EARTH'S ROTATIONAL EFFECT ON THE BUBBLE SEXTANT.

Under this title, Lieutenant Commander P.V.H. WEEMS, U.S. Navy (retired), and Captain T.L. THURLOW, U.S. Air Corps, in an article in the U.S. Naval Institute Proceedings of October 1940, draw the attention of aviators to the effect of the Coriolis inertial force on the apparent vertical.

It is known that if ω is the angular velocity of the earth's rotation, V the velocity of the moving body and L the latitude, the horizontal component of the acceleration due to the Coriolis force is given by the expression:

$$a = 2\,\omega\,V \sin L,$$

and is directed along the normal to the direction of motion V; to the right if the flight is in the northern hemisphere and to the left in the southern.

The Coriolis acceleration, combined with the acceleration of gravity g, will cause an angular deviation from the vertical equal to $\frac{a}{g}$.

This angle is small enough to be neglected in navigation in general, but it assumes greater importance at the high speeds of modern airplanes and, although it is of the same order, and often less than the angular displacements of the bubble due to the various accelerations to which the planes are subjected, it may however not be absolutely negligible when applied to the mean of the observations.

In the northern hemisphere, every position line obtained by means of the bubble sextant must be displaced parallel to itself and normal to the course towards the right of the velocity vector, by an amount equal to $\frac{a}{g}$; or, if the position has been determined by two or more position lines without the course being altered, this point may be translated by this amount in a direction normal to the course and to the right of same.

If the calculation of the position is made, as is usual in navigation in minutes of arc, the displacement of the line of position should be made in terms of nautical miles. For this it will suffice to express the angular velocity ω of the earth's rotation per second in sexagesimal minutes of arc. We have then :

$$2\,\omega = \frac{1}{2}.$$

If we take the value of g as 9.80 m/sec., then V should be expressed in metres per second. If V_K is the velocity in kilometres/hour, we have :

$$V = \frac{V_K}{3,6}.$$

It follows that :

$$(1) \qquad \frac{a}{g} = \frac{V_K \sin L}{70,56} = 0,01417\ V_K \sin L.$$

If V_M represents the velocity in nautical miles per hour :

$$V = \frac{V_M \times 18,52}{36};$$

$$(2) \qquad \frac{a}{g} = \frac{V_M \times 18,52 \sin L}{72 \times 9,8} = 0,02625\ V_M \sin L.$$

If V_S is the velocity in statute miles per hour :

$$V = \frac{V_S \times 16,093}{36};$$

$$(3) \qquad \frac{a}{g} = \frac{V_S \times 16,093 \sin L}{72 \times 9,8} = 0,0228\ V_S \sin L.$$

In any case formula N° 2 may be employed, provided the same unit of measurement of velocity be used for the ground speed of the airplane and the translation of the line of position.

The following tables gives the amount of the translation of the line of position in the same units as the ground speed of the airplane for the different latitudes.

Latitude \ Velocity	100	150	200	250	300	350	400	500
0	0	0	0	0	0	0	0	0
10	0,5	0,7	0,9	1,1	1,4	1,6	1,8	2,28
20	0,9	1,3	1,8	2,2	2,7	3,1	3,6	4,49
30	1,3	2,0	2,6	3,3	3,9	4,6	5,3	6,56
40	1,7	2,5	3,4	4,2	5,1	5,9	6,7	8,43
50	2,0	3,0	4,0	5,0	6,0	7,0	8,0	10,06
60	2,3	3,4	4,5	5,7	6,8	8,0	9,1	11,36
70	2,5	3,7	4,9	6,2	7,4	8,6	9,9	12,33
75	2,5	3,8	5,1	6,3	7,6	8,9	10,1	12,68

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