S

$150.-

DO YOU SURVEY?

THE MERIDI-O-GRAPH

Determines in a minute or two
TRUE MERIDIAN—AZIMUTH—TRUE NORTH
to an accuracy of 1′ to 2′

YOU NEED
- No Night Work
- No Attachments
- No Computation
- No Books or Tables
- No Knowledge of Time
- No Knowledge of Astronomy
- No Apprehension of Error
- No Incumbrance on Transit
- No Waste of Field Time

YOU DO NEED
- A Transit
- Two Minutes of Spare Time
- A MERIDIOGRAPH

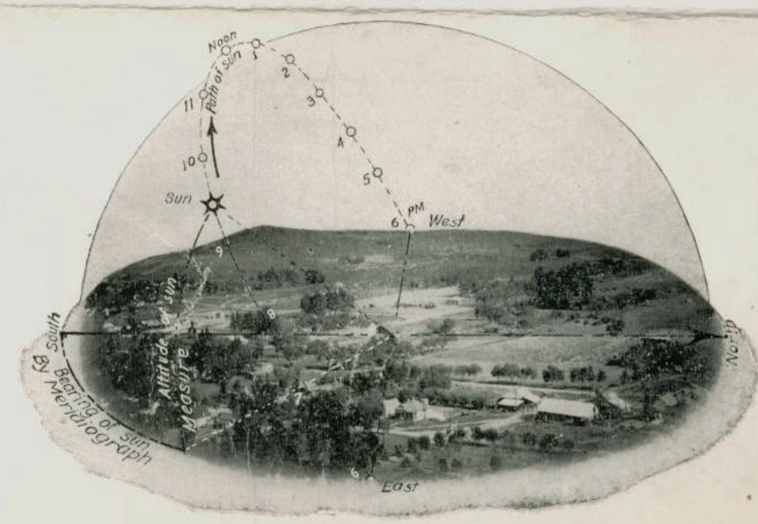


FIG. 1 shows the DAILY PATH OF THE SUN. The surveyor measures its height above his horizon; then the Meridiograph gives the exact horizontal angle from the sun to the TRUE north line.

The MERIDI-O-GRAPH is a new instrument for surveyors and engineers to find TRUE NORTH quickly and accurately. With its aid, any one who can read an angle may determine in a few minutes a true meridian,—without computation, books, tables or attachments.

PROCEDURE—Measure the sun's altitude (Figs. 1 and 2), take its declination from the ephemeris, and your latitude from a map. Set these angles on the Meridiograph (Fig. 3),—just as angles are set on an ordinary protractor; and read directly the exact horizontal angle from the sun to the TRUE NORTH (Figs. 1 and 4). An additional setting gives, if desired, accurate astronomic time.

Its accuracy in the early forenoon or late afternoon is within 1′, closer to noon within 2′. The field procedure takes 2 or 3 minutes; while the reduction with the Meridiograph is made right at the transit (or checked in the office) in about a minute. The Meridiograph is 7 INCHES IN DIAMETER; it consists of two graduated, rotating discs,—and a reading arm. The graduations are 5′ and 10′ mainly; on them the data are set,—as on an ordinary protractor,—to an accuracy of about 1′. The transit is used only to measure the sun's altitude; the Meridiograph is not attached to, and in no way interferes with, the transit. Its use requires no knowledge of mathematics or astronomy.

"Just what we Engineers have long wanted and needed."—..........Civil Engineer.

"Am loth to part with it, as I use it daily in my work."—..........Civil and Cons. Eng.

