TABLE II. NEAR-INTEGRAL ALTITUDES

L.H.A.	Lat.	Dec.	Alt.	Error 0°000 001	Azimuth angle
°	°	°	°	°	°
42	75	78	80	+ 6	53·24
138	45	56	17	+10	23·03
59	55	14	29	−10	108·02
119	65	72	53	+10	26·69
106	72	24	18	−11	67·42
123	9	72	1	+12	15·02

If the initial object had been to discover such near-integral solutions, it would have been almost trivial to have programmed the computer to call attention to them when doing the basic calculations.

Acknowledgment is made to Mrs. M. E. Buontempo, Mrs. K. A. Long and Mrs. L. V. Morrison for the care taken in the examination, and to Mr. G. E. Taylor for the recomputations.

Simplified Tidal Calculations

A. N. Black

THE Admiralty Tide Tables give the utmost accuracy in tidal calculations, but at the cost of a number of tedious interpolations. Many seamen, particularly those in small vessels, would be willing to sacrifice some of this accuracy if they could have a simpler form of calculation. In any case meteorological effects, and the uncertainty of the time and height corrections for some of the smaller ports impose uncertainties which upset the apparent accuracy. In fact many yachtsmen do not use the Admiralty Tide Tables, but use tables in commercial almanacs, usually giving the times and heights of high water only.

The following method has been developed for use in a pilotage book for yachtsmen, covering the northern part of the Bay of Biscay. It could be adapted, with some loss of simplicity, to areas where the tides are less regular. It is based on the following assumptions:

(i) The mean tidal level (M.T.L.) is the same at a given place for all tides.
(ii) The range of the tide on a particular day is the same multiple of the local mean spring range at all places in the area covered.
(iii) The form of the curve of rise and fall of the tide is the same at all places in the area covered.
(iv) The interval between local H.W. and H.W. at the standard port is constant.

As a result of assumptions (i) and (ii) the levels of H.W. and L.W. can be calculated as

$$M.T.L. \pm S.H.R. \times P.F. \times T.F.,$$

where S.H.R. is the standard half range, that is half the range of mean springs at the standard port, P.F., the port factor, is the ratio of the mean spring range at the port considered to the mean spring range at the standard port, and T.F., the tide factor, is the ratio of the day's range at the standard port to the mean spring range at that port.

Taking logarithms, the logarithm of the last term is

$$\log S.H.R. + \log P.F. + \log T.F.$$

The first of these is a constant, and can be allowed for in the tabulations, the second can be calculated once and for all for each port, and is here called the Port Index, and the third, called the Tide Index, can be obtained from the range (or less accurately the height of H.W.) at the standard port, by a single line table. If the method became sufficiently popular the Tide Index could be tabulated in the almanacs, in a similar way to the 'coefficient of the tide', which is tabulated in the French almanacs.

To find the height of tide at any time it is only necessary to have a table giving the correction to M.T.L. for given intervals from local high water, in terms of the value of the Total Index = Port Index + Tide Index. An extract from this table appears below. The instructions are:

From the almanac take the time and height of H.W. Brest (standard port).

From the port details take the time of local high water as compared with Brest, the Port Index and M.T.L.

Calculate the time of local high water.

Calculate the interval between local high water and the time when the tidal height is required.

In the tide table, find the column with the nearest height of H.W. Brest.

Note the corresponding Tide Index, add the Port Index, and locate the column headed by the total. Another way of putting this is that the Port Index tells you how many columns to move to the right. Run down the column to the correct interval from local high water, calculated above and read off the correction which is to be added to, or subtracted from, the M.T.L. The table is in metric units, but could equally be calculated in feet.

Example: Required the height of tide at Le Croisic on 17 August 1969 at 1340.

From the almanac; Brest H.W. at 1834, height 23·1 ft.

From port information for Le Croisic H.W. is –0020 Brest, Port Index 1, M.T.L. 2·8 m.

Working: Local H.W. is 1834 – 0020 = 1814.

Interval is 1814 – 1340 = 4h 34.

In the table, extract below, for H.W. Brest 23·1 ft., the nearest figure is 23·3 ft., giving a Tide Index of 13; adding the Port Index, 1, gives a total of 14. In the column headed 14, for interval 4h 30 (the nearest to 4h 34) the correction to M.T.L. is – 1·2. Subtracting this from the M.T.L. for Le Croisic, 2·8 m., gives the height as 1·6 m.

It is a disadvantage of the method that, since the columns are spaced logarithmically, they cover small increments of the range for small tidal ranges, but the increments are correspondingly large when the range is large. This seems a small

https://doi.org/10.1017/S0373463300032586 Published online by Cambridge University Press

price to pay for the simplicity of basing all calculations on the simple sum of two Index numbers, one for the port and one for the day's tidal range.

The base of the logarithms, which determines the increment in half range between one column and the next, has been arbitrarily chosen to give reasonable steps. The Tide Index varies between 0, for a tide less than mean neaps, and 18 for extreme springs. For the coast between Brest and the Gironde the Port Index varies between 0 and 5.

EXTRACT FROM TABLE

	Brest HW	ft.	22·7	23·3	23·9	24·5
		m	6·9	7·1	7·3	7·5
	Tide Index		12	13	14	15
			add port index			
	Total index		12	13	14	15
Interval from local high water	0h 00	A	1·8	1·9	2·1	2·2
		D				
	20	D	1·8	1·9	2·0	2·2
	...	...	...	...	...	...
	4h 20	S	0·9	1·0	1·1	1·1
		U				
	30	B	1·0	1·1	1·2	1·3
		T				
	40	R	1·2	1·2	1·3	1·4
		A				
	50	C	1·3	1·4	1·5	1·5
		T				
	...	...	...	...	...	...

Revised Rules for Preventing Collisions at Sea

Rear-Admiral J. García-Frías

Captain P. A. Thompson's paper, Revised Rules for Preventing Collisions at Sea, in the January issue of the *Journal* should be discussed. I agree with him that 'rules (the ones which are mainly based on the operational aspect[2] of the collision problem, i.e. manœuvring rules) to cover every conceivable circumstance would be of such length as to be impracticable.' However, in my opinion, rules based on the principles—the organic aspects[2]—can cope practically because then the object of the rules is to define the collision problem and its solution so that use of the rules can be immediate, easy and effective. For example, by establishing a safety distance[1] the passing operation would have to be carried out such that the miss distance would always be greater than the safety distance. Furthermore, by keeping the ship's range above the safety distance, one ensures