically reviewed. --R. M.

E-501 Texas. Univ. Electrical Engineering Research Lab., Measurements and analyses of index of refraction of the atmosphere. Contract AF 19(604)-494, Report No. 6-19, Final Report, March 31, 1957. 16 p. Bibliog. of technical reports under the contract, and papers published in journals or presented at meetings concerned with the results of research activities under the Contract AF 19(604)-494, as well as several theses. DWB (M94. 7 T355r)--Development, installation and testing of three air-borne refractometers as conducted from Aug. 1, 1952 through Feb. 28, 1957 is reviewed here. Two of the refractometers were designed for altitudes up to 30,000 ft and the third for altitudes up to 100,000 ft. Accuracy of all refractometers was 1 N unit; the two former were direct electronically supplied, the latter was direct or battery supplied for power. (Met. Abs. 8J-169)--W. N.

E-502 Tolbert, C. W. and Straiton, A. W., Attenuation and fluctuation of millimeter radio waves. IRE Convention Record, N. Y., Pt. 1, 1957. p. 12-18. 8 figs., 10 refs. DLC--This paper contains a resume of the millimeter propagation measurements conducted by the Electrical Engineering Research Laboratory of the Univ. of Texas. These measurements were made at wavelength of 8.6 millimeters and 4.3 millimeters, and more recently and as yet unreported, at a wavelength of 3.35 millimeters. The 8.6 and 4.3 millimeter measurements were made at elevations of 0.25 km and 4 km above sea level. The path length ranged from 3.5 to 61 mi. The 3.5 millimeter measurements were made at an elevation of 0.25 km over a path length of 7.5 mi. The measured oxygen and water vapor attenuations at the 3 millimeter wavelength are compared to theoretical attenuations. Spectra of scintillations are shown and several of the refraction characteristics are noted. A comparison of the propagation of the millimeter wavelength with that of 3.2 cm wavelengths is also made. --Authors' abstract.

E-503 Twersky, Victor, On scattering and reflection of electromagnetic waves by rough surface. IRE Transactions on Antennas and Propagation, N. Y., 5(1):81-90, Jan. 1957. 2 figs., foot-refs., 64 eqs. DBS--Simple approximations for the reflection coefficients and differential scattering cross sections per unit area of a random distribution of arbitrary protuberances on a ground plane are given in terms of the scattering amplitude of an isolated protuberance, their average number in unit area, and the given incident wave. These functions take into account multiple coherent scattering, and are mutually consistent in fulfilling the energy principle. It is shown, in general, that if the horizon angle approaches zero, then the reflection coefficients approach unity linearly, and the horizontal/vertical back scattering vanishes like the fourth/second power of the angle. General results are then specialized to arbitrary hemispheres and circular semi-cylinder, and applied to limiting cases of perfect conductors with radii very small or very large compared to wavelength. --Author's abstract.

E-504 Vvedenskii, B. A. and Arenberg, A. G., Dal'nee troposfernoe rasprostranenie ul'trakorotkikh voln. (Long distance tropospheric propagation of ultrashort waves.) Radiotekhnika, Moscow, 12(1):3-11, Jan. 1957 and 12(2):10-21, Feb. 1957. 14 figs., 40 refs., 5 eqs. Transl. into English in Radio Engineering, N. Y., 12(1): 1-13 and 12(2):10-25, 1957. DLC--This paper, in two parts, is essentially a survey of literature on the subject of transhorizon tropospheric propagation of radio waves up to 1956. The historical elaboration of the problem from the 1920's is traced, and includes information on early experiments. Several pages are devoted to the nature of fading. The problem of incoherent scattering is covered and the concept of the scattering volume is explained. The final section of the paper deals with the problems of coherent scattering, refraction, and diffraction of waves. --R. M.

E-505 Vvdenski, B. A. and Sokolov, A. V., Issledovaniia troposfernogo rasprostraneniia metrovykh, detsimetrovykh i santimetrovykh radiovoln v SSSR. (Investigations of tropospheric propagation of m, dm and cm radio waves in the U.S.S.R.) Radiotekhnika i Elektronika, Moscow, 2(11):1375-1389, Nov. 1957. Transl. into English in Radio Engineering and Electronics, N.Y., 2(11):84-105, 1957. 2 figs., 91 refs., 2 eqs.--Scientific research work conducted in the U.S.S.R. since 1922 in connection with the propagation of ultrashort radio waves in the troposphere is summarized. At the present time the problems under investigation consist of the explanation of the general mechanism of ultrashort wave propagation to different distances and the formation of a new theory, to allow engineering calculation of long distance ultrashort wave lines of communication. --E. K.

E-506 Vysokovskii, D. M., Geometricheskie kharakteristiki rasseianiia radiovoln na turbulentnykh neodnorodnostiakh troposfery. (Geometrical characteristics of radiowave scattering by the turbulent inhomogeneities of the troposphere.) Elektrosviaz', Moscow, 11(9):12-19, Sept. 1957. 2 figs., 4 refs., 43 eqs. DLC --Exact and approximate formulas are derived for determining the dimensions of the scatter volume and the angle of scatter. An expression is given for scattered power in the form of an integral for the scatter volume. Dimensions of the effective scatter volume with wide radiation patterns are determined on the basis of investigations of the extreme of this integral. The problem of selecting antenna dimensions for communication by scatter propagation is discussed, and the main geometrical characteristics of the scatter volume with narrow radiation patterns are given. --R. M.

E-507 Vysokovskii, D. M., K vyvodu vyrazheniia secheniia rasseianiia v teorii diffuznogo rasprostraneniia UKV v troposfere. (Derivation of an expression for the scattering cross section in the theory of tropospheric scattering of ultrashort waves.) Radiotekhnika i Elektronika, Moscow, 2(5):659-660, May 1957. 2 refs., 17 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 2(5): 194-196, 1957. --The author presents a mathematical analysis of the notion of the scattering cross section introduced by Booker and Gordon (1950) and elaborated by Staras (1952). The author generalizes the cross section by a spectral function which characterizes inhomogeneities in the dielectric constant and which is derived from the correlation function. It is shown that the scatter cross section is a function of scattering angle, not of wavelength. --R. M.

E-508 Vysokovskii, D. M., Vliianie refraktsii na diffuznoe rasprostranenie ul'trakorotkikh voln v troposfere. (Effects of refraction on tropospheric scatter propagation of ultrashort waves.) Radiotekhnika, Moscow, 12(5):30-36, May 1957. 2 figs., 2 refs., 27 eqs. Transl. into English in Radio Engineering, N.Y., 12(5):38-47, 1957. DLC--Approximate formulas are derived for the determination of such factors of the effects of refraction on the diffuse propagation or forward scattering of radio waves as decrease with the altitude of the scattering volume, change in the angle of scattering and change in the value of the scattering volume. The variation in power at the reception point in the presence of refraction is calculated. The results obtained are compared with the data of the theory of scattering of radio waves by turbulent inhomogeneities of the troposphere and with the experimental data. --R. M.

E-509 Wait, James R., A note on the propagation of the transient ground wave. Canadian Journal of Physics, Ottawa, 35(9):1146-1151, Sept. 1957. 3 figs., 9 refs., 17 eqs. DWB, DLC--Calculations are presented for "the wave forms of the ground wave field radiated from a transient electromagnetic source on the surface of the earth. The variations of the source dipole moment are taken to be ramp, step, and impulse functions, in turn. "The influence of the source on the radiative waveform is illustrated graphically for the ramp, step and impulse function on a spherical earth. Time parameter t vs. actual time t' for various distances (200-10,000 km) are shown on a nomogram for a perfectly conducting earth and for propagation over sea water. (Met. Abs. 10.5-217)--M. R.

E-510 Wait, J. R., Amplitude and phase of the low frequency ground wave near a coastline. U.S. National Bureau of Standards, Journal of Research, 58(5):237-242, May 1957. 3 figs., 18 eqs., foot-refs. DLC--A theoretical analysis is given for the amplitude and the phase exchange of the ground wave, originating from a distant transmitter on land, as it crosses a coastline. The land and sea are assumed to be smooth, and homogeneous with a sharp boundary of separation. Attention is focussed on the effects that take place near the coastline when it is not permissible to employ arguments based on the principle of stationary phase. A limited comparison is made with recent experimental work of Pressey, Ashwell, and Fowler. --Author's abstract.

E-511 Wait, J. R. (Nat'l. Bu. of Stands, Boulder, Colo.), Propagation of a pulse across a coast line. Institute of Radio Engineers, N.Y., Proceedings, 45(11):1550-1551, Nov. 1957. 3 figs., 3 refs., 13 eqs. DLC--The transformation of the pulse shape of the ground wave as it crosses a coast line for a source over the sea is briefly discussed. Numerical results for various mixed paths previously obtained are generalized to the case of a transient or pulsed source. To simplify the problem, the earth's curvature was neglected and the sea was assumed to be perfectly conducting. --E. K.

E-512 Wait, J. R., The transient behavior of the electromagnetic ground wave on a spherical earth. IRE Transactions on Antennas and Propagation, N.Y., 5(2): 198-202, April 1957. 5 figs., 7 refs., 20 eqs. DBS--Some calculations are presented to show the nature of the transient ground wave radiated from an electric dipole which is situated over a spherical earth. The moment of the dipole is considered to vary with time in a linear manner. It is shown that the departure of the leading edge of the radiation field from a step function form is a consequence of diffraction and loss in the finitely conducting ground. --Author's abstract.

E-513 Wait, J. R. and Murphy, Anabeth, Influence of a ridge on the low frequency ground wave. U.S. National Bureau of Standards, Journal of Research, 58(1):1-5, Jan. 1957. 4 figs., 6 refs., 9 eqs. DLC--The problem of a plane wave incident on a semi-elliptical boss on an otherwise perfectly conducting flat ground plane is considered. A solution in terms of elliptic wave functions is obtained. Numerical values of the field on the near and far side of this idealized ridge are given for a base width of about two thirds of a wavelength and various ellipticity ratios. --Authors' abstract.

E-514 Watt, A. D. and Maxwell, E. L. (both, Nat'l. Bureau of Standards, Boulder, Colo.), Characteristics of atmospheric noise from 1 to 100 Kc. Institute of Radio Engineers, N. Y., Proceedings, 45(6):787-794, June 1957. 18 figs., 10 foot-refs., 3 eqs. DLC--The results of some preliminary statistical measurements of the envelope of narrow band atmospheric noise are presented for a range of center frequencies from 1 to 100 kc. The variation of level and dynamic range, as a function of frequency, is examined and compared with results expected on the basis of lightning discharge spectra, thunderstorm distribution, and propagation phenomena. (Met. Abs. 9.7-110)--Authors' abstract.

E-515 Wheelon, Albert D. (Ramo-Wooldridge Corp., Los Angeles), Relation of radio measurements to the spectrum of tropospheric dielectric fluctuation. Journal of Applied Physics, N. Y., 28(6):684-693, June 1957. 10 figs., 20 refs., numerous eqs. DLC--The size spectrum of isotropic fluctuations in the troposphere's dielectric constant is related to quantities measured by radio means. Two classes of experiments are analyzed: (1) line-of-sight phase and amplitude instability, and (2) refractometer measurements of dielectric fluctuations. This analysis is independent of models for the dielectric fluctuations and provides a system from which the spectrum can be estimated from experimental data. The measured quantities are expressed as weighted integrals of the spectrum, many of which may be inverted to give the spectrum directly in terms of the data. Aerial smoothing by the receivers and finite data sample effects are studied, in addition to the basic propagation mechanisms. (Met. Abs. 8J-173)--Author's abstract.

E-516 Wheelon, A. D., Spectrum of turbulent fluctuations produced by convective mixing of gradients. Physical Review, 105(6):1706-1710, March 15, 1957. Fig., 199 refs., 5 eqs. DLC--Isotropic fluctuations of a passive scalar ψ produced by turbulent convection are investigated. The source of irregularities is considered to be the turbulent mixing of an established gradient of ψ. The mixing velocity field is described by HEISENBERG's spectrum for homogeneous, isotropic turbulence. Replacing the (self-mixing) transfer of energy down the spectrum by an equivalent diffusion term, the local fluctuation spectrum becomes

$$S(k) = (\nabla\psi)^2 \frac{1}{k^3} \frac{1}{\left[1 + (k/k_s)^4\right]4/3} \frac{1}{\left[1 + (k/k_s)4/3\right]^{2'}}$$

where k_s is the viscosity cutoff wave number of the velocity field. In the inertial range ($k \ll k_s$) this result agrees with spectrum deduced from purely dimensional arguments. Support for the above spectrum comes from the scattering of radio waves by dielectric fluctuations in the troposphere and ionosphere. (Met. Abs. 8J-172)--Author's abstract.

E-517 Wiesner, Jerome B., New methods of radio transmission. Scientific American, N. Y., 196(1):46-51, Jan. 1957. 8 figs. (incl. photos). DWB, DLC--A non-technical, illustrated article on the fundamentals of ionospheric and tropospheric propagation, and especially on "scatter propagation" from the troposphere and ionosphere. The latter enables fairly long distance communication by means of 30 to 70 megacycle waves, but equipment and operations are costly. Line-of-sight (30 mi) transmission is much cheaper but requires more installation and personnel, and is not always possible in Arctic or at sea. Some of the giant antenna used (e.g. at Cedar Rapids, Iowa and S. Dartmouth, Mass.) are illustrated. (Met. Abs. 8J-174)--M. R.

E-518 Wille, H., Ergebnisse von Ausbreitungsmessungen an einer 15 GHz Strecke. (Data on propagation measurements over a 15 GHz path.) Siemens Entwicklungsberichte, 20:226-227, Nov. 1957. (Unchecked)--The field strength of a 15 GHz radio transmission over a 44 km path was measured over a period of 642 hr. The transmitter and receiver set-up is described. Analysis of the frequency recordings shows 84 hr with interference fading. Selective fading was observed at 50 MHz when the field strength, as caused by non-selective fading, dropped 10 db below the median value. The interference fading by multiple path propagation was distinctly separable into fading due to water vapor and that of rain. --N.T.G.

E-519 Wiltse, J.C.; Schlesinger, S.P. and Johnson, C.M., Back-scattering characteristics of the sea in the region from 10 to 50 KMC. Institute of Radio Engineering, N.Y., Proceedings, 45(2):220-228, Feb. 1957. 11 figs., 9 refs., 7 eqs. DLC--Measurements of radiation back scattering from the ocean have been made over the frequency range from 10 to 50 kmc by means of several cw, Doppler, microwave systems operating simultaneously. The systems were mounted on the bow of a ship and various antenna depression angles from 0° (horizontal) to 90° were used. Data were obtained for vertical, horizontal, circular polarization, and for the cross polarized component of vertically polarized radiation. Horn antennas of 20 db gain were used at all of the operating frequencies and, in addition, higher and lower gain antennas were used at certain selected frequencies. Signals recorded from a variety of sea conditions have been used to calculate the back-scattering cross section per unit area, σ^{o}, and these calculations indicate that σ^{o} is nearly constant with microwave frequency and increases as the antenna depression angle is increased. The Doppler frequency characteristics of the returned signals have also been obtained from these measurements. A comparison is made between the experimental results and the characteristics predicted from simple scattering mechanisms. (Met. Abs. 8J-175)--Authors' abstract.

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E-520 Aksenov, V.I., O rasseianii elektromagnitnykh voln na sinusoidal'nykh i trokhoidal'nykh poverkhnostiiakh s konechnoĭ provodimost'iu. (The scattering of electromagnetic waves from sinusoidal and trochoidal surfaces of finite conductivity.) Radiotekhnika i Elektronika, Moscow, 3(4):459-466, April 1958. Fig., 6 refs., 29 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 3(4):1-10, 1958.--The solution to the problem of scattering of electromagnetic waves from a bounded section of a sinusoidal or trochoidal surface with finite conductivity is obtained in the Kirchhoff approximation. The solution permits the field to be calculated in the distant zone. A method is presented for the determination of the wave amplitudes in the scattering lobe maxima and an example of the calculation of scattering of electromagnetic waves from a sinusoidal surface is considered. --Author's abstract.

E-521 Anastassiades, M. and Paraskevopoulos, P., Sur la variabilite des conditions troposphériques determinée par les considerations radioélectriques. (Variability of tropospheric conditions determined from radioelectric considerations.) Académie des Sciences, Paris, Comptes Rendus, 246(26):3656-3658, June 30, 1958. 3 refs. DLC--Thera Island is connected with the island of Crete through a hertzian beam, operating on 1750 Mc/s with a purely maritime run of 120 km. Certain meteorological factors can have an effect on the intensity of the field picked up. The examination of a large number of field recordings has established that the experimental curves of the field distribution did in fact agree with Raleigh's rule in the case of periods superior to a certain limit. By using a special recorder, the authors were able to draw the experimental curves of the field distribution for time-periods ranging as far as a fraction of one minute. Generally, the field distribution agrees entirely with Rayleigh's rule, but departs from this distribution in a very characteristic way as soon as time-periods shorter than 10 min are reached. The deviation from this rule indicates unchanging tropospheric conditions, and in this manner, starting from radioelectric determinations, one could determine the longest period during which the troposphere presents unchanging characters. (Met. Abs. 10.8-191)--A.V.

E-522 Anderson, L.J. (Smyth Res. Associates, 3930 Fourth Ave., San Diego, Calif.), Tropospheric bending of radio waves. American Geophysical Union, Transactions, 39(2):208-212, April 1958. 7 figs., table, 2 refs., 8 eqs. DWB, DLC--A simple and accurate method is presented for computing the refractive bending of radio waves in the lower 100,000 ft of the atmosphere. A given refractive index profile is approximated by a series of straight lines (layers of constant gradient) and the incremental bending computed for each layer. The method is applied to the 'standard' atmosphere, and total bending is plotted against the surface refractive index for various vertical angles of arrival from 0 to 1 radian. (Met. Abs. 10.3-206) --Author's abstract.

E-523 Angell, B.C.; Foot, J.B.L. and Lucas, W.J., Propagation measurements at 3480 Mc/s over a 173 mi path. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105 (Supplement 8):128-142, 1958. 25 figs., 5 tables, 15 refs. DN-RL--The paper presents an account of an experimental study of beyond-the-horizon radio scatter propagation at a frequency of 3480 Mc/s over a path of 173 statute miles between Start Point and Wembley. Details of the path and brief details of the transmitting, receiving and recording equipment are given. Propagation data, collected from May 1956 to April 1957, are presented. The performance of the link is measured by the hourly median transmission loss, L, defined as the ratio, expressed in decibels, of the power transmitted to that received. The diurnal and seasonal variations in L are discussed. The distribution of the amplitude of the received signal within a period of an hour is used to investigate the characteristic rapid fading of the scattered signal. Some attempt has been made to associate variations in L with general trends in the weather. Experimental estimates of the aerial coupling loss are given and compared with various theoretical predictions. Preliminary measurements on double diversity, using aerials which can be separated in the vertical direction by distances varying from 9 to 17 ft, are reported. The effects produced by aircraft flying through the beam are discussed, and a series of tests in which a naval aircraft flew both along and transversely across the transmission path are described.--Authors' abstract.

E-524 Asai, Juniichi; Fujikawa, Masatoshi; Tsuchiya, Kiyoma; Ishii, Takahiroo and Kajikawa, Makota, Relation of the meteorological variables to the fading types of VHF propagation over the sea. Japan. Radio Research Laboratories, Tokyo, Review, 4(17):266-276, Oct. 1958. 8 figs., 4 tables, 6 refs. In Japanese; English summary p. 266. DLC--The purpose of this paper is to describe the relation of certain meteorological variables, such as velocities and directions of winds, states of the sky, etc., to the fading types of VHF. One way transmission tests were carried out from Jan. 1955 to Dec. 1957 over the Sea of Kashimanada, a distance of 77 km on the frequencies 60 and 150 Mc. Deductions from the chi-square test are as follows: (1) considerable effects are apparent under the following conditions of the surface wind velocity, especially on 150 Mc than on 60 Mc. When the velocity is over 8 m/sec, roller types decrease and scintillation types increase; when below 8 m/sec, reverse is the case. (2) The difference of air masses or weather charts is effectual and the seasonal variation is apparent, for example, roller types increase in summer, while scintillation types increase in winter. (3) When the wind sits on the sea, roller types increase; and on the land, scintillation types increase. (4) Interesting effects are observed under certain states of the sky and with kinds of clouds. When lower clouds disappear and strati or stratocumuli appear, roller types increase markedly, scintillation types decreasing. When fractocumuli or fractonimbi appear, roller types decrease and scintillation types increase. (Met. Abs. 14.2-117)

E-525 Bauer, John R. and Meyer, James, H., Microvariations of water vapor in the lower troposphere with applications to long-range radio communications. American Geophysical Union, Transactions, 39(4):624-631, Aug. 1958. 6 figs., 14 refs., 5 eqs. DWB, DLC--Variations of water vapor in the troposphere are calculated from simultaneous airborne measurements of radio refractive index and temperature obtained respectively with a microwave refractometer and an aerograph employing a sensitive bead thermistor. The partial pressure of water vapor is calculated from the well known equation

$$e(mb) = 2.7\,(n - 1)T^2 - 2.1 \times 10^{-4}\,PT$$

where n is the refractive index; T is temperature, °K; and P is total atmospheric pressure mb. The method is applied to the investigation of the horizontal and vertical structure of water vapor associated with a thin inversion layer found near 9800 ft pressure altitude. Evidence is offered for the vertical stability and absence of turbulent mixing of the air in the region of the inversion. When the reflection coefficient of the observed layer at radio wavelengths of 600 and 72 cm is computed at a range of 200 mi beyond the horizon, better than an order of magnitude agreement is obtained between the calculated and observed path losses at this range. --Authors' abstract.

E-526 Bean, B. R. (Radio Met. Sec. Nat'l. Bur. of Standards, Boulder, Colo.), First meeting on radio climatology. Institute of Radio Engineers, Proceedings, 46(7): 1425-1426, July 1958. Eq. DWB, DLC--On Jan. 15, 1958, a meeting was held at the Boulder Laboratories of the National Bureau of Standards, to determine methods and standards for compilation of radio propagation indexes based on meteorological data. The U.S. NBS, Air Defense Command, Army Signal Radio Propagation Agency, Army Electronic Proving Ground, Navy Weather Research Facility, and Naval Electronics Laboratory were represented. Agreement was reached that constants $K_1 = 77.6$ and $K_2 = 4810$ should be used in expressions for refractivity in formula $N = \frac{K_1}{T} P + \frac{K_2 e\,RH}{T}$ where P is station pressure (mb), RH – relative humidity, e – vapor pressure in mb at absolute temperature T (Kelvin). Also a listing should be made of past data for general use and these and all punched cards at the N. W. R. C. (Asheville) should be sent to C. R. P. L. (Boulder). Calculations of radio refractivity will be made from radiosonde data at N. W. R. C. and five years of daily observations for Feb., May, Aug. and Nov. will be minimum for radio climatology of a place. (Met. Abs. 10.9-71)--M. R.

E-527 Beckmann, Petr, Height errors in radar measurements due to propagation causes. Acta Technica, Prague, 3(6):471-488, 1958. 9 figs., 2 tables, 7 refs., 59 eqs. Russian summary p. 487-488. DLC--Corrections to be used in target height determinations on account of height distribution and variations of refractive index are deduced analytically. Values for probability estimates of height error without aerological measurements, and corrections when aerological measurements are available (pressure, temperature and humidity) are derived and presented in diagrams. --G. T.

E-528 Bigler, Stuart G. (Dept. of Oceanog. & Met., A. & M. College), On the observation and application of angel echoes using the AN/CPS-9 radar. Weather Radar Conference, 7th, Miami Beach, Florida, Nov. 17-20, 1958, Proceedings, issued 1958. Sec. D:22-30. 8 figs., 8 refs. DWB (M01.81 R124pc, 1958)--Echoes from regions in the atmosphere where no reflecting of scattering sources could be seen are described. Such echoes, commonly called angels, include the following types, (1) echo lines caused by wind shifts associated with dry fronts, squall lines, and air mass showers; (2) echoes indicating the presence of layers aloft; (3) others which are uniform and diffuse, origin uncertain, and (4) fibrilliform echoes presumably resulting from thermals. One or more of these echo types were photographed (but may have been observed more often) on 79% of the 37 radar operating days between June 1 and July 23, 1958. Meteorological conditions during the observations are described. Application of the observation in short range forecasting and in the study of certain atmospheric processes are proposed. (Met. Abs. 11H-15)--Author's abstract.

E-529 Bolgiano, R., Jr., The role of turbulent mixing on scatter propagation. IRE Transactions on Antennas and Propagation, N. Y., 6(2):161-168, April 1958. 4 figs., foot-refs., eqs. throughout. DLC--The Villars-Weisskopf-Wheelon theory describing turbulent mixing of an established gradient is shown to contain a contradiction which necessitates its being discarded. To fill the gap thus created, the theory of isotropic mixing is extended to account for the presence of a gradient. The results indicate that mixing in gradient cannot be employed to explain the wavelength dependence characteristic of much of the radio data. On the other hand, it is shown that experimentally determined spectra of refractive index fluctuations lend strong support to the mixing theory herein set forth. Hence, the conclusion is reached that scatter theory, as it is currently based on atmospheric turbulence, can provide, at best, an incomplete description of transhorizon propagation. --Author's abstract.

E-530 Bonavoglia, Luigi, Correlazione fra fenomeni meteorologici e propagazione oltre l'orizzonte sul Mediterraneo. (Correlation between meteorological phenomena and propagation beyond the horizon over the Mediterranean.) Alta Frequenza, Milan, 27(6):815-824, Dec. 1958. 5 figs. DBS (TK6540. AS)--On the basis of results of radio propagation experiments beyond the horizon over the open sea at different altitudes between the island of Minorca and Sardinia, and of meteorological data on humidity, pressure and temperature obtained at different hours of the day at the observatories of Mahon, Carloforte and Elmas, variations of refractive index at the surface and at different altitudes are determined and correlations are established between recession levels, gradients and refractive indices. --Transl. of author's abstract.

E-531 Braham, Roscoe R., Jr.; Harrington, Edward L. and Hoffer, Thomas E., Cloud refractive index studies, Pt. 2, Use of distributions of Δ N vs. Δ S for estimating mechanical turbulence. Chicago Univ. Dept. of Meteorology, Contract AF 19(604)-1931, Technical Note, No. 17, Sept. 2, 1958. 18 p. 8 figs., 2 refs., eq.(Appendix: numerous tables.) DWB--An analysis has been made of fine structure variations of refractive index in and around a group of about 70 cumulus clouds with a view toward relating these variations to mechanical turbulence parameters. Frequency distributions of refractive index gradients were prepared for each level of flight for clear air, cloud core and regions of transition at the cloud boundaries. Similar distributions were prepared for refractive index increments. The latter distributions, in the form of tables of N change vs. gradient size (ΔS), are presented as an appendix. From these distributions a parameter analogous to the "mixing length" of early turbulence theory was computed. This study shows that eddies of the transition regions of cumulus clouds have dimensions of a few tens of meters and are carried for distances of the order of 30-50 m before losing their identity. Mixing lengths of clear air eddies are much larger than those of cloud eddies, except, possibly, for those eddies in the uppermost parts of the clouds. (Met. Abs. 10.9-178)--Authors' abstract.

E-532 Braude, S. Ia., O raspredelenii rasseivaiushchikh elementov pri rasprostranenii radiovoln nad vzvolnovannoĭ poverkhnost'iu moria. (Distribution of scattering elements in radio wave propagation over an agitated sea surface.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 1(3):25-29, 1958. 2 figs., 9 refs., 2 eqs. DLC, NNC--A method is proposed for the statistical study of the distribution of scatterers on the basis of measurements of radio signals reflected from an agitated sea surface. The method is similar to that used in radio astronomy for determining the distribution of discrete radio sources. Experimental verification shows that the method proposed makes it possible to determine characteristics of the distribution of elements by which radio waves are scattered. --Transl. of author's abstract.

E-533 Braude, S. Ia. and Bass, F. G., O vozmozhnosti opredeleniia funktsii raspredeleniia rasseivateleĭ na vzvolnovannoĭ poverkhnosti moria radiolokatsionnymi metodami. (Feasibility of determining the distribution function of scatterers on an agitated sea surface using radar.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 1(3):161-162, 1958. DLC, NNC--The power of signals scattered by the sea may be written

$$\left(\frac{\bar{P}}{\bar{P}_o}\right) \simeq \left(\frac{R}{R_o}\right)^{-\alpha}$$

Where $\bar{P}$ and $\bar{P}_o$ is the power received by the radar station at distances R and R_o. If N and N_o are used to designate the total number of sources which will scatter power $\bar{P}$ and $\bar{P}_o$ and more, then, according to the literature, the following experimental relationship holds.

$$\left(\frac{N}{N_o}\right) \simeq \left(\frac{\bar{P}}{R_o}\right)^{-k}$$

The proposed method of determining the distribution function of scatterers is applicable when experimental data can be described by the above equations and the antenna pattern of the locator is sufficiently narrow that the distribution function does not depend on angular coordinates. --R. M.

E-534 Bremmer, H., Applications of operational calculus to ground wave propagation, particularly for long waves. IRE Transactions on Antennas and Propagation, N. Y., 6(3):267-272, July 1958. 11 refs., 24 eqs. DLC--All results of the approximative diffraction theory dealing with the propagation of radio waves around a smooth spherical earth (surrounded by a homogenous atmosphere) can be derived from a one dimensional integral equation originally discussed by Hufford. This equation can be solved in terms of operational calculus which leads, first of all, to the well known residue series. In this treatment the Sommerfeld theory for a flat earth appears at once as a limiting case; moreover, analytic expressions for correction terms accounting for the finite value of earth's radius are easily determined. Finally, the equation in question can also be used for the extension to inhomogeneous soil conditions, without neglecting the earth's curvature. --Author's abstract.

E-535 Buxton, A.J. and Felix, M.O., The reduction of threshold by the use of frequency compression. Institution of Electrical Engineers, London, Proceedings, Pt.B, 105 (Supplement 8):117-121, 1958. 8 figs., 4 refs., 4 eqs. DN-RL--Any angle modulated system suffers from a threshold when the instantaneous noise vector becomes equal to or larger than the carrier. This effect is a limiting factor in most f.m. scatter systems, since the signal to any one receiver will fall below threshold for a far from negligible part of the time. The paper shows that the threshold level depends only on the combined bandwidth of the r.f. and i.f. circuits, and is unaffected by the existence of the frequency-compression loop. Thus, such a receiver enables one to combine the large f.m. improvement of the wide deviation signal with the low threshold of the narrow i.f. band. --Authors' abstract.

E-536 Cherenkova, Elena Lazarevna, Dal'nee rasprostranenie ul'trakorotkikh voln. (Long distance propagation of ultrashort waves.) Moscow. Gosudarstvennoe Izdatel'stvo Literatury po Voprosam Sviazi i Radio, 1958. 42 p. 26 figs. DLC (TK6553.C7)--A systematic survey, in popular form, of existing literature on long distance propagation of ultrashort waves by tropospheric and ionospheric scattering. Attention is centered on the explanation of physical processes occurring in this type of propagation and the results of experiments in this field. Requirements of equipment for ionospheric and tropospheric scatter links are covered. --Author's abstract.

E-537 Chisholm, J.H.; Rainville, L.P.; Roche, J.F. and Root, H.G., Measurements of the bandwidth of radio waves propagated by the troposphere beyond the horizon. IRE Transactions on Antennas and Propagation, N.Y., 6(4):377-378, Oct. 1958. 3 figs., foot-ref. DLC--A brief summary of experiments designed to investigate the transmission characteristics as a function of time and frequency is presented. The results of the analyses in the time and frequency domains are consistent and both suggest that the multipath delays are less than predicted by the scattering model used by S.O. Rice.--E.K.

E-538 Denisov, N.G., O rasprostranenii voln v plosko-sloistoĭ srede, soderzhashcheĭ statisticheskie neodnorodnosti. (Propagation of waves in a plane stratified medium containing statistical inhomogeneities.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 1(5/6):34-40, 1958. 5 refs., 31 eqs. DLC--On the basis of the Einstein-Focker equation, the propagation of waves in a medium containing regular and statistical inhomogeneities is analyzed. Fluctuations of the angle of reception, the angular spectrum and the lateral correlation function of the wave field passing through the inhomogeneous layer are calculated. Intensity fluctuations are also computed. --Transl. of author's abstract.

E-539 Dinger, H.E.; Garner, W.E.; Hamilton, D.H., Jr. and Teachman, A.E., Investigation of long distance overwater tropospheric propagation at 400 mc. Institute of Radio Engineers, Proceedings, 46(7):1401-1410, July 1958. 15 figs., foot-refs. DWB, DLC--The results of an investigation of overwater tropospheric propagation under both summer (July 1955) and winter (Feb. 1956) conditions are presented. Transmissions were from a point on the south shore of Massachusetts, near New Bedford, to a ship traveling along Great Circle courses to a maximum distance of 630 naut mi (724 statute mi) from the transmitter. A 10 kw, 385.5 mc transmitter feeding a 28 ft paraboloid antenna was used for the summer phase. For the winter investigation, this same facility was used, supplemented by a 40 kw transmitter feeding a 60 ft paraboloid for use at the greater distances. The frequency used for the winter was 412.85 mc. The receiving antenna aboard the ship was a 17 ft paraboloid for both series of tests. All antennas were horizontally polarized and approximately 100 ft above sea level. The data obtained are presented to show the median path loss vs. distance. The strip chart recordings of the received signal levels are analyzed with respect to fading characteristics in an effort to separate out those transmissions which were enhanced by super refractive conditions. The fast fading signals, which were well represented by the Rayleigh distribution, were assumed to be unaffected by superrefractive conditions. The data for the fast fading Rayleigh type signals appear to show a cyclic variation of the attenuation rate with distance although there is no substantial deviation from a linear rate of between 0.16 and 0.18 db per nautical mile. (Met. Abs. 10.4-163) --Authors' abstract.

E-540 Dropkin, Herbert A., Direct reading microwave phase meter. IRE National Convention Record, Pt. 1-6:57-63, 1958. 8 figs., 9 refs. --An instrument for rapid measurements of the phase properties of microwave networks is described and discussed. Adjusted to a single frequency ± 1° phase measurements are feasible. The method is applicable for general use and at other microwave frequency ranges. --W. N.

E-541 du Castel, Francois; Misme, Pierre and Voge, Jean, Reflexion d'une onde electromagnetique par une couche d'atmosphère présentant une variation de l'indice de refraction. (Reflection of an electromagnetic wave from an atmospheric layer with a variable refractive index.) Académie des Sciences, Paris, Comptes Rendus, 246(12):1838-1840, March 24, 1958. DLC--A general formulation of the reflection coefficient, which may be interpreted as an increasing function of the atmosphere thickness where great stability prevails, is presented. (Met. Abs. 10.1-342) --A. V.

E-542 du Castel, F.; Misme, P. and Voge, Jean, Réflexions partielles dans l'atmosphere et propagation a grande distance. Pt. 1. Mesures meteorologiques. (Partial reflections in the atmosphere and long range propagation. Pt. 1. Meteorological measurements.) Annales des Télecommunications, Paris, 13(7/8):209-214, July/Aug. 1958. Ibid. Pt. 2. Interpretation des mesures météorologiques. (Interpretation of meteorological measurements.) Ibid. 13(9/10):265-270, Sept./Oct., 1958. 19 figs., 11 refs. Also: du Castel, F.; Misme, P.; Spizzichino, A. and Voge, J., Supplement to Pt. 2, entitled: Variations des dimensions des feullets en fonction de l'altitude. (Layer size variations in function of altitude.) Ibid. 15(1/2):48—50, Jan./Feb. 1960. 2 tables, 2 refs. DLC--Theories of the electrical field beyond-the-horizon are reviewed in Pt. 1. Find each theory valid for a particular model atmosphere. Present results of measurements in France and elsewhere. In Pt. 2, the authors study the two possible forms of flux in the atmosphere: laminar and turbulent. The distinct studies of humidity mixing ratio and of temperature lead to specify the turbulence conditions. It is, therefore, concluded that the atmosphere is composed of two different families of layers: a stable one that corresponds to a laminar flux, and an unstable or turbulent one.

Each type of layer is separately examined with regard to the variation of the refractive index. Here the authors have investigated a certain number of parameters relating to stable layers and to turbulent layers, but the horizontal extent range of these layers has not been expressed in function of the altitude and only results from measurements in the first kilometers of the atmosphere were given. In this article the authors compute the variations of two proportional parameters: the one having the same horizontal sizes and the layers, the other having the thickness on the transition zone between the stable zone and the turbulent zone. The stable layers possess comparable characteristics in the first kilometers of the atmosphere The irregularity characteristics of length and thickness are in the same range, and all measurements made either by refractometer or by radar in the low stratosphere are comparable to each other and permit to fix with a fair precision which parameters intervene in the numeric calculations of the partial reflections theory. (See refs. E-628, 785, 786, 772, and 715 for other parts) (Met. Abs. 14. 1-55)--A. V.

E-543 Eckart, Gottfried, Uber die Polarisationsdrehung elektrischer Wellen in inhomogenen isotropen Dielektriken unter besonderer Berücksichtigung der Troposphäre. (Polarization shifts of electrical waves in inhomogeneous isotropic dielectric media with particular attention to the troposphere.) Zeitschrift für Angewandte Physik, Berlin, 10(8):393-395, Aug. 1958. 2 refs., 32 eqs. DLC--Polarization shifts have been observed in ultrashort wave propagation where the path is entirely within the troposphere. Taking account of the known tropospheric inhomogeneities such shifts are explained on the basis of the Maxwell equations and conditions are determined under which the shifts do not occur. --Transl. of author's abstract.

E-544 Evdokimov, M. A., Izuchenie rasseianiia radiovoln na troposfernykh neodnorodnostiiakh pokazatelia prelomleniia metodom radioastronomicheskikh izmereniĭ. (Investigation of radio wave scattering by tropospheric inhomogeneities of the refractive index using radioastronomical measurements.) Radiotekhnika i Elektronika, Moscow, 3(12):1430-1440, Dec. 1958. 3 figs., 4 tables, 8 refs., 6 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 3(12):28-42, 1958. DLC--Results are presented of measurements on intensity of scattered solar radiation on wavelength 3.2 cm. The results obtained are compared with theoretical estimates. --Author's abstract.

E-545 Felsenheld, R. A.; Harstad, H.; Jatlow, J. L.; Levine, D. J. and Pollack, L., Wide band ultrahigh frequency over-the-horizon equipment. Communication and Electronics, N.Y., No. 35:86-93, March 1958. 22 figs., 2 tables, 5 refs. DLC--Wide band over the horizon radio equipment in the 680 to 900 mc (megacycle) band suitable for use in toll quality multichannel telephone or TV circuits is described. The system comprises 60 foot parabolic antennas fed with dual polarization horns, 10 watt drivers, 10 kw amplifiers using 6 cavity klystrons, and receivers which permit dual or quadruple diversity by combining the received signals at the IF (intermediate frequency). The over all 1 db bandwidth is 15 mc, and the time delay distortion characteristics are suitable for interconnection with existing toll quality radio links. --Authors' abstract.

E-546 Flock, W. L.; Mackey, R. C. and Hershberger, W. D., Propagation at 36,000 megacycles in the Los Angeles basin. California. Univ. at L. A. Dept. of Engineering, Report, 58-14, Feb. 1958. 55 p. 20 figs., table, 13 refs., 29 eqs. DWB (M(051) C153pr)--Microwave propagation studies, at a frequency of approximately 36,000 Mc, have been carried out in the Los Angeles basin. The basin is characterized by the presence of the persistent, low level temperature inversion of the eastern edge of the Pacific anticyclone, and this inversion is responsible for the trapping of atmospheric pollutants. The index of refraction profile associated with the temperature inversion strongly influences microwave propagation. An 11.4 mi path from City Hall to the UCLA campus has been set up and used for obtaining experimental data. The system was completed in 1956 and data was obtained regularly in the fall of 1956. Operation on a smaller scale has been carried out since that time and the system is intact and available for further use. The purpose of the investigation has been two fold. In the first place, it was anticipated that information would possibly be obtained about air pollutants and about the atmospheric conditions associated with air pollution. Secondly, basic information concerning propagation characteristics and mechanisms, as influenced by an inversion layer, was desired. No positive indication of the role of air pollutants has been obtained, but the report presents information concerning propagation characteristics and mechanisms. (Met. Abs. 13.7-125)--Authors' abstract.

E-547 Fok, V. A.; Vainshtein, L. A. and Belkina, M. G., Rasprostranenie radiovoln po prizemnomu troposfericheskomu volnovodu. (Radio wave propagation in a surface tropospheric duct.) Radiotekhnika i Elektronika, Moscow, 3(12):1411-1429, Dec. 1958. 17 figs., 4 tables, 7 refs., 70 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 3(12):1-27, 1958. DLC--The article is devoted to the theory of radiowave propagation between communication points in an inversion layer (tropospheric duct) at the surface. A method for calculating the attenuation factor in the presence of super refraction is developed. A number of concrete cases of propagation are calculated. More exact criteria are given determining the existence or absence of long distance propagation as a function of the inversion layer properties and wavelength. --Authors' abstract.

E-548 Gough, M. V., Diurnal influences in tropospheric propagation. Marconi Review, London, 21(131):198-212, 1958. 8 figs., 14 refs. DLC--The existence of diurnal variations in the signal strength of very short waves has considerable scientific interest. As is now well appreciated, the basic cause of these variations is the nocturnal cooling of heated land by radiation when the sky is clear, which gives rise during the night and early morning to pronounced atmospheric stratification near the ground. After a brief historical survey of observations of these effects, this article appraises the results of 80 Mc/s signal strength recordings maintained for 6 months over a 137 km nonoptical path in the Persian Gulf, where the phenomenon occurred to a noteworthy degree. Modified refractive index profiles derived from selected upper air soundings made near the radio path have shown a clear association between (a) very weak signals and an approximately standard atmosphere, and (b) very strong signals and the presence of pronounced elevated or ground based inversion layers. Measured and theoretical signal strengths are compared on the basis of a uniformly graded atmosphere, reflection at an idealized elevated inversion layer, and propagation within a duct as treated by BOOKER. Finally, an analysis is made of M-profiles exhibiting the presence of ground based ducts, which were found to be associated with high signal levels over the test path. It is shown that in 12 out of 19 instances, trapping of the first transmission mode was taking place on a wavelength of 3.75 m. These observations, made in exceptional climatic conditions, provide evidence of recurrent nocturnal trapping on a wavelength which is perhaps longer than has hitherto been considered possible. (Met. Abs. 12.2-89)--Author's abstract.

E-549 Graf, Calvin R. (U.S.A.F., San Antonio), Lightning enhancement of a VHF tropospheric scatter signal. Institute of Radio Engineers, Proceedings, 46(5, Pt. 1):915, May 1958. Ref. DLC--Observations of enhancement of TV tropospheric scatter signals each time lightning is seen are reported and details of the phenomenon and accompanying circumstances are described. The observations were made in San Antonio, Tex., with video signals received from Houston and Midland, 200 and 300 mi distant. (Met. Abs. 14.2-731)--G.T.

E-550 Grozier, A.L., Captive Balloon refractovariometer. Review of Scientific Instruments, N.Y., 29(4):276-279, April 1958. 5 figs., 3 refs. DLC--A system is described for measuring and recording rapid (3 cps) fluctuations of refractive index, humidity (vapor pressure), and temperature using fast response thermistor beads. The system utilizes wet and dry thermistors whose changes are fed into a simple analog computer. The accuracy of the system is 1 part in 10^7 for refractive index, about 0.1 mbar for humidity and 0.1°C for temperature. Measurements can be obtained to an altitude of 5000 ft above the measuring site, with an altitude accuracy of 50 ft under optimum weather conditions.--Author's abstract.

E-551 Hirai, Masaichi; Fuji, Yoshihisa and Saito, Hiromu, An experimental investigation of the diffraction at VHF and UHF by mountain ridges. Japan. Radio Research Laboratories, Journal, 5(21):189-210, July 1958. 19 figs., 8 tables, 10 refs., 3 eqs. DBS--A diffraction propagation test over a distance of about 280 km between Tokyo and Sado across the Mikuni Mountains was performed at the frequencies 159.49 and 600.00 Mc simultaneously. On the basis of results of these measurements, this paper discusses the temporal variations, spatial variations and transmission losses of the diffraction waves.--Authors' abstract.

E-552 Hirao, Kunio, Diurnal variation in intensity of fading of VHF wave. Japan. Radio Research Laboratories, Journal, 5(20):105-107, April 1958. Fig., 5 refs. DBS--In the present paper, the ratio of the intensity of fading in the daytime to that in the nighttime is discussed by means of the data of observations at several localities. The result of an analysis shows that the diurnal variation in received signal becomes feasible when the cross point of the lines of sight drawn from both the transmitter and receiver becomes higher than about 1 km above the surface.--Author's abstract.

E-553 Isted, G.A., Guglielmo Marconi and communication beyond the horizon: a short historical note. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105(Supplement 8):79-83, 1958. 5 figs., 11 refs. DN-RL. Also same article in Point to Point Communications, Essex, England, 2(2):5-17, Feb. 1958. DLC--The paper describes experiments, carried out between 1928 and 1936 by Guglielmo Marconi, which demonstrated that transmission beyond the horizon by means of microwaves was practicable. Furthermore, the influence of tropospheric mechanisms on radiowave propagation was recognized by him at the time.--Author's abstract.

E-554 Isted, G.A., Marconi and tropospheric scatter. Marconi Review, London, 21(129):41-42, 1958. DLC--Several cases are cited from Marconi Review of 1933 where beyond-the-horizon reception of microwaves (30-600 mc) was achieved by MARCONI in the Rome-Castel Gandolfo transmission route (mountains intervene) from Sardinia to the Italian mainland (270 km or 8 times optical distance) and from the steamer "Elettro" in the Mediterranean to Santa Margherita on the Italian

Riviera (250 km or 9 times optical distance). The assumption made by MARCONI was that there was a stratification below the ionosphere (i.e., the troposphere) that would account for this nonoptical transmission. (Met. Abs. 12.2-90)--M.R.

E-555 Johnson, M.A., Review of tropospheric scatter propagation theory and its application to experiment. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105(Supplement 8):165-176, 1958. 33 refs., 48 eqs. DN-RL--A comprehensive review is made of published work on the theory of beyond horizon propagation of radio waves by means of oblique scattering from randomly distributed irregularities of refractive index in the troposphere. A scattering theory is formulated which attempts to take as accurate account as possible of all effects likely to be important in practice, consisting of some new results combined with the best features of existing theories. Application of this theory to a variety of experimental results yields generally good agreement. Possible causes of some discrepancies, and the likely relative importance of scattering and certain other long distance propagation mechanisms, are discussed. (Author's abstract.

E-556 Jones, R.F. (Met. Office, London), Radar echoes from atmospheric inhomogeneities. Royal Meteorological Society, Quarterly Journal, 84(362):437-442, Oct. 1958. 2 tables, 9 refs., 14 eqs. DWB, DLC--The possibility that radar echoes from atmospheric inhomogeneities are the explanation of echoes received in conditions which made it certain they are not received from precipitation elements ("angel" echoes) is examined quantitatively. It is shown that such an explanation is theoretically possible but that the required refractive index changes are large, involving changes of a few mb in vapor pressure and/or a few degrees C in temperature in a distance of about 25 cm. Reflection of the main or side lobe energy at a limited quasi-horizontal surface is shown to give the most likely meteorological explanation, but the inability to measure changes of refractive index in the free atmosphere to the required accuracy prevents positive confirmation. (Met. Abs. 10.8-132)--Author's abstract.

E-557 Josephson, B. and Carlson, G., Distance dependence, fading characteristics and pulse distortion of 3000 Mc trans-horizon signals. IRE Transactions on Antennas and Propagation, N.Y., 6(2):173-175, April 1958. 6 figs. DLC--Statistical analysis of signal recordings at 10 cm wavelength has given the following results. The distance dependence of the half hour signal median F_m over a sea path corresponds to a scattering parameter which is approximately inversely proportional to the height. Between F_m and the surface value of M a correlation coefficient of 0.62 is found, and between F_m and the dew point 0.55. A unit increase of M seems to be followed by a signal increase between the limits 0.3 and 0.8 db. The fading range, as defined between the 10% and 90% of time levels, is 12-14 db, and the fading frequency mostly about 2 c/s for a 300 km path. Over a 260 km land path the pulse broadening was normally 0.1-0.2 which corresponds to a scattering parameter varying inversely as the first to second power of the height. A severe pulse distortion caused by selective fading is found to be very common. Some other propagation characteristics are also discussed. --Authors' abstract.

E-558 Josephson, B. and Eklund, F., Some microwave propagation experiences from a just below horizon path. IRE Transactions on Antennas and Propagation, N.Y., 6(2):176-178, April 1958. 5 figs., 2 refs. DLC--Based on comparisons between field strength records at 2300 Mc and simultaneously measured M curves, it is concluded that the most important propagation disturbances on the test path are caused by reflection from discontinuities in the refractive index profile. The occurrence probability for such discontinuities is shown to have marked seasonal and diurnal period with a maximum in the summer and around sunrise. --Authors' abstract.

E-559 Jowett, J. K. S., The measurement and prediction of VHF tropospheric field strengths at distances beyond the horizon. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105(Supplement 8):91-96, 1958. 7 figs., table, 16 refs. DN-RL--Following a brief historical review of theoretical and practical deductions concerning the characteristics of VHF tropospheric propagation beyond the horizon, an account is given of a series of measurements made since 1948 by the Post Office at receiving sites within the United Kingdom. Particular attention is given to the concept of angular distance and to the effect of path profile on the median levels of field strength, as well as on the range of fading observed. Simple transmission laws deduced from the observed data enable empirical curves of field strength versus distance to be drawn for various percentages of the time. --Author's abstract.

E-560 Joy, W. R. R., Radio propagation far beyond the horizon at about 3-2 cm wavelength. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105 (Supplement 8):158-164, 1958. 5 figs., 2 tables, 6 refs. DN-RL--A series of measurements on transmissions of 3.2 cm wavelength at ranges far beyond the radio horizon has been made over various paths, at arbitrary periods of time. These have established the existence of an essentially permanent extra-diffraction signal field. While its level does not change appreciably with time, the character of this signal can vary from that typical of a scattering process to that due to a coherent mode of propagation. Further, although the observed signal attenuation rate with distance is similar to that expected for a scattered field, the average level is found to be some 10-15 db below that predicted from theory. There appear to be factors affecting the long range propagation of 3.2 cm waves through the lower atmosphere which are incompletely understood. Although no extensive analysis of meteorological conditions has been made, there is some evidence to show that the existence of extensive well pronounced anticyclonic systems results in poor propagation conditions for the extra diffraction signals. --Author's abstract.

E-561 Joy, W. R. R., The long range propagation of radio waves at 10 cm wavelength. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105(Supplement 8):153-157, 1958. 11 figs., 2 tables, 7 refs. DN-RL--A survey is presented of the results obtained in a series of short term experiments on the propagation of 10 cm radiation over clear sea paths to distances well beyond the diffraction region, under a variety of weather conditions. Very slowly attenuated signals have been received consistently, under normal atmospheric conditions, from an initial threshold beyond the horizon when the diffracted signal is some 60 db below the corresponding free space level. Analysis of the amplitude distributions of some of the received signals confirms that propagation to ranges in the extra diffraction region was due to a scattering process. --Author's abstract.

E-562 Kalinin, Iu. K., K voprosu o difraktsii radiovoln nad neodnorodnoĭ sfericheskoĭ poverkhnost'iu Zemli. (The question of diffraction of radio waves over an inhomogeneous spherical Earth surface.) Radiotekhnika i Elektronika, Moscow, 3(10): 1274-1279, Oct. 1958. 4 refs., 17 eqs. Transl. into English in Radio Engineering and Electronics, N. Y., 3(10):77-85. DLC--A formula is obtained for the attenuation function when the path consists of n sections. A particular case is considered of paths consisting of a large number of sections and paths in which one of the sections is small. The formula for the attenuation function is generalized to the case of continuously varying path parameters. --Author's abstract.

E-563 Kalinin, Iu. K. and Feinberg, E. L., Rasprostranenie zemnoi volny nad neodnorodnoi sfericheskoi poverkhnost'iu Zemli. (Ground wave propagation over the surface of an inhomogeneous spherical earth.) Radiotekhnika i Elektronika, Moscow, 3(9):1122-1132, Sept. 1958. 5 figs., 8 refs., 24 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 3(9):25-41, 1958. DLC--The theory of ground wave propagation over an inhomogeneous path is generalized to the case of a spherical Earth. Formulas for the attenuation function (for beyond the horizon reception) when the path consists of 2 or 3 homogeneous sections, are given. Coastal refraction is also considered. --Authors' abstract.

E-564 Kennaugh, E. M. and Cosgriff, R. L., The use of impulse response in electromagnetic scattering problems. IRE National Convention Record, N.Y., Pt. 1-6:72-77, 1958. 7 figs., 2 refs.--Nearly exact solution to electromagnetic scattering problems for any source frequency by an approximation to the impulse response of the scatterer is illustrated for several types of scatterers. Comparison of this novel method described is made with results as obtained by standard methods. --W. N.

E-565 Kitchen, F. A. and Johnson, M. A. (both, Royal Naval Scientific Service, London), Role of turbulent scattering in long distance radio propagation at Metre wave-lengths. Nature, London, 182(4631):302-304, Aug. 2, 1958. Fig., 7 refs. DWB--A report on experiments apparently confirming the theoretical prediction of the mechanism of long distance propagation of short waves as a function of scattering of the randomly distributed irregularities of the refractive index associated with atmospheric turbulence. A frequency of 203.5 Mc/s was used in the experiments conducted by the Admiralty Signal and Radar Establishment, Nov. and Dec. 1957, in the English Channel. A ship-borne transmitter against a shore based receiver near Portsmouth gave the practical confirmation of the presence of the phenomenon at meter wavelengths. (Met. Abs. 13.9-111)--W. N.

E-566 Kitchen, F. A.; Richards, E. G. and Richmond, I. J., Some investigations of meter-wave radio propagation in trans-horizon region. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105(Supplement 8):106-116, 1958. 12 figs., table, 21 refs. DN-RL--Investigations have been made of the characteristics of metric radio transmissions in the trans-horizon region, at ranges up to 400 nautical miles. These indicate the essentially continuous existence of troposphere supported signal components in this region, although their detailed characteristics are subject to variations. Under particular meteorological conditions, such as the formation of an elevated inversion layer, an additional propagation mode is present, leading to a composite signal at intermediate ranges. --Authors abstract.

E-567 Malkowski, G., Kleinraumige Superrefraktionserscheinungen hinter einem abziehenden Gewitter. (Small scale superrefraction phenomena behind a moving thunderstorm.) Meteorologische Rundschau, Berlin, 11(5):141-145, Sept./Oct. 1958. 13 figs., table, 3 refs., 4 eqs. DWB, DLC--The mechanism of superrefraction of cm waves is discussed with the aid of a formula expressing the refraction index, and three principal types of vertical distribution of the refractive index are established. These are as follows: Type I in which the refraction index (N) increases with elevation in the 0-3 km layer above the ground (dN/dh > 0); Type II is characterized by N being constant with altitude (dN/dh 0) and in Type III, N decreases with altitude (dN/dh = 0). A case of small scale superrefraction arising behind a passing thunderstorm observed with the Berlin radarscope during the evening of May 8, 1958, is presented. With the aid of radar pictures the author describes the propagation of the radar echo. After passage of the echo ENE, numerous brightly illuminated ground targets appeared. These additional ground echoes became visible only within a 35 km wide strip traversed by the storm; in the other zones of the radar area the propagation toward ground targets remained normal. Two explanations are given for the brief improvement in propagation. One explanation suggests that the cause is the heavy rainfall released by the storm; as a result of rain penetration into the uppermost ground layers (in the case of 3 cm radar a ground layer of only several centimeters thickness suffices) the reflection capacity of the ground is raised. The change of reflection capacity caused by the rain is computed by means of the Fresnel equation. The other explanation is based upon the assumption that behind a thunderstorm there occur processes which bring about an N distribution in the lower troposphere that favor the superrefraction. Detailed considerations of both explanations, graphs of the computed refraction index and radarscope pictures are presented. (Met. Abs. 11.2-171)--I.L.D.

E-568 Millington, G., Propagation at great heights in the atmosphere. Marconi Review, London, 21(131):143-160, 1958. 9 figs., 10 refs., 62 eqs. DLC--This article considers tropospheric propagation over the earth through an atmosphere which is standard at small heights but in which the refractive index approaches unity asymptotically at great heights. The departure from the linear decrease leads in the geometric optical region to a reduced horizon distance and in the diffraction region to a reduction in height gain. The latter may be interpreted as an equivalent change in distance which is found to be effectively independent of frequency and identical with the decrease in horizon distance. It follows that the shape of the propagation curve as a function of distance is maintained and that the important thing to establish is the position of the horizon for the assumed model of the atmosphere. The theory is illustrated by using a refraction index that decreases exponentially to unity. (Met. Abs. 12.5-66)--Author's abstract.

E-569 Misme, P., The correlation between the electric field at a great distance and a new radio meteorological parameter. IRE Transactions on Antennas and Propagation, N.Y., 6(3):289-292, July 1958. 9 figs., foot-refs. DLC--The daily variations of hourly median 1046 Mc transmission loss recorded over a 370 km propagation path, are found to be correlated with a new meteorological parameter that combines the thermodynamic stability of the atmosphere and the useful gradient of the radio refractive index. The thermodynamic stability is evaluated from the area contained between the observed temperature distribution with height and the pseudo adiabatic temperature lapse, while the useful gradient of the refractive index is derived from ray tracing considerations, and is weighted toward the initial gradient. --Author's abstract.

E-570 Moler, William F. (U.S. Navy Elec. Lab.), Macro- and meso-scale meteorological effects upon microwave trans-horizon fields. Weather Radar Conference, 7th, Miami Beach, Florida, Nov. 17-20, Proceedings, issued 1958. Sec. E:26-33. 7 figs., 7 refs. DWB (M01.81 R124pc, 1958)--Results of correlations between X and L band microwave signal strengths and meteorological parameters are presented. Median signal strengths over periods of the order of days are best correlated with the macro-scale middle and upper tropospheric flow. Short term large scale fluctuations of trans-horizon electromagnetic fields are often observed during apparently spatially homogeneous time stationary macro-scale synoptic regimes. A meso-scale analysis shows that these fluctuations occur concurrently with minor perturbations developing over or moving across the radio links. (Met. Abs. 12. 2-93)--Author's abstract.

E-571 Okamoto, Hironobu; Aida, Kazuo and Ose, Masami, Scattering short-waves over the sea. Japan. Radio Research Laboratories, Tokyo, Review, 4(14):16-19, Jan. 1958. 4 figs., table, 2 refs. In Japanese; English summary p. 16. DLC--New type of scattering echoes of radio waves were observed in almost the entire course of Japan's Antarctic Research Expedition I. These echoes have regular diurnal variations and are distinctly different in strength depending whether they are over the sea or near the land. This paper describes the type of the echoes and their diurnal variations, including some investigations carried out after returning to Japan. (Met. Abs. 14. 5-139)--Authors' abstract.

E-572 Onoue, Michio; Hirai, Masaichi and Niwa, Shuntaro, Results of experiment of long distance overland propagation of ultra-short waves. Japan. Radio Research Laboratories, Journal, 5(20):79-94, April 1958. 11 figs., 6 tables, 18 refs. Also Japanese version with English Summary in its Review, 4(15):85-94, April 1958. DBS--This paper explains the results of a VHF and UHF path loss test performed over a distance of 364 km between Tokyo and Osaka. Frequencies used were 159. 49 Mc and 600. 00 Mc. The measurement was made from Nov. 1956 to Aug. 1957. The data were statistically analyzed to investigate the temporal variation of field strength, the spatial correlation of field strength, and relations between the transmission loss and meteorological conditions. (Met. Abs. 14. 4-119)

E-573 Parry, C. A., Factors affecting the use of over-the-horizon links in telecommunication networks. Communication and Electronics, N. Y., No. 38:485-496, Sept. 1958. 9 figs., 2 tables, 20 refs. DLC--An attempt is made to evaluate the scatter link, not so much in terms of performance, as in its compatibility with existing communication facilities and surrounding facets of the social technology and economic structure. It is pointed out that the scatter link has the basic advantage of being effective over relatively large spans without losing the principal advantages that have been normally associated with radio relays. --E. K.

E-574 Prosin, A. V., K raschetu moshchnosti rasseianiia pri dal'nem troposfernom rasprostranenii ul'trakorotkikh voln. (Calculations of scattered power in long distance tropospheric propagation of ultrashort waves.) Elektrosviaz', Moscow, 12(8):13-21, Aug. 1958. 17 refs., 24 eqs. DLC. Transl. into English in Telecommunications, N. Y., No. 8:811-822, 1958. --The author develops a method for calculating scattered power in connection with the use of directional and non-directional antennas. Some conclusions are reached concerning antenna directivity in the horizontal and vertical planes. Losses in antenna gain are also studied. Experimental results are compared with theoretical data. (See ref. E-765)--R. M.

E-575 Prosin, A. V. and Tsvetkov, A. N., Radiorele̍inye linii sviazi. (Radio relay links.) Moscow, Akademiia Nauk SSSR, 1958. 108 p. 33 figs., 18 eqs. DLC (TK6553. P74)--A popular science booklet containing a discussion of the principles and equipment of radio relay links operating within the normal horizon and beyond the horizon, in the latter case by means of tropospheric and ionospheric propagation of ultrashort waves. These links are intended to facilitate multichannel telephone and telegraph service and the interurban transmission of television programs. Existing Soviet radio relay links and some in the planning stage are mentioned. Some applications of radio relay communications are also discussed. --R. M.

E-576 Rautenfeld, Friedrich von, Zur statistischen Auswertung von Feldstarkemessungen (Vorläufige Mitteilung). (Statistical evaluation of field strength measurements. (Preliminary communication).) Rundfunktechnische Mitteilungen, Hamburg, 2(4): 178-180, Aug. 1958. 3 figs., 12 refs. English, German and French summaries p. 178. DLC--The author describes the fundamental outline of a method for storing several statistically fluctuating parameters on a magnetic tape, which also operates with cheap domestic magnetic sound recording currently to be found on the market. The advantages compared with the well known method of recording curves on paper tape: facility of storage of measured values and protocol texts, automatic maintenance of time correlation, relief of a fully automatic statistical evaluation, the possibility of using tape again after evaluation. Furthermore, a new evaluation device is mentioned which simultaneously finds and prints as percentages the results of statistical distributions, statistical sums and correlation of several variables. --Author's abstract.

E-577 Richards, E. G., The estimation of transmission loss in the trans-horizon region. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105 (Supplement 8): 177-183, 1958. 9 figs., 2 tables, 11 refs., 16 eqs. DN-RL--The expression for the scattering cross section derived by Batchelor has been integrated over the useful scattering volume for transmitting and receiving aerials aligned on a great circle path, and formulas have been derived for the transmission loss. The application of the theory to experimental results at 86, 3000 and 10, 000 Mc/s suggests that mean-square variations of refractive index of the atmosphere may be independent of height up to about 2200 ft and may then vary with the inverse square of height. --Author's abstract.