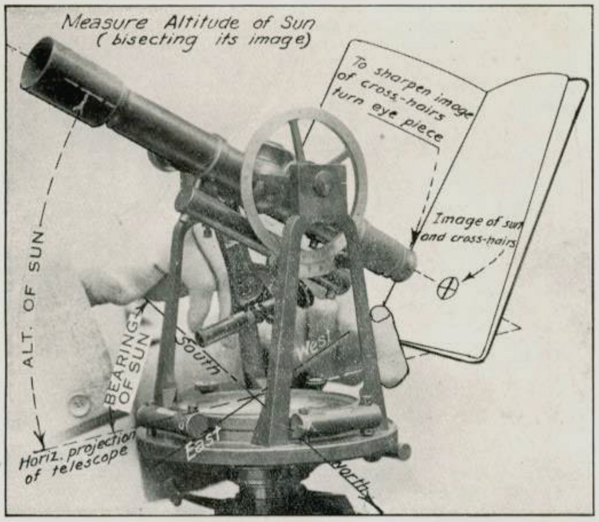


FIG. 2

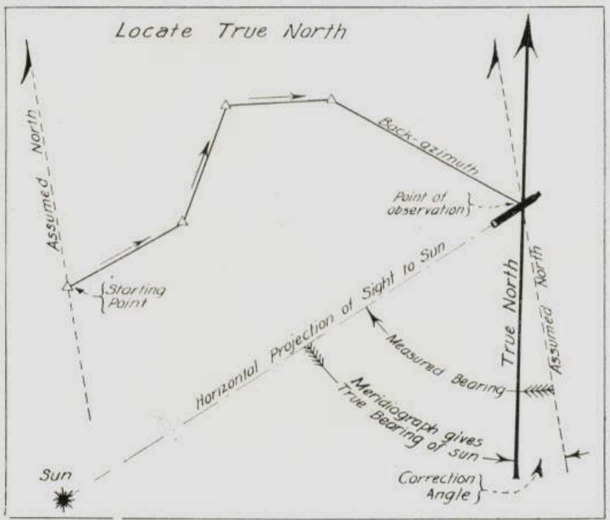


FIG. 4

FIELD RECORD OF OBSERVATION

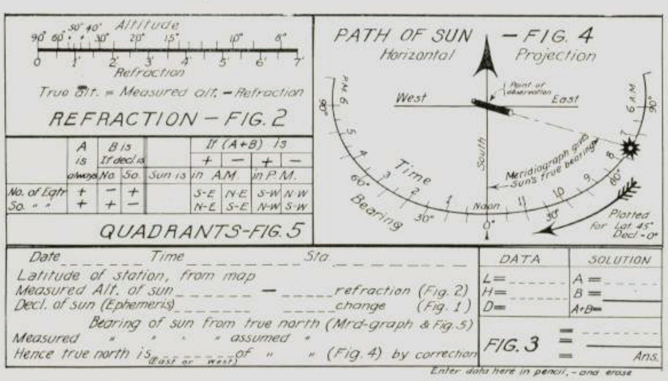


Fig. 3 shows how the DATA L, H, and D are obtained; the SOLUTION of A, B, and True Bearing of Sun is then made by two settings of the Meridiograph.

HOW TO

TRUE N

BY T

MERIDI-C

FIG. 2 shows DETAILS C at sun, let its image fall through screws bisect image both ways; and horizontal angles.

FIG. 3 shows the MERIDI set your latitude, the sun's alt as angles are set on an ordin directly the exact horizontal TRUE north line.

"Checked observation to nearest minute."—...... ter Supply.

"Made observations o bearings were known, d ridiograph; results chec For a quick and simpl taining true meridian, I it."—.......... Inspector Ger

"Surprised at its pleased to recommend —.......... Civil Engineer.

FIG. 4 shows CONNECTI sun's bearing may be measured line; the Meridiograph gives i north. The difference, or corre the ASSUMED north gives the

FIG. 5 shows the MERIDIO in dia., sharply engraved, preci sible magnifier, and strong lea books.

INFO
ROSS
further

FOR

TO FIND

NORTH

Y THE

-O-GRAPH

ILS OF MEASUREMENT. Aim
rough telescope, with the tangent
ways; read and record the vertical

RIDIOGRAPH, Model 20. On it
's altitude and declination,—just
ordinary protractor. This gives
ntal angle from the sun to the

vations, results identical
."—............Asst. Engr. Wa-

ions on lines whose exact
own, data reduced by Me-
s checked to the minute.
simplified method of ob-
lian, I heartily recommend
or General.

its ease and rapidity;
nend it as a labor saver."
neer.

ECTION IN THE FIELD. The
sured from any ASSUMED north
ives its bearing from the TRUE
correction angle, swung off from
s the TRUE north.

RIDIOGRAPH, Model 10; 7 inches
precisely machined, with collap-
g leather shoulder bag for field-

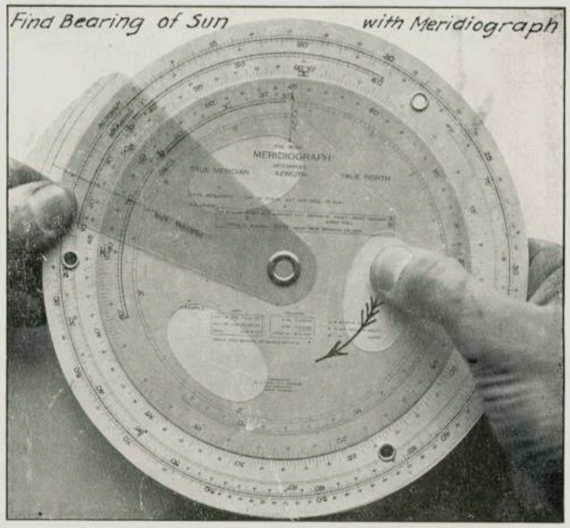


FIG. 3

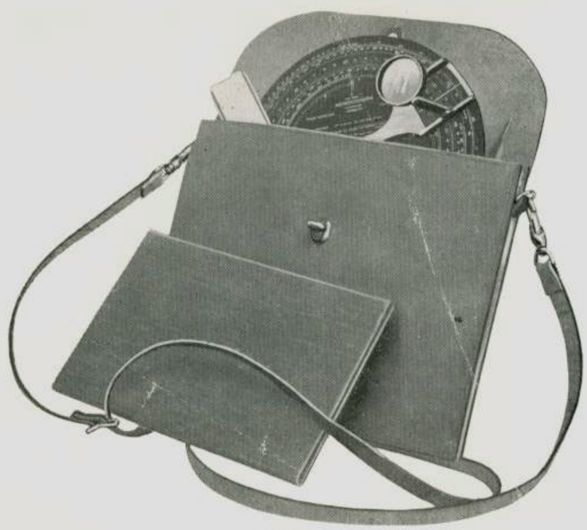


FIG. 5

INFORMATION BLANK.—I am interested in the
OSS MERIDIOGRAPH, but would like to have
rther information with regard to:

....

....

....

....

....

....

ADDRESS BLANK.—The following men would
be interested in the ROSS MERIDIOGRAPH. Please
send them description.

Name ....

Address ....

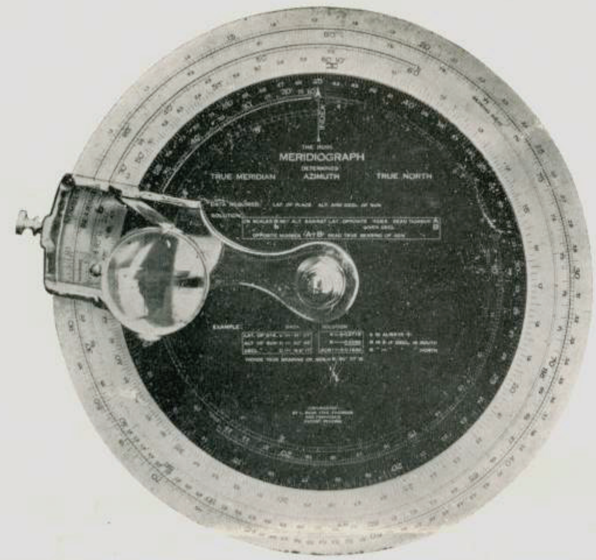
Name ....

