depending upon whether the height of eye of the observer above sea level is in *feet* (h_f) or in *meters* (h_m).

Distance to the radar horizon (art. 506, vol. II), in *nautical miles* can be calculated using the formula:

$$d = 1.22\sqrt{h_f}$$

or

$$d = 2.21\sqrt{h_m},$$

depending upon whether the height of the antenna above sea level is in *feet* (h_f) or in *meters* (h_m).

T5. Dip of the sea short of the horizon.—The basic calculator can be used instead of table 22 for the solution of the dip of the sea short of the horizon (art. 726, vol. II) by means of the formula:

$$D_s = 60 \tan^{-1}\left(\frac{h_f}{6076.1\, d_s} + \frac{\beta_o\, d_s}{2r_o}\right),$$

where D_s is the dip short of the horizon in minutes of arc; h_f is the height of eye of the observer above sea level in feet and must be entered in the formula in nautical miles or parts thereof; β_o is a parameter (0.8321) which characterizes terrestrial refraction; r_o is the mean radius of the earth, 3440.1 nautical miles; and d_s is the distance to waterline of obstruction in nautical miles.

The formula simplifies to:

$$D_s = 60 \tan^{-1}\left(\frac{h_f}{6076.1\, d_s} + \frac{d_s}{8268}\right).$$

T6. Use with tables of trigonometric functions.—The basic calculator can be used with tables of natural trigonometric functions (table 31) to avoid the use of logarithmic functions which might otherwise be necessary.

The solutions of the examples given in article 706 of volume II can be effected with the basic calculator if the natural trigonometric functions are extracted from table 31 or other tables of trigonometric functions. The solutions by this method are generally more laborious and time consuming than the use of the intermediate calculator (art. T7) or modern sight reduction tables.

Intermediate Calculators

T7. Intermediate calculators provide the trigonometric functions and inverse trigonometric functions lacking in the basic calculator, but these calculators cannot be programmed. The intermediate calculators normally contain many of the special features which enhance the use of the calculator for solving navigational problems. In addition to the special features which the basic calculator may have, the intermediate calculator may have the capability for conversion of degrees and minutes to degrees and decimal degree, and for rectangular to polar coordinate conversion. These intermediate calculators usually have additional working storage registers and addressable storage registers for expeditious solution of the more complex arithmetic operations.

The intermediate calculators can be used for the solutions of most, if not all, of the problems normally encountered in marine navigation. Some of the applications of these intermediate calculators are discussed under the following categories: (1) sight reduction, (2) azimuth and amplitude solutions, and (3) the sailings.

T8. Sight reduction by basic formulas permits the use of the normally nonintegral values of latitude of the observer, and LHA and declination of the celestial

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