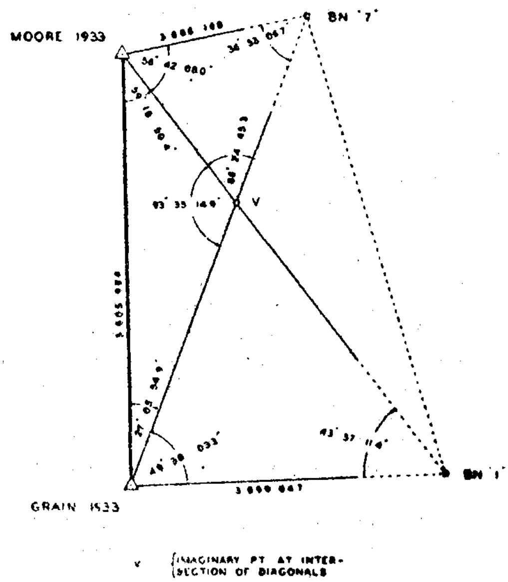
When each beacon was abeam of the taut-wire apparatus, the registering sheave was read and recorded. A run was made in each direction and the total distance of each run of four miles agreed, in terms of the sheave readings, within two revolutions or approximately 3.6 meters in 7,500 which is better than one part in 2,000.

SKETCH SHOWING DATA OBTAINED FROM ADJUSTED TRIANGULATION



These readings between the end beacons were used in computing the conversion factor, the readings on the intermediate beacons serving only as checks.

It is interesting to note, in the result, the slight difference between the 1935 and the 1937 calibrations, the factors being 1.86163 and 1.86194 respectively. Since the factor is used to the third decimal only, 1.862 serves for both calibrations. However, the method used in 1937 is considered the more accurate and is recommended whenever similar control is available.

CREATING A HORIZON

by

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(Article printed on the back of U.S. Hydrographic Office Chart N° 2600, *Pilot Chart of the South Atlantic Ocean*, for June, July and August 1939, and published by permission of the U.S. Naval Institute.)

The modern navigator is so indoctrinated with the use of the sea horizon, that it becomes difficult to persuade him that there are other methods of bringing down a heavenly body so as to obtain a true altitude. In the good old days it was not an infrequent occurrence to see a ship's captain make use of a soup plate of molasses in taking his time sight. And this is still a good practice, especially when one takes full advantage of the use of gimbals by placing the plate of molasses atop his pelorus.

The vagaries of our friend "sea horizon" are so many that at times one wonders where he is. Especially is this true in localities where there is a marked difference in temperature between the air and sea water. This is especially so around the Gulf Stream where the water is so much warmer than the air that the sea horizon is often displaced as much as 14' of arc. One of the most striking examples of displaced horizons occurs in the Red Sea. The hot winds and sands blowing from the deserts create a marked difference between the air and sea water temperatures, and the visible horizon is raised out of all proportion to its true position. As a result the dip is increased and the resultant true altitude is often as much as 18' greater than that obtained by using the ordinary dip table.

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Let us consider the reasons that sometimes cause poor navigation (or rather, poor results). There is a general drift current that sets to the north out of the antarctic regions. This current upon striking the shores of the South American continent is divided into two branches. One of these branches, known as the Peruvian, Chilean or Humboldt current, flows northeast in the direction of Valparaiso conforming somewhat to the coast lines of Chile and Peru. Near Cape Blanco the current leaves the coast of America and bears toward the Galapagos Islands. This current is exceedingly cold. As an illustration, on one side of Albermarle Island of this group, the temperature of the sea was once found to be 80° while on the other side of the same island it was 60° — a difference of 20°. Small wonder that our old friend, the sea horizon, has the "jumps" especially when we consider that these islands are practically on the equator.

It is the writer's belief that this remarkable current has considerable effect on our navigation outside of the Panama Bay area. From the writer's own experience, there have been many days when a heavy mist hung over the horizon in spite of a beautiful sky overhead.

To overcome these difficulties of navigation in regions where this condition exists, whether the horizon can be seen or not, it is recommended that the method to be described be used when possible.