Address ....

Name ....

Address ....

OR SALE BY:—



MODEL 10. The Meridiograph is made of bronzed metal; the graduations are sharply engraved, distinct, and easy to read; an adjustable magnifier is collapsibly mounted on the reading arm, to be swung instantly on or off scales as desired. The instrument is precisely machined, neatly finished, and tested; its weight is about 1 pound. Packed in a strong, sewed leather, shoulder bag, with additional pockets for note-books, etc., with full instructions and an Ephemeris—a complete, permanent and convenient North-finder.

Price Complete, $20

MODEL 20. A secondary grade is made of grained ivory-celluloid, water and weather proof; the scales are permanently protected from being soiled or worn; weighs 2 ounces, flexible and thoroughly durable. Packed in fine, flexible leather case, with full instructions and an Ephemeris—a serviceable, light and accurate North-finder.

Price Complete, $7.50

The mechanical superiority of the metal Meridiograph, Model 10, doubles its accuracy. For continuous surveys requiring the utmost precision it is strongly recommended.

Postpaid on receipt of price; money back if unsatisfactory.

COMPUTER MFG. CO., 25 California St., San Francisco

MADE ENTIRELY IN U. S. A.
UNDER FEDERAL CHILD LABOR ACT OF SEPTEMBER 1, 1916.

"The Meridiograph does away entirely with laborious calculations and solves for a true meridian in a most satisfactory manner. Checked a number of observations, invariably obtained results within 1′ (2′ at the most) of those given by analysis."—.......... M. Can. S. C. E.

"Tested the Meridiograph very thoroughly, and checked my meridian by observations on Polaris within 1′."—......Civil Engineer.

"Would like to have one for each of our crews."—..........U. S. Asst. Superv. Surveys.

"I consider it a valuable addition to my equipment."—U. S. Surveyor.

ORDER BLANK

COMPUTER MFG. CO., 25 California St., San Francisco

Please send me a ROSS MERIDIOGRAPH, Model

No.......................with complete directions. I enclose (money order

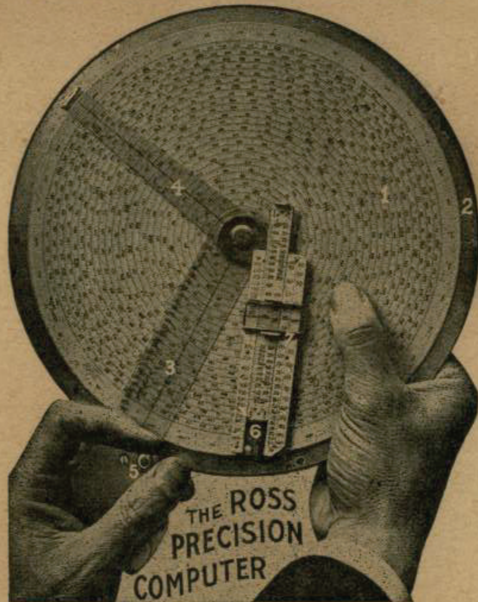
or check?)..for $..............................

If the instrument fails to do what is claimed for it, or proves otherwise unsatisfactory, I will return it in good condition within two weeks after its receipt, and my remittance is to be refunded in full.

Name ....

Address ....

REMARKS:



The Ross Precision Computer is a new multiplier-and-divider of UNUSUAL PRECISION. It solves problems like 879.65 × 72.638 ÷ 74.769 = 854.58,—with an accuracy of 5 figures, i. e. to an ultimate accuracy of 1/1000 of 1%, or 1 in 100,000. It is 100 times as accurate as the slide-rule;—if a slide-rule were made 100 FEET long and graduated with spaces no greater than the ordinary 10-inch rule, it would still be less accurate than the Precision Computer. Send for folder M44.

The Ross Meridi-o-graph reduces quickly and accurately the observation for finding TRUE NORTH. A practicing civil engineer writes:

"I have consumed $100 worth of time at night and exhausted ALL of my patience trying to get satisfactory results from Polaris observations; whilst with your Meridiograph I can refer every survey to the true meridian in a few minutes, with absolutely no loss of time in making observation." Send for folder M31.

The Ross RAPID COMPUTER corresponds to a 20-inch slide-rule in accuracy, but excels it in many ways. It is simpler—can be used at first sight. It handles three—note, THREE factors at one setting; figures traverses, stadia, and all trigonometric problems with great facility. Double Dial in form; flexible, durable. No warping, shrinkage, or binding; no glass parts to break. Eight-inch desk size, and 6-inch pocket Computer. Send for folder M4.

COMPUTER MFG. CO., 25 California St., San Francisco

DO YOU SURVEY?