E-578 Rider, G. C., Propagation measurements at 858 Mc/s over paths up to 585 km. Marconi Review, London, 21(131):184-197, 1958. 13 figs., 9 refs. DLC--The purpose of this paper is to present the results of some propagation measurements at a frequency of 858 Mc/s made in the United Kingdom over a two and one-half years period. The objective was to obtain the knowhow in the application of the tropospheric scatter mode of propagation. The path investigated have been progressively increased in length up to a total distance of 585 km. The general picture presented by the measurements described accords well with comparable published results. However, the attenuation rate of 0.103 db/km may be noted, as also the diversity distances which are larger than was expected. --E. K.

E-579 Rider, G. C., Some tropospheric scatter propagation measurements and tests of aerial siting conditions at 858 Mc/s. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105 (Supplement 8):143-152, 1958. 10 figs., 6 tables, 8 refs. DN-RL--A tropospheric scatter link has been in operation for three months over a 98 mi path and for eight months over a 200 mi path at a frequency of 858 Mc/s. Received signals are shown to agree well with predictions of mean levels, while seasonal and diurnal variations are slightly less than was anticipated. Height/gain and space diversity tests are described, and a comparison is made of signals received at four sites of very different aspects within the same locality. The fast fading is described in terms of fading range and fading rate, and an attempt is made to relate this information, together with the slower changes, to meteorological observations. A program of synchronous beam rotation has been carried out, and tests of received polarization show the polarization to be well preserved in propagation. The disturbing effect of local flying is investigated and discussed. --Author's abstract.

E-580 Riggs, Lowell P., An investigation of the atmospheric physical conditions associated with microwave propagation. Texas. Agricultural and Mechanical College, Contract AF 19(604)-1564, Technical Note, No. 4, March 1958. 65 p. 30 figs. (incl. photos), 5 tables, 20 refs., eqs. DWB (M94.7 T353te)--In an attempt to evolve procedures whereby meteorologists, using ordinary weather observations, can predict anomalous propagation of radar energy, relationships between radar observations and weather factors which might reasonably be expected to influence "trapping" have been examined. No significant correlation between any single meteorological parameter and the degree of trapping could be found. Instead, as might be expected, it appears that a number of factors contribute to the degree of refraction. The most sensitive parameter is (for the regions studied) the degree of stratification of layers from the surface to 5000 ft alt. When the height of the low level moisture layer reaches this altitude, trapping is negligible. Procedures for the preparation of objective forecasts of anomalous propagation are presented. (Met. Abs. 10.5-214)--Author's abstract.

E-581 Ringwalt, D.L.; Ament, W.S. and MacDonald, F.C., Measurements of 1250 Mc scatter propagation as function of meteorology. IRE Transactions on Antennas and Propagation, N.Y., 6(2):208-209, April 1958. DLC--The evaluation of 105 full length refractometer soundings showed a break of about 40 or 50 n units in a 1000 ft interval centered at altitudes from 4000 to 6000 ft, moist oceanic air of high refractive index being found below the break. Near and above the inversion, the Rayleigh fading was usually superimposed on a slower fade having a period of about one minute with fades of about 10 db. The slow underlying fade in the signals at inversion height suggests the duct mechanism, while the midpath shear correlation supports the leaky ceiling picture. --E.K.

E-582 Rowden, R.A.; Tagholm, L.F.; Stark, J.W., A survey of tropospheric wave propagation measurements by the B.B.C., 1946-1957. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105 (Supplement 8):84-90, 1958. 4 figs., table, 7 refs. DN-RL--The paper describes beyond-the-horizon tropospheric wave propagation measurements made by the B.B.C. Research Department during the years 1946-57. Initially, the data were used to assist the B.B.C. in planning common frequency working within the United Kingdom for VHF sound broadcasting and television, and later became a contribution toward the collection of data organized internationally by the C.C.I.R. and used by that body in the preparation of field strength/distance curves representing average tropospheric conditions. --Authors' abstract.

E-583 Schmelovsky, Karl-Heinz, Probleme der Ausbreitung in tropospharischen und ionospharischen Wellenleitern. (Problems of propagation in tropospheric and ionospheric wave guides.) Germany. (Democratic Republic) Meteorologischer und Hydrologischer Dienst, Abhandlungen, 7(49), 1958. 41 p. 14 figs., 2 tables, 23 refs., numerous eqs. DLC--An attempt is made to find a general procedure for determining the propagation characteristic of a wave guide, in particular its propagation damping. In the derivation of these characteristics the author constructs a model which describes the field in the wave guide as a process of interference of waves which are reflected at the limits. By using this model it is possible to retain the concept of the reflection factors. The problems considered include exclusively wave guides having a propagation constant that is very complex as a result of radiation or reflection losses, thereby the boundary wavelength looses its fundamental importance; approximately spherical symmetrical guides are present; the ratio of longitudinal to transverse measurements is usually substantially smaller than in the case of artificial hollow guides. The mathematical treatment of the propagation in the case of homogeneous wave guides, in tropospheric wave guides and in homogeneous wave guides are presented and application and illustrations for the interpretation of sunrise effects on the atmospheric noise level, in the longest wavelengths and propagation constants of tropospheric wave guides are given. (Met. Abs. 11E-137)--I.L.D.

E-584 Schunemann, R., Über die Ausbreitung ultrakurzer Wellen an rauhen Schichten. (Propagation of ultrashort waves over rough surfaces.) Hochfrequenztechnik und Elektroakustik, Leipzig, 66(6):171-173, May 1958. 2 refs., eqs. DLC--Supplementing an earlier paper on long distance propagation mechanisms (see E-492) received field intensities are calculated for scattering layer sections with different degrees of overlapping in the 1st Fresnel zone. The calculated values are found to be within the measurement error even with small degrees of overlapping and small variations of refractive index gradient. Time variations may be determined from the probability distribution of amplitudes of a constant vector and a Rayleigh distribution vector.--Transl. of author's abstract.

E-585 Senn, H.V. (Marine Lab., Univ. of Miami), Observations and possible explanations of certain fine lines. Weather Radar Conference, 7th, Miami Beach, Fla., Nov. 17-20, 1958, Proceedings, issued 1958. Sec. D:31-36. 4 figs., table, 6 refs. DWB (M01.81 R124pc, 1958)--Observations of several radar "thin bands" on both MPS-4, 4.7 cm and SP-1M, 10.7 cm radars show that at least one type of band is confined to very low levels. Several possible explanations are given for the existence of these bands. But most evidence seems to indicate that ground targets are being observed, probably as a result of a combination of refraction and forward scattering from abrupt low level changes in the refractive index which are caused by local convective activity. Another type of fine line, which appears as a circular arc on airborne radars, can be attributed to solid targets which are picked up on side lobes of the radar beam. (Met. Abs. 11H-132)--Author's abstract.

E-586 Smyth, John B., Tropospheric radio propagation, Report on URSI Commission II. Institute of Radio Engineers, N.Y., Proceedings, 46(7):1358-1361, July 1958. DLC--The technical papers and discussions presented were organized into three broad categories: 1) tropospheric propagation within the horizon, 2) tropospheric propagation beyond the horizon, and 3) radio and meteorology. Each individual contribution is briefly summarized.--E.K.

E-587 Sofaer, E., Phase coherent back scatter of radio waves at the surface of the sea. Institution of Electrical Engineers, N.Y., Proceedings, 105B(22):383-394, July 1958. 15 figs., 3 tables, 6 refs., appendices. DLC--Soon after the completion of the B.B.C.'s television transmitting station in Devon and the establishment of a full scale service, complaints were received from coastal areas around Plymouth that the transmission was subject to rhythmic variations in amplitude. The investigations which followed these reports are described. The variations are found to be due to phase coherent back scatter from the sea, and to depend on the configuration of the surface of the sea. The phenomenon is examined theoretically. --Author's abstract.

E-588 Starkey, B.J.; Turner, W.R. and Badcoe, S.R., The effects of atmospheric discontinuity layers up to and including the tropopause on beyond-the-horizon propagation phenomena. Institution of Electrical Engineers, London, Proceedings, Pt. B, 105 (Supplement 8):97-105, 1958. 11 figs., table, 11 refs., 7 eqs. DN-RL--Field strength measurements at distances extending far beyond the horizon from a transmitter on a frequency of 91.3 Mc/s have been carried out in an aircraft flying at heights of about 10,000 ft. It is shown that the results obtained and other experimental data can be explained more readily on the assumption that the mechanism of tropospheric propagation over such distances is due to reflections from discrete discontinuity layers in the atmosphere up to the height of the tropopause than by the theory of forward scatter due to turbulence. --Authors' abstract.

E-589 Tao, Kazuhiko; Orimo, Jinsuke; Sakurazawa, Akira et al., The present status of the scatter propagation, Pt. 1. Japan. Radio Research Lab., Tokyo, Quarterly Review, 3(13):256-283, Oct. 1957. English summary p. 256. 17 figs., tables, numerous eqs., 67 refs. Pt. 2, Ibid., 4(14):20-60, Jan. 1958. Numerous figs., tables (some fold.), 70 refs., eqs. In Japanese. DLC--In recent years a series of experiments on both ionospheric propagation of VHF waves and tropospheric propagation of ultrashort waves and microwaves far beyond the horizon have been carried out in various countries. The propagation mode of these experiments has been attributed to the scattering by fluctuation of electron density or refractive index. Therefore, the subject of radio propagation by scattering processes has acquired a great theoretical and practical importance. The object of this paper is to introduce the present status of the scatter propagation both in the ionosphere and troposphere. In Ch. 1 of the paper, turbulence in the ionosphere and troposphere and the various theories of scattering in terms of turbulence are discussed. In Ch. 2, summaries of the experiments carried out in various countries and the instruments used, the propagation characteristics of ionospheric scattering, and moreover, the utilization in practical communication are described. In Ch. 3, the same problems stated in Ch. 2 are introduced for tropospheric scattering. (Met. Abs. 14.1-58)--Authors' abstract.

E-590 Tatarskii, V.I., O rasprostranenii voln v lokal'no izotropnoĭ turbulentnoĭ srede s plavno meniaiushchimisia kharakteristikami. (Propagation of waves in a locally isotropic turbulent medium with gradually changing characteristics.) Akademiia Nauk SSSR, Doklady, 120(2):289-292, 1958. 9 refs., 127 eqs. DLC--It is shown that in calculating phase and amplitude fluctuations of short waves propagated in a real atmosphere, account must be taken of the fact that turbulence along the path of the beam may vary in intensity, as, for example, with altitude. Expressions are derived for amplitude and phase fluctuation intensity and variations in the refraction index are considered according to the two-thirds law. --R.M.

E-591 Trenev, N.G., Difraktsiia poverkhnostnykh elektromagnitnykh voln na impedansnoĭ stupenke. (The diffraction of surface electromagnetic waves on the impedance stage.) Radiotekhnika i Elektronika, Moscow, 3(1):27-37, Jan. 1958. 5 figs., 5 refs., 52 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 3(1):38-53, 1958. DLC--This article considers the problem of diffraction of surface E and H waves on the impedance stage. Expressions are given for the reflection and transmission coefficients. The diffraction field and the radiation characteristics are determined. --Author's abstract.

E-592 Trenev, N. G., Difraktsiia poverkhnostnykh elektromagnitnykh voln na polubeskonechnoĭ impedansnoĭ ploskosti. (Diffraction of surface electromagnetic waves on a semi-infinite impedance plane.) Radiotekhnika i Elektronika, Moscow, 3(2): 163-171, Feb. 1958. 4 figs., 3 refs., 50 eqs. Transl. into English in Radio Engineering and Electronics, N. Y., 3(2):227-238, 1958. DLC--The article considers the problem of diffraction of surface E and H waves at the edge of a two sided impedance plane. Expressions are derived for the coefficients of reflection and transmission, the diffracted field and the radiation diagrams. --Author's abstract.

E-593 Trolese, L. G. and Anderson, L. J., Foreground terrain effects on overland UHF transmission. IRE Transactions on Antennas and Propagation, N. Y., 6(4):330-337, Oct. 1958. 22 figs., table, foot-refs. DLC--This paper describes an experimental study of the influence of the shape of foreground terrain profiles near terminals of UHF links on the received field. A gently rounded shape of the foreground profile causes a marked diffraction pattern to be superimposed on the normal variation of field strength with height. The diffraction geometry shows similarity to knife edge geometry and the rounded terrain feature appears to act geometrically as an equivalent knife edge. The amplitude of the spatial variations in signal are, however, much greater than knife edge theory predicts. A sizeable foreground diffraction enhancement of received field can be realized by locating the antenna at the height of the first diffraction maximum. Changing refraction due to meteorological variations can change both the position in height and intensity of the diffraction pattern. --Authors' abstract.

E-594 Tsel'min, A. E. and Krauz, L. I., Vliianie vysot antenn na moshchnost' priema pri rasprostranenii v usloviiakh troposfernogo rasseianiia. (The effect of aerial height on received power for propagation in conditions of tropospheric scattering.) Radiotekhnika, Moscow, 13(11):11-17, Nov. 1958. 5 figs., 4 refs., 29 eqs. Transl. into English in Radio Engineering, N. Y., 13(11):12-21, 1958. DLC--An expression for the attenuation function is derived which makes it possible to design a communication link using tropospheric scattering of radio waves in the meter band, taking into account the effect of the Earth's surface on the radiation pattern of the aerial. Graphs are given showing the dependence of the attenuation function on distance and antenna heights for the case where the dependence of turbulence on height has a quadratic form. --Authors' abstract.

E-595 U. S. Navy Weather Research Facility, Some aids for estimating atmospheric refractive conditions. Project AROWA, Interim Research Report on Task 31 (Meteorological aspects of refraction and propagation of radar waves), June 1958. 52 p. 13 figs., 5 charts, 2 tables. Bibliog. p. 39-52. DWB (M93.1 U585so)--The U. S. Navy Weather Research Facility has been developing new techniques for predicting the atmospheric refractive index as a part of the meteorological aspects of refraction and propagation of radar waves. This report contains the results of their efforts. The report covers the refractive index formulas, the atmospheric effects on radar propagation, the needed computation aids, the atmospheric refractive data and 113 selected references on related atmospheric conditions. (Met. Abs. 11.3-224) --N. N.

E-596 Vysokovskii, David M., Diffuznoe rasprostranenie ul'trakorotkikh voln v troposfere pri antennakh s bol'shoĭ napravlennost'iu. (Scatter propagation of ultrashort waves in the troposphere with highly directive antennas.) Elektrosviaz', Moscow, 12(5):16-22, May 1958. 4 figs., 5 refs. DLC. Transl. into English in Telecommunications, N. Y., No. 5:488-497, 1958. --Expressions are derived for the power scattered by inhomogeneous turbulence, losses in antenna gain, and the widening of the radiation pattern with scatter propagation for wide and narrow radiation patterns. It is found that the scatter volume integrated as a prism is twice as large as the actual scatter volume, requiring the division of the results by 2 for narrow radiation patterns. It is shown that with a radiation pattern width of 0.25-3° (antenna gain 58-36 db), antenna gain losses obtained by Booker and Bettencourt are 4-8 db too high. --R. M.

E-597 Vysokovskii, David Markovich, Nekotorye voprosy dal'nego troposfernogo rasprostraneniia ul'trakorotkikh radiovoln. (Long distance tropospheric propagation of ultrashort radio waves.) Moscow, Izdatel'stvo Akademiia Nauk SSSR, 1958. 153 p. 58 figs., 173 refs., numerous eqs. At head of T-p: Akademii Nauk SSSR. Institut Nauchno-Tekhnicheskoĭ Informatsii. --This is a review of international literature including a large amount of data and mathematical formulation. The material is discussed under the following seven chapter headings: 1) Atmospheric turbulence and refractive index fluctuations; 2) Theory of radio wave scattering by tropospheric turbulent inhomogeneities; 3) Fluctuations of the scattered field; 4) Experimental investigation of field characteristics in long distance propagation; 5) Phase fluctuations in scatter propagation; 6) Calculation of USW long distance links, and 7) Equipment for USW long distance links. --G. T.

E-598 Wait, James R., On the theory of propagation of electromagnetic waves along a curved surface. Canadian Journal of Physics, Ottawa, 36(1):9-17, Jan. 1958. 2 figs., 16 refs. DLC--The problem of propagation of vertically polarized waves along a surface whose curvature and electrical properties have a discontinuity is considered. The mutual impedance Z between two short vertical antennas on either side of the boundary of separation is considered to be the fundamental quantity which is sought. By utilizing the principle of stationary phase and concept of surface impedance, an approximate expression is derived for Z. It is shown that to a first order of magnitude, the effects of the conductivity contrast and curvature change are additive corrections to the mutual impedance between dipoles over a single homogeneous spherical surface. --Author's abstract.

E-599 Waterman, A.T., Jr., A rapid beam swinging experiment in trans-horizon propagation. IRE Transactions on Antennas and Propagation, N.Y., 6(4):338-340, Oct. 1958. 7 figs., 8 refs. DLC--By using a broadside phased array for an antenna, a narrow beam can be swung rapidly and in quick succession through a limited sector by fast control of the phasing, rather than by movement of the entire antenna structure. This technique is used at the receiving end of a 101 mi beyond the horizon transmission path in order to probe the portion of the troposphere through which the signal is propagated. At a frequency employed of 3.12 kmc, a 0.49° beam is swung in azimuth through a 4.2° sector each tenth of a second. A variety of phenomena are observed with this technique which have not been directly apparent in slower beam swinging experiments. The beam broadening effect attributed to atmospheric scattering is not always evident on any one sector scan. However, the change from scan to scan is frequently rapid enough so that a time average would show the broadening. At times the scan to scan changes are systematic and show a continuity indicative of a motion of the scattering or reflecting regions; in some cases this motion is too rapid to be accounted for by transport of air, thus implying a wave motion rippling through the atmosphere. At other times the atmospheric structure is too fine to be resolved by the beamwidth employed, and the time variations too rapid to reveal a continuity from one scan to the next. --Author's abstract.

E-600 Waterman, A.T., Jr., Some generalized scattering relationships in trans-horizon propagation. Institute of Radio Engineers, N.Y., Proceedings, 46(11):1842-1848, Nov. 1958. 4 figs., 2 tables, foot-refs., 18 eqs. DLC--An analysis is made of the consequences to be derived from some fairly broad assumptions as to the nature of turbulent scattering and its effect on waves propagated through the troposphere. The intent is to provide a means for testing the general applicability of this model as an explanation for trans-horizon propagation. General relationships for the variation of received power with distance are derived for various scatter angle dependencies, and for various beam width configurations. These relationships are then extended to cover the phenomenon of aperture medium coupling loss. The results are applied toward distinguishing those experiments which are definitive from those which are not. --Author's abstract.

E-601 Yeh, L.P., Basic analysis on the controlled carrier operation of tropospheric scatter communications system. IRE National Convention Record, 8:261-283, 1958. 13 figs., 24 refs., 14 eqs. DLC--This paper analyzes the possibility of applying controlled carrier operation to tropospheric scatter communication systems which means that the transmitter power will change as closely as possible in accordance with the fluctuation of the received signal level with time. Basic requirements, mainly in the field of propagation, are discussed in detail. Certain advanced thinking in tropospheric scatter propagation is also presented, such as: 1) one minute as the sampling period of Rayleigh Distribution Fast Fading; 2) long term minutely median distribution as the long term slow fading distribution; 3) probability combination of fast and slow fading distributions as the combining fading distribution to determine system reliability; 4) effect of detector time consonant on the fast fading distribution. --Author's abstract.

E-602 Yeh, L.P., Tropospheric scatter system design. Communication and Electronics, N.Y., No.39:707-716, Nov. 1958. 8 figs., 5 tables, 14 refs. DLC--A comprehensive procedure is presented, from an approach partly experimental and partly theoretical, for the design of tropospheric scatter communication systems, using single side band (SSB) or frequency modulation (FM) and frequency division multiplex (FDM). --E.K.

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E-603 Ames, L.A. and Rogers, T.F., 220 Mc radiowave reception at 700-1000 miles. Institute of Radio Engineers, N.Y., Proceedings, 47(1):86, Jan. 1959. Fig., 6 refs. DLC--An account of two airborne investigations of long distance 220 Mc field strength conducted in March and April 1958. Results of measurements during the two flights are presented. In the latter case, the signal was still being received at 1000 statute miles, where it was a very few db above the noise level. The indicated median path loss throughout the 800-1000 mi region was 275 db ± 5 db. --E.K.

E-604 Anderson, W.L.; Beyers, N.J. and Fannin, B.M., Comparison of computed with observed atmospheric refraction. IRE Transactions on Antennas and Propagation, N.Y., 7(3):258-260, July 1959. 2 figs., 2 tables, 3 refs., 6 eqs. DLC--Ray tracing methods have been applied in the computation of atmospheric refraction for a path at White Sands Missile Range, N. Mex., with a range of about 48 mi and an elevation angle of 14.5 milliradians. The atmosphere was assumed to be horizontally stratified. Refractive index profiles were derived from meteorological data obtained from surface observations, wiresondes, radiosondes, and airborne refractometer soundings. The profiles were classified "A", "B", or "C", in descending order of reliability, prior to radar refraction computations. The classification system considered the variety of data available, the time lag between radar and weather observations, and the proximity of the sounding to the propagation path. A good correlation between observed and computed angles resulted and the correlation was directly related to the classification. Radar observations were made in the X band and instrumental precision maintained to within 0. 25 milliradian. Total bending ranged between 0. 56 and 2. 23 milliradians, with standard deviation 0. 38 milliradian. The rms deviation of computed from observed angles ranges from 0. 19 to 0. 41 milliradian for class A and class C data, respectively. The correlation coefficient ranges from 0. 81 to 0. 13. It is concluded that within the limits of this experiment: a) ray tracing methods are justified, b) horizontal stratification may be assumed, and c) the accuracy of bending predictions is increased by improving the meteorological data. --Authors' abstract.

E-605 Atlas, David, Radar studies of meteorological 'angel' echoes. Journal of Atmospheric and Terrestrial Physics, N. Y., 15(3/4):262-287, Oct. 1959. 19 figs., bibliog. p. 283-284, 9 eqs. DLC--A review, supplemented by new data, is presented of 'angel' echoes from meteorological sources. The major angel types are enumerated. Special angel types, such as those associated with the sea breeze front add to the impressive evidence of the association of angels with meteorologically induced gradients in refractive index. In every case, however, the gradients required by theory exceed reasonable or measured values by at least one or two orders of magnitude, apparently due in large part to the lack of high resolution refractometer measurements. The observations indicate frequent conditions suitable for enhanced forward scatter beyond the horizon and also testify to the feasibility of Friend's 1939 proposal to use radio reflections for sounding air mass boundaries. --Author's abstract.

E-606 Atlas, D. (GRD, A. F. Cambridge Res. Ctr.), Sub-horizon radar echoes by scatter propagation. Journal of Geophysical Research, Wash., D. C., 64(9):1205-1218, Sept. 1959. 8 figs., 3 tables, 13 refs., 8 eqs. DLC--The paper deals with a unique 3 cm radar observation in which echoes arranged in cellular and striated patterns were detected out to a maximum range of 90 mi. The cellular structure closely resembles a Benard convection pattern and the cell scale is consistent with that to be expected when convection is restricted to a layer of the observed depth. The echoes cannot be attributed to clouds or precipitation, which were absent. Birds, insects, or other particulate matter are also illogical targets. Direct backscatter or angel echoes from atmospheric inhomogeneities are also precluded except at very short ranges, because of the restricted echo heights and great ranges. The echoes can only be attributed to a mechanism of forward scatter by atmospheric eddies to ground targets and back, via the same path. The resulting echo structure is then that of the convectively patterned atmospheric "mirror" upon which are superimposed the more prominent features of the topography. Theoretical analysis indicates that the magnitude of the forward scatter intensity function must be extremely high. However, extrapolation of the frequencies with which smaller scatter intensities have been observed indicates that the required magnitude might be expected to occur with a frequency which is in general accord with the rarity of the present phenomenon. Although the required index irregularities are extremely sharp, they are physically conceivable. (Met. Abs. 11H-3)--Author's abstract.

E-607 Baeyer, H. J., Selective fading effects on UHF tropospheric scatter path. Institute of Radio Engineers, N. Y., Proceedings, 47(11):2021-2022, Nov. 1959. 8 figs., ref. DLC--Some results of tests that were made during the winter 1954-55 are shown on figures. The majority of fading effects had the characteristics of a level depression moving in either direction through the frequency band, only a few had more random character. The greatest observed level differences over the frequency band were of the order of 15-20 db per Mc lasting for not more than one second. --E. K.

E-608 Bass, F. G. and Kaner, E. A., Korreliatsiia fliuktuatsii elektromagnitnogo polia v srede so sluchainymi neodnorodnostiami nad ideal'no provodiashcheǐ ploskost'iu. (Correlation of fluctuations of an electromagnetic field in a medium with random inhomogeneities over an ideally conducting surface.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 2(4): 565-572, 1959. 3 refs., 12 eqs. DLC--Space correlation functions are determined. Calculations are based largely on a companion paper by Kaner and Bass in the same issue of the journal. (See E-645). --R. M.

E-609 Bean, Bradford R., Climatology of ground based radio ducts. U. S. National Bureau of Standards, Journal of Research, Sec. D, 63(1):29-34, July-Aug. 1959. 7 figs., 3 tables, 8 refs., 17 eqs. DLC, DBS--An atmospheric duct is defined as occurring when geometrical optics indicate that a radio ray leaving the transmitter and passing upward through the atmosphere is sufficiently refracted that it is traveling parallel to the Earth's surface. Maximum observed incidence of ducts was determined as 13% in the tropics, 10% in the arctic and 5% in the temperate zone by analysis of 3 to 5 yrs of radiosonde data for a tropical, temperate, and arctic location. Annual maximums are observed in the winter for the arctic and summer for the tropics. The arctic ducts arise from ground based temperature inversions with the ground temperature less than $-25^{\circ}C$ while the tropical ducts are observed to occur with slight temperature and humidity lapse when the surface temperature is $30^{\circ}C$ and greater. --Author's abstract.

E-610 Bean, B. R. and Gallet, R. M. (both, Nat'l. Bur. of Stands., Boulder, Colo.), Applications of the molecular refractivity in radio meteorology. Journal of Geophysical Research, Wash., D.C., 64(10):1439-1444, Oct. 1959. 5 figs., 13 refs., 9 eqs. DLC--Consideration of the molecular refractivity has led to a value of the radio refractive index referred to zero altitude or sea level that effectively removes the systematic altitude dependence of air density. The advantages of this new parameter are illustrated by two applications. The first application, the preparation of climatic charts of the radio refractive index, illustrates that this new parameter brings climatic differences into sharp relief. The second application deals with the vertical variation of air mass properties across a classic warm front and clearly delineates air mass differences, thus indicating the utility of this new parameter for synoptic studies. (Met. Abs. 14.7-105)--Authors' abstract.

E-611 Bean, B. R. and Horn, J. D., Radio refractive index climate near the ground. U.S. National Bureau of Standards, Journal of Research, Sec. D, Radio Propagation, 63(3):259-271, Nov./Dec. 1959. 14 figs., 5 tables, 17 refs., 5 eqs. DLC--The radio refractive index of air is a function of atmospheric pressure, temperature and humidity and is found to vary in a systematic fashion with climate. It was found that the surface value of the refractive index may be estimated four to five times more accurately from charts of reduced to sea level values than from similar sized charts of surface index. Worldwide maps of 5 yr means of this reduced value are presented for the months of Feb. and Aug., for the minimum monthly mean value of the year and for the range of monthly mean values. Year to year variation of monthly means is also considered. Application of these data to the prediction of radio field strength indicate a possible 30 db difference in median level of identically equipped tropospheric communications system due to climate alone. --Authors' abstract.

E-612 Bean, B. R. and Riggs, L. P., Synoptic variation of the radio refractive index. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(1):91-97, July/Aug. 1959. 18 figs., 12 refs., 4 eqs. DLC, DWB--The synoptic variation of the atmospheric radio refractive index, evaluated from standard weather observations, is examined during an outbreak of polar continental air. It is found that the reduced-to-sea-level value of the refractive index is a more sensitive synoptic parameter than the station value. The reduced value is quite sensitive to the humidity and density structure of the storm under study while the great station elevation dependence of the station value tends to mask synoptic changes. The reduced value changes systematically with the approach and passage of the polar front. The present system shows a consistent increase of the reduced value in the warm sector of the wave and a marked decrease behind the cold front. (Met. Abs. 11.4-241)--Authors' abstract.

E-613 Bean, B. R.; Riggs, L. P. and Horn, J. D., Synoptic study of the vertical distribution of the radio refractive index. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(2):249-254, Sept./Oct. 1959. 14 figs., 16 refs., 3 eqs. DWB, DLC--An analysis of the vertical structure of an intense outbreak of continental polar air is presented in terms of the radio refractive index of the atmosphere. Employed for the first time is a reduced index analogous to potential temperature. The reduced value shows the refractive index structure more clearly than the classical methods used heretofore. The new unit is a measure of both atmospheric density and humidity and shows, on a single cross section, the air mass structure and the dynamic mixing of air around the frontal interface. (Met. Abs. 14.7-109) --Authors' abstract.

E-614 Bean, B. R. and Thayer, G. D., Central radio propagation laboratory exponential reference atmosphere. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(3):315-317, Nov./Dec. 1959. Fig., table, 6 refs., eq. DLC--The background and development of an exponential model of stratospheric radio refractivity, the "C.R.P.L. Exponential Reference Atmosphere" is outlined. A set of ray tracings for the model is presented in the form of tables of refraction variables for the complete range of observed values of surface refractive index. A detailed analysis of the accuracy of the ray tracing and tabulation methods is made for these tables. The variables are presented as numbers between one and ten multiplied by the appropriate power of 10, thus maintaining a maximum number of significant figures. The tables may be used for the solution of practical refraction problems involving elevation angle errors, range errors, and similar quantities. --Authors' abstract.

E-615 Bean, B. R. and Thayer, G. D. (both, Nat'l. Bu. of Stands., Boulder, Colo.), Models of the atmospheric radio refractive index. Institute of Radio Engineers, N.Y., Proceedings, 45(5, Pt. 1):740-755, May 1959. 24 figs., 3 tables, 24 refs., 29 eqs. DWB--Evaluation of atmospheric refraction effects on UHF-VHF radio propagation has long been accomplished with the convenient four-thirds earth concept of SCHELLING, BURROWS and FERRELL. This method has proven particularly useful in evaluating performance of point-to-point radio communications systems. However, relatively new long range applications have demanded a model of atmospheric radio refractive index more representative of observed refractive index profiles than the simple linear decay inherent in the four-thirds earth approach. This paper introduces two models of atmospheric radio refractive index which can be used to predict refraction effects from the value of the refractive index at the transmitting point. Both models offer considerable improvement over the four-thirds earth model, particularly for applications at long distances and high elevations in the atmosphere. Further, both models may be adjusted to represent mean conditions at different times of year and in different geographical locations. A new method of predicting radio ray refraction at very low initial elevation angles is introduced which utilizes both the initial value and the initial height gradient of the refractive index over roughly the first 100 m above the earth's surface. This method, which is dependent only upon the first two radiosonde reporting levels or simple tower measurements of the common meteorological elements, results in a considerable improvement of the values of ray refraction predicted by the model. (Met. Abs. 12.6-141) --Authors' abstract.

E-616 Bolgiano, Ralph, Jr. (School of Elec. Eng., Cornell Univ., Ithaca), Wavelength dependence on transhorizon propagation. Institute of Radio Engineers, N.Y., Proceedings, 47(2):331-332, Feb. 1959. Fig., 7 refs., 7 eqs. DLC--Results of two tests made simultaneously during the winter, spring and early summer of 1957 at the Lincoln Laboratory of MIT on 417.05 Mc and 2290 Mc are described. Tests were conducted on the transhorizon path from Round Hill, Mass. to Crawford's Hill, N.J. During the period Feb. 11 to July 11, data were collected continuously for intervals of 12 to 72 hrs. From closely scaled antennas, continuous signals of 3.5 kw and 10 kw were radiated on 417 Mc and 2290 Mc, respectively. Cumulative distributions of the signal level received on each channel during the 241 cases (hours) investigated were then recorded. Differences in the measured hourly median for the basic transmission loss is illustrated graphically. It shows the empirical distribution of the wave length dependence, the variation of the data at substantially better than the 0.001 level. A significant relation of this variation to meteorological phenomena is drawn. (Met. Abs. 12.3-100)--N.N.

E-617 Bugnolo, Dimitri S., Correlation function and power spectra of radio links affected by random dielectric noise. IRE Transactions on Antennas and Propagation, N.Y., 7(2):137-141, April 1959. 3 figs., 11 refs., 42 eqs. DLC--The correlation function and corresponding power spectrum of an electromagnetic wave affected by random dielectric noise is related to the power spectrum of the source by an extension of the motions of time variable linear networks. It will be shown that in general, the power spectrum of the received signal can be regarded as the output of a network characterized by a time variable transfer function. The results are applied to a long line of sight radio link and used to predict the error in the received signal in a mean squared sense. This will be used to show that the rate of a source is bounded such that there exists a maximum rate R given a bandwidth δ and scattering parameters of the atmosphere. --Author's abstract.

E-618 Bullington, K. (Bell Telephone Lab., Inc., Murray Hill, N.J.), Status of tropospheric extended range transmission. Institute of Radio Engineers, Transactions on Antennas and Propagation, Vol. AP-7(4):439-440, Oct. 1959. 2 figs. DLC--This paper is a summary of a talk at the National Symposium on Extended Range Transmission in Washington, D.C., Oct. 7, 1958. It summarizes the present status of extended range tropospheric transmission with brief mention of the history, principal characteristics, nature of the mechanism and general usefulness. Figures show the curves for estimated range for beyond horizon transmission and the calculations involved in beyond horizon tropospheric transmission. (Met. Abs. 13.7-132)--E.Z.S.

E-619 Chisholm, J.H.; Rainville, L.P.; Roche, J.F. and Root, H.G., Angular diversity reception at 2290 Mc over a 188 mi path. IRE Transactions on Communications Systems, N.Y., 7(3):195-201, Sept. 1959. 16 figs., 13 refs. DLC, DBS--Experiments were performed over the 188 mi Round Hill-Crawfords Hill path at 2290 Mc to determine the feasibility of using angular diversity reception in a tropospheric scatter system. Using a 28 ft reflector, two beams were produced with two separate feed systems. The correlation of the signals received on one or two beams with that received on the other was determined for various spacing of the beams, as well as for the azimuthal position of the antenna. These experiments show that angular diversity techniques can be effective depending on the proper choice of frequency, antenna size, and beam separation for path in the neighborhood of 200 mi in length. A substantial diversity gain can be achieved even though partial correlation exists. These results also appear to be in good agreement with theoretical predictions for equal means and for the short periods of time applicable to obtaining reliable voice and high speed teletype communication. --Authors' abstract.

E-620 Crawford, A.B.; Hogg, D.C. and Kummer, W.H., Studies in tropospheric propagation beyond the horizon. Bell System Technical Journal, N.Y., 38(5):1067-1178, Sept. 1959. 79 figs., 7 tables, 29 refs., 36 eqs. DLC--This paper describes an extended series of experiments in beyond the horizon propagation on a 171 mi overland path using 460 and 4110 Mc. The following aspects of the propagation were investigated: the effect of antenna size on signal level and fading characteristics, wavelength dependence, seasonal and diurnal effects, a new form of diversity reception, the bandwidth capability of the medium. Many of the experiments were directed toward a better understanding of the mechanism of propagation. --Authors' abstract.

E-621 De, A.C., Some experiments on the determination of the structure and refractive index of the lower troposphere (lowest 200 ft) over Dum Dum Airport, Calcutta. Indian Journal of Meteorology and Geophysics, Delhi, 10(3):295-312, July 1959. 6 figs., 3 tables, 4 refs. DWB, DLC--The results of low level (lowest 200 ft) radiosonde sounding made on certain selected dates and at certain selected hours during the winter of 1956-57 and premonsoon season of 1957 over Dum Dum Airport are discussed. The results indicated the formation of ducts at certain hours. The variations of the meteorological data with the progress of night are shown in a tabular form. The radarscope observations at the corresponding hours are also discussed. On two occasions in March and April 1957, the duct heights were abnormally high and prevailed for the whole night persisting until or even after sunrise. It is shown that these ducts extended horizontally in all directions to about 60 mi. Some radarscope observations during Feb.-March 1956 are also discussed. On two occasions during Feb. 1956, elevated ducts were noticed. These prevailed for the whole night. The attenuation produced by the appearance of thick fog over the station and its masking effect on the ground clutters are also discussed. (Met. Abs. 11.2-168)--Author's abstract.

E-622 Deam, A.P., An expendable atmospheric radio refractometer. Texas. Univ. Electrical Engineering Research Lab., Contract Nonr 375(08), Report No. 108, May 15, 1959. 9 p. plus appendices, 16 figs., 3 refs., 24 eqs. DWB (M84 T355r)--This report describes a device which has been designed to measure atmospheric index of refraction profiles at a frequency of 403 Mc/s. It is a prototype instrument and should be capable of ejection from an aircraft as well as elevation with a balloon. Transmitted frequency is received at a receiver whose recorded output is relative radio index of refraction. This instrument has been successfully tested in a balloon flight to elevations of the order of 60,000 ft. (Met. Abs. 12.10-134)--Author's abstract.

E-623 de Belatini, P.C.M., Inadequacy of scatter mechanism in tropospheric radio propagation. Nature, London, 184(4698):1558-1559, Nov. 14, 1959. 2 figs., 3 refs. DLC--In this note author concludes that a scatter mechanism is not principally responsible for tropospheric propagation and this leads to the question of a replacement theory. His unpublished theory is briefly discussed, which shows that the main features of tropospheric propagation can be adequately explained, both qualitatively and quantitatively in terms of toroidal thermal motions in the atmosphere which are known as "Bénard cells". --E.K.

E-624 Denisov, N.G. and Zverev, V.A., Nekotorye voprosy teorii rasprostraneniia voln v sredakh s sluchaĭnymi neodnorodnostiami. (Some theoretical problems of wave propagation in media with weak inhomogeneities.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 2(4): 521-542, 1959. 31 refs., 90 eqs. DLC--On the basis of international literature the author presents a detailed review of the theory of wave propagation in a randomly inhomogeneous medium. The particular problems treated are those of 1) approximation of geometrical optics, 2) method of even inhomogeneities, 3) diffraction of waves by an irregular screen, and 4) scattering of waves by weak inhomogeneities. --G.T.

E-625 Doherty, Lorne H. (Radio and Elect. Div., Nat'l. Res. Council, Ottawa, Canada), Scatter propagation experiment using an array of six paraboloids. IRE Transactions on Antennas and Propagation, 7(4):419-428, Oct. 1959. 8 figs., 5 tables, 20 refs., 18 eqs. DLC--Using an antenna system whose aperture could be varied in 4 ft steps between 4 and 24 ft, aperture to medium coupling loss measurements have been made on a 2720 msec, 216 mi path. These measurements reveal an intrinsic variability in the scattering mechanism which is not accounted for in most current theories. Diversity and fading rate measurements were also made. A simple mathematical model of the diffracted field yields calculated values of the normal component of the wind which agree well with the measured wind. Calculated and measured values of fading rate are also seen to be in good agreement. An estimate is made of the turbulent wind velocity. --Author's abstract.

E-626 Doherty, L.H. and Neal, G.A., A 215 mile 2720 Mc radio link. IRE Transactions on Antennas and Propagation, N.Y., 7(2):117-126, April 1959. 16 figs., table, 4 refs. DLC--The results from the operation of a 215 mi, 2720 Mc radio link are discussed. The link was opened for a period of 20 months. The yearly median signal level was 79 db below free space with a seasonal variation between 12 and 14 db in the hourly medians. If attention is confined to a single season, the hourly medians have a log normal distribution. No diurnal variation was observed. Probability distributions of signal amplitude based on 30 sec samples were most commonly Rayleigh although some significant departures from this law did occur. A study of the time variation of the 30 sec median shows the standard deviation of these medians 5 min apart to be about 1 db, and 30 min apart to be 2.6 db. The same type of analysis is also performed on the hourly medians. A diurnal variation is observed in the fading, with the midafternoon rate being almost twice that recorded during the early morning. Pulse distortion and meteorological correlations are discussed quantitatively. --Authors' abstract.

E-627 Dolukhanov, M.P., O kharaktere iskazheniĭ signalov v sisteme telefonii na odnoĭ bokovoĭ polose v troposfernykh liniiakh sviazi. (Nature of signal distortions in a single sideband telephonic system for a tropospheric link.) Elektrosviaz', Moscow, 13(11):12-16, Nov. 1959. 7 figs., 5 refs., 24 eqs. Transl. into English in Telecommunications, N.Y., No. 11:1180-1188, 1959. DLC--Distortions arising during propagation of signals in a steady state tropospheric link are investigated theoretically. An ideal case of the interference of two beams is examined and then extended to the real troposphere. It is found that no transient distortions occur during propagation in the SSB telephonic transmission. The sole types of distortions are fading and Doppler shift. --Transl. of author's abstract. -R.M.

E-628 du Castel, F.; Misme, P. and Voge, J., Reflexions partielles dans l'atmosphère et propagation a grande distance, Troisième partie, Réflexion en milieu inhomogène. (Partial reflections in the atmosphere and long range propagation, Pt. 3, Reflection in inhomogeneous medium.) Annales des Telecommunications, Paris, 14(1/2):33-40, Jan./Feb. 1959. 10 figs., ref., eqs. DLC--After establishing some general results concerning the reflection of a plane wave upon an irregular surface, authors investigate a real case of emitter and receiver at a definite distance. Reflected field is divided into a spicular relection and a diffuse relection component. Both components have peculiarities (mean amplitude, distribution laws, direction, phase, reflecting surface) complying with very different laws. These are specified in the instances of slightly and highly contorted surfaces. (See refs. E-542, 735, 786, 772, 715). (Met. Abs. 14.1-56)--A.V.

E-629 Feinberg, E.L., Propagation of radio waves along an inhomogeneous surface. Nuovo Cimento, Bologna, Ser. 10, Supplemento to 11(1):60-91, Jan. 1959. 13 figs., 26 refs., eqs. DLC--In the study a fundamental integral equation is presented which gives a useful and convenient basis for treating propagation of radiowaves, both for flat and for spherical earth, for homogeneous or inhomogeneous surfaces. Reference is made to a particular combination of inhomogeneity and corrugation for spherical earth on the basis of this equation. The paper reviews systematically the basic ideas and the main results of the method. --E.K.

E-630 Finney, R.G., Short time statistics of tropospheric radio wave propagation. Institute of Radio Engineers, N.Y., Proceedings, 47(1):84-85, Jan. 1959. 3 refs., 2 eqs. DLC--An experimental investigation of short time statistics which characterize beyond the horizon tropospheric propagation, is briefly summarized. The paper concludes that the envelope amplitude was frequently Rayleigh disturbed, however, enough non-Rayleigh results were obtained to suggest other processes. --E.K.

E-631 Furutsu, Koichi, Wave propagation over an irregular terrain, Pt. 3, diagrams of ridge and precipice effects on ground waves. Japan. Radio Research Laboratories, Journal, 6(23):71-102, Jan. 1959. 11 figs., eqs. DBS--The formulas of field strength over an irregular terrain, obtained on a rather general condition in previous papers (see E-459) are here used for the estimation of the ridge and precipice effects on ground waves. The results are displayed in diagrams for practical use. Most of these diagrams have reference to cases where propagation distances over the media adjacent to a ridge or precipice are so long that the top or edge of the boundary is out of sight from the transmitter and the receiver. The rest concern cases where the propagation distances over the first or final section of inhomogeneous earth are sufficiently short. --Author's abstract.

E-632 Gusiatinskii, I. A., Shirina polosy i moshchnost' perekhodnykh pomekh pri radiosviazi rasseianiem v troposfere. (Bandwidth and power of transient interference in radiocommunication by tropospheric scattering.) Elektrosviaz', Moscow, 13(4): 3-12, April 1959. 5 figs., 7 refs., 56 eqs. Transl. into English in Telecommunications, N. Y., No. 4:355-367, 1959. --The bandwidth has been determined for signals transmitted with permissible magnitude and probability of distortion of the amplitude spectrum; formulas are obtained for the calculation of the power of transient interference arising from multiple ray propagation in multi-channel FM systems. --Author's abstract.

E-633 Hachenberg, O. and Schachenmeier, R., Die Refraktion von dm-Wellen in der Troposphäre. (Refraction of decimeter waves in the troposphere.) Hochfrequenztechnik und Elektroakustik, Leipzig, 68(1):1-7, May 1959. 7 figs., 3 tables, 3 refs., 17 eqs. DLC--By means of receiving apparatus for 20 cm waves refraction is measured on the basis of nearness to the horizon. From the cover curve the moment at which the middle of the sun passes the line of the horizon is derived, and, for that purpose, the zenith distance is calculated on the basis of the known position of the sun. Refraction is thus determined. Refraction values are obtained which are approximately 40% greater than the optical. Moreover, the scattering area is considerably greater. By way of proof, the radiation path is calculated from known quantities of the troposphere which are taken from synoptic records. Refraction is calculated from this. The proposed calculation procedure is applicable to a spherical troposphere with any type of stratification. The measured and computed refraction angles were compared for 43 sunrises and sunsets in 1956. --Transl. of authors' abstract-R. M.

E-634 Hartman, W. and Wilkerson, J., Path antenna gain in an exponential atmosphere. U.S. National Bureau of Standards, Journal of Research, Sec. D, Radio Propagation, 63(3):273-1286, Nov./Dec. 1959. 11 figs., 10 refs., numerous eqs. DLC--The problem of determining path antenna gain is treated here in greater detail than previously. The method used here takes into account, for the first time, the exponential decrease of the gradient of refractive index with height, and a scattering cross section inversely proportional to the 5th power of scattering angle. Results are given for all combinations of beamwidth and path geometry, assuming that atmospheric turbulence is isotropic. The result appears as a function of both of the beamwidths, in addition to other parameters, and thus the loss in gain cannot be determined independently for the transmitting and receiving antennas. The values of the loss in gain are generally lower than the previous estimates for which a comparison is possible. --Authors' abstract.

E-635 Hathaway, S. D. and Evans, H. W., Radio attenuation at 11 Kmc and some implications affecting relay system engineering. Bell System Technical Journal, N. Y., 38(1):73-97, Jan. 1959. 21 figs., 10 refs., eqs. DWB--Radio waves at 11 kmc are attenuated by rain. In order to derive rules for engineering radio relay systems at 11 kmc, a one year experiment was conducted in a region of frequent heavy rainfall. The attenuation of paths 27 and 12 mi long was measured, together with rainfall at 2 mi intervals along the paths. The instrumentation and the test results are described, and some implications related to systems engineering are pointed out. --Authors' abstract.

E-636 Hay, D. R., Apparent correlation between tropopause height and long distance transmission loss at 490 Mc. Institute of Radio Engineers, N. Y., Proceedings, 47(6):1144-1145, June 1959. 2 figs., 10 refs. DLC--A short term experiment has been carried out in central Ontario to examine 490 Mc transmission over a 640 mi path. Results indicate that the periods of relatively stable transmission and higher loss were concurrent with a low tropopause, and periods of relatively unstable transmission and lower loss occurred when the troposphere was high. --E. K.

E-637 Hay, D. R. (Dept. Physics, Univ. Western Ontario) and Poaps, G. E., Frontal perturbation of a troposphere scatter path. Canadian Journal of Physics, Ottawa, 37(11):1272-1282, Nov. 1959. 5 figs., table, 22 refs. DWB, DLC--A 2 yr study of 500 Mc/s radio transmissions over an 85 mi path near Ottawa has shown that the signal fading rate rises well above the diurnal maximum when the transmission path is perturbed by a weather front. The fading rate reaches a maximum when the upper boundary of the frontal zone is 3000 ft above the center of the radio path, and the fading rate remains high as long as any part of the frontal zone is between the surface and 3000 ft. A similar relationship between frontal position and signal fading rate is found for Arctic, Maritime, or Polar fronts in the Ottawa area, but the Arctic fronts provide the clearest definition. There is some indication that high fading rate also may be associated with horizontal layers of contrasting humidity at low levels in the troposphere. (Met. Abs. 12. 9-103)--Authors' abstract.

E-638 Herbstreit, J. W. and Rice, P. L., Survey of Central Radio Propagation Laboratory research in tropospheric propagation. NBS Technical Note, No. 26, PB 151385, Sept. 1959. DBS--This report summarizes and abstracts publications concerned with the National Bureau of Standards tropospheric propagation research program dating back to the formation of the Central Radio Propagation Laboratory. Some technical papers are reproduced here as supplements to this report and excerpts from some of the longer technical reports are also included. (Met. Abs. 10. 2-174) --Authors' abstract.

E-639 Hirao, Kunio; Akita, Kin-Ichiro and Shiro, Isao, Vertical distribution of the scattering parameter for radiowave. Japan. Radio Research Laboratories, Journal, 6(27):595-601, July 1959. 6 figs., table, 4 refs. Japanese version in its Review, 5(21):260-263, Oct. 1959. DBS--By means of both kytoon and refractive index variometer, the scattering parameter for radio wave in the layer below 1000 m above the ground was measured at the Tateno Aerological Observatory during Sept. 1957 and Nov. 1958. The observational results show that the vertical distribution of the scattering parameter is proportional to -2/3 power of the height and that it has seasonal variation. --Authors' abstract.

E-640 Hogg, D. C., Effective antenna temperature due to oxygen and water vapor in the atmosphere. Journal of Applied Physics, 30(9):1417-1419, Nov. 1959. 5 figs., 7 refs. DLC--Calculations of the effective noise temperature at the terminals of a high gain antenna due to oxygen and water vapor in the atmosphere are given for the frequency range 0.5 to 40 kmc. In the 1 to 10 kmc band, the effective temperature increases from about 3° to 100°K at the zenith angle is increased from 0° to 90°. Calculated values of the total attenuation through the atmosphere are given. --Author's abstract.

E-641 Jehn, K.H., Use of potential refractive index in synoptic scale radio meteorology. Journal of Meteorology, Boston, 17(3):264-269, June 1960. 8 figs., 3 refs., 6 eqs. DWB, DLC. Also issued as: Texas. Univ. Electrical Engineering Research Lab., Contract AF 19(604)-2249, Report No. 6-29, Sept. 15, 1959. 10 p. 8 figs., 3 refs., 6 eqs. DWB (M94.7 T355r)--The concept of potential refractive index is examined in the light of earlier work and of the present emphasis on synoptic scale radio meteorology. A new potential refractive index is defined and illustrated. It is concluded that the new parameter has operational utility in long range microwave radio and radar transmission, as well as in refractive index mapping. An example is worked out and illustrated with synoptic charts, refractive index charts, cross sections and radiosonde refractive index diagrams for the cold wave of Feb. 19, 1952 in Northern and Central Plains of the U.S. (Met. Abs. 12.2-92)--Author's abstract and M.R.

E-642 Kalinin, A.I., The coherence theory of long distance tropospheric propagation of ultra short waves. Telecommunications, N.Y., No. 6:621-634, 1959. 4 figs., 6 refs., 35 eqs. Transl. of Russian article in Elektrosviaz', Moscow, No. 6:41-49, 1959. DLC--This article gives the results of a theory of long distance tropospheric propagation of ultra short waves based on the hypothesis of coherent reflection of waves from stratified inhomogeneities in the troposphere and on the exponential dependence of the dielectric constant of air on height above the earth's surface. A comparison of the theoretical and experimental results is also made. --Author's abstract.

E-643 Kaner, E.A., K teorii rasprostraneniia voln v srede so sluchaĭnymi neodnorodnostiami. (Theory of the propagation of waves in a medium with random inhomogeneities.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedniĭ, Radiofizika, 2(5):827-829, 1959. Table, 4 refs., 14 eqs. DLC--The author analyzes the effect of fading and changes in phase velocity in the average field due to scattering by random irregularities. The method of small perturbations in a form proposed by Lifshits, Kaganov, and Tsukernik is used. It is shown that fading of the average field due to scattering by small irregularities obeys the Rayleigh law, while in the case of large scale irregularities fading is determined not only by amplitude fluctuations, but also by fluctuations in the phase of the radiated field. --R.M.

E-644 Kaner, E.A. and Bass, F.G., K statisticheskoĭ teorii rasprostraneniia radiovoln nad ideal'no provodiashcheĭ ploskost'iu. (Statistical theory of radio wave propagation over an ideally conducting plane.) Akademiia Nauk SSSR, Doklady, 127(4): 792-795, 1959. 6 refs., 14 eqs. DWB, DLC--The authors calculate the statistical characteristics of an electromagnetic field propagated in a medium with small random fluctuations $\delta\varepsilon$ in permittivity $\varepsilon = \langle\varepsilon\rangle + \delta\varepsilon$ over an ideally conducting half space. The interface is assumed to be plane, and the medium over the surface to be statistically regular. The radiation source (a dipole with moment d) is situated at a height z_0 above the interface. The origin of the coordinates coincides with the projection of the dipole on the interface plane, the axis O_z runs along a straight projection connecting the dipole with the point of observation r (L, O, z). The treatment is limited to large scale fluctuations, when the characteristic correlation radius ℓ is large in comparison with wavelength λ. --R.M.

E-645 Kaner, E. A. and Bass, F. G., Rasprostranenie elektromagnitnykh voln v srede so sluchaĭnymi neodnorodnostiami nad ideal'no provodiashcheĭ ploskost'iu. (Propagation of electromagnetic waves in a medium with random inhomogeneities over an ideally conducting surface.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 2(4):553-564, 1959. 7 refs., 48 eqs. DLC--Elaboration of a theory of the propagation of electromagnetic waves in a statistically homogeneous medium over an ideally conducting surface. The authors calculate the basic statistic characteristics (mean field, mean-square fluctuations of amplitude and phase) and their dependence on radio wave frequency and polarization, distance, and height of the receiving and transmitting antennas. The effect of a sharp increase in fluctuations near interference minimums of the mean field and on the edge of the first lobe is also investigated. (See E-608)--Transl. of authors' abstract.- R. M.

E-646 Keary, T. J., International conference on radio wave propagation. Institute of Radio Engineers, N.Y., Proceedings, 47(6):1147-1148, June 1959. DLC--A brief summary of the conference which was held on Oct. 6-11, 1958 at Liege, Belgium. A total of 55 papers was presented. Major discussions concentrated on the following subjects: 1) distant (beyond the horizon) propagation of ultra short radio waves and the application to radio communications; 2) ionospheric investigations, particularly those using back scatter sounding techniques; 3) forward scattering of radio waves from the ionized trails of meteors; 4) propagation of low frequency radio waves. Some of the papers which were considered as significant by the author are summarized. --E. K.

E-647 Kummer, W. H., Sweep frequency studies in beyond-the-horizon propagation. IRE Transactions on Antennas and Propagation, 7(4):428-433, Oct. 1959. 9 figs., table, 6 refs., eq. DLC--This paper considers the bandwidth characteristics of the propagating medium in tropospheric beyond-the-horizon propagation. To study this problem, a frequency sweep experiment was performed over a 171 mi experimental circuit. A 4.11 kmc transmitter was frequency modulated at 1000 cps rate over a 20 Mc band. The receiver was swept nonsynchronously over the same band at a 30 cps rate. The resultant pulses were displayed on an oscillograph and photographed at the rate of one frame every 2 sec. The experiment used a 28 ft transmitting antenna and 8-, 28- and 60 ft receiving antennas. Sequences of selected sweep frequency pictures are shown for various antenna combinations and transmission conditions. The bandwidths from the experiment are compared with a calculation based on the common volume geometry. Photographs of signals received simultaneously from a twin feed horizontal diversity system are also shown and discussed. --Author's abstract.

E-648 LaGrone, A. H., Report of the TASO Committee 5.4 on Forecasting Television Service Fields. IRE National Convention Record, N.Y., 7:159-164, 1959. 9 refs. DLC--The propagation of VHF and UHF television signals over a spherical, irregular surface such as the Earth, is examined theoretically and experimentally and the principal factors evaluated. Among the more important factors found are meteorology, frequency, terrain, and the absorbing effect of vegetation. These are all included in a new method suggested for forecasting the service fields of television stations. The new method is compared with field measured cases with good results. --Author's abstract.

E-649 Lu, Pao-wei, Theory of forward scatter propagation of ultrashort radio waves. Scientia Sinica, Peking, 8(7):761-780, 1959. Fig., 5 refs., 91 eqs. DLC--The author considers present theories of tropospheric and ionospheric propagation of UHF waves beyond the horizon imperfect, namely, that in tropospheric propagation, scattering by inhomogeneities due to turbulence is the chief mechanism, and that insufficient attention has been given to the gradient of the dielectric constant with altitude. Scattering in the ionosphere is examined only as affected by turbulence inhomogeneities and the effect of meteor trails is neglected. Results obtained by applying the statistical theory of turbulence are given separately for the troposphere and for the ionosphere. --R. M.

E-650 McDonald, D. J. and Frost, C. E., Quebec-Labrador tropospheric scatter radio system. Engineering Journal, Montreal, 42(4):43-57, April 1959. 9 figs., ref. DLC--Report on the engineering and construction of a scatter radio system to provide telephone and miscellaneous communication services to Schefferville and Goose Bay and to other locations in Northern Quebec and Labrador. Particular emphasis is on the broad planning of the system and on the construction aspects. Pt. I deals with the engineering aspects of the system; Pt. II deals with the design and construction of buildings, towers, roads, etc. --Authors' abstract.

E-651 McGavin, Raymond E. and Maloney, Leo J., Study at 1046 megacycles per second of the reflection coefficient of irregular terrain at grazing angles. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(2):235-248, Sept./Oct. 1959. 13 figs., 2 tables, 25 refs., 3 eqs. DWB, DLC--An experimental determination of the reflection coefficient over rough terrain is reported. The reflected signal received over rough terrain is considered to be made up of two components, one that is a specular component and the other a Rayleigh distributed component. Where one terminal is low, the Rayleigh component is considered to be small with respect to the specular component but increases in relative magnitude as the height of the lower terminal increases. A terminal height is reached where the specular component is no longer significant, and the reflected energy is essentially Rayleigh distributed. A terminal height is quickly reached above which the mean value of the reflected energy is relatively constant, of a low value, and independent of the grazing angle. (Met. Abs. 14.4-113)--Authors' abstract.

E-652 Men', A. V., K voprosu o korreliatsii fliuktuatsiĭ SVCh radiovoln pri rasprostranenii v neodnorodnoĭ srede. (Problem of the correlation of fluctuations of shf radio waves propagated in an inhomogeneous medium.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 2(3):395-399, 1959. 3 figs., 7 refs., 14 eqs. DLC--The longitudinal correlation of fluctuations in the line of sight is determined. Expressions are derived for correlation functions of phase and amplitude fluctuations at distributed points oriented arbitrarily with respect to the source. --Transl. of author's abstract-R. M.

E-653 Men', A. V.; Braude, S. Ia. and Gorbach, V. I., Eksperimental'noe issledovanie fazovykh fliuktuatsiĭ santimetrovykh radiovoln nad morskoĭ poverkhnost'iu. (Experimental investigation of phase fluctuations of centimeter waves propagated over the sea surface.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 2(6):848-857, 1959. 11 figs., 14 refs., 5 eqs. DLC--Report on results of experimental measurement of the fluctuation of phase fronts during the propagation of vertically polarized radio waves over the sea surface. The frequency employed was 3000 Mc/s and the experiments were carried out under various meteorological conditions during July - Sept. and Oct. - Dec., over a fixed sea route having a length of 33 km. The differential method of measurement was employed, in which the fluctuations of the phase differences of the signals received by spaced antennas were employed to determine the intensity and the decorrelation of the phase fluctuations at various points of the wave front. Fixed transmitting and receiving antennas were used. In order to reduce the effect of the shore refraction, the receiving systems were situated at 15 to 20 meters from the shore with distances of 2, 5, 10, 30 and 100 meters separating them from the first (reference) antenna. The error in the measurement of the phase difference fluctuations was less than $\pm 1^{\circ}$, even when the amplitude of the received signals varied as much as 60 db. Results of measurements are shown in 11 figures. --R. M.

E-654 Men', A. V.; Gorbach, V.I. and Braude, S. Ia., Vliianie poverkhnosti razdela na fliuktuatsii radiovoln, rasprostraniaiushchikhsia v neodnorodnoĭ srede. (Effect of an interface on the fluctuations of radio waves propagated in an inhomogeneous medium.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 2(3):388-394, 1959. 4 figs., 10 refs., 16 eqs. DLC--The authors obtain approximate expressions for determining amplitude and phase fluctuations in the line of sight and beyond the horizon in connection with propagation in an inhomogeneous medium over a plane interface. It is shown that there is substantially no dependence of the intensity of fluctuations on distance, wave length, and altitude in comparison with the free space case. Computed values are compared with experimental data. --Transl. of authors' abstract. -R. M.

E-655 Millington, G., Study Group IV, ground wave propagation, V, tropospheric propagation. Point to Point Telecommunications, Chelmsford, England, 4(1):49-55, Oct. 1959. DLC--This is a brief report on functions and activities of the study groups IV and V of the International Radio Consultative Committee (C.C.I.R.), and includes some aspects and problems of current interest. Study Groups IV and V are now united into the single group No. V. (IV will be the study group for space communication). --W. N.

E-656 Nishikori, Kiyoshi; Takahira, Akira and Irie, Hiromi, Microwave propagation over the sea beyond the line of sight. Japan. Radio Research Laboratories, Journal, 6(23):57-70, Jan. 1959. 15 figs., 2 tables, 5 refs. DBS--The experiments were conducted at a frequency of 9375 Mc/s along the Sea of Kashima in 1955-57, the waves being transmitted by Inubo Radio Wave Observatory. This paper contains an analysis of the propagation mechanism and associated meteorological phenomena. Quantitative values are obtained for attenuation and fading in the duct propagation by the use of the ray tracing method and Fresnel's theoretical formulas of reflection and penetration. M curve models are determined for all seasons. Problems of forecasting duct propagation conditions are also discussed. --G. T.

E-657 Norton, K. A., Recent experimental evidence favoring the $\rho k_1(\rho)$ correlation function for describing the turbulence of refractivity in the troposphere and stratosphere. Journal of Atmospheric and Terrestrial Physics, London, 15(3/4):206-227, Oct. 1959. 7 figs., 4 tables, 21 refs., 15 eqs. DLC--The purpose of this paper is to show that although atmospheric turbulence is extremely variable, the log normally modified $\rho' K_1(\rho')$ correlation function may be used to describe the characteristics of refractivity variations as exemplified in three independent kinds of measurement: 1) direct measurements of the variations of n with time at a fixed location made with a refractometer, 2) measurements of variations with time of the phase of a radio wave received over a line of sight path, and 3) measurements of the received power of radio waves scattered in the forward direction to a receiving point beyond the radio horizon of the transmitter. --E. K.

