Hamel, *Rigel* and the Moon. No details of the observations are given, but the cocked hat for the star fix is too small to be seen, and the error of the true fix, as compared with an independent determination, is indicated as less than 3 miles. If the error in the star fix, resolved perpendicular to the Moon position line is e' and the error of the observed altitude of the Moon (including the effects of personal error, sextant error, dip, refraction and altitude corrections) is E', then the error in the true fix (at the time of observation) is 27 $(e+E)$ minutes of arc. The actual error of less than 3 minutes of arc suggests that $e+E$ are together not more than 0′.1; this implies a truly remarkable set of observations, and it would be interesting to have details of the actual sextant readings and times.

It is good to know that so many navigators have been experimenting with the old methods of finding longitude without time; let them not be disheartened if they cannot match the accuracy above—if they can get longitude within 10, 15 or even 20 miles they should be well content.

Captain Flinders

R. St. J. Fancourt

The publication of Admiral Ritchie's E. G. R. Taylor Lecture (*Journal*, 20, 1) brings into perspective so many names familiar to the practising navigator; indeed the achievements of these great men are surveyed and charted with great clarity. Captain Flinders receives mention only in passing and his initial surveys of the greater part of Australia do not appear on the summary diagram. Yet, in other contexts, his ship, his mentor and his kinsmen all obtain special mention.

Of the nineteenth-century explorers, Flinders must surely be the first in time as *Investigator* sailed under his command in 1801 for a three-year cruise which ended in Flinders' imprisonment by the French. The *Investigator* was, I suggest, the old *Xenophon* and was converted for survey and exploration purposes at the instance of Sir Joseph Banks. The vessel was provided by the Navy Board and the change of name occurred in 1799 for the purpose of Matthew Flinders' great voyage. This followed upon his earlier achievements in surveying in *Tom Thumb* and *Cumberland*.

It may be worth mentioning that on the *Investigator* voyage Franklin, who was a cousin of Flinders, was a subordinate officer and it may well have been Flinders' example that moulded the character of the subsequently famous Sir John Franklin. Was it a coincidence that Bass, Flinders, Banks and Franklin were all Lincolnshire men from the region of Spilsby?

Can any members complete the following link—Bligh and Banks sailed under Cook, Flinders sailed under Bligh, and Franklin sailed under Flinders?

Rear Admiral G. S. Ritchie (Hydrographer of the Navy) writes:

Flinders' earliest surveys were made at the end of the eighteenth century, whilst those of *Investigator* (formerly H.M.S. *Xenophon* and renamed for Flinders'

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voyage) were completed within the first three years of the nineteenth century which entire period is covered by my paper. In referring to the great amount of material Flinders brought back after his release from Ile de France in 1810, I felt that justice had been done in a brief paper covering such a long period of hydrographic activity.

Flinders' surveys were omitted in the diagram, for by 1855 many of these areas had been surveyed in greater detail by Blackwood, Owen Stanley, Lort Stokes and King, all of whose names are shown.

That I do not ignore Flinders' great part in the history of British hydrography is clear from my book *The Admiralty Chart*, where I have devoted two chapters to his work, and have traced the 'tuition chain' down from Cook, through Bligh and Flinders to Franklin, just as Fancourt has done in his interesting note.

'The Metrication of Navigation'

from D. H. Sadler

(*Superintendent, H.M. Nautical Almanac Office*)

In his note (*Journal* **21**, 81) on this subject, Ronald Turner says 'No longer will orbital periods of the rotation of the Earth on its axis be measures of time'. This is not so, either in general or in the particular case of navigation.

Universal Time (U.T.), which is the generally accepted name for Greenwich Mean Time (G.M.T.), continues to be *essential* for all purposes (in astronomy, geodesy, surveying and navigation) for which are required astronomical observations related to the precise position of the observer on the Earth's surface. *The Nautical Almanac* must continue to tabulate the positions of the Sun, Moon, planets and stars with G.M.T. as the time-argument; and observations should be timed in a time-system related to U.T., such as the broadcast time-signals of Coordinated Universal Time (U.T.C.).

U.T.C. is actually based on Atomic Clock Time, obtained by the integration of the reciprocal of the frequency of the caesium resonance transition that now defines the second in the Système International des Unités; but it is at present adjusted, under international control, by both offsets of frequency and small discontinuities, so that it does not deviate from U.T.2 by more than about ±100 milliseconds ($0^{s}.1$). U.T.2 is a measure of time defined by the rotation of the Earth; it is obtained from the observed time at any place (U.T.0) by the application of small corrections, not exceeding about ±70 milliseconds, for the motion of the pole of rotation (local corrections) and for seasonal variations in the rate of rotation. Thus the navigator and the topocentric surveyor can use U.T.C., instead of U.T.0, without appreciable error; the astronomer and the geodesist, who require greater accuracy, can afford to wait to reduce their observations until definitive corrections to the broadcast U.T.C. are published by the Bureau International de l'Heure in *Bulletin Horaire*.

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