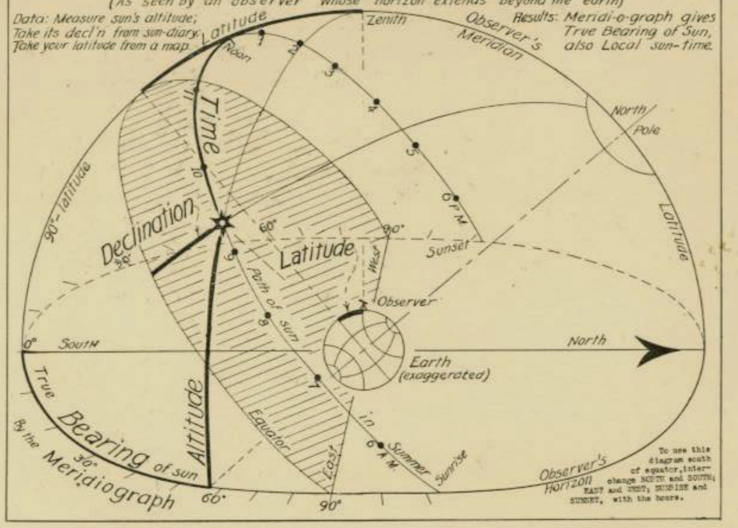
HERE IS YOUR

1917

SUN-DIARY

EXPLANATION

Elements involved in finding True North by the Ross Meridi-o-graph
(As seen by an observer whose horizon extends beyond the earth)



DECLINATION.—The sun travels parallel to the equator; North of it in Summer, South of it in Winter,—changing gradually from 23° 27′ north to 23° 27′ south. Its distance from the equator is called "declination,"— and is given for each day of the year in the sun-diary. In the figure the declination is about 10° north, that is about April 15, or August 25.

LATITUDE.—If you were as far north of the equator as the sun is, the sun's path would lie directly overhead. If you are farther north, as in figure, the sun is south of you. Your latitude less the sun's declination is the amount the sun is south of you. In figure the observer is at about 40° latitude, the sun's path is therefore 30° south of him.

ALTITUDE vs. BEARING AND TIME.—In the figure, the sun is about 45° high; its direction, or bearing is then about S. 57° E., and the sun-time is about 9.20 a. m. The higher the sun, the nearer to noon, the less its bearing. At any given latitude and date (the date gives the declination), the sun's altitude fixes its bearing, and also the sun-time.

MERIDI-O-GRAPH.—The relation between the sun's altitude and bearing is solved by the Meridiograph. Knowing the sun's bearing, the true bearing of any line desired can be located from it on the ground. Look up your latitude and the sun's declination; measure the sun's altitude. Set them on the Meridiograph; it gives your true meridian and local sun time.

Daily Distance of Sun from Equator (i.e. Apparent Declination) at Greenwich Mean Noon

Date	Jan.	Feb.	March	April	May	June	Date	July	August	Sept.	Oct.	Nov.	Dec.	Date
	° ′	° ′	° ′	° ′	° ′	° ′		° ′	° ′	° ′	° ′	° ′	° ′	
1	S23 1.9	S17 10.7	S7 41.5	N 4 25.8	N14 59.2	N22 1.1	1	N23 8.5	N18 6.6	N8 24.2	S 3 4.1	S14 20.6	S 21 46.2	1
2	22 56.9	16 53.5	7 18.6	4 48.9	15 17.3	22 9.1	2	23 4.4	17 51.5	8 2.4	3 27.3	14 39.8	21 55.4	2
3	22 51.4	16 36.1	6 55.7	5 11.9	15.35.2	22 16.8	3	22 59.9	17 36.0	7 40.5	3 50.6	14 58.7	22 4.2	3
4	22 45.4	16 18.4	6 32.7	5 34.9	15 52.8	22 24.2	4	22 55.0	17 20.3	7 18.4	4 13.8	15 17.4	22 12.6	4
5	22 39.0	16 0.4	6 9.6	5 57.7	16 10.1	22 31.1	5	22 49.7	17 4.3	6 56.3	4 37.0	15 35.9	22 20.6	5
6	22 32.1	15 42.1	5 46.4	6 20.5	16 27.2	22 37.6	6	22 44.0	16 48.0	6 34.0	5 0.1	15 54.1	22 28.1	6
7	22 24.8	15 23.5	5 23.2	6 43.1	16 43.9	22 43.7	7	22 37.9	16 31.5	6 11.6	5 23.1	16 12.0	22 35.2	7
8	22 17.0	15 4.7	4 59.8	7 5.6	17 0.4	22 49.5	8	22 31.4	16 14.6	5 49.1	5 46.1	16 29.7	22 41.9	8
9	22 8.8	14 45.7	4 36.4	7 28.0	17 16.7	22 54.8	9	22 24.6	15 57.5	5 26.5	6 9.0	16 47.1	22 48.1	9
10	22 0.2	14 26.4	4 13.0	7 50.3	17 32.6	22 59.7	10	22 17.3	15 40.2	5 3.8	6 31.8	17 4.2	22 53.8	10
11	21 51.1	14 6.8	3 49.5	8 12.4	17 48.2	23 4.2	11	22 9.7	15 22.6	4 41.0	6 54.5	17 21.0	22 59.1	11
12	21 41.7	13 47.0	3 25.9	8 34.4	18 3.6	23 8.4	12	22 1.6	15 4.7	4 18.1	7 17.2	17 37.5	23 4.0	12
13	21 31.7	13 27.0	3 2.3	8 56.3	18 18.6	23 12.1	13	21 53.2	14 46.7	3 55.2	7 39.7	17 53.7	23 8.4	13
14	21 21.4	13 6.8	2 38.7	9 18.0	18 33.4	23 15.4	14	21 44.5	14 28.3	3 32.2	8 2.2	18 9.6	23 12.3	14
15	21 10.7	12 46.3	2 15.0	9 39.6	18 47.8	23 18.3	15	21 35.3	14 9.8	3 9.1	8 24.5	18 25.2	23 15.8	15
16	20 59.6	12 25.7	1 51.3	10 1.0	19 1.9	23 20.8	16	21 25.8	13 51.0	2 46.0	8 46.7	18 40.5	23 18.8	16
17	20 48.0	12 4.8	1 27.6	10 22.3	19 15.7	23 22.8	17	21 15.9	13 32.0	2 22.8	8 8.8	18 55.4	23 21.3	17
18	20 36.1	11 43.8	1 3.9	10 43.3	19 29.2	23 24.5	18	21 5.7	13 12.8	1 59.6	9 30.8	19 10.0	23 23.4	18
19	20 23.7	11 22.5	0 40.1	11 4.2	19 42.3	23 25.7	19	20 55.0	12 53.3	1 36.3	9 52.6	19 24.2	23 25.0	19
20	20 11.0	11 1.1	S 0 16.4	11 25.0	19 55.1	23 26.6	20	20 44.1	12 33.7	1 13.0	10 14.3	19 38.1	23 26.1	20
21	19 57.9	10 39.5	N 0 7.3	11 45.5	20 7.6	23 27.0	21	20 32.8	12 13.9	0 49.7	10 35.8	19 51.7	23 26.8	21
22	19 44.5	10 17.7	0 31.0	12 5.8	20 19.7	23 27.0	22	20 21.1	11 53.8	0 26.3	10 57.1	20 4.8	23 27.0	22
23	19 30.6	9 55.8	0 54.7	12 26.0	20 31.5	23 26.6	23	20 9.1	11 33.6	N 0 2.9	11 18.3	20 17.6	23 26.7	23
24	19 16.4	9 33.8	1 18.3	12 45.9	20 42.9	23 25.7	24	19 56.8	11 13.2	S 0 20.5	11 39.3	20 30.1	23 26.0	24
25	19 1.9	9 11.6	1 44.9	13 5.6	20 53.9	23 24.5	25	19 44.1	10 52.7	0 43.9	12 0.2	20 42.1	23 24.7	25
26	18 47.0	8 49.2	2 5.5	13 25.1	21 4.6	23 22.8	26	19 31.2	10 31.9	1 7.3	12 20.9	20 53.8	23 23.0	26
27	18 31.7	8 26.8	2 29.0	13 44.4	21 15.0	23 20.8	27	19 17.9	10 11.0	1 30.6	12 41.3	21 5.1	23 20.9	27
28	18 16.2	S 8 4.2	2 52.5	14 3.5	21 24.9	23 18.3	28	19 4.2	9 49.9	1 54.0	13 1.6	21 15.9	23 18.3	28
29	18 0.3		3 15.9	14 22.3	21 34.5	23 15.4	29	18 50.3	9 28.7	2 17.4	13 21.7	21 26.4	23 15.2	29
30	17 44.1		3 39.3	N14 40.9	21 43.7	N 23 12.2	30	18 36.0	9 7.4	S 2 40.7	13 41.5	S 21 36.5	23 11.6	30
31	S17 27.5		N 4 2.6		N21 52.6		31	N18 21.5	N 8 45.8		S14 1.2		S23 7.6	31
Date	Jan.	Feb.	March	April	May	June	Date	July	August	Sept.	Oct.	Nov.	Dec.	Date