E-658 Norton, Kenneth A., System loss in radio wave propagation. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(1):53-73, July/Aug. 1959. 14 figs., 6 tables, 33 refs., 79 eqs. DLC, DWB--A summary is presented of the ways in which the concept of system loss and the closely related concepts of transmission loss, basic transmission loss, propagation loss, and path antenna gain may be used for precise, yet simple, descriptions of some of the characteristics of radio wave propagation which are important in the design of radio systems. Definitions of various terms associated with the concept of system loss are given which introduce a greater flexibility into its use without any loss in precision. It is shown that the use of these added terms and concepts makes feasible the extension of the use of this method of description to any portion of the radio spectrum. A more general formula for the system loss is given which may be used for antennas with an arbitrarily small separation. Using this formula, it is shown that the system loss between small electric or magnetic dipoles separated by a distance $d \ll \lambda$ can be made arbitrarily small even though the individual antennas have large circuit losses. Formulas are developed for the percentage of time that a desired signal is free of interference, and these are used to demonstrate methods for the efficient use of the spectrum. In particular, contrary to general belief, it is shown that efficiency is promoted by the use of high power and high antennas and, in the case of a broadcast service, sufficiently small separations so that there is appreciable mutual interference. An analysis is made of the variance of the path antenna gain in ionospheric scatter propagation. Methods are given for the calculation of the transmission loss for the ground wave and tropospheric scatter modes of propagation through a turbulent model atmosphere with an exponential gradient. Examples of such calculations are given which cover a wide range of frequencies and antenna heights. Finally, examples are given of the expected range of various tropospheric point-to-point scatter systems such as an FM multichannel teletype system, a television relay or an FM broadcast relay. --Author's abstract.

E-659 Norton, Kenneth A., Transmission loss in radio propagation, Pt. 2. U.S. National Bureau of Standards, Technical Note, No. 12, June 1959. 118 + p. 51+ figs., tables, 73+ refs., eqs. Appendix I-III following p. 118. DLC, DBS--In an earlier report with this title, the concept of transmission loss was defined and its advantages explained. In this report a survey will be made of the transmission losses expected for a wide range of conditions, i. e., for distances from 10 to 10,000 statute miles; for radio frequencies from 10 kc to 100,000 Mc; for vertical or horizontal polarization; for ground waves, ionospheric waves, and tropospheric waves; over sea water or over land which may be either rough or smooth; and for various geographical and climatological regions. --Author's abstract.

E-660 Obukhov, A. M. (Inst. of the Physics of the Atmosphere, Acad. of Sciences, Moscow), Scattering of waves and microstructure of turbulence in the atmosphere. Journal of Geophysical Research, Wash., D.C., 64(12):2180-2187, Dec. 1959. 7 figs., 20 refs., 4 eqs. DLC--The paper deals with a brief survey of the theory of scattering of waves by turbulent inhomogeneities. Experiments on the study of scattering phenomena of sound by turbulence in the surface layer of the atmosphere are discussed. These experiments were carried out to obtain some information on the turbulent spectrum; their results are compared with the data of meteorological measurements in the surface layer. Applying the method of scattered radio waves to the study of turbulence in the ionosphere is discussed. (Met. Abs. 11F-101) --Author's abstract.

E-661 Plank, V. G., Convection and refractive index inhomogeneities. Journal of Atmospheric and Terrestrial Physics, N.Y., 15(3/4):228-247, Oct. 1959. 10 figs., 2 tables, refs. DLC--Certain observations and theories in the field of cumulus convection are reviewed and an attempt has been made to integrate them into a more or less comprehensive picture. The picture was then interpreted in terms of refractive index structure. --Author's abstract.

E-662 Ponomarenko, L. M., Opredelenie napriazhennosti elektromagnitnogo polia v diapazone ukv v oblasti glubokoĭ teni za schet kogerentnogo rasseianiia v atmosfere. (Determination of USW electromagnetic field intensity due to coherent atmospheric scattering in the deep shadow region.) Radiotekhnika i Elektronika, Moscow, 4(6):930-935, June 1959. Fig., 4 refs., 17 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 4(6):29-37, 1959. DLC--The process of long distance USW propagation due to coherent scattering in the troposphere is analyzed theoretically using the parabolic equation method of Leontovich and Fok instead of the more complicated normal wave method proposed by Carroll and Ring. A characteristic equation of the eigenvalues of the dependence of the refractive index on height for a bilinear profile of the refractive index is presented. Numerical values are derived for the field strength in a region of deep shadow for a wavelength of 6 m, a transmitter and receiver height of 300 m, an antenna directivity coefficient of 1, and a transmitted power of 1 kw. The results obtained agree fairly well with those of Carroll and Ring, the height of the transition layer obtained being 8.45 km as against 9.3 km obtained by Carroll and Ring. --R.M.

E-663 Prosin, A. V., K raschetu perekrestnykh iskazheniĭ pri mnogoluchevom rasprostranenii radiovoln. (Contribution to the calculation of intermodulation crosstalk in multipath transmission of radio waves.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Nauchnye Doklady Vysshei Shkoly; Radiotekhnika i Elektronika, No. 1:53-61, 1959. 4 refs., 19 eqs. --On the basis of the correlation theory of stationary random processes, the author works out a method of calculating the power of intermodulation crosstalk due to multipath propagation or mismatch and irregularities in multichannel FM radio relay links with frequency division. The formulas derived are correct for (1) two-path propagation with different amplitude relationships between the direct and the reflected wave, and (2) multipath propagation when the intensity of the reflected signals is low in comparison with the main signal. The calculation formulas also make it possible to determine intermodulation due to reflections in the feeder. --Transl. of author's abstract. -R.M.

E-664 Prosin, A. V., O vliianii statisticheskikh kharakteristik turbulentnoĭ troposfery na rasseiannoe rasprostranenie ul'trakorotkikh voln. (Influence of statistical characteristics of the turbulent troposphere on the scatter propagation of ultrashort waves.) U.S.S.R. Ministervstvo Vysshego Obrazovaniia, Nauchnye Doklady Vysshei Shkoly, Radiotekhnika i Elektronika, No. 1:43-52, 1959. 4 figs., 12 refs., 24 eqs. --The author presents a generalized expression for the class of correlation functions of the irregularities of the dielectric constant of air which is correct for the anisotropic and the isotropic turbulence of the troposphere. The correlation function is written as follows:

$$B(\rho) = \overline{(\Delta\varepsilon)}^2 \quad \frac{2(1\ p)}{\Gamma(p)} \quad (\frac{\rho}{l})^p\ K_p\ (\frac{\rho}{l})$$

Where $B_2(\rho)$ is the correlation function of the dielectric constant; $(\Delta\varepsilon)^2$ is the intensity of fluctuation of the dielectric constant of air; is the extent of turbulent irregularities; K_p is the modified Bessel function (MacDonald function); Γ is the gamma function; and ρ is the distance between two points in a turbulent flow in which fluctuations of the dielectric constant are considered. The author analyzes the dependence of the effective cross section of scattering (scattering coefficient) on the form of correlation function and energy spectrum of turbulent irregularities of the troposphere on the extent of irregularities and on a number of other parameters. Results of different scattering theories are compared on the basis of the aforementioned correlation function. --R. M.

E-665 Prosin, A. V. and Gubskii, V. F., K teorii raznesennogo priema pri dal'nem troposfernom rasprostranenii UKV. (Contribution to the Theory of diversity reception in extended range tropospheric propagation of ultrashort waves.) Radiotekhnika, Moscow, 14(5):23-33, May 1959. 4 figs., 6 refs., 47 eqs. Transl. into English in Radio Engineering, N. Y., 14(5):31-44, 1959. --On the basis of the theory of the scattering of radio waves by turbulent irregularities of the troposphere, the authors consider the effect of the parameters of tropospheric scatter links and parameters of the scattering medium on the correlation of received signals with space and frequency diversity. The formulas and curves obtained for correlation functions make it possible to calculate the necessary separation of receiving points in planning transhorizon communication systems. Transl. of authors' abstract. -R. M.

E-666 Prosin, A. V.; Levshin, I. P. and Slobodeniuk, G. I., Eksperimental'noe issledovanie dal'nego troposfernogo rasprostraneniia ukv pri sdvoennom prieme. (Experimental investigation of long distance tropospheric propagation of USW using space diversity reception.) Radiotekhnika, Moscow, 14(10):3-14, Oct. 1959. 17 figs., table, ref., 6 eqs. Transl. into English in Radio Engineering, N. Y., 14(10):1-18, 1959. DLC--The results of experimental studies of the statistical characteristics of signals transmitted at 3000 Mc over a 275 km path are discussed and compared with theory. The signals were received on a two element antenna, (high-gain and a low gain), positioned normal to the path, and recorded simultaneously on a loop oscillograph and a double track electronic oscilloscope. The mean field strength at the receivers, losses in antenna gain, the unidimensional and dual dimensional distribution of instantaneous signal values for short periods of time, the correlation coefficient describing the degree of association between rapid signal fading at both elements of the antenna, the correlation coefficient when the signals were spaced in time, the velocity of rapid fluctuations of the field level beyond the horizon, and the distribution of pulse durations are examined individually. The results obtained may be used to set up radiocommunication links using long range tropospheric propagation of USW, being valid for a 10 cm wave length and a 275 km path. Good agreement between theoretical and experimental values, however, permits extrapolation of the results for other frequencies and distances within certain limits. --R. M.

E-667 Rice, P.L.; Longley, A.G. and Norton, K.A., Prediction of the cumulative distribution of ground wave and tropospheric wave transmission loss. U.S. National Bureau of Standards, Technical Note, No. 15, July 1959. 81 p. 44 figs., 7 tables, refs., eqs. DLC, DBS--A method for predicting the cumulative distribution with time of transmission loss at frequencies above 10 megacycles per second over path of arbitrary length, is described. The method makes use of available information about terrain profiles and surface meteorological data, and is based on the CRPL radio standard atmospheres, in which the radio refractive index decreases linearly with height for the first kilometer above ground, and the decreases exponentially with height. Discussion of the theoretical basis for this formula and a demonstration of its accuracy by comparison with experimental data are reserved for later parts of this report. --Authors' abstract.

E-668 Rodak, M.I. and Frantsesson, A.V., On the use of turbulence theory to investigate the scattering of radio waves from wandering inhomogeneities. Radio Engineering and Electronics, N.Y., 4(3):66-74, 1959. 6 refs., 16 eqs. Transl. from Russian in Radiotekhnika i Elektronika, Moscow, 4(3):398-403, March 1959. DLC--Scattering of radio waves from particles, the motion of which can be described in terms of Kolmogorov and Obukhov's turbulence theory, is investigated. The conditions are clarified, which make it permissible to evaluate the correlation function (the spectrum) of the scattered field (of the components of its amplitude) and the correlation function (the spectrum) of its intensity, while assuming the velocity of the scattering centers to be constant. --Authors' abstract.

E-669 Semenov, A.A. and Karpeev, G.A. Investigation of rapid fading of radio signals at medium distances along the Earth's surface. Radio Engineering and Electronics, N.Y., 4(2):43-54, 1959. 5 figs., 12 refs., 6 eqs. Transl. from Russian in Radiotekhnika i Elektronika, Moscow, 4(2):187-194, Feb. 1959. DLC--The results of investigations on the fading of 3 cm band signals reflected from standard reflectors with surface propagation in the zone of direct visibility are given. A result of the investigation is a preliminary estimate of the effect of the surface on the formation of reflected radio signal amplitude fluctuations. The result of the work may be useful for passive retranslation, as well as in radiolocation of ground level targets. --Authors' abstract.

E-670 Semenov, A.A. and Karpeev, G.A., O sviazi chastoty zamiraniĭ amplitudy polia UKV so skorost'iu dreĭfa neodnorodnosteĭ v troposfere i chastotoĭ nesushcheĭ. (Relationship between the fading frequency of the ultrashortwave field amplitude and the drift velocity of tropospheric inhomogeneities and the carrier frequency.) Moscow. Universitet, Vestnik, Seriia Matematiki, Mekhaniki, Astronomii, Fiziki, Khimii, No. 6:131-136, 1959. 5 figs., 7 refs. (Unchecked)--In their evaluation of the effect of regular drift of the medium and chaotic movement of irregularities, the authors investigate the space-time correlation function of the complex field amplitude in two points. A moving coordinate system is introduced and an equation is derived for the field amplitude. It is found that field fluctuations are determined by characteristics of receiving and transmitting equipment as well as by permittivity fluctuations and velocity of the drift of irregularities. Some experimental data are compared with theoretical data. The fading rate increases with an increase in carrier frequency but the authors find it impossible to confirm a linear dependence. --R.M.

E-671 Siforov, V.I., Aleksandr Stepanovich Popov i razvitie radioelektroniki, (Aleksandr Stepanovich Popov and the development of radioelectronics.) Radiotekhnika, Moscow, 14(3):3-8, March 1959. Transl. into English in Radio Engineering, N.Y., 14(3):1-12, 1959. DLC--Brief historical account of Popov's contributions to radio and electronics followed by a series of short statements about each of the various electronic fields ranging from propagation theory, electronic computers, and instrumentations to scattering and antennas. Points out achievements, trends, plans for future development and the author's views pertaining to current deficiencies in several fields. --R.M.

E-672 Staras, H. and Wheelon, A.D., Theoretical research on tropospheric scatter propagation in the United States, 1954-1957. IRE Transactions on Antennas and Propagation, N.Y., 7(1):80-87, Jan. 1959. 2 figs., table, 38 refs., 25 eqs. DLC--Recent progress in the theory of tropospheric scatter propagation in the U.S. is outlined. In the past 3 yrs, the emphasis of theoretical research has shifted from the analysis of the average signal level to the analysis of the signal statistics and to the underlying hydrodynamics of atmospheric turbulence. As might be expected in such a new and complete field, there is far from unanimity of opinion as to the best model to explain the myriad experimental results. --Authors' abstract.

E-673 Stiles, K.P., Tropospheric scatter path loss tests Florida - Bahamas. IRE Transactions on Communications Systems, N.Y., 7(3):205-208, Sept. 1959. 8 figs. DLC (TK5101.I22)--Telephone service between the U.S. and the Bahama Islands is now provided by means of high frequency radio systems working in the 2-7 Mc range. To handle properly the large volume of traffic during the peak winter season requires that more than present nine circuits be provided. The lack of available frequencies in the 2-7 Mc range, together with the comparatively poorer grade of facility obtained from these radio systems, makes it desirable to investigate other methods of providing telephone facilities. The fact that the present Miami-Havana tropospheric scatter system is performing so well, and that the distance from Miami to Nassau is the same as that to the Cuban terminal, made this type of system very attractive. At the time the Cuban system was being developed, klystron tubes capable of high outputs above 1000 Mc, were not available. For this reason, the Cuban system was designed to operate in the 700-900 Mc range. Since that time tubes capable of high output levels at frequencies above 2000 Mc have been developed, and it was considered desirable to operate at these higher frequencies rather than in the lower part of the UHF spectrum. Path loss tests were made over a 9 week period on the Florida-Nassau path using a frequency of 1970 Mc. These tests are discussed and some comparisons are drawn between them and the path loss tests made to Cuba at 800 Mc two years earlier. The Nassau tests indicated that a satisfactory 60 channel radio system could be provided through use of 10 kw transmitters and 30 ft parabolic antennas. --Author's abstract.

E-674 Svien, Arlon S. and Domingue, Jules C., Tropospheric scatter propagation characteristics. IRE National Convention Record, Pt.1:3-9, 1959. 8 figs., table, 3 refs. DBS--Two parameters of tropospheric propagation, the effects of elevated horizons and antenna height, are discussed on the basis of 2½ yrs of detailed measurements conducted at the U.S. Army Electronic Proving Ground in Arizona and New Mexico, over paths varying between 50 and 385 mi, at frequencies of 810, 380 and 950 Mc. Agreement between experimental values and those obtained from literature is found to be excellent. --G.T.

E-675 Tao, Kazuhiko and Sawaji, Kazuaki, On the graphical method of calculation of field strength for effective Earth radii other than 4/3 times the actual radius and for any antenna heights and frequencies. Japan. Radio Research Laboratories, Tokyo, Journal, 6(25):311-329, April 1959. 3 tables, eqs. DBS. Japanese version with English summary in its Review, 5(19):93-144, April 1959. 7 figs., 4 tables, 3 refs., eqs. DLC--In resolution No. 21, the VIII Plenary Assembly of the C.C.I.R. requested the Director of the C.C.I.R. to prepare a supplement to the C.C.I.R. Atlas (1955) by using a suitable mathematical transformation for the calculation of field strength for the effective Earth radii other than 4/3 times the actual radii and for other values of earth's conductivity. Resolution No. 22 also provided to find a method of interpolation for antenna heights and frequencies different from those contained in the Atlas. Concerning the above mentioned corrections, the method of calculating field strength in the diffraction region has been proposed by the C.C.I.R. Secretariat. Though the method of the C.C.I.R. is very useful, yet the calculation is fairly complicated and needs much time for complete processing. A much simpler graphical method has been obtained which enables to measure the required field strength in a few minutes. Moreover, another method to find out the position of interference patterns in an optical region is given. (Met. Abs. 14.5-144)--Authors' abstract.

E-676 Tatarskiĭ, Valerian Il'ich, Teoriia fluktuatsionnykh iavlenii pri rasprostranenii voln v turbulentnoĭ atmosfere. (Theory of fluctuation phenomena associated with the propagation of waves in a turbulent atmosphere.) Moscow, Akademiia Nauk SSSR, 1959. 230 p. 45 figs., 99 refs., numerous eqs. DLC (QC931.T3)--A unique and useful textbook or monograph presenting the basic theory of statistical turbulence and its application to the solution of problems concerning propagation of radio, light and sound waves in a turbulent atmosphere. Methods of observing or recording turbulent fluctuations of temperature, wind, and of computing the data, the nature or microstructure of turbulent flow, the scattering of electromagnetic waves in a turbulent atmosphere and of sound waves in local isotropic turbulence, solution of amplitude and phase fluctuation problems for monochromatic waves on the basis of geometric optics and on the basis of wave equation and of spherical waves and finally, experimental data for the lower troposphere for radio and light waves and scintillation data for stars and telescopes. (Met. Abs. 11.11-13)--M.R.

E-677 Thompson, M.C., Jr. and Janes, H.B., Measurements of phase stability over a low level tropospheric path. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(1):45-51, July/Aug. 1959. 9 figs., 5 eqs. DLC, DWB--A knowledge of the statistics of atmosphere induced variations in the phase of the received signal (i.e., variations in electrical path length) is essential in evaluating the reliability of any system using radio waves for measuring distance and/or velocity. This paper describes an analysis of phase variations measured at 9400 megacycles per second over a 9.4 mi path near Boulder, Colo., during a 40 hr period in Sept. 1958. This power spectral density of these variations is shown to be approximately proportional to $f^{-2.8}$ over a wide range of frequencies throughout the period of recording. The long term phase variations are closely correlated with atmospheric refractivity measurements made at the path terminals. (Met. Abs. 12.3-98)--Authors' abstract.

E-678 Tomlinson, H.T. (Chance-Vought Aircraft Corp., Arlington, Tex.) and Straiton, A. W. (Univ. of Texas, Austin), Analysis of 3 cm radio height gain curves taken over rough terrain. IRE Transactions on Antennas and Propagation, 7(4):405-413, Oct. 1959. 27 figs. (incl. photos), table, 3 refs., 4 eqs. DLC--This report describes the effect of terrain and meteorological conditions on the height gain pattern of 3.2 cm radio waves over various short transmission paths. Equivalent reflection coefficients are obtained and potential reflection areas are investigated. A study of time variations in the height of nulls in the signal strength pattern is made and the relationship between movement of the nulls and the corresponding refractive index distribution is considered. (Met. Abs. 12.8-392)--Authors' abstract.

E-679 Venkateswarlu, P. and Satyanarayana, R. (both, Physics Dept. S.V. Univ., Tirupati), Propagation of ground waves across a land/sea boundary. Current Science, Bangalore, 28(6):239, June 1959. Table, 3 refs. DWB, DLC--Observations on the field strength of ground waves of 447.9 m wave length from A.I.R. Calcutta station suggest that a recovery of field strength as expected from MILLINGTON's analysis (1949) is possible even at these wave lengths. Relative intensities determined theoretically and experimentally at widely separated stations in India are tabulated. The details regarding the extent of recovery and the field strength expected at Tirupati on the basis of NUKKUBGTIB's theory are being worked out. (Met. Abs. 12.10-137)--E.Z.S.

E-680 Vogelman, J.H.; Ryerson, J.L. and Bickelhaupt, M.H., Tropospheric scatter system using angle diversity. Institute of Radio Engineers, N.Y., Proceedings, 47(5):688-696, May 1959. 18 figs., 7 refs. DLC--This paper proposes an extension of the angle diversity technique as a means toward solution of several prob--lems restricting use of over the horizon microwave communications. The paper suggests application of a microwave multibeam system as an attack on the problems of transmitter tube limitations, "medium to aperture" coupling loss, and VHF band interference. A simple experiment is described and results evaluated. The experiment provides a measure of verification of previous theoretical work on which the proposed technique is based. Results of numerous path calculations are included to provide the reader with an estimate of improvement to be gained by the use of this expansion of the angle diversity technique over a continental system.--Authors' abstract.

E-681 Weisbrod, S. and Anderson, L.J., Simple methods for computing tropospheric and ionospheric refraction effects on radio waves. Institute of Radio Engineers, N.Y., Proceedings, 47(10):1770-1777, Oct. 1959. 7 figs., 7 refs., 51 eqs. DLC--The paper describes a simple and accurate method for computing ionospheric and tropospheric bending. The only assumptions made are that the refractive gradient is radial and that the refractive index profile can be approximated by a finite number of linear segments whose thickness is small compared with the earth's radius. These assumptions are readily justifiable in all practical cases. Since there are no limitations on the angle of elevation and the shape of the refractive index profile, the method has a wide application and it is extended to cover other refractive effects such as retardation, Doppler error and Faraday Rotation.--Authors' abstract.

E-682 Wheelon, A. D., Radio scattering by tropospheric irregularities. Journal of Atmospheric and Terrestrial Physics, N. Y., 15(3/4):185-205, Oct. 1959. 5 figs., table, bibliog. p. 203-204, numerous eqs. DLC--The existence of time varying irregularities in the tropospheric index of refraction has been firmly established by numerous measurements with microwave refractometers. The physical reality of these apparently random fluctuations poses an important problem for turbulence theory in itself. The effects of such irregularities in scattering radio waves both within and beyond the horizon has raised a much broader and more vital class of questions. The combination of turbulence theory and electromagnetic propagation theory has been used to explain the propagation of microwaves beyond the horizon. The important role of refractive fluctuations is suggested by the fading and band width limitations of scatter signals. Scintillation of the amplitude and phase of electromagnetic waves propagated through a region of refractive irregularities is discussed with the same techniques. --Author's abstract.

E-683 Zhevankin, S. A. and Troitskii, V.N., Absorption of centimeter waves in the atmosphere. Radio Engineering and Electronics, N. Y., 4(1):30-41, 1959. Fig., 2 tables, 6 refs., 36 eqs. Transl. from Russian in Radiotekhnika i Electronika, Moscow, 4(1):21-27, Jan. 1959. DLC--In this article general expressions are derived for the absorption of a wave propagated in the atmosphere. A "moist" atmosphere is taken as representative of the atmosphere with certain parameters which vary exponentially with the altitude. --Authors' abstract.

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E-684 Abbott, Richard L., Bibliography of tropospheric radio wave scattering. U.S. National Bureau of Standards, Technical Note No. 80, Nov. 1960. 79 p. 681 titles. DWB (M(055) U585te)--Except for 65 references to literature prior to 1950, the 681 unannotated entries cover the period 1950-1960. The bibliography is arranged alphabetically by author, in chronological order. It is provided with an author index, and a subject index with brief subdivisions under the classifications 1) theoretical, and 2) experimental. (Met. Abs. 14.6-91)--W. N.

E-685 Akima, Hiroshi, Experimental test of reciprocal radio wave propagation over a VHF circuit. Japan. Radio Research Laboratories, Journal, 7(30):125-128, March 1960. 2 figs., 3 refs. DBS--From an experimental test of reciprocal radio wave propagation over a circuit of the frequency 152.05 Mc/s and a path about 125 km long, no phenomena could be found that would deny the reciprocity of propagation. --Author's abstract.

E-686 Akima, Hiroshi et al., Experiment in the intermittent communication of the VHF teletype channel. Japan. Radio Research Laboratories, Journal, 7(34):637-641, Nov. 1960. Fig., 3 tables. DBS--A simple experimental investigation of the intermittent communication is made on a VHF radio teletype channel. Frequency shift (FS) modulated teletype signals are intermitted by the control signal from the receiving station. This control signal is of on-off carrier, which is modulated by the signal (plus noise) level of the receiving station which is higher or lower than the limited level. The results of the test show that the character error rate of the intermittent communication is 0.0073% and that of the continuous method is 0.14%. These errors occur in case of interference of various kinds, but considering the errors due to signal fade-out alone, the character error rate is 0.0021% for the intermittent communication and it is 0.11% for the continuous communication. The mean transmission loss of the intermittent communication is about 7%. --Authors' abstract.

E-687 Ames, L.A.; Martin, E.J. and Rogers, T.F. (all, AF Cambridge Res. Center, Bedford, Mass.), Airborne measurement of 1.36 m fields to ranges in excess of 900 miles and at altitudes from the surface to 40,000 ft. (In: Desirant, M. and Michiels, J.L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 215-226. 14 figs.) CU-S (QC661.D458)--The decay of tropospheric fields well beyond the radio horizon at 1.36 m is a monotonically decreasing function of distance out to about 800 statute miles. The "effective" distance concept was shown to be accurate and useful for calculating path losses over a smooth Earth in the distance region of 100-600 mi. Large height gains were predicted in the tropospheric scatter field which decrease with increasing distance. It was found that scatter fields exist above the tropopause and their magnitude and characteristics did not differ to any great extent from predictions. The ionosphere persistently manifests its influence at a wavelength much shorter than has heretofore been demonstrated to exhibit characteristics of continuous ionospheric propagation. --Authors' abstract and E.Z.S.

E-688 Anderson, W.L.; Beyers, N.J. and Rainey, R.J., Comparison of experimental with computed tropospheric refraction. IRE Transactions on Antennas and Propagation, N.Y., 8(5):456-461, Sept. 1960. 4 figs., 3 tables, 4 refs. DLC--Limits of applicability of ray tracing in computing tropospheric refraction at White Sands Missile Range have been further explored. 286 comparisons were made, all for a path from radar to fixed beacon of about 45 mi and an elevation angle of 17.99 milliradians. A horizontally stratified atmosphere was assumed. Refractive index profiles were prepared from a variety of weather data, and classified A, B, or R, in descending order of reliability prior to ray tracing calculations. Angle observations were made with an FPS-16 C-band radar having a quoted instrumental accuracy of 0.14 milliradian rms. Angle readings varied from 18.36 to 20.54 milliradians, with mean of 19.01 milliradians and standard deviation of 0.41 milliradians. The rms deviation of computed from experimental angles ranges from 0.28 to 0.41 milliradian for different classes of data. The ratio of this deviation to the deviation from over all mean varies from 0.68 for Class A to 1.00 for Class R. Thus the improvement over a standard atmosphere varies from 32% to 0, and correlates directly with quality of weather information. For this experiment it is concluded that most of the rms elevation angle error is contributed by atmospheric conditions. Although ray tracing methods provide a significant correction when sufficiently good weather information is available, there still remains a large uncertainty not accounted for by equipment. --Authors' abstract.

E-689 Andrieux, G.; Cayzac, J. and Ducot, C., Equipment hertzien téléphonique pour propagation par diffusion troposphérique. (Tropospheric diffusion radio link equipment.) L'Onde Electrique, Paris, 40(394):74-81, Jan. 1960. 10 figs. DLC--The authors describe an experimental 30 channel equipment using tropospheric diffusion transmission. The transmitter operates at 900 Mc/s and radiates a power of 1.5 kW. It incorporates a 3 cavity klystron amplifier which has been developed by the Laboratoires d'Electronique et de Physique. The gain of this amplifier is 35 db for a bandwidth of 2 Mc/s. The carrier wave is frequency modulated in a 3 tripler stage phase corrected modulator. The receivers use the EC56/57 tube as UHF pre-amplifier; the noise factor so obtained is less than 8 db. Double space diversity with a low frequency weighting is employed. The experimental results obtained on the Paris-Caen (204 km distance diffusion angle 1.5°) are given. With an aerial of 5 m diameter, the median fluctuation noise in the most unfavorable channel, in a pure frequency modulation system was −46 db as measured on a psophotometer. Inter-modulation noise with normal loading of the system was in the region of − 53 db. It is possible to deduce the performance of the equipment with larger aerials, with pre-emphasis, etc. (Met. Abs. 15.1-99)--Authors' abstract.

E-690 Asai, Jun-ichi; Fujikawa, Masatoshi; Tsuchiya, Kiyoma; Ishii, Takahiroo and Kajikawa, Makoto, Statistical results of VHF propagation over the sea on the path beyond the horizon. Japan. Radio Research Laboratories, Tokyo, Review, 6(26):261-267, Sept. 1960. 12 figs., 5 tables, 4 refs. In Japanese; English summary p. 261. DLC--This paper gives some statistical results of VHF propagation tests which were made on the path beyond the horizon, about 77 km, over the Kashima Nada. During the tests simultaneous transmissions on 60 Mc/s and 150 Mc/s were measured for the whole year from Dec. 1957 to Nov. 1958. Three statistics were used such as, the relative field intensity, fading range, and fading rate for an hour, in order to describe the character of propagation. There was a marked seasonal variation of the field intensity. On 60 Mc/s the monthly mean values of hourly medians registered the maximum value 15. 5 db in Dec. and the minimum 8. 4 db in July. On 150 Mc/s, the maximum value was 18 db in Sept. and the minimum 10. 1 db in March. There was generally little diurnal variation. For a seasonal variation of the fading range for an hour, there was a marked similarity on 60 Mcs and 150 Mc/s. The maximum value of monthly mean values was 6. 6 db in July and the minimum was 1. 7 db in Feb. on 60 Mc/s, and the maximum was 7. 2 db in Sept. and the minimum 1. 3 db in Feb. on 150 Mc/s. There was a similar seasonal variation of the fading rate for an hour on both frequencies. The maximum value of monthly mean values was 46 fades/hr in March and the minimum 12 fades/hr in June on 60 Mc/s, and the maximum was 47 fades/hr in Oct. and the minimum 11 fades/hr in June. The diurnal variation of the fading rate was in general greater in the daytime and less at night. (Met. Abs. 14. 4-121) --Authors' abstract.

E-691 Bass, F. G., Granichnye usloviia dlia elektromagnitnogo polia na poverkhnosti s proizvol'nym znacheniem dielektricheskoĭ pronitsaemosti. (Boundary conditions for the electromagnetic field at a surface with arbitrary dielectric constant.) Radiotekhnika i Elektronika, Moscow, 5(3):389-392, March 1960. 2 refs., 11 eqs. Transl. into English in Radio Engineering and Electronics, N. Y., 5(3):49-53, 1960. --Boundary conditions are derived for the electromagnetic field at a surface with arbitrary dielectric constant. In the general case these conditions are nonlocal. Cases where passage to local boundary conditions is possible are considered. --Author's abstract.

E-692 Bayot, R. and Forest, A., Un équipment pour faisceaux hertziens transhorizon dans la bande des 170 MHz. (A transhorizon radio link system in the 170 Mc/s band.) Onde Electrique, Paris, 40(394):65-73, Jan. 1960. 15 figs. DLC--The design and performance characteristics of a tropospheric scatter system for a maximum of 36 telephone channels are described, and block diagrams of its components are given. The system uses a phase modulator with de-emphasis, has a transmitting power of 1 kw, obtained by a single output tube, and two receivers with double diversity resulting from combining carrier frequencies. ---R. M.

E-693 Bean, Bradford R. (NBS, Boulder, Colo.), Atmospheric bending of radio waves. (In: Desirant, M. and Michiels, J. L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 163-181. 10 figs., 3 tables, 12 refs., 10 eqs.) CU-S (QC661. D458)--Presents several models of the height distribution of atmospheric refractive index that should be of use in radio propagation problems. Considering the average refractive index structure of the atmosphere and results of recent statistical studies of radio ray bending, it was found that these models may be expressed in terms of the value of the refractive index at the Earth's surface. --E. Z. S.

E-694 Bean, B.R.; Cahoon, B.A. and Thayer, G.D., Tables for the statistical prediction of radio ray bending and elevation angle error using surface values of the refractive index. U.S. National Bureau of Standards, Technical Note, No. 44, March 16, 1960. p. 3+, Fig., 3 tables, 3 refs. DLC--Radio ray bending, τ, and elevation angle error, ε, have been calculated for a wide range of meteorological conditions at 13 climatically diverse U.S. radiosonde stations. The parameters in the observed linear regression equations of τ and ε upon the surface value of the refractive index are given for heights of 0.1 to 70 km and initial elevation angles of the ray from 0 to 900 milliradians. --Authors' abstract.

E-695 Bean, B.R. and Dutton, E.J., On the calculation of the departures of radio wave bending from normal. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(3):259-263, May/June 1960. 3 figs., 3 tables, 22 refs., 14 eqs. DWB, DLC--The calculation of non-normal tropospheric bending of radio waves is treated in terms of a reduced-to-sea level value of the refractive index. This method emphasizes departures of bending from the average bending for the U.S. and consists of visualizing ray bending as consisting of two parts; an "average" component and a "departure from average" component. The "average" component comprises most of the bending and is obtained accurately from refraction tabulations while the component due to departures is easily obtained by graphical means. (Met. Abs. 14.4-127)--Authors' abstract.

E-696 Bean, B.R.; Horn, J.D. and Ozanich, A.M., Jr., Climatic charts and data of the radio refractive index for the U.S. and the World. U.S. National Bureau of Standards, Monograph No. 22, 1960. 178 p. 117 figs., 11 tables, 18 refs. DLC (QC100.U556)--The radio refractive index of air, $n = 1 + N 10^{-6}$, is a function of atmospheric pressure, temperature, and humidity and varies in a systematic fashion with climate. Included in this paper is a compilation of refractive index data. Data listings made up of observations from 45 U.S. surface weather stations for 2 hr intervals over an 8 yr period are given. Mean values, maxima, minima and standard deviations of the refractive index have been calculated and tabulated for these observations. Additionally, mean vertical profiles of the refractive index have been prepared for 43 U.S. upper air sounding stations from long term means of pressure, temperature, and humidity. Earlier studies of refractive index climate are assimilated and put into perspective. One such study is an extensive analysis and mapping of the refractive index climate of the U.S. A worldwide radio refractive index climatology is developed, based upon monthly mean observations of pressure, temperature, and humidity. An important finding of these climatological investigations is the strong correlation of N with height. A reduced-to-sea-level value of the index, termed N_o, is used to eliminate this systematic height dependence. The surface value of N, N_s, may be estimated 4-5 times more accurately from charts of N_o than from similar sized charts of N_s itself. From climatic charts of N_o, N_s may be estimated at any given location in the U.S. throughout the day during every season. In addition, detailed annual and diurnal cycles, as well as 8 yr cumulative probability distributions, are given for 12 representative U.S. stations. On a worldwide basis, charts of mean N_o are presented for both summer and winter seasons. (Met. Abs. 14.6-21) --Authors' abstract.

E-697 Bean, B.R.; Horn, J.D. and Riggs, L.P. (all, Nat'l. Bur. of Standards, Boulder, Colo.), Refraction of radio waves at low angles within various air masses. Journal of Geophysical Research, Wash., D.C., 65(4):1183-1187, April 1960. 5 figs., table, 23 refs., 5 eqs. DLC--The refractive index structure and bending of radio ways within air masses of nonexponential refractive index height structure is treated in terms of the value expected in an average atmosphere of exponential form. It is demonstrated that refraction differences within air masses arise from departures of refractive index structure from the normal exponential decrease with height. The effect upon radio ray refraction of these departures from the normal exponential refractive index structure is most pronounced for small initial elevation angles of the radio ray. (Met. Abs. 12.10–131)--Authors' abstract.

E-698 Bean, B. R.; Thayer, G. D. and Cahoon, B. A., Methods of predicting the atmospheric bending of radio rays. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(5):487-492, Sept./Oct. 1960. 5 figs., 14 refs., 11 eqs. DWB, DLC--Three methods for predicting the bending of radio rays when the refractive index profile above the surface layer is unknown have been developed recently by the authors. These methods are a statistical technique for refraction at high initial elevation angles, estimation of bending from an exponential model of atmospheric refractive index, and a modification of the exponential model to account for the heavily weighted effects of anomalous initial refractive index gradients at small initial elevation angles. Each model is dependent upon the value of the refractive index at ground level, or in the case of superrefraction, the additional knowledge of the refractive index gradient next to the earth's surface. Each method works best in a particular range of initial elevation angles or meteorological conditions. The height and angular ranges of application of each method are checked by comparison with values obtained from 77 diverse refractive index profiles representative of wide climatic variation. It is found that the use of the best of the three methods will always result in a prediction of the total atmospheric bending within 10% for initial elevation angles from zero to 10 milliradians and to within 4% for initial elevation angles greater than 17 milliradians (1 def). (Met. Abs. 12.10-132)--Authors' abstract.

E-699 Beckmann, Petr (Czechoslovakia Academy of Sciences, Prague), Generalized Rayleigh distribution and its application to tropospheric propagation. (In: Desirant, M. and Michiels, J.L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p.445-449. Fig., table, 6 refs., 8 eqs.) CU-S (QC661. D458)--Derives the probability distribution of the amplitude of the vector sum of n random unit vectors with given (not necessarily uniform) phase distribution, which includes the Rayleigh distribution as a special case, and compares the result with experimentally measured distribution of the rapid fading in transhorizon tropospheric propagation. --E. Z. S.

E-700 Beckmann, P., Die Einrichtung einer 1.3 GHz Strecke zwischen Prag und Kolberg bei Berlin. (Installation of a 1.3 kMc link between Prague and Kolberg bei Berlin.) Radio und Fernsehen, 9(3):71-73, Feb. 1960. 3 figs., ref. DLC--The authors first consider the basic principles and problems of long distance propagation of radio waves. Two explanations of field intensity are set out: on the one hand, the scatter concept, particularly current in the U.S., and on the other hand, that of partial reflections in the area of deviating refraction characteristics. Both explanations are based on tropospheric irregularities. The median value of the signal far beyond the optical horizon is relatively constant. Seasonal and weather conditions as well as very short amplitude fluctuations due to movement in the troposphere modify the signal. Antenna-to-medium coupling loss is explained. Space and frequency diversity are found to increase link stability and to considerably reduce short period signal fluctuations. Measurements and practical operations of scatter links are described. There are three 1.1 - 1.2 kMc links in East Germany: Dresden - Kolberg (125 km); Fichtelberg - Kolberg (208 km); and Inselberg -

Kolberg (280 km); and a 1.3 kMc link between Prague and Kolberg operated jointly by the Institute of Radio Engineering and Electronics in Prague and the Industrial Laboratory of Radio and Television in Kolberg. The equipment, measurements and operational factors on the latter link are described and field strength records are given. A profile map of the link is also shown. The link is expected to continue daily operations for two years.

E-701 Bellman, Richard and Kalaba, Robert (both, Rand Corp., Santa Monica, Calif.), Invariant imbedding and wave propagation in stochastic media. (In: Desirant, M. and Michiels, J.L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 243-252. 4 figs., 27 refs., 30 eqs.) CU-S (QC661. D458)--Describes an application of the theory of invariant imbedding to the propagation of electromagnetic waves through an inhomogeneous medium, especially where the inhomogeneity is stochastic in origin. Problems of this sort arise in a variety of fields including radio wave propagation and acoustics. --Authors' abstract and E. Z. S.

E-702 Blomquist, Åke (Res. Inst. of Nat'l. Defence Stockholm), Local ground wave field strength variations in the frequency range 30-1000 MHz. (In: Desirant, M. and Michiels, J.L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 127-142. 12 figs., ref., 8 eqs.) CU-S (QC661. D458)--Results from a number of field strength recordings of the ground wave are presented. Measurements were made over different types of terrain in middle Sweden and at different seasons both at vertical and horizontal polarization. Local field strength variations due to vegetation and ground moisture conditions with low antennas are discussed and field strength distribution curves are given. --Author's abstract and E. Z. S.

E-703 Boithias, L. and du Castel, F., Etude d'un faisceau hertzien transhorizon en Afrique Occidentale. (Study of an over the horizon radio beam in West Africa.) L'Onde Electrique, Paris, 40(394):39-45, Jan. 1960. 15 figs., 9 refs. French and English summaries. DLC--Propagation tests at 100 and 430 Mc/s have been carried out by the Centre National d'Etudes des Telecommunications between Dakar and Conakry from Nov. 1957 to April 1958. The systems studied were 270, 280 and 170 km in length. The results obtained were examined from the point of view of the variation in the mean loss. An important diurnal effect was noted. A correlation between the monthly variations in propagation loss and a parameter and the climatic conditions of the region concerned, is attempted. The study included the variations of 3 parameters, the refractive index at ground, the mean gradient index defined by the values of the index at the surface and at the altitude of 1000 m, the stability of the lower atmospheric layers and the vapor tension at the surface. The annual variations of radio meteorological parameters are very different and therefore it is difficult to select the most favorable season for propagation. It seems that in tropical regions the radio meteorological parameters comply with more complex laws than in temperate climates. The index gradient is probably the most suitable parameter. Therefore, it is concluded that from Dec. to Feb. would be the worst period. The variations of signal strength are then examined. The analysis of the amplitude yields information on the characteristic laws, while the analysis of duration provides other interesting information. The results are used to design an over the horizon project between Dakar and Conakry. Some general inferences are drawn on the influence of a tropical region of UHF over the horizon propagation. (Met. Abs. 12.1-99)--A. V. and Authors' abstract.

E-704 Bolgiano, Ralph, Jr. (Cornell Univ.), A theory of wavelength dependence in ultrahigh frequency transhorizon propagation based on meteorological considerations. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(3):231-237, May/June 1960. 6 figs., table, 24 refs., 13 eqs. DWB, DLC--Recent radio data indicate that the wave length dependence of ultrahigh frequency transhorizon propagation varies widely in time. This is in contradiction with theoretical explanations previously set forth. Each attempt to account for the underlying effects of ever-present atmospheric motions has, in the past, pointed toward a unique form of the dependence. Extensive discussions have resulted as to the validity and relative merits of the various forms, but at no time has a variable wave length dependence been proposed. Since scatter propagation theory has predicted so satisfactorily the broad aspects of the radio signals, it is retained as the basis for further analysis. A new model is developed for the structure of refractive index fluctuations induced by turbulence. Grounded on a theory of homogeneous turbulence in a stably stratified atmosphere, which has been developed concurrently by the author, this new model provides an explanation for the observed distribution of wavelength dependence. It suggests that at times when the dynamic stability of the air within the scattering volume is neutral, the received power should be nearly independent of radio wavelength. On the other hand, when the atmosphere is dynamically stable the signal strength should be proportional to the square, or higher power, of the wavelength. These predictions have been tested by comparing the results of a scaled frequency experiment with simultaneous meteorological data gathered along the path. Richardson's number for the 1 to 3 kilometer layer, within which the principal scattering volume lies, has been employed as an index of dynamic stability, though it falls short of ideal in some respects. The 0.8 value of correlation found between Richardson's number and the wavelength dependence is highly suggestive that a relation of the nature predicted does, in fact, exist. (Met. Abs. 12.10-133)--Author's abstract.

E-705 Bremmer, H., On the theory of wave propagation through a concentrically stratified troposphere with a smooth profile, Pt. 1, Discussion of the extended W.K.B. approximation. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(5):467-482, Sept./Oct. 1960. Fig., 13 refs., 64 eqs. DLC, DBS--The W.K.B. approximation for the solution of the height gain differential equation for a curved stratified troposphere is discussed in detail. (For Pt. 2, see E-892). The approximation depends mainly on a variable $u_l(\underline{r})$ which can be interpreted as the height dependent contribution of the phase for a field solution obtained by separation of variables. An expansion of $u_l(\underline{r})$ with the aid of partial integrations leads to further approximations which facilitate the determination of the eigenvalues, and of the amplitudes of the modes connected with the propagation problem. The influence of the refractive index profile, if assumed as smooth, then appears to be restricted to a dependence on the surface values of this index and of its gradient insofar as propagation over ground is concerned. Further, all height effects of elevated antennas can be expressed in terms of the distance to the corresponding radio horizon. This results in simple relations between the fields connected with two different refractive index profiles, provided both profiles coincide near the earth's surface. (Met. Abs. 14.7-110)--Author's abstract.

E-706 Broussaud, G. and Malnar, L., Prototype de transmission multiplex par diffusion troposphérique. (A prototype of multiple tropospheric scatter propagation.) L'Onde Electrique, Paris, 40(394):83-95, Jan. 1960. 24 figs., foot-refs., eqs. DLC--The development of a prototype 2000 Mc/s over the horizon radio link equipment is described. The principal characteristics of the equipment are: power 10 kW, 12 m diameter parabolic reflectors, frequency diversity, 36 telephone channels, frequency modulation. After considering the general criteria which determined the choice of characteristics, the most important features of the development are examined and in particular certain interesting wave guide sections are described. (Met. Abs. 12.1-98)--Authors' abstract.

E-707 Bugnolo, Dimitri S. (Dept. of Elec. Engr., Columbia Univ.), On the question of multiple scattering in the troposphere. Journal of Geophysical Research, Wash., D.C., 65(3):879-884, March 1960. 2 figs., 17 refs., 3 eqs. DLC--A criterion is developed to serve as a measure of multiple scattering in the troposphere as a result of dielectric noise. The question to be answered is: What is the probability that any ray of the incident field will be scattered at least twice in a distance R? This useful criterion can serve as a measure of reliability for the usual single scatter approximations. It is developed in detail for an arbitrary dielectric noise and is applied to a number of special cases. The results indicate that multiple scattering effects should be of importance in the microwave spectrum. (Met. Abs. 12.3-99)--Author's abstract.

E-708 Bull, Gunther and Lange, Heinz, Fernausbreitung der Ultrakurzwellen. (Long distance propagation of ultrashort waves.) Radio und Fernsehen, 9(3):67-70, Feb. 1960. 5 figs., 3 refs. DLC--The authors examine possible mechanisms for the propagation of ultrashort waves. These are: refraction in an inhomogeneous atmosphere; bending on the curved surface of the earth or other obstacles; partial reflection from layers and irregularities of the atmosphere; scattering in tropopause and propagation through the ionosphere due to scattering by inhomogeneities and meteor trails. Exceptional propagation conditions are also considered, and are found to be due to the following: ground or elevated duct formation (rare in temperate zones); partial reflection from tropospheric layers (predominant for distances of 700-800 kilometers); occasional regular reflections from ionospheric layers in the case of the longer meter waves; and scattering by meteor trails.--R.M.

E-709 Cabessa, R., Les liaisons transhorizon. Conditions d'utilisation et performances réalisables. (Operating conditions and performance of over the horizon links.) L'Onde Electrique, Paris, 40(394):24-31, Jan. 1960. 12 figs. DLC--The UHF of over the horizon propagation through "tropospheric diffusion" is applied to actual systems. For the radioelectric waves transmitted by the troposphere, conditions of the free space propagation exist to a distance corresponding to the visible horizon of the transmitting aerial. The diffraction zone begins beyond this distance wherein the attenuation depends on frequency and diffraction. The experimental results make it possible to compute the propagation loss. The daily, seasonal and sudden variations in propagation weakening are given. This technique offers new possibilities of constructing telephone systems in insecure or inaccessible areas. The transmission characteristics of circuits are already meeting the national requirements in spite of the difficulties of enormous attenuation between transmitter and receiver. The relation of such performance has led to the development of special methods for the overall projects, i.e., the choice of sites, the conduct of propagation tests and the installation of telephone systems over horizon. Cost data and examples of the completed projects enable the future of these links to be forecast. (Met. Abs. 15.1-100)--A.V. and author's abstract.

E-710 Chernov, Lev Aleksandrovich (USSR, Acad. of Sciences), Wave propagation in a random medium. Transl. from the Russian by R.A. Silverman. N.Y., McGraw-Hill, 1960. 168 p. 13 figs., 61 refs., 455 eqs. Price $7.50. Review by Philip M. Morse in Physics Today, 13(10):50, Dec. 1960. Transl. of Rasprostranenie Voln V srede so sluchainymi neodnorodnostiam. (Propagation of waves in a medium with random inhomogeneities.) Moscow. Izd. vo Akademii Nauk, 1958. 158 p. --

This monograph contains a systematic treatment of the theory of wave propagation in a medium with random inhomogeneities. In Pt. 1, the problem of wave propagation is studied using the ray approximation; Pt. 2, deals with the diffraction theory of wave propagation; Pt. 3, discusses the question of how fluctuations in the incident wave affect the diffraction image formed by a focusing system. Some theoretical deductions are compared with experimental data. --E. K.

E-711 Clinger, A.H. and Straiton, A. W. (both, Univ. Texas), Adaptation of the radiosonde for direct measurement of radio refractive index. American Meteorological Society, Bulletin, 41(5):250-252, May 1960. 2 figs., 6 refs., 2 eqs. DWB--This paper describes a technique for converting a radiosonde for direct measurement of radio refractive index of air using standard meteorological sensors. Although limited by the response time of the sensors, this device would provide for continuous and direct measurement of refractive index to an accuracy satisfactory for many radio applications. (Met. Abs. 12.2-11)--Authors' abstract.

E-712 Denman, Eugene D. (Midwest Res. Inst., Kansas City, Mo.), A note on scatter propagation. Institute of Radio Engineers, Proceedings, 48(1):112-113, Jan. 1960. 2 figs., ref., 14 eqs. DLC--Recent work in the field of scattering of electromagnetic energy from a periodic dielectric perturbation in the atmosphere shows an interesting correlation to cover the horizon scattering from random turbulence. This note describes and graphically illustrates the theoretical predictions for the magnitude of the scattered electromagnetic energy from the periodic perturbation. (Met. Abs. 13.11-94)--I. S.

E-713 Dockes, J. and Koreicho, W., Liaisons hertziennes transhorizon dans la gamme 4400 - 5000 MHz. (Over the horizon radio link systems in the 4400 - 5000 Mc/s band.) L'Onde Electrique, Paris, 40(394):100-105, Jan. 1960. 8 figs., 5 refs. French and English summaries. DLC--The article reviews the general information available on tropospheric propagation in the neighborhood of 4500 Mc/s and establishes the basis for calculating the principal transmission characteristics of a given system. A general description is then given of equipment operating in the 4400 - 4500 Mc/s ranges. (Met. Abs. 12.1-102)--Authors' abstract.

E-714 du Castel, Francois, Les faisceaux hertziens transhorizon, situation actuelle et avenir. (Over the horizon radio links, present and future position.) L'Onde Electrique, Paris, 40(394):9-18, Jan. 1960. 16 figs., 14 refs. French and English summaries. DLC--The author first reviews the principal knowledge on over the horizon transmission with ultrashort waves; the propagation loss observed in a number of practical cases, the characteristics of fluctuations, theoretical interpretation of the propagation phenomenon, and then he shows practical means of approximately evaluating the loss of a given system. The considered cases relate to transmissions over various distances from 300 up to 500 km. Figures reproduce the linking characteristics and the damping distribution. The experimental results are likely to confirm the interpretation that the propagation is a phenomenon of partial reflection on the more or less stratified irregularities of the atmosphere. The reflection of the incident radiation may have different values owing to the variation of the reflective index with the nature of the atmospheric irregularities. The influences of climate and relief appear to play an important part in the propagation losses. The author then considers the basic factors controlling the design of such an over the horizon radio link, and the method of determining the quality for telephone and telegraphic transmission. Finally, he discusses the performance which is obtained and is likely to be obtained with present and future links for multiplex over the horizon systems. Satellites seem to be the coming solution for transmission over very great distances as the reflected beams may prolong the over the horizon links. (Met. Abs. 12.1-101)--A.V. and author's abstract.

E-715 du Castel, F., Reflexions partielles dans l'atmosphere et propagation a grande distance, VII, Note sur les phenomenes de propagation tropospherique. (Partial reflections in the atmosphere and far reaching propagation, Pt. 7, Note on tropospheric propagation phenomena.) Annales des Telecommunications, Paris, 15 (5/6):137-142, May/June 1960. 9 figs. DLC--The author studies the reflection phenomenon by introducing the reflective elements of the irregular surface of a tropospheric tilt. He gives evidence of the specular and diffused reflection processes as mentioned by A. SPIZZICHINO and J. VOGE and emphasizes the difference of treatment of the problem by these two authors. Applying these results as well as the turbulent diffusion process to the phenomenon of tropospheric propagation, he points out the various elements composing this complex phenomenon and establishes a comparison between them. (See refs. E-542, 628, 785, 786, and 772 for the other parts.) (Met. Abs. 13.4-101)--A.V.

E-716 du Castel, F., Résultat expérimentaux en propagation troposphérique transhorizon. (Experimental results in transhorizon tropospheric propagation.) Annales des Télécommunications, Paris, 15(11/12):225-259, Nov./Dec. 1960. 6 figs., 2 tables, 3 refs. DLC--Some results are given of the experimental studies made in France on tropospheric propagation beyond the horizon, between 1957 and 1960. In the first part of this paper, a study and comparison are made of the results obtained in various climatic regions, using frequencies of the order of 500 MHz, on paths of 150 to 400 km. These regions are located in Western Europe, Western Mediterranean, the Sahara, West and Equatorial Africa. In the second part, an account is given of the characteristics of various propagation mechanisms based on the results obtained on some experimental links in France. This study is concerned with the microscopic and macroscopic characteristics of the propagation and those of the troposphere, and brings out clearly three fundamental mechanisms of propagation. The third part describes the results obtained in an original experiment of the analysis of the rapid field variations in propagation beyond the horizon. (Met. Abs. 13.4-102)--Author's abstract.

E-717 Ducot, C.; Andrieux, G. and Cayzac, J., Télécommunications utilisant la propagation troposphérique. (Telecommunications by means of tropospheric propagation.) Acta Electronica, Paris, 4(1):97-114, Jan. 1960. 12 figs., 13 refs. DLC--With the comparatively recent discovery that wave propagation beyond the horizon may result in fields much higher than the conventional diffraction theory indicated, it has become possible to extend appreciably the range of UHF telecommunications, which were formerly restricted to line-of-sight paths. Important studies have been devoted to the phenomena responsible for beyond-the-horizon propagation by the troposphere. Data obtained from these studies are briefly recalled. The requirements determining the development of the suitable equipment can be deduced from those data. The model of a 900 MHz equipment is described. Intended for the transmission of a 30 telephon channel multiplex signal, it was set to operate in Nov. 1959 between Paris and Caen. The main results of tests are given. Ways of improving the performances of tropospheric transmission are considered, with particular emphasis on increasing range. --R.M.

E-718 Felsen, L.B. and Siegel, K.M., Diffraction and scattering. U.S. National Bureau of Standards, Journal of Research, Ser. D, 64(6):707-714, 750, Nov./Dec. 1960. Foot-refs., bibliog. p. 713-714, 750. DLC--This report is concerned with high frequency diffraction (involving obstacles with dimensions large compared to the wavelength), Rayleigh scattering (obstacle dimensions small compared to the wavelength) and scattering in the resonance region (obstacle dimensions comparable to the wavelength). Primary emphasis is placed on recent theoretical developments, and selected pertinent experimental results are mentioned only in conjunction with verification of certain theoretical predictions discussed in the text. --From authors' abstract.

E-719 Fenton, Lawrence F., The sum of log-normal probability distributions in scatter transmission systems. IRE Transactions on Communications Systems, N.Y., 8(1):57-67, March 1960. 16 figs., 4 tables, 3 refs., 39 eqs. DLC--The long term fluctuation of transmission loss in scatter propagation systems has been found to have a logarithmic normal distribution. In many important communication systems (e.g., FM), the noise power of a radio jump, or hop, has log-normal statistical distribution. In a multihop system, the noise power of each hop contributes to the total noise. The resulting noise of the system is therefore the statistical sum of the individual noise distributions. In multihop scatter systems and others, such as multichannel speech transmission systems, the sum of several log-normal distributions is needed. No exact solution to this problem is known. The discussion presents an approximate solution which is satisfactory in most practical cases. --Author's abstract.

E-720 Florman, E.F. and Plush, R.W., Measured statistical characteristics and narrow band teletype message errors on a single sideband 600 mile long ultrahigh frequency tropospheric radio link. U.S. National Bureau of Standards, Journal of Research, Ser. D, 64(2):125-133, March/April 1960. 10 figs., table, 7 refs. DLC--Measurements of a 417 megacycles per second unmodulated radio carrier over a 600 mi tropospheric path indicated that the variations of the received carrier envelope amplitude with time over 30 min periods roughly approximated a Rayleigh distribution in the majority of tests. Cumulative time distributions of the carrier fade durations were obtained over a range of carrier envelope power levels and were found to resemble corresponding distributions for narrow band thermal noise. The fade rate of the carrier envelope, at the median power level, was less than 0.2 cycle per sec; this comparatively low fade rate is thought to be due mainly to the narrow (1°) antenna beam width that were used and the consequent low order of multipath propagation of the radio waves. The half hour median power levels of the received carrier varied over a range of approximately ± 8 db. The effective low path bandwidth of the carrier spectrum was found to vary from 0.06 to 0.17 cycle/sec. The measured median transmission loss was approximately 183 db which is within 3.5 db of the calculated value for the summer afternoon hours covered by the tests. With antennas spaced (normal to path) at each end by 150 wavelengths it was found that parallel path, divergent path, or convergent path types of transmission gave cross correlation coefficients of the carrier envelopes which ranged from 0.08 to 0.20. For the same antenna spacing but using crossed path type transmission, the cross correlation coefficient was 0.57. Diversity measurements of single path crossed polarization type of transmission indicated that the cross correlation coefficient of the carrier envelopes was very close to unity. Nondiversity narrow band FSK error measurements, indicated that an 18 db signal to noise power ratio over an effective bandwidth of 290 cycles/sec (at the limiter-discriminator input) for a fading signal resulted in 0.8% binary errors and 4.0% teletype character errors. Extrapolation of these results indicates that a signal to noise ratio of 27 db is required to reduce the teletype character error rate to 0.1% in the same effective bandwidth. --Authors' abstract.

E-721 Fostoff, B. and Iltis, J., Faisceauz herziens transhorizon THC 953. (The T.H.C. 953 transhorizon radio links.) Onde Electrique, Paris, 40(394):46-57, Jan. 1960. 17 figs. DLC--A new French transhorizon radio link system is described. The system operates at 450-600 Mc/s and provides 60 telephone channels over distances of several hundred kilometers. Parabolic reflectors 10 meters in diameter are used. The power amplifiers are ceramic tetrodes with an output of 1 kw., and the receivers have a very low noise factor. Double or quadruple diversity is used to reduce variations in propagation. Air conditioning permits operation of the equipment under the most severe tropical or desert conditions. --R. M.

E-722 Geiger, G. V.; La Frenais, N. D. and Lucas, W. J., Propagation measurements at 3480 and 9640 Mc/s beyond the radio horizon. Institution of Electrical Engineers, London, Proceedings, Pt. B, 107(36):531-546, Nov. 1960. 26 figs., 7 tables, 7 refs. DLC--The paper gives an account of scatter propagation measurements made at S and X band during the period May 1957 to May 1959. The work at S band continued throughout the whole of this time, while the X band measurements were made during the period of a year from June 1958 to May 1959. The S band transmitter, using a 3.480 Gc/s c.w. magnetron with a power output of 500 watts, was established at Start Point in Devon. Receiving terminals were set up at Wembley, Middlesex, and Witnesham, Suffolk, at distances of 173 and 247 statute miles, respectively, from the transmitter, the former being maintained in operation throughout the whole of experimental period and the latter for a period of 9 months from Sept. 1957 to June 1958. Diurnal and seasonal variations in the median level of the received signal are discussed and a comparison is made of measurements taken simultaneously at Wembley and Witnesham. The distribution of S band fading rate as a function of level is studied and a limited amount of work concerned with the distribution of the duration of fades below a given level and the power spectrum of the detected signal is described. The transmission path for the X band system, which used a pulsed magnetron at a frequency of 9.640 Gc/s, also lies between Start Point and Wembley; the pulse length was 2 microsec and the pulse repetition frequency 500 c/s, the peak power in the pulses being 180 kW. The X and S band links were operated together whenever possible, and a comparison is made of the median level and fading rate of the signals received simultaneously at the two frequencies over the same propagation path. In addition, a series of measurements to investigate the aerial coupling loss of the X band system are described. (Met. Abs. 13.4-103)--Authors' abstract.

E-723 Gossard, E. E., Power spectra of temperature humidity and refractive index from aircraft and tethered balloon measurements. IRE Transactions on Antennas and Propagation, N.Y., 8(2):186-201, March 1960. 17 figs., 4 tables, 24 refs., 16 eqs. DLC--Fifty seven spectra of temperature, vapor pressure and refractive index were computed from captive balloon data taken at elevations up to 3000 ft MSL. Eight spectra of refractive index were obtained using an aircraft equipped with a microwave refractometer. It was found that atmospheric stability apparently has a pronounced effect on the variation of turbulent intensity with height. Although the spectra of all three parameters generally approach a -5/3 power law at high wave numbers, stability seems to have a controlling influence on spectral form at the low frequency end of the wave number range studied. It is therefore concluded that methods of computing microwave scattered fields from the mean square dielectric perturbations and scale size obtained from the auto covariance are unreliable. The forms of the experimental auto covariances appear to be best represented by an exponential function or perhaps by a Modified Bessel Function of the second kind and 1/3 order. The temperature humidity cospectrum may influence the shape of the refractive index spectrum, especially under unstable conditions. The equivalence of Eulerian space and time spectra is verified for refractive index in a series of aircraft balloon fly-bys. --Author's abstract.

E-724 Gough, M. W. (Marconi's Wireless Telegraph Co. Ltd., Essex), Diurnal influences in tropospheric propagation. (In: Desirant, M. and Michiels, J.L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 557-573. 8 figs., 14 refs.) CU-S (QC661. D458)--Attention is given to marked diurnal variations in signal strength attributable to the nightly occurrence of tropospheric inversion layers promoted by the cooling by radiation of heated ground when the night sky is clear. After a brief review of observations by various workers, the author appraises 80 Mc/s signal strength recordings maintained continuously for 6 mo over a 137 km nonoptical path in the Persian Gulf, where the effect persistently occurred to a noteworthy degree. The test path lay mostly over land, between Bahrain Islands and Doha on the Qatar Peninsula. Modified refractive index profiles, derived from selected meteorological soundings at Bahrain, show the association between (a) very weak signals and an approximately standard atmosphere, and (b) very strong signals and pronounced elevated or ground based inversions. Theoretical and measured signal strengths are compared. Observations made under exceptional climatic conditions, provide evidence of recurrent nocturnal trapping on a wavelength which is perhaps longer than has been considered possible. --Author's abstract and E. Z. S.

E-725 Grisdale, G.L. and Paynter, D.A., A tropospheric scatter link over a 200 mi path. Point to Point Telecommunications, 5(1):34-59, Oct. 1960. 13 figs., 5 refs. DLC--This article reviews the performance of an operational link carrying various types of traffic over a period of one year. The measured signal strengths obtained with this experimental link agree in the main, with the predicted values. The median signal strength variation was as high as 80 db. --E. K.

