TAUT WIRE AND SUN AZIMUTH TRAVERSE COMPUTATION

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The hydrographic surveys executed by the ship *Hydrographer* during the 1936 field season were in an area in which it was necessary to use surveying buoys for the major part of the control. Lines of buoys were established normal to the shore line from the limit of visibility of shore signals out to the 11 fathom curve, a distance of about twenty miles. The buoys at the inshore end of each line were located by sextant angles to three or more shore signals and their positions were determined graphically on aluminum sheets on a scale of 1:40,000. Closed traverse loops were formed by two adjacent lines of buoys and the connection at the outer ends. The corrected taut-wire distances and sun-azimuths between adjacent buoys were computed in a plane traverse to give the positions of the buoys in these loops. All except the outer two lines of buoys are used in the computations of two traverse loops, each line of buoys being used with the adjacent line on each side to form a traverse loop. The final positions of these buoys are the mean values obtained from the two traverse loops.

Plate I, *Control for Hydrographic Surveys*, shows the relative positions and the method of location of all buoys used during the season.

The computation and adjustment of two adjacent traverses are given in detail. In the form, *Computation of Traverse*, in columns No. 2 and 3 are entered the corrected sun azimuths and taut-wire distances between adjacent buoys. The sines and cosines of the sun azimuths are entered in columns No. 4 and 5. The latitude differences and departures in columns No. 6, 8, 10 and 12 are obtained by multiplying the taut-wire distances by the sines and cosines of the sun azimuths. The loop closures are determined by taking the difference between the totals of the north and south columns for latitude and the like difference of the east and west columns for longitude. These are then compared with the differences between the geographic positions of the two fixed inshore buoys as scaled from the 1:40,000 scale aluminum sheets. To the differences of longitude it is necessary to apply a correction for the convergence of meridians before the loop closures can be determined. This correction is obtained by multiplying the difference between the values of one minute of longitude at the north end and at the south end of the loop by the longitude difference between the two inshore fixed buoys. After the latitude and longitude closures are determined, the loop adjustment corrections are applied to the latitude differences and departures as entered in columns No. 7, 9, 11 and 13. The corrected differences of latitude and longitude in meters are entered in columns 14 and 17. These corrected differences of latitude and longitude are then applied to the geographic position of the fixed buoy and the adjusted latitudes in minutes and meters are entered in columns 15 and 16, and the adjusted longitudes in columns 18 and 19.

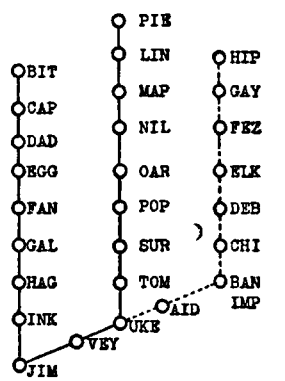
The final positions of the buoys in the line PIE-UKE are obtained by taking the means of the positions from the two traverses of which the line of buoys forms a part.

It is believed that the above described method of obtaining buoy positions is superior to other methods for similar areas. For the data available this method is believed to give more accurate positions than any graphic method and the resulting positions are obtained more quickly. The motion and vibration of the ship at sea make accurate location by graphical means very difficult whereas they do not interfere with computations.

At the beginning of the season graphic methods were used to locate the control buoys. A projection, scale 1:80,000, had been constructed on an aluminum sheet and this scale was necessary in order to include sufficient area of the working ground. The positions scaled from this sheet were to be used in hydrographic surveys, scale 1:40,000. Since the enlargement of the scale of a control survey is extremely undesirable, other possible methods were considered. An excessive number of aluminum sheets would have been required to cover the area on a scale of 1:40,000. The method finally adopted and which is described herein requires a series of aluminum sheets, scale 1:40,000, which include the shore control and the buoys along the shore at the inshore end of the traverses; and an offshore aluminum sheet at the scale of the R.A.R. survey for the graphic location of the offshore R.A.R. buoys.