March: See directions less than 0.1 — Now B (in A+B) is

Sept.: See directions less than 0.1 — Now B (in A+B) is

Sun's declination changes gradually, continuously.
When declination is 23°27′ 23° 22° 21° 20° 15° 10° 5° 0°
Then
It changes each hour 0 .1′ .2′ .3′ .4′ .5′ .6′ .7′ .8′ .9′ 1.0′
Hence, to find declination at any hour and place, correct the tabulated declination for the hours elapsed since Greenwich noon.

N = North of Equator S = South of Equator
Example: 90° long.; 7.30 a.m.; Aug. 10, 1917.
Decl. = N15°40.2′ − (6 − 4.5) hrs. x 0.72′ hourly change;
= 15°40.2′ − 1.5 x 0.72′ = 15°40.2 − 1.1′ = 15°39.1′
Use No. 15°39′ = ANSWER -

1915 Apparent Declination of Sun at Greenwich Mean Noon 1915

Date	Jan.	Feb.	March	April	May	June	Date
	° '	° '	° '	° '	° '	° '	
1	S23 04.5	S17 19.5	S 7 53.2	N 4 13.9	N14 49.9	N21 56.9	1
2	22 59.7	17 2.6	7 30.5	4 37.0	15 8.2	22 5.1	2
3	22 54.4	16 45.3	7 7.6	5 0.1	15 26.1	22 13.0	3
4	22 48.7	16 27.7	6 44.6	5 23.1	15 43.9	22 20.6	4
5	22 42.5	16 9.8	6 21.6	5 46.0	16 1.3	22 27.7	5
6	22 35.8	15 51.7	5 58.4	6 8.8	16 18.5	22 34.4	6
7	22 28.7	15 33.3	5 35.2	6 31.5	16 35.5	22 40.7	7
8	22 21.2	15 14.6	5 11.9	6 54.1	16 52.1	22 46.7	8
9	22 13.2	14 55.6	4 48.5	7 16.6	17 8.5	22 52.2	9
10	22 4.8	14 36.4	4 25.1	7 39.0	17 24.6	22 57.4	10
11	21 56.0	14 17.0	4 1.6	8 1.2	17 40.4	23 2.1	11
12	21 46.7	13 57.3	3 38.1	8 23.3	17 55.9	23 6.4	12
13	21 37 0	13 37.4	3 14.4	8 45.2	18 11.1	23 10.3	13
14	21 26.9	13 17.2	2 50.8	9 7.0	18 23.0	23 13.9	14
15	21 16.4	12 56.9	2 27.[illegible]	9 28.7	18 40.6	23 17.0	15
16	21 5.4	12 36.3	2 3.4	9 50.2	18 54.9	23 19.6	16
17	20 54.1	12 15.6	1 39.7	10 11.5	19 8.8	23 21.9	17
18	20 42.4	11 54.6	1 16.0	10 32.7	19 22.5	23 23.8	18
19	20 30.2	11 33.5	0 52.2	10 53.7	19 35.8	23 25.2	19
20	20 17.9	11 12.1	0 28.5	11 14.5	19 48.7	23 26.3	20
21	20 4.8	10 50.6	S 0 4.8	11 35.1	20 1.4	23 26.9	21
22	19 51.5	10 29.0	N 0 18.9	11 55.6	20 13.6	23 27.1	22
23	19 37.9	10 7.1	0 42.6	12 15.8	20 25.6	23 26.9	23
24	19 23.9	9 45.2	1 6.3	12 35.8	20 37.2	23 26.3	24
25	19 9.5	9 23.0	1 2[illegible].9	12 55.7	20 48.4	23 25.3	25
26	18 54.8	9 0.8	1 53.5	13 15.3	20 59.3	23 23.9	26
27	18 39.7	8 38.4	2 17.0	13 34.7	21 9.8	23 22.0	27
28	18 24.4	S 8 15.9	2 40.5	13 53.8	21 20.0	23 19.7	28
29	18 8.6		3 3.9	14 12.8	21 29.7	23 17.1	29
30	17 52.6		3 27.3	N14 31.5	21 39.2	N23 14.0	30
31	S17 36.2		N 3 50.6		N21 48.2		31

