APPENDIX A. CALCULATION OF REFRACTIVITY

The speed of a radio wave varies inversely with the density of the medium through which it travels, and the radio refractive index of air is the ratio of the speed of propagation in a vacuum to its speed in the atmosphere under given conditions of pressure, temperature, and humidity. This ratio, n, is approximately 1.0003 under standard conditions near the earth's surface. For convenience, a scaled-up value, N, or refractivity, is normally used in propagation studies; this may be obtained from the following relationship (Smith and Weintraub, 1953):

$$N = (n - 1)10^6 = \frac{77.6}{T}\left[P + \frac{4810\, e_s RH}{T}\right]$$

where P = pressure in millibars

T = temperature in degrees kelvin

e_s = saturation vapor pressure in millibars

RH = relative humidity in percent

Values of the saturation vapor pressure are available in the Smithsonian Meteorological Tables (List, 1958).

Although the relative humidity is the parameter measured by most radiosondes, the RAOB humidity as transmitted on the national and international meteorological teletypewriter circuits is in terms of the dewpoint temperature. Figure A-1 is a useful nomogram for deriving refractivity values directly from the parameters given in the RAOB reports available at domestic and foreign weather stations (pressure in millibars, temperature in °C, dewpoint in °C).

Calculations of the refractivity gradient from RAOB reports should be based upon both the standard (or mandatory) levels (e.g., the 1000, 850, and 700 mb pressure levels) and the significant levels (those which are included because of a change in temperature or humidity exceeding specified limits). The significant levels include the surface data, the data at the bases and tops of significant temperature inversion layers, any other points where the departure of temperature equals or exceeds ±1°C from the preceding trend of the recorder trace, and points where the

relative humidity deviates by 10% or more from linearity on the recorder trace (Federal Meteorological Handbook No. 3, 1971).

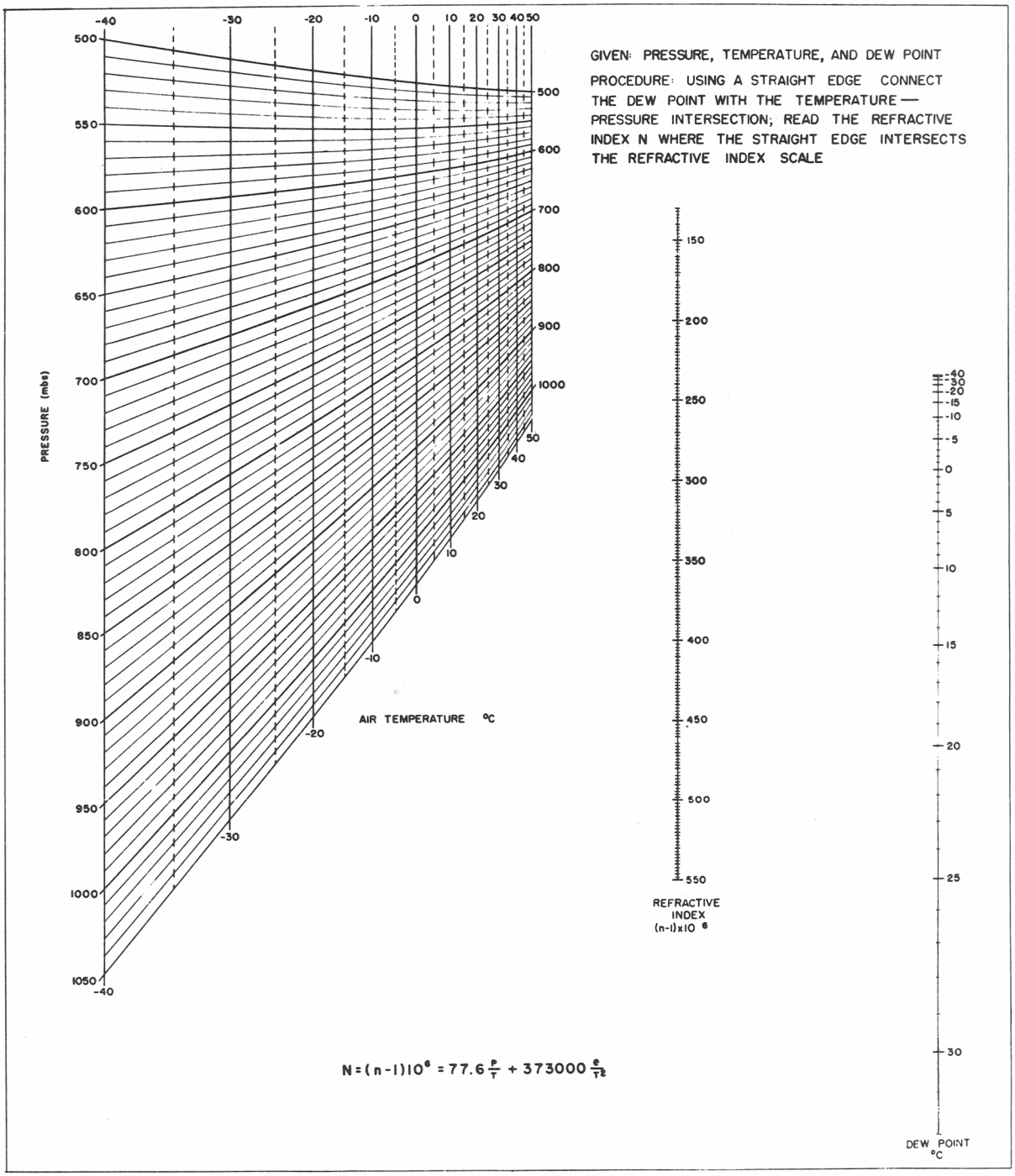

Figure A-1. Refractive index nomogram (Moreland, 1965).