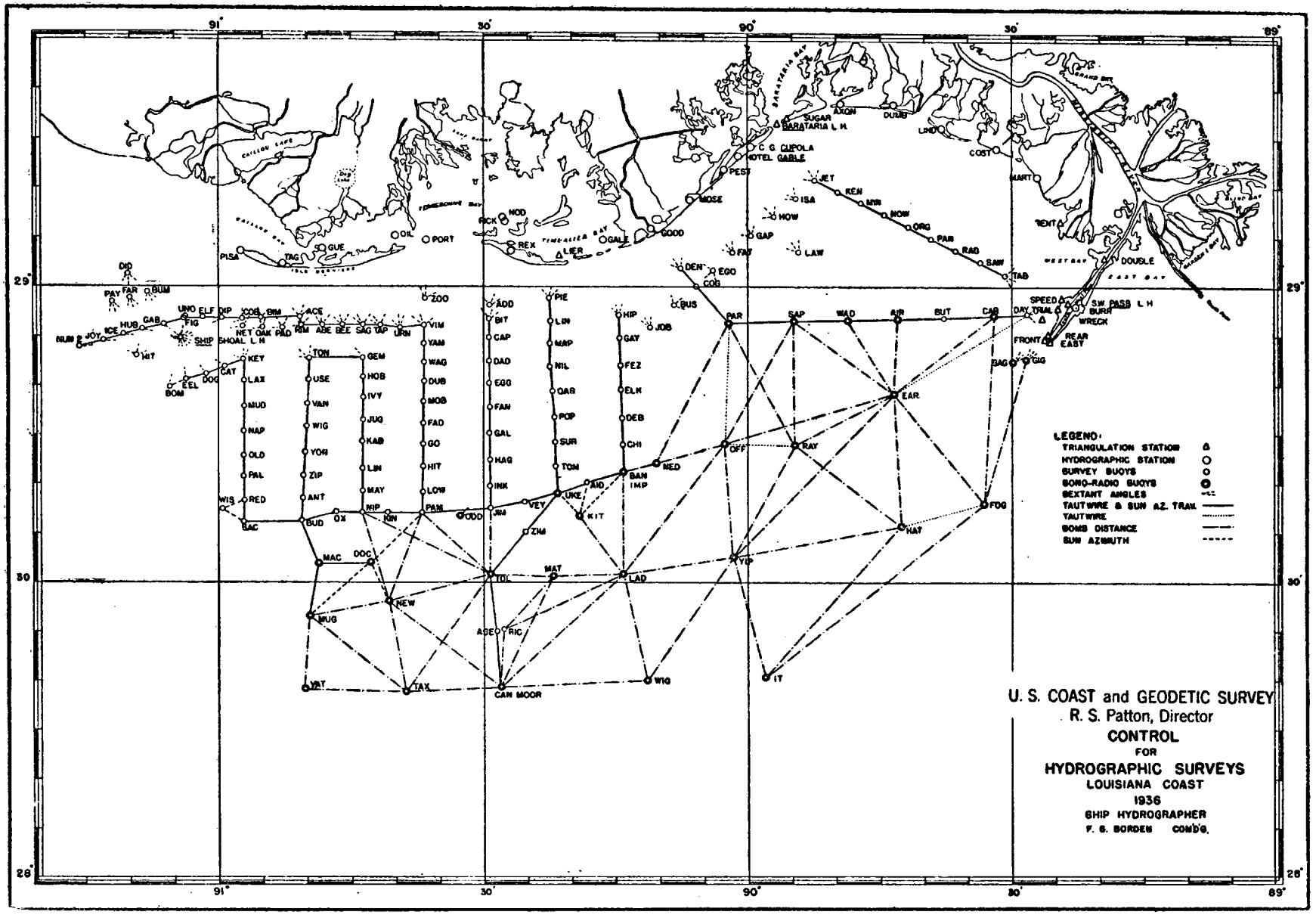
COMPUTATION OF TRAVERSE
PIE to BIT

(1) BUOY NAME	(2) SUN AZIMUTH	(3) TAUT WIRE DIST	(4) SINE	(5) COSINE	(6) (7) LATITUDE N c/n*		(8) (9) DIFF. S c/n*		(10) (11) DEPARTURES E c/n*		(12)(13) W c/n*		(14) (15)(16) LATITUDE CORR. DIFFS	ADJUST-ED		(17) (18)(19) LONGITUDE CORR. DIFFS	ADJUST-ED	
	° '	m.			m.	m.	m.	m.	m.	m.	m.	m.	m.	'	m.	m.	'	m.
PIE													(28°)	58	1244	(90°)	22	810
LIN	179 08	4290	.01513	.99989			4290	+ 3	65	- 3			-4293	56	645	-62	22	748
MAP	179 28	4181	.00931	.99996			4181	+ 3	39	- 3			-4184	54	156	-36	22	712
NIL	175 54	4393	.07150	.99744			4382	+ 3	314	- 3			-4385	51	1312	-311	22	401
OAR	178 07	4597	.03286	.99946			4595	+ 3	151	- 3			-4598	49	409	-148	22	253
PAD	178 08	4878	.03257	.99947			4875	+ 3	159	- 3			-4878	46	1072	-156	22	97
SUR	178 08	4691	.03257	.99947			4689	+ 3	153	- 3			-4692	44	75	-150	21	1575
TOM	177 57	4585	.03577	.99936			4582	+ 3	164	- 3			-4585	41	1031	-161	21	1414
UKE	178 23	4622	.02821	.99960			4620	+ 3	130	- 3			-4623	39	103	-127	21	1287
VEY	252 31	5725	.95380	.30043			1720	+ 3			5461	+ 3	-1723	38	227	+5464	25	232
JIM	255 50	12469	.96959	.24474			3052	+ 4			12090	+ 9	-3056	37	741	+12099	29	347
INK	358 58	4276	.01803	.99984	4275	- 3					77	+ 3	+4272	39	1319	+80	29	427
HAG	358 47	4818	.02123	.99977	4817	- 3					102	+ 3	+4814	42	591	+105	29	532
GAL	359 24	4843	.01047	.99995	4843	- 3					51	+ 3	+4840	44	1737	+54	29	586
FAN	359 58	4715	.00058	1.00000	4715	- 3					3	+ 3	+4712	47	907	+6	29	592
EGG	0 06	4564	.00175	1.00000	4564	- 3			8	- 3			+4561	49	1774	-5	29	587
DAD	359 09	4353	.01483	.99989	4353	- 3					65	+ 3	+4350	52	582	+68	29	655
CAP	359 55	4271	.00145	1.00000	4271	- 3					6	+ 3	+4268	54	1156	+9	29	664
BIT	0 47	3777	.01367	.99991	3777	- 3			52	- 3			+3774	56	1235	-49	29	615
SUMS					35615		39266		1235		12394							
							35615				1235							
DIFFERENCES BY TRAVERSE							3651				11159							
POSITIONS SCALED FROM ALUMINUM SHEET:																		
					m.						m.							
PIE		28° 58'			1244		90° 22'				810							
BIT		28° 56'			1235		90° 29'				615							
DIFFERENCES		2'			9		6'				1430							
DIFFERENCES METERS					3703						11178							
CONVERGENCE OF MERIDIANS CORR.							38 meters				11216							
DIFFERENCES BY TRAVERSE					3651						11159							