Date	July	August	Sept.	Oct.	Nov.	Dec.	Date
	° '	° '	° '	° '	° '	° '	
1	N23 10.5	N18 14.4	N 8 35.4	S 2 52.0	S14 10.6	S21 41.3	1
2	23 6.6	17 59.4	8 13.7	3 15.3	14 29.9	21 50.8	2
3	23 2.4	17 44.1	7 51.8	3 38.6	14 49.0	21 59.8	3
4	22 57.7	17 28.5	7 29.8	4 1.9	15 7.9	22 8.4	4
5	22 52.6	17 12.6	7 7.7	4 25.1	15 26.5	22 16.6	5
6	22 47.1	16 56.5	6 45.4	4 48.2	15 44.8	22 24.4	6
7	22 41.2	16 40.1	6 23.1	5 11.3	16 2.9	22 31.7	7
8	22 34.9	16 23.4	6 0.6	5 34.4	16 20.7	22 38.6	8
9	22 28.2	16 6.4	5 38.1	5 57.3	16 38.3	22 45.0	9
10	22 21.2	15 49.2	5 15.4	6 20.1	16 55.5	22 51.0	10
11	22 13.7	15 31.7	4 52.7	6 42.9	17 12.5	22 56.6	11
12	22 5.9	15 14.0	4 29.9	7 5.6	17 29.1	23 1.6	12
13	21 57.7	14 56.0	4 7.0	7 28.2	17 45.5	23 6.3	13
14	21 49.1	14 37.8	3 44.0	7 50.7	18 1.6	23 10.4	14
15	21 40.1	14 19.3	3 21.0	8 13.1	18 17.3	23 14.1	15
16	21 30.8	14 0.7	2 57.9	8 35.4	18 32.7	23 17.4	16
17	21 21.1	13 41.8	2 34.[illegible]	8 57.5	18 47.8	23 20.2	17
18	21 11.0	13 22.7	2 11.5	9 19.5	19 2.6	23 22.5	18
19	21 0.6	13 3.4	1 48.3	9 41.4	19 17.0	23 24.3	19
20	20 49.8	12 43.8	1 25.0	10 3.1	19 31.1	23 25.7	20
21	20 38.7	12 24.1	1 1.7	10 24.7	19 44.8	23 26.6	21
22	20 27.2	12 4.2	0 38.4	10 46.1	19 58.1	23 27.1	22
23	20 15.4	11 44.1	N 0 15.0	11 7.4	20 11.1	23 27.0	23
24	20 3.3	11 23.8	S 0 8.4	11 28.5	20 23.8	23 26.5	24
25	19 50.8	11 3.3	0 31.8	11 49.5	20 36.0	23 25.5	25
26	19 38.0	10 42.7	0 55.2	12 10.2	20 47.9	23 24.1	26
27	19 24.8	10 21.9	1 18.5	12 30.8	20 59.4	23 22.2	27
28	19 11.4	10 0.9	1 41.9	12 51.2	21 10.4	23 19.8	28
29	18 57.6	9 39.8	2 5.3	13 11.3	21 21.1	23 16.9	29
30	18 43.5	9 18.5	S 2 28.7	13 31.3	S21 31.4	23 13.6	30
31	N18 29.1	N 8 57.0		S13 50.1		S23 9.8	31

Spring equinox, March 21-22 Summer solstice, June 22 Autumnal equinox, Sept. 23-24 Winter solstice, Dec. 22
N= North of equator; S = South of equator This table, with the time correction on back, will serve till 1930

To find declination at any hour and place, interpolate between the given and next date,- in proportion to hours elapsed since Greenwich noon

If declination is	23°27'	23°				20°			15°	10°	5° 0°
Then it changes each hour	0	.1'	.2'	.3'	.4'	.5'	.6'	.7'	.8'	.9'	1.0'

