of the base. Prepare a small radial arm of the form illustrated, and in the upper projection drill a hole about the size of a pin, so that the sun's rays may pass through and illuminate a small spot on the lower projection. This arm is attached to the block by means of a pin or small nail near the upper end put in at the exact center of the protractor. Set the arm at 90° , and with the steel square resting on the same horizontal surface as the block, make a small dot on the lower projection of the arm to indicate where the sun's image should fall.

To determine a meridian, carefully level up any convenient flat surface, on which the block should be moved about until the surface of the protractor is in the plane of the sun. Adjust the angle of the arm until the image falls on the small indicating dot, then record the sun's direction by drawing a line with a sharp pencil on the horizontal surface using the lower edge of the block as a ruler, after which read the altitude. The above formula will then give the relation of the sun to the meridian, which may be laid off with a protractor set on the line previously drawn.

By consulting an ephemeris it will be seen that for practical purposes the exact time is not a matter of great importance. To avoid the necessity of interpolating with the eye in reading the altitude, one may follow the sun for a minute or two until the reading is an exact division on the arc, when the mark may then be made on the horizontal surface. This may be repeated several times in a few minutes, and the mean of all the results taken.

A very convenient ephemeris of the sun and Polaris may be had from the Superintendent of Documents, Government Printing Office, Washington, for five cents.

AN IMPROVED TOWING SPAR WHICH CAN BE USED AS A NAVIGATIONAL INSTRUMENT.

By LIEUT. COMMANDER S. F. HEIM, U. S. Navy.

In these days of radio compasses and gyro controlled artificial horizons, it might be considered rather late to offer a scheme for taking sights by bringing the heavenly body down to a spar towed by the ship. The writer has read in the U. S. Naval Institute Proceedings of sights being taken on the waterline of another ship, on a boat sent out by the ship and even on a chip log astern of the ship, but spar which would seem to be the logical method because it can be let out from the ship without stopping or altering speed and its distance from the ship can be controlled accurately by marks on the tow line.

The scheme seemed so simple and plausible that the writer wondered why it had not been done before and he inquired of experienced officers and searched the files of the Naval Institute but failed to find where it had ever been tried. To test his theory he went out in the bay off Greenbury Point on a submarine chaser and steamer both day and night and took sights, using an ordinary towing spar with only 350 feet of line. A small waterproof storage battery light was attached to the spar at night. The results of these trials were accurate far beyond expectations. These results in altitude difference by Marcq Saint-Hilaire method were accurate within 1 minute of arc.

Of course it is realized that conditions here were ideal, with no wave movement of either the spar or the ship; but it is proposed to eliminate these errors as far as practicable at sea by use of the improved towing spar which will remain afloat with 500 or 600 yards of line out from the ship. The longer the length of line the more accurate will be the results. The maximum possible error due to rising and falling of spar in sea will be the angle with tangent equal to maximum rise divided by length of tow line. Thus with a 3-foot rise and fall of spar with 600 yards of line the maximum error would be 5 minutes in altitude.

The three views of the towing spar are self-explanatory and a description is unnecessary. This spar was developed and used by the commanding officer of the "U. S. S. Charleston"

while engaged in convoy duty during the war. The old navy towing spars and special sheet metal tank spars supplied to ships were useless for this work because they would tow under at the distances at which they were desired to be used. The towing under was caused by two things: their shape and the towing line. The improved spar shown in sketch was towed by a small wire rope of about the diameter of a lead pencil. This wire line was wound on a small reel secured just forward of the quarterdeck winch. The spar was hauled in by means of the deck winch. It was found that manila line was unsatisfactory for towing logging and friction tend to pull the spar under. It will be noted that a strong keel or centerboard is attached to the spar. This is an important feature which causes it to tow during turns and prevents capsizing.

TOWING SPAR USED ON THE U. S. S. "CHARLESTON"

By having at hand a table of "dips" to use for different speeds and lengths of tow line, the operation of taking a sight would be comparatively simple. He could take the bearing of the heavenly body to be observed and then head the ship directly away from the body and with spar out take a series of sights. The average of the series should be taken to counteract the errors due to wave heights of the spar. By practice in fair weather when the "dip corrections" are computed he could determine the limits of accuracy and how much confidence to place in it when occasion for its use arrives. We have all experienced the occasion when a sight was highly desirable or even necessary with the sun out or stars shining but no horizon visible.—Copyrighted by the U. S. Naval Institute. Reprinted by permission, from the *Proceedings* of the Institute, March, 1920.

CONCRETE PONTOONS FOR SHIP SALVAGE.

A set of reinforced concrete floats have been built by Messrs. Christiani and Nielsen says *Le Génie Civil* (Feb. 21, 1920) for the salvage of ships. The floats are cylindrical and measure 21 meters long and 3.60 meters in diameter. Each float has a bearing capacity of 100 tons and is designed to lift 200 tons. It can withstand an external pressure 2 kg. per cm^2 and in exceptional cases 4 kg. per cm^2 so that it may be used at depths of 40 meters.