CLOSURES			LAT.		-52		LONG.				-57							



*LOOP CLOSURE ADJUSTMENT

In the *Computation of Traverse* the Monroe computing machine was used to advantage. The taut-wire distance was multiplied on the machine by the natural sine or cosine to obtain respectively the difference in latitude and departure. At first a table was computed from which the difference in latitude and departure were taken directly, but the use of the table was abandoned in favor of direct computation when the extent of the necessary table was learned. The computing machine was used also to obtain the final position in minutes and meters of latitude and longitude by applying the corrected differences to the values for the preceding buoy in the traverse.


91°
30'
90°
30'
89°
29°
30°
28°
LEGEND:
TRIANGULATION STATION
HYDROGRAPHIC STATION
SURVEY BUOYS
SONO-RADIO BUOYS
SEXTANT ANGLES
TAUTWIRE & SUN AZ. TRAV.
TAUTWIRE
SOMS DISTANCE
SUN AZIMUTH
U. S. COAST and GEODETIC SURVEY
R. S. Patton, Director
CONTROL
FOR
HYDROGRAPHIC SURVEYS
LOUISIANA COAST
1936
SHIP HYDROGRAPHER
F. S. BORDEN COMDG.

ADJUSTED POSITIONS OF BUOYS ON LINE PIE-UKE

	LATITUDE				LONGITUDE		
	Trav. 1 m.	Trav. 2 m.	Mean m.		Trav. 1 m.	Trav. 2 m.	Mean m.
LIN	28° 56'	645	652	648	90° 22'	748	747	748
MAP	28 54	156	169	163	90 22	712	710	711
NIL	28 51	1312	1332	1322	90 22	401	398	400
OAR	28 49	409	435	422	90 22	253	249	250
PAD	28 46	1072	1105	1088	90 22	97	92	94
SUR	28 44	75	114	95	90 21	1575	1569	1572
TOM	28 41	1031	1077	1054	90 21	1414	1406	1410
UKE	28 39	103	155	129	90 21	1287	1277	1282

The computed positions of the buoys at the offshore ends of the traverses were plotted on an aluminum sheet, scale 1:80,000, and from them the positions of offshore R.A.R. buoys were obtained graphically on the sheet.

The approximate lengths and closing errors of the computed traverses are as follows :

KEY - TON	40 miles, Lat.	— 115 m.	Long.	— 48 m.
TON - GEM	39 miles, Lat.	— 45 m.	Long.	— 84 m.
GEM - VIM	41 miles, Lat.	+ 10 m.	Long.	+ 29 m.
VIM - BIT	42 miles, Lat.	— 61 m.	Long.	— 128 m.
BIT - PIE	47 miles, Lat.	+ 52 m.	Long.	— 57 m.
PIE - HIP	43 miles, Lat.	— 84 m.	Long.	— 42 m.
JET - TAB	22 miles, Lat.	+ 7 m.	Long.	+ 11 m
PAR - DAY	30 miles, Lat.	+ 1 m.	Long.	— 135 m.

Average closing error per mile, Lat. 1.2 m., Long. 1.8 m.