REFRACTION

by

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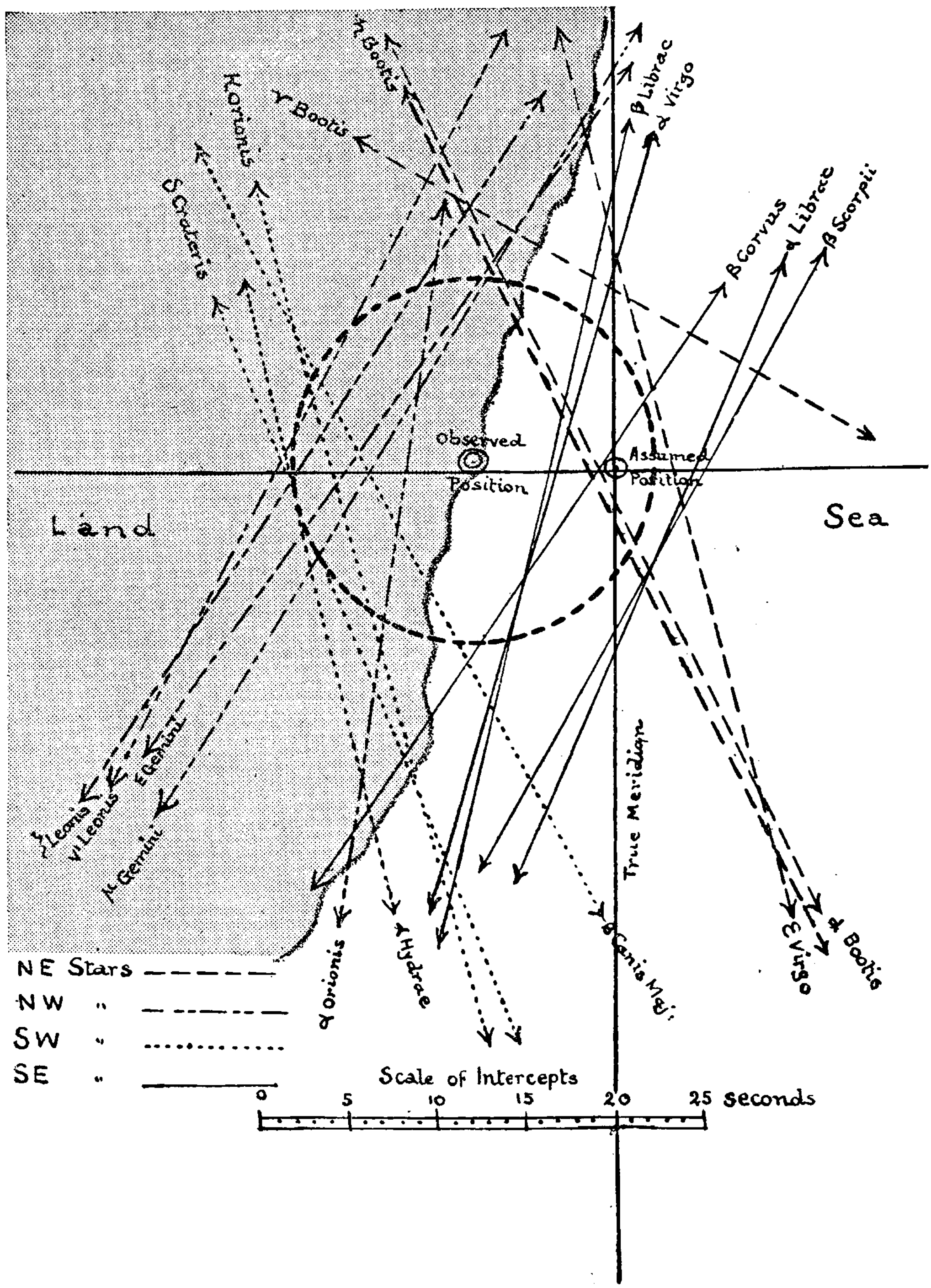
Of the various duties the Marine Surveyor is called upon to undertake that of obtaining astronomical observations at stations ashore is one of the more important. He is now supplied with extremely accurate instruments for measuring the altitude of the heavenly bodies, portable wireless sets for obtaining Time Signals at the observation spot, instruments for automatically recording the time of each observation, accurate Nautical Tables, logarithm tables calculated to the 7th place of decimals, and he uses the most intricate mathematical formulae for calculating the intercepts and thus obtaining the final astronomical position of the station.

The accuracy of the result is dependent on two main items: Time and Altitude. The former can now be obtained to the hundredth part of a second thanks to the rhythmic system of Time Signals transmitted from many of the Wireless Stations throughout the world, and the latter can be observed with great accuracy by means of the Prismatic Astrolabe or other modern instruments. The only element of doubt is the Refraction Correction to be applied to the altitudes thus observed, for as Sir Charles CLOSE says in his *Text Book of Topographical and Geographical Surveying*: "It is impossible to be certain that the value obtained from any table is the true value". This is especially the case when observations are obtained at stations situated on or near the coast when half of the heavenly bodies observed may be over the sea and the other half over the land, for it can be safely assumed that the refraction over the sea differs from that at the same time over the land, especially in the Tropics, and therefore the error due to Refraction is only partly minimised by observing objects at opposite points of the compass.