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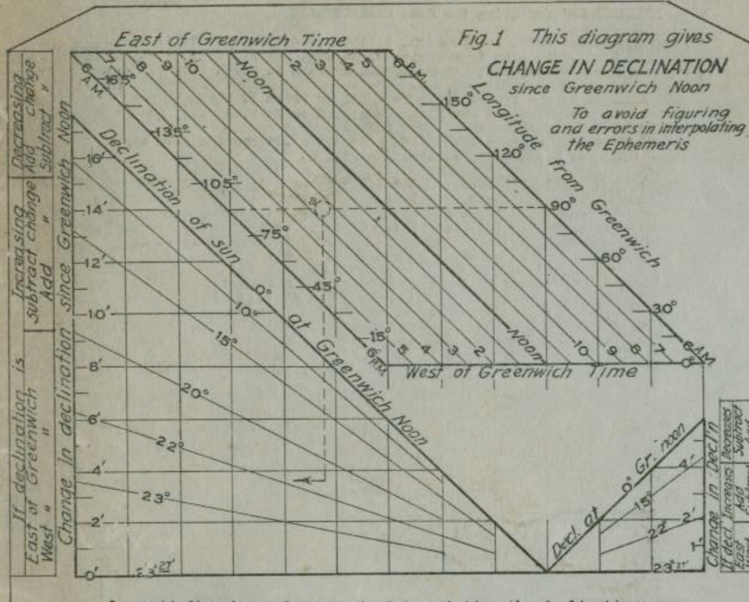


To avoid figuring and errors in interpolating the declination, use this diagram. Example:- Find decl. of sun at 2.30p.m., May 26, 1915, 90° West of Greenwich. Ephemeris gives decl. at Greenwich noon, N.20°59.3'.
On upper diagram locate point a(90°, 2.30p.m.); project vertically to Decl. 20°59', and read between horizontals, 3½' = increase in decl. since Greenwich noon. Hence, Decl. = 20°59.3' + 3½' = N.21°03', Answer.

HOW TO FIND

TRUE NORTH BY THE MERIDIOGRAPH

Measure the sun's altitude, take its declination from this table, and your latitude from a map. Set these angles on the Meridiograph,- just as angles are set on an ordinary protractor; read directly the exact horizontal angle from the sun to the true north. One additional setting gives, if desired, accurate astronomic time.

Ephemeris for 1916 to 1930

The 1915 table may be used till 1930 by applying the time correction given below, thus:- To the given time add the hours under the given year, and use the 1915 table as before.

Year	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Hours	+18	+12½	+ 6¾	+ 1	+19	+13	+ 7½	+ 1¾	+20	+14	+ 8	+ 2¼	+20¾	+15	+9
"	- 6				- 5				- 4				- 3¼		

In leap-years, from Jan. 1 to Feb. 29 only, subtract the hours marked "-"

Thus:- Declination at any time and place in 1919 is the same as in 1915, at the same place, 1 hour later.
Example:- 4.30 p.m., Oct. 7, 1920, longitude 90° West.
4.30 p.m. + 19 hrs. = 11.30 a.m. of Oct. 8;
Decl.= S.5°34.4' +(6-½)x.96' = 5°34.4'+5¼' = S.5°40', Answer.

INSTRUCTIONS for using the Ross MERIDIOGRAPH

Data required:- latitude, declination, altitude,- all correct to 1'.
LATITUDE of place take from any accurate map. If not available, measure at noon sun's altitude H; then, if declination is north L=90°-H+D; if declination is south L = 90° - H - D.
DECLINATION of sun is its distance north or south of the equator; take it from the sun-diary under the given date; add or subtract the "change in declination since Greenwich noon", from Fig. 1.
ALTITUDE of sun measure carefully, also its exact bearing from any fixed point. Subtract refraction, as shown in Fig. 2.

The observation will give best results if it is made in early forenoon or late afternoon; when the sun is nearly due east or west; when its altitude is between 15° and 25°. It is not always possible to combine all these favorable conditions; do the best possible. Close to noon observations for azimuth are quite unreliable. When the sun is below 10° the refraction is uncertain, therefore the true altitude of sun is in doubt.

IMPORTANT

The Meridiograph consists of two scaled discs and a reading arm. The READING LINE on this arm is set and held on the outer disc, then the inner disc is turned to bring the desired angles on the two discs opposite each other and under the READING LINE. Each scale is designated on the reading arm, directly over the graduations. Do not search for scales without the reading arm; with it no searching is necessary; any scale desired is found instantly, without mental effort, directly under the proper designation.

The scales a and b are for reading either altitude or latitude. The two b scales are heavy in outline,- to prevent confusion with scales of BEARING and DECL. Before moving the arm or inner disc, note the approximate position of the desired angle, and go to it the shortest way around.
To increase the accuracy of the Meridiograph,- read both points at which the two given angles on scales a register, same for scales b; read numbers A and B as closely as possible, to the 4th significant figure, estimating tenths of fractional divisions; repeat readings and take average.
The time angle gives the hours from the sun to 6 o'clock; add it to 6 in the forenoon, subtract it from 6 in the afternoon.

Read the NUMBER scale with the decimal point as printed; the rare exceptions:

Occur when:	If	Then shift decimal point thus:
Lat. more than 50°	H°xL° more than 2000	A is 10 times number opposite INDEX
" less " 30°	" less " 300	A " 1/10 of " " "
March, Sept.-2 wks.	DECL. " " 4°	B " 1/10 " " " given DECL.
" " 5 dys.	" " " 1°	B " less in proportion
Sun just E. or W.	(A+B) " " 0.10	read inner loop of BEARING scale

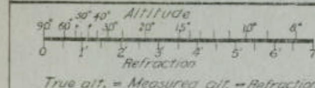
These exceptions are very rare; omit their consideration until after general use of Meridiograph has been mastered.

