

Restoration of corner monument
to 145 25 x 36 T139 R25 5 P.M.

Found at above described
location, a windfall, Balsam
13 1/2 ins. dia., lying on ground - top of
tree had broken off 4 ft. above ground
logs to the eastward badly decomposed,
4 ft. section had stood for some time
and then dropped to ground breaking
off at 1 ft. above ground, marked
145 B.T. with 2 1/2 ins. growth
out from face of blaze.

Field notes gave distance from
off stake to B.T. as 16 1/2 ft.
Stranstad and I measured from
stump to the NW approximating the
angle, and set a pin. We then measured
from pin to the north a distance of
9.6 ft. and after removing saw found
the roots of a tree. This we determined
to be the B.T. for 5 x 25. Flat
measurement from the roots of this
tree and the stump of the balsam
tied to a common point.

Stranstad and I carefully dug

Weather Warm, clear

Oct. 7, 1937

Harold C. Nilson

Arthur J. Stranstad

Ken Huls Eesser

Staff Compass

100 ft. steel tape.

around the point after
definitely locating it by temporary
the measurement. We found a dark spot
that extended from a point 1 ft. under
dirt to a point 2 ft. below surface.

At paper point we set an
iron post, $4\frac{1}{2}$ ft. long by $1\frac{1}{2}$ ins. dia.,
 $2\frac{1}{2}$ ft. in the ground with $\frac{1}{2}$ in. by 12 in.
anchor rod thru bottom of pipe, and
firmly drilled in rock and dirt around
it for the reactivation monument to
the 14^{th} cor. 525 and 36 with $2\frac{1}{4}$ in. steel
cap marked $\begin{matrix} T. 139 \\ 25 \\ 36 \\ R. 25 \end{matrix}$ from which

Old balsam stake 10.7 ins. dia., bears
 $52\frac{1}{2}^{\circ}$ E, 16.6 ft. dist. marked 145 B.T.
Roots of tree bears $11\frac{1}{2}^{\circ}$ W 4.6 ft.

and

A balsam, 10.7 ins. dia., bears $56\frac{1}{2}^{\circ}$ W,
34.9 ft. dist. which I scribed 145 B.T.
A balsam, $7\frac{1}{2}$ ins. dia., bears 115° W,
19.6 ft. dist., which I scribed 145 B.T.

Random stake to iron pipe -

10 ft. E. and 4 ft. south.

I destroyed approx. stake.

Restoration of corner monument
to Secs. 25, 26, 35 and 36
T 139 N. R 25 W 5 P.M.

Found at above described corner
Two stabs, 3 ft high scribed with
T 139 N 535 evident.

A tan. tree, dead and standing, 8 ins. dia.
with grain together seam which
when cut open revealed a 2 1/2 in. face
plainly scribed R 25 W T 139 N 526 B.

I did not open further to see the T.
A tan. tree, dead and standing, 10 ins.
dia. with seam on side which
when partially opened up disclosed
2 1/2 in. face, 2 in. in diameter
with worm holes marked SW T 139 N 5.

I did not open further to see rest
of marks.

A tan, 9 ins. dia, living. I opened up
seam to disclose iron marks but did
not open so all markings were
evident due to its being a living tree.

Stranstad and I took flat
measurements from the B. T. according
to the distance given in the notes.

Weather Warm, clear

Keeneth's Exam
Shell Compress
100 lb stool tape

Oct. 9, 1937

Harold C. Nelson

Arthur J. Stranstad

These did not meet at a
common point. We then paired
the SW & NW B.Ts to a common point,
the NW & NE B.Ts to a common point,
and the SW & SE B.Ts to a common point
by flat measurements according to
distances given for each B.T. We
then determined the center of
this triangle, dug a hole and set a
4 1/2 ft. iron pipe, 1 1/2 ins. dia., 2 1/2 ft. into
ground with 1/2 in. by 1/2 in. anchors set out
secured by anchor logs in peat for
the restoration monument to the corner of
25, 26, 35 and 36 with a 1/2 in. steel
cap marked

T 139

26/25

35/36

R 25

from which:

A fam. stake 3 ft. high, bears S 52 1/2° W,
29.2 ft. dist., marked T 139 N 535

A fam. standing dead, 8 ins. dia., bears
N 49 1/2° W, 28.3 ft. dist., marked R 25 W T 139 N 526

A fam. standing dead, 10 ins. dia., bears N 28° E,
11.55 ft. dist. marked SW T 139 N 5.

A fam. lying, 9 ins. dia., bears S 36 1/2° E,
29.5 ft. dist., with iron marks showing.

T 139 from random stake to pipe
2.9 ft. east and 2.6 ft. south.

Restoration of corner monument
to 535 and 36 West 5 PM.
and 52 and 1 West 5 PM.

Went to above described location
arriving there at 9 AM and found
a stake rotten at ground and moss
covered, a square stake with 2 1/4 in.
face, set marked with 1 1/2 in. ground and
2 1/2 ft. out of ground immediately beside old
stake and immediately to the west a sign
with post - evidently intended for a
corner post.

A iron which
A iron stamp, with 2 1/4 section lying
alongside it on ground with face down.
Face side ground with 3 ins. of growth
outside 2 1/2 in. face, bears N 53° W E,
14.5 ft. dist., marked N 536 with
part of B.T. showing at base of
section.

A iron stamp, 1 ft. high and 1 1/2 diam.
rotten, bears N 62° W, 8 1/2 ft. dist.
A iron stamp 1 ft. high and 1 1/2 diam.
very rotten showing at base facing
stake, indication of line with

Weather: Cloudy, cool.