The Temperature and Height of Barometer are of course observed at frequent intervals *at the observation spot* throughout the whole series of observations, but this would not appear to supply the accurate data for use with the Refraction Tables under these conditions, *i. e.* at stations situated at or near the coast. So far, however, as the writer knows, this problem has never been satisfactorily solved and it is therefore one that might with advantage be discussed through the medium of the *Hydrographic Review*.

As an example of the above a tabulated list of observations taken by the writer on the night 18-19 September, 1929, is now given:



Land
Sea
Observed Position
Assumed Position
True Meridian
NE Stars
NW "
SW "
SE "
Scale of Intercepts
0 5 10 15 20 25 seconds

Star.	*Azimuth.*	*Observed Altitude.*	*Refraction*	*Corrected Altitude.*	*Observed Z. D.*	*Calculated Z. D.*	*Resulting Intercept.*		*Quadrant.*
ϰ Orionis	S74.55W	45°00'00".04	0'54".030	44°59'06".010	45°00'53".990	45°01'09".476	15".486	Towards	S. W.
α Orionis	N80.48W	45 00 00 .02	0 54 .030	44 59 05 .990	45 00 54 .010	45 01 05 .905	11 .895	Towards	N. W.
μ Gemini	N58.39W	45 00 00 .16	0 54 .051	44 59 06 .109	45 00 53 .891	45 01 05 .810	11 .919	Towards	N. W.
β Canis Maj.	S62.47W	45 00 00 .110	0 54 .051	44 59 06 .059	45 00 53 .941	45 01 06 .762	12 .821	Towards	S. W.
ε Gemini	N54.33W	45 00 00. 200	0 54 .081	44 59 06 .119	45 00 53 .881	45 01 06 .524	12 .643	Towards	N. W.
β Corvus	S54.55E	45 00 00 .200	0 54 .143	44 59 06 .057	45 00 53 .943	45 00 52 .952	0 .991	Away from	S. E.
ε Virgo	N75.12E	45 00 00 .030	0 54 .143	44 59 05 .887	45 00 54 .113	45 00 57 .227	3 .114	Towards	N. E.
α Virgo	S73.20E	45 00 00. 040	0 54 .175	44 59 05 .865	45 00 54 .135	45 00 50 .905	3 .230	Away from	S. E.
η Bootis	N64.23E	45 00 00 .090	0 54 .206	44 59 05 .884	45 00 54 .116	45 00 52 .619	1 .497	Away from	N. E.
α Bootis	N63.12E	45 00 00 .100	0 54 .237	44 59 05 .863	45 00 54 .137	45 00 53 .286	0 .851	Away from	N. E.
α Librae	S66.03E	45 00 00 .090	0 54 .283	44 59 05 .807	45 00 54 .193	45 00 57 .864	3 .671	Towards	S. E.
β Librae	S75.44E	45 00 01 .150	0 54 .298	44 59 06 .852	45 00 53 .148	45 00 49 .095	4 .053	Away from	S. E.
α Hydrae	S76.51W	45 00 00 .030	0 54 .289	44 59 05 .741	45 00 54 .259	45 01 12 .864	18 .605	Towards	S. W.
γ Bootis	N30.39E	45 00 01 .110	0 54 .294	44 59 06 .816	45 00 53 .184	45 01 01 .714	8 .530	Towards	N. E.
ξ Leonis	N56.47W	45 00 00 .180	0 54 .298	44 59 05 .882	45 00 54 .118	45 01 09 .286	15 .168	Towards	N. W.
γ'Leonis	N62.13W	45 00 00 .110	0 54 .298	44 59 05 .812	45 00 54 .188	45 01 11 .762	17 .574	Towards	N. W.
β Scorpii	S60.13E	45 00 00 .120	0 54 .313	44 59 05 .807	45 00 54 .193	45 00 58 .619	4 .426	Away from	S. E.
δ Crateris	S68.03W	45 00 00 .080	0 54 .316	44 59 05 .764	45 00 54 .236	45 01 12 .046	17 .810	Towards	S. W.

From these intercepts the difference of Latitude and Longitude from the assumed position was found by calculation to be 0".344 N. and 7".994 W.

The results of these observations are graphically shown in the accompanying diagram, in which the position lines obtained from each star are shown plotted by the SUMNER method.

Assuming that the direction of the coast runs in a N b E and S b W direction it is probable that the refraction over the land area, shaded grey, differs from that over the sea area, unshaded.

In working out the observations however the only difference in the refraction correction applied is that due to change in the Barometer and Thermometer readings during the course of the observation; in which case the final observed position obtained may be slightly erroneous.