THE DETERMINATION OF GEOGRAPHICAL POSITION FOR SCIENTIFIC OBSERVATIONS AT SEA AND ESPECIALLY IN CONNECTION WITH MAGNETIC WORK

by

O. W. TORRESON.

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The value of scientific observations at sea may be enhanced or diminished according as the determinations of geographical position of the different observations are good or poor. For the best determinations of position, there must exist the closest co-operation between the ship's officers and the scientific staff, and this co-operation is best attained when each group has a fairly good understanding and appreciation of the problems of the other. Perhaps the very best results are obtained when the members of one group participate regularly and rather extensively in the activities of the other. On the *Carnegie* this latter arrangement always existed. Two or more members of the scientific staff always participated in the navigational work, making the customary astronomical observations, computing dead-reckoning, and making the necessary adjustments of navigational data in its application to all the scientific observations. The ship's officers, on the other hand, took active part in the scientific work and were thus made aware of the need for effective notes on unusual features of meteorological conditions, ship's operation, or scientific work. The result to both groups was greater appreciation of the demands for highest accuracy in all phases of the work.

On all cruises of the *Carnegie* the accuracy required in navigation was secured by having three observers — two members of the scientific staff and the first watch-officer — make all the astronomical observations. Furthermore, six altitudes of a celestial body were taken, weather permitting, in rapid succession for longitude-sights, the computations being based upon the mean of the six altitudes. Chronometer-corrections were known to tenths of seconds with the aid of the radio and were used to that degree of accuracy, and watch-corrections were taken to fifths of second. The results of the three independent computations ranged usually over approximately one mile, making the mean probably only a few tenths of a mile in error. Observations of latitude at noon likewise ranged usually over about one mile.

The accuracy of the dead-reckoning was limited by the correctness of assumption as to drift when hove-to, to leeway when sailing, and to current. The judgment of the sailing officers on these details was based not only upon their long experience at sea, but upon their appreciation of the importance of navigational details in relation to the scientific work, and was therefore accepted for the dead-reckoning computations.

On the *Carnegie* between 10 and 30 geographical positions were required each day for the various scientific observations and the dead-reckoning had to be adjusted back over varying intervals, from each of the astronomical observations, for each of the positions. It is believed that the positions as determined were accurate to within less than a mile under good sailing and navigating conditions.

On any future expedition it is possible that echo-soundings alone may greatly increase the number of geographical positions to be determined each day, the total becoming perhaps as much as 40 or 50, or more. Some of the observations will require more accurate positions than others, among them being the magnetic measurements. The program outlined for magnetic measurements on a ship that has been adapted and not specially constructed for the purpose will require star-sights to precede the swing for declination-observations if the latter are made in the morning, or to follow if the observations are made at sunset. Sun-sights will provide the position of the swing for the other magnetic measurements during the day.

It is not intended here to specify any particular method of navigation or to suggest that the scientific staff should participate in that work, but it does seem desirable to emphasize the fact that the determination of positions is, in reality, part of the scientific work and requires more detailed attention than is given to it in ordinary navigation.