The use of another ship as a horizon is by no means new. It has been described and used on many occasions. However, the writer has compiled a set of convenient tables with which to correct the resultant altitude, thus making such a procedure easy.

The method is simple. The observing ship directs the "target" ship to steam on a course at right angles to the bearing of the heavenly body. The observing ship then steams on a parallel course on the line of bearing of the "target" ship and the heavenly body and at a known distance from the "target" ship. The heavenly body is then brought down to the water line of the "target" ship and corrections from table A and B are applied similar to the method employed in the front of H.O. Publication N° 208. Table A contains the correction to be applied for semidiameter, parallax, and refraction in the case of the sun and for the mean refraction in the case of stars. Table B contains the dip to be applied for various heights of eye and for various distances in yards between the two ships. It was computed from the formula :

$$\text{dip} = \frac{.565\text{h}}{\text{d}} + 423\text{d}$$

where h = height of eye in feet, and d = distance between the ships in nautical miles.

From an inspection of them it will be seen that the lower the height of eye and the further away the "target" or horizon, the less the correction becomes.

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CORRECTIONS TO BE APPLIED TO THE OBSERVED ALTITUDE OF THE SUN'S LOWER LIMB OR OF A STAR.
TO FIND THE TRUE ALTITUDE WHEN ANOTHER SHIP OR THE SHORE IS USED AS A HORIZON

TABLE A

OBS ALT.	SUN'S CORR.	STAR'S CORR.
° ′	′	′
6 30	+ 8.3	-7.9
7 00	+ 8.8	-7.4
7 30	+ 9.2	-7.0
8 00	+ 9.6	-6.6
8 30	+10.0	-6.2
40	+10.1	-6.1
50	+10.2	-6.0
9 00	+10.3	-5.9
20	+10.5	-5.7
40	+10.7	-5.5
10 00	+10.8	-5.3
20	+11.0	-5.2
40	+11.2	-5.0
11 00	+11.3	-4.9
30	+11.5	-4.6
12 00	+11.7	-4.5
30	+11.9	-4.3
13 00	+12.0	-4.1
30	+12.2	-4.0
14 00	+12.3	-3.8
15 00	+12.6	-3.6
16 00	+12.8	-3.3
17 00	+13.0	-3.1
18 00	+13.2	-3.0
19 00	+13.4	-2.8
20 00	+13.5	-2.6
22 00	+13.8	-2.4
24 00	+14.0	-2.2
26 00	+14.2	-2.0
28 00	+14.3	-1.8
30 00	+14.5	-1.7
32 00	+14.6	-1.6
34 00	+14.7	-1.4
36 00	+14.8	-1.3
38 00	+14.9	-1.2
40 00	+15.0	-1.2
45 00	+15.2	-1.0
50 00	+15.3	-0.8
55 00	+15.4	-0.7
60 00	+15.5	-0.6
65 00	+15.6	-0.5
70 00	+15.7	-0.4
75 00	+15.8	-0.3
80 00	+15.9	-0.2
85 00	+15.9	-0.1
90 00	+16.0	-0.0

