poses distances will be measured in kilometres and speed in kilometres/hour and all instruments using the dimension of length will need re-scaling, e.g. distance and speed recorders, depth recorders and radar sets.

For great circle and rhumb line calculations the practical navigator assumes the Earth to be spherical and hence existing formulae will suffice with the addition of a conversion factor. For example if the length of 1′ on a spherical Earth is assumed to be 1852 m. (the now obsolescent international nautical mile), then the rhumb line formulae become

$$D.\ \text{Lat.} = (d \cos \theta)/1852$$
$$D.\ \text{Long.} = (d \sin \theta \sec \phi)/1852$$

where

$$d = \text{distance in metres}$$
$$\phi = \text{mean lat.}$$
$$\theta = \text{rhumb line course}$$

and *D*. lat. and *D*. long. are in minutes of arc.

The adoption of the radiation characteristics of the caesium atom as a measure of time interval will not have any noticeable effect on practical navigation but will cause some fundamental changes in the way that the navigator is taught.

No longer will orbital periods or the rotation of the Earth on its axis be measures of time. We no longer have to worry about the Sun as an erratic time-keeper or cope with the Mean Sun as a better one. In short we will not need to consider the equation of time and all the various 'years', 'days' and 'times' can be dispensed with. We merely acknowledge the fact that all the various celestial bodies and reference points have their individual rates of change of hour angle measured with reference to the one all-embracing atomic time.

CONCLUSION. It is evident that the adoption of S.I. units for navigation will lead to simplifications particularly when dealing with lengths. Those who will benefit most are the young people brought up on S.I. units who will learn their navigation without having to absorb many different units for the same dimension. Existing navigators may well prefer to remain unconverted but since the decision has been taken to adopt S.I. units it is best that the change over be made as quickly as possible.

There is evidently much scope for those who teach marine navigation to consider very carefully the future content and presentation of the subject.

BIBLIOGRAPHY

Changing to the metric system (1965). National Physical Laboratory.

Hariot's Meridional Parts

from Frank George

I WAS interested to see Mr. Pepper's note in the July issue of the *Journal*. The intriguing question of Hariot's unexplained approach to a problem that appears to require a knowledge of the integral calculus and exponential functions had

https://doi.org/10.1017/S0373463300037000 Published online by Cambridge University Press

attracted my attention when Taylor and Sadler[1] published their paper in 1953. In 1956 a note by me on this subject was published, with a comment by Mr. Sadler,[2] which offers much the same explanation. I, too, was unaware that there was any evidence of Hariot's familiarity with the conformal property of the stereographic projection.

In a later paper published elsewhere[3] I extended the relationship between the equiangular spiral and the rhumb line to provide a set of graphical constructions and formulae for the conical orthomorphic projections, either on the sphere or the spheroid.

REFERENCES

1 Taylor, E. G. R. and Sadler, D. H. (1953). The doctrine of nauticall triangles compendious. This *Journal*, 6, 131–147.

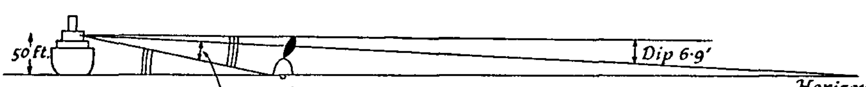
2 George, F. (1956). Hariot's meridional parts. This *Journal*, 9, 65–69.

3 George, F. (1960). A spiral transformation for the conical orthomorphic projections and a graphical construction. *Empire Survey Review*, 15, 215–222.

Distance by Vertical Angle—Height Unknown

from P. H. Sayers

An interesting, easy and useful method of finding the observer's distance from a ship, buoy or isolated lighthouse, the height of which is unknown, is by measuring the angle between its waterline and the horizon. To this is added the angle of dip for the height of eye.



From the figure it can be seen that the angle so obtained is equal to the angle at the object between the observer's height of eye and his own waterline.

By using Lecky's tables or the formula

$$\text{Dist.} = \frac{\text{Height of eye} \times 0{\cdot}565}{\text{Angle in minutes}}$$

the distance is obtained.

https://doi.org/10.1017/S0373463300037000 Published online by Cambridge University Press