E-726 Grudinskaia, Galina Petrovna, Rasprostranenie ul'trakorotkikh radiovoln. (Propagation of ultrashort radio waves.) 2nd rev. ed. Moscow, Gosenergoizdat, 1960. 103 p. 62 figs., 6 refs., 29 eqs. DLC--This book is intended for radio amateurs and its purpose is to explain the physical aspects of ultrashort wave propagation. Methods for calculating field intensity in simple cases are described and unsolved problems in ultrashort wave propagation are indicated. Chapter 4 deals with propagation in the troposphere. Diffraction, refraction and the occurrence of atmospheric ducts, reflection from laminar irregularities in the troposphere and scattering of radio waves from tropospheric irregularities are discussed. Ch. 5 is devoted to ionospheric propagation of ultrashort waves due to reflection from layers of the ionosphere and meteor trails, as well as to the scattering of waves by inhomogeneity of the ionosphere. --R. M.

E-727 Head, Howard T., The influence of trees on television field strengths at ultrahigh frequencies. Institute of Radio Engineers, N. Y., Proceedings, 48(6):1016-1020, June 1960. 8 figs., 9 refs. DLC--Field studies of UHF wave propagation between television transmitting and receiving antennas indicate that typical woods are essentially opaque at these frequencies. The signal in the presence of woods near the receiving antenna appears to be principally that diffracted over the trees, with a small residual leakage field observable where the diffracted fields are very weak. The results of measurements are compared with diffraction theory, and the attenuation below free space fields due to the woods is found to be in good agreement with that predicted for a spherical obstacle having a four-thirds earth's radius. The conclusions are applied to the estimation of average losses in large areas. --Author's abstract.

E-728 Herbstreit, Jack W., The Ninth Plenary Assembly of the CCIR. Institute of Radio Engineers, N.Y., Proceedings, 48(1):45-53, Jan. 1960. 2 refs. DLC--The International Radio Consultative Committee held its Ninth Plenary Assembly in Los Angeles, Calif., April 2 - 29, 1959. The CCIR studies the technical factors affecting international radio telecommunications and makes recommendations to administrations which are of importance in the international allocation and usage of the radio spectrum. These studies are made by 14 Study Groups, each dealing with certain aspects of international telecommunication. Group V studied the propagation of radio waves over the surface of the Earth, taking into account changes in the electrical constants of the Earth and irregularities of terrain, and including the effects of the troposphere. A new set of radio propagation curves, giving tropospheric field strength for distances beyond the horizon for frequencies of 30 to 300 Mc was prepared by an international working party. (Met. Abs. 12.3-103)--Author's abstract and E.K.

E-729 Hickin, E.M. (Research Laboratories, Gen. Elec. Co., Ltd., Wembley, England), Radio wave propagation and attenuation in the troposphere. Research, London, 13(12):503-506, Dec. 1960. 5 figs., 7 refs. DLC, DWB--The study of the attenuation of radio waves in the troposphere becomes more important as pressure on spectrum space increases. New applications have been discovered for frequencies just above 10 kMc/s and 11,000 Mc/s. Experiments in the U.S. at 10,000 Mc/s have shown that the attenuation by rain at these frequencies is a function of the diameter of the raindrops, the wavelength and the number of drops per unit volume of air in the path. Using average rainfall figures for Europe, the author has constructed a map showing the contours of constant path length for a fixed time out of service for 11,000 Mc/s radio links in Europe. A figure is also given showing the attenuation of microwaves by oxygen and water vapor. (Met. Abs. 13.4-106)--R.B.

E-730 Hirai, Masaichi; Fukushima, Makocla, and Kurihara, Yoshitaka, Correlation between amplitudes of radio waves of different frequencies in VHF beyond the horizon propagation. Japan. Radio Research Laboratories, Journal, 7(33):509-529, Sept. 1960. 7 figs., 4 tables, 4 refs., 40 eqs. DBS--Selective fading in VHF beyond the horizon propagation is caused by the interference between multipath waves. Based on this phenomenon, a correlation coefficient between amplitudes of radio waves of different frequencies is derived theoretically. Relations of this coefficient with amplitude ratio distribution of multipath wave distribution are also derived. These relations are examined by use of the experimental data in 600 and 2120 Mc bands on circuits of 220 km from Kokubunji to Nihonmatsu and of 345 km from Kokunbunji to Furakawa, and thus the applicability of the theoretical formulas is illustrated.--Authors' abstract.

E-731 Hirai, Masaichi et al., Studies in VHF overland propagation beyond the horizon. Japan. Radio Research Laboratories, Journal, 7(31):137-176, May 1960. 32+ figs., 8 tables, 14 refs., numerous eqs. DBS--A series of experiments in beyond the horizon propagation were conducted over two overland paths (226 and 345 km), using mainly 159.49, 599 and 2120 Mc, for the period from winter through summer in 1959. The following aspects were investigated: the temporal variation of transmission loss, the variation in received power with antenna beam rotated, the height gain pattern at receiving site, the characteristics of space diversity and frequency diversity, and the quality of television signal transmission. The principal aim was the study of the mechanism of propagation and the bandwidth capability of the medium. Comparisons of the experimental data with the theoretical values suggest favorable applicability of the theoretical formulas in estimating the propagation characteristics.--Authors' abstract.

E-732 Hirai, Masaichi; Inoue, Ryosuke and Kido, Yoshihisa, Variation in received signal power with narrow beam antennas rotated horizontally in UHF beyond the horizon propagation. Japan. Radio Research Laboratories, Tokyo, Journal, 7(33): 487-507, Sept. 1960. 14 figs., table, 9 refs., 32 eqs. DLC. Also Japanese version in their Review, 6(26):251-260, Sept. 1960. DBS--In UHF beyond the horizon propagation, the variation in received signal power with narrow beam antennas rotated does not only depend on the patterns of antenna directivities, but also on the mode of propagation, the geometrical feature of propagation path and the method of antenna rotation. Theoretical formula on the above variation in received signal power is derived under the assumption of tropospheric scatter propagation, and its comparison with experimental data indicates fairly good coincidence. (Met. Abs. 14.4-123)--Authors' abstract.

E-733 Hiser, H. W. and Ray, P. R., Weather radar receiving system. Miami. Univ. (at Coral Gables). Marine Lab., Contract NOas 59-6217-C, Final Report, June 17, 1959 to June 17, 1960, pub. July 1960. 50 p. 16 figs., 4 tables, 21 refs., 21 eqs. DWB--Calibration procedures and tests of a Range Attenuation Corrector and a video inversion type Isoecho Contour device developed under previous contracts are described and sources of error are discussed. Some theoretical aspects of range attenuation correction are presented which include a discussion of the use of logarithmic receivers and the problems of beam filling, earth shadow, and reflections. A brief description of a new developmental weather radar receiver system, which is being procured under the FY-1960 contract, is given. Statistical results of a precipitation echo height study based upon data from an MPS-4 height finder radar are presented and the application of this echo height information to the range attenuation correction problem is discussed. A general discussion of laboratory activities and performance is also included. (Met. Abs. 14B-74) --Authors' abstract.

E-734 Hoffman, J. D., A thin route beyond the horizon VHF system in the Middle East. IRE Transactions on Communications Systems, N.Y., 8(4):263-271, Dec. 1960. 16 figs., 3 tables, 9 refs. DLC--The application of thin route technique in an economical integrated small scale VHF system in the 156 - 174 Mc band is described. The system provides point to point multi channel voice, teletype and mobile communications between the main office of the Trans-Arabian Pipe Line Co. in Beirut, Lebanon, and pumping stations and mobile units along the route of the pipe line through Lebanon, Syria, Jordan and Saudi Arabia. In addition, supervisory control and telemetering of 5000 HP combustion gas turbine pumping installations over portions of the system, including a 120 mi long link, is described. The terminals of this link and others, 90 to 105 mi long, are well beyond the horizon.--From author's abstract.

E-735 Ikegami, F., A preliminary study of radiometeorological effects on beyond horizon propagation. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(3):239-246, May/June 1960. 11 figs., 13 refs., 3 eqs. DLC, DWB--A study was made of American and Japanese radiometeorological data in order to suggest the dominant factors in propagation beyond the horizon. The diurnal variability of radio field strength seems to be sensitive to the crossover height of rays tangent to the radio horizon and disappears for crossover heights greater than about 500 m. High hourly median field strength were observed in Japan corresponding to the existence of a marked refractive index discontinuity layer in a common volume of two antenna beams. The results of these experiments suggest that laminar structures of the atmosphere play an important role in beyond horizon radio propagation. (Met. Abs. 11.10-49)--Author's abstract.

E-736 Janes, H.B.; Stroud, J.C. and Decker, M.T., An analysis of propagation measurements made at 418 megacycles per second well beyond the radio horizon (a digest). U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(3):255-257, May/June 1960. 2 figs., 3 refs. DLC, DWB--During an 18 mo period in 1952 and 1953, transmission loss measurements at 418 megacycles were made over a 134 mi path between Cedar Rapids, Iowa, and Quincy, Ill. Continuous recordings made simultaneously at several receiving antenna heights from 30 to 665 ft yielded information on diurnal and seasonal variations in both the hourly median basic transmission loss and in height gain. These data are compared to predictions made using the method developed by Rice, Longley, and Norton and are found to be in good agreement, particularly at the lower antenna heights. An analysis of the correlation of short term signal level variations observed at horizontally and vertically spaced antennas is described. (Met. Abs. 11.10-48)--Authors' abstract.

E-737 Johler, J.R.; Walters, L.C. and Lilley, C.M., Amplitude and phase of the low and very low radio frequency ground wave. U.S. National Bureau of Standards, Technical Note, No. 60, June 1, 1960. 40 p. 8 figs., 26 tables, 4 refs. DLC--Graphs and tables of the low and very low radio frequency ground wave are presented as a function of frequency, 100 c/s to 1000 kc. --Authors' abstract.

E-738 Kalinin, A.I., Dal'nee troposfernoe rasprostranenie ul'trakorotkikh voln. (Long distance tropospheric propagation of ultra short waves.) Elektrosviaz', Moscow, 14(6):39-49, June 1960. 13 figs., 3 refs., 7 eqs. Transl. into English in Radiocommunications, N.Y., No. 6, 1960. DLC--A review of experimental findings on tropospheric propagation of ultrashort waves based on English language papers. Emphasis is placed on signal characteristics including slow and fast fades, dependence of signal level on distance, wavelength, antenna orientation and height, wave polarization, dielectric constant of the air, and meteorological conditions. Loss in antenna gain, an operating frequency band, and signal distortion are also considered. --R.M.

E-739 Kalinin, A.I., Dal'nee troposfernoe rasprostranenie UKV; teoreticheskie ob"iasneniia eksperimental'nykh rezul'tatov. (Long distance tropospheric propagation of USW; theoretical explanations of experimental results.) Elektrosviaz', Moscow, 14(7):38-46, July 1960. 8 figs., 10 eqs. Transl. into English in Radiocommunications, N.Y., No. 7, 1960. DLC--This paper is a follow up on one by the same author containing experimental data on extended range propagation of ultrashort waves. Here, the author presents theoretical explanations of experimental data. Theories of the phenomenon of tropospheric scatter propagation are briefly reviewed and signal amplitude as a function of various parameters is discussed. The widening of antenna directivity patterns and the phenomenon of losses in antenna gain are briefly explained. The importance of tropospheric radio relay links is mentioned. --R.M.

E-740 Kalinin, Iu.K., Nekotorye voprosy rasprostraneniia radiovoln nad neodnorodnoĭ sfericheskoĭ poverkhnosti'iu Zemli. (Some problems of radio wave propagation over the heterogeneous spherical surface of the Earth.) Akademiia Nauk SSSR. Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Trudy, No. 17(27):50-129, 1960. 38 figs., table, 45 refs., eqs. DLC--Propagation of radiowaves around the Earth is analyzed with special emphasis on heterogeneous properties and boundary conditions of the terrestrial surface. Radiowave propagation along coastal lines is given special attention. A comparison of theoretical and experimental data, available from literature gives satisfactory results. The analysis may be particularly useful for correcting errors introduced by electric heterogeneities into the operation of radio navigational systems working on ground waves and for providing some useful directions to radio bearing stations. --S. N.

E-741 Katzin, M.; Pezzner, H.; Koo, B.Y.C. et al., The trade wind inversion as a transoceanic duct. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(3):247-253, May/June 1960. 6 figs., 4 tables, 6 refs., eq. DWB, DLC--Radiosonde data for stations in the South Atlantic trade wind belt are analyzed to determine the potentialities of the trade wind inversion as an elevated duct for transoceanic radio transmission. These were supplemented by refractometer soundings made by an aircraft during the latter part of 1958. These records indicate that a duct is present in the majority of the cases. Since it is known that the radiosonde underestimates ducting because of its slow response, it is concluded that a duct is present practically all the time. On the basis of the data analyzed, an experiment with two aircraft is suggested to test the propagation potentialities of this mechanism. A frequency of around 200 megacycles per second appears to be a good choice for an initial experiment. (Met. Abs. 12.3-349)--Authors' abstract.

E-742 Kinber, B.E., O medlennykh zamiraniĭ signala pri troposfernom rasseianii. (On slow fading of signals in tropospheric scattering.) Radiotekhnika i Elektronika, Moscow, 5(3):521-522, March 1960. Fig., 8 refs., 3 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 5(3):237-239, 1960. DLC--It has been shown that the mean hourly signal level in tropospheric scattering obeys log normal distribution. The author demonstrates that this distribution may be obtained on the basis of the hypothesis that slow fades of the signal are linked with changes in refraction (gradient of permittivity of the air). Mean square deviations of slow fades are represented graphically as a function of path length. --R.M.

E-743 Knudtzon, N.H. and Gudmandsen, P.E., Results from a three hop tropospheric scatter link in Norway with parallel operations on 900 Mc and 2200 Mc. IRE Transactions on Communications Systems, N.Y., 8(1):20-26, March 1960. 10 figs., ref. DLC--From measurements on a 360 km hop in the period Oct. 1957 to June 1958, it is concluded that: 1) the monthly amplitude distributions are approximately Gaussian, and the 1 min amplitude distributions are of the Rayleigh type, 2) the signals are generally considerably stronger in summer than in winter, 3) the monthly median strength of the 900 Mc signals is generally stronger than that of the 2200 Mc signals, 4) the foreground conditions may be critical, 5) the 1 min fade duration distributions are approximately log normal, 6) the normalized 1 min fade duration distributions are about equal for 900 Mc and 2200 Mc, 7) considerable reductions in telegraph error rate are affected by increasing orders of diversity reception, 8) the telegraph error rates are equal for 900 Mc and 2200 Mc signals of equal medium strength, 9) frequency modulated telegraph multiplex equipment is slightly superior to two tone telegraph multiplex equipment, when adjusted to equal loadings, 10) antenna radiation diagrams depend critically on local surroundings, such as woods. --Authors' abstract.

E-744 Koch, G.F., Die verschiedenen Ansätze des Kirchhoffschen Prinzips und ihre Anwendung auf die Beugungsdiagramme bei elektromagnetischen Wellen. (Different methods based on Kirchhoff's principle and their applications to the refraction diagram in the case of electromagnetic waves.) Archiv der Elektrischen Übertragung, Stuttgart, 14(2):77-98, Feb. 1960 and 14(3):132-153, March 1960. 39 figs., 53 refs., 221 eqs. German and English summaries. DLC--Following a brief review (Sec. I) of the possibilities of accounting analytically for the diffraction problems encountered at microwave frequencies, a short outline (Sec. II) is given of the methods using the statement of Kirchhoff, which have most practical importance, and the methods are applied for diffraction at a diaphragm and at a disk (reflector). The results are stated for the far field of the diffraction wave in the illuminated and nonilluminated spaces of diaphragm and reflector with the scalar methods of Kirchhoff, the two scalar methods of Sommerfield, the vectorial method of Franz, and the two vectorial methods of Luneberg. The features of these methods, of which under certain conditions the vectorial methods yield the same results as the corresponding scalar methods, are pointed out and their differences studied in detail (Sec. III). On the basis of experimental results the capabilities of the various methods are checked, above all with oblique incidence, for in this case the differences between the various methods are far greater than with vertical incidence, and the influence of the polarization makes itself felt far more strongly, whereas with vertical incidence it is but slight. The so-called revolving mirror test allows a simple presentation of the diffraction diagrams with vertical incidence, and permits conclusions to be drawn with respect to the diffraction diagrams with oblique incidence in the plane of incidence. A direct measurement of the diffraction diagrams with oblique incidence confirms these conclusions: furthermore the value of the results of the methods is studied with reflectors of the order of several wave lengths, as well as the influence of the polarization of the incident wave. The investigations showed as a rule a superiority of the scalar statement of Kirchhoff and the vectorial statement of Franz, in particular with cases of oblique incidence, which are critical with respect to polarization. The experimental investigations, which were only made for the plane incidence, also allow conclusions to be drawn with respect to the capabilities of the methods outside the plane of incidence, however (Sec. IV). From the results of the experiments Sec. V draws some conclusions for the handling of Kirchhoff's approximation methods. In Sec. VI consideration is given to the reflection at reflectors of the order of a few wavelengths, investigations and calculations are stated concerning the surface utilization and conclusions are drawn from the capabilities of the approximation methods as to the calculation of the reflecting cross sections of plane reflectors. (Met. Abs. 12.5-67)--Author's abstract.

E-745 LaGrone, Alsfred H., Forecasting television service fields. Institute of Radio Engineers, N.Y., Proceedings, 48(6):1009-1015, June 1960. 10 figs., 3 tables, foot-refs. DLC--The propagation of VHF and UHF television signals over a spherical, irregular surface such as the earth, is examined theoretically and experimentally and the principal factors evaluated. The principal factors are found to be frequency, meteorology, terrain and vegetation. It is shown that meteorology, terrain and vegetation vary a significant amount geographically and the local values should be used in forecasting local service fields. The principal factors are included in a new empirical method suggested for forecasting the service fields of television stations. The signal forecast by the new method is compared with field measured signals with good results. --Author's abstract.

E-746 Laurens, A.; Koenig, J. D. and Carzan, C., Essais de transmission au-delà de l'horizon d'images de télévision à 4000 MHz. (Over the horizon transmission of television signals at 4000 MHz.) Onde Electrique, Paris, 40(394):106-111, Jan. 1960. 11 figs., table, 3 refs. French and English summaries. DLC--The authors first compare 800 and 4000 Mc/s frequencies for over the horizon transmission of television signals, particularly from the point of view of signal to noise and bandwidth obtained. They then describe an experimental system operating at 4000 Mc/s over a distance of 220 km. Finally, they discuss the results obtained and analyze the recordings made. (Met. Abs. 12.1-103)--Authors' abstract.

E-747 Lemoine, P., Un combineur de diversité pour liaisons transhorizon. (Diversity mixer for beyond-the-horizon links.) Onde Électrique, 40(394):112-115, Jan. 1960. Fig., 2 refs. DLC--After a review of the general principles of diversity systems, various existing systems are compared, and the system adopted by the Compagnie Generale d'Electricite is described. The C. G. E. system is based on the principle of the combination into a basic band of a group of 2 channels, and uses a standard cathode mixer. The signal-noise ratio of the combined channel differs by less than 0.5 db from the optimum signal-noise ratio. The system operates correctly at noise levels from + 25 db to –40 db in relation to the threshold noise level. The total harmonic is less than –70 db for signal levels differing by 1 db in the channels to be combined. The time of response of the system is less than 5 ms/c. --R. M.

E-748 Lotova, N. (Acad. Scien., U.S.S.R.), On estimating the angle of scattering of radio waves. Soviet Astronomy AJ, New York, 3(5):881-883, March/April 1960. 3 refs., 3 eqs. Transl. of her K otsenke ugla rasseianiia radiovoln in Astronomicheskii Zhurnal, Moscow, 36(5):907-909, Sept./Oct. 1959. DLC--An expression is derived for the dispersion of the angle of scattering of a plane electromagnetic wave in a statistically nonuniform medium. A discussion is given of the case where the dispersion of the refractive index is a slow function compared with the dimensions of statistical irregularities. (Met. Abs. 12.6-162)--Author's abstract.

E-749 Mackey, C.L. (Rome Air Devel. Center, Griffiss AF Base, Rome, N.Y.), Tropospheric scatter developments. (In: Desirant, M. and Michiels, J.L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 685-697. 16 figs.) CU-S (QC661. D458)--Developments in the field of tropospheric scatter equipment are reviewed and advances in the state of the art in power klystrons, diversity, solid state devices, antennas, modulators, and miniaturization techniques for mobile application are discussed and areas of future investigation are indicated. --Author's abstract and E. Z. S.

E-750 McLeish, C. W., Measurements of coastal deviation of high frequency radio waves. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(1): 57-59, Jan./Feb. 1960. 3 figs., 2 tables, 8 refs., eqs. DWB, DLC--The angular deviation of the phase front of a wave propagated across a fresh water shoreline has been measured over the frequency range from 3 to 20 Mc. The deviation is found to be roughly half that which theoretically would be obtained if the same sites were adjacent to infinitely conducting surfaces. (Met. Abs. 14.4-114) --Author's abstract.

E-751 Martin, S. J. (Hughes Aircraft Co., Fullerton, Calif.), Note on scatter propagation. Institute of Radio Engineers, N. Y., Proceedings, 48(11):1915-1916, Nov. 1960. Fig. DWB--Discusses experimental results of tropospheric forward scatter transmission as conducted at 400 and 800 Mc/s over the 156 mi over sea path, Key Marathon, Fla. and Jaruco, Cuba, aimed at determining (1) the variation in fading rates as a function of antenna elevation, (2) the variation in frequency selective fading as a function of frequency separation of two side bands, and (3) the effects of antenna beam width on path multipath. (Met. Abs. 13.4-107)--W. N.

E-752 Misme, P. (Centre Nat'l. d'Etudes de Telecommun., Paris), (Comment on) B.R.Bean and C. D. Thayer: Models of the atmospheric refractive index (and reply by) Bean and Thayer. Institute of Radio Engineers, N. Y., Proceedings, 48(8):1498-1499, Aug. 1960. Figs., tables, 16 refs., eqs. (For abstract on original article, see E- 614). DLC--MISME questions BEAN and THAYER's expression N(h) = No exp ah, which he attempts to show is restricted to certain regions only. In a set of critical tests of Misme's hypothesis that s $<$ 10g/kg is a prerequisite for a good correlation between Ns and beyond the horizon radio fields, BEAN and THAYER's results indicate that their exponential model is reasonably applicable since the N structure is generally representative for the first km wherever applied under a variety of geographical (hence climatological) conditions. (Met. Abs. 13.6-100)--W. N.

E-753 Misme, P., Influences radioclimatiques sur les liaisons transhorizon. (Influence of radio climatic conditions on over the horizon links.) L'Onde Electrique, Paris, 40(394):116-123, Jan. 1960. 13 figs., 3 tables, 13 refs. French and English summaries. DLC--The author begins with the radioclimatic effects on over the horizon propagation, and on the interference that a transmitter may produce on an existing system. He then develops the idea of the useful gradient of the refractive index and shows that this parameter is more representative of the atmosphere than the difference between the indices at levels of zero and 1000 m. The forms which are taken by the refractive index as a function of height are considered theoretically and experimentally, and it is shown that this is not an exponential function. The form is quasi-exponential within following regions: 1°) the polar caps, extended to the zones, where, for a great percentage of days in each month, the soil temperature is lower than 14°C; 2°) the temperate zones during winter; 3° the deserts, hot during daytime; 4°) the altitudes higher than the surface s = 10 g/kg (s = specific humidity); 5°) certain temperate zones during the whole year. One can consequently determine a priori, when in more than half of the globe the index gradient at a place is a function of the refractive index at the same spot. From this it is deduced that a good correlation between the refractive index and its gradient is not likely to exist in the lower atmosphere layers. This article also calls attention to other important radioclimatic parameters which are still little studied, for example, the stability of the atmosphere. (Met. Abs. 12.1-104)--A. V. and author's abstract.

E-754 Misme, P., Le gradient équivalent, mesure directe et calcul théorique. (Equivalent gradient, direct measurement and theoretical calculation.) Annales des Télécommunication, 15(3/4):92-99, March-April 1960. 8 figs., tables, 5 refs. --First the concept of equivalent gradient is determined. The application of this definition yields an easy method to measure its quantity by means of radio. The theoretical calculation of equivalent gradient is then presented and the method used is adapted to the climate of Niamey (Nigeria). The order of magnitudes then found prove that values of equivalent gradient vary according to the type of propagation (scattering, diffuse reflection, or specular reflection), and according to the length of path of a link. --Transl. of author's abstract.

E-755 Moler, William F. and Holden, D.B., Tropospheric scatter propagation and atmospheric circulations. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(1):81-93, Jan./Feb. 1960. 16 figs., table, 15 refs., eqs. DWB, DLC--Transhorizon VHF and UHF fields exhibit deep fades or large signal enhancements of several hours' duration, as the propagation mechanism alternates between partial reflection and scattering caused by turbulent dielectric fluctuations in the atmosphere. Such alternations occur when strong refractive layers develop below 3000 ft. Surface wind streamline analyses show that mesoscale centers of convergence or divergence cause local redistribution of refractive layering, tending to produce the change from one mechanism to the other. Current scattering theory and the empirical findings of others are examined to determine the gross meteorological factors that influence changes in scattered fields. The two variables in the turbulent scattering coefficients, the scattering angle and the intensity of dielectric fluctuations at high wave numbers, are found to be dependent upon the refractive layering and the thermal stability of the air mass. It has been shown elsewhere that refractivity and stability are principally functions of the vertical velocity in the atmosphere. It is shown here that the direction and relative magnitude of the vertical velocity can be inferred from the upper tropospheric wind velocity divergence. Received scattered signals are found to be well correlated with computed velocity divergence. It is suggested that the variations of scattered signal level or range can be predicted in a routine manner by regular meteorological personnel using ordinarily available meteorological data. (Met. Abs. 13.9-113)--Authors' abstract.

E-756 National Research Council, Wash., D.C., U.S. National Committee on the International Scientific Radio Union, Report of U.S. Commission 2 on Tropospheric Radio Propagation, to the 13th General Assembly of the ISRU, London, Sept. 5-15, 1960. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(6):607-627, Nov./Dec. 1960. Bibliog. of papers published since the 12th General Assembly, p. 622-627. DWB, DLC--This report contains a brief summary of the work of the U.S. National Committee of Commission II on Tropospheric Radio Propagation arranged in accordance with the topics to be discussed at the XIII General Assembly in London 1960. The bibliography includes principally the papers published since the XII General Assembly. The topics include the physical characteristics of the troposphere, theories on the tropospheric propagation, experimental results from investigation of tropospheric propagation and radio meteorology. (Met. Abs. 12.8-111)--E.Z.S.

E-757 Nemirovskii, A.S., O prieme so slozheniem signalov raznesennykh po uglu prikhoda lucha, pri dal'nem troposfernom rasprostranenii ukv. (Reception involving the combining of signals with diversity based on the beam angle of arrival under conditions of long range UHF tropospheric propagation.) Elektrosviaz', Moscow, 14(8):19-25, Aug. 1960. 11 figs., 8 refs., 16 eqs. Transl. into English in Radiocommunications, N.Y., No. 8, 1960. DLC--The author presents a new method of diversity reception for long range UHF tropospheric links based on diversity with respect to the beam angle of arrival in the horizontal and vertical planes. Angular diversity is effective only for high directivity antennas and yields higher values of improvement in the horizontal plane than in the vertical plane. Graphs show the improvement as a function of the half power width of the antenna directivity pattern and the reliability of ordinary reception. --Transl. of author's abstract -R.M.

E-758 Norton, Kenneth A. (Boulder Labs., Boulder, Colo.), Carrier frequency dependence of the basic transmission loss in tropospheric forward scatter propagation. Journal of Geophysical Research, Wash., D.C., 65(7):2029-2045, July 1960. 8 figs., 3 tables, 19 refs., eqs. DLC--A further interpretation is given of certain Lincoln Laboratory data obtained in an experiment using scaled antennas as published by BOLGIANO (1959). This paper has three objectives: 1) to consider the significance of these data as regards the theory of radio propagation through a turbulent atmosphere; 2) to describe a suitable method for the measurement of the meteorological parameters entering the theory; 3) to apply a further statistical analysis to these data. On the basis of this analysis of the Lincoln Laboratory data, it is concluded 1) that the

$$\left\{2/\Gamma(\underline{\mu})\right\} (\underline{\rho}/2)^{\mu} K_{\mu}(\rho)$$

correlation model provides a description of tropospheric turbulence adequate for the description of these data with μ assigned the fixed value 1, and 2) that the variation of the carrier frequency dependence of the basic transmission loss from hour to hour arises simply from a lack of correlation in the hourly median losses on widely separated carrier frequencies rather than from changes of μ in this correlation model. (Met. Abs. 12.9-109)--Author's abstract.

E-759 Olivier, M. and Pellerin, J., Le faisceau hertzien Medea-Laghouat-Ouargla. (The Medea-Laghouat-Quargla radio link.) Onde Electrique, 40(394):32-38, Jan. 1960. 12 figs. DLC--Description of a 450 Mc/s radio link in Algeria. The system, 604 kilometers in length, includes a number of repeater stations using over-the-horizon propagation. Criteria used in the selection of equipment and the measures taken to ensure reliability of operation are discussed. The system is basically the TH 949 system, modified to fit local conditions. The modifications include the addition of a UHF preamplifier to reduce the noise factor, the design of buildings and towers, and special equipment to ensure continuous operation of the system. --R.M.

E-760 Parry, C.A., Criteria for the ultimate capability of the optimized tropospheric scatter system. IRE Transactions and Communications Systems, N.Y., 8(3):187-192, Sept. 1960. 12 figs., table, 8 refs., 8 eqs. DLC--Behavior of the tropospheric scatter mechanism is now sufficiently well understood to permit a determination of optimum transmission criteria. The requirements for optimazation are established from the channel signal to noise ratio equation. It is shown that the optimum is related, not only to the basic RF transmission loss, but also to the effective noise figure, antenna gain and medium aperture loss. --From author's abstract.

E-761 Petrovskii, A.D. and Feinberg, E.L., O priblizhennom granichnom uslovii v teorii rasprostraneniia radiovoln vdol' Zemli. (On the approximate boundary condition in the theory of radiowave propagation along the Earth.) Radiotekhnika i Elektronika, Moscow, 5(3):385-388, March 1960. Fig., 6 refs., 9 eqs. Transl. into English in Radio Engineering and Electronics, N.Y., 5(3):43-48, 1960. DLC--Homogeneous boundary conditions are formulated for the field in the problem of radiowave propagation along the Earth at large distances from the source and from disturbances of homogeneity of the surface, remaining valid for the case of complex dielectric constant close to unity. --Authors' abstract.

E-762 Pluchard, A. G., Le programme d'équipment en faisceaux hertziens transhorizon de l'Algerie et du Sahara. (Program for the establishment of over-the-horizon radio links in Algeria and the Sahara.) Onde electrique, Paris, 40(394):19-23, Jan. 1960. 2 figs. DLC--The need for over-the horizon radio links in Algeria and the Sahara is discussed. Local problems, such as climatic conditions, power supply, and maintenance, are reviewed. Criteria used in the selection of the station sites, requirements for equipment (including towers and antennas), and stations are described. The need for propagation tests is stressed. --R. M.

E-763 Priimak, G. I., Korreliatsionnaia funktsiia signala, proshedshego sredu s khaoticheski dvizhushchimisia neodnorodnostiami. (Correlation function of a signal passing through a medium with randomly moving inhomogeneities.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 3(5):778-788, 1960. 3 refs., 44 eqs. DLC--The problem of correlation function of a signal passing through a medium with randomly moving inhomogeneities is analyzed theoretically. Although the analysis is primarily concerned with acoustical signals, it equally applies to radio wave propagation. --Transl. of author's abstract. -G. T.

E-764 Prosin, A. V., K teorii perekrestnykh iskazhenii pri dal'nem troposfernom rasprostranenii ukv. (On the theory of cross distortion with long distance tropospheric UHF propagation.) Radiotekhnika i Elektronika, Moscow, 5(7):1052-1964, July 1960. 6 figs., 10 refs., 56 eqs. Transl. into English in Radio Engineering and Electronics, N. Y., 5(7):27-45, 1960. DLC--The author considers a method for calculating cross noise occurring in multichannel long distance systems with frequency modulation and frequency division multiplex due to the interaction of the constant and scattered fields at the point of reception. --Transl. of author's abstract. -R. M.

E-765 Prosin, A. V., O zavisimosti moshchnosti rasseianiia ot napravlennosti antenn. (Dependence of scattered power on antenna directivity.) Radiotekhnika i Elektronika, Moscow, 5(2):330-333, Feb. 1960. 2 figs., 7 refs., 7 eqs. Transl. into English in Radio Engineering and Electronics, N. Y., 5(1):215-219, 1960. DLC--Evdokimov has found that for tropospheric propagation it is more efficient to use antennas with greater horizontal directivity than vertical directivity. (See ref. E-574). On the basis of his earlier work, the author of this note demonstrates that the opposite is true, i. e., an antenna with greater vertical directivity is the more efficient even though in a limited area antenna directivity in the horizontal plane has a greater effect on antenna gain losses. --R. M.

E-766 Prosin, A. V., O zavisimosti moshchnosti rasseianiia ot statisticheskikh kharakteristik turbulentnoĭ troposfery. (Dependence of the amount of scattering on statistical characteristics of tropospheric turbulence.) Elektrosviaz', Moscow, 14(12):3-10, Dec. 1960. 3 figs., table, 5 refs., 14 eqs. Transl. into English in Telecommunications, N. Y., No. 12, 1960. DLC--On the basis of a correlation function and assuming an arbitrary gradient of dielectric transmissivity fluctuation, a generalized method of calculating the amount of scattering and the reduction of antenna gain for both directional and nondirectional antennas is developed. The formula obtained are found to make it possible to investigate, in general terms, the dependence of the amount of scattering and the reduction of antenna gain on statistical characteristics of atmospheric turbulence, and also to compare results of various theories of scattering. --Transl. of author's abstract.

E-767 Prosin, A.V., Perekrestnye iskazheniia v mnogokanal'nykh sistemakh sviazi s ChM, voznikaiushchie pri rasseiannom rasprostranenii UKV. (Intermodulation distortion in multichannel links with FM in USW scatter propagation.) Radiotekhnika, Moscow, 15(8):3-12, Aug. 1960. 8 figs., 13 refs., 53 eqs. Transl. into English in Radio Engineering, N.Y., 15(8):1-17, 1960. DLC--The author develops a method for computing the cross distortion due to multibeam scatter propagation of ultrashort waves in multichannel FM systems with frequency division multiplex. Formulas are derived for determining the cross noise power. The relationship between cross distortion and the path length, the width of the antenna directivity patterns, and a number of other characteristics is established. --Transl. of author's abstract. --R.M.

E-768 Remizov, L.T.; Golubtsov, M.G. and Tiufiakin, L.S., Priemnoe ustroĭstvo dlia izmereniia statisticheskikh kharakteristik signalov pri troposfernom rasprostranenii radiovoln. (Receiving equipment for the measurement of statistical signal characteristics with tropospheric propagation of radio waves.) Radiotekhnika i Elektronika, Moscow, 5(7):1065-1071, July 1960. 9 figs., 3 refs. Transl. into English in Radio Engineering and Electronics, N.Y., 5(7):46-56, 1960. DLC--The paper contains a brief description of a receiver designed for simultaneous recording of the variations in the level of sinusoidal signals at three frequencies with a discretely varying interval between them. Considerations in selecting the basic parameters of the receiver and some results of tests are set out. A block diagram of the unit is included. --R.M.

E-769 Rubinshtein, Ia.M., Rasprostranenie radiovoln i antenno-fidernye ustroĭstva. (Radiowave propagation and antenna feeder equipment.) Leningrad. Izd-vo Morskoi Transport, 387 p., 1960. Figs., tables, 55 refs., eqs. DLC--This book deals with problems relating to the theory and design of antenna feeder systems of both coastal and naval radio stations. Emphasis is on medium and short wave equipment. In connection with possible long distance and worldwide communications systems, ionospheric conditions and the absorption, reflection, and refraction of radio waves in the ionosphere are discussed. One of the 14 chapters is devoted entirely to ultrashort wave propagation and antennas for this purpose. In it, field strength in the far zone, fading of signals, tropospheric scatter, and other problems are considered. Space diversity reception is also explained. --R.M.

E-770 Salomonovich, A.E. and Ataev, O.M., Teplovoe izluchenie i pogloshchenie v zemnoĭ atmosfere radiovoln 8 mm diapazona. (Thermal radiation and atmospheric absorption of 8 mm radio waves.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 3(4):606-613, 1960. 7 figs., 12 refs., 11 eqs. DLC--Values of molecular absorption of 8 mm radio waves were obtained from data of proper thermal radiation of the Earth's atmosphere. In obtaining these values a spherically symmetrical model of a moist atmosphere was assumed, neglecting absorption and scattering by condensation products. For clear days, which are in good agreement with this model, the following values of absorption coefficient are obtained for oxygen 0.0046 neper/km (0.04 db/km); for water vapor 0.00046 neper/km (or 0.004 db/km), for each g/m^3. With the help of these values the total absorption of 8 mm radio waves may be obtained from data on absolute humidity and path length. --Transl. of authors' abstract. -G.T.

E-771 Saxton, J. A. (Radio Res. Station, Ditton Park, Slough, England), Quelques réflexions sur la propagation des ondes radioélectriques à travers la troposphère. (Some reflections on the radio wave propagation through the troposphere.) Onde Electrique, Paris, 40(400/401):505-514, July/Aug. 1960. 3 figs., 58 refs. DLC--After an historical sketch of developments in the study of long distance tropospheric propagation and a summary of the propagation characteristics for frequencies above 30 Mc/s, the writer analyzes present day knowledge about tropospheric diffusion. Recent investigations are described and arguments advanced for a theory which considers propagation beyond the horizon as being based on a troposphere layer rather than solely or even principally upon atmospheric turbulence. (Met. Abs. 13. 3-98) --Author's abstract.

E-772 Spizzichino, A., Réflexions partielles dans l'atmosphère et propagation à grande distance, VI, Les différentes composantes du champ au delà de l'horizon. (Partial reflections in the atmosphere and long distance propagation, Pt. 6, The various components of the field beyond the horizon.) Annales des Télécommunications, Paris, 15(5/6):122-136, May/June 1960. 13 figs., 15 refs. DLC--The author first reviews the results given in the previous articles dealing with reflections by irregular surfaces and shows how they may be applied to tropospheric reflections. He takes as a basis these results and those of the classical diffusion theory to compare the reflection and diffusion phenomena. The characteristics of the fluctuations of the reflected field and of the diffused field are very different, so that they can be easily recognized. Experience shows that the field received beyond the horizon sometimes has the characteristics of a reflected field and sometimes those of a diffused field. All the practical consequences of the coexistence of these two phenomena are finally derived. (See refs. E-542, 628, 785, 786, 715) (Met. Abs. 13. 1-121)--A. V.

E-773 Springer, P. and Rawhauser, R. (both, Wright Patterson AF Base, Dayton, Ohio), Instantaeous electronic ray tracing computer for the solution of electromagnetic propagation problems. (In: Desirant, M. and Michiels, J. L. (eds.), Electromagnetic wave propagation. London, Academic Press, 1960. p. 227-242. 20 figs.) CU-S (QC661. D458)--Describes a new analog computer capable of providing instantaneous ray tracing solutions to the Wave Propagation Equation developed for the Wright Air Development Center. With this computer and current refractive index profiles it is possible to determine tropospheric propagation conditions while they exist. Excellent correlation between ray tracing predictions and measured propagation data was obtained. --Authors' abstract and E. Z. S.

E-774 Stanley, Glenn M., Layered earth propagation in the vicinity of Point Barrow, Alaska. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(1): 95-97, Jan./Feb. 1960. 4 figs., 4 refs., 10 eqs. DWB, DLC--The relative field strength of a vertically polarized low frequency radio signal was measured as a function of distance over several radial paths in the vicinity of Point Barrow, Alaska. The attenuation of the recorded signal was very much less than predicted by the theory of propagation of a ground wave signal over a plane, homogeneous, infinitely conducting earth. The analysis of these data in terms of a plane, layered, finitely conducting earth appears to resolve the anomaly. (Met. Abs. 14. 4-115)--Author's abstract.

E-775 Straiton, A. W. and Tolbert, C. W., Anomalies in the absorption of radio waves by atmospheric gases. Institute of Radio Engineers, N. Y., Proceedings, 48(5):898-903, May 1960. 5 figs., table, 22 refs. Correction. Ibid., 49(1):220, Jan. 1961. Table. DLC--This paper summarizes recent measurements of the attenuation of radio waves by atmospheric gases and compares the measured losses with those predicted by Van Vleck. Reasonably good agreement had been noted between the predicted and measured losses for oxygen, but the measured loss for water vapor is considerably in excess of that predicted. Various factors which may influence this discrepancy are discussed. --Authors' abstract.

E-776 Takahira, Akira and Irie, Hiromi, Characteristics of maritime advective duct and their effect on the micro wave propagation beyond the line of sight. Japan. Radio Research Laboratories, Tokyo, Review, 6(22):3-11, Jan. 1960. 12 figs., table, 6 refs. In Japanese; English summary p. 3. DLC. Also in Japan. Radio Research Laboratories, Journal, 7(33):531-544, Sept. 1960. 12 figs., 8 refs., 8 eqs. DBS--In order to study the microwave propagation over the sea beyond the line of sight, a comprehensive survey of the maritime meteorology has been carried out on the Sea of Kashima by means of a helicopter. The experimental results of the vertical distribution of atmospheric refractive indexes over the Sea of Kashima are summarized. The development of space distribution of maritime advective ducts is discussed in detail introducing the eddy diffusion equation. A general procedure to "predict" the map and profile of M curve over the sea up to 20 km from the coastline is described too. It is shown that the "predicted" map agrees well with the observational results. (Met. Abs. 13. 12-56)--Authors' abstract.

E-777 Takahira, Akira; Irie, Hiromi and Nakamura, Takuma, Observational results of VHF, UHF and SHF propagation beyond the radio horizon. Japan. Radio Research Laboratories, Tokyo, Journal, 17(31):197-211, May 1960. 13 figs., 3 tables, 9 refs., 6 eqs. DLC. Also Japanese version in their Review, 6(24):146-154, May 1960. --Overland radio propagation tests were conducted at the distance of 125 km beyond the radio horizon in the Kanto plain in Nov. and Dec. 1957, and July, Aug., and Sept. 1958. The frequency bands were VHF 150 Mc/s, UHF 600 Mc/s, and SHF 3 Gc/s and 10 Gc/s. From the observational results the following conclusions were obtained: In the daytime the reflected waves from the elevated layer were superposed on the diffracted waves in VHF band, but in UHF band the reflected waves from the elevated layer were predominant, and in SHF band the scattered waves predominated, while at night the reflected waves from the elevated layer were predominant in all bands. (Met. Abs. 14. 4-120)--Authors' abstract.

E-778 Tao,Kazuhiko and Hirao, Kunio, Vertical distribution of radio refractive index in the medium height of atmosphere. Japan. Radio Research Laboratories, Journal, 7(30):85-93, March 1960. 5 figs., 3 tables, 2 refs. DBS--The mean vertical distribution of the refractive index is studied by the use of various kinds of data. Though the distribution in the lower part of the atmosphere agrees well with the form of an exponential curve, the upper part is not to be expressed by the extrapolation of this formula. Further, a new method available for the check of stability of the mean distribution curve is introduced with some examples of application to data obtained in Japan. --Authors' abstract.

E-779 Tatarskiĭ, V.I., Radiofizicheskie metody izucheniia atmosfernoĭ turbulentnosti. (Radiophysical methods of the study of atmospheric turbulence.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 3(4):551-583, 1960. 22 figs., 48 refs., 57 eqs. DLC--This is an analytical review (based on Russian and foreign literature) of results achieved so far in the study of atmospheric turbulence by means of radio propagation experiments, and in comparison of results of such studies with direct measurements of turbulence. The problems considered in particular are: 1) characteristics of atmospheric turbulence, 2) scattering of radio waves in a turbulent atmosphere; phase and amplitude fluctuation, 3) experiments in the atmospheric layer near the ground, 4) tropospheric refractive index fluctuations and 5) turbulence in the ionospheric E layer. The last two points are treated in considerable detail. --G.T.

E-780 Thompson, Moody C., Jr.; Janes, H.B. and Kirkpatrick, A.W. (all, Nat'l. Bur. of Standards, Boulder, Colo.), An analysis of time variations in tropospheric refractive index and apparent radio path length. Journal of Geophysical Research, Wash., D.C., 65(1):193-201, Jan. 1960. 15 figs., 8 refs. DWB, DLC--The National Bureau of Standards has been conducting a series of measurements for a study of the characteristics of the turbulent lower atmosphere and its effect on the accuracy of radio direction finding, guidance, and geodetic measurement systems. The results of three experiments are presented, one consisting of recordings of refractive index and apparent path length variations at 9400 Mc/s over a 15.5 mi path on Maui, Hawaii and the other two consisting of similar measurements made over a 9.5 mi path near Boulder, Colo. The correlation of refractive index and apparent path length fluctuations is discussed as well as the power (variance) density spectra of both variables. (Met. Abs. 12.3-97)--Authors' abstract.

E-781 Thompson, Owen (General Electric Co.), Microwave propagation. Wire and Radio Communications, Ridgewood, N.J., 78(4):13-15, 48-49, April 1960. 2 figs., table, eqs. DWB--The basic elements of radio wave propagation and the effect of many vagaries of atmospheric change on the system's reliability are discussed. The discussion includes path clearance, atmospheric refractive index, space and frequency diversity, parabolic antennas, and passive reflectors. (Met. Abs. 13.5-129)--O.T.

E-782 Toman, Kurt (GRD, AF. Camb. Res. Center), Focusing, defocusing and refraction in a circularly stratified atmosphere. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(3):287-288, May/June 1960. 2 figs., 3 refs. DWB, DLC--Focusing, defocusing, astronomical refraction and path length of rays as a function of the departure angle Δ of the ray at the source is described for cases with the source outside, inside, or on the boundary of a circular stratification. Relative to zero elevation angle symmetrical and centrosymmetrical distributions are found. (Met. Abs. 14.2-124)--Author's abstract.

E-783 Troitskiĭ, V.N., Rasprostranenie santimetrovykh voln na gornykh trassakh bol'shoĭ protiazhennosti. (The propagation of centimeter wave over long distance mountain paths.) Radiotekhnika i Elektronika, Moscow, 5(12):1919-1924, Dec. 1960. 9 figs., ref. Transl. into English in Radio Engineering and Electronics, N.Y., 5(12): 61-69, 1960. DLC--This article is concerned with the fading of cm and dcm waves on long distance mountain routes. Experimental data on the fading on three mountain routes in Central Asia are given. Conclusions are made concerning the nature of the fading on mountain routes using the long distance tropospheric propagation of ultrashort waves. --Author's abstract.

E-784 U.S. Navy Weather Research Facility, Meteorological aspects of radio-radar propagation. U.S. Office of Naval Operations, NAVWEPS 50-IP-550, June 1960. 173 p. Figs., tables, 26 refs.--This publication is intended as a comprehensive reference in radio-radar meteorology for Naval Weather Service personnel. The material is presented in 4 parts. Pt. 1 deals with electromagnetic propagation and radio-radar propagation. Pt. 2 is devoted to the atmospheric refractive index, to the standard atmosphere, and to the actual atmosphere. Pt. 3 speaks of the computation of atmospheric refractive effects on radio-radar performance, and Pt. 4 is devoted to the meteorological studies of the atmospheric refractive index. (Met. Abs. 14B-126) --M. B. G.

E-785 Voge, J., Réflexions partielles dans l'atmosphère et propagation à grande distance, IV, Réflexion speculaire et réflexion diffuse sur des feuillets atmosphériques. (Partial reflections in the atmosphere and long range propagation, Pt. 4, Specular reflection and scattered reflection from atmospheric layers.) Annales des Telecommunications, Paris, 15(1/2):33-47, Jan./Feb. 1960. 7 figs., 20 refs., eqs. DLC--After discussing the principles of existing theories (diffusion and partial reflections) on the propagation of ultrashort waves at great distance, the author emphasizes the necessity to distinguish between the "space" and "time" variables and to consider the instantaeous characteristics of the received signal. They also discuss the data concerning the splitting up of the atmosphere and establish formulas permitting to compute the power reflected on a layer with a regular surface, and with an irregular surface. The author hypothesizes that the irregularities of the surface of the layer may be due to atmospheric turbulence, showing a connection between the phenomena of reflection and turbulence. The formulas will be employed in a future paper to calculate the characteristics of the signal strength. The author then gives an account of the results which lead him to distinguish between three types of propagation (specular reflection, diffused reflection, diffusion in an important volume of the atmosphere) with a possibility of progressive transition from the one to the other when frequency increases. The 3 mechanisms may theoretically intervene simultaneously according to frequency, with a progressive transition from the first to the latter when the wavelength is lowered. (See refs. E-542, 628, 786, 772, 715.) (Met. Abs. 12. 1-100)--A. V.

E-786 Voge, J., Réflexions partielles dans l'atmosphère et propagation a grande distance, V, Réflexion et diffusion troposphérique des ondes radioélectriques. (Partial reflections in the atmosphere and long distance propagation, Pt. 5, Tropospheric reflection and scattering of radioelectric waves.) Annales des Telecommunications, Paris, 15(5/6):107-121, May/June 1960. 9 figs., 22 refs. DLC--After pointing out in the introduction some of the most important results which he proposes to discuss, the author determines, on the basis of formulas included in the preceding article (Pt. 4), the power received at the end of propagation paths through specular and diffuse reflection on atmospheric tilts or on stretched layers formed by a group of tilts. He next reviews the principal conclusions of the theoreticians of turbulent diffusion. This leads to a systematic comparison of the 3 mechanisms of long distance propagation of ultrashort waves. The author tries to specify the conditions and more especially the frequency bands for which one or another of the phenomena has a preponderant influence in the signal received; he shows that, in most cases, the diffuse reflection is locally far more important than the turbulent diffusion, while, on the other hand, the last concerns a larger volume of the atmosphere. The various propagation mechanisms are also compared from the point of view of the variations of fields in function of distance and frequency, and as regards the fine characteristics of the signal received: diversity distances, width of transmission band, rapid fluctuations. The article ends with a study of the "instantaneous" characteristics of the field received which, according to the author's opinion, very frequently gives evidence of the influence of discrete reflections on tilts, rather than turbulent diffusion phenomena. (See refs. E-542, 628, 785, 772, 715.) (Met. Abs. 13. 1-120)--A. V.

E-787 Voge, J., Theories de la propagation troposphérique au-delà de l'horizon. (Theories on tropospheric transhorizon propagation.) Annales des Télécommunications, Paris, 15(11/12):260-265, Nov./Dec. 1960. 38 refs. DLC--The author limits his investigations to the so-called "transhorizon" or "through tropospheric diffusion" normal propagation, excluding the superrefraction phenomena. In addition, a special investigation is made of the works carried out since the latest ISRU General Assembly (Boulder 1957). This survey and restatement do not claim completeness, their principal purpose is to emphasize a certain number of results and to present the discussions they raised. The three main types of theories set forth to explain the characteristics of the "transhorizon" propagation are successively examined: turbulent diffusion in the troposphere, partial reflections upon atmospheric discontinuity layers and model theories. (Met. Abs. 13.5-130)--A.V.

E-788 Wade, H.D. and Fannin, B.M., Wave propagation through a turbulent tropospheric layer. Texas. Univ. Electrical Engineering Research Laboratory, Contract AF 19 (604)-5504, Report No. 6-34, May 30, 1960. 61 p. 5 figs., 27 refs., 132 eqs. DWB--The analysis of wave propagation phenomena induced by homogeneous tropospheric layers is adequately accomplished through the use of conventional wave theory (microwave optics). Propagation through homogeneous tropospheric turbulence can be handled theoretically by the use of a first Born approximation (single scattering) approach in many cases. The choice of the proper theory to apply to the case of propagation through a tropospheric layer of anisotropic turbulence is not clearly established. This report presents a preliminary analysis of wave propagation through such a layer. A comparison is made of single scattering and wave theory analyses of wave propagation through a homogeneous non-turbulent tropospheric layer in order to gain insight into the validity of single scatter theory for a limiting case. The single scattering approach is then applied to an assumed mathematical model of an anisotropically turbulent tropospheric layer, and integral expressions are derived for the cross correlation functions of the amplitude and phase, respectively, of a wave which has passed through the layer. A preliminary investigation of the possibility of using a thin, random, phase changing screen as an approximation of the turbulent layer is reported. Conclusions drawn from this research and recommendations for future research are given. (Met. Abs. 13.8-140)--Authors' abstract.

E-789 Williamson, V.L. et al., A summary of VHF and UHF tropospheric transmission on loss data and their long term variability. U.S. National Bureau of Standards, Technical Note, No. 43, March 1960. 37+ p., 137 figs., 4 tables, 2 refs. DLC--Cumulative distributions of hourly median basic transmission loss are presented for 135 beyond line-of-sight radio path in the U.S. In order to allow for seasonal trends of transmission loss, the year is divided into a summer period, May through Oct., and a winter period, Nov. through April. The long term variability of observed hourly medians is compared with predicted variability based on empirical curves by Rice, Longley and Norton.--Author's abstract.

E-790 Willson, F.E. and Runge, W.A., Data transmission tests on tropospheric beyond the horizon radio systems. IRE Transactions on Communications Systems, N.Y., 8(1):40-43, March 1960. 7 figs., 3 refs. DLC--Results of data transmission tests made on both single link and multi link tropospheric beyond the horizon systems are presented. Tests were made at 750 or 1300 bits per sec, employing both double sideband AM and FM methods of data modulation. In the single link tests the data performance was determined for various transmission parameters such as median channel noise, peak channel noise, radio received carrier level, and order of diversity. Data were satisfactorily transmitted on a 2400 mi circuit consisting of nine different beyond the horizon paths and 6 line of sight paths. The FM data modulation was notably superior to the AM type.--Authors' abstract.

E-791 Zlotykamin, C., Réalisations de klystrons de puissance à large bande. (Development of wide band power klystrons.) Acta Electronica, Paris, 4(1):47-57, Jan. 1960. 8 figs., 16 eqs. DLC--Many telecommunication units intended for tropospheric scatter propagation require the use of klystrons operating with a high gain and a wide frequency band. The conditions which must be met if such features are to be obtained are examined. The author then considers the influence of electrical and geometrical parameters on both gain and bandwidth. Some features leading to a reduction of the losses encountered in the transmission of the electron beam are indicated. An electron gun is described. Finally, some examples of klystrons actually developed are given to illustrate the principles set forth. --R.M.

E-792 Zverev, V.A., Rasseianie modulirovannykh voln na sluchaĭnykh neodnorodnostiakh. (Scattering of modulated waves by random inhomogeneities.) U.S.S.R. Ministerstvo Vysshego Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 3(5):903-904, 1960. Ref., 12 eqs. DLC--It is shown that an analysis of the propagation of modulated waves makes it possible to determine the degree of correlation of fluctuations of waves at different frequencies and provides information on the magnitude of the scattering volume and its form, data that are important in the experimental solution of the problem of the occurrence of a scattered field. --R.M.

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E-793 Abraham, L.G., Jr. and Bradshaw, J.A., Weather and reception level on a troposphere link: annual and short term correlations. U.S. Nat'l. Bureau of Standards, Journal of Research, Sec. D, 65(2):155-156, March/April 1961. 2 figs., 13 refs. DWB, DLC--The weather parameters suggested by the Booker-Gordon theory are correlated with data from a troposphere link not previously reported. While the correlations over the whole year's weather cycle are high, the short term correlations practically vanish. The former without the latter lend little support to this theory. (Met. Abs. 13.4-99)--Authors' abstract.

E-794 Aksenov, V.I., Utilization of Kirchhoff's approximation in the problem of the scattering of radio waves by periodically rough surfaces with finite conductivity. Radio Engineering and Electronic Physics, N.Y., No.3:307-314, 1961. 2 figs., 2 tables, 4 refs., 20 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(3):347-354, March 1961. DLC--On the basis of the Huygens-Kirchhoff principle and of approximations from geometrical optics, solutions to the problem of the scattering of radio waves by a limited region of double sinusoidal (undulation in two dimensions), and sawtooth surfaces with finite conductivity are obtained. These solutions can be used in the analysis of the scattered field in the far zone. The solution for a sawtooth surface is obtained in a finite form; for a double sinusoidal surface, it is the form of a rapidly converging series. Examples of the analysis of the scattering of waves by the indicated surface are examined. --Author's abstract.

E-795 Armand, N.A. and Vvedenskii, B.A., Allowance for antenna directivity pattern in the calculation of radio wave diffraction around the Earth. Radio Engineering and Electronic Physics, N.Y., No.8:1083-1090, 1961. Table, 13 refs., 38 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(8):1219-1227, Aug. 1961. DLC--The diffraction field of a directional antenna with its plane normal to the Earth's surface is investigated. It is shown that the directional properties of a low lying antenna can be accounted for in the calculation of the diffraction field by multiplying the dipole field equations by the antenna directive gain. In the case of a high lying antenna the diffraction field is determined by the part of the energy flux radiated from the antenna in the horizontal direction. --Authors' abstract.

E-796 Armand, N. A.; Vvedenskii, B. A.; Kalinin, A. I. et al., Long range tropospheric propagation of ultrashort waves (survey). Radio Engineering and Electronic Physics, N. Y., No. 6:775-791, 1961. 9 figs., 119 refs., 2 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(6):867-885, June 1961. DLC--An analysis of experimental and theoretical work on long range tropospheric propagation of ultrashort waves is given. The field intensity is examined as a function of distance, wavelength and time. The gain losses of antennas, the distortion of the signal, and the band of transmitted frequencies are all analyzed. Various theories describing the mechanism of long range tropospheric propagation of radio waves are considered. On the basis of the comparison with experimental data, it is shown that none of the existing theories can completely explain all the available experimental results. --Authors' abstract.

E-797 Barghausen, A. F. and Peterson, C. F., Path loss measurements vs prediction for long distance tropospheric scatter circuits. IRE Transactions on Communications Systems, N. Y., 9(4):439-445, Dec. 1961. 9 figs., table, 9 refs., 7 eqs. DLC--Before any communications circuit can be established between two points, whether it be by wire lines, or by tropospheric or ionospheric radio propagation, a thorough knowledge of the intended path should be obtained so that an efficient and economical installation can be made. Each system should have as high a reliability as is required for its intended use. Tropospheric forward scatter circuits have established their place in the worldwide communication network of the military and it is the intent of this paper to illustrate by a specific example how the performance of a circuit of this type may be predicted with adequate accuracy without making costly transmission loss measurements over the intended path. --Authors' abstract.

E-798 Barsis, A. P. and Johnson, Mary Ellen, Prolonged space wave fadeouts in tropospheric propagation. U. S. National Bureau of Standards, Technical Note, No. 88, Feb. 8, 1961. 40 p. 30 figs., 14 tables, 10 refs., 2 eqs. DWB (M(055) U585te) --This paper contains the results of studies performed during the last several years on the short term variability of tropospheric signals received over within-the-horizon paths. Signal variations of this type have been termed "prolonged space-wave fadeouts", as they are mainly characterized by reductions in signal level to many decibels below presumably constant values determined from geometrical optics methods. The data described here were obtained from measurements over propagation paths in the Pacific Coast region of Southern California, and the continental region of Eastern Colorado. Fadeouts are analyzed as a function of carrier frequency, path characteristics, and meteorological parameters. The study also includes an evaluation of fadeouts observed over a path using a mountain peak as a diffracting knife edge like obstacle between transmitter and receiver. (Met. Abs. 13.1-341)--Authors' abstract.

E-799 Barsis, A. P. and Kirby, R. S. (both, Central Radio Propagation Lab., Nat'l. Bur. of Stds., Boulder, Colo.), VHF and UHF signal characteristics observed on a long knife edge diffraction path. U. S. National Bureau of Standards, Journal of Research, Sec. D, 65(5):437-448, Sept./Oct. 1961. 16 figs., 9 tables, 16 refs. Also in IRE International Convention Record, N. Y., Pt. 1:17-34, 1961. DWB, DLC--

During 1959 and 1960, long term transmission loss measurements were performed over a 223 km path in eastern Colorado using frequencies of 100 and 751 Mc/s. This path intersects Pikes Peak which forms a knife edge type obstacle visible from both terminals. The transmission loss measurements have been analyzed in terms of diurnal and seasonal variations in hourly medians and in instantaneous levels. As expected, results show that the long term fading range is substantially less than expected for tropospheric scatter paths of comparable length. Transmission loss levels were in general agreement with predicted knife edge diffraction propagation when allowance is made for rounding of the knife edge. A technique for estimating long term fading ranges is presented and the results are in good agreement with observations. Short term variations in some cases resemble the space wave fadeouts commonly observed on within-the-horizon paths, although other phenomena may contribute to the fading. Since the foreground terrain was rough, there was no evidence of direct and ground reflected lobe structure. In most cases comparatively high correlation exists between signals received simultaneously on two antennas with 8. 3 and 14 m vertical separation. These separations were chosen as being representative for practical space diversity systems designed for eliminating the effects of fading arising from direct and ground reflected phase interference phenomena. The comparatively high correlation observed suggests that space diversity will be relatively less successful in mountain obstacle paths with rough terrain near the terminals than on tropospheric scatter paths or on line-of-sight paths over smooth terrain. The enhancement of field strength associated with propagation over mountain ridges may cause concern in applications where mountains are being counted on to shield unwanted radio waves. Some radio astronomy installations have been located in mountain valleys for this reason, and it is possible that obstacle gain effects may aggravate rather than alleviate interference. (Met. Abs. 13. 6-92)--Authors' abstract.

E-800 Barsis, A.P.; Norton, K.A.; Rice, P.L. and Elder, P.H., Performance predictions for single tropospheric communication links and for several links in tandem, U.S. National Bureau of Standards, Technical Note, No. 102, Aug. 1961. 154 p. 22+ figs., bibliog. p. 151-154, eqs. throughout. DLC--Performance of long distance tropospheric communication circuits, either singly or in tandem, is predicted in terms of the probability of obtaining a specified grade of service or better for various percentages of time. The grade of service is determined by the minimum acceptable ration of hourly median predetection RMS signal to RMS noise for the type of intelligence to be transmitted. The standard deviation of prediction errors depends upon the percentage of hours the specified grade of service is required and on parameters characterizing the propagation path. The possibility of reducing this standard deviation by making path loss measurements is discussed. It is shown that no improvement is possible unless the test path is very nearly the same as the proposed operational path; in particular, unless the test path and operational path have terminals less than one mile apart it is shown to be doubtful in most cases whether the observations will be useful in improving the reliability of the predicted performance of the proposed system. Assuming that the test path and proposed operational paths are identical, estimates are given of the number of days of observations required to halve the prediction uncertainty or, alternatively, to reduce it to 3 db; in some cases several years of observations are required. A tutorial discussion is given in Appendix III of the concepts of the effective noise figure and the effective input noise temperature of a receiving system. --Authors' abstract.

E-801 Bass, F. G., Rasprostranenie radiovoln nad statisticheski neodnorodnoĭ poverkhnost'iu. (Radio wave propagation over a statistically inhomogeneous surface.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 4(3):476-483, 1961. 5 refs., 32 eqs. English summary p. 483. DLC--By means of boundary conditions obtained in a previous paper (see E- , an examination is made of radio wave propagation over a random irregular surface. Reflection coefficients and attenuation function are obtained for the average field propagated over such a surface. --Author's abstract.