Equation of time. Owing to the non-uniform motion of the sun, the exact length of a solar day is not uniformly 24 hours; the actual time given by the sun is called "apparent local time". The clock, having a uniform movement of 24 hrs. per day, averages 4 times a year the irregularities of the sun's movement, and is said to keep "mean local time". The number of minutes difference between sun-time and mean local time, for every other day in the year, is given in this table:-

(EQUATION OF TIME) = (MEAN LOCAL TIME) - (APPARENT LOCAL TIME)

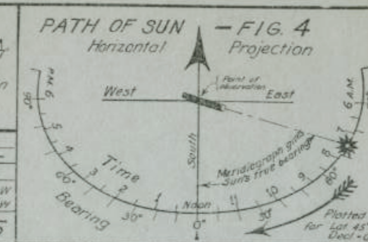
Date	Jan.	Feb.	Mar.	Apr.	May	June	Date	July	Aug.	Sep.	Oct.	Nov.	Dec.	Date
1	+ 3½	+13½	+12½	+ 4	- 3	- 2½	1	+ 3½	+ 6	+ 0	-10	-16¼	-11	1
3	4½	14	12	3½	3	2	3	4	6	- ½	10½	16¼	10½	3
5	5½	14	12	3	3½	2	5	4	6	1	11½	16¼	9½	5
7	6	14½	11½	2½	3½	1½	7	4½	5½	2	12	16¼	8½	7
9	7	14½	11	2	3½	1	9	5	5½	2½	12½	16	8	9
11	8	14½	10½	1	3½	½	11	5	5	3	13	16	7	11
13	8½	14½	10	½	4	- ½	13	5½	5	4	13½	15½	6	13
15	9½	14½	9½	+ 0	4	+ 0	15	5½	4½	4½	14	15½	5	15
17	10	14	8½	- ½	4	½	17	6	4	5½	14½	15	4	17
19	10½	14	8	½	3½	1	19	6	3½	6	15	14½	3	19
21	11½	14	7½	1	3½	1½	21	6	3	6½	15	14	2	21
23	12	13½	7	1½	3½	2	23	6½	2½	7½	15½	13½	1	23
25	12½	13½	6½	2	3½	2	25	6½	2	8	16	13	- 0	25
27	13	13	5½	2½	3	2½	27	6½	1½	9	16	12½	+ 1	27
29	13	+12½	5	- 2½	3	+ 3	29	6½	1	- 9½	16	-12	2	29
31	+13½		+ 4½		- 2½		31	+ 6	+ ½		-16½		+ 3	31

(+) means add to "apparent local time" to obtain "mean local time".
(-) " subtract from " " " " " " " "
Standard (or R.R.) time="Mean time" at standard meridian of 75°, 90°, 105° or 120°.
Standard time = Mean local time + 4 mins. for each degree that the local meridian is west of standard meridian.



True alt. = Measured alt. — Refraction

REFRACTION — FIG. 2



PATH OF SUN — FIG. 4

	A is	B is If decl is			D' (A+B) is			
					+	−	+	−
	always	No.	So.	Sun is	in A.M.		in P.M.	
No. of Eqtr	+	−	+		S-E	N-E	S-W	N-W
So. " "	+	+	−		N-E	S-E	N-W	S-W

QUADRANTS—FIG. 5

Date ________ Time __________ Sta __________

Latitude of station, from map

Measured Alt. of sun ______ — ______ refraction (Fig. 2)

Decl. of sun (Ephemeris) ______ ______ change (Fig. 1)

Bearing of sun from true north (Mrd-graph & Fig. 5)

Measured " " " " assumed "

Hence true north is (East or West) ____ of " " (Fig. 4) by correction

DATA	SOLUTION
L= ______	A = ______
H= ______	B = ______
D=	A+B= ______

FIG. 3 = ______ = ______ = ______ Ans.

Enter data here in pencil,- and erase

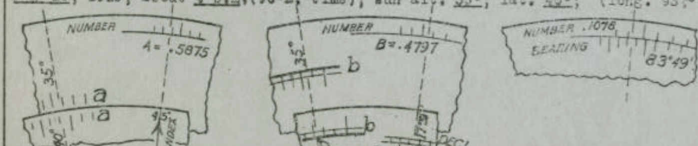
Warning. The Meridiograph will eliminate nearly all your labor, cost, and time of checking alignment. It reads as simply as a transit, protractor, or level-rod,--and it is as sure. You need no previous knowledge, mathematics, astronomy, books or tables. But you must first read these instructions,- every statement and diagram,- with care. They contain all the essential information.
If you find any difficulty,- examine the face of the instrument and read these instructions again,- and again. If the answer to your difficulty is not in the instructions, please write, with complete data, details and sketch. Your query will be accepted as a courtesy, and will be answered gladly, promptly and fully.

Example --- completely solved --- illustrated

Follow each step with Meridiograph, check numbers approximately. Obtain and arrange your own data as shown in Fig. 3. Set these DATA on the Meridiograph as shown here; read the two numbers, designated as A and B: opposite their algebraic sum read the true bearing of the sun.

IMPORTANT

May 10, 1915; about 4 p.m.(90°E. time); sun alt. 35°; lat. 40°; (long. 93¼°)



On scales a set alt. 35° against lat. 40°; opposite INDEX read A = +0.5875
" " b " " " " " " " 17°31' DECL. " B = -0.4797
Opposite number .1078 read S. 83°49' W. = true bearing of sun. A+B= +0.1078

The two scales a are similar; it is quite immaterial which of them is used for alt., and which for lat. The same is true of the two b scales.
The difference between the measured bearing of the sun and the true bearing given by the Mrdgrph is the correction to be applied to your line.

Astronomic time. Use scales b only,- no others.

Set alt. 35° against (90°-bearing 83°49' =) 6°11';
opposite decl. 17°31' read time angle = 31°20'
31°20' = 2 hours 5¼ minutes (1° = 4 mins.)
Local sun time = 6 - 2.05¼ = 3.54¾ p.m.
" mean " = 3.54¾-3½m. (Eq. of time)= 3.51 "
R.R. (90°) " - 3.51 +3¼°x4m.=3.51+13m. = 4.04 "