TABLE B

Height of eye	DISTANCE OF SHIP USED AS HORIZON IN YARDS												
	500	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
Feet	′	′	′	′	′	′	′	′	′				
10	-22.7	-11.3	-6.1	-4.4	-3.7	-3.3	-3.2	-3.1					
11	-25.0	-12.6	-6.6	-4.8	-4.0	-3.5	-3.3	-3.3					
12	-27.3	-13.8	-7.2	-5.2	-4.2	-3.8	-3.6	-3.4	-3.4				
13	-29.5	-14.9	-7.8	-5.5	-4.5	-4.0	-3.7	-3.6	-3.5				
14	-31.8	-16.0	-8.3	-5.9	-4.8	-4.2	-3.9	-3.7	-3.7				
15	-34.0	-17.2	-8.9	-6.3	-5.1	-4.4	-4.1	-3.9	-3.8				
16	-36.3	-18.3	-9.5	-6.7	-5.4	-4.7	-4.3	-4.1	-4.0	-4.0			
17	-38.5	-19.4	-10.0	-7.0	-5.6	-4.9	-4.5	-4.2	-4.1	-4.0			
18	-40.8	-20.6	-10.6	-7.4	-5.9	-5.1	-4.7	-4.4	-4.2	-4.2			
19	-43.0	-21.7	-11.2	-7.8	-6.2	-5.4	-4.8	-4.6	-4.4	-4.3	-4.3		
20	-45.3	-22.8	-11.7	-8.2	-6.5	-5.6	-5.1	-4.7	-4.5	-4.5	-4.4		
21	-47.6	-23.9	-12.3	-8.6	-6.8	-5.8	-5.2	-4.9	-4.7	-4.6	-4.5		
22	-49.8	-25.1	-12.9	-8.9	-7.1	-6.0	-5.4	-5.0	-4.8	-4.7	-4.6		
23	-52.1	-26.2	-13.4	-9.3	-7.3	-6.3	-5.6	-5.2	-4.9	-4.8	-4.7	-4.7	
24	-54.4	-27.4	-14.0	-9.7	-7.6	-6.5	-5.8	-5.4	-5.1	-5.0	-4.9	-4.8	
25	-56.6	-28.5	-14.5	-10.1	-7.9	-6.7	-6.0	-5.5	-5.2	-5.0	-4.9	-4.9	
26	-58.9	-29.6	-15.1	-10.4	-8.2	-6.9	-6.2	-5.7	-5.4	-5.2	-5.1	-5.0	
27	-61.1	-30.7	-15.7	-10.8	-8.5	-7.2	-6.3	-5.8	-5.5	-5.3	-5.2	-5.1	-5.1
28	-63.4	-31.9	-16.3	-11.2	-8.8	-7.4	-6.6	-6.0	-5.7	-5.5	-5.3	-5.2	-5.2
29	-65.6	-33.0	-16.8	-11.6	-9.1	-7.6	-6.7	-6.2	-5.8	-5.5	-5.4	-5.3	-5.3
30	-67.9	-34.1	-17.4	-11.9	-9.3	-7.8	-6.9	-6.3	-5.9	-5.7	-5.5	-5.4	-5.4
31	-70.2	-35.2	-17.9	-12.3	-9.6	-8.1	-7.1	-6.5	-6.1	-5.8	-5.6	-5.5	-5.5
32	-72.5	-36.4	-18.5	-12.7	-10.0	-8.3	-7.3	-6.7	-6.2	-6.0	-5.8	-5.7	-5.6
33	-74.7	-37.5	-19.1	-13.1	-10.2	-8.5	-7.5	-6.8	-6.3	-6.1	-5.8	-5.7	-5.6
34	-76.9	-38.6	-19.6	-13.5	-10.5	-8.7	-7.7	-7.0	-6.5	-6.2	-6.0	-5.8	-5.7
35	-79.2	-39.8	-20.2	-13.8	-10.8	-9.0	-7.8	-7.1	-6.6	-6.3	-6.1	-5.9	-5.8
36	-81.5	-40.9	-20.8	-14.2	-11.0	-9.2	-8.1	-7.3	-6.8	-6.4	-6.2	-6.1	-6.0
37	-83.7	-42.0	-21.3	-14.6	-11.3	-9.4	-8.2	-7.4	-6.9	-6.6	-6.3	-6.1	-6.0
38	-86.0	-43.2	-21.9	-15.0	-11.6	-9.6	-8.4	-7.6	-7.1	-6.7	-6.4	-6.2	-6.1
39	-88.2	-44.3	-22.5	-15.3	-11.9	-9.9	-8.6	-7.8	-7.2	-6.8	-6.5	-6.3	-6.2