E-802 Bauer, Louis H., Correlation of wind shear with tropospheric scatter signals. IRE Transactions on Antennas and Propagation, N.Y., 9(5):466-470, Sept. 1961. 6 figs., 11 refs., eqs. DLC--Discusses the result of experimental data obtained by AF Cambridge Research Center over East-West 400 mi path from Bedford to Wilson, N.Y. Correlation of the 10 - 90% fading range of the 915 Mc scatter records with wind shear gave coefficients of 0.76 to 0.8 at a point 70 mi from the common volume. Fading range increased by 1.4 db/m/sec/km. --W.N.

E-803 Bean, B. R., Comparison of observed tropospheric refraction with values computed from the surface refractivity. IRE Transactions on Antennas and Propagation, N.Y., 9(4):415-416, July 1961. Fig., 7 refs., 3 eqs. DLC--Radar elevation angle observed in the Tularosa Basin of New Mexico are compared with values predicted from the surface value of the radio refractive index. Although this method of prediction is not particularly efficacious under the conditions of this experiment encouraging agreement nevertheless was obtained between predicted and observed: a) mean value of elevation angle error, b) variation of elevation angle error with Ns, and c) the degree of reduction in the uncertainty of prediction gained over the use of a single standard atmosphere. --Author's abstract.

E-804 Bean, B. R. (CRPL, Nat'l. Bur. of Stds., Boulder, Colo.), Concerning the bi-exponential nature of the tropospheric radio refractive index. Beiträge zur Physik der Atmosphäre, Frankfurt a. M., 34(1/2):81-91, 1961. 9 figs., 2 tables, 16 refs., 9 eqs. German, English and French summaries p. 81-82. DWB, DLC--This paper is concerned with examining the model $N = (n-1)\,10^6 = D_o \exp\ -z/H_d\ + W_o \exp\ -z/H_w$ for the height, z, variation of the radio refractive index, n, within the troposphere. The first term, D, is the component of the refractive index due to oxygen and the second term, W, is the water vapor component. The scale heights, H_d and H_w, are sensitive indicators of climatic differences and maps of each are given for the U.S. for both summer and winter. The bi-exponential model yields more accurate estimates of N structure in the troposphere than the earlier single exponential model and consequently gives more reliable estimates of refraction for initial elevation angles in excess of 3 degrees but only a negligible improvement for the near zero angles of departure commonly used in tropospheric propagation. (Met. Abs. 13.6-495)--Author's abstract.

E-805 Bean, B. R. and Cahoon, B. A., Correlation of monthly median transmission loss and refractive index profile characteristics. U.S. National Bureau of Standards, Journal of Research, Sec. D, Wash., D.C., 65(1):67-74, Jan./Feb. 1961. 5 figs., 5 tables, 20 refs., 17 eqs. DWB, DLC--The difference in the monthly mean values of the refractive index at ground level and at one kilometer above the ground level is often used for the purpose of predicting the annual cycle of radio transmission loss. The present study investigates the possibility of utilizing differences to heights other than one kilometer. A comparison of 100 megacycles per second transmission loss recorded over 21 paths with various refractivity differences from the surface to 3 km reveals that the surface value of the refractive index yields as good a correlation as any of the refractive index differences due to the high correlation between the surface values and these differences; therefore, the more accessible surface value can be effectively substituted for the differences. Specifying the refractive index profile at two or three additive points and using multiple correlation techniques does not significantly increase the correlation. The use of radio data over the same path does not significantly improve the correlation over that obtained from only meteorological data, indicating the very practical result that inexpensive meteorological data may be used to predict the seasonal trend of VHF radio field strengths with as much accuracy as expensive radio path measurements. (Met. Abs. 13.5-123)--Authors' abstract.

E-806 Bean, B. R. and Dutton, E. J., Concerning radiosondes, lag constants, and radio refractive index profiles. Journal of Geophysical Research, Wash., D.C., 66(11): 3717-3722, Nov. 1961. 2 figs., table, 11 refs., 15 eqs. DWB, DLC--Temperature and relative humidity reported by the radiosonde have long been converted to radio refractive index without regard to sensor time lag. Past studies of radio ducting incidence have shown that under restricted conditions only corrections for humidity sensor lag need be made. It is here shown that lag constants currently in the literature are inadequate under conditions of superrefraction of radio waves. Use of currently available lag constants indicates that, should any correction be made, both temperature and humidity sensor lags must be considered for any climatological comparison of ducting incidence. By ignoring sensor time lag, one tends to underestimate ducting incidence; by correcting only for humidity sensor lag, one tends to overestimate ducting incidence. (Met. Abs. 13.8-143)--Authors' abstract.

E-807 Bean, B. R. and Horn, J. D., Concerning the potential refractive index and the molecular refractivity. Journal of Meteorology, Boston, 18(3):427-429, June 1961. 10 refs., 6 eqs. Comment by K. H. Jehn, p. 428-429. DWB, DLC--The authors consider K. H. JEHN's suggestion that the concept of the potential refractive index and its application to synoptic scale weather analysis is more fundamental, and that the approach of BEAN and HORN is essentially empirical. This note purports to clarify the differences between the two approaches. The advantages of the use of molecular refractivity are explained, which has the advantage of allowing the recovery of the refractive index at a point solely from a knowledge of the altitude of the point while, on the other hand, one cannot recover the refractive index at a point from the potential refractive index without further information about the actual values of temperature and vapor pressure. The A unit (referred to in the authors' previous paper) has advantages for radio meteorological analysis over Ø (Katz's potential refractive modula) (or K the potential refractive index), since it introduces the meteorological effects of heights upon the refractive index in a much simpler way, gives a direct quantitative measure of radio refraction anomalies without further calculation and, in addition, may be easily utilized as a synoptic tool. K. H. JEHN elaborates on his previous comments. (Met. Abs. 14.7-108)--E. Z. S.

E-808 Bean, B. R. and Horn, J. D., On the average atmospheric radio refractive index structure over North America. Beiträge zur Physik der Atmosphäre, Frankfurt a. M., 34(1/2):92-104, 1961. 20 figs., table, 15 refs., 3 eqs. German, English and French summaries p. 92. DWB, DLC--The variation of the radio refractive index in the first 3 km over North America is found to delineate the gross climatic features of both surface and upper air conditions, particularly with respect to humidity content. Maritime climates are characterized by low mean values as well as small seasonal and diurnal variations, while continental climates have larger mean values as well as larger seasonal and diurnal ranges. Extensive charts illustrate these conclusions. Further, continental cross sections of vertical refractive index structure are presented for the first time. (Met. Abs. 13.6-93)--Authors' abstract.

E-809 Benoliel, I. and Potts, J.B., Interdependence between hourly median transmission loss and surface refractivity index observed at 900 Mc on a 232 mile far beyond the horizon path. IRE Transactions on Communications Systems, N.Y., 9(4):445-450, Dec. 1961. 5 figs., 5 tables, 12 refs. DLC--A detailed analysis is made of propagation data obtained from the North Atlantic Scatter System installed in Iceland. In particular, the correlation of the transmission loss and meteorological observations on a long path is analyzed in detail. By separating the data into various time periods, it is shown that for periods of time during which the received field is lowest, the correlation between transmission loss and surface refractivity is very high. The ability to establish a strong correlation between transmission loss and surface refractivity for this period allows the system designer to make more accurate predictions of the lower expected received fields and thus is able to calculate the minimum required transmitter with greater accuracy. --Authors' abstract.

E-810 Bowhill, S.A. (Penn. State Univ.), The scattering of radio waves by an extended randomly refracting medium. Journal of Atmospheric and Terrestrial Physics, London, 20(1):9-18, Feb. 1961. 2 figs., 11 refs., 19 eqs. DLC--A continuous medium containing 3 dimensional random inhomogeneities of refractive index scatters an electromagnetic wave which is incident upon it. This paper derives the form of the emerging angular power spectrum of the wave, for the case where the scales of the inhomogeneities are different in the 3 spaced directions. It is shown that the medium cannot be analyzed as a series of superposed thin phase screens, spaced in the propagation direction, and with independent phase profiles. When a limiting process is carried out, allowing for an arbitrary spatial correlation function for the inhomogeneities in the 3 directions, a quite different result is obtained. This disparity is due to diffractive changes in the wave in passing from one inhomogeneity to the next. (Met. Abs. 14.3-157)--Author's abstract.

E-811 Braude, S.Ia.; Ostrovskii, I.E. and Sanin, F.S., Ispol'zovanie poniatia otritsatel'nogo ekvivalentnogo radiusa Zemli dlia otsenki intensivnoĭ refraktsii radiovoln. (Use of the concept of negative equivalent Earth radius for estimating strong refraction of radio waves.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 4(1):67-73, 1961. 4 figs., table, 5 refs., 15 eqs. DLC--The concept of the negative equivalent Earth's radius is introduced in the well known rays alignment method to be applied to the case of the positive refraction: $dn/dh \quad -1,57.10^{-7}m^{-1}$ (n being the refractive index, h - height above Earth's surface). The Earth's sfericity is taken into account and Frenels formulas are used for the field calculations. The problem comes to plane boundary one by the introduction of the corresponding reduced heights. Formulas and curves are given for the heights of the interference maximums versus the values of the negative equivalent radius at the given distance from the source of radiation. All calculations are carried out with the assumption that there exists a constant gradient of the refractive index in a sufficiently thick atmospheric layer. --Authors' abstract.

E-812 Byatt, W.J. and DeVault, G.P. (both, Sandia Lab., Albuquerque, N.Mexico), An iteration variation method for wave propagation problems. Journal of Geophysical Research, Wash., D.C., 66(6):1793-1797, June 1961. Fig., 3 refs., 32 eqs. DLC --In a medium in which the index of refraction varies in one space coordinate only, transform methods are convenient for reducing an inhomogeneous scalar wave equation to an ordinary differential equation in which the square of the space dependent index of refraction appears explicitly. An iteration variation method for obtaining approximate expressions for the dispersion relations within the medium is discussed. The ordinary differential equation is converted to an integral equation, the solution of which is begun by iteration. The individual terms in the series thereby formed, which we shall call iterates, then form the basis of a trial function for use in a variational principle. The method is illustrated by an example. (Met. Abs. 14. 5-130)--Authors' abstract.

E-813 Casini, G. and Fagiolio, Atmospheric dispersion and absorption of microwaves. Italy. Centro di Studio per la Fisica delle Microonde, Florence, Contract AF 61 (052)-437, Final Report, Sept. 1961. 63 p. Figs., tables, refs., eqs. (CFCRL-62-136) DWB (M(051)188fi)--The experimental results of measuring the refractive index of nitrogen, oxygen and argon discussed here, were obtained with a refractometer and with addition of some devices subsequently added for improved performance. The techniques for increase of the signal-to-noise ratio of a crystal amplifier detecting system and to permit the realization of cavities having a very high $Q(3.10^5)$ and a single resonant mode are described. The results are given in tables and graphs. (Met. Abs. 14. 9-164)--Authors' abstract.

E-814 Cassedy, E.S. and Fainberg, J., Comments on Scatter communications with radar chaff. IRE Transactions on Antennas and Propagation, N.Y., 9(5):497-498, Sept. 1961. 15 refs. DLC--The authors point out that pertinent references were missing in the above cited paper by R.A. HESSEMER (see E-831). These references "should be made in order to verify (or refute) the formulas and data presented by Hessemer." Hessemer replies that these references were included in an earlier paper (Univ. of Arizona, Appl. Res. Lab., S-5. 80146, March 1959) and thus clears up the minor differences mentioned. --W. N.

E-815 Chisholm, J.H.; Goodman, S.J. et al., Frequency variations due to over-the-horizon tropospheric propagation. IRE Transactions on Antennas and Propagation, N.Y., 9(4):384-389, July 1961. 11 figs., 6 refs., eqs. DLC--Discuss and present data obtained by a well organized experimental UHF transmission over the 161 mi path between Alpine, N.J. and Round Hill, Mass., using 388 Mc transmitted, returned heterodyned to 416. 7 and retransmitted at 388. Detailed results are presented in graphs and may be summarized as follows: For path lengths about 100 mi between radio horizons, carrier frequency of about 400 Mc, the standard deviation of frequency fluctuations was approximately 0. 6 cps, indicating transmissions feasible at an accuracy of about 0. 15 parts in 10^8. --W. N.

E-816 Clutts, C.E.; Kennedy, R.N. and Trecker, J.M., Results of bandwidth tests on the 185 mi Florida-Cuba tropospheric scatter radio system. IRE Transactions on Communications Systems, N.Y., 9(4):434-439, Dec. 1961. 10 figs., table, 4 refs. DLC--The first in a planned series of tests was conducted during March 1960, over the 185 mi FM system between Florida City, Fla. and Guanabo, Cuba. The system was loaded with random noise of various bandwidth up to 2. 5 Mc, and peak deviations up to $\pm$ 8 Mc were used. Tests were made with no diversity and with dual diversity. It was found that intermodulation, resulting from multipath propagation, can limit system performance. Both deviation and base bandwidth are important and have an influence on intermodulation and tone stability. Diversity has little effect on intermodulation but improves tone stability appreciably. The paper presents numerical results of the measurements of average intermodulation and some information on cumulative probability distributions for various combinations of base bandwidth, deviation, and diversity. --Authors' abstract.

E-817 Davids, H.H., Thin route tropo - a new approach to long range communications. IRE Transactions on Vehicular Communication, N.Y., 10(2):28-35, Aug. 1961. (Unchecked)--This new system of communications makes use of tropospheric scatter for the transmission of digital information over long distances more reliably than high frequency radio, more economically than wire, less vulnerable than microwave or VHF, and cheaper than conventional tropospheric scatter systems. Using only a narrow bandwidth, it can be used for transmission of data (teletype, telemetry, facsimile, etc.) over distances up to 500 mi, using relatively low power transmitters and simple aerial systems. --Author's abstract.

E-818 de Jong, A., Telecommunicatie door middel van troposferische verstrooiing ("tropospheric scatter"). (Telecommunication by means of tropospheric scatter.) Electrotechnick, The Hague, 39(23):581-593, Nov. 9, 1961. 26 figs., 2 tables, 9 refs. DLC--Results of measurements by the Dutch Post Office between April 1958 and March 1960 over a 180 km North Sea path between Domburg and den Helder, two points on the coast of Holland, are discussed. The received signal was continuously recorded by a double pen recorder; slow fading recordings (6 min time constant) were made and monthly cumulative time distribution curves are shown. The link chosen can be regarded as comparable with a similar one with England, The results agreed well with others obtained in various parts of the world and it is concluded that a North Sea link for telephony or, if need be, a television, is technically possible using tropospheric scatter. --Electr. Eng. Abs.

E-819 Dennis, Arnett S., Performance of tropospheric scatter systems as a function of weather conditions. Stanford Research Institute, Menlo Park, Calif., Contract DA-36-039 SC-85052, Final Technical Report 5, June 1961. 32 p. 5 figs., 3 tables, 22 refs., 25 eqs. DWB (M(051) S785fin)--Previous studies have shown that signal levels on tropospheric scatter links are related to weather conditions along the path. It has been found that monthly median signals are correlated with radio refractivity gradients near the ground. Thus, climatological data can be used to improve estimates of basic transmission loss for projected scatter links. In this paper the correlations of hourly median signals with refractivity gradients and the surface refractivity are investigated for an over-water and a coastal path and found to be significant. This indicates that short range forecasts of scatter circuit performance over water and some coastal areas can be made using routinely available meteorological data. The question of extending the STARCOM network in the western Pacific using tropospheric scatter links is discussed briefly in the light of these considerations. --Author's abstract.

E-820 Dixon, J.M., Temporal variation of medium frequency ground wave field strength. Institution of Radio Engineers, Australia, Proceedings, 22(4):250-252, April 1961. 5 figs., table, 5 refs., 2 eqs. DLC--The results of medium frequency ground wave field strength measurements are analyzed to show the temporal variation to be expected under Australian conditions. Data of measurements made during 1953-56 are presented and compared with similar measurements made in Europe and North America. The Australian results are found to be different from those obtained elsewhere, since no common seasonal trend or correlation with temperature could be ascertained. The variation in field strength at noon was small; in good conductivity soil the results show a trend toward more stable conditions with decrease in frequency which corresponds to an increase in penetration. --G.T.

E-821 Dutton, E. J., On the climatology of ground based radio ducts and associated fading regions. U.S. National Bureau of Standards, Technical Note, No. 96, June 1961. 38 p. 51 figs., 7 tables, 10 refs., 30 eqs. DWB--This estimation of variation of occurrence of radio ducts with arctic, temperate, and tropical climate conditions is based on a geometrical optics definition of the limiting case in which ray techniques may be used. This criterion is applied to 3-5 yrs of radiosonde observations. Maximum observed incidence of ducts was 13% for tropical, 10% for temperate and 5% for arctic locations. Mean initial elevation angle of radio ray trapping was about 3 mr, maximum 5.8 mr. Steepest gradient of N observed was -420 N units/km. Observed ducts trap radio waves of frequency $\gtrsim$ 1 kMc at all locations for at least 50% of the time. --Author's abstract.

E-822 Dutton, E. J. and Thayer, G. D., Techniques for computing refraction of radio waves in the troposphere. U.S. National Bureau of Standards, Technical Note, No. 97, Oct. 17, 1961. 55 p. 8 figs., 26 tables, 43 eqs. DWB (M(055) U585te)--Eight methods of computing atmospheric refraction of radio rays are discussed with appropriate theoretical background. These methods are: 1) the high angle, or astronomical, refraction case; 2) the statistical method; 3) the low angle, or terrestrial, refraction case (Schulkin's method); 4) the four-thirds Earth model; 5) the exponential model; 6) the initial gradient correction method; 7) the departures from normal method; 8) a graphical method (Weisbrod's and Anderson's method). Sample computations are included for each of the above methods. (Met. Abs. 13.9-109) --Authors' abstract.

E-823 Edinger, James G. and Holzworth, George C., Attempts to detect inversions using the AN/TPQ-6 radar. (In: Edinger, James G., Variability of low level thermal stratification over coastal terrain in southern California. California. Univ. at L.A. Dept. of Meteorology, Contract CWB-9666, (unnumbered report), May 1961. p. 15-28. 10 figs., tables, 9 refs.) DWB (M(051) C153v)--A vertically pointing radar, wavelength 0.86 cm has been operated near the southern California coast by the U.S. Weather Bureau for a number of months during the past two years. One of the purposes of this operation has been to examine the possibility of determining the thermal and/or water vapor stratification of the lower atmosphere, in particular the top surface of the marine layer, from angel activity. Angels were frequently observed through the lower few thousand feet and occasionally were highly concentrated in relatively narrow bands that persisted over several hours. From the radar records, recorded by facsimile, attempts were made to relate angel activity to meteorological variables. In this connection U.S. Weather Bureau radiosonde observations at the radar site have been utilized. Generally, the relationships are consistent with the hypothesis that angels are the result of echoes from regions of very high index of refraction gradient. Such gradients are believed to be produced by elaborate deformation of initially simple strata that are characterized by some lesser index of refraction gradient. Consequently, angel activity seems best related to stirring in the atmosphere. --Authors' abstract.

E-824 Feĭnberg, E.L., Rasprostranenie radiovoln vdol'zemnoĭ poverkhnosti. (Radio wave propagation along the Earth's surface.) Moscow, Akademiia Nauk SSSR, 1961. 546 p. Numerous figs., numerous eqs. Bibliog. p. 535-543. DLC (QC661.F4)--This comprehensive monograph covers all aspects of the theory of surface (i.e., non-ionospheric) radio wave propagation, based on extensive study of world literature. After setting out the basic equations of radio wave propagation, the author analyzes the medium in which propagation takes place, propagation in homogeneous media, refraction by a plane boundary, the field near a plane boundary, dipole near a plane and a spherical earth, the field over an electrically inhomogeneous surface and propagation over an irregular surface, through an inhomogeneous stratified medium and through a turbulent troposphere. --G. T.

E-825 Filipp, N. D., O kharaktere fluktuatsii radiosignala na ukv pri rasprostranenii nad neodnorodnoĭ poverkhnost'iu. (Character of fluctuations of a UHF radio signal propagating over an inhomogeneous surface.) Radiotekhnika i Elektronika, Moscow, 6(9):1432-1441, Sept. 1961. 6 figs., 12 refs., 19 eqs. Transl. into English in Radio Engineering and Electronic Physics, N. Y., No. 9:1270-1278, 1961. DLC --Approximate expressions are obtained for the mean level of the radio signal and its relative fluctuations at the output of a square law detector for propagation in an inhomogeneous medium over an irregular interface. The values of the normalized functions of the spatial and temporal correlations of the fluctuations of the wave field in the presence of an irregular interface are compared with the values of these functions in free space. The deductions obtained are compared with experimental data. --Transl. of author's abstract.

E-826 Foot, T. B. Lowell and Lucas, W. J., Tropospheric scatter propagation. GEC, Journal of Science and Technology, London, 28(3):126-138, 1961. 19 figs. DBS--Describes a long term investigation started in 1955, into the characteristics of an unmodulated tropospheric scatter signal in the band 3-10 Gc/s. A 3480 Mc/s link over a 173 mi path was operated for 3 yrs, and for part of the time signals were also recorded at a point on the same line 247 mi from the transmitter. Later a link at 9640 Mc/s was established over the same 173 mi path and operated simultaneously. Details are given of short and long term variation of median transmission loss, of correlation between signals at the two receiving sites, of the distribution of rapid amplitude fluctuations, and of fading characteristics at both operating frequencies. --Electr. Engr. Abs.

E-827 Ghosh, S. N. and Malaviya, V. (both, J. K. Inst. of Applied Physics, Univ. of Allahabad, India), Microwave absorption in the Earth's atmosphere. Journal of Atmospheric and Terrestrial Physics, London, 21(4):243-256, July 1961. 9 figs., 2 tables, 9 refs., 12 eqs. DLC--In this paper the microwave absorption has been calculated for different layers of the earth's atmosphere around peak resonance frequencies for each consitutent gas. The total absorption for the whole atmosphere is then obtained. For such calculations, it is necessary to know the peak absorption at the center of the absorption line and its half width. It has been shown that for atmospheric gases the peak absorption is pressure independent and that it varies as $(3-x)_{th}$ power of absolute temperature for diatomic (O_2) and linear polyatomic (N_2O) molecules and as $(7/2-x)_{th}$ power of absolute temperature for symmetric (H_2O) and asymmetric top (O_3) molecules. The half widths of the absorption lines have been calculated after assuming the temperature from ARDC Model Atmosphere and the vertical distribution of atmospheric constituents as given by MILLER. Three sets of curves are also presented whereby the amount of absorption at an operating frequency can be calculated for different atmospheric layers. (Met. Abs. 13.6-95) --Authors' abstract.

E-828 Gray, R. E., Tropospheric scatter propagation and meteorological conditions in the Caribbean. IRE Transactions on Antennas and Propagation, N. Y., 9(5):492-496, Sept. 1961. 5 figs., table, 13 refs. DLC--The UHF transmission loss beyond the horizon in this region was found to be far less than over similar path lengths in temperate climates. The large gradient of the atmosphere refractive index prevalent in the Caribbean may be responsible for the differences discussed comparatively. --W. N.

E-829 Gusiatinskiĭ, I. A., Iskazheniia pri peredache televideniia po troposfernym liniiam sviazi s chastotnoĭ moduliatsieĭ. (Distortions in television transmission over tropospheric FM links.) Elektrosviaz', Moscow, 15(9):15-21, Sept. 1961. 4 figs., 10 refs., 26 eqs. Transl. into English in Telecommunications, N. Y., No. 9:16-23, Sept. 1961. DLC--Frequency variations at the receiver input are determined for different transmitter frequencies on the basis of a trapezoidal law. The formula is applicable to estimating distortion of TV signals in FM. --Transl. of author's abstract.

E-830 Hayre, H. S. and Moore, R. K. (both, Elec. Engrg. Dept., Univ. of New Mexico, Albuquerque), Theoretical scattering coefficient for near vertical incidence from contour maps. U. S. National Bureau of Standards, Journal of Research, Sec. D, 65(5):427-432, Sept./Oct. 1961. 4 figs., 2 tables, 21 refs., 17 eqs. DWB, DLC--In calculation of the theoretical scattering coefficient for a terrain, previous authors tentatively assumed the normalized autocovariance function

$\rho(r) = e^{-Ar^2}$ for the ground elevation as a function of distance from a given point. Recently autocorrelation studies were made using maps with contours ranging from one to twenty-five feet. These resulted in curves of $\rho(r)$, which are approximated by $\exp(-|r|/B)$. The theoretical scattering cross section (σ_0) of many such terrains can be expressed as

$$\sigma_0 = 4\sqrt{2}\ \frac{\pi B^2}{\lambda^2}\ \frac{\theta}{\sin\theta}\ e^{-4k^2\sigma^2\cos^2\theta} \sum_{n=1}^{\infty} \frac{(4K^2\sigma^2)^n(\cos^2\theta)^{n+1}}{(n-1)!(2K^2B^2\sin^2\theta + n^2)^{3/2}}$$

where σ, λ, k, and θ are standard deviation of the target terrain, wavelength, wave number $(2\pi/\lambda)$ and the angle of incidence respectively. For the case where 1/B is small as compared to k, the above expression becomes

$$\sigma_0 = \frac{4\sigma^2}{\lambda B}\ (\theta \cot^4\theta) f_0 + 0 \neq 0°$$

These expressions, when normalized, are in agreement with experimental results of other authors. It is also noteworthy that the results obtained with an acoustic simulator model compared very well with this theoretical expression. This work is based on the property that the ground is conducting and has random elevation variations. Theoretical results calculated on the basis of varying ground impedance rather than its elevation are also in agreement with this expression. (Met. Abs. 14. 9-170)--Authors' abstract.

E-831 Hessemer, R. A., Jr., Scatter communications with radar chaff. IRE Transactions on Antennas and Propagation, N.Y., 9(2):211-217, March 1961. 4 figs., table, 9 refs., 35 eqs. DLC--Attempts to establish moderate range communications between non-line of sight points using numerous metallic half-wave dipoles (chaff) interspaced randomly as scattering agents. An analytical expression for the scattering cross section is sought in the first part of the paper, and the second part is devoted to a comparison of the reradiation loss and horizontal ensemble gain. The results are presented in graphs and a table. (See ref. E-814)--W. N.

E-832 Hirai, Masaichi, Diversity effects in spaced antenna reception of tropospheric scatter waves. Japan. Radio Research Laboratories, Journal, 8(38/39):301-329, Sept. 1961. 7 figs., 3 tables, 19 refs., 154 eqs. DBS--Amplitude correlations between signals received with spaced antennas in tropospheric scatter propagation beyond the horizon are considered theoretically and it is shown that theoretical values coincide fairly well with experimental data. A new general formula expressing the received signal strength in tropospheric scatter propagation is derived, taking the directivities of both transmitting and receiving antennas into consideration. The correlation of angle diversity reception in tropospheric scatter propagation is also discussed theoretically. --Author's abstract.

E-833 Hirai, Masaichi, Multipath properties of tropospheric propagation of very short radio waves beyond the horizon. Japan. Radio Research Laboratories, Journal, 8(37):147-170, May 1961. 11 figs., 3 tables, 5 refs., 91 eqs. DBS--This paper contains theoretical considerations of mutual relations between the arrival angle distribution of multipath waves, the space diversity characteristics, the beyond-the-horizon antenna beam pattern and the antenna-to-medium coupling loss in tropospheric propagation of very short radio waves beyond the horizon and illustrates some numerical examples with experimental data. --Author's abstract.

E-834 Hirao, Kunio (Radio Res. Labs.), Short range echoes of HF waves observed on the Antarctic Research Expedition ship. Antarctic Record, Tokyo, No. 11:184-190, Jan. 1961. 6 figs., 3 refs. Japanese summary p. 184. DWB--Reports on the short range echoes of HF waves observed during the Antarctic Research Expedition in 1956 and compares these with records made in 1958 and 1959. It is concluded that good propagation conditions over the ocean cause the backscatter of HF waves, that the backscatter "may be due to sea waves". Since the echoes show diurnal variations, daily changes may occur in the refraction and diffraction of radio waves or in their reflection in the lower troposphere. It is also assumed that some aerosol above the sea may affect the refractivity. This assumption is to be tested in the near future. (Met. Abs. 14.11-113)--E. Z. S.

E-835 Johler, J. R. and Lilley, C. M., Evaluation of convolution integrals occurring in the theory of mixed path propagation. U.S. National Bureau of Standards, Technical Note, No. 132, Oct. 15, 1961. 20 p. 4 figs., 4 refs., 39 eqs. DLC--The theory of propagation of electromagnetic waves around a sphere treats the smooth homogeneous case, i.e., the case in which the surface impedance of the sphere is interrupted by an abrupt change in conductivity such as a land/sea boundary. It is known, however, that such theory can be extended to treat inhomogeneous, irregular terrain by formulating certain convolution integrals which utilize the smooth homogeneous formulas. The evaluation of these integrals can be accomplished with dispatch on a large scale electronic computer with the aid of numerical analyses techniques. The particular case of a land/sea boundary in a smooth, spherical surface is illustrated for a variety of cases by evaluating the convolution integrals on a large scale computer. --Authors' abstract.

E-836 Kalinin, A.I., Effect of earth in UHF tropospheric scatter propagation. Radio Engineering and Electronic Physics, N.Y., No. 5:640-644, May 1961. 2 figs., 5 refs., 27 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(5):725-727, May 1961. DLC, DBS--A solution is found for determining the average magnitude of the field intensity in tropospheric scatter propagation of UHF waves, based on the hypothesis of coherent scattering from inhomogeneities of the troposphere, exponential variation of the permittivity of air with altitude above the earth's surface and diffraction around the earth's surface. --Author's abstract.

E-837 Kirby, Robert S.; Rice, P.L. and Maloney, L.J., Characteristics of point-to-point tropospheric propagation and siting considerations. U.S. National Bureau of Standards, Technical Note, No. 95, Oct. 19, 1961. 93 + 8 p. 29 figs., 5 tables, 28 refs., 32 eqs. Price $2.50. DWB (M(055) U585te)--Instrumental, topographic, atmospheric, extraterrestrial and man-made noise factors influencing the propagation of radiowaves through the troposphere are discussed in some detail, and accompanied with useful graphs and tabular data. Means to improve radio communication and to countermeasure interferences are of particular interest to the communication engineers and system designers. Several experimental radio transmissions under a variety of conditions are referred to. Finally, some biological, as well as other hazards of electromagnetic radiation, are discussed. Appendices include useful conversion factors and constants, formulas, etc. --W. N.

E-838 Kitchen, F.A.; Joy, W.R.R. and Richards, E.G., Some factors influencing 3 cm radiowave propagation oversea within and beyond the radio horizon. Institution of Electrical Engineers, London, Proceedings, Pt. B, 108(39):257-263, May 1961. 9 figs., table, 8 refs. DLC--The results of a number of short term oversea measurements of the variation of received signal level with range from a 10 Gc/s transmitter are presented. It is shown that the variation of signal level within the horizon was rarely that expected for propagation through an atmosphere having a uniform refractive index gradient. Signal losses of from 5 to 30 db frequently occurred well within the horizon, these losses being recovered when the range between transmitter and receiver was sufficiently reduced. A well defined interference pattern usually occurred in the region of reduced signal level. Some data on the variation of refractive index with height up to about 700 ft above sea level were gathered using a radio sonde and a captive balloon, but the detail was not sufficiently fine to enable a direct relationship to be established between signal losses within the horizon and the occurrence of irregularities in the refractive index profile at low elevations. A direct relationship was found to exist between the signal level within the horizon and that propagated well beyond the horizon into the extra diffraction region. (Met. Abs. 13.12-55)--Authors' abstract.

E-839 La Grone, A.H. and Chapman, C.W., Some propagation characteristics of high UHF signals in the immediate vicinity of trees. IRE Transactions on Antennas and Propagation, N.Y., 9(5):487-491, Sept. 1961. 10 figs., 8 refs. DLC--Report of results obtained with 2880 Mc vertically polarized signals at several very low angles. The effects of local vegetation determined and presented in graphs and discussed. A brief pointing error signal analysis of a hypothetical direction finding system is included. --W. N.

E-840 Lane, J. A. (D. S. I. R. Radio Res. Station, Clough), The radio refractive index gradient over the British Isles. Journal of Atmospheric and Terrestrial Physics, London, 21(2/3):157-166, June 1961. 6 figs., table, 6 refs., 4 eqs. DLC--Reference atmospheres, specifying the average change of refractive index at radio frequencies with height, are derived from basic meteorological data. The atmospheres are represented by the equation $N_h = N_s \cdot e^{-bh}$, where N_s and N_h are the average values of $(n-1) 10^6$ at the surface and at a height h, respectively, n being the refractive index. This exponential relation is in agreement with the results of a series of measurements with a microwave refractometer. The variations in N_s and b over the British Isles are relatively small in comparison with the changes observed in other areas (e. g., over the United States); however, some local effects are evident which are illustrated on maps of N_o, the average value of $(n-1) 10^6$ at sea level. A high correlation is found between N_s and ΔN (the average decrease in the first kilometer) but ΔN for a given N_s is slightly smaller for the region of the British Isles than for the U.S. (Met. Abs. 13.6-98)--Author's abstract.

E-841 McCollum, Robert (comp.), Selected foreign references on scatter propagation of ultrashort waves, 1956-1960. Wash., D.C., Science and Technology Div., Library of Congress, 1961. 87 p. 214 refs. with abstracts. DLC. Alphabetical by author, with original title in parentheses. Translations indicated where known. "Comprises material in three broad categories: theoretical investigation of the atmospheric scattering of ultrashort waves and closely related phenomena; practical applications and equipment such as antennas and output tubes; and surveys of developments in scatter propagation research. Over half of the refs. cited are Russian." --D. M. G.

E-842 Maenhout, A. G. (Roy. Met. Inst., Belgium), Bijdrage tot de kennis van het brekingsindexklimaat-voor zeer korte radiogolven, over Belgie. (Contribution to the knowledge of the refractive index climatology for very short wavelengths over Belgium.) Vlaamse Academie voor Wetenschappen, Letteren en Schőne Kunsten van België Klasse der Wetenschappen, Mededelingen, 23(4), 1961. 25 p. 10 figs., 6 tables, 13 refs. DLC--The atmospheric refractive index plays an important part in the study of the tropospheric propagation of waves with short wave lengths and in their use to determine distances (radar, tellurometer) as well as in radio localizing (radiotheodolite, radio telescope, etc.). By means of radio soundings made at Uccle (Belgium) during the last 6 yrs the author computed the refractive index of air for the electromagnetic waves with wavelengths between 5 m and 2 cm and determined average variation of this index in terms of the altitude. For this purpose a refractive co-index has been defined by

$$N = (n-1) \cdot 10^6 = \frac{A\,p}{T} + \frac{AB}{T^2} \cdot p_v$$

where N = co-index; n= refractive index; T= absolute air temperature; p = atmospheric pressure (in mb); p_v = vapor pressure (in mb) and A = 77.6° K/mb and B= 4810° K. The average variation of the index with the altitude of Uccle is given by the exponential law lnN= 5.79−0.13 , This study also determines vertical gradient of the refractive index in lower layers and its value at the ground surface, as well as the annual variation of these parameters and their mutual dependence. The gradient of the refractive index shows an appreciable annual variation in the lower kilometers of the atmosphere. The co-index presents an annual and a diurnal variation. A rough correlation is found between the value of the co-index at ground level and the average index gradient in the air layer (surface −850 mb standard level). The geometry of a tropospheric radio communication shows a yearly variation resulting from the annual variation of the refractive index. (Met. Abs. 14.9-173)--A. V.

E-843 Maenhout, A. G., L'influence de l'origine de la masse d'air sur la propagation troposphérique des ondes métriques. (Influence of air mass source on tropospheric propagation of meter waves.) Beiträge zur Physik der Atmosphäre, Frankfurt a. M., 34(1/2):112-117, 1961. 3 figs., 2 tables, 6 refs. German, English and French summaries p. 112. DWB, DLC--The electromagnetic field, beyond the horizon, at 230 km of a radiotransmitter, with a wavelength of 3.4 m, was measured. The measurements were analyzed in function of the air mass over the transmission path. We found a correlation between the type of air mass and the measured median path loss expressed in decibel referred to the value that would be expected for free space transmission. We also noted that the diurnal variation of the radio field strength is related to the type of air mass. The smallest path loss is observed in maritime air of tropical origin and when maritime air lays above cold continental air (in winter). In an unstable air mass the path loss is much higher. These experimental results can be explained by the layer reflection theory. (Met. Abs. 13.6-99) --Author's abstract.

E-844 Meadows, R. W., Tropospheric scatter observations at 3480 Mc/s with aerials of variable spacing. Institution of Electrical Engineers, London, Proceedings, Pt. B, 108(40):349-360, July 1961. 16 figs., 3 tables, 15 refs. DLC--Short term measurements are described of signal amplitude, fading characteristics, correlation distances and height gain at three ranges (130, 258, and 398 km) from a transmitting system radiating horizontally polarized waves. Although the results were variable and at times difficult to interpret, it is considered that 150 λ should be an adequate horizontal spacing, even at the shortest ranges, for directional receiving aerials operated in diversity, with a tendency toward smaller values for vertical spacing. Fading rates lying generally between 1 and 10/sec are found, with Rayleigh type fading tending to occur at the longer ranges. No consistent relationship between signal amplitude, fading and correlation distance is found, although the highest fading rates are often accompanied by low correlation distances. Cross correlation measurements show definite evidence of the steady drifting of scattering centers. Diffraction effects leading to height gain are found, and there is some indication of standing waves due to ground reflections. Aerial siting is discussed and the transportable equipment which was developed for the tests is briefly described. (Met. Abs. 13.12-58)--Author's abstract.

E-845 Men', A. V., Time (spectral) characteristics of phase difference fluctuations occurring in the propagation of radio waves in the troposphere. Radio Engineering and Electronic Physics, N. Y., No. 10:1451-1459, 1961. 6 figs., 18 refs., 4 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(10):1625-1635, Oct. 1961. DLC--Average statistical characteristics of phase difference fluctuations, obtained from experimental measurements over sea water, of fluctuations on a wavelength, λ = 10 cm and on a fixed path 33 km long, are given for a wide frequency interval. The data obtained pertain to the case of transverse correlation with different distances between receiving antennas (bases) b, ranging from 2 to 100 m, corresponding to different ratios $d/l \gtrless 1$ (l --characteristic correlation scale). The measurements were carried out in the illuminated region as well as in the penumbral and shadow regions. --Author's abstract.

E-846 Misme, Pierre, Essais de radio climatologie dans le bassin du Congo. (Radio climatology tests in the Congo Basin.) Annales des Télécommunications, Paris, 16(1/2):28-40, Jan./Feb. 1961. 16 figs., 3 tables, 10 refs. DLC--In this article, the refractive index, its gradient, the stability of the lower layers, and the water vapor pressure at various altitudes are successively dealt with. The author investigates the variation with height, up to about 20 km, and the annual variation of each parameter. Concerning atmospheric stability, he demonstrates that a negligible error is made when the mean work developed to elevate a unity mass air particle from one level to another is deduced from the mean monthly values. This study further points out that the variations of the radio meteorological parameters in altitude are correlated with surface precipitation intensity. The geographical zone to which the results obtained are applicable is delimited at the end of this paper. (Met. Abs. 14.3-161)--A.V.

E-847 Misme, P. (C.N.E.T.), L'influence du gradient équivalent et de la stabilité atmosphérique dans les liaisons transhorizon au Sahara et au Congo. (Effect of the equivalent gradient and atmospheric stability on communications to a location beyond the horizon in Sahara and Congo.) Annales des Télécommunications, Paris, 16(5/6):110-116, May/June 1961. 7 figs., 2 tables, 7 refs., 4 eqs. French summary p. 110. DLC--Tests of radio transmission to a location beyond the horizon have been carried out in the Sahara and the Congo for securing continuous radio communication service. The study of transmission at 471 Mc at a distance of 160 km in the Sahara climate proved that classical radio meteorological parameters do not explain a difference of 20 decibels in radio reception occurring in two different months of the year. By applying theories of diffuse reflection, the role of atmospheric stability was found to be a major factor in radiowave propagation. The computed field variations compared well with those observed. A more generalized law was derived, in which atmospheric stability plays a role equivalent to that of the reflection gradient. The law was tested with satisfactory results in radio communications at 471 Mc at a 300 km distance in equatorial Africa. (Met. Abs. 13.9-112)--S.N.

E-848 Nemirovskiǐ, A.S., Shirina polosy propuskania pri odinarnom i raznesennom prieme signalov dal'nego troposfernogo rasprostraneniia ukv. (Useful bandwidth of single and dispersed signal reception in distant tropospheric propagation of USW.) Elektrosviaz', Moscow, 15(5):18-25, May 1961. 3 figs., 7 refs., 25 eqs. Transl. into English in Telecommunications, N.Y., No. 5:17-26, May 1961. DLC--It is shown the useful band in tropospheric radio relay links become considerably wider when, in addition to the scattered component, a regular diffracted component is also received, or when reception of dispersed signals is achieved by means of linear integration into an FM detector.--Transl. of author's abstract.

E-849 Northover, F.H. (Carleton Univ., Ottawa), Effect of multiple atmospheric inversions on tropospheric radio propagation. Journal of Atmospheric and Terrestrial Physics, London, 20(4):295-296, April 1961. 3 refs. DLC. Also issued in U.S. National Bureau of Standards, Journal of Research, Sec. D, 65(4):385-392, July/Aug. 1961. Fig., 6 refs., 27 eqs. DWB, DLC--In "addition theorem", which makes it possible to deduce the field under a system of multiple inversions from the standard analysis given by the author in 1952 and 1955 for a single inversion, has been discovered. The addition theorem is explained and the note is concluded with the remark that there is one special case of the theorem in which the characteristic properties of the propagation can be clearly perceived. It occurs when the layers are close together. The propagation is actually equivalent to that which would be caused by a single inversion at the mean height having a dielectric discontinuity equal to the algebraic sum of the discontinuities of the separate inversions. A mechanism has been found which is capable of explaining the long distance fields without having to invoke the existence of a single strong elevated high level inversion layer. (Met. Abs. 13.1-116)--E.Z.S.

E-850 Norton, K.A.; Herbstreit, J.W. et al., An experimental study of phase variations in line-of-sight microwave transmission. U.S. National Bureau of Standards, Monograph No. 33, Nov. 1, 1961. 91 p. 74 figs., 15 tables, 3 refs. DBS--During 1956 an experiment was conducted in Maui, Hawaii, to study the time variations in the phase of arrival of microwave signals propagated over 15 mi path and the time variations in the phase difference of signals. These time variations are analyzed in terms of their serial correlation functions and power density spectra for different times of day. In some instances there was evidence of a diurnal cycle in total variance of both phase and refractive index with larger variances during the day time, but in other instances this diurnal effect was not detectable. The slope of the phase spectra appeared to be independent of time of day or meteorological conditions. The long term variations in single path phase were well correlated with variations in the mean value of refractive index measured at 5 points along the path. --Authors' abstract.

E-851 Ortwein, N.R.; Hopkins, R.U.F. and Pohl, J.E., Beyond-the-horizon overwater microwave fields. U.S. Navy Electronics Lab., San Diego, Calif., NEL Report 1011, April 24, 1961. 149 p. Numerous figs. (incl. photos), 4 tables, 36 refs., 40 eqs. DWB (M(055) U585r)--The purpose of this study was to gain detailed knowledge of the physical causes of tropospheric scattering, determine and measure the characteristics, compare the practical results with existing theories in order to optimize system designs. The methods used, including description of the specific instrumentation, conclusions drawn, and the design equations obtained, are contained in this report. The study was conducted in cooperation with the NEL field station of the Univ. of Calif., and covers the period Jan. 1, 1956 – May 1, 1960. (Met. Abs. 13.9-114)--W.N.

E-852 Ortwein, N.R.; Hopkins, R.U.F. and Pohl, J.E. (all, U.S. Navy Electronics Lab., San Diego, Calif.), Properties of tropospheric scattered fields. Institute of Radio Engineers, N.Y., Proceedings, 49(4):788-802, April 1961. 26 figs., 3 tables, 30 foot-refs. DLC--Tropospheric scatter tests were performed in the Southern California region in conjunction with extensive meteorological measurements. The turbulent spectra were found to be, in the region of interest, proportional to $k^{-5/3}$. In general, the scattered signals were found to agree with the turbulent single scattering model predicted by such a dielectric spectrum. Horizontal beamswinging experiments gave a dependence on the scattering angle of $\theta^{-14/3}$. A stronger dependence was observed for vertical beamswinging and is explained by a height dependence of the turbulent fluctuation spectra rather than anisotropy. This explanation is further supported by agreement with Booker and deBettencourt aperture-to-medium coupling loss. A $\lambda^{-1/3}$ wavelength dependence was observed under standard atmospheric conditions. In the presence of weak turbulent layers a $\lambda^{0.9}$ dependence in the lower frequency region was observed and is explained in terms of a frequency dependent layer reflection phenomena. The spectra of the envelope of the scattered signal are also given. They are generally Gaussian in shape with the width dependent upon the range, frequency and scattering angle. Other details of their fine structure are also discussed. (Met. Abs. 14.2-120)--Authors' abstract.

E-853 Pappas, C.F.; Vogler, L.E. and Rice, P.L., Graphical determination of radio ray bending in an exponential atmosphere. U.S. National Bureau of Standards, Journal of Research, Sec. D, 65(2):175-179, March/April 1961. 7 figs., table, 4 refs., 4 eqs. DWB, DLC--This paper presents a simple engineering method for calculating the amount of bending undergone by a radio ray passing through an exponential model atmosphere. For any initial takeoff angle and for values of the surface refractivity ranging from 200 to 450, the bending angle may be determined as a function of height above the earth's surface, using a few graphs and a few calculations. Indications of the accuracy of the method are given at the end of this paper. (Met. Abs. 13. 7-126)--Authors' abstract.

E-854 Parry, Charles A., Equipment configuration and performance criteria for fully optimized tropospheric scatter systems. IRE Transactions on Communications Systems, N.Y., 9(4):427-433, Dec. 1961. 4 figs., 2 tables, 19 refs., 15 eqs. DLC--The optimum system is examined with the aid of a basic equation related to channel SNR. Expressions are then developed which show that for equal channel loading and capacity, FM systems are likely to be superior to SSB systems for normal voice channel operation. Further improvement in FM performance may be achieved with phase locked receivers. Performance equations for such receivers are used in basic expressions for optimized scatter circuits to express channel capacity as a function of maximum distance for minimum power. From this equipment configurations for various performance capabilities are developed. These data then give the maximum capability of the tropospheric scatter system when all relevant design parameters are optimized. --From author's abstract.

E-855 Prosin, A.V., Calculation of cross noise power in long distance scatter communication systems. Radio Engineering and Electronic Physics, N.Y., No. 1:9-18, 1961. 4 figs., table, 8 refs., 53 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(1):14-24, Jan. 1961. DLC--The paper determines the cross noise power arising in long distance communications systems with frequency modulation and frequency multiplex, due to the multipath propagation of radio waves. It is shown that in the presence of the constant component of the field the value of cross noise in telephone communications channels using long distance tropospheric microwave propagation may be extremely small. --Author's abstract.

E-856 Prosin, A.V., Calculation of reliability of tropospheric communication system in the presence of correlated fading. Radio Engineering and Electronic Physics, N.Y., No. 9:1407-1410, 1961. 2 refs., 26 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(9):1578-1580, Sept. 1961. DLC--An analysis of the presented calculations shows that the reliability of a communication system in the case of separated reception increases appreciably as the power of the constant signal increases compared with the power of the random signal. The reliability is least when only the random component of the field is present at the point of reception. An increase in the coefficient of correlation between the separated signals greatly reduces the reliability of the communication. --E. K.

E-857 Prosin, A.V., On the calculation of the bandwidth in UHF tropospheric scatter propagation. Radio Engineering and Electronic Physics, N.Y., No. 8:1234-1236, 1961. Fig., 4 refs., 17 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(8):1392-1394, Aug. 1961. DLC--In this brief communication an attempt is made to determine the bandwidth of the troposphere in the presence of a constant field and scattered field at the reception point. It has been found that the bandwidth of the troposphere increases with increasing effective band, intensity of the constant wave, and coefficient of the frequency correlation, --E. K.

E-858 Prosin, A.V., Transient noise in two path radiowave propagation. Radio Engineering and Electronic Physics, N.Y., No. 11:1722-1726, 1961. 3 figs., table, 2 refs., 17+ eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(11):1932-1936, Nov. 1961. DLC--In this brief note author presents a procedure for calculating the transient noise occurring in two path propagation of radiowaves, for the special case when automatic frequency control of the transmitter is used to select the optimum operating point on the phase characteristics of the two path channel. --E. K.

E-859 Rai, D.B., Role of tropospheric scatter in radar propagation. Institution of Telecommunication Engineers, New Delhi, Journal, 7(5):220-224, Sept. 1961. 4 figs., 6 refs., 7 eqs. DBS--Two instances of radar echoes believed to be caused by scatter propagation are presented and discussed in relation to the prevailing atmospheric conditions. Obukhov's mixing theory appears to be more suited to the present observations and is applied for the estimation of the dielectric fluctuations and gradients required to account for these echoes. The values obtained are found to be within reasonable limits. At near horizontal incidence direct backscatter is a contributing factor at short ranges, but at longer ranges the echoes are exclussively due to return from terrain through forward scatter. At high antenna elevations only direct backscatter appears to be significant. --Author's abstract.

E-860 Rai, D.B. (India Meteorological Dept.), Some aspects of anomalous propagation at 3 cm wavelength. Institution of Telecommunication Engineers, New Delhi, Journal, 7(4):177-180, July 1961. 6 figs., 3 refs. DBS--Some cases of superrefraction observed with 3 cm radar at different stations in India have been analyzed. One of the significant features is the asymmetrical distribution of the duct with respect to the station; another is the fictitious display of some target heights. Ducts appear to be effectively present only in the small scale anticyclonic regions near the station. The spurious height of the echoes is attributed to the presence of a sufficiently thick duct allowing different Gamow modes for different angles of aerial elevation. --Author's abstract.

E-861 Ringwalt, D.L. and MacDonald, F.C., Elevated duct propagation in the tradewinds. IRE Transactions on Antennas and Propagation, 9(4):377-383, July 1961. 11 figs., 2 tables, 5 refs. DLC--Report on the experimental transmission using 220 Mc over the sea path between Brazil and Ascension Island during Nov. 1959. It was found that the long range propagation (500-1200 mi) was due to a strong duct near 6000 ft altitude, cloud base (2000 ft) which influenced range very little, if any. Radio signal fluctuation rate independent of maximum propagation range, though slow fade rate usually were associated. Field strength measurements at 4000 ft were 40 db > than those at lower levels, at 6000 ft decrease was slow to 10,000 ft. --W. N.

E-862 Santomauro, Luigi, Preliminari per uno studio sull'andamento dell'indice di rifrazione relativo alle microonde, nei bassi strati atmosferici. (Preliminaries for a study of variations of the microwave refractive index in the low atmospheric layers.) Rivista di Meteorologia Aeronautica, Rome, 21(3):23-40, July/Sept. 1961. 5 figs., 6 tables, 4 refs., 9 eqs. Italian, French, English and German summaries p. 23. DLC--This research, the first of its kind, has been carried out at the request of the U.S. Air Weather Service, and deals with the index of diffusion of microwaves in lower atmospheric layers (up to 1500 m). The theories of refractive index and of the standard and anomalous propagation of microwaves are presented; then follows the calculation of refractive index, by means of L. J. ANDERSON's duly modified slide rule. The graphic representation in time and space of the modified refractive index behavior (M) for the winter 1959-60 and for Milan area, is then given as an example. The tabulated data concerning atmospheric pressure, temperature, vapor pressure at 1000 m above the ground, as well as the indexes of refraction (in whole N-units) for standard and intermediate levels up to 500 mb, are finally given for the same area. (Met. Abs. 13.5-126)--Author's abstract.

E-863 Shaft, Paul D., Information bandwidth of tropospheric scatter systems. IRE Transactions on Communications Systems, N.Y., 9(3):280-287, Sept. 1961. 9 figs., 6 tables, 12 refs., 7 eqs. DLC--A set of design curves of peak intermodulation distortion due to frequency selective fading, as a function of information bandwidth, is derived for tropospheric scatter systems. These curves are applicable to systems frequency modulated with frequency division multiplexed telephone and telegraph channels. A two ray tropospheric scatter model was selected in order to derive general results. This, however, restricts the use of the design curves to the region where the information bandwidth is less than the propagation bandwidth. Equations for intermodulation distortion are evaluated for parameters normally encountered in tropospheric scatter systems. A method of obtaining a probability distribution of the distortion is indicated, and an example is worked out in detail. The intermodulation distortion due to frequency selective fading will exceed the thermal noise in some systems, and should be taken into consideration when designing tropospheric scatter systems. --Author's abstract.

E-864 Shur, A.A. and Maksimov, G.S., One method of measuring the fluctuation of the phase of radiowaves in a study of tropospheric scatter propagation. Radio Engineering and Electronics, N.Y., No. 5:734-735, May 1961. Fig., 3 refs. Transl. from original Russian in Radiotekhnika i Elektronika, Moscow, 6(5):828-829, May 1961. DLC, DBS--Describes a simple method based on NYQUIST's principle for measuring the phase fluctuations of radiowaves propagated in the troposphere. --Electr. Engr. Abstract.

E-865 Sindler, Iu.B., Concerning the accumulation of noise and fading in radio relay communication line with long distance tropospheric propagation. Radio Engineering and Electronic Physics, N.Y., No. 12:1876-1877, 1961. Ref., 7 eqs. Transl. of original Russian in Radiotekhnika i Elektronika, Moscow, 6(12), Dec. 1961. DLC--In the investigation of processes occurring in radio relay lines with long distance tropospheric propagation, it is of interest to obtain an asymptotic estimate of the noise distribution when slow fading in the neighboring sections is correlated. An analysis shows that the asymptotic formula is valid also in the case when the slow fading is synchronous (i.e., the correlation coefficient is equal to unity). Thus, in the case of complete correlation of the slow fading in neighboring sections and when the values of the fadings in these sections are independent, the asymetric properties of the distribution of the total noise turns out to be the same. --E.K.

E-866 Smith-Rose, R.L., Fifty years' research in radio wave propagation. Wireless World, London, 67(4):203-207, April 1961. 2 figs. --A brief history of the progress of research and understanding of the mechanism of radiowave propagation since 1911. Previous to that time it had been thought that radiowaves travelled over the surface of the earth. The possibility of an ionospheric layer refracting the radiowaves was first visualized in 1912 at a meeting of the British Association. It was shortly after this that a series of international meetings began which led to the formation of the U.R.S.I. in 1922. It was in 1925 that APPLETON carried out his series of experiments which first definitely demonstrated the existence of the ionosphere. The discovery of the E and F layer followed. More recently it has been possible to experiment with more powerful techniques using radar. Propagation at VHF was developed to ensure greater reliability of service. Possible trends in future research are discussed in the light of the conclusions and recommendations of the various Commissions of the U.R.S.I. (Met. Abs. 13.3-99)--R.B.

E-867 Stein, S. and Johansen, D.E., A theory of antenna performance in scatter type reception. IRE Transactions on Antennas and Propagation, N.Y., 9(3):304-311, May 1961. 4 figs., 14 refs., 32 eqs. DLC--The results of this theoretical investigation enable evaluation of efficiency of antennas. The model consists of a receiving antenna viewing a site of radio sources, on an idealized celestial sphere. Comparison shows existence of a significant gap between performance of current or contemplated systems, and the theoretical optimum. --W.N.

E-868 Thayer, G.D., A formula for radio ray refraction in an exponential atmosphere. U.S. National Bureau of Standards, Journal of Research, Sec. D, 65(2):181-182, March/April 1961. Fig., 5 refs., 6 eqs. DWB, DLC--A formula for the radio ray refraction angle is derived by integration of the approximate differential equation for the case where the refractivity, $(n-1) 10^6$, decreases exponentially with height above the surface of a smooth, spherical earth. The solution is in terms of the widely tabulated exponential and error functions, and is accurate to within 4% over the useful range of the variables employed. (Met. Abs. 13.7-127)--Author's abstract.

E-869 U.S. Naval Research Lab., Elevated duct propagation in the trade winds. Prepared by Wave Propagation Branch. Its NRL Report 5602, June 1, 1961. 38 p. 15 figs., 2 tables, 5 refs. DWB (M(055) U586r)--All of the maximum propagation ranges (at 220 Mc/s) observed in the present study in an elevated duct region varied from 500 to 1200 mi, compared to less than 400 mi observed with the same equipment outside the duct. The measurements were made at the optimum season (Nov.) in a tradewind region between Brazil and Ascension Island (8°S lat.). The field strengths above 4000 ft are as much as 40 db larger than those at lower altitudes. From the level at average duct height (10,000 ft) the field decreases slowly to 6000 ft, the maximum altitude investigated. The slow fading rate usually associated with duct propagation is not always observed, even on the very long range runs. An extrapolation to propagation conditions in the month of March via refractive index measurements indicates minimal ducting conditions 10 to 20% of the time. (Met. Abs. 13.6-105)--Author's abstract.

E-870 Wilson, Alvin C. (CRPL, Nat'l. Bur. Stds., Boulder, Colo.), Measurements of low angle radiation from a monopole. U.S. National Bureau of Standards, Journal of Research, Sec. D, 65(6):641-645, Nov./Dec. 1961. 4 figs., 3 refs., eq. DWB, DLC--Experimental measurements using scale model techniques have been carried out to determine the effectiveness of a ground system of long wire radials to obtain low angles of departure of transmission. Since transmission was to be in one direction only, the ground wires were laid out to form a ground plane sector approximately 18° wide centered in the direction of transmission. The antenna was a base driven vertical monopole. Measurements were made of the relative response in decibels for the monopole used as a receiving antenna at a frequency of 400 Mc/s. The target transmitter antenna was always located at a distance of 200 wavelengths. At this separation the ground plane sector was in the near field of the target transmitting antenna and appropriate corrections must be made. The received signal strength improvement due to the presence of the ground sector was approximately 14 db. The measured lobe positions of the first and second beam maximums and the first null are in good agreement with theory. (Met. Abs. 14.5-147)--Author's abstract.

E-871 Wolf, E.; Kopeck, R. and Mondloch, A. (Sylvania Amherst Labs., Buffalo, N.Y.), Millimeter wavelength atmospheric absorption. Institute of Radio Engineers, N.Y., Proceedings, 50(4, Pt. 1):478, April 1961. 2 refs. DLC, DBS--A two way communication link was set up with one terminal at Sylvania's Amherst Labs., the other 6.1 km away at the Univ. of Buffalo. The test frequency being used is 69.9 kMc. Preliminary results of the measurements show that on a sunny day with a temperature of 67°F and relative humidity of 68%, the attenuation is 1.35 db/km. The discrepancy between this value and the theoretical 1.27 db/km is attributed to inaccuracies in the measured noise figures. Measurements are being continued to establish absorptions due to oxygen, uncondensed water vapor and light rain and fog. --G.T.

E-872 Yoshino, Takeo (Univ. of Electro-Communications), Radio wave propagation on the ice cap. Antarctic Record, Tokyo, No. 11:228-233, Jan. 1961. 13 figs. Japanese summary p. 228. DWB--A brief report of a study of radio wave propagation in Antarctica. Measurements of specific dielectric constant and loss in high frequencies are made by the tuning circuit resonance method for 1.5 Mc and 10 Mc, and by using the Lecher line for 100, 250, 300 and 3000 Mc. It was found that the snow and ice composing the ice cap have an excellent insulating property for the electromagnetic waves of UHF or higher. Results of measurement of directional pattern, input impedance characteristics and gain by setting a doublet antenna tuned for 100 Mc and an 8 element YAGI beam antenna tuned for 300 Mc are included. One of the main results was that the best type of antenna to be used was determined. (Met. Abs. 15.2-232)--E.Z.S.

E-873 Zinichev, V.A.; Ryzhov, Iu.A. and Iudin, O.I., Metod issledovaniia radiovoln v troposfere pod bol'shimi uglami. (Method of studying radio waves in the troposphere under large angles.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 4(1): 177-178, 1961. 3 refs. DLC--The purpose of the method described in this note is to investigate the role of scattering in tropospheric radio wave propagation. It was worked out and tried at the Radio Research Institute of Gorki University. A directive antenna is used; the angle of scattering is 20-60° and the distance between transmitter and receiver about 25 km. By using large angles of scattering, diffraction and wave guide effects are eliminated. Preliminary results of experiments conducted with this technique yielded results which appear to be in agreement with the theory of locally homogeneous turbulence worked out by Silverman (see E-416) and Tatarskii (see E-676). --G.T.

1962

E-874 Anastassiades, M.A.; Karapiperis, L.N.; Kariambas, N.K. et al. (all, Univ. of Athens), Prediction of the field strength fading forms by means of weather situations. Geofisica Pura e Applicata, Milan, 52:143-152, May/Aug. 1962. 8 figs., 2 tables, 2 refs. DWB, DLC--In this study the different forms of the electromagnetic field strength recordings at the Thera-Crete microwave link are examined, in comparison with the corresponding weather situations prevailing over that area. According to the amplitude of fluctuations, the different forms of recordings have been classified in three basic types A, B, C and the annual frequency of the appearance of these types has been observed. Finally, the influence of weather situations on radio wave propagation was examined and it has been found that in most cases a close relationship exists between weather situations and the different fading forms of the electromagnetic field so that a prediction of the fading form may become possible by means of the weather forecast. --Authors' abstract.

E-875 Armand, N. A. et al. (Academy of Sciences, Moscow), Long range tropospheric propagation of ultra-short radio waves. International Scientific Radio Union, Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 91-118. 9 figs., 119 refs. English and French summaries p. 91. DLC (QC973. I575), DWB (M10.62 I61mo)--Experimental results on long range tropospheric propagation are reviewed and the various signal characteristics pointed out. Some aspects of radiometeorology and of the theory of long range propagation are discussed; and an indication is given of where further research in these fields is necessary. (Met. Abs. 14.9-163)--Authors' abstract.

E-876 Armand, N. A., O difraktsii radiovoln vokrug zemli v usloviiakh sloisto-neodnorodnoĭ atmosfery. (Diffraction of radio waves around the Earth through inhomogeneous atmospheric layers.) Radiotekhnika i Elektronika, Moscow, 7(2):223-229, Feb. 1962. 18 refs., 31 eqs. Transl. into English in Radio Engineering and Electronic Physics, N.Y., No. 2:206-212, Feb. 1962. DLC--The effect of nonlinear altitude profiles of the specific inductive capacitances of air during diffraction of ultrashort waves at the Earth's surface are examined. The problem is analyzed by the method of reference equations. It is shown that the result depends on the magnitude of the so called "Schwartz derivative". When the magnitude of this derivative is small, the effect of nonlinearity of the altitude profile of the specific inductive capacitance results in slight adjustments in the magnitude of the equivalent radius of the Earth. --Transl. of author's abstract.

