When the correct value of θ has been bracketed, the value of d can be interpolated. The rate of change of θ with d gives an estimate of the potential accuracy of the observation, bearing in mind that abnormal refraction will reduce the accuracy.

The calculation of J. W. Crosbie's example ($\theta = 28.0'$, $h_0 = 56$ ft., $h = 5230$ ft.) goes as follows:

$h_0 = 56$, $d_0 = 8{\cdot}6$ M
Try $d = 60$ M, $d_1 = 60 - 8{\cdot}6 = 51{\cdot}4$ M
$h_1 = 2000$ ft, $h_2 = 5230 - 2000 = 3230$ ft.
$\theta = 0{\cdot}565 \times 3230/60 = 30{\cdot}4'$
Try $d = 65$ M, $d_1 = 65 - 8{\cdot}6 = 56{\cdot}4$ M
$h_1 = 2400$ ft., $h_2 = 5230 - 2400 = 2830$ ft.
$\theta = 0{\cdot}565 \times 2830/65 = 24{\cdot}6'$.

Interpolating for $\theta = 28{\cdot}0'$ gives $d = 62$ M. The rate of change of angle with distance in this case is about $1{\cdot}2'$ per mile.

Observations of small vertical angles on objects *between* the observer and his visible horizon are obviously incapable of giving accurate distances off. But when the object is beyond the horizon, moving away from it reduces the angle not only because the same object appears smaller, but also because more of the object disappears below the horizon. Consequently even quite small observed angles can give a useful position line. Provided that the height of the object is not less than twice that of the observer the rate of change of vertical angle with distance will not be less than $\frac{1}{2}'$ per mile.

REFERENCES

1 Crosbie, J. W. (1970). Distance off by vertical sextant angle. This *Journal*, **23**, 253.
2 Lecky, S. T. S. *The Danger Angle, and Off-shore Distance Tables*, 21st Edition, 1918.

Rhumb-line Sailing

J. E. D. Williams

If Turner[1] is right that 'the underlying theory of the traditional approach (to rhumb-line sailing) is obscure' and that there is a 'lack of ready availability of a table of distances of parallels of latitude from the equator, it is certainly not the fault of this *Journal* which precisely 20 years earlier[2] published a paper which gave:

1. The correct mathematical theory of rhumb-line sailing on an oblate spheroid.
2. The name 'meridional distance' to what Turner now calls the $L(\phi)$ function.
3. A table to reduce latitude to meridional distance.

4. A rule of thumb procedure to calculate rhumb-line distances correctly with no more labour than that which has always been used to do it wrongly.
5. A method (with table) for use on the spheroid when the track angle is nearly 90° and the method Turner discusses is impracticable.
6. A survey of methods and tables then current.

Subsequently, the meridional distance table was published (with acknowledgments) in the 1951 edition of Burton's Nautical Tables. The *Notes* included an explanation and a worked example.

A few years ago, I was told that the method had found practical application in calculating the sector lengths to set up on airborne navigation computers used with doppler and also in the statistical analysis of the accuracy of such systems. Igather from Turner's paper that sailors just carry on as before.

REFERENCES

1 Turner, R. J. (1970). Rhumb-line sailing with a computer. This *Journal*, **23**, 233.
2 Williams, J. E. D. (1950). Loxodromic distances on the terrestrial spheroid. This *Journal* **3**, 137.

Metrication and the Nautical Mile

R. J. Turner

ALTHOUGH Admiral Ritchie does not agree, I still think that some significance does attach to the difference between the British Standard Nautical Mile and the International Mile.[1] It is a matter of definition and is of vital importance to the young student beginning to study navigation. Unless basic definitions are clear and unambiguous continual difficulty arises which obscures practical considerations of the reliability of measurements that are made. Moreover, it is extremely unfortunate that the length of a minute of arc of a meridian was ever given the label 'mile'—a standard of measurement of distance, or that anyone should ever have suggested measuring distance with a unit of variable length. The confusion that has been caused in the minds of student navigators over the years is enormous and the opportunity now exists for this source of confusion to be removed.

However, all this is beside the point. 'Whether the nautical mile should be abandoned altogether in favour of S.I. units is another question'—it is *the* question and is what the discussion is about. The proposal is to adopt S.I. units, and to suggest that a 'nautical kilometre' is contemplated is to put forward one of those private metric systems that are to be deplored.

It was stated that one reason for metrication, namely international standardization, had not been mentioned by me. Since the decision has been made to adopt the Système International d'Unités (S.I.) it seemed unnecessary to labour the point. However to quote from *The Use of S.I. Units*,[2] 'The United Kingdom