40	-90.6	-45.5	-23.0	-15.7	-12.2	-10.1	-8.8	-8.0	-7.4	-7.0	-6.7	-6.5	-6.3
41	-92.8	-46.5	-23.6	-16.1	-12.4	-10.3	-9.0	-8.1	-7.5	-7.1	-6.8	-6.5	-6.4
42	-95.0	-47.7	-24.2	-16.5	-12.7	-10.6	-9.2	-8.2	-7.6	-7.2	-6.9	-6.6	-6.5
43	-97.3	-48.8	-24.7	-16.8	-13.0	-10.8	-9.4	-8.4	-7.8	-7.3	-7.0	-6.7	-6.6
44	-99.6	-50.0	-25.3	-17.2	-13.3	-11.0	-9.6	-8.6	-7.9	-7.5	-7.2	-6.9	-6.7
45	-101.8	-51.1	-25.8	-17.6	-13.6	-11.2	-9.7	-8.7	-8.0	-7.6	-7.2	-7.0	-6.8
46	-104.1	-52.2	-26.4	-18.0	-13.9	-11.5	-9.9	-8.9	-8.2	-7.7	-7.3	-7.1	-6.9
47	-106.3	-53.3	-27.0	-18.4	-14.1	-11.7	-10.1	-9.0	-8.3	-7.8	-7.4	-7.2	-7.0
48	-108.7	-54.5	-27.6	-18.7	-14.4	-11.9	-10.3	-9.3	-8.5	-8.0	-7.6	-7.3	-7.1
49	-110.8	-55.6	-28.1	-19.1	-14.7	-12.1	-10.5	-9.4	-8.6	-8.1	-7.7	-7.4	-7.2
50	-113.1	-56.7	-28.7	-19.5	-15.0	-12.4	-10.7	-9.5	-8.7	-8.2	-7.8	-7.5	-7.2
51	-115.4	-57.8	-29.2	-19.9	-15.3	-12.6	-10.9	-9.7	-8.9	-8.3	-7.9	-7.6	-7.3
52	-117.6	-59.0	-29.8	-20.2	-15.6	-12.8	-11.0	-9.9	-9.0	-8.4	-8.0	-7.7	-7.4
53	-119.9	-60.1	-30.4	-20.6	-15.8	-13.0	-11.2	-10.0	-9.2	-8.6	-8.1	-7.8	-7.5
54	-122.1	-61.2	-30.9	-21.0	-16.1	-13.3	-11.4	-10.2	-9.3	-8.7	-8.2	-7.9	-7.6
55	-124.4	-62.4	-31.5	-21.4	-16.4	-13.5	-11.6	-10.3	-9.5	-8.8	-8.3	-8.0	-7.7
60	-135.7	-68.0	-34.3	-23.2	-17.8	-14.6	-12.6	-11.2	-10.2	-9.4	-8.9	-8.5	-8.2
65	-147.0	-73.7	-37.1	-25.1	-19.2	-15.7	-13.5	-11.9	-10.9	-10.1	-9.5	-9.0	-8.7
70	-158.3	-79.3	-40.0	-27.0	-20.7	-16.9	-14.4	-12.8	-11.2	-10.7	-10.0	-9.5	-9.1
75	-169.6	-85.0	-42.8	-28.9	-22.1	-18.0	-15.4	-13.6	-11.9	-11.3	-10.6	-10.0	-9.6
80	-180.9	-90.6	-45.6	-30.8	-23.5	-19.1	-16.3	-14.4	-13.0	-12.0	-11.2	-10.6	-10.1
85	-192.2	-96.3	-48.4	-32.7	-24.9	-20.3	-17.3	-15.1	-13.7	-12.6	-11.7	-11.1	-10.5
90	-203.5	-101.9	-51.3	-34.6	-26.3	-21.4	-18.2	16.0	-14.4	-13.2	-12.3	-11.6	-11.0
95	-214.8	-107.6	-54.1	-36.4	-27.7	-22.5	-19.2	-16.8	-15.1	-13.8	-12.9	-12.1	-11.5
100	-226.1	-113.2	-56.9	-38.3	-29.1	-23.7	-20.1	-17.6	-15.8	-14.5	-13.4	-12.6	-12.0

ADDITIONAL CORRECTION FOR SUN'S ALTITUDE

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
+'.3	+'.2	+'.1	-'.1	-'.1	-'.2	-'.2	-'.2	-'.1	+'.1	+'.2	+.'3