E-877 Arsac, Jacques; Tremblay, Real and Simon, Jean-Claude, Propagation des ondes: prodiffusion troposphérique. (Wave propagation: tropospheric forward scattering.) Académie des Sciences, Paris, Comptes Rendus, 255(5):984-986, July 30, 1962. Fig., 2 refs. DWB, DLC--The inhomogeneities of the atmosphere are responsible for the propagation of hertzian waves beyond the horizon. Disregarding any hypothesis on atmospheric structure, the author propounds that the fundamental phenomenon is a deformation of the wave fronts emitted which results from optical variation due to index heterogeneities, any absorption phenomenon being disregarded. Three particularly important cases are considered: a) the inhomogeneities of the atmosphere which have a stationary character; b) there exists in the atmosphere a privileged horizontal layer where index fluctuations prevail, and c) the inhomogeneities moreover are localized in a layer of negligible thickness. The fluctuations of the wave propagation in time are linked with atmospheric motions. The interpretation and the forecasting of tropospheric proscattering can be made without being obliged to make a hypothesis on the nature of the index fluctuations in the atmosphere. The homogeneities considered cause a distortion of the phase surface of a transmitted wave; they are stationary over large areas or on the contrary, limited to a rather thin layer in order to correctly describe the field fluctuations in terms of the frequency. It is sufficient to know that the atmospheric motions are entirely disorderly or on the contrary due to a steady wind for describing the fluctuations in time, and in the latter case, they are described by the same laws as the fluctuations in frequency. (Met. Abs. 14.7-102)--A.V.

E-878 Arsen'ian, T.I. and Semenov, A.A., Sravnenie statisticheskikh kharakteristik fluktuatsiĭ polia priamogo i otrazhennogo signalov ukv v troposfere. (Comparison of statistical characteristics of fluctuations in direct and reflected fields of microwave signals in the troposphere.) Radiotekhnika i Elektronika, Moscow, 7(10): 1699-1702, Oct. 1962. 3 figs., 8 refs., eq. Transl. into English in Radio Engineering and Electronic Physics, N.Y., No. 10:1573-1576, Oct. 1962. DLC, DBS--The report presents the experimental results of comparison of the statistical characteristics of fluctuations in the direct and reflected fields of microwave signals under identical or similar propagation conditions. It is shown that the time autocorrelation functions of fluctuations in the direct and reflected signals coincide. The space autocorrelation functions (transverse) undergo oscillations which are similar in nature in the direct and reflected signals. The experimental results are compared with the theoretical behavior of the space correlation for the special case of the correlation function for fluctuations in the refractive index of the medium in the form of a Gaussian curve. --Authors' abstract.

E-879 Bankston, L. and Fast, N. (both, Range Development Dept.), Microwave refractive climate of the lower 10,000 ft of atmosphere over a portion of the North Pacific Ocean. U.S. Pacific Missile Range, Point Mugu, Calif., Technical Memorandum 62-4, July 3, 1962. 104 p. Mostly figs., table, 5 refs. DWB (M10.62 U585me)--Knowledge of the microwave refractive climate over the North Pacific Ocean is important to the Pacific Missile Range. An estimate of this climate is given based on small samples of radiosonde data. From these samples the means and standard deviations of the refractivity are computed for each month for which data were available. (Met. Abs. 14.7-103)--Authors' abstract.

E-880 Barlow, Howard Everard Monteagle and Brown, J. (both, Univ. College, London), Radio surface waves. Oxford, Clarendon Press, 1962. 200 p. Figs., bibliog. p. 187-195, eqs. Price: 42s. (International Monographs on Radio) DLC (QC661. B264). Review by A.L. Cullen in Science Progress, London, 50(200):657, Oct. 1962. --This highly technical monograph is primarily concerned with the type of electromagnetic wave, which may be described as one that propagates without radiation along an interface between two different media. The treatment includes the discussion of: conditions for the support of surface waves at an interface between two different homogeneous areas: power carried by surface waves; the azimuthal surface wave supported by a cylindrical surface; other types of surface waves; radiation and discontinuities; application of surface waves, etc. --E.K.

E-881 Barsis, Albrecht P. and Johnson, Mary Ellen (both, CRPL, Nat'l. Bur. of Stds., Boulder, Colo.), Prolonged space wave fadeouts in tropospheric propagation. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(6):681-694, Nov./Dec. 1962. 14 figs., 10 tables, 12 refs., eq. DWB, DLC--This paper contains the results of studies performed during the last several years on the short term variability of tropospheric signals received over within-the-horizon paths in Colo. and Calif. Signal variations of the type observed over such paths have been termed "prolonged space wave fadeouts". They are analyzed as a function of carrier frequency, path characteristics, and meteorological parameters. The study also includes an evaluation of fadeouts observed over a path using a mountain peak as a diffracting knife-edge obstacle between transmitter and receiver. Principal results show a stronger diurnal trend of fadeout incidence in continental climates than in maritime climates. A significant dependence of the fadeout characteristics on the refractive index structure has been observed in maritime climates. In general, fadeouts tend to be more frequent but of shorter duration for higher frequencies. There are also indications that the occurrence of fadeout is well correlated on vertically spaced antennas. Thus, conventional space diversity techniques may not be effective to increase the reliability of systems operating over within the horizon paths. (Met. Abs. 14.8-130)--Authors' abstract.

E-882 Barsis, Albrecht P.; Norton, K.A. and Rice, P.L., Predicting the performance of tropospheric communication links singly and in tandem. IRE Transactions on Communications Systems, N.Y., 10(1):2-22, March 1962. 21 figs., table, 18 refs., 44 eqs. DLC--This performance prediction of long distance tropospheric communication circuits is based on the best available estimates, and is discussed in terms of (1) "Service probability", and (2) "Time availability". Terms which stand for (1) a grade of service during a given percentage of time as a function of the system parameter and (2) expressed in percentage of all hours. A more detailed discussion of the function will be published as NBS, Tech. Note No. 101. --W. N.

E-883 Barton, John H., A selective survey of Soviet Bloc scatter development. IRE Transactions on Antennas and Propagation, N.Y., 10(3):335-337, May 1962. 67 refs. DLC--Lists 67 entries for the literature period 1956-1959. The brief discussion includes the development of the problem, ionospheric scatter, tropospheric scatter, backscatter and meteor scatter. It is concluded that most of the Soviet bloc work parallels that of the U.S.A. --W. N.

E-884 Bass, F.G.; Kaner, E.A. and Pospelov, L.A., Fliuktuatsii radiovoln v blizhneĭ zone nad ploskoĭ poverkhnostiu razdela. (Radio wave fluctuations in a near zone over a plane interface.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 5(2): 255-259, 1962. 5 refs., 15 eqs. English summary p. 259. DLC--An examination is made of phase fluctuations and relative amplitude fluctuations of radio waves in the troposphere over a perfectly conducting plane interface. In the limiting case of near zone the amplitude and phase fluctuations are determined from partial phase fluctuations in different regions of direct and reflected signals. A distribution law is found for field component fluctuations, phases and amplitudes, the dependence of the root-mean-square fluctuations on frequency, path length, polarization of radiation and heights of transmitter and receiver over the interface. Correlation of phase and amplitude fluctuations are calculated for a transverse direction and the region in the vicinity of the zeroes of the mean field (minima of lobes) is examined. It is shown that the existence of an interface in the case of near zone causes a number of relationships of fluctuation characteristics which are different from those which appear in the case of infinite space or in a distant zone in the presence of an interface. --Authors' abstract.

E-885 Bazer, J. and Karp, S.N., Propagation of plane electromagnetic waves past a shoreline. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(3): 319-334, May/June 1962. Figs., 28 refs., numerous eqs. DWB, DLC--The problems of the diffraction of homogeneous plane waves and ground waves by a linear shoreline in a planar land-sea surface are discussed. The direction of propagation of these incident waves is assumed perpendicular, and that of their magnetic vectors parallel, to the shoreline. At the air-land interface, the customary impedance boundary condition is imposed while the sea is treated as a perfect conductor; atmosphere and ionospheric effects are ignored. Exact integral representations of the solutions are presented. In the case of homogeneous plane wave excitation originating over the sea, the integral representations are employed to obtain expressions for the geometrical optics field and for the far field form of the remaining scattered field, transition regions included. The possibility of coastal refraction is discussed. --Authors' abstract.

E-886 Bean, Bradford R. (Central Radio Propagation Lab., Nat'l. Bur. Stds., Boulder, Colo.), The radio refractive index of air. Institute of Radio Engineers, N. Y., Proceedings, 50(3):260-273, March 1962. 7 figs., 9 tables, 51 refs., 50 eqs. Correction to Table 1, Ibid., 50(6, Pt. 1):1520, June 1962. DLC--This is a tutorial paper. The derivation of the classical Debye expression for the radio refractive index is reviewed. Recent determinations of the constants in this expression are reviewed and the conclusion reached that differences between constants are small compared with the error in using standard meteorological data in the formula. The various transformations of refractive index data are discussed as a natural result of the model assumed for its height distribution. The effect of the use of the various units is illustrated by examples drawn from radio climatology and the refraction of radio waves. --Author's abstract.

E-887 Bean, B. R. (Nat'l. Bur. of Stds., Boulder, Colo.); Fehlhaber, L. and Grosskopf, J. (both, Fernmeldetechnische Zentralamt, Darmstadt, Germany), Comparative study of the correlation of seasonal and diurnal cycles of transhorizon radio transmission loss and surface refractivity. U. S. National Bureau of Standards, Journal of Research, Sec. D, 66(5):593-599, Sept./Oct. 1962. 12 figs., 2 tables, 12 refs., 7 eqs. DWB, DLC--Correlations between the surface refractivity, Ns, and transhorizon recordings of VHF radio transmission loss are examined for 34 U.S. and 9 German radio paths. The largest correlations are found to be associated with the seasonal cycle of nighttime recordings and diurnal cycles during the summer months. The annual cycles may be represented by a single regression coefficient of -0.18 db/Ns for either night or day. The regression coefficients for the diurnal cycles lie between -0.2 and -1.1 db/km and vary with distance and season, being greatest between 175 and 200 km and in the winter months. A promising method of estimating the within-month distribution of hourly median transmission loss is suggested by combining the seasonal and diurnal correlation analysis. It is indicated that Ns provides as useful a prediction of diurnal and seasonal variations of monthly median values of transmission loss as radio measurements made over the actual radio path in previous years. (Met. Abs. 14.7-107)--Authors' abstract.

E-888 Blake, L. V., Tropospheric absorption loss and noise temperature in the frequency range 100-10,000 Mc. IRE Transactions on Antennas and Propagation, N. Y., 10(1):101-102, Jan. 1962. 6 figs., table, 10 refs. DLC--This brief discussion on atmospheric absorption includes Blake's set of curves (pub. in NRL Rep. No. 5601, 1961). These curves permit direct readings of the total radar atmospheric attenuation as a function of total length of paths from 0^{o} to 10^{o} ray elevation angles. Reference is also made to works by Bean and Abbott, Hogg and other researchers. --W. N.

E-889 Boithias, Lucien and Misme, Pierre (both, Centre National d'Etudes des Telecommunications, (C. N. E. T.)), Le gradient équivalent: nouvelle détermination et calcul graphique. (Equivalent gradient: redetermination and graphical computation.) Annales des Telecommunications, Paris, 17(5/6):134-139, May/June 1962. 8 figs., 3 refs., 7 eqs. DLC--For the determination of the atmospheric effect on transhorizon radiowave propagation the curvature of the trajectories has to be computed. Because of the complexity of the function N(h) of the refractive index N of the atmosphere varying with the height h, the introduction of an equivalent gradient was suggested, i.e., a constant gradient in a ficititious atmosphere which in a final result will produce the same total refraction effect as in a real atmosphere. A new method in which the computation is carried out by a simplified graphical method was presented. The computation consists of two parts: determination and drawing of radio electric rays (trajectories) starting with the curve N(h) and the determination of the equivalent gradient in function of altitude at a specified distance.

Two operational modes: communications within visibility (radar) and transhorizon transmissions were theoretically explained. (Met. Abs. 14.7-111)--S.N.

E-890 Booker, Henry G. (Cornell Univ., N.Y.), Future of propagation research and development. Institute of Radio Engineers, N.Y., Proceedings, 50(5):717-718, May 1962. 10 foot-refs. DLC--It is predicted that the future of propagation research and development will involve: 1) worldwide radio communication via satellites; 2) greatly increased interest in the magnetosphere and the solar atmosphere; 3) greatly increased interest in the atmospheres and surfaces of planets; 4) a far wider interpretation of the notion of radio frequency, both at the lower and the upper ends of the spectrum; 5) extensive use of new methods for investigating the top side of the ionosphere by both reflection and scattering techniques; 6) the discovery of new phenomena by the use of large antennas, high power transmitters and low noise receivers, and 7) greatly increased interest in the propagation of sonic and tidal waves in the atmosphere. (Met. Abs. 14.10-94)--Author's abstract.

E-891 Braude, S.Ia. and Kaner, E.A., Fliuktuatsii radiovoln razlichnoĭ chastoty v troposfere. (Fluctuations of radio waves of different frequency in the troposphere.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 5(2):246-254, 1962. 3 figs., 10 refs., 35 eqs. English summary p. 254. DLC--The dependence of the correlation of radio waves of different frequency in the troposphere on the frequency deviation is considered for the cases of near and distant zone, in free space and in the presence of a plane interface. It is shown that in a near zone the coefficient of correlation is independent of frequency deviation, while in a distant zone there is a strong dependence on frequency deviation when it has small values. The correlation factor decreases sharply in this region and even changes its sign. Comparison of results of the calculations with experimental data confirms the theoretical conclusions. --Authors' abstract.

E-892 Bremmer, H. (Philips Res.Labs., Eindhoven, Netherlands), Theory of wave propagation through a concentrically stratified troposphere with a smooth profile, Pt. 2, Expansion of the rigorous solution. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(1):31-52, Jan./Feb. 1962. 6 refs., 124 eqs. DWB, DLC. (For Pt. 1, see E-705)--This paper is concerned with the height gain differential equation in order to obtain a series for the complete solution which starts with the extended W.K.B. approximation discussed in Pt. I. The coefficients of this equation depend for each mode among other things, on the parameters fixing the refractive index profile. However, the explicit dependence on these parameters can only be given in terms of expansions with respect to $(k_0a)^{-2/3}$ (k_0a = circumference of the Earth divided by the wavelength). In turn, these expansions are derived with the aid of other ones for the complex turning point connected with the height gain differential equation. The final expansion for the solution of the differential equation is substituted in the boundary condition at the Earth's surface. This leads to corresponding expansions, with respect to $(k_0a)^{-2/3}$, of the quantity u_ℓ (a), and next, of the eigenvalues ℓ themselves. (Met. Abs. 13.9-107) --Author's abstract.

E-893 Burrows, Charles R. (Datronics Engineers, Inc., Bethesda, Md.), History of radio wave propagation up to the end of World War I. Institute of Radio Engineers, N.Y., Proceedings, 50(5):682-684, May 1962. 37 refs. DLC--HERTZ in the 1880's demonstrated electromagnetic wave propagation predicted by MAXWELL from his equations in 1864. HEAVISIDE and KENNELLY postulated the ionosphere to explain MARCONI's historical transatlantic reception of radio waves in 1901. AUSTIN derived the first formula for radio propagation in 1911 from experimental data in the kilometer wave length range taken in the daytime. Much theoretical effort was expended on the effect of the electrical properties of the ground but the problem was not resolved until later. WATSON, however, cleared up the problem of diffraction around a perfectly conducting sphere in 1919. Up to the end of World War I, it was generally believed that radio transmission improved with an increase in wave length, so the experimental data are concentrated in this region. (Met. Abs. 14.10-95)--Author's abstract.

E-894 Chisholm, J.H. (Lincoln Lab., M.I.T.) et al., Properties of 400 Mcps long distance tropospheric circuits. Institute of Radio Engineers, N.Y., Proceedings, 50(12):2464-2482, Dec. 1962. 41 figs., 12 refs. DLC--Measurements are reported on beyond-the-horizon propagation losses at 400 Mcps. Data are given on the losses and their variations from 98 to 830 mi beyond the horizon. The transmission loss between isotropic antennas varies from about 190 db at 100 mi to about 300 db at 800 mi distance. Also described are measurements of frequency selective fading, space diversity, and variations in the angle of arrival of the signals. --Author's abstract.

E-895 Crawford, Arthur B. (Bell Tel. Labs., Red Bank, N.J.), Experimental results from investigations on wave propagation through the troposphere. International Scientific Radio Union, Commission II on the Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of the URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 3-15. 27 refs. English and French summaries p. 3. DLC (QC973.I575), DWB (M10.62 I61mo). Also in National Research Council, Wash., D.C., Publication No. 8880:95-107, 1961. DWB, DLC--This review is restricted to experimental work conducted in the U.S. since the last general assembly in 1957. The subject is discussed in terms of: 1) propagation beyond the horizon (medium range); 2) long range results; 3) propagation within the horizon and 4) tropospheric propagation in relation to communication via satellites. (Met. Abs. 14.9-166)--W.N.

E-896 Deam, A.P. (Univ. of Texas, Electrical Eng. Res. Lab., Austin, Texas), Radiosonde for atmospheric refractive index measurements. Review of Scientific Instruments, N.Y., 33(4):438-441, April 1962. 6 figs., 4 foot-refs. DWB, DLC--Detailed description of a reliable, light weight and inexpensive instrument to sample the atmosphere with a resonant cavity nominally resonant at 403 Mc/s, extendable to higher frequencies, and capable of providing remote information. The radiosonde shown photographically and in a circuit diagram has been tested; two profiles are given. The instrument is also successfully usable in polarization studies, electron density measurements, etc. (Met. Abs. 14.7-507)--W.N.

E-897 Dennis, Arnett S., Correlation between hourly median scattered signals and simple refractivity parameters. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(3):285-289, May/June 1962. 4 figs., 13 refs., 3 eqs. DWB, DLC--Measured signals on two tropospheric scatter links have been analyzed in the light of radio refractivity profiles prepared from radiosonde data. On the shorter link (San Diego—Santa Ana, 85 mi) the basic transmission loss was found to be approximately a linear function of ΔN, the change in radio refractivity from the ground to a height of 1 km. On the longer (Cape Canaveral—New Providence Island, Bahamas, 300 mi) the relationship between transmission loss and ΔN was nonlinear, and better results were obtained by averaging the refractivity gradient over 5000 ft. Correlation coefficients on the San Diego—Santa Ana link range from 0.39 in Aug. to 0.84 in Feb. On the Cape Canaveral—New Providence link the correlation factor is 0.92. The results show the feasibility of forecasting signal-to-noise ratios on over water tropospheric scatter communications systems on a daily or hourly basis. (Met. Abs. 13.12-57)--Author's abstract.

E-898 Dezerega, Bartolome and Vollhardt, Dieter, Note sur des essais de propagation par diffraction au Chili. (Note on cases of propagation by scattering in Chile.) Annales des Télécommunications, Paris, 17(3/4):89-90, March/April 1962. 4 figs. DLC--Study of some particular cases of transhorizon propagation made in Chile. The installation of an experimental arrangement for determining scattering on a ridge of the Cordillera de los Andes is described and some experimental results are given. The author points out the possible role of a second ridge which influences the functioning of the visible Earth's curvature. (Met. Abs. 14.3-158) --A.V.

E-899 du Castel, Francois, Influence de la terre en propagation transhorizon. (Influence of the Earth in transhorizon radio links.) Onde Electrique, Paris, 42(418):48-66, Jan. 1962. 7 figs., 29 refs. DLC--This paper is the first summary in the French language of the work of V. FOCK, of Leningrad Univ., on diffraction and the first systematic application of FOCK's method to these problems. The author analyzes the theoretical interpretations of the tropospheric propagation phenomena of ultrashort waves in which the influence of the Earth plays some role. The atmosphere is considered as a macroscopic homogeneous medium, i.e., producing only refraction phenomena. The terrestrial orography, on the other hand, produces diffraction effects and the study of the influence of the Earth on the propagation of radiation is essentially that of the diffraction phenomena. The results differ according to whether the Earth is considered as a smooth sphere or according to whether the relief is considered to play a leading role. The results differ also according to the importance of the refraction phenomena with respect to the diffraction phenomena, i.e., according to the atmospheric model adopted. An atmosphere with a constant refractive index suppresses the refraction phenomena and an atmosphere having an index varying linearly with altitude can be reduced to the preceding case by introducing an equivalent radioelectric ray. An atmosphere with uniform index variation but with a nonconstant gradient can introduce phenomena of refraction and reflection, partial or total, leading to a steering of the radiation. In spite of the rough approximation of such atmospheric models, the results of the diffraction theory may be of interest in certain practical cases of evaluating the propagation diminution. (Met. Abs. 14.8-131)--A.V.

E-900 du Castel, F., Le role du processus de réflexion partielle dans la propagation des ondes. (Role of partial reflection processes in wave propagation.) Acta Technica, Budapest, 39(1/2):179-186, 1962. 4 figs., 5 refs. French, English, German and Russian summaries p. 185-186. --Investigation of the partial reflection of a beam incident on an irregular surface of atmospheric discontinuity showed the existence of a specular reflection term and of a diffuse one. The application of this investigation to the case of stable tropospheric layers coexistent with turbulent strata led to a synthetic view of the transhorizon tropospheric propagation. The consideration of both the partial reflection term and the diffuse reflection term allowed for the evaluation of the work of the experimental observations. --Author's abstract.

E-901 du Castel, F.; Misme, P.; Spizzichino, A. et al., On the role of the process of reflection in radio wave propagation. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(3):273-284, May/June 1962. 11 figs., 31 refs., 73 eqs. DWB, DLC--Nature offers numerous examples of irregular stratification of the medium for the propagation of radio wave. A study of the process of reflection in such a medium distinguishes between specular reflection and diffuse reflection. The phenomenon of transhorizon tropospheric propagation offers an example of the application of such a process, necessary for the interpretation of experimental results. Other examples are those of ionospheric propagation (sporadic E layer) and propagation over an irregular ground surface (phenomenon of albedo). (Met. Abs. 13.12-50)--Authors' abstract.

E-902 Flavell, R.G. and Lane, J.A. (both, D.S.I.R. Radio Res. Station, Slough, Eng.), Application of potential refractive index in tropospheric wave propagation. Journal of Atmospheric and Terrestrial Physics, London, 24(1):47-56, Jan. 1962. 6 figs., 5 refs., 7 eqs. DLC--The paper discusses the concept of potential refractive index, K, and its application in studies of VHF and UHF propagation. A rapid method of deriving values of K from radiosonde data is summarized, and the results illustrate the advantages of this parameter in investigations of the physical structure of the troposphere. A simple technique for locating major layer type discontinuities is suggested, and a correlation is established between the presence of such discontinuities and the reception of abnormally high signals over land paths in the frequency range 100-1000 Mc/s. (Met. Abs. 13.11-90)--Authors' abstract.

E-903 Freeman, J.J. (J.J. Freeman Associates, Inc., 8416 Georgia Ave., Silver Spring, Md.), Range error compensation for a troposphere with exponentially varying refractivity. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(6): 695-697, Nov./Dec. 1962. Fig., 2 tables, 3 refs., 15 eqs. DWB, DLC--An explicit formula for tropospheric range error is derived with a spherically symmetric refractivity which varies exponentially with height. The correction is given as function of surface refractivity and ray elevation angle, and its accuracy and limitations are discussed. (Met. Abs. 14.10-98)--Author's abstract.

E-904 Fukushima, Madoka; Iriye, Hiromi and Akita, Kin-ichiro, Spatial distribution characteristics of atmospheric refractive index from helicopter and kytoon observations. Japan. Radio Research Laboratories, Tokyo, Journal, 9(45):369-383, Sept. 1962. 13 figs., 4 tables, 5 refs., 3 eqs. DWB, DLC--Atmospheric refractivity profiles, elevated inversion layer characteristics and turbulence spectra were observed at elevations up to 2000 m MSL by the use of a helicopter and a kytoon, during Aug. 1960, to July to Aug. and Nov. 1961. It was found that the value of k of the Earth's effective radius ka varied 1.52 (Aug. 1960), 1.59 (July-Aug. 1961) to 1.30 (Nov. 1961). Large scale elevated inversion layer characteristics were obtained with the extraordinarily intense and stable signals in UHF beyond the horizon propagation. The turbulence spectra nearly approach a -2 power law at high wave numbers. (Met. Abs. 14.8-133)--Authors' abstract.

E-905 Funakawa, Kenji and Kato, Joji, Experimental studies of propagational characters of 8.6 mm wave on the 24 km path. Japan. Radio Research Laboratories, Tokyo, Journal, 9(45):351-367, Sept. 1962. 21 figs., table, 9 refs. DWB, DLC--Propagation experiments of 8.6 mm wave on the 24 km path have been carried out nearly all the year round. From the results of the rain attenuation measurements, an empirical method was developed for the estimation of the long term distribution of rain attenuation. During no rainfall period, the fading range is large in the morning and about midnight in summer. The estimated value of absorption by water vapor is somewhat larger than the value measured by Texas Univ. There is a fairly noticeable correlation between the fading range and the appearance of temperature inversion in the atmosphere. (Met. Abs. 14.9-167)--Authors' abstract.

E-906 Furutsu, Koichi, Effect on ridge cliff and bluff at coastal line on ground radio waves. Japan. Radio Research Labs., Tokyo, Journal, 9(41):85-122, Jan. 1962. Figs., 7 refs., 15 eqs. DWB, DLC--Semi-theoretical problems of radio waves along an inhomogeneous earth have been treated for a smooth earth but not for terrain having elevations like in the case of a coast line. In this paper, the effects of ridge, cliff and bluff at coastal lines on ground radio waves are computed and displayed in sets of charts for medium and low frequencies in a wide range of parameters. The formulas are applications of the theory which appeared in other papers. As expected, a ridge on lossy ground has an obstacle gain even though the ground be a plane, when the Sommerfeld numerical distance from the ridge is sufficiently large. Also when the radio waves propagate across a coastal line having a bluff, the rate of change of the relative phase with the propagation distance over sea becomes larger as the height of the bluff increases and is sometimes much more than that without a bluff.--Author's abstract.

E-907 Gerks, I.H., Use of a high speed computer for ground wave calculations. IRE Transactions on Antennas and Propagation, N.Y., 10(3):292-298, May 1962. 6 figs., 4 tables, 10 refs., 41 eqs. DLC--Outlines mathematical methods and programming by which the field strength relative to free space can be calculated when ionosphere is neglected and tropospheric refraction is approximated by appropriate constant gradient of the refractive index. Two programs, one on the plane earth approximation and the other on a spherical Earth were tested with an IBM 650 computer.--W.N.

E-908 Glenn, A.B. and Lieberman, G., Effect of propagation fading and antenna fluctuations on communication systems in a jamming environment. IRE Transactions on Communications Systems, N.Y., 10(1):43-60, March 1962. 22 figs., table, 7 refs., 96 eqs. DLC--Interference on propagation fading with and without antenna fluctuations were studied individually, summarized and classified accordingly. Formulas derived for 9 basic situations (of which 6 were studied) are applicable to system margin calculations for different fading conditions and antenna gain variances.--W.N.

E-909 Gordon, W.E. (Air Force Arecibo Radio Obs., Puerto Rico), Physical characteristics of the troposphere. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 59-64. 5 figs., 9 refs. English and French summaries p. 59. DLC (QC973.I575), DWB (M10.62 I61mo)--Recent studies in the U.S. of the physical characteristics of the troposphere related to radio propagation are considered. The characteristics are discussed under two broad headings: synoptic scale and irregularities. The characteristics pertinent to a synoptic scale include: an exponential model of the atmosphere, elevated layers (particularly in the trade wind regions) and the climatology of refractivity near the ground. The irregularity characteristics include the spectrum of the fluctuations and the effect of thermal stability on the spectrum. (Met. Abs. 14.9-168)--Author's abstract.

E-910 Gossard, Earl E., The reflection of microwaves by a refractive layer perturbed by waves. IRE Transactions on Antennas and Propagation, N. Y., 10(3):317-325, May 1962. 13 figs., 8 refs., 38 eqs. DLC--Effects of internal tropospheric waves on radio and radar performance are discussed, including description of the waves and their theoretical explanation. Power spectra of amplitude and slope of several cases on a radio refractive layer are shown. --W. N.

E-911 Gough, M. W., Propagation influences in microwave link operation. British Institution of Radio Engineers, London, Journal, 24(1):53-72, July 1962. 28 figs., 33 refs., 17 eqs. DBS--Basic characteristics of ground-to-ground propagation in the frequency band 50-10,000 Mc/s are discussed, with emphasis on the operation of point-to-point radio links. Practical applications of such knowledge are illustrated by appraisals of the use of flat radio mirrors for circumventing mountain obstruction on microwave radio links, and of the capabilities of large aperture aerials and space diversity systems in reducing fading. Ground reflections are shown to be a large factor in the performance of very short wave radio links and the influence of inhomogeneities in the lower atmosphere is also stressed. It is pointed out how statistical analysis of temporal and spatial strength variations can often reveal the nature of the propagation mechanism at work, while at the same time, pointing the way to improvements in circuit reliability. --Author's abstract.

E-912 Grosskopf, J. (Fernmeldtechnisches Zentralamt, Darmstadt, Germany), Fading investigations for tropospheric propagation paths. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 39-50. 7 figs., table. English and French summaries p. 39. DLC (QC973.I575), DWB (M10.62 I61mo)--An analysis of fading records obtained in West Germany, with transmissions on frequencies in the region of 100, 200, 500 and 2000 Mc/s over paths of the order of 240 to 250 km in length. The analysis is confined to scatter-type signals. Auto-correlation functions of the field strength variations on all 4 frequencies have been examined. While the exact form of the function is not yet established, it is clear that it is frequency dependent and that it is not a simple Gaussian function. Cross correlation studies, with vertically spaced aerials at 2000 Mc/s, in conjunction with the autocorrelation measurements, indicate the existence of a vertical drift of the scatter medium. (Met. Abs. 14. 9-169)--Author's abstract.

E-913 Grosskopf, J. and Fehlhaber, L., Häufigkeit und Dauer einzelner Schwundeinbrüche bei troposphärischen Scatterstrecken. (Frequency and duration of single fading irruptions on tropospheric scatter paths.) NTZ Nachrichtentechnische Zeitschrift, Brunswick, 15(2):71-78, Feb. 1962. 16 figs., 2 tables, 4 refs., 16 eqs. DLC--Observations of fading phenomena were made on 3 links of lengths 194, 242 and 393 km, respectively, at frequencies between 100 and 2000 Mc/s. From the result obtained, the short time distribution of fading duration on tropospheric scatter path can be determined. The long period distribution of the mean fading frequency was obtained from observations during a whole year on a 100 Mc/s path. The relation between the long period mean field strength, the fading frequency and the operating frequency is not sufficiently well known. --Electr. Eng. Abstract.

E-914 Hansel, Christian (Geophy. Inst. der Karl-Marx-Univ., Leipzig), Ein Vergleich von UKW-Feldstärkemessungen mit meteorologischen Zustandsänderungen. (Comparison of VHF field intensity measurements with changes in meteorological conditions.) Zeitschrift fur Meteorologie, Berlin, 16(1/2):34-40, Jan./Feb. 1962. 3 figs., 8 refs. German and English summaries p. 34. DWB, DLC--Time variations of the vertical gradient of the refractive index, obtained from meteorological measurements of a mountain and a flat country station, are compared with actual diurnal variations of the VHF receiving field strength. Sufficient interpretation of field strength variations may be obtained from changes of refraction conditions. There is evidence of the receiving strength being particularly modified by meteorological conditions below the intersection of the tangential surfaces going through the transmitting and receiving antennas. (Met. Abs. 14.11-111)--Author's abstract.

E-915 Hay, D. R. and Pemberton, E. V. (both, Univ. of Western Ontario. E. V. Pemberton now at Univ. Saskatchewan), On the eddy transfer of water vapor above an outdoor surface. Canadian Journal of Physics, Ottawa, 40(9):1182-1190, Sept. 1962. 3 figs., table, 30 refs., 5 eqs. DWB, DLC--Fluctuations in the refractive index of the air above an outdoor surface have been examined by a 180 ft microwave interferometer. The observed standard deviations of refractivity are less than 10^{-6}. These deviations are associated with instability of the air at the interferometer path but not with instability of the air immediately above it. Smallest refractivity deviations occur for weak eddy transfer of water vapor downward through moist air in the radio path; intermediate deviations are associated with strong eddy transfer of vapor upward through drier air in the path. Largest refractivity deviations are observed for less vigorous upward transfer of water vapor from the surface. It is suggested that the more vigorous eddies disperse the entrained water vapor more rapidly into smaller eddies than do the less vigorous eddies; and hence, lesser local fluctuations in air refractivity appear along an extended path that is highly unstable than along the same path under conditions of greater stability. (Met. Abs. 14.3-159)--Authors' abstract.

E-916 Hay, D. R. and Reid, W. M., Radar angels in the lower troposphere. Canadian Journal of Physics, Ottawa, 40(1):128-138, Jan. 1962. 4 figs., 3 tables, 27 refs. DWB, DLC--A study of radar angels at 6800 Mc/s has been carried out at London, Canada, over a period of 1 yr. Examination of the clear air reflections from heights between 300 and 1500 m above the vertically directed radar has shown that persistent angels occur for surface air temperatures between 30° and 50°F, and that transitory angels are present for surface temperatures above 20°F that are outside of this range. The maximum incidence of angels increases with type of air mass in the order cA, mA, mP, mT, although the most common duration is approximately the same in these air masses. If the angel is due to reflection at a horizontal flat stratum, the power reflection coefficient of the stratum lies between 10^{-16} and 10^{-14} for transitory angels and is as large as 10^{-11} for persistent angels. It is shown that transitory angels may arise through eddy mixing in the lower troposphere when refractivity contrasts of about one part per million occur, but that the reflecting stratum must be no more than a few centimeters in depth. It appears that persistent angels are associated with a high concentration of moisture at the ground, but their physical origin is not clear. (Met. Abs. 13.8-515)--Authors' abstract.

E-917 Herbstreit, J. W. (Nat'l. Bur. of Standards, Boulder), Radio refractometry. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsvier Pub. Co., 1962. p. 187-196. Table, 44 refs., 2 eqs. English and French summaries p. 187. DLC (QC973. I575), DWB (M10. 62 I61mo)--A discussion of the refractive index measurement of the troposphere at radio frequencies, with particular reference to measurements made by the radiosonde technique and by radio refractometers. The application of radio refractometry to propagation problems is also considered. (Met. Abs. 14. 9-171)--Author's abstract.

E-918 Hogg, D.C., The aperture to medium coupling loss in beyond horizon propagation. Institute of Radio Engineers, Proceedings, N.Y., 50(1):1529, Jan. 1962. Fig., foot-refs. DLC--The note suggests a curve based upon experimental data for evaluating coupling loss when narrow beam antennas are used in tropospheric propagation beyond the horizon. The dependence of the coupling loss on path length and frequency is not fully understood. It is concluded that more long term experimental data are needed to clarify the situation. --E. K.

E-919 International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission II on radio and troposphere during the 13th General Assembly of URSI, London, Sept. 1962 (i.e., 1960). Ed. by J. A. Saxton. Amsterdam, Elsevier Pub. Co., 1962. 199 p. Figs., tables, refs., eqs. (International Scientific Radio Union, URSI Monographs). --The 12 invited papers are in either English or French, furnished with abstracts and bibliographic references. The papers are classified into the following 4 sections at the end of which the ensuing discussions of the papers are summarized. (i) Experimental data on tropospheric propagation, (4 papers); (ii) Physical characteristics of the troposphere (4 papers); (iii) Tropospheric propagation theories (2 papers); and (iv) Radio meteorology and climatology (2 papers). (For abstracts of the individual papers see E-716, 785 - 787, 875, 895, 909, 912, 917, 923, 932, 936, 942, 944). (Met. Abs. 14. 10-7) --W. N.

E-920 Knudtzon, N., Shape's troposcatter systems in Norway. Teknisk Ukeblad, Oslo, 109(48):1241-1254, Dec. 27, 1962. (Unchecked)--This is a survey of the telecommunications system of Allied Command Europe, which includes the ACE High troposcatter system extending from northern Norway to eastern Turkey. A review of troposcatter theories and characteristics is given. The 3 leg "Hot line" system between Oslo and Bodö, built in 1956/1958 to obtain experience for the planning of the ACE High system is described with details of construction work and costs. A selection of results of a program of measurements is also given; these measurements were taken for the planning of the ACE High system and relate to signal variations and fading, intermodulation noise, parametric amplifiers, reflections from aircraft. ACE High has a capacity corresponding to 36 telephone channels. --Electr. Engr. Abstract.

E-921 Koido, H., Case study of the relationship between meteorological conditions and fluctuations of field intensity of radio waves in the Ryukyu Islands. Journal of Meteorological Research, Tokyo, 14(8):545-550, Aug. 1962. 4 figs., table, 2 refs. In Japanese; English summary p. 545. DWB, DLC--In connection with the propagation study of VHF and UHF waves for telephone and TV networks in the Nansei Islands, a practical test beyond the horizon was carried out with 970 Mc and 265.3 Mc waves in the period March 10 – May 1, 1960. Using the results of this test and the simultaneous aerological observations obtained in this district, relationships between meteorological conditions and the accompanying fluctuations of field intensity were analyzed. Some features of fluctuations in field intensity due to characteristic changes of meteorological conditions are shown. The results are as follows: 1) Unstable fluctuations are likely to occur when an inversion layer exists near the 900 mb surface. 2) The above condition seems to occur when the said district is in the southwestern domain of a traveling high from China. 3) Unstable conditions are found at the passage of cold and warm fronts. 4) Unstable conditions are also found near the center of low and the convergence zone of a stationary front. The unstable conditions are the results of irregularity of refraction which comes from irregular distribution of water vapor in the atmosphere. (Met. Abs. 15.2-34)--Author's abstract.

E-922 Koono, Tetsuo; Hirai, Masaichi; Inoue, Ryosuke and Ishizawa, Yoshihiro, Antenna beam deflection loss and signal amplitude correlation in angle diversity reception in UHF beyond horizon communications. Japan. Radio Research Labs., Tokyo, Journal, 9(41):21-49, Jan. 1962. 16 figs., 2 tables, 6 refs., 54 eqs. DWB, DLC--A loss due to deflection of antenna beam and an amplitude correlation between signals received in the angle diversity reception in UHF beyond horizon communications are studied experimentally and theoretically. The principal researches are made by utilizing the results obtained from antenna beam swing measurements. It is noteworthy that the scatter wave and the so-called elevated layer reflection wave can be found as separated distinctly in the beam swing measurements. Theoretical formulas are derived for the antenna beam deflection loss and for the angle diversity correlation in the scatter wave propagation. These are applied to the elevated layer reflection propagation. Fairly good coincidences are found between the experimental and theoretical results, but more studies are needed for the angle diversity correlation in the elevated layer reflection propagation. --Authors' abstract.

E-923 Krasil'nikov, V.A. and Tatarskii, V.I. (both, Academy of Science, Moscow), Atmospheric turbulence and radio wave propagation. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 145-160. 3 figs., 30 refs. English and French summaries p. 145. DLC (QC973.I575), DWB (M10.62 I61mo)--The aim of this work is to consider the tropospheric radio wave propagation beyond the horizon and also of the fluctuations of elements of the waves from the point of view of Kolmogorov-Obukhov's local isotropy theory of turbulence. This theory has now been well developed, and numerous experimental investigations show that it satisfactorily describes the principal phenomena of the phase and amplitude fluctuations. This theory also gives the right order of value for the effective cross section of scattering in the transhorizon propagation. However, it is impossible to explain the fields observed beyond the horizon solely by means of this theory. (Met. Abs. 14.9-172)--Authors' abstract.

E-924 Krylov, G.N., Rasprostranenie radioimpul'sa nad ploskoĭ odnorodnoĭ zemleĭ. (Propagation of radio pulses over a flat homogeneous earth.) Radiotekhnika i Elektronika, Moscow, 7(4):579-589, April 1962. 9 refs., 30 eqs. Transl. into English in Radio Engineering and Electronic Physics, N.Y., No. 4:549-558, April 1962. DBS, DLC--The present article attempts a rigorous solution of the problem involving the propagation of pulses of arbitrary shape over a flat earth of arbitrary permittivity and conductivity. Approximate expressions are obtained for calculating the field in the cases of radio and video pulse propagation. In their final form the equations may be effectively applied to the calculation of the vertical component of the electrical field, especially if electronic computers are used. --Author's abstract.

E-925 Kulshrestha, S. M. (Met. Office, New Delhi), Further evidence of "abnormal" superrefraction. Indian Journal of Meteorology and Geophysics, Delhi, 13(1): 135-137, Jan. 1962. 2 figs., table, refs. DWB, DLC--Discusses a case of abnormal superrefraction recorded by the 3 cm CPS-9 radar at Safdarjung Airport on April 14, 1962 (New Delhi) with a view to provide further evidence of the correctness of the ideas put forth by MATHUR and KULSHRESTHA. The weather recorded at Safdarjung Observatory is tabulated, the PPI photograph is reproduced and a map of the area covered by the photograph is presented. It is stated that the weather observations in the present case fully support the earlier ideas as concerns the occurrence of rainfall, the cooling at Earth's surface of the order of 10°C, light wind after the thunderstorm had passed, the cloudy sky thereafter, and the frontal characteristic of the storm. (Met. Abs. 14B-245)--D. B. K.

E-926 Kulshrestha, S. M., Hot weather angels associated with high level temperature inversions. Indian Journal of Meteorology and Geophysics, Delhi, 13(2):218-226, April 1962. 8 figs., table, 4 refs. DWB, DLC--During the hot weather months (April to June), the CPS-9 radar installed at Safdarjung Airport, New Delhi, has been recording angel echoes having certain peculiar characteristics; the most important among them being the apparent association of the angel activity with an upper level temperature inversion or an isothermal layer between 6 to 11 km above ground. Examples of this type of angel activity, observed on 7 different dates spread over a 3 yr period (1958-1960) are presented and their characteristics discussed in this paper. Their apparent association with high level temperature inversion is also explained. (Met. Abs. 14.6-629)--Author's abstract.

E-927 Latorre, V. R., A new scattering coefficient for tropospheric scatter propagation. IRE Transactions on Antennas and Propagation, N. Y., 10(4):471-472, July 1962. 2 figs., 7 refs., 9 eqs. DLC--This brief communication presents a determination of a scattering coefficient from the basic propagation loss curves experimentally determined by Collins Radio Company. --E. K.

E-928 Laurens, A., Television tropospheric scatter link between France and North Africa. Philips Telecommunication Review, Hilversum, 23(4):149-166, Oct. 1962. 18 figs., 2 tables, 11 refs. DLC--The tropospheric scatter circuit used to transport television signals between France and Algiers spans the distance in two hops; the intermediate station is on Majorca in the Balearic Islands. The circuit offers the following 3 possibilities: a) transmission of a single program to North Africa with quadruple diversity reception; b) transmission of two programs to North Africa with dual diversity reception; c) transmission of a single program to France with dual diversity reception. The frequencies used are in the Gc/s band, and the output power of the transmitter is 500 w. The properties of a tropospheric scatter link and the results deduced from observation of variations in the received signal strength are discussed. --Author's abstract.

E-929 McGavin, R.E., Survey of the techniques for measuring the radio refractive index. U.S. National Bureau of Standards, Technical Note, No. 99, May 1962. 37 p. 10 figs., table, 26 refs., 8 eqs. DWB (M(044) U585te)--The radio refractive index can be measured either directly or indirectly. The former method is utilized by radio frequency refractometer; the latter method involves measurement of temperature, pressure and humidity and conversion to refractive index. In terms of convenience and accuracy the direct method is superior; however, lack of the universal use of refractometers requires the use of weather service type of data for the bulk of refractive index structures. Meteorological sensing is limited mainly by the inaccuracy in measuring humidity which, under ideal conditions, appears to limit the accuracy to $\pm$ 1.0 N. Gradient measurements utilizing radiosondes reflects an accuracy no better than $\pm$ 3 N units. Radio frequency refractometers are capable of accuracies as much as an order of magnitude better than that achieved by meteorological sensors. Lightweight refractometers have been devised for balloon-borne and dropsonde measurements reflecting accuracies inferior to the conventional refractometer but superior to the radiosonde. --Author's abstract.

E-930 Maenhout, A.G., Quelques données sur le radioclimat d'Uccle. (Some data on the radio climate of Uccle.) Ciel et Terre, Brussels, 78(11/12):391-396, Nov./Dec. 1962. 2 figs., 4 tables, 5 refs. DWB, DLC--The propagation of radio waves with frequencies of more than 30 Mc/s and influenced by the thermodynamic conditions of the atmosphere are dealt with. The knowledge of this propagation depends on some physical properties of the medium within which the waves propagate and especially on the refractive index. Three tables give the mean values of the refractive index at surface and at a few standard levels. These mean values were computed on the basis of observations made from Jan. 1, 1956 to Dec. 31, 1960 at the Royal Met. Inst. in Uccle. The author points out that the radio waves undergo a deflection due to decrease of the refractive index with height and emphasizes the importance of this deflection for very high frequency radio communication as well as in the field of space communication. (Met. Abs. 14.9-174) --A.V.

E-931 Maheshwari, R.C. (Met. Office, New Delhi), Radio refractive index structure over northern India and its synoptic variation. Indian Journal of Meteorology and Geophysics, Delhi, 13(1):57-62, Jan. 1962. 6 figs., 5 refs., 3 eqs. DWB, DLC--Synoptic distribution of the radio refractive index over northern India and its variation in association with some winter systems have been studied. Analysis of one particular system is presented here. It is noted that the refractive index shows a systematic variation with the passage of the systems and can be utilized as a synoptic parameter. Mean sea level chart of refractive index and its distribution on standard isobaric surfaces might probably be used for forecasting at least qualitatively, the conditions of VHF propagation over northern India. (Met. Abs. 14.3-160)--Author's abstract.

E-932 Marshall, J.S. (McGill Univ., Montreal), Precipitation. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 77-90. 7 figs., 13 refs. English and French summaries p. 77. DLC (QC973.I575), DWB (M10.62 I61mo)--Heavy rain can contribute a significant fast fading term to trans-horizon scattering. The pattern of rain-shower intensities can be studied by radar at wavelengths from 10 down to 6 cm; at 3.2 cm intensity values are seriously diminished by attenuation by the rain itself. There would be great use for any sensing device that would reveal cloud as radar reveals precipitation. Millimetric receivers used to measure sky temperature are sensitive to cloud; their potentiality for cloud measurements should be explored and exploited. --Author's abstract.

E-933 Medhurst, R. G. (Gen. Elec. Co., Ltd., Telecommunications Res. Lab., Hirst Res. Centre, Wembley, England), Distortion problems in f. m. multi-channel communication. Institution of Electrical Engineers, Journal, 8(92):384-386, Aug. 1962. 4 figs. DLC--This article is based on a lecture at the Nov. 6, 1962 meeting of the Electronics and Communications Section at Savoy Place. Noise and distortion problems encountered in frequency division multiplex (f. d. m.) long distance telephony and transmissions of TV and radio, using the "baseband" frequency region, are discussed in terms of the white noise test signal. Formulation of reliable theoretical techniques, some of which are demonstrated here, are requisite in lieu of the too costly prototype systems for experimental purposes. --W. N.

E-934 Men', A. V., O korreliatsii amplitudnykh i fazovykh fluktuatsiĭ radiovoln, rasprostraniaiushchikhsia v troposfere. (On the correlation of amplitude and phase fluctuations of radio waves propagated in the troposphere.) Radiotekhnika i Elektronika, Moscow, 7(2):232-238, Feb. 1962. 3 figs., 12 refs., 11 eqs. Transl. into English in Radio Engineering and Electronic Physics, N. Y., No. 2:215-221, Feb. 1962. DLC--The correlation between amplitude and phase fluctuations are examined, at the same point in space, which arise during propagation of waves above a flat interface in an inhomogeneous turbulent medium. It is shown that the theoretical results concerning the lack of correlation of these fluctuations in a distant region, which Chernov obtained under the assumption of an unlimited medium, hold also for the present case. Results of experimental measurements of the correlation of amplitude and phase fluctuations during propagation in lower tropospheric layers are presented for both the illuminated region and the region obscured by the curvature of the Earth's surface. --Transl. of author's abstract.

E-935 Men', A. V., O vliianii effekta perenosa neodnorodnosteĭ v prostranstve na fluktuatsii radiovoln v turbulentnoĭ srede. (On the influence of the effect of transfer of inhomogeneities in space on radio wave fluctuation in a turbulent medium.) Radiotekhnika i Elektronika, Moscow, 7(3):369-374, March 1962. 4 figs., 11 refs., 5 eqs. Transl. into English in Radio Engineering and Electronic Physics, N. Y., No. 3:345-351, March 1962. DLC--The influence of the effect of transfer of inhomogeneities on the fluctuation of radio waves propagated in the troposphere is examined. Preliminary results of experimental investigations conducted in a distant zone are described. These results are in good qualitative agreement with those derived by calculations. --Transl. of author's abstract.

E-936 Misme, P. (C. N. E. T., Issy-les-Moulineux, Seine), Quelques aspects de la radiométéorologie et de la radioclimatologie. (Some aspects of radiometeorology and of radioclimatology.) International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 169-186. Figs., 11 refs. French and English summaries p. 169. DLC (QC973. I575), DWB (M10. 62 I61mo)--The author considers the following topics: the layer structure of the atmosphere, refraction, and the fundamentals of radioclimatology. Initially it is shown that the work done in France and in the United Kingdom proves that the atmosphere must be considered as a turbulent medium within which exist permanently some stable thin layers. Orders of magnitude of the latter are given. For refraction, consideration is given to the difficulties in the choice of a parameter to represent the phenomenon: refractive index or gradient of refractive index. The author indicates the importance of the equivalent gradient. Finally, in radioclimatology, the role of parameters of atmospheric stability, as well as those of refraction, is discussed. --Author's abstract.

E-937 Naito, K. (Meteorological Res. Inst., Tokyo), Some statistical considerations on transhorizon propagations of microwaves -- with application to radio meteorology, Pt. 1. Papers in Meteorology and Geophysics, Tokyo, 13(3/4):207-215, Dec. 1962. 3 figs., 8 refs., 24 eqs. English summary p. 207; Japanese summary p. 215. DWB--Since sampling time of actual analysis or recording period of observation is of finite length, statistical values obtained are sample means, sample variances and so on, and not ones computed with the use of data over all members of the ensemble. Taking this fact into consideration, the received fields in transhorizon propagation of microwaves are found to present, for a short sampling time, apparent coherency, which explains the results of WATERMAN's rapid beam swinging experiments. Furthermore, a method is presented to determine whether or not only radio scattering due to atmospheric eddies is dominant in transhorizon propagation. Actual analyses seem to show that, in most cases, not only scatterings due to eddies but reflections due to wavy layers are dominant in over sea transhorizon propagation of 3000 Mc/s and 1300 Mc/s, apart from other possible mechanisms which may be relevant to the propagations. In a few cases obtained in a well mixed atmosphere, the most dominant seemed to be eddy scatterings. It may also be suggested that the sort of analyses made here would be useful in affording some measure of weather situation on the so-called mesoscale. --Author's abstract.

E-938 Nekrasov, L.B., K voprosu o prichinakh obrazovaniia radioekho diskretnokogerentnogo tipa. (Causes for the formation of radar echoes of a discrete coherent type.) Leningrad. Glavnaia Geofizicheskaia Observatoriia, Trudy, No. 128: 77-83, 1962. 7 figs., 3 refs. Russian summary p. 77. DWB, DLC--Radio echoes from a cloudless sky are discussed, as well as meteorological conditions favoring the radio echo formation of a discrete coherent type. Aerological data are presented and conclusions are drawn on the relation of the radio echoes to thermal convection in lower atmospheric layers. --Transl. of author's abstract-S. N.

E-939 Norton, K.A.; Barrows, E.C. et al., Variance of radio frequency caused by atmospheric turbulence in line-of-sight transmissions. IRE Transactions on Instrumentation, N.Y., 1-2(3/4):153-155, Dec. 1962. 4 figs., 5 refs., 5 eqs. DBS--The frequency stability of a radio signal propagated over a line of sight path is reduced by time variations in phase velocity along the path. This instability caused by the atmosphere will produce errors in frequency measurements made by averaging a standard frequency transmission over a period of time, T, and also in time interval measurements made by counting the number of cycles of the standard frequency received during a period of time, T. Recent measurements of the variations in phase of a received signal at microwave frequencies permit estimation of both types of error as a function of T. These atmosphere induced errors are compared to the errors inherent in the best currently available crystal oscillators and it appears that the latter source of error is dominant for line in sight path through the atmosphere. The level and slope of the frequency spectra have been observed to vary over wide ranges with time and geographic location. The spectral form $W(f) \sim f^{-2/3}$ expected on the basis of the Obukhov-Kolmogorov theory of atmospheric turbulence has a slope which lies well within the range of observed slopes for the range of fluctuation frequencies from 1 cycle/day to 1 cps. --Authors' abstract.

E-940 Raghavan, S. and Soundararajan, K. (both, Regional Meteor. Centre, Madras), Study of abnormal radar propagation around Madras. Indian Journal of Meteorology and Geophysics, Delhi, 13(4):501-509, Oct. 1962. 5 figs., 3 tables, 4 refs. DWB, DLC--Occurrence of supernormal radar propagation in the 3 cm band around Madras has been investigated. The results generally agree with the findings of DURST (1946). The temperature and humidity distribution giving rise to favorable refractive index gradients in the various seasons and the wind distribution and synoptic features aiding the setting of superrefraction are discussed. The occurrence of superrefraction prior to formation of mist or fog has also been discussed in relation to its forecasting value. --Authors' abstract.

E-941 Rider, G. C., Median signal level prediction for tropospheric scatter. Marconi Review, London, 25(146):203-210, Third Quarter 1962. 5 figs., table, 10 refs. DBS--Data from the BROMLEY-CATTERICK experimental link have been further analyzed to give a regression line of refractive index upon path attenuation. A slope of 0.43 db per N unit is found, and this is shown to be in agreement with GRAY's results for some Caribbean paths, (Elec. Comm. Vol. 36, p. 60, 1959). GRAY's propagation curves for 900 Mc/s are shown to give good predictions, very simply, for seven paths in widely differing climatic regions. For other frequencies and for difficult paths, it suggested that the new regression coefficient be used in NORTON's classical prediction formula. --Author's abstract.

E-942 Robinson, G. D. (Meteorological Office, London), Physical characteristics of the troposphere. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI. London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 65-76. 4 figs., 2 tables, 10 refs. English and French summaries p. 65. DLC (QC973.I575), DWB (M10.62 I61mo)--Statistics are given of the occurrence of temperature inversions over England, and the structure of some examples, as revealed by aircraft-borne thermometers, hygrometers, and radio refractometers, is exhibited. Attention is called to the work of Danielsen on the continental scale of layered structures. Some recent analyses of frontal structures by Sawyer and others, display considerable divergence from the classical model, and an unexpected humidity pattern. The spectrum of atmospheric turbulence at heights of 1000-2000 ft, as revealed by results of CRANE and CHILTON and recently by those of Smith, is discussed and the adequacy of some theoretical and empirical formulas examined. (Met. Abs. 15.2-325) --Author's abstract.

E-943 Ryzhov, Iu. A., O vzaimoĭ funktsii korreliatsii fluktuatsiĭ amplitudy i fazi volny, rasprostraniaiushcheĭsia v neodnorodnoĭ srede. (Cross correlation function of fluctuations in amplitude and phase of a wave propagated in an inhomogeneous medium.) Radiotekhnika i Elektronika, Moscow, 7(10):1824-1825, Oct. 1962. 2 refs., 13 eqs. Transl. into English in Radio Engineering and Electronic Physics, N. Y., No. 10:1686-1688, Oct. 1962. DLC, DBS--Formulas are given for the cross correlation of fluctuations of level and phase of a plane wave in the case of a locally uniform and isotropic turbulence. --G. T.

E-944 Saxton, J.A. (Dept. of Sci. and Indus. Res. Radio Research Station (U.K.)), Some long distance tropospheric propagation studies in the United Kingdom. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radio wave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of U.R.S.I., London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 28-38. 9 refs. English and French summaries p. 28. DLC (QC973.I575), DWB (M10.62 I61mo)--After a brief description of the development of tropospheric propagation studies, with emphasis on transmission to points well beyond the horizon, the nature of tropospheric scatter propagation problem is discussed. A survey is then made of recent British experimental contributions to this subject, covering investigations at frequencies in the range 50 to 10,000 Mc/s and over distances of 100 to 800 km. No simple model of the troposphere is likely to account for the various observed characteristics of scatter signals, and it is evident that a much more exhaustive examination of the fine structure of the refractive index of the troposphere is required. (Met. Abs. 14.9-175)--Author's abstract.

E-945 Schunemann, R. and Pucher, G., Über eine Deutung der UKW Ausbreitung in der troposphäre nach untersuchungen der amplituden variationen bei 10 cm Wellenlänge. (An explanation of VHF propagation in the troposphere from an investigation of amplitude variations of 10 cm waves.) Hochfrequenztechnik und Elektroacustik, Leipzig, 71(1):34-40, Feb. 1962. DLC--The experiments conducted in measuring field strength at 10 cm wavelength show in several instances, that only 20% of the temporary amplitude distribution corresponds to Rayleigh distribution, and 80% of the readings had constant characteristics. It is concluded that the partial reflections on the atmospheric layers play a considerable role in the long distance propagation of the ultra short waves. --E.K.

E-946 Shaft, P.D., Comparison of calculated and measured bandwidth of the Florida - Cuba tropospheric scatter system. IRE Transactions on Communications Systems, N.Y., 10(4):457-, Dec. 1962. Fig., table, 2 refs. DLC--The calculated distortion was greater than the measured, probably attributable to the propagation model (i.e., two paths defined by the extremities of the common scatter volume). The results are valid for information bandwidths < 4.2 Mc/s. --W.N.

E-947 Sichak, W. and Adams, R.T., Intermodulation noise in FM troposcatter links. Institute of Radio Engineers, Proceedings, N.Y., 50(10):2113, Oct. 1962. Fig., table, 5 refs., 5 eqs. DLC--The purpose of this note is to give an approximate formula for the intermodulation noise produced by tropospheric scattering. The measured and calculated values of the signal to intermodulation ratio are shown in a figure. --E.K.

E-948 Straiton, A.W.; Deam, A.P. and Walker, G.B., Spectra of radio refractive index between ground level and 5000 ft above ground. IRE Transactions on Antennas and Propagation, N.Y., 10(6):732-737, Nov. 1962. 9 figs., table, 8 refs. DLC--Atmospheric index of refraction has been measured from ground level to 5000 ft using the Deam telemetering refractometer which permitted accurate spectral analysis of these data. The results of the analysis show a wide variation in the mean slope and intensity of the spectra. Some of the spectra are presented and their characteristics discussed. --Authors' abstract.

E-949 Tatarskiĭ, V.I., Vtoroe priblizhenie v zadache o rasprostranenii voln v srede so sluchaĭnymi neodnorodnostiami. (Second approximation in the problem of wave propagation in media with random inhomogeneities.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 5(3):490-507, 1962. 11 refs., 102 eqs. English summary p. 507. DLC--A second approximation to the smooth perturbation method is considered and applied to solving the problem of short wave propagation in media with random inhomogeneities. Second order corrections to mean values, spectra and correlation functions of wave amplitude and phase are determined in small nonlinear terms. On the basis of these solutions the limits of validity of the "smooth perturbation method" are investigated. --Author's abstract.

E-950 Tatarskiĭ, V.I. and Golitsyn, G.S., O rasseianii elektromagnitnykh voln turbulentnymi neodnorodnostiami troposfery. (Electromagnetic wave scattering by turbulent inhomogeneities of the troposphere.) Akademiia Nauk SSSR. Institut Fiziki Atmosfery, Trudy, No. 4:147-202, 1962. 15 figs., 52 refs., numerous eqs. DLC. Transl. into English in corresponding issue of its Transactions, issued Consultants Bureau, N.Y. DLC--The authors attempt to present from a general point of view the theory of scattering of radio waves in the troposphere. Particular attention is devoted to an overall physical interpretation of the mechanism of scattering of radio waves by random inhomogeneities. The contents of this comprehensive study include the following: the initial equations, that is, the Maxwell equations and their solution; the scattering field in the zone of Fraunhofer diffraction; the representation of a scattering field by the spectrum of the refractive index; Brogg's statistical formula; scattering on random inhomogeneities in the approximate Fresnel diffraction; the microstructure of fluctuations of dielectric permeability in a turbulent atmosphere; computation of the mean scattering power for real tracks; correlation function of the scattering field; statistical properties of the scattering field; and scattering of an impulse. (Met. Abs. 14.9-176)--I.L.D.

E-951 Tohsha, M. (Met. Res. Inst., Tokyo), On the regional distributions of radio meteorological elements in the one kilometer layer. Papers in Meteorology and Geophysics, Tokyo, 13(2):163-170, Sept. 1962. 4 tables, 5 refs., 7 eqs. English summary p. 163. Russian and Japanese summaries p. 169-170. DWB--Some local characteristics of the refractive index which are needed for the research of microwave propagation are described in a general way. The refractive indices on the surface and at 900 mb level are calculated with the use of the aerological sounding data. The vertical gradient of the refractive index is obtained by the use of these values. The local values of the refractive index decrease toward north. The maximum values are located on about 30° zone of north latitude. On the open sea and at the end of the peninsulas, the vertical gradients of the refractive index have comparatively large values. In the cold season, the gradient values on inland are larger than ones of the coastal stations, and in the warm season, the above mentioned situation is the opposite. With the exception of Hokkaido Island, the values of effective earth which is used in the theory of radio wave propagation are larger than the value got by the assumption of the standard atmosphere. (Met. Abs. 14.11-115)--Author's abstract.

E-952 Tremblay, R., Etude théorique et expérimentale des problèmes de fluctuations rapides en propagation troposphérique. (Theoretical and experimental study of the problems of rapid fluctuations in tropospheric propagation.) Annales de Radioélectricité, Paris, 17(70):280-296, Oct. 1962. 13 figs., 6 tables, 20 refs., 68 eqs. DBS--This study concerns the problem of rapid fluctuation of the received signal in tropospheric transmission. An analysis of signal fluctuations as a function of time shows the correlation between fluctuation and the transverse component of upper air wind. A great similarity is found between the amplitude frequency and the amplitude time spectra, except when the fluctuations in time are caused by atmospheric turbulence. An elaborate experimental study (Cholet-Orsay path, 3300 Mc) confirms the theoretical results. Data obtained in the experiment are presented. --From author's abstract.

E-953 Vergara, W.C.; Levatich, J.L. and Carroll, T.J., VHF air-to-ground propagation far beyond the horizon and tropospheric stability. IRE Transactions on Antennas and Propagation, N.Y., 10(5):608-621, Sept. 1962. 19 figs., table, 39 refs. DLC--The results of twilight region propagation experiments on 128 Mc/s over the air line route San Francisco, Calif. - Honolulu, Hawaii are presented and discussed. The results include the largest air-to-ground VHF measurements known to exist. Mechanism of minimum twilight propagation is explained in terms of wave mode due to partial reflections in a gravitationally stratified atmosphere. The significance of the height of the antenna over the ground is demonstrated. VHF air-to-ground propagation is extendable everywhere and at all times, to at least twice the horizon range. --W. N.