Oct. 11, 1937

Harold C. Nelson

Arthur J. Stensted

Keuffel & Esser

5 ft. ft. Compass

100 ft. steel tape.

healing growth around, moss covered,
where B.T. would have been scribed -
A. Lar. stump, 1 1/2 ft. dia., 19.6 ft. dist.
with hole at base, taller toward the
southeast, moss covered. We turned it
over and found it marked.

R25W T138N 5 on 3 in. face with
3 ins. of growth outside of face bears
S 23° E, 40.9 ft. dist.

Stood out I determined the
position of rolled stone by measuring
that measurement, dug a hole and set
a 4 1/2 ft. iron pipe, 1 1/2 in. dia., 2 1/2 ft.
in the ground with anchor rod and piled
rock and earth around it. It has a 2 1/4
in. slot deep marked.

T137 R25

35/36

2/1

T138 R25

from which

A white pine, dead top, 15 ins. dia., bears
N 1 1/2° W, 48 ft. dist., which I
scribed T137 N R25W 536 B.T.
A birch, 1 1/2 ins. dia., bears S 64 1/2° E,
84.9 ft. dist., which I scribed.

50

SW
26
out

T138N R25W S1 B.T.

An elm, 12 ins. dia, bears S 40° W,
12.9 ft. dist, which I scribed.

T138N R25W S2 B.T.

A birch, 9 1/2 ins. dia, bears N 29 1/2° W,
62.3 ft. dist, which I scribed.

T139N R25W S35 B.T.

We chained west to old trail
from iron pipe and placed a yellow
log on line alongside trail, 267
west of the iron pipe to cor. ^{25/15} 311

Restoration of corner monument to
secs 34 and 35 T139N R25W 5 P.M.
and secs 3 and 4 T138N R25W 5 P.M.

Went to above described location
and found:

A firm stub approx 40 ft tall, 17 ins
dia. with 3 in. face, 5 ins. wide face
outer edge of tree to side of face
that had been cut open and stumps
marked with scribe

T138N 52

Scam extends beyond but did not
open further.

A firm stump, 2 1/2 ft. high, rotten
showing saw cut on top and axe marks
down side; marked with scribe showing
part of the B and part of the T.
4 ins. in from outer edge of tree

Stronstad and I by flat
measurement, according to the
distances given by the original
surveyor, laid the distances from
the respective trees noted above
and found them lying on the ground
at the intersection.

Weather: P. Cloudy
Cool.

Keathel & Esser
Staff Compass
100 ft. steel tape

Oct. 12, 1937
Harold C. Nilson
Arthur J. Stronstad

Old original stake, pointed that
had been in the ground 16 ft. with
2 ft. firmly out of ground weathered.

A new stake, 4 ft. long, 3/4 in. dia.
2 in. face and sharpened to point on
two sides that had been set in
recently.

From the point on ground:

The new stake, 17 in. dia., bears
S 10 1/2° E, 90 ft. dist, marked T138 N S₂

The new stake, bears N 29° E,
24.4 ft. dist, showing part of B and
part of T.

A depression left by tamu telling
to the north and extremely deep,
bears N 84° W, 59.4 ft. dist back.

Struck out I marked the
point by the measurement to two
temporary points, dig a hole and
set a 4 1/2 ft. by 1 1/2 in. iron pipe
for the restoration monument to
secs. 34-35 S and 2. This we firmly
anchored with 2 1/2 ft. of pipe in the
ground and 2 ft. out of ground.

It has a steel cap with 2 1/4 in.
face marked.

T 139 R 25

34/35

3/2

T 138 R 25

from which

A black spruce, $13\frac{1}{2}$ ins. dia., bears

$N 35^{\circ} E$, 63 $\frac{1}{2}$ ft. dist., which I

scribed T 139 N R 25 W 535 B.T.

An ash, 9 ins. dia., bears $521^{\circ} E$,

69.2 ft. dist., which I scribed

T 139 N R 25 W 52 B.T.

An ash, $10\frac{1}{2}$ ins. dia., bears $530^{\circ} W$,

43.8 ft. dist., which I scribed

T 138 N R 25 W 53 B.T.

An ash, $9\frac{3}{4}$ ins. dia., bears $N 23^{\circ} W$,

60.8 ft. dist., which I scribed

T 139 N R 25 W 534 B.T.

We set up wooden stakes

alongside iron pipe, and made

a tie from stake set on approx.

course on random line from the

east to the iron pipe which is

3 ft. west and at the north

We then removed the approx. stakes

Restoration of copper museum
to secs. 27-26-34 135 T39N R25W
5 P.M.

At above described location I
found a fir snag wind falling to
the north west that had been ground
up with an axe years ago to reveal
the markings made by the original
surveyor. It is marked 39N 526 on
a 4 in. face, 3400 in from where stump
tree. It is appr. 12 ins. in dia. and lies
immediately alongside and on the west
side of a logging road running north
and south. There is a scar depression at
the base of the rotten stump.

Stump had been cut a piece
at the distance given in the notes
and located the following:

Roots of firm tree that had been close
cut for skidding in logging road, bears
568° E, 16 1/2 ft. distant.

Roots of firm tree bears 550° W,
9.2 ft. distant. Bark rotted away.

Rotten tree stump with bark falling
to the northeast and the west.

Weather: Cloudy, Cold
Snow flurries

Keuffel & Esser
5th N. Compass
100 ft. steel tape.

Oct. 13, 1937

Harold C. Nilson

Arthur J. Shansel

N 41° W, 29 ft. dist.
Bearing tree first described bears
N 3° E, 11.9 ft. dist.

Stronstad and I found a stump
1 ft. to the southwest of the intersection
of distances by that measurement from
the location of bearing trees described,
with the stem fallen to the northeast -
a 4 in. diam. spaced on 4 sides.