E-954 Wait, James R. (Nat'l. Bur. of Standards, Boulder, Colo.), Note on the propagation of electromagnetic pulses over the Earth's surface. Canadian Journal of Physics, Ottawa, 40(9):1264-1269, Sept. 1962. Fig., 15 refs., 12 eqs. DWB, DLC--A note considering the propagation of electromagnetic pulses over the Earth's surface first refers to the classic work of VAN DER POL (1956) and others including the author's previous work, then shows how the Sommerfeld (1926) form of the attenuation function is applicable to pulse propagation over a flat Earth provided the dielectric constant is reasonably large compared with unity. On the basis of the present calculations, the form of the numerical distance $\sqrt{sq}$ as suggested by NORTON (1937) appears to lead to more accurate results. --E. Z. S.

E-955 Wait, J. R., Wave propagation around a curved boundary which contains an obstacle. Canadian Journal of Physics, Ottawa, 40(8):1010-1016, Aug. 1962. 13 refs., 32 eqs. DWB, DLC--The problem is to calculate the field of an electric dipole on a smooth spherical or cylindrical surface which contains a localized obstruction. An approximate solution is obtained by combining the rigorous theory of diffraction by a sphere and the approximate Kirchoff diffraction theory for black screens. The application to ground wave propagation is briefly indicated. (Met. Abs. 14.3-162)--Author's abstract.

E-956 Walters, Lillie C. and Johler, J. Ralph (both, Nat'l. Bur. of Stands., Boulder, Colo.), Diffraction of spherical radio waves by a finitely conducting spherical Earth. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(1):101-106, Jan./Feb. 1962. 7 figs., 15 refs., 41 eqs. DWB, DLC--The theory for the diffraction of spherical electromagnetic waves by a finitely conducting spherical Earth was developed from Maxwell's equations by WATSON (1918) and the intricate computation details were later worked out by VAN DER POL and BREMMER (1936) as the now classical series of residues. Two aspects of this computation present considerable difficulty, especially at low frequencies: (1) The calculation of the height gain factor which takes account of an elevated transmitter and/or receiver. (2) The evaluation of the special roots, $\mathcal{T} = \mathcal{T}s$ of Riccati's differential equation, $\frac{\alpha \delta}{\delta \tau} - 2\delta^2 \mathcal{T} + 1 = 0$ near the circle of convergence, $|\delta^2 \tau| = 1/2$. These analytic difficulties are avoided with the aid of modern analysis techniques applied to a large scale electronic computer. Hankel functions of the first and second kind of order one-third and two-thirds are calculated by numerical integral methods and then used with iteration to solve Riccati's differential equation. The amplitude and phase of the spherical radio wave diffracted in the vicinity of the Earth with various altitudes above the surface of the Earth, of both the transmitter and the receiver, are then calculated by a summation of the series of residues. (Met. Abs. 14.4-122).--Authors' abstract.

E-957 Wilkerson, Robert E., Defocusing of radio rays by the troposphere. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(4):479-485, July/Aug. 1962. 5 figs., table, 8 refs., eqs. DWB, DLC--When radio rays pass through the atmosphere, they are defocused due to its presence. This effect is measured by the divergence coefficient and general formulas are derived for D_1, the divergence coefficient of the direct ray, and D_2, the divergence coefficient of the reflected ray – assuming a smooth spherical earth. As examples, D_1 and D_2 are shown for some typical cases with an "exponential" atmosphere (troposphere). (Met. Abs. 14.3-163)--Author's abstract.

E-958 Wolf, James M., Radar ring "angels". Symposium on Remote Sensing of Environment, 1st, Univ. of Michigan, Feb. 1962, Proceedings. Ann Arbor, March 1962. p. 57-60. 8 refs. DWB (M(051) S989p 1962)--"Angels" the false echoes picked up by the more powerful and more sensitive radars have been believed to be due to irregularities in the atmosphere. This short paper describes a peculiar angel in the form of an expanding ring observed in the summer of 1955 about 10 mi S of the radar site at Willow Run Airport. A film of this angel presented at the Symposium is discussed. A published analysis of the film with accompanying meteorological data showed that the rings were seen under a great diversity of weather conditions. It was found that, as in Texas and in England, the rings were produced by the birds leaving their roosts. The author states that the study of bird movements by radar has become a part of ornithology. (Met. Abs. 14.6-828)--D.B.K.

E-959 Wright, F. Edward (U.S. Navy), The effect of neglecting horizontal variations in refractivity. 1962. Thesis (Ms.Sci. in Met.) - U.S. Naval Postgraduate School, Monterey, Calif. 26 p. 4 figs., 3 tables, 3 refs., 28 eqs. DWB--Atmospheric models which depict the vertical distribution of refractivity in exponential form are commonly used when tracing high frequency radio ray paths. To date, in the determination of ray paths using these models, one generally neglects horizontal variations of refractivity and the implied variation of vertical gradient of refractivity along the ray path. The effects of these simplifications are investigated, using a regional exponential model based upon radio climatology compiled by BEAN and THAYER. An accurate method for ray path construction is devised, and it is found that the horizontal gradient of refractivity of the model has little effect upon the ray path to horizontal distances of 400 mi. However, a variation in the horizontal gradient is associated with a much larger horizontal variation of the vertical gradient, which does significantly affect the ray path. (Met. Abs. 14.10-100)--Author's abstract.

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E-960 Anderson, J. Bach, Reception of skywave signals near a coastline. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(3):325-330, May/June 1963. 3 figs., 8 refs., numerous eqs. DWB, DLC--An experimental investigation has been made on the influence of ground inhomogeneities on the reception of skywave signals, especially the influence of the conductivity contrast near a coastline. This gives rise to a rapid decrease in field strength near the coastline as is well known from ground wave mixed path theory. Comparison with theory is given. Influence of diffuse reflection from the ionosphere is also considered. --Author's abstract.

E-961 Anway, Alan C., Empirical determination of total atmospheric refraction at centimeter wavelengths by radiometric means. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(2):153-160, March/April 1963. 9 figs., table, 9 refs., 3 eqs. DWB, DLC--The experimental procedures and data analysis methods used in the determination of total atmospheric refraction by radiometric means are described. The results of 5 months' observations are presented in plots of the mean refraction, its standard deviation, and standard error of estimate for specified altitude angles between 2 and 65 degrees. The a.m. values of refraction are significantly greater than those of the p.m. at the same altitude angle. This effect is attributed to the diurnal cycle. The measured total refraction exhibits a strong linear correlation with surface refractivity. --Author's abstract.

E-962 Arendt, P. R. and Soicher, H. (both, U.S. Army Electronic Res. and Dev. Lab., Fort Monmouth, N. J.), Radio horizon distribution variation on 108 megacycles per second measured with satellite signals. Journal of Geophysical Research, Wash., D.C., 68(4):1039-1049, Feb. 15, 1963. 5 figs., table, 7 refs. DWB, DLC--The radio horizon of satellite signals for an observer on Earth is measured with a satellite of 780 km average altitude and a beacon frequency of 108 Mc/s. The analyzed data consist of measurements from 295 orbits from July 13, 1961 to Dec. 4, 1961. The statistical distribution of radio horizon data differs considerably from the geometric horizon and from the radio horizon calculated to allow for refraction effects using an equivalent radius of 4/3 the Earth's radius. The observed radio horizon depends on seasonal changes as well as on the topographical regions along which the radio waves travel when the satellite is at low elevation. During summer the data are sporadic, in contrast to fall and winter when the data are more uniform. The either sporadic or uniform nature of the data is ascribed to the seasonal variation of the ionosphere. However, whereas the average radio horizon along sea is at all times longer than the corresponding geometric horizon by approximately 300 mi, the one along land was always found to be considerably shorter during the summer and late fall and only slightly longer during the winter. The lengthening along sea goes beyond the radio horizon calculated with 4/3 the Earth's radius. It is suggested that a tropospheric duct, facilitated by the Gulf stream near the station and greater abundance of water vapor above the sea, is responsible for lengthening the radio horizon along the sea. (Met. Abs. 14.9-162)--Authors' abstract.

E-963 Atkinson, Neal W., Evaluation of automatic Picture Transmission Ground Station (APTGS) for army mobile use. U.S. Army Electronic Research and Development Labs., Ft. Monmouth, N.J., Technical Report, 2396, Oct. 1963. 10 p. 2 figs., 2 refs. DWB (M(055) U5812te)--This report is an evaluation of an Automatic Picture Transmission Ground Station (APTGS), as developed by the National Aeronautics and Space Administration, designed to provide facsimile reproductions of local cloud cover pictures transmitted from an orbiting Nimbus satellite. An analysis of this system is presented, outlining the problems and recommended solutions of using this basic system design to create an experimental mobile version of the APTGS suitable for Army field type applications. --Author's abstract.

E-964 Barghausen, A.F.; Guiraud, F.O.; McGavin, R.E. et al., Equipment characteristics and their relation to system performance for tropospheric communication circuits. U.S. National Bureau of Standards, Technical Note, No. 103, Jan. 15, 1963. p. 173. 52 figs., 4 tables, bibliog. p. 169-173. 68 eqs. DLC--The performance of a tropospheric communication system, either within the limit of sight or beyond the line of sight, is directly dependent on the operating characteristics of the equipment. Performance predictions of a communication system are made on the basis that equipment will operate in a prescribed manner. The degree of success of the communications system will depend largely upon how well these predicted values correspond to the actual operating values. Consideration is given to those portions of the equipment that have definite effect upon the operating performance. Specific items of equipment and methods for determining their performance are considered. Representative results in light of the present state of the art permits an evaluation of an actual system in terms of realizing an optimum system. In systems that do not have the optimum characteristics desired consideration is given to laboratory devices which may alleviate these deficiencies. Future systems should consider incorporating these devices as development permits. --Authors' abstract.

E-965 Barsis, A.P.; Barghausen, A.F. and Kirby, R.S., Studies of within-the-horizon propagation at 9300 Mc. IEEE Transactions on Antennas and Propagation, 11(1): 24-38, Jan. 1963. 15 figs., 4 tables, 14 refs., 8 eqs. DLC--Propagation characteristics of radio signals over a 113 km tropospheric path in Eastern Colorado was investigated with stress on the short term fading characteristics. Sampling the 9250 and 9350 Mc instantaneous carrier amplitude at the rate of one per second, 0.91 was the over all cross correlation coefficient. Expressed in db, the standard deviation averaged 0.76 db, maximum hourly 1.81 db. --From authors' abstract.

E-966 Bass, F.G. and Verbitskii, I.L., O chastotnom spektre elektromagnitnykh voln, rasseiannykh statisticheski nerovnoĭ poverkhnost'iu. (Frequency spectrum of electromagnetic waves scattered by a statistically rough surface.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedenii, Radiofizika, 6(2):290-296, 1963. 7 refs., 25 eqs. English summary p. 296. DLC--Expressions are given for various tensors of the electromagnetic field scattered by a statistically rough surface, taking into account curvature and finite conductivity of the average surface. The effect of dissipative processes upon the spectral line width of the scattered field is considered and corrections to the spectral density of the field are obtained in the second approximation of the theory of perturbations. --Authors' abstract.

E-967 Beach, C.D. and Trecker, J.M., A method for predicting inter-channel modulation due to multi path propagation in FM and PM tropospheric radio systems. Bell System Technical Journal, N.Y., 42(1):1-36, Jan. 1963. --This paper describes a method for predicting the magnitude of interchannel modulation due to multipath propagation on angle modulated tropospheric scatter radio systems. Values of signal to intermodulation ratio, S/I, are calculated for various pairs of signal reflections in the troposphere, taking into account the base bandwidth and frequency deviation of the system, the antenna patterns, the path geometry, and climatic conditions during the worst month of propagation. The lowest value of S/I (worst inter-modulation) computed for such pairs of signal reflections is then corrected empirically to account for multiple reflections. The result represents the median value of S/I expected during the worst month of transmission on a specified path. The method yields results that, when compared to measured results from four widely different path normalized to worst month conditions, have a standard error of estimate of about 2.6 db. --Authors' abstract.

E-968 Bean, B. R.; Dutton, E. J.; Lane, J. A. et al. (all, Nat'l. Bur. Standards, Boulder), Radiometeorological study, Pt. 3, A new turbulence parameter. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):605-608, Nov./Dec. 1963. Table, 4 refs., 20 eqs. (For Pt. 1, see E-996; for Pt. 2, see E-969). DWB, DLC-- The concept of thermal stability is utilized to derive expressions for the radio refractivity of an air parcel undergoing adiabatic compression or expansion. These expressions are of exponential form with scale heights of 12.5 km for the dry adiabatic process and 7.0 km for the wet adiabatic process. The adiabatic curves for N are determined solely from conditions at the Earth's surface. A new turbulence parameter, II, is derived as the difference of the environmental refractive index structure and the adiabatic curves for an air parcel lifted from the surface to 3 km. This parameter yields correlations with 3 hourly median field strength data that are not statistically different from those obtained with the much simpler parameter, Δ N. The correlations obtained with the equivalent gradient are not statistically different from zero. --Authors' abstract.

E-969 Bean, B. R.; Frank, V. R. and Lane, J. A. (all, Nat'l. Bur. Standards, Boulder), Radiometeorological study, Pt. 2, An analysis of VHF field strength variations and refractive index profiles. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):597-604, Nov./Dec. 1963. 7 figs., 3 tables, 17 refs., 7 eqs. (For Pt. 1, see E-996; for Pt. 3, see E-968) DWB, DLC--This paper discusses the cumulative probability distributions of field strength for four 200 km VHF paths in Illinois in terms of a classification of refractive index profiles. It is shown that extended elevated layers produce signal enhancements of 10 to 25 db above the level observed in unstratified conditions. Assuming the layer characteristics given by radiosonde data, the best agreement between calculated and measured values of field strength is obtained using a layer model with a linear n profile. The possible influence of smaller layers is also discussed in relation to the observed results for conditions judged to be unstratified or well mixed on the basis of sonde data. --Authors' abstract.

E-970 Bean, B. R. and Thayer, G. D., Comparison of observed atmospheric radio refraction effects with values predicted through the use of surface weather observations. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(3):273-285, May/June 1963. 12 figs., 3 tables, 14 refs., 3 foot-notes, 15 eqs. DWB, DLC-- Past theoretical work has shown that it should be possible to estimate the atmospheric refraction of radio waves quite accurately simply from a knowledge of the radio refractive index at the surface of the Earth. Prediction equations have been developed for use in estimating both elevation angle errors and radio range errors by means of performing linear regressions of ray traced refraction variables on the values of surface refractivity, N_s, for a standard sample of radio refractivity profiles. In this paper the accuracy of these prediction equations is examined through a comparison with some precise measurements of total absolute refraction made with a radio sextant by the Collins Radio Co., some absolute elevation angle error measurements made at White Sands Missile Range in the lower atmosphere, and measurements of both relative elevation angle error and relative range and range difference errors made over various paths in the lower atmosphere. The validity of the refractive index profile sample used is confirmed through a test on some independent data obtained from four locations well outside the area of selection of the original sample. All results are shown to be consistent with the theoretical prediction model. (Met. Abs. 14.11-110)--Authors' abstract.

E-971 Bolgiano, R., Jr. (Cornell Univ.), Evidence of anisotropy in tropospheric microstructure. Journal of Geophysical Research, Wash., D.C., 68(16):4873-4874, Aug. 15, 1963. Fig., 11 refs., 2 eqs. DWB, DLC--Reports a study of the spectral structure of refractive index in the troposphere by radio methods. Experimental results indicate varying degrees of anisotropy in the lower atmosphere during summer days. The degree of anisotropy apparently varies from day to day, and may, in some occasions, be negligible. --E. Z. S.

E-972 Boudouris, George (Univ. Paris), On the index of refraction of air, the absorption and dispersion of centimeter waves by gases. Transl. from original French by G. Wm. Curtis. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6): 631-684, Nov./Dec. 1963. 37 figs., 8 tables, bibliog. p.681-684, numerous eqs. DWB, DLC--The index of refraction, the absorption and dispersion are studied for several gases and vapors (pressure from 0 to 1 atm, temperature from 0 to 50°C, frequency from 7000 to 12,000 Mc/s). The first part is devoted to a description of the microwave spectrometer used, while the second part is a survey of the several theories implied in the interpretation of the results. In the third part, we present first the results concerning the index of refraction of atmospheric gases, of dry air, and of damp air. Then we study the absorption and dispersion by several vapors, and of ammonia and chloroform, principally. Finally, a new method is indicated, making use of gaseous mixtures. The original results are discussed and presented within the frame of reference of works of other authors by means of comparison and intensive bibliographies. --Author's abstract.

E-973 Bradshaw, John A. (Gen. Elec. Res. Lab., Schenectady, N.Y.), Some implications of aircraft interference patterns in troposcatter reception. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(4):405-415, July/Aug. 1963. 17 figs., 12 refs., eqs. DWB, DLC--Aircraft interference patterns in troposcatter signal records betray the plane's velocity across the link axis. The patterns also reveal the phase variations in the normal signal path. Similarly, the spectra of records free of aircraft patterns reveal the cross axis velocity of winds aloft. The amplitude distributions of such records often come close to the Rayleigh model but do not follow weather parameters closely. The distributions of ratios and products of correlated amplitudes also fit the Rayleigh model in records free of aircraft reflections. --Author's abstract.

E-974 Clarke, R.H. (Dept. of Electrical Engrg., Univ. College, London), Measurements on radiation reflected obliquely from a rough surface. Institution of Electrical Engineers, London, Proceedings, 110(11):1921-1927, Nov. 1963. 8 figs., 2 tables, 7 refs., 14 eqs. DLC--Experiments are described, and their results analyzed, of the reflection (at oblique incidence) of microwaves of 8 mm wavelength from a rippled water surface. The surface profile was, to a good approximation, randomly rough, and a series of roughness states, extending from 'slightly rough' to 'very rough' and whose statistical characteristics were known, were used. The time variation of the amplitude and phase of the reflected radiation was observed for the two principal polarizations of the incident radiation, as well as their covariation when the incident radiation was polarized in a direction at 45° to the plane of incidence. The results are discussed in terms of recently proposed theories, and some encouraging agreement is found. --Author's abstract.

E-975 David, P., Rappel de quelques généralités sur la propagation des ondes dans différents milieux. (Some generalities on wave propagation in different mediums.) (In: NATO Advanced Study Institute, Corfu, Meteorological and astronomical influences on radio wave propagation. Ed. by Björn Landmark. N.Y., Macmillan, 1963. p.121-137. Fig., table, 34 eqs. English summary p.121.) DLC, DWB (621.384 N864me)--Electromagnetic wave propagation in dielectric and ionized mediums is treated. The treatment includes the effect of collisions, but is limited to homogeneous and isotropic mediums. Formulas for dielectric constants, conductivities and refractive indexes, are derived. Different limiting cases are considered. Phenomena connected with passage from one medium to another is treated. In an appendix some relations between phase velocity and group velocity are explained. --Author's abstract.

E-976 David, P. and Voge, J., Role de la troposphère. (Role of the troposphere.) (In: NATO Advanced Study Institute, Corfu, Meteorological and astronomical influences on radio wave propagation. Ed. by Björn Landmark. N.Y., Macmillan, 1963. p.251-279. 18 figs., table, 13 refs., 23 eqs. English summary p.251. DLC, DWB (621.384 N864me)--The relevant meteorological aspects are briefly reviewed. The formulas for atmospheric refraction are deduced, and equivalent models for propagation calculations are given. The influence of the fine structure of the troposphere on the propagation over paths of different lengths is treated, ending with a discussion of tropospheric scatter communication. Finally, the importance of absorption in the atmosphere is considered. --Authors' abstract.

E-977 Doherty, Lorne H. (Nat'l. Res. Council, Ottawa), Electrical conductivity of the Great Lakes. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):765-771, Nov./Dec. 1963. 6 figs., table, 10 refs. DWB, DLC--A critical examination has been made of the electrical conductivity values assigned, for radio propagation purposes, to the waters of the Great Lakes. Discrepancies between conductivity values measured in the laboratory and those deduced from field strength measurements are shown to have been the result of both experimental error and the use of faulty standard theoretical field strength curves. The latter source of error is the result of error in the standard curves themselves and in the use of a dielectric constant of 15 for over water propagation. Conductivity values derived from laboratory measurements of water samples are significantly different from those published in conductivity maps. Large seasonal variations in conductivity, approaching a factor of two in some cases, are a significant complicating factor. --Author's abstract.

E-978 Drimmel, Julius (Vienna), Eine meteorologische Untersuchung von Fernseh-Weitempfang in Wien. (A meteorological investigation of distant television reception in Vienna.) Wetter und Leben, Vienna, 15(9/10):196-198, 1963. 4 refs. German and English summaries p.196. DLC--The television reception over distances from about 1000 to 2000 km in middle latitudes is examined from a meteorological viewpoint. It is found that the anomalous propagation of the television waves is combined in 80% with showery or thundery weather conditions between the transmitter and receiver. This propagation anomaly in the field of ultrashort waves is caused by reflection of the waves on the sporadic E layer. Therefore, the formation of latter in middle latitudes is presumably released in many cases by showers and thunderstorms in summer. --Author's abstract.

E-979 Franceschetti, Giorgio (Istituto Univ. Navale, Naples, Italy), An approach to tropospheric duct propagation. Institute of Electrical and Electronics Engineers, N.Y., Proceedings, 51(11):1481-1486, Nov. 1963. 2 figs., 12 foot-refs., 29 eqs. DLC--A model solution for the em propagation in a spherical stratified troposphere is derived, via the Marcuvitz-Schwinger formalism. The approximations due to the small curvature of the Earth are illustrated. The representation of the sources via the complete set of model solutions is presented, as well as the excitation factors, computed for the vertical electric or magnetic dipole. The possible use of digital and analog computers is highlighted. Future plans for the work are the computations of a great deal of digital and analog solutions, and also the study of the influence of the random variability of the tropospheric refraction index. In the Appendix, a preliminary case $f(z)=az$ is presented. --Author's abstract.

E-980 Furutsu, K., On the statistical theory of electromagnetic waves in a fluctuating medium, Pt. 1. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(3):303-323, May/June 1963. 9 figs., 12 refs., numerous eqs. DWB, DLC--The subject of electromagnetic wave scattering by a randomly varying medium is reviewed giving special emphasis to the technical method of approach. The symbolic representation of Maxwell's equations is introduced to make it easier to survey the whole subject and to formulate the equations. The Feynman diagram method is applied to the computation of the correlation of the fields at different points in space to any order of approximation. The differential equation to be satisfied by the latter correlation function is also derived from another point of view. Then the theory is developed on the "renormalization" of the constants, i.e., the effective propagation constant in a fluctuating medium and the effective coupling constant between the field and the medium, etc.; the explicit expression of the former is obtained to the first order of approximation. The dispersion relation is derived as a connected problem. In Pt. II of this series of papers, a fundamental theory of statistics of the electromagnetic field in a fluctuating medium will be developed. In Pt. III, a few applications to tropospheric scattering will be given. --Author's abstract.

E-981 Furutsu, K. (Nat. Bur. of Stands., Boulder, Colo.), On the theory of radio wave propagation over inhomogeneous Earth. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(1):39-62, Jan./Feb. 1963. 27 figs., 19 refs., 5 eqs. DWB, DLC--The formulas of field strength over an inhomogeneous spherical Earth are obtained on the conditions that (I) the radius and the electrical properties of the Earth's surface discontinuously change several times along the wave path, or (II) the surface of terrain arbitrarily changes in height along the wave path, but it is still smooth everywhere and the radius of curvature is sufficiently large as compared with the wavelength. The case (I) is considered to be more general than those of mixed paths on a smooth Earth, because the latter can be seen as special cases of the former. The case (II) corresponds to the case of multiple diffraction of radio waves by several mountains having finite radii of curvature. In both cases, the unified formulas of field strength are obtained in the form of a multiple residue series, which is reduced to the ordinary Van der Pol and Bremmer formula in the special case of homogeneous ground. The convergence of series of the formulas is very good when the propagation distance on every section of the inhomogeneous ground is long enough or the diffraction loss is large enough, and is poor when any one of these distances is so short that the section is effectively seen as a flat plane, or the diffraction loss on the section is very small. In these cases, the flat Earth or other approximations can be used, and several supplementary formulas are prepared for cases of poor convergence. Several special applications are given. --Author's abstract.

E-982 Gates, David M.; Vetter, M.J. and Thompson, Moody C. (all, National Bureau of Standards, Boulder Labs., Boulder, Colo.), Measurement of moisture boundary layers and leaf transpiration with a microwave refractometer. Nature, London, 197(4872):1070-1072, March 16, 1963. 3 figs., 4 refs. DWB, DLC--The refractive index of air at microwave frequencies is determined chiefly by the air temperature, the total pressure and the partial pressure of the water vapor present. The dependence of the index on the last quantity is sufficiently large that instruments (refractometers) which measure the index can be used to study variations in water vapor pressure. A microwave refractometer is described here which is shown to be extremely sensitive and responsive for the detection of the moisture concentration within a boundary layer near a moist surface. The air must be drawn very slowly into the refractometer. A hyperdermic needle was used as a probe in the experiments described. The boundary layer profile was measured over a free water surface. The transpiration of leaves was observed while they were subjected to various stimuli of light and darkness. Changes in moisture concentration amounting to a variation as little as 0.1 percent relative humidity (at 20° C) can be detected. By reducing the size of the microwave cavity (for example, going to the K band rather than X band) it should be possible to reduce the response time by about one order of magnitude and increase the sensitivity. --R.B.

E-983 Goliashov, A.V., O graficheskom opredelenii effektivnykh znachenii elektricheskikh parametrov pochvy trassy dlia ukv. (Graphical determination of the effective electrical parameters of the ground along a USW communication link.) Radiotekhnika i Elektronika, Moscow, 8(3):389-393, March 1963. 2 figs., table, 3 refs., 8 eqs. Transl. into English in Radio Engineering and Electronic Physics, N.Y., No. 3:341-345, 1963. DLC--A graphical method is proposed for determining the effective dielectric constant and electrical conductivity of the ground along a USW link. The basic quantity used in the method is the field intensity, measured at different USW frequencies along the route and reduced to the same radiated power and antenna gain (directivity). --Transl. of author's abstract.

E-984 Gough, M.W., The plane of polarization as a factor in VHF and UHF broadcasting. Marconi Review, Chelmsford, 26(149):117-131, Second Quarter 1963. 6 figs., 9 refs., 12 eqs. DBS--The prevailing preference for the use of horizontal polarization in the VHF and UHF bands, both in broadcasting systems and in point-to-point links, has prompted a critical appraisal of the comsequences of this policy from the propagation viewpoint. Attention is focused on those regions within the visual range where destructive interference between direct and surface reflected waves may cause deep nulls wherein the field strength is much below the desirable "free space" value. Consideration of representative frequencies in the broadcast bands I-V inclusive, shows that the use of vertical polarization, rather than horizontal, can confer a substantial increase in field strength in the nulls (particularly for oversea paths), under practical conditions which are defined in the article. --Author's abstract.

E-985 Hargreaves, J.K. and Hargreaves, S., Numerical approach to the solution of radio diffraction problems. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):685-698, Nov./Dec. 1963. 18 figs., 2 tables, 9 refs., 10 eqs. --It is proposed that some diffraction problems can be conveniently solved by a direct numerical integration of the Fresnel-Kirchhoff formula. The required properties of the diffraction screen are represented by a series of numbers which can be either regular and periodic, or partially random. The necessary limits and integration intervals are considered, and the method is found to be convenient for Fresnel diffraction and for irregularities not too large compared to the wavelength. Both deep and shallow modulation can be treated. The accuracy of the computations is verified in a simple case of sinusoidal modulation, and some new results are derived for random phase screens. --Authors' abstract.

E-986 Hartman, William J. (Nat'l. Bur. of Stds., Boulder, Colo.), Path antenna gain and comments on "Properties of 400 Mcps long distance tropospheric circuits". Institute of Electrical and Electronics Engineers, N.Y., Proceedings, 51(5):847-848, May 1963. 7 refs. DLC--In connection with Chisholm's paper (see E-894) the author demonstrates by a practical example, how it does not hold that there be no loss in path antenna gain applying an isotropic antenna only at one end of a tropospheric scatter path. Furthermore, neither by theory nor by observation can the loss be determined separately at each end of a path. The purpose of this note is to clear up the prevailing misunderstanding of loss and gain concepts. --W. N.

E-987 Hay, D. R. and Turner, H. E. (both, U. of Western Ontario), Investigation of refractometer measurements in the atmosphere at high relative humidities and temperatures. London, Ontario. Univ. of Western Ontario. Dept. of Physics, Contract AF 19(628)-444, Final Report, July 1963. 146 p. Numerous figs., tables, 140 refs., numerous eqs. (AFCRL-63-631) DWB--Results are presented from a laboratory study of the interaction with air humidity of the sensors of the microwave refractometer and the capacitor type refractometer. Included is a description of the experimental technique, which employs an optical ellipsometer and a specially designed environmental wind tunnel. It has been found that water vapor adsorption occurs at high relative humidities in both the microwave refractometer cavity and the capacitor type refractometer sensor in amounts which cause apparent refractivity errors well in excess of one part per million. --Authors' abstract.

E-988 Heffner, R. W., Ground wave propagation effects on microsecond pulses at 141 Mc/s. Institute of Electrical and Electronic Engineers, International Convention Record, N.Y., 11(8):182-196, March 25-28, 1963. 17 figs., 5 refs., 9 eqs. DBS--A test program was performed to investigate the propagation effects around 141 Mc/s using microsecond pulses of different carrier frequencies. These investigations used omnidirectional antennas at the transmitter and receiver locations. Antenna height at both locations was 12 ft. The results to be discussed are: a) propagation attenuation contour; b) pulse stretching; c) selective fading and enhancement of pulses within the time frequency matrix frame; d) backscatter pulse stretching, and e) polarization dependence. --Author's abstract.

E-989 Hirai, Masaichi et al., Results of propagation tests at 600 Mc and 2120 Mc over long range beyond horizon paths. Japan. Radio Research Labs., Tokyo, Journal, 10(50):311-329, July 1963. 18 figs., 5 tables, 7 refs. DWB, DLC--Measurements were made at 600 Mc and 2120 Mc over 339 km and 802 km paths. Hourly medians of the signal level over the 802 km path were characterized by very small variation during the diurnal, monthly and seasonal periods in contrast with the larger variation observed at ranges of a few hundred kilometers. Small variation in the hourly medians of the signal level at long ranges was closely correlated with stable meteorological parameters in the stratosphere, favoring the theoretical model of primary scattering. Prominent dependence of the hourly medians of the signal level on the carrier frequencies was also observed. The ratio of the median basic transmission loss at 600 Mc to that at 2120 Mc was about 20 decibels on the 802 km path, and it corresponded nearly to the fourth power of the frequency ratio. --Authors' abstract.

E-990 Hirai, Masaichi et al., Transmission loss in VHF and UHF overland propagation beyond the horizon. Japan. Radio Research Labs., Tokyo, Journal, 10(51):357-422, Sept. 1963. Figs., tables, refs., numerous eqs. DWB, DLC--Analysis of the transmission loss in VHF and UHF overland propagation beyond the horizon is made by the use of tropospheric forward scatter theory and of the results of propagation experiment conducted over the 310 km path between Tokyo and Sendai during the period of about 2 yrs at 159.49 Mc/s, 599 Mc/s and 2120 Mc/s, simultaneously. The transmission loss, which is defined by the ratio in decibels of transmitted to received signal power, can be expressed by the combination of 5 terms: the basic transmission loss, the antenna beam deflection loss, the antenna to medium coupling loss, the transmitting antenna gain and the receiving antenna gain. The first three losses are discussed experimentally and theoretically, and their new estimation formulas are established. Noteworthy is that the frequency dependence of seasonal variation of basic transmission loss, the relation between the antenna beam deflection loss and the antenna-to-medium coupling loss, and also the separation of the elevated layer reflection wave from the tropospheric forward scatter wave in the antenna beam swinging experiment are clarified experimentally and theoretically. --Author's abstract.

E-991 Hopfield, H.S. (Johns Hopkins Univ. Applied Physics Lab., Silver Spring, Md.), Effect of tropospheric refraction on the Doppler shift of a satellite signal. Journal of Geophysical Research, Wash., D.C., 68(18):5157-5168, Sept. 15, 1963. 12 figs., 3 refs., 13 eqs. DWB, DLC--An expression for the contribution made by tropospheric refraction to the Doppler shift of a satellite signal is derived. It is assumed that the troposphere is horizontally stratified and does not vary during the time of a pass; a two parameter quadratic expression is used as an approximation to the refractivity profile. The qualitative effect of the troposphere during any satellite pass is to steepen the slope of the Doppler shift versus time curve, making the tracking station appear slightly closer to the orbit than it actually is. When Doppler data from several passes are used for orbit computation, the resultant effect of the troposphere in general is not zero; thus it may bias the orbit slightly, the amount depending on the geometry of the selected passes. Conversely, if the orbit is assumed to be known, the station position as determined by a single satellite pass may be shifted toward the orbit by 50 meters or more. Such errors are not negligible if precise geodetic work is to be done with satellites. The residual tropospheric error in the Doppler shift can probably be reduced by an order of magnitude by using a computed tropospheric correction of the type described here. Some Doppler data from observed satellite passes are presented in corroboration of the theory. --Author's abstract.

E-992 Isted, G.A., Field strength surveys of VHF and UHF broadcast and television service areas. Marconi Review, Chelmsford, 26(149):93-106, Second Quarter 1963. 6 figs., 3 refs. DBS--Notwithstanding the high degree of accuracy attained by prediction techniques in determining the probable performance of VHF and UHF television and broadcast services, practical measurements of field strength still have most important functions to perform. This article describes principally the techniques used for final measurement surveys; this is followed by a discussion of pilot surveys with the aid of a balloon. The apparatus used for mobile and fixed long term surveys is described, and some discussion is devoted to calibration, maintenance and automatic recording. The effect of fading signals on the measurements is also discussed, and means are described to meet the problem. The reporting procedure is an important feature of a practical survey and this is dealt with in the article. --Author's abstract.

E-993 Japan. Science Council. Japanese National Committee for the URSI, Progress in radio science in Japan. Ueno Park, Tokyo, Pub. by the Committee, Sept. 1963. 146 p. Figs., tables, bibliog. at end of each ch. Affiliations of the researchers p. 137-144. Addresses of the organizations p. 145-146. DWB--In Ch. 2, "Radio and troposphere" (p. 21-43); tropospheric propagation, radio climatology, radar meteorology and cloud physics, and space communication are considered. The section treating tropospheric propagation discusses the following topics: a) line of sight propagation, b) beyond the horizon propagation, c) radio propagation across mountains, and d) radio propagation over irregular terrains. --E. K.

E-994 Jones, D.S., High frequency refraction and diffraction in general media. Royal Society of London, Philosophical Transactions, Ser. A, Mathematical and Physical Sciences, 255(1058):341-387, Feb. 21, 1963. 7 figs., 40 refs., 143 eqs. DLC, DWB--The working hypothesis of this paper is that the effect of an opaque boundary on the propagation of high frequency waves in a general medium is to produce a wave reflected according to the laws of geometrical optics together with a field which, to a first approximation, depends upon the difference between the curvatures of a tangent ray and the boundary. In order to determine the latter field, the model of a medium, whose properties vary linearly, above a straight boundary is employed. A first approximation to the field with this model is found, together with an estimate of the error. The formula for the field is then cast into a form which is invariant under a conformal mapping. Since the difference in curvatures of a tangent ray and the boundary is invariant, it is suggested that the field is applicable for all media and boundaries provided certain conditions imposed in deriving the approximation are fulfilled. As a check, the predictions of the formula are compared with independent calculations on (i) a stratified medium above a straight boundary, (ii) a circular cylinder in a homogeneous medium, (iii) a parabolic cylinder in a homogeneous medium, (iv) a circular cylinder in a circularly stratified medium. In all cases the two calculations are in agreement. In a final section the results are extended to phenomena which are aperiodic in time. The proposed universal formula is simple to apply, requiring only the calculation of rays in the medium. --Author's abstract.

E-995 Kashprovskii, V.E. and Kuzubov, F.A., Neodnorodnosti rel'efa pochv i ikh vliianie na rasprostranenie poverkhnostnykh voln. (Irregularities of the soil relief and their influence on the surface wave propagation.) Geomagnetizm i Aeronomiia, Moscow, 3(3):525-536, May/June 1963. 10 figs., table, 14 refs., 8 eqs. Russian summary p. 525. Transl. into English in the corresponding issue of Geomagnetism and Aeronomy, Wash., D.C. DWB, DLC--This paper is concerned with the propagation of medium and long ground (surface) radio waves in particular their scattering by the inhomogeneities of local relief over which the routes of the propagating waves proceed. The results of determinations of the apparent conductivity, σ_k, obtained by measurements of the field potential of the radio stations over the actual paths and from computations taking into account the geometrical properties of the terrain of these paths are presented. It is shown that it is possible in practice to calculate the propagation of medium range ground waves on the basis of maps of distribution of local conductivities, σ_l, and analysis of the terrain of the paths. A number of monograms for simplifying calculations are presented. The capacity of the sea surface to scatter radio waves is analyzed. It is shown that in stormy weather the field potential of coastal radio stations may fall several times at a distance of about 100 km and more in the case of a wave range of 300-600 m. This phenomenon is explained by the fact that the apparent conductivity σ_k of the sea surface diminishes by tens or even hundreds of times. (Met. Abs. 15.1-103) --I. L. D.

E-996 Lane, J. A. and Bean, B. R. (both, Nat'l. Bur. Standards, Boulder, Colo.), Radiometeorological study, Pt. 1, Existing radiometeorological parameters. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):589-595, Nov./Dec. 1963. 5 figs., 2 tables, 29 refs., 3 eqs. (For Pt. 2, see E-969; Pt. 3, see E-968) DWB, DLC--A survey is made of existing radiometeorological parameters, including those derived from the vertical profile of refractive index, n, and others which involve the concept of thermal stability. Quantitative comparison of radio and meteorological data confirm the value of N_s (the surface value of n-1 10^6) and N (the difference in value of N_s and N at one kilometer) in a wide variety of conditions. For particular areas, however, it seems desirable to develop improved prediction techniques using a parameter which is related to the size, stability, and intensity of elevated layers in the troposphere. --Authors' abstract.

E-997 Lee, Chi-chen and others (all, Dept. of Geophysics, Peking Univ.), On the scattering of radar wave by fluctuations of atmospheric refractivity. Acta Meteorologica Sinica Ch'i Hsiang Hsueh Pao. Peking, 33(1):115-125, Feb. 1963. 6 figs., table, 13 refs., 42 eqs. In Chinese. Chinese summary p. 115; English summary p. 125. DLC--Scattering of radar wave by fluctuations of atmospheric refractivity is studied in this paper. The main results are as follows: 1. In case of intensive atmospheric refractivity fluctuations, the power of back scattered radiation due to the refractivity fluctuations may exceed the minimum detectable power of radar, and is of the same order of magnitude as the meteorological "angel" wave. It is suggested that the scattering by refractivity fluctuations may be an important mechanism in the formation of meteorological "angel" wave. 2. An equation is derived to express the wave magnitude as a function of the distance propagated in the medium with refractivity fluctuations. It is found that the scattering effect does not affect the wave magnitude significantly in general, but it may cause the wave width to spread when the scale length of refractivity as well as the wave width of radar are quite small. --Authors' abstract.

E-998 Lizuka, Keigo, Experimental investigation on the behavior of the dipole antenna near the interface between the conducting medium and free space. Harvard Univ. Div. of Engineering and Applied Physics, Contract AF 19(604)-7262, Scientific Report No. 4, April 15, 1963. 20 p. 14 figs., 14 refs. (AFCRL-63-455)--A study was made of the driving point admittance and the amplitude and phase distribution of the current for a dipole antenna near and parallel to the interface between the conducting medium and free space. The loss tangent of the medium, the depth and the length of the antenna were taken as parameters. --Author's abstract.

E-999 Maenhout, A. G., La distribution de deux parametres radiométéorologiques à Uccle (1957-1962). (Distribution of two radiometeorological parameters at Uccle (1957-1962).) Ciel et Terre, Brussels, 79(9/10):303-310, Sept./Oct. 1963. 8 figs., 5 tables, 7 refs. DWB, DLC--The author describes the statistical distribution of two radiometeorological parameters: the atmospheric refractive index and the average gradient of this index between the ground surface and the 850 mb level. Both values were computed twice a day at the aerological station of the Royal Meteorological Institute (Uccle) from April 1, 1957 to March 31, 1962. The cumulative distribution of the index and its gradient computed from the meteorological observations at 00h and 12h UT for a 5 yr period (April 1957 - March 1962) are represented in 8 graphs showing the time percentage during which the value in ordinates is not exceeded. Some characteristic data of these distributions are represented in four tables. Another table gives the scattering of the values of refractive index at the surface and of its gradient around their median value. It is shown that this scattering is more important at 12h than at 00h and in both cases it is higher in summer than in winter. --A. V.

E-1000 Martin, F.L. and Wright, F.E. (both, U.S. Naval Postgraduate School, Monterey, Calif.), Radar ray refraction associated with horizontal variations in the refractivity. Journal of Geophysical Research, Wash., D.C., 68(7):1861-1869, April 1, 1963. 4 figs., 2 tables, 7 refs., 46 eqs. DWB, DLC--The relative bending effects on a radio ray of the horizontal and vertical gradient of refractivity are investigated. With the use of ray curvature formulas developed by WONG, convenient differential equations governing the 3 dimensional ray path are derived. It is also shown that the ratio of 'horizontal to vertical' bending effects is maximum when the ray is propagated in the vertical plane containing the horizontal gradient of refractivity. In a two dimensional example, computations of path height as a function of horizontal distance are obtained by numerical integration. For this purpose, a regional space-time averaged exponential model drawn from climatological studies of BEAN and THAYER has been used. Even though this smoothed model and an extreme version of it derived synthetically by increasing the horizontal gradient everywhere by a factor of 10 have comparatively strong horizontal gradients, the 'horizontal bending' effect is virtually negligible. It is not implied, however, that this conclusion is necessarily applicable to an atmosphere exhibiting small scale fluctuations in the refractivity pattern. The ray paths corresponding to the nonhomogeneous model are significantly different from those in a horizontally uniform atmosphere. The problem of replacing a nonhomogeneous model by an equivalent horizontally uniform one is also investigated. The choice of the best uniform atmosphere depends upon minimizing the rms height error over a designated horizontal path length, and this in turn requires the specification of several ray propagation parameters in addition to the distribution of refractivity. --Authors' abstract.

E-1001 Matsuo, Masaru, Backscattering measurements by an FM radar method. IEEE, Transactions on Antennas and Propagation, 11(4):485-489, July 1963. 11 figs., 11 refs., 4 eqs. DLC--The principles and method for measuring the backscattering cross section of an arbitrary target demonstrates that a nonreflecting behind the target is not requisite. --W. N.

E-1002 Meyer, Hans Klaus (German Weather Service, Central Office, Offenbach (Main), The troposphere. (In: NATO Advanced Study Institute, Corfu, Meteorological and astronomical influences on radio wave propagation. Ed. by Björn Landmark. N.Y., Macmillan, 1963. p.83-119. 16 figs., 3 tables, 23 refs., eqs.) DLC, DWB (621.384 N864me)--A detailed description of the troposphere is given. The motions and irregularities of the inversion layers, and the different aspects of turbulence are discussed. Finally, the meteorological influences on radio wave propagation are considered. --Author's abstract.

E-1003 Morris, D. (Nat'l. Res. Council, Ottawa), Surface wave propagation over plane layered dielectrics. Canadian Journal of Physics, Ottawa, 41(2):405-413, Feb. 1963. 4 figs., 11 refs., eqs. DWB, DLC--A two layer dielectric system, consisting of a thin polystyrene sheet on top of water, is examined as a possible guiding structure for surface waves. Experimental investigations, at a frequency of 9.35 Gc/sec, of the phase velocity of the waves close to the surface of the upper layer, and the power variation with height above it, are described. A slow wave was found to propagate near the surface and its phase velocity was found to agree with that predicted theoretically for a TM surface wave. Qualitative agreement between the experimental and theoretical power variation with height confirmed the existence of a surface wave contribution to the total field above such a layered dielectric system. --Author's abstract.

E-1004 Morrow, W. E., Jr. et al. (all, Lincoln Lab., M.I.T.), Influence of terrain shielding on radio wave propagation at 8000 Mc. Institute of Electrical and Electronics Engineers, N.Y., Proceedings, 51(6):955-956, June 1963. 2 tables, foot-ref. DLC--Terrain shielding measurements at 8350 Mc were conducted at two locations (1.05 mi and 10.8 mi distance) June 20-22, 1962 by the M.I.T., Lincoln Lab. Loss in excess of free space for the two sites were 102 db and 116 db respectively and compared with 400 Mc data corrected to 8000 Mc the loss would be 96 db and 123 db. It is concluded that terrain shielding which effectively protects receivers from neighboring high power transmitters will suffer during precipitation. --W. N.

E-1005 Muchmore, R. B. and Wheelon, A. D., Frequency correlation of line-of-sight signal scintillations. IEEE, Transactions on Antennas and Propagation, 11(1):46-51, Jan. 1963. 4 figs., 12 refs., 44 eqs. DLC--The problem is calculated theoretically, using the spectrum method and an arbitrary model of the turbulent irregularities. Estimate the scintillation coherence between adjacent frequencies in the RF spectrum. Correlation vs. separation frequency results are compared with experimental results. --W. N.

E-1006 Nefedov, E. I., Nestatsionarnye iavleniia pri beregovoĭ refraktsii radiovoln. (Nonstationary phenomena associated with coastal refraction of radio waves.) Radiotekhnika i Elektronika, Moscow, 8(10):1659-1664, Oct. 1963. 2 figs., 12 refs., 22 eqs. Transl. into English in the corresponding issue of Radio Engineering and Electronic Physics, N.Y. DLC-- With the help of an inverse Fourier transform applicable to exact solution of the stationary problem of radio wave diffraction at a shoreline, a solution of the nonstationary problem is obtained, which is suitable for a broad class of pulsed signals. --Transl. of author's abstract.

E-1007 Parkinson, C. E., Long range interference in band III. Marconi Review, Chelmsford, 26(14):107-116, Second Quarter 1963. 9 figs., 3 refs. DBS--The article gives an analysis of field strength measurements recorded in Hereford, of Mendlesham and Chillerton Down, I.T.A. transmissions, as a means of assessing the probable levels of co-channel interference which would be experienced by an ancillary television station broadcasting in channel 11. The results are compared with those from similar surveys. The correlation between the incidence of high signal levels and anticyclonic weather conditions is demonstrated. --Author's abstract.

E-1008 Parry, Charles A. (ITT Communication Systems, Inc., Paramus, N.J.), The aperture to medium coupling loss in tropospheric scatter systems. Institute of Electrical and Electronics Engineers, N.Y., Proceedings, 51(6):933-934, June 1963. 2 figs., 9 foot-refs., 2 eqs. DLC--Brief discussion of a new theoretical curve plotted for comparison with the curves for the relations between loss Lc and (θ/ϕ) of some other workers. The new curve apparently will be useful in future scatter system design. --W. N.

E-1009 Parry, C. A., On the prediction of the inherent bandwidth capability of the tropospheric scatter link. IEEE International Convention Record, 8:215-232, March 1963. 11 figs., 5 tables, 30 refs., 22 eqs. DLC--The tropospheric scatter mode of propagation exhibits a multipath characteristic that limits the usable bandwidth. In this paper, the background on this subject is briefly reviewed, and equations are derived which may be used for estimating bandwidth in terms of intermodulation noise level. Predicted bandwidth vs. performance curves are also given. The need for further experimental data on this problem is strongly emphasized. --E. K.

E-1010 Patrick, W.S. and Wiggins, M.J., Experimental studies of the correlation bandwidth of the tropospheric scatter medium at five gigacycles. IEEE Transactions on Aerospace and Navigational Electronics, N.Y., 10(2):133-137, June 1963. 12 figs., 3 refs., 2 eqs. DLC--An experimental program has been conducted to collect information concerning the correlation bandwidth of the tropospheric scatter medium in the 5 Gc region. By transmitting bursts on 5 different frequencies, data were obtained on separations of 1, 5, 3.0, 4.5 and 6.0 Mc for a 100 mi path. An IBM 7090 computer was programmed to calculate the cross correlation coefficients between the pair of frequencies. The experimental results are in agreement with theory, and indicate that frequencies as closely spaced as 1.5 Mc can have correlation coefficients of the order of 0.4. --Authors' abstract.

E-1011 Prescott, Howard (Radio Engrg. Labs., Inc., Bethesda, Md.), Intermodulation distortion on tropospheric scatter systems. Institute of Electrical and Electronics Engineers, N.Y., Proceedings, 51(9):1244, Sept. 1963. 2 figs., 4 foot-refs. DLC --Pending the publication of a paper prepared on a method by which the time distribution of S/I (i.e., signal-to-intermodulation ratio) can be determined for specific paths, this note contains universal curves based on "smooth Earth" profiles and a surface refractivity of Ns = 301. --W.N.

E-1012 Rainey, R.J., Jr. and Thorn, D.C., A refraction correction technique which include nonsymmetric index of refraction. IEEE, Transactions on Antennas and Propagation, 11(4):446-450, July 1963. 3 figs., 6 refs., 13 eqs. --At White Sands Missile Range, elevation angle errors > 20 the radar capabilities occur at 1° launch angle and 50 mi range. A method to compute the atmospheric refraction directly from the basic equation of a ray path in a variable velocity medium is described here. --W.N.

E-1013 Rider, G.C., Weather and radar. Marconi Review, Chelmsford, 26(149):144-162, Second Quarter 1963. 13 figs., 9 refs., 5 eqs. DBS--The article reviews the way in which meteorology and radar engineering impinge on one another. The radar equation is briefly derived for extended targets and the optimization of its parameters is then illustrated in various circumstances according to whether precipitation is a wanted or an unwanted target. The use of radar is discussed for storm warning, rainfall measurement, wind finding, etc., and techniques for eliminating weather echoes are outlined. Anomalous propagation is also mentioned. --Author's abstract.

E-1014 Ring, Rose M., Theoretical study of tropospheric radiowave propagation. Boston College, Contract AF (628)-2772, Scientific Report No. 1, May 1963. 82 p. 5 figs., 11 refs., numerous eqs. (AFCRL-63-713)--Similar methods to those of V.A.FOCK are used to study the following radio wave propagation problems: field calculation, a homogeneous and an inhomogeneous atmosphere, and superrefraction. (Met. Abs. 15.5-18)--W.N.

E-1015 Ryzhov, Iu.A., O vliianii diagramm napravlennosti antenn na intensivnost' prinimaevogo izlucheniia pri rasseianii radiovoln na neodnorodnostiakh troposfery. (Influence of directional patterns of antennas on received signal intensity of radio waves scattered by tropospheric irregularities.) U.S.S.R. Ministerstvo Vysshego i srednego Spetsial'nogo Obrazovaniia, Izvestiia Vyshikh Uchebnykh Zavedeniĭ, Radiofizika, 6(5):952-957, 1963. Fig., 11 refs., 21 eqs. English summary p. 957. DLC--The problem of the influence of receiving and transmitting antennas on parameters of received scatter signals is considered. A general formula is obtained which expresses signal intensity in the form of an integral from the produce of antenna patterns and angular energy spectrum of the scattered field. In the particular case of narrow antenna patterns, it is shown that the functional dependence of scattering on the parameters considered is the same as in the case of radio wave scattering within the given volume with irregularities. --Author's abstract.

E-1016 Smith-Rose, R.L. (Vice-President, Institution of Electrical Engineers, President, I.S.R.U., Brussels), Radio and international geophysical research. Nature, London, 199(4888):11-15, July 6, 1963. DWB, DLC--This paper is the substance of an address delivered at the U.S. National Telemetering Conference, Albequerque, on May 21, In it the author reviews the various methods by which radio, especially the practice of telemetry, is used in studies of atmospheric properties. The atmosphere is divided into 3 regions, the troposphere, the ionosphere and the region above the ionosphere. Radio studies of the troposphere which are discussed are radiosonde techniques, the study of cloud and precipitation centers using radar, atmospherics, lightning studies, 'angels', and the development of microwave refractometers. --R.B.

E-1017 Sweezy, W.B. and Bean, B.R., Correction of atmospheric refraction errors in radio height finding. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(2):139-151, March/April 1963. 9 figs., 9 tables, 9 refs., 31 eqs. DWB, DLC--Atmospheric refraction errors in height finding radar are studied by means of detailed refraction calculations for a wide range of meteorological conditions. For targets up to 70,000 ft above ground and 150 mi ground distance from the radar site, the mean height error was found to be as much as 5000 ft with a standard deviation of 1200 ft. A correction for the surface value of the refractive index at the radar site would eliminate the mean height error and reduce the maximum standard deviation to less than 900 ft. An additional correction for the initial gradient of the refractive index and the value of the refractive index at one kilometer above the surface would reduce the maximum standard deviation to less than 400 ft. Methods of correcting height errors based on available meteorological data are presented and shown to be operationally practical. --Authors' abstract.

E-1018 Tratas, Iu.G., Osobennosti optimal'nogo priema impul'snogo signala pri dal'nem troposfernom rasprostranenii radiovoln. (Features of optimum reception of a pulsed signal in long distance tropospheric propagation of radio waves.) Radiotekhnika i Elektronika, Moscow, 8(4):546-551, April 1963. 3 figs., 4 refs., 19 eqs. Transl. into English in Radio Engineering and Electronic Physics, N.Y., No. 4:590-594, 1963. DLC--The detection of a pulse signal beyond the horizon is discussed. The design of an optimum receiver is determined. The increase in the signal duration at the receiver output as compared with the case where the transmitter and receiver are in the line of sight is discussed. --Transl. of author's abstract.

E-1019 Tsydypov, Ch.Ts., Vliianie rel'efa na kogerentnoe otrazhenie ukv v neodnorodnoĭ troposfere. (Influence of local topography on coherence of ultrashort wave reflection in an inhomogeneous troposphere.) Radiotekhnika i Elektronika, Moscow, 8(5):868-870, May 1963. Fig., table, 4 refs., 8 eqs. Transl. into English in Radio Engineering and Electronic Physics, N.Y., No. 5:875-877, 1963. DLC--In the coherent theory of upper tropospheric propagation of ultrashort waves the earth is taken as an ideally smooth sphere which is not the case with actual paths. As a result of this discrepancy the altitude of the first reflecting layer depends on the choice of location of the terminal points of the link. In this note an attempt is made to calculate the characteristics of topography and to obtain a formula for coherent reflections, suitable for paths of arbitrary profile. --G.T.

E-1020 Turner, H. E. and Hay, D. R. (both, Dept. of Physics, Univ. of Western Ontario, Canada), Fine structure of temperature and refractivity in the lower troposphere. Canadian Journal of Physics, Ottawa, 41(10):1732-1737, Oct. 1963. 3 figs., 13 refs., eq. DWB, DLC--Two improved devices were used for measuring the fine structure of the air, in particular, the inhomogeneities in the refractive index of the air, responsible for reflection or scattering of radar microwaves. The contrasts in air refractivity are associated with temperature fluctuations or changes in partial pressure of water vapor. The instruments, a capacitor type refractometer and a temperature sonde which uses a resistance wire probe, both designed for balloon borne sounding, were tested in the field with satisfactory results. The direct measurements confirmed the existence of atmospheric irregularities, although physically smaller than measured previously. --S. N.

E-1021 Vickers, G. A., Radio wave propagation and the planning of VHF and UHF sound and television services. Marconi Review, Chelmsford, 26(149):55-92, Second Quarter 1963. 6 figs., 8 refs. DBS--The article begins by stressing the importance of detailed planning of VHF and UHF sound and television services if the desired service area is to be achieved within the limited number of available frequency channels and without causing undue co-channel interference. After a summary of the chief features of radio wave propagation in these bands, the field strength requirements for satisfactory reception are reviewed and the relative performance in the 3 television bands is contrasted. Since the planning requires a knowledge of the relationship between radiated power and field strength at each receiving locality, the various available methods of establishing this relationship are discussed, with special reference to the theoretical or "paper" method used extensively by the Marconi Co. A description is given of the estimation of co-channel interference levels and the preparation of predicted coverage maps, and the article ends with a review of some of the many practical aspects of the planning, including the selection of transmitting sites. --Author's abstract.

E-1022 Waibel, E. (Inst. für Stratosphären-Physik, Hannover, Germany), Method to eliminate noise during the transmission of radio pulses. Review of Scientific Instruments, N.Y., 34(1):31-33, Jan. 1963. 4 figs., 5 ft. refs. DWB, DLC--The wide frequency emission band of noise signals which interfere with signals of radio transmitters is used for eliminating these noise signals. They are received separately beside the telemetering frequency and are quenched by a suitable anticoincidence circuit. --Author's abstract.

E-1023 Wait, J. R., Oblique propagation of ground waves across a coastline, Pt. 1. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):617-624, Nov./Dec. 1963. Pt. 2, by J. R. Wait and C. M. Jackson, Ibid., 67(6):625-630, Nov./Dec. 1963. --In Pt. 1, the amplitude and phase of the ground wave are calculated for oblique propagation across a flat lying coastline. This land and sea are assumed to be smooth and homogeneous. Attention is focused on the effects which take place near the coastline. It is shown that the reflected wave depends critically on the angle of incidence, θ_σ , while the transmitted wave has only a weak dependence on θ_σ . In Pt. 2, the amplitude and phase are calculated for oblique propagation across a coastline with a sloping beach. In this case, the land and sea are taken to be plane surfaces and the beach slope is constant. It is shown that the reflected wave may be quite significant and it has a fundamentally different character from the reflected wave in the case of a flat lying coastline. --Author's abstract.

E-1024 Wait, James R. (NBS, Boulder, Colo.), Review of mode theory of radio propagation in terrestrial waveguides. Reviews of Geophysics, Wash., D.C., 1(4):481-505, Nov. 1963. Bibliog. p. 500-505, 98 eqs. DWB--This paper is an expository review of the theory of guided waves that occur in the Earth's atmosphere. We introduce the subject by treating the problem of radio propagation around the surface of an airless spherical Earth. This leads readily to the classical solutions of VAN DER POL and BREMMER and the more recent work of FOCK in the USSR. The influence of a troposphere with a smooth profile of refractive index is then considered. This analysis, which follows the recent work of ARMAND, confirms that a monotonically varying or smooth profile will not change the basic structure of the diffraction field. The modifications resulting from the presence of a tropospheric duct are developed by using a parabolic profile of refractive index in the manner suggested by FOCK, WEINSTEIN, and BELKINA. It is shown that the dominant modes in this system have low attenuation. The second and major part of the paper is devoted to the theory of the mode propagation of VLF radiowaves. Here the effective waveguide is the space formed by the Earth's surface and the lower edge of the ionosphere. The mode solution is developed as a natural generalization of the classical airless Earth theory. It is shown, for frequencies less than about 10 kc/s, that the field may be described in terms of flat Earth modes analogous to those in a straight rectangular microwave guide. At higher frequencies, however, the Earth curvature plays a major role and the character and excitation of the modes are changed drastically. Complications resulting from the anisotropy of the ionosphere are also considered. A critical discussion of the recent work on the subject is given. --Author's abstract.

E-1025 Wait, J. R. and Walters, L. C., Curves for ground wave propagation over mixed land and sea paths. IEEE, Transactions on Antennas and Propagation, 11(1):38-45, Jan. 1963. 9 figs., 20 refs., 14 eqs. DLC--Specific numerical results are presented for ground wave propagation over paths which are part sea and part land. The problem is idealized to the extent that earth is a smooth spherical surface. The method is based on a previous formulation in terms of mutual impedance between two vertical electric dipoles on an inhomogeneous spherical earth. Amplitude and phase of the ground wave are given for various combinations of the following parameters: frequency 1000, 100, and 20 kc; land conductivities 100 and 10 mmhos/m; and a sea conductivity of 4 mhos/m. Most of the curves exhibit the well known recovery effect which occurs beyond the coast line for propagation from land toward the sea. --Authors' abstract.

E-1026 Waterman, A. T., Jr. and Strohbehn, J. W. (both, Stanford Univ.), Reflection of radio waves from undulating tropospheric layers. U.S. National Bureau of Standards, Journal of Research, Sec. D, 67(6):609-616, Nov./Dec. 1963. 9 figs., 14 refs., 8 eqs. DWB, DLC--This report examines the nature of coherent reflections of radio waves at near grazing incidence, from a horizontal atmospheric layer on which is superimposed a slight wave motion. The existence of reflections of this type is merely postulated, and the development then proceeds to examine the consequences of such a postulate with reference to measurements obtainable in trans-horizon propagation experiments. The properties of angle of arrival, signal level, fading rate, and Doppler shift are examined, together with their rates of change with time. --Authors' abstract.

E-1027 Watt, A. D.; Mathews, F. S. and Maxwell, E. L. (all, DECO Electronics, Inc., Boulder Div., Boulder, Colo.), Some electrical characteristics of the Earth's crust. Institute of Electrical and Electronics Engineers, N.Y., Proceedings, 51(6):897-910, June 1963. 18 figs., table, 39 refs., 16 eqs. DLC--Wave propagation over ground, particularly at $< 10^6$ cps is affected by the changing conductivity of surface materials and conditions. Measurements of ground conductivity from samples or in situ by 1) the bridge method, 2) four electrode array and 3) the magnetotelluric method are discussed. Conductivity variations with depth below surface for frequencies between 0-10 cps are considered. Conductivities of various soils, rocks and water as well as of snow, ice and permafrost are tabulated. Temperature and pressure affect the electric properties of the Earth's surface materials, the conductivity of which was found to range from 5 mhos/m for sea water to between 10^{-8} and 10^{-9} mhos/m for very dry rocks. --W. N.

E-1028 Weston, V.H., Theory of absorbers in scattering. IRE Transactions on Antennas and Propagation, 11(5):578-584, Sept. 1963. Fig., table, 10 refs., 21 eqs. DLC--Two new theorems are introduced. Considers the effect of absorbers on scattering from complex shapes, diffracted field taken into account. High frequency scattering from any smooth convex body is examined. Uses the conditions given in the theorems to determine their effect on the creeping waves, greater attenuation of which would be less from a perfectly conductive surface. Shows how highly refractive absorbers reduce back scattered cross section for smooth convex bodies in the resonance region. --From author's abstract.

E-1029 Whale, H.A. (Seagrove Radio Research Station, Univ. of Aukland, New Zealand), Focusing effects in spherical Earth radio propagation. Nature, London, 197(4870): 886-887, March 2, 1963. 2 refs. DWB, DLC--The flat Earth scattering theory for the propagation of short radio waves over long distances has been extended to cover propagation around a spherical Earth. Using a coordinate system, in which the transmitter is located at the pole and the transmitter is located by means of a co-latitude and a longitude measured from the direction of maximum strength of the transmitted beam, formulas are given for the distribution of received power, the standard deviation of the spread of the incoming fan of waves and the extent of the antipodal area. Along a line at 260° angular distance from the transmitter the deviation of the main incoming direction from the great circle is zero, irrespective of the beamwidth, direction or ionospheric scattering coefficient of the transmitter. It is proposed to call this line the reciprocal line to the transmitter. (Met. Abs. 14. 10-167)--R.B.

E-1030 Wood, H.B. (Standard Telecommunication Labs., Ltd.), Performance of v.f.f.m. teleprinter circuits operating over a tropospheric scatter link. Institution of Electrical Engineers, London, Proceedings, 110(11):1933-1940, Nov. 1963. 10 figs., 3 refs., 13 eqs. DLC--The paper describes an investigation undertaken to derive data on which to base estimates of the telegraph performance to be expected over tropospheric scatter radio links. H.B. LAW has shown how the telegraph error rate depends on the signal/noise ratio at the input to the telegraph equipment for the case of a steady signal, and also for the case of one subject to Rayleigh fading. As the signal received over a tropospheric scatter link has a short term amplitude distribution following the Rayleigh law, it might be expected that LAW's results could be applied directly. The problem is complicated, however, by the fact that most operational scatter links employ frequency modulation of the radio carrier, with the result that the receiver exhibits threshold effects. When the fading signal falls below the receiver threshold, which it may frequently do, the output signal/noise ratio is no longer linearly dependent on the input carrier/noise ratio. It is shown, however, that, if the output/input characteristic of the radio receiver is known, the telegraph error rate can still be calculated in terms of the mean carrier/noise ratio. An empirical law for the output/input characteristic of an f.m. radio receiver is proposed, and, using this law, the telegraph performance of circuits carried by tropospheric scatter links is then calculated for the cases of non-diversity and dual and quadruple selector type diversity receiving systems.

It was considered desirable to make experimental checks, and an analogue method was employed in which the effects of the radio path were recorded and used to operate a fading machine, so as to reproduce, in the laboratory, the conditions which had existed over an actual radio path. A comparison is made of predicted values of telegraph error rate with experimental results obtained using the fading machine. --Author's abstract.

E-1031 Zhevakin, S. A. and Naumov, A. P., O koeffitsiente pogloshcheniia elektromagnitnykh voln vodianymi parami v diapazone 10 $\mu \div 2$ sm. (Absorption coefficient of electromagnetic waves by water vapor in the 10 $\mu \div 2$ cm range.) U.S.S.R. Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniia, Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Radiofizika, 6(4):674-694, 1963. 17 figs., 2 tables, 54 refs., 19 eqs. English summary p. 694. DLC--Calculations are made of the absorption of radiation in the $10\mu \div 2$ cm range by atmospheric water vapor. The shape of lines is obtained from a solution of the kinetic equation and half widths of lines are calculated by using Anderson's theory. Matrix elements of the direction cosines for the rigid asymmetrical top are used, however, centrifugal perturbation is taken into account in counting the molecular terms of H_2O. The results are in good agreement with experiment. --Authors' abstract.

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E-1032 Bell, M.B.; Hay, D. R. and Johnston, R. W. (all, Univ. of Western Ontario, London, Ont.), Observations upon clear air stratification in the lower troposphere. Canadian Journal of Physics, Ottawa, 42(2):273-286, Feb. 1964. 5 figs., 2 tables, 27 refs., 6 eqs. DWB, DLC--A study of the fine structure of air refractivity in the lower troposphere has been continued through the spring and summer of 1962 by the observation of weak radio reflections from clear air (radar angels), with a vertically directed radar of special design operating at 6770 Mc/s. These observations have been limited to the layer of frictional influence, within 1500 meters of the surface. The interpretation suggests that the reflecting centers are broad strata whose refractivity contrasts weakly with that of their environment, whose vertical depths are no more than a few centimeters, and which are either flat over horizontal distances of at least several meters or concave downwards with radii of curvature somewhat less than their height above ground. The incidence of transitory reflections generally follows a regular distribution in the vertical, with a maximum at 300 m; the form of this distribution is modified by the intrusion of weather fronts, thermals, and other clear weather structures. The transitory reflecting stratus is cut off from its generating source early in its life history, to be dispersed into its environment by molecular or eddy diffusion. The total incidence of transitory angels fluctuates quasi-periodically in time, with a period of about 10 min; it is suggested that this periodicity is due to the influence of internal gravity waves in the atmosphere. In contrast, persistent reflections are associated with a more stable environment; the maximum incidence is at the lowest heights observed, with a gradual decrease toward higher levels. Their relationship to clear weather structure is less certain than for the transitory reflections. The persistent reflecting stratus must be replenished continuously by the generating source during its lifetime to offset diffusion into the environment. --Authors' abstract.

E-1033 Braam, G.P.A. (Royal Netherlands Meteor. Inst., De Bilt), Propagation of radio waves with frequency 99.9 Mhz as a function of the vertical structure of the atmosphere derived from daily radiosonde observations. U.S. National Bureau of Standards, Journal of Research, Sec. D, 68(2):257-260, Feb. 1964. Fig., 5 tables, 14 refs. DWB, DLC--A special parameter was derived from radiosonde observations to indicate the atmospheric structure. The relation between this parameter and the propagation of UHF radio waves beyond the horizon was investigated statistically. It was found that this relation was strong at midnight, but much weaker, though not absent, at noon. As an analogous difference exists between summer and winter data, it is suggested that for abnormal propagation apart from special layers with a large gradient of the refractive index, also, a stable atmosphere in the lower levels is required. --Author's abstract.

E-1034 Gjessing, Dag T., An experimental study of the variation of the tropospheric scattering cross section and air velocity with position in space. IEEE Transactions on Antennas and Propagation, N. Y., 12(1):65-73, Jan. 1964. 17 figs., 10 refs., 8 eqs. DLC--An experimental study of the spatial homogeneity of the tropospheric permittivity and air velocity fields is presented. Knowledge regarding the homogeneity is imperative in order to measure the 4 dimensional spectrum of the permittivity fluctuations to be discussed in a later report. It is found that in most cases the scattering ability of the troposphere is enhanced with height. The variation of scattered power with position of the scattering volume along a horizontal direction varies very little. Similarly, it is shown that the wind velocity varies very little with height in the height region under consideration, while the velocity varies somewhat in a horizontal direction. Velocity and scattered power do not seem to correlate. --Author's abstract.

E-1035 Gjessing, Dag T. and Irgens, F., On the scattering of electromagnetic waves by a moving tropospheric layer having sinusoidal boundaries. IEEE Transactions on Antennas and Propagation, N. Y., 12(1):51-64, Jan. 1964. 12 figs., 15 refs., 24 eqs. DLC--The transhorizon signal is assumed to be adequately described by a simple Waterman scatter model and to be ascribable to a partial reflection from a rippled atmospheric layer. Here it is assumed that the boundary of this layer is space sinusoidal in a plane normal to the line determined by the transmitter and receiver points. The thickness of the layer is approximately uniform and the permittivity is assumed to vary in a Gaussian manner. Theoretical and experimental descriptions of the vertical transverse permittivity spectrum are obtained and compared. A corresponding comparison is made between the theoretical and Waterman experimental received power vs azimuth angle patterns. In both cases, there is a qualitative agreement provided the ratio of ripple amplitude wavelength is large. In addition an estimate of the transhorizon signal power spectrum is compared with experimental observations. Experimentally, the power spectrum is found to broaden with increasing scattering angle and beamwidth, while the present scatter model yields a power spectrum whose width is an inverse function of scattering angle and beamwidth. --Authors' abstract.

E-1036 Kane, Julius (U. of R.I., Kingston) and Karp, Samuel N. (Div. of Electromagnetic Research, N.Y. Univ.), Simplified theory of diffraction at an interface separating two dielectrics. U.S. National Bureau of Standards, Journal of Research, Sec. D, 68(3):303-310, March 1964. Figs., 10 refs., 18 eqs. DWB, DLC--Many electromagnetic problems involving more than one dielectric medium are not susceptible to an exact solution, when the appropriate boundary conditions are considered. The purpose of the present paper is to formulate a new boundary condition, which is capable of leading to mathematically tractable problems, with limited sacrifices in accuracy. --Authors' abstract.

E-1037 Misme, Pierre, Le feuilletage atmosphérique. (Atmospheric foliation.) Annales des Télécommunications, Paris, 19(1-2):49-59, Jan./Feb. 1964. 6 figs., 2 tables, 17 refs., 22 eqs. DLC--It is shown that irregularities of the horizontal fields of temperature and humidity at a given level manifest themselves as pressure irregularities at another level. Horizontal air movements in the atmospheric layer between these two levels are studied. It is found that above a certain altitude the horizontal oscillatory movements destroy the source of the pressure irregularity and this leads to "foliation" The atmosphere is considered as a thermal machine containing warm and cold sources, the difference between the two being maintained by the radiative balance. This makes it possible to calculate the amount of thermal energy being transformed into movement. Using Obukhov's hypothesis, the smallest size of turbulent elements is calculated, which makes it possible to determine the vertical distance between "foils". The study is generalized to apply to all levels of the atmosphere. Experimental examples taken from different authors are in agreement with this theory. An appendix indicates a method for identifying foliation in the upper stratosphere. --Transl. of author's abstract.

E-1038 Misme, P., Radioelectricite et troposphere (Commission II, 14e Assemble e Generale de l'U. R. S. I., Tokyo, Sept. 1963). (Radioelectricity and troposphere, Commission 2, 14th General Assembly of the I. U. S. R., Tokyo, Sept. 1963.) L'Onde Electrique, Paris, 44(444):234-237, March 1964. 2 figs. DBS--Contains brief summaries of reports presented to the Commission by some 20 authors on progress achieved in the study of atmospheric models, radio climatology, radar meteorology, tropospheric influences on space communication, influence of terrain irregularities, and propagation of millimeter waves. --G. T.

E-1039 Wait, James R. (Central Radio Propagation Lab., Nat'l. Bur. of Standards, Boulder, Colo.), Oblique propagation of ground waves across a coastline, Pt. 3. U.S. National Bureau of Standards, Journal of Research, Sec. D, 68(3):291-295, March 1964. 8 figs., 5 refs., 16 eqs. DWB, DLC--This paper, which is a continuation of two earlier papers of the same title, (See E-1023), contains numerical results for the field anomaly near a coastline when the surface impedance changes in a linear manner between land and sea. The earlier results for an abrupt boundary are recovered as the width of the transition region is reduced to zero. In general, it is found that the characteristics of the transition region will not produce significant modifications of the transmitted field. However, the magnitude of the reflected field is greatly reduced as the width of the transition zone is increased beyond about one-quarter wavelength. --Author's abstract.

E-1040 Wait, J. R. (Central Radio Propagation Lab., Nat'l. Bur. of Stds., Boulder, Colo.), Coherence theories of tropospheric radio propagation. IEEE Transactions on Antennas and Propagation, N.Y., 12(5):649-651, Sept. 1964. 11 refs., 6 eqs. DLC--Using a model atmosphere refractive index, which is maximum at ground level, decreasing monotonically to the free space value at greater height, an attempt is made to appraise the existing and fundamentally disagreeable two approaches to the problem. --W. N.

E-1041 Wait, J. R. and Jackson, C. M. (both, Central Radio Propagation Lab., Nat'l. Bur. of Stds., Boulder, Colo.), Influence of the refractive index profile in VHF reflection from a tropospheric layer. IEEE Transactions on Antennas and Propagation, N.Y., 12(4):512-513, July 1964. 3 figs., 4 refs., 16 eqs. DLC--This theoretical investigation shows what happens when the change of refractive index ( ) is not abrupt but is a continuous function of height . Notwithstanding consideration to the finite horizontal extent of the tropospheric layers as in a practical situation, the results presented provide insight into gradient-type reflection. --W. N.

E-1042 Wait, J. R. (Nat'l. Bu. of Standards, Boulder, Colo.), Note on VHF reflection from a tropospheric layer. U.S. National Bureau of Standards, Journal of Research, Sec. D, 68(7):847-848, July 1964. 2 figs., 4 refs. --Some remarks concerning reflection from tropospheric layers are made with special reference to a recent paper by Bean, Frank, and Lane on the subject. It is indicated that the finite vertical extent of the layer must be considered in the analysis.

SUPPLEMENTARY MATERIAL

E-1043 Ames, L.A.; Martin, E.J. and Rogers, T.F. (all, A.F.Camb.Res.Ctr., Bedford, Mass.), Some characteristics of persistent VHF radiowave field strengths far beyond the horizon. Institute of Radio Engineers, N.Y., Proceedings, 47(5, Pt. 1):769-777, May 1959. 13 figs., 32 refs. DWB--The most recent results of a continuing research program devoted to the study of long distance VHF radiowave propagation are presented. Data obtained from measurements made at 50 and 220 mc on the surface and in the air are given which extend our previous results and clarify some important aspects of tropospheric and ionospheric propagation at extreme distances and heights. (Met. Abs. 11E-9)--Authors' abstract.

E-1044 Barghausen, A.F.; Decker, M.T. and Maloney, L.J., Measurements of correlation, height gain, and path antenna gain at 1046 megacycles on spaced antennas far beyond the radio horizon. Institute of Radio Engineers, N.Y., Convention Record, Pt. 1:78-81, 1955. 5 figs. DLC (TK 6541.I5)--Studies made and reported by the National Bureau of Standards in 1953 on the correlation of 1046 Mc radio fields on spaced antennas at distances far beyond the radio horizon are supplemented by more recent measurements. Measurements were made on the NBS Cheyenne Mountain transmission path in Colorado and Kansas at a frequency of 1046 Mc, the receiving location being at an angular distance of 27 milliradians (for standard atmosphere), i.e., approximately 150 mi beyond the transmitter radio horizon. In addition to the correlation of instantaneous fields, the correlation of hourly median fields and the diurnal variation of the received signals are shown. (Met. Abs. 8J-65)--From authors' abstract.

E-1045 Barsis, A.P.; Herbstreit, J.W. and Hornberg, K.O., Cheyenne mountain tropospheric propagation experiments. U.S. National Bureau of Standards, Circular No. 554, Jan. 3, 1955. 39 p. 46 figs., 2 tables, 18 refs., eqs.--Measurements at five frequencies from 92 to 1046 Mc/s were conducted over 393 and 617 mi paths and reported on. The studies include effects of rough terrain, dependence of transmission loss on refractive index profiles, height gain functions and application of related theories, e.g. the new theory of propagation embodying Booker-Gordon's scattering principles as extended by Staras. --W.N.

E-1046 Barsis, A.P. and Capps, F.M. (Nat'l.Bur. of Standards, Boulder, Colo.), Effect of superrefractive layers on tropospheric signal characteristics in the Pacific coast region. Institute of Radio Engineers, IRE Wescon Convention Record, Pt. 1:116-133, 1957. 11 figs., table, 10 refs. DLC--Results of tropospheric radio wave propagation measurements over two paths between San Nicolas Island and the California coast near Pt. Mugu are correlated with the characteristics of refractive index profiles determined at the path terminals simultaneously with the radio measurements. The radio paths extend to the vicinity of and slightly beyond the radio horizon. Specifically, it was found that the existence of superrefractive layers (either ground-based or elevated) favors the occurrence of prolonged space-wave fadeouts for the within-the-horizon path, and increases the short term fading range for the beyond-the-horizon path. It was found that the base and top elevations of a superrefractive layer, and also the magnitude of the refractive index gradient within the layer have a noticeable effect on various characteristics of the received signal for both paths. An example of this is found if the hourly median basic transmission loss for the beyond-the-horizon path is plotted as a function of the layer heights. These results generally agree with earlier observations by Smyth and Trolese. --Authors' abstract.

E-1047 Bean, Bradford R. and Cahoon, B. A., The effect of atmospheric horizontal inhomogeneity upon ray tracing. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(3):287-292, Nov./Dec. 1959. 6 figs., 2 tables, 11 refs., 9 eqs. DWB, DLC. Also issued as: U.S. National Bureau of Standards, NBS Report No. 6054, April 10, 1959. 13 p. 6 figs., 2 tables, 10 refs., 9 eqs. DWB (621.384 U585ef)--The tracing of radio rays is normally carried out under the assumption that the refractive index varies only in the vertical direction. Although this assumption appears to be quite reasonable in the average or climatic sense, it is seldom satisfied under actual conditions and is strongly violated by horizontal air mass changes occurring near frontal and land-sea interfaces. This latter case is investigated by tracing rays through two instances of observed marked horizontal variation of the refractive index. The bending for these ray paths were then compared with values obtained under the normal assumption of horizontal homogeneity. Although at one kilometer and above these horizontal changes appear to have little effect, rays emitted at low elevation angles are sensitive to extreme horizontal variations of the atmosphere near the surface, such as those associated with ducting conditions. However, since it appears that such conditions occur less than 15% of the time at most locations, the majority of ray path calculations may be carried out under the normal assumption of horizontal stratification of the refractive index. (Met. Abs. 12.6-142)--Authors' abstract.

E-1048 Beckmann, Petr, Statistical distribution of the amplitude and phase of a multiply scattered field. U.S. National Bureau of Standards, Journal of Research, Sec. D, 66(3):231-240, May/June 1962. 19 figs., table, 13 refs., 52 eqs. DWB, DLC--The probability distribution of the amplitude and phase of the sum of a large number of random two-dimensional vectors is derived under the following general conditions: Both the amplitudes and the phases of the component vectors are random, the distributions being arbitrary within the validity of the Central Limit Theorem; in particular, the distributions of the individual vectors need not be identical, the amplitude and phase of each component vector need not be independent and the distributions need not be symmetrical. The distributions formerly derived by Rayleigh, Rice, Hoyt, and Beckmann are shown to be special cases of this distribution. --H.T.D.

E-1049 Bogle, A.G., Some aspects of microwave fading on an optical path over sea. Institution of Electrical Engineers, London, Proceedings, Pt. III, 99(61):236-240, Sept. 1952. 6 figs., 9 refs. DLC--Long term measurements of microwave transmission over a 39 mi optical path have shown fading too deep to be easily accounted for by simple theory. It is concluded from experimental evidence that both scattering from turbulence and movements of the interference pattern contribute to the fading. --

E-1050 Bremmer, H., On the theory of fading properties of a fluctuating signal imposed on a constant signal. U.S. National Bureau of Standards, Circular 599, May 25, 1959. 32 p. 9 refs., eqs. DLC (QC100.U555)--This paper deals with a theoretical investigation of the fading properties of a signal composed of a fluctuating contribution, and another steady contribution with fixed amplitude and phase. It is assumed that the central limit theorem may be applied to two proper quantities describing the fading signal as a quasi-monochromatic function of the time. The results are applicable to any autocorrelation function for the fluctuating contribution. The first part of the paper (sections 1 - 16) is mainly restricted to the idealized case in which any two components of the fluctuating part of the complete signal that are in quadrature with respect to their phase do have identical statistical properties; the fluctuating part is then termed a "random" signal. This idealized case is shown to constitute but an approximation if applied to the fluctuating field due to first order scattering in a turbulent atmosphere. Therefore, in the second part of the paper (sections 17 - 26), the theory has been extended to fluctuating contributions (then termed "quasi-random" contributions) not satisfying the above condition of isotropy. All results then depend on two complex correlation functions a(r) and b(r) instead of on the single function a(r) governing the simplified theory. In contrast to a(r) the function b(r) does not exclusively depend on the energy spectrum of the fluctuating contribution. --From author's abstract.

E-1051 Brilliant, Martin, Fading loss in diversity systems. Institute of Radio Engineers, Transactions on Communication Systems, 8(3):173-176, Sept. 1960. Fig., 27 eqs. DLC--In a communication system using optimum diversity combining the mean signal-to-noise ratio of the combined signal is the sum of the mean signal-to-noise ratios of the separate signals. However, the effective signal-to-noise ratio of the combined signal is less than this. The ratio of the mean to effective signal-to-noise ratios of the combined signal is called the fading loss. The effective signal-to-noise ratio, and hence the fading loss, depends upon the measure of effectiveness used, which in turn depends upon the form of information conveyed by the signal. In a high quality speech system, the fading loss is shown to depend principally upon the order of diversity (the number of signals combined). In a binary communication system, the fading loss is shown to depend principally upon the mean signal-to-noise ratio of the separate signals. The system design considerations in these two cases are therefore different. --Author's abstract.

E-1052 Clarke, R.H. (Bell Tel.Labs., Inc., Holmdel, N.J.) and Hendry, G.O. (Brobeck & Ass., Berkeley, Calif.), Prediction and measurement of the coherent and incoherent power reflected from a rough surface. IEEE Transactions on Antenna and Propagation, N.Y., 12(3):353-363, May 1964. 6 figs., table, 15 refs., 57 eqs. DLC--Experimental measurements of the behavior of radio wave signals of 8-40 mm reflected from a rough sea surface are described. A slightly modified version of Manton's original apparatus was used. The two components of the random signal; one in phase with the constant signal, the other in phase quadrature, are not equal in variance except for very rough surfaces. The theoretical results are shown to conform with the experimental ones. --W.N.

E-1053 Crain, C.M. and Booker, H.G. (both, Rand Corp.), Effects of nuclear bursts in space on the propagation of high frequency radio waves between separated Earth terminals. Journal of Geophysical Research, Wash., D.C., 68(8):2159-2166, April 15, 1963. 3 figs., 4 tables, ref., 21 eqs. DWB, DLC--Discusses a possible method for detecting nuclear bursts in space. The method is based on the effects that the bursts should have on the phase and amplitude of high frequency radio transmission between separated terminals on the Earth's surface. Relations are derived that show how these effects should vary with time after the nuclear detonation and how they are related to bomb temperature, yield, and distance from the Earth. The phase shift is independent of bomb temperature over a wide range of temperatures, whereas attenuation decreases by a factor of about 10 (db) for each 50% decrease in bomb temperature. Thus, absorption measuring techniques become decreasingly attractive for detecting cooler bombs. It is concluded that measurements of high frequency phase and amplitude change, in conjunction with very low frequency phase measurements, may provide a very sensitive means for detecting nuclear bursts in space by ground based radio equipment, even for quite cool bombs. The possibility of determining bomb temperature is also shown. (Met. Abs. 14.9-165)--Authors' abstract.

E-1054 Decker, Martin T., Airborne television coverage in the presence of cochannel interference. U.S. National Bureau of Standards, Technical Note No. 134, Jan. 1962. 16 p. Appendix with 56 figs. (no pagination), 19 refs. DLC--Predictions are made of the coverage to be expected from a network of airborne television transmitters operating in the UHF television band. Various system performance and interference conditions are assumed. The results are presented in a series of graphs with probability of service as a function of receiving location and in terms of the total effective area of a station or network of stations. System requirements for a coverage approaching 100% of a large area are indicated. --Author's abstract.

E-1055 Dougherty, H.T. and Maloney, L.J. (both, Central Radio Propagation Lab., Nat'l. Bur. of Standards, Boulder, Colo.), Application of diffractions by convex surfaces to irregular terrain situations. U.S. National Bureau of Standards, Journal of Research, Sec. D, 68(2):239-250, Feb. 1964. 10 figs., 25 refs., 18 eqs. --Previous solutions by Rice and by Wait and Conda are combined and extended to provide more readily evaluated formulas for the diffraction of radio waves by the "rounded obstacles" encountered in irregular terrain situations. A comparison with experimental data is also provided. --Authors' abstract.

E-1056 Freeman, J.A. and Chen, Y.Y. (NASA Goddard Space Flight Center. System Analysis Office, Beltsville, Md.), Compensation of tropospheric effects on Doppler tracking. IEEE Transactions on Antennas and Propagation, N.Y., 12(4): 513-514, July 1964. Fig., 2 tables, 4 refs. DLC--Condensed description of a method of measurements of range rate. Details to appear shortly in a NASA Technical Note. --W. N.

E-1057 Gough, M.W., VHF and UHF propagation within the optical range. Marconi Review, No. 95, 12(4):121-139, Oct.-Dec. 1949. 14 figs., tables, refs. in footnotes, eqs. DLC--The mechanism of VHF and UHF propagation can be explained in terms of five major factors, namely: (1) atmospheric refraction; (2) ionospheric reflections; (3) tropospheric reflections; (4) diffraction; (5) Ground reflections. (5) is the dominant influence on propagation within the optical range, and it is with this aspect of the problem that this article is concerned. From the ray concept of propagation, a technique has been evolved using simple microwave field strength measurements to forecast the behavior of VHF and UHF transmissions over a specific optical path. In particular, the method predicts, without further measurement, the best height for the receiving aerial on any frequency in the VHF or UHF band. The process is based on the assumption that ground reflection is confined to a point. This assumption becomes increasingly invalid with increasing wavelength and may lead to errors. However, these can be corrected to a large extent by evoking Fresnel's zone theory, which defines what region of the path is involved in reflection. Furthermore, by examining the ground irregularities in this region the reflecting power of the ground can be assessed. This article develops the theory of the microwave survey technique and describes and interprets a survey made over a test path, from which the behavior of specific longer waves is predicted. It concludes with a description of confirmatory experiments made over the same path which verify the predictions. The "calibration" of optical paths by the use of microwaves eliminates the necessity for tests on operational wavelengths, and coupled with the lightness and compactness of microwave equipment, saves experimental labor, particularly if the path is to carry transmissions on more than one wavelength. --Author's abstract.

E-1058 Gudmandsen, P. and Larsen, B. F., Statistical data for microwave propagation measurements on two oversea paths in Denmark. Institute of Radio Engineers, N. Y., Transactions on Antenna and Propagation, 5(3):255-259, July 1957. 7 figs., 4 refs. DLC--Measurements were carried out on 6.4 cm and 17 cm wavelength on two optical paths, 54 km and 82 km long, stretching over sea nearly East-West and starting at the same point. For the greater part of the measurements, height spaced receivers were used. The bulk of the statistical data comprises distributions of field strengths for every day of measurement. Curves for single receivers and diversity combinations of two receivers have been worked out. Distributions for every hour of a day, as well as distributions of fadurations for a few days with special propagation conditions, were obtained. A study of special fading phenomena with almost coinciding fades on the receivers in operation has been made. The data reveal that the field strength distribution for single receivers on days with a great number of fades generally approximates the Rayleigh distribution irrespective of wavelength path, and antenna height within the range of height considered. The field strength distributions for diversity systems approximate the diversity Rayleigh distribution, which is derived from two uncorrelated Rayleigh distributed signals. Deviations from appropriate Rayleigh distribution toward more serious fading conditions seem to be more frequent and more pronounced for diversity systems than for single receivers. Distributions of fade durations are found to be log-normal. Measurements on three height spaced receivers on 17 cm wavelength indicate that the simple two ray theory is insufficient to describe the fadings on a path over sea. --Authors' abstract.

E-1059 Herbstreit, J. W. (Nat'l. Bur. of Standards, Boulder), Radio refractometry. International Scientific Radio Union. Commission II on Radio and Troposphere, Monograph on radiowave propagation in the troposphere: Proceedings of the Commission, 13th General Assembly of URSI, London, 1960. Amsterdam, Elsevier Pub. Co., 1962. p. 187-196. Table, 44 refs., 2 eqs. English and French summaries p. 187. DLC (QC973. I575), DWB (M10. 62 I61mo)--A discussion of the refractive index measurement of the troposphere at radio frequencies, with particular reference to measurements made by the radiosonde technique and by radio refractometers. The application of radio refractometry to propagation problems is also considered. (Met. Abs. 14. 9-171)--Author's abstract.

E-1060 Hubbard, R. W. and Thompson, M.C., Jr. (Nat'l. Bur. of Standards, Boulder, Colo.), Phase generator for tropospheric research. Electronics, N.Y., 29(10): 220-223, Oct. 1956. 4 figs., photo., 7 refs. DLC--Laboratory standard instrument provides phase displaced signals, either pulses or sinusoids, for checking and calibrating phase shifting networks, oscilloscope sweeps, phase meters and other instruments where separation of periodic signals is important. Phase displacement may be selected in steps of two electrical degrees over range of 360°. --Authors' abstract.

E-1061 Ikegami, F., Influence of an atmospheric duct on microwave fading. Institute of Radio Engineers, N.Y., Transactions on Antenna and Propagation, 7( ):252-257, 1959. (Unchecked)--The results of continuous observation of a duct carried out utilizing a tower 312 meters high are presented together with those of measurements of microwave fading conducted simultaneously. The variation of duct height with time, as well as the influence of the duct on fading for a horizontal and an oblique propagation path, are investigated in detail. A ray-theoretical analysis is given, indicating that fading may be attributed to the divergence or the convergence of radio waves and to the interference of two or more rays, caused by existence of a duct, or, more generally, of nonlinear M-profile. A comparison of calculation with experimental results shows that many of the characteristics of microwave fading are well explained by means of this interpretation. --Author's abstract.

E-1062 Joint Technical Advisory Committee (IRE-RTMA), Radio spectrum conservation: program of conservation based on present uses and future needs. A report of the Joint Committee of the Institute of Radio Engineers and the Radio-Television Manufacturers' Association. N.Y., McGraw-Hill, 1952. 221 p. Figs., bibliog. p. 199-208. DLC (HE8667.J65)--This survey gives an evaluation of the radio spectrum related to industrial, scientific and medical use. Allocations of different frequency bands are suggested, and some general characteristics of propagation at different frequencies are discussed in relation to meteorological conditions in the ionosphere and troposphere. (See ref. E-10)--W. N.

E-1063 Joint Technical Advisory Committee (IRE-RTMA), Radio transmission by ionospheric and tropospheric scatter. Pt. 1, Ionospheric scatter transmission. Institute of Radio Engineers, Proceedings, 48(1):4-29, Jan. 1960. 23 figs., tables, 83 refs. Pt. 2, Long range tropospheric transmission. Ibid., p. 30-44. 10 figs., tables, 43 refs. "This is a supplement to the earlier comprehensive report, Radio spectrum conservation, issued by the Joint Committee of the Institute of Radio Engineers and the Radio Television Manufacturers Association, (abstracted separately), published N.Y., McGraw-Hill, 1952." DLC--The ionospheric and tropospheric scatter communication techniques are summarized individually; the present knowledge on ionospheric propagation theories, instrumentation practice, etc., including frequency allocation, is treated in the first part. Second part deals with the same as applied to the troposphere. (Met. Abs. 12.8-113)--W. N.

E-1064 Katz, Isadore (Appl. Phys. Lab., Johns Hopkins Univ., Silver Spring, Md.), Radar reflectivity of the ocean surface for circular polarization. IEEE Transactions on Antennas and Propagation, N.Y., 11(4):451-453, July 1963. 2 figs., 4 refs., 16 eqs. DLC--The vector model of rough sea reflectivity is extended to include circular polarization. Some of the problems to which the technique discussed, are applicable include: (1) Prediction of coverage pattern of a search radar; (2) discrimination against rain clutter up to 17 db and (3) airport radar tracking of aircraft during storms. --W. N.

E-1065 Kiely, D. G. and Carter, W. R., An experimental study of fading in propagation at 3 cm wavelength over a sea path. Institution of Electrical Engineers, London, Proceedings, 99(58):53-60, March 1952. 8 figs., 4 tables, 8 refs. DLC--The paper describes an experimental study of fading in propagation over a sea path within the radio horizon at a wavelength of 3 cm carried out between July 1950 and Jan. 1951. Horizontal polarization was used. The object of the investigation was to record the general fading characteristics (i. e. depth, duration and frequency of occurrence) for summer, autumn and winter and to present the results in such a form that the effects of fading on the operational ranges of radar experiments would be readily appreciated. An initial assessment of the transmitter power required for reliable operation of a beacon under given conditions has also been made. --Authors' abstract.

E-1066 Kirby, R. C. and Little, C. G., Conference on Arctic Communication. U.S. National Bureau of Standards, Journal of Research, Sec. D, 64(1):73-80, Jan./Feb. 1960. DWB, DLC--A Conference on Arctic Communication was sponsored by the Central Radio Propagation Laboratory and held at the Boulder Laboratories, National Bureau of Standards, March 3 to 6, 1959. Approximately 275 persons attended, representing universities and research, consulting, and engineering organizations, as well as the Department of Defense and other government agencies. Foreign representation included Canada, Great Britain, SHAPE Air Defense Technical Center, and (by communication) the Norwegian Defense Research Establishment. The objectives of the conference were to review the results of recent arctic radio research and to discuss current research and operational problems. The opening session was devoted to a review by various laboratories of their arctic research programs. Forty-six papers were then presented at four open and two classified sessions. The conference closed with an informal discussion period, during which three panels, devoted respectively to communication at VLF to LF, HF to VHF, discussed fields requiring further research. The full proceedings of the conference will not be published, as it is expected that appropriate papers will be published in technical journals by individual authors. (Met. Abs. 14.8-137)--Authors' abstract.

E-1067 Kitchen, F. A.; Joy, R. R. and Richards, E. G. (all, Admiralty Signal and Radar Establishment, Portsdown, Cosham), Influence of the semi-permanent low level ocean duct on centimeter wave scatter propagation beyond the horizon. Nature, London, 182(4632):385-386, Aug. 9, 1958. 3 figs., 7 refs. DWB--A number of observations conducted since 1949 by the Admiralty Signal and Radar Establishment showed the extra-diffraction signal levels relative to free space to be 10-15 db lower at 10,000 Mc than at the corresponding levels at 3000. Some characteristic interference patterns are plotted. There were no marked discrepancies when the measured free space level of the contributing lobes, rather than the theoretical values, were used. --W. N.

E-1068 Koch, J. W.; Harding, W. B. and Jansen, R. J. (Nat'l. Bur. of Standards, Boulder, Colo.), Fading rate recorder for propagation research. Electronics, N. Y., 32(51):78-80, Dec. 18, 1959. 3 figs., photo, 3 refs. DLC--Continuous, simultaneous recordings of radio signal strengths and fading rates are needed in radio propagation research. An instrument is discussed which provides strip-chart recordings of fading rates from almost zero cps up to 300 cps, and which provides a means for comparing average fading rates for various propagation conditions and transmission frequencies. --Authors' abstract and P. A. K.

E-1069 Krevsky, Seymour (RCA Surface Communication Systems Labs., N.Y.), HF and VHF radio wave attenuation through jungle and woods. IEEE Transactions on Antennas and Propagation, N.Y., 11(4):506-517, July 1963. Fig., table, 7 refs., 3 eqs. DLC--Extension of Stratton and Wheeler's theory is applied to propagation experiments in New Guinea. The spread of typical physical constants at 3 Mc and at 30 Mc are tabulated and the upper and the lower limits are plotted. --W. N.

E-1070 Kuperov, L.P., Kratkosrochnoe radioprognozirovanie na radiolinii o. Diksona-Moskva v navigatsiiu 1958 g. (Short range radio forecasting on the Dickson Island-Moscow radio path during the 1958 navigation period.) Problemy Arktiki i Antarktiki, Leningrad, No. 1:119-, 1959. DWB, DLC--From Aug. to Nov. 1958 O.L.Solovskii and L.A.Iudovich of the Dickson Island Observatory, carried out short range forecasts of the passage of short radiowaves along the Dickson Island-Moscow route. Four 6-hr forecasts were made daily. The forecasts were made according to the method developed in the Arctic and Antarctic Institute. During Oct.-Nov. the verification of forecasts of non-passage of the waves was 86.8%; the verification of recommendations of operating frequencies was 89%. --I.L.D.

E-1071 Lewin, L., Diversity reception and automatic phase correction. Institution of Electrical Engineers, London, Proceedings, Pt. B, 109(46):295-304, July 1962. 12 figs., 8 eqs. DLC--The interference between the direct ray and a ground reflected ray gives rise at the receiver of a communication link to a sinusoidal field pattern in the vertical plane consisting of nodes and maxima. The position and pattern w wavelength of this field depend on the receiver and transmitter heights and spacing and on propagation conditions in an effective curvature parameter, C. This parameter varies in time and is the cause of most fading at a single antenna. Its upper limit, which may be as high as 2.5 for a small percentage of the time, determines minimum antenna heights for line-of-sight transmission under extreme conditions. C is normally about 3/4. Its range of variation determines the optimum spacing of a pair of diversity antennae, and suitable design formulas are given. Experiments using a pair of mirrors, a varying transmitter frequency, and photographs of osolograph traces indicate an extreme lower value of C over water of -1.5. A moving film display shows that conditions can vary rapidly from minute to minute, although at other times the display is steady for hours at a time. An automatic phasing junction has been designed for insertion in the feed from two diversity antennas, the drive for the phasing element being taken from the receiver. A combined signal nowhere smaller than the greater of the received signals is obtained from the combining element, and when the diversity spacing is chosen with regard to the extreme values of curvature obtained on the path, an excellent overall response is ensured. Some preliminary figures are given for the performance of an improved combining network and phase control apparatus operating in conjunction with a height - diversity microwave system over a 69 mi overwater path. --Author's abstract.

E-1072 McPetrie, J.S. and Saxton, J.A., Diffraction of ultra-short waves. Nature, London, 144(3649):631, Oct. 7, 1939. Table, 3 refs. DLC--In this set of experiments with 3 m waves, the transmitter was located at a fixed position, about 200 yds from the edge, whereas the receiver was moved to several locations of a slope at Dunstable Downs, England. It was found that the vertical electric field increased relative to its horizontal equivalent when the receiver was moved down hill into the shadow. The results presented in a table are discussed. (See E-32) --W. N.

E-1073 Ortwein, N. R., An annotated bibliography of literature pertinent to tropospheric scatter propagation, 1945-1957. U.S. Navy Electronics Laboratory, San Diego, Calif., Research Report No. 858, Aug. 4, 1958. 28 p. 18 refs. --The bibliography includes a total of 126 references (of which 77 are annotated) arranged chronologically in alphabetical order by the authors' names. The brief introduction is followed by individual summaries of theoretical and experimental works. An author index, but no subject index, is given. --W. N.

E-1074 Ortwein, N. R. and Voss, P.L. (both, U.S. Navy Elect. Lab., San Diego, Calif.), A study of the oceanic duct between San Diego and Hawaii at 445 Mc and 220 Mc. Navy Science Symposium, 5th, Annapolis, April 1961, Proceedings, Vol. 3, pub. 1961. p. 823-833. 6 figs. DWB (359 N327pr)--Extensive and persistent temperature and refractive index inversions were found in the trade wind areas. These are sharp enough to trap VHF signals and propagate them to extreme ranges. The characteristics of the signals received ground to ground, the effect of holes in the duct, and some anomalies of the attenuation rate are discussed. The radio meteorological data given indicate the necessity of a continuous duct between terminals in order to obtain ground to ground, ground to air, or air to air contact. On the other hand, when the duct is continuous the radio data indicate the lack of the attenuation with distance which would be expected. Since the duct is not limited in the horizontal direction, the absolute signal strength would be expected to decrease at least as fast at inverse distances. This is apparently contradicted by the presence of the signal plateaus. A possible explanation is suggested. (Met. Abs. 13. 10-292)--E. Z. S.

E-1075 Pivarunas, Frank A., Tropospheric and Ionospheric scatter propagation in the transition zone. U.S. Air Force Cambridge Research Center, Bedford, Mass., Technical Report, No. 59-136, April 1959. Figs., 15 refs. (Unchecked)--There is a zone of receiver distances in which a transition from tropospheric to ionospheric scatter propagation for the received signals can and does take place for frequencies generally used for ionospheric scatter propagation (between about 35 and 60 Mc). The diurnal and seasonal variations of the median signal levels in each mode determine when and where the signal levels of both modes are within a few db of each other so that the transition region can occur. Since the fading rates peculiar to the ionospheric scatter mode are different from those of the tropospheric scatter, the transition region is readily recognized by the superimposed fading rates on signal level recordings. The scatter volumes for the transition zone are in the stratosphere for the tropospheric scatter mode. This may account for some of the changes in tropospheric scatter signal characteristics as distance increases to reach the transition zone. A mode diversity system to improve reception of signals in this zone by using optimum beamwidths and orientations of the antennas used in transmitting and receiving was proposed. --Author's abstract.

E-1076 Rice, Philip L. (Nat'l. Bur. of Standards, Boulder, Colo.), Tropospheric fields and their long term variability as reported by TASO. Institute of Radio Engineers, N.Y., Proceedings, 48(6):1021-1029, June 1960. 13 figs., table, foot-refs. DLC--This report presents data from long term recordings of radio field strength over a large number of propagation paths, and presents curves for predicting field strength over a smooth earth for frequencies between 40 megacycles and 1000 megacycles per second. The basic data provided for the Television Allocations Study Organization during 1957 and 1958 include recordings made in several parts of the world and over various types of terrain and were supplied by numerous sources. --Author's abstract.

E-1077 Ruina, J.P. and Angulo, C.M., Antenna resolution as limited by atmospheric turbulence. IEEE Transactions on Antenna and Propagation, N.Y., 11(2):153-161, March 1963. 5 figs., 10 refs., 28 eqs. DLC--The purpose of this theoretical examination was to determine the resolution capability of microwave antennas as governed by the effects of the refractive index variations on the phase and the amplitude of a radio wave propagating through the atmosphere. --W.N.

E-1078 Samoilov, G.P., Dal'nii priem televizionnykh peredach. (Long distance reception of television broadcasts.) Moscow. Gos. izd-vo lit-ry po voprosam sviazi i radio, 1957:199. 34 refs., all Russian. (Unchecked)--In the first chapter, after reviewing the mechanism of the propagation of meter waves, the author discusses long distance and very long distance reception of television programs. Chapters two through six deal with equipment for long distance reception and techniques for improving reception. The final chapter discusses techniques and possibilities of long distance television programs. --R.M.

E-1079 Sharpless, William M., Measurement of the angle of arrival of microwaves. Institute of Radio Engineers, N.Y., Proceedings, 34(11):837-845, Nov. 1946. 8 figs., 3 refs. DLC--This paper describes a method of measuring the direction from which microwaves arrive at a given receiving site. Data which have been collected on two short optical paths using a wavelength of 3 1/4 centimeters are presented to illustrate the use of the method. Angles of arrival as large as 1/2 degree above the true angle of elevation have been observed in the vertical plane, while no variations greater than ± 1/10 degree have been found in the horizontal plane. These results indicate that radar directions for low angles of elevation may be in error by several tenths of a degree during times when anomalous propagation conditions are present. Possible solutions to the problems introduced by variations in the angle of arrival are suggested. --Author's abstract.

E-1080 Saxton, J.A. et al. (all, Radio Research Station, DSIR), Layer structure of the troposphere: simultaneous radar and microwave refractometer investigations. Institution of Electrical Engineers, London, Proceedings, 111(2):275-283, Feb. 1964. 8 figs., 3 tables, 25 refs., 23 eqs. DLC--A discussion is presented of the manner in which layer type echoes may arise and be observed using a 10 cm radar at vertical incidence; such echoes are due to variations in the gaseous refractive index and not to water droplets in clouds or precipitation. Specular reflection and scattering processes are compared and the conditions indicated when an echo may be due to one or the other process, although the applicability of the turbulence theories used to relatively thin layers needs to be established. The results of the analysis are discussed in relation to data obtained from simultaneous soundings of the troposphere by radar and airborne microwave refractometers. Some comments are made regarding further experimental and theoretical investigations of the fine structure of elevated layers. --Authors' abstract.

E-1081 Silberstein, Richard (U.S. Nat'l. Bur. of Standards, Boulder, Colo.), Tropospheric effects on 6 Mc pulses. Institute of Radio Engineers, N.Y., Proceedings, 46(12): 1968, Dec. 1958. 2 refs. DLC--Describes test of independent measurement of the virtual height of echoes, conducted at Boulder, Colo., over a 5.2 km north-south path. The mountainous area in west apparently caused the scatter with fluctuations producing variable multipath interference of that part of ground wave signal remaining when discriminated against by substituting the dipole with a rotating vertical loop antenna. --W.N.

E-1082 Suzuki, M., Experimental analysis of equivalent reflection coefficient of various reflecting rough surfaces in microwave propagation. ETJ of Japan, 4:3-6, 1958. (Unchecked)--The reflection coefficient is evaluated for various angles of incidence and types of surfaces and terrain with crop cover. --H. T. D.

E-1083 Texas. Univ., Austin. Electrical Engineering Research Lab., Bibliography of technical reports, publications, and theses, Feb. 1959-Feb. 1961. Contract Nonr 375(01) NR 371 032, Report No. 121, Feb. 28, 1961. 16 p. DWB, DLC--This bibliography supplements Electrical Engineering Research Laboratory Report No. 106 which presented a consolidated listing of publications of the laboratory through 1958. The present report is specifically concerned with publications covering 1959 and 1960. No effort was made to list informal reports of the memorandum or quarterly status variety except where significant technical information is involved. The bibliography lists serially, first, the technical reports of sponsoring agencies. In addition to the title, the authors and the contract number are noted. The next group of titles are designated as technical publications. Authors and publication sources are noted. The third grouping of titles is devoted to master's and doctoral theses. The bibliography is followed by a complete distribution list. (See ref. E-337)--M. B. G.

E-1084 Ugai, Shigetaka, Statistical consideration of the structure of atmospheric refractive index. Reports of ECL, Japan, 7:253-289, Aug. 1959. (Unchecked)--A 300 meter tower is employed to obtain 12 level samplings of the refractive index gradient on an hourly basis over a two month period. These are compared with radiosonde data obtained twice a day for the same period. The resulting distribution of vertical refractive index gradient was found to be approximately normal. The analysis is then extended to determine the resulting mean and standard deviations from radiosonde data between 900 and 1000 mb levels on a monthly basis and for 8 geographical locations. --H. T. D.

E-1085 Volland, H., Comparison between mode theory and ray theory of VLF propagation. U.S. National Bureau of Standards, Journal of Research, Sec. D, 65(4):357-361, July/Aug. 1961. 4 figs., 2 tables, 16 refs., 12 eqs. DWB, DLC--It is shown that the field strength according to mode theory and ray theory in the VLF band are derivable from the same expression of the original vector potential, and the result of one theory is the analytic continuation of the other one in another range of convergence. In fact, both ranges of convergence overlap. Estimates of these ranges are made and an example shows that within this overlapping region (between distances of 300 and 2000 km) both theories give the same result. Using this fact calculations of frequency spectra are possible which in the case of white noise dipole show some similar features to measured frequency spectra of lightning discharges. (Met. Abs. 14.10-99)--Author's abstract.

E-1086 Wait, James R., Excitation of surface waves on conducting, stratified, dielectric clad, and corrugated surfaces. U. S. National Bureau of Standards, Journal of Research, 59:365-377, Dec. 1957. 27 refs. DLC--An expression for the field of an electric dipole located over a flat surface with a specified surface impedance Z is derived from the formal integral solution by a modified saddle point method. Using the value of Z appropriate for a homogeneous conducting ground, the general expressions reduce to those given by Norton. In this case the phase of Z lies between 0 and 45°. When the phase exceeds 45°, as it may for a stratified ground, the radiated wave of the dipole becomes partially trapped to the interface. This effect is most pronounced for an inductive surface where the phase of Z is 90°, in which case the energy of the wave is confined within a small distance from the surface. Such inductive surfaces are a metallic plane with a thin dielectric film or a corrugated surface. This unifying treatment provides a link between the surface waves of Zenneck, Sommerfeld, Norton, and Goubau, and indicates that the phase angle of Z controls the extent to which these waves may exist for a dipole excitation. --Author's abstract.

E-1087 Wait, J. R. and Murphy, Anabeth, Further studies of the influence of a ridge on the low frequency ground wave. U.S. National Bureau of Standards, Journal of Research, 61:57-60, July 1958. 4 figs., foot-refs. DLC--Computations are presented in graphical form for the perturbation of a plane wave by a semicylindrical boss on an otherwise flat ground plane of perfect conductivity. The height of the ridge is comparable to the wavelength. This is an extension of earlier work on the semielliptical boss. --Authors' abstract.

E-1088 Wait, J. R. and Conda, A. M., On the measurement of ground conductivity at VLF. Institute of Radio Engineers, N.Y., Transactions on Antennas and Propagation, 6(3):273-277, July 1958. 3 figs., 8 refs., 21+ eqs. --The applicability of the four electrode methods of measuring ground conductivity at VLF is discussed. The general theory is extended to include anisotropy in the substrata. In view of the spurious coupling between the current and potential line in conventional configurations, an alternative array is proposed which is arranged so that the inductive coupling is zero. A number of charts are computed which facilitate the interpretation of the measured or apparent conductivity in terms of a two-layer earth. --Authors' abstract.

E-1089 Wait, J. R., Transmission and reflection of electromagnetic waves in the presence of stratified media. U.S. National Bureau of Standards, Journal of Research, 61:205-232, Sept. 1958. 12 figs., 15 refs., eqs. DLC--A general analysis is presented for the electromagnetic response of a plane stratified medium consisting of any number of parallel homogeneous layers. The solution is first developed for plane-wave incidence and then generalized to both cylindrical and spherical wave incidence. Numerical results for interesting special cases are presented and discussed. The application of the results to surface wave propagation over a stratified ground is considered in some detail. --Author's abstract.

E-1090 Wait, J. R., Guiding of electromagnetic waves by uniformly rough surfaces, Pt. 1-2. Institute of Radio Engineers, Transactions on Antennas and Propagation, Special supplement to Vol. 7, Dec. 1959. p. 154-168. 8 figs., 35 refs., eqs. DLC--A simple derivation is given for the reflection of electromagnetic waves from a perfectly conducting plane surface which has a uniform distribution of hemispherical bosses whose electrical constants are arbitrary. The spacing between the centers of the bosses is taken to be small, which is the justification for neglecting the incoherent radiation. The excitation of surface waves on the rough surface is then discussed. It is indicated that to a first order, a rough surface of the kind described here possesses an inductive surface reactance and will support a trapped wave. The effect of finite conductivity of the bosses is to damp exponentially this trapped wave. In Pt. 2, using the model of a single rough surface described in Pt. 1, the influence of curvature is considered. The starting point is a residue series solution for a vertical dipole over a sphere with an arbitrary surface impedance. It is shown that the curvature has a profound influence on the nature of the surface wave, although it uniformly approaches the conditions for a plane boundary as the radius of curvature approaches infinity. --Author's abstract.

E-1091 Wait, J. R. and Conda, A. M., Diffraction of electromagnetic waves by smooth obstacles for grazing angles. U.S. National Bureau of Standards, Journal of Research, Sec. D, 63(2):181-197, Sept.-Oct. 1959. 8 figs., 26 refs., 42 eqs. DLC--The diffraction of electromagnetic waves by a convex cylindrical surface is considered. Attention is confined primarily to the region near the light shadow boundary. The complex integral representation for the field is utilized to obtain a correction to the Kirchhoff theory. Numerical results are presented which illustrate the influence of surface curvature and polarization on the diffraction pattern. Good agreement with the experimental results of Bachynski and Neugebauer is obtained. The effect of finite conductivity is also considered. --Authors' abstract.

E-1092 Wait, J. R., On the excitation of electromagnetic surface waves on a curved surface. Institute of Radio Engineers, N. Y., IRE Transactions on Antenna and Propagation, AP-8(4):445-448, July 1960. 2 figs., foot-refs. DLC--The excitation and propagation of surface waves on a spherical inductive boundary are considered. The source is taken to be a vertical electric dipole. The circumferential attenuation rates of the various modes are discussed where it is indicated that the dominant mode is very similar to the trapped surface wave for a plane inductive boundary. The results appear to conflict with those of Barlow, but are in sympathy with some numerical data of Elliott for the circumferential attenuation rate of the dominant mode. --Author's abstract.

E-1093 Wait, J. R., Survey and bibliography of recent research in the propagation of VLF radio waves. U. S. National Bureau of Standards, NBS Technical Note, No. 58, May 1960. 44 p. Bibliog. p. 14-44. Also issued in: International Scientific Radio Union. Commission IV on Radio Noise of Terrestrial Origin. Amsterdam, Elsevier, 1962. DWB (M(055) U585te)--The subject is discussed in terms of theoretical studies, analyses of experimental data, recent applications of VLF and suggestions for future work. The valuable bibliography which covers the literature period 1919-1960 contains a total of 320 references classified individually and listed alphabetically by authors under the breakdown of 17 topics into which the subject is divided. (Met. Abs. 14.2-126)--W. N.

E-1094 Wait, J. R., On the theory of mixed path ground wave propagation on a spherical Earth. U.S. National Bureau of Standards, Journal of Research, Sec. D, 65(4): 401-410, July/Aug. 1961. 2 figs., 20 refs., 51 eqs. --The problem formulated concerns the mutual impedance between two vertical dipole antennas A and B located near the surface of a spherical smooth earth. The path between A and B is made up of a number of homogeneous segments where the surface impedance is constant. Various formulas are developed, for two- and three-section paths, which are suitable for computation. Certain limiting cases are discussed and where possible, a physical interpretation of the results is given. Comparisons with previous work are made. --Author's abstract.

E-1095 Wait, J. R., Electromagnetic waves in stratified media. N. Y., Macmillan, 1962. Price $15.00. 372 p. Figs., tables, refs. (International Series of Monographs on Electromagnetic waves, Vol. 3). CU-S, DLC. Review by H. J. Hagger in Physics Today, N. Y., 17(4):76, April 1964. --This book is intended to be used as a reference. Though basically of a theoretical nature, numerous numerical examples and references to experimental data are included. The introductory chapter contains references to supplementary reading. Ch. II contains a general analysis for the electromagnetic response of a plane stratified medium consisting of any number of parallel homogeneous layers. In Ch. III, the reflection of electromagnetic waves from planar stratified media is discussed. Ch. IV considers the oblique reflection of plane electromagnetic waves from a continuously stratified medium. The basic theory of wave propagation around a sphere is given in Ch. V. In Ch. VI, a self contained treatment of the waveguide mode theory of propagation is presented. In Ch. VII, the mode theory of VLF propagation is considered from another point of view. In Ch. VIII, the influence of a steady or d. c. magnetic field on reflection from ionized media is considered in some detail. In Ch. IX, approximate techniques for solving the VLF modal equation are described. In Ch. X, the mode theory of propagation of electromagnetic waves at extremely low frequencies (1. 0 - 3000 c/s) is considered. In Ch. XI, the physical connections between mode and ray theory are developed. In Ch. XII, the theory of propagation in a spherically stratified medium is considered. --E. Z. S.

E-1096 Watt, A. D.; Coon, R. M.; Maxwell, E. L. and Plush, R. W., Performance of some radio systems in the presence of thermal and atmospheric noise. Institute of Radio Engineers, N. Y., Proceedings, 46(12):1914-1923, Dec. 1958. 20 figs., 36 refs., 6 eqs. DLC--The performance of several basic types of communication systems are determined experimentally and in some cases theoretically, under typical conditions with steady or fading carriers, and in the presence of thermal and atmospheric noise. The relative efficience of various carriers and the interference factor of various types of noise are found to be dependent upon the characteristics of the particular communication system as well as the characteristics of the carrier and noise themselves. Methods are considered for calculating errors expected from a given system, based upon the amplitude distribution of the noise envelope. --Authors' abstract.

E-1097 Wong, Ming S. (AFCRC Propagation Lab., Bedford, Mass.), Refraction anomalies in airborne propagation. Institute of Radio Engineers, Proceedings, 46(9):1628-1638, Sept. 1958. 16 figs., foot-refs., 5 eqs. DLC--Propagation at 250-10,000 Mc of ten encounters dense fadings, radio holes, antiholes or radio ducting. These anomalies are portrayed by ray tracings using a differential analyzer which solves the simplified ray equation

$$\frac{d^2h}{dx^2} = n\frac{(h, x)}{h} + \frac{1}{a}$$

Both hypothetical prototype and complex measured refractive index profiles of the atmosphere are used for the analog computation of the ray tracings which are interpreted to explain refraction anomalies in radio wave propagation, and are compared with signal strength measurements. They involve divergence of rays, and concentration and crossing of direct rays in multipath transmission. Resulting radar angular and range errors are shown, as are spatial variations of elevation angles of arrival of interfering rays at the points where they cross, corroborating radio astronomical data on angular deviation of stars. (Met. Abs. --From author's abstract.

ANONYMOUS

E-1098 Arctic Radio Communication Conference. U.S. National Bureau of Standards, Technical News Bulletin, 43(11):213-217, Nov. 1959. --R.C. Kirby (Boulder Labs.) served as conference chairman over the some 250 scientists, engineers and other professionals from U.S.A. and abroad, assembled at U.S. National Bureau of Standards Laboratories at Boulder, Colo., March 4-6, 1959. A summarized report of the several aspects, involved in ionospheric as well as tropospheric radio wave propagation in the Arctic, are given. --W. N.

E-1099 Effect of sub-refraction on radar range. Marine Observer, 27(176):114-116, April 1957. DLC--W. BURGER inquired whether radar horizon at sea can be reduced to 1-3 mi as a result of sub-refraction. R.F. JONES regarded this as impossible. CAPT. WYLIE agreed. (Met. Abs. 8J-159)--C.E.P.B.

E-1100 Forward scatter of radio waves. Pt. II. Tropospheric forward scatter. Pt. III. Causes and theories of propagation by scattering due to turbulence. U.S. National Bureau of Standards, Technical News Bulletin, 40(2):24-29, Feb. 1956. 7 figs., 9 refs. --First part deals with ionospheric scattering. Pt. II deals with work on tropospheric scatter propagation which began Jan. 1949. Instrumentation and facilities involved in the experimental transmissions are described briefly. Pt. III is devoted to the causes and theory of scattering due to turbulence in the troposphere, as well as in the ionosphere. Some of the results obtained are mentioned. --W. N.

E-1101 Inauguration de la liaison hertzienne experimentale Paris - Nancay de la Compagnie Generale d'Electricite. (Inauguration of an experimental radio link between Paris and Nancay created by the Compagnie Generale d'Electricite.) Onde Electrique, 40(400/401):544-545, July/Aug. 1960. 2 figs. DLC--Brief report on experimental scatter communication link between Paris and Nancay, a distance of 180 km. The purpose of the link is to investigate equipment operating in the 900 Mc band. Such equipment is to be installed in the Algiers-Setif-Constantine-Bone system in 1961. The transmitting station in Paris has a 2 kw transmitter, a 4 cavity klystron amplifier, and a parabolic antenna 10 m in diameter. A double or quadruple diversity receiving system, with two 10 m parabolic antennas, is situated at Nancay. The link has a capacity of 84 telephonic channels.

E-1102 Konferentsiia po voprosam dal'nego rasprostraneniia UKV. (Conference on problems of forward scatter of ultrashort waves.) Radiotekhnika, Moscow, 12(4): 67-68, April 1957. Transl. in Radio Engineering, N.Y., 12(4):80-83, 1957. DLC--Report of a conference in Jan. 1957 on forward scatter of ultrashort waves which was sponsored jointly by the A.S. Popov Society, the All-Union Scientific Council for Radio Physics and Radio Engineering, and the Institute of Radio Engineering and Electronics. Five papers were devoted to problems in tropospheric scatter. P.P. Biriulin's paper dealt with an integral equation for the vector potential of the scatter field in a medium with fluctuating permittivity. V.A. Zverev described methods of computing the mean intensity of the scatter of radio waves by random irregularities. D.M. Vysokovskii's paper was concerned with a critical analysis of the derivation of the general formula for the effective scattering volume in the troposphere. The paper by A. A. Semenov and G. A. Karpeev described the results of an experimental investigation of rapid fluctuations in the amplitude of signals reflected from two fixed reflectors and received by two spaced antennas. L. Ia. Kazakov and A. N. Lomakin devoted their paper to a survey of the principle of performance and design of a radio refractometer for measuring the irregularities in permittivity. A. N. Kazantsev surveyed the materials of the 8th Plenary Conference on Ionospheric Forward Scatter of Meter Waves. He also dealt briefly with the utilization of meteor trails in this form of communication. In his paper, Ia. L. Al'pert described results of a theoretical analysis of ionospheric scatter using a correlation function of a particular form. B. N. Gershman derived the effective area of ionospheric scatter taking into account the turbulent shifting of ionized gas. M. V. Boenkov surveyed the problems of using forward scatter of 6 - 10 meter waves by reflection from layers of the ionosphere. The papers by S. F. Mirkotan and L. A. Drachev, and by Iu. V. Berezin described the investigation of the irregular structure of the ionosphere using frequency diversity and recording the variations of the phase path of the reflected signal. The reports by V. A. Bubnov, A. I. Khachaturov and S. I. Sotnikov were devoted to various cases of the long distance reception of meter waves, foreign television programs, etc. --R. M.

E-1103 Measurement of service area for television broadcasting. U.S. National Bureau of Standards, Technical News Bulletin, 41(8):113-115, Aug. 1957. 5 figs., table, ref. DLC--Some of the advantages of the new method of area concept of service as developed by NBS, are discussed comparatively with the contour concept method heretofore used. --W. N.

E-1104 NBS establishes radio refractive data center. Electronics, N. Y., 34(49):28, Dec. 8, 1961. DWB, DLC--The National Bureau of Standards has established a Radio Refractive Index Data Center at its Boulder, Colo. Lab. to assist studies of radio propagation in the earth's atmosphere. Data on meteorological parameters affecting refractivity is sent to Boulder by more than 300 weather stations and ships around the world. More than seven million punched card records have been prepared. The center can compute index profiles for certain areas or make cards available. (Met. Abs. 14.7-118)--S. N.

E-1105 Radar and meteorological conditions. Marine Observer, London, 33(202):212-214, Oct. 1963. Table. DWB, DLC--The following aspects of anomalous propagation of radar waves, as influenced by the refractive index of the atmosphere, are discussed, namely: sub-refraction, superrefraction, and ducting, second or multiple trace echoes, and atmospheric discontinuities. --I. L. D.

E-1106 Radio waves round corners. Discovery, London, 23(7):5-6, July 1962. DLC--A brief note on a successful experiment carried out by IBM engineers in transmitting low power microwaves using the principle of knife edge diffraction by a mountain ridge. --R. B.

E-1107 The Radio Research Station, Slough. Nature, London, 181(4624):1642-1643, June 14, 1958. DWB, DLC--When the Radio Research Board visited the Research Station, Britain, on May 20, 1958, the research programs now underway at the station were shown. The major research work is intended to help radio services in the area of field communication. Substations connected with the main stations are quoted. Above all, a new technique for studying high frequency radio propagation was displayed. They have developed also a new microwave refractometer for exploring meteorological conditions in the troposphere and relating these to the associated radio phenomena. --N. N.

E-1108 Tropo-scatter antenna cuts installation costs. Electronics, N. Y., 34(46):149, Nov. 1961. DWB, DLC--The antenna developed by the Boeing Co. is claimed to operate up to 500 mi without signal boosters. Available in 30, 60, and 120 ft reflector widths, the parts (3/4 usual) when color coded, permit assembly of a 60 ft antenna in 50 hr by unskilled non-English speaking men. (Met. Abs. 13.8-228)--W. N.

E-1109 Tropospheric scatter propagation: 200 mi transmission on frequencies in the UHF band. Wireless World, London, 61(6):253-254, June 1955. Fig., 2 refs. DLC--The turbulent troposphere is visualized as made up of a number of spherical blobs in which the dielectric constant differs from that of the medium as a whole. These scatter the energy, mainly forward, and are usable by highly directive beam aerials up to 200 mi. Practical applications are described. (Met. Abs. 8J-115)--C. E. P. B.

E-1110 A tropospheric scatter system. Point to Point Telecommunications, 3(1):20-28, Oct. 1958. 4 figs., ref. DLC--For two years the Marconi Co. has operated an experimental tropospheric scatter system to assess the potentialities of this medium of communication and to provide data on attenuation and fading characteristics. A full scale scatter circuit was set up between Start Point in Devon and Galleywood, near Chelmsford, in Essex, a distance of 200 mi. Measurements are being made using a multichannel telephony system. Frequency modulation is being used and tests using single sideband modulation in conjunction with a linear transmitter are being made to provide comparative data. Wideband transmissions are also to be made to assess the possibility of using channel capacities of up to 600 telephone circuits. Television pictures are also to be transmitted over the link. Some findings to date are evaluated. The route and profile of the link are shown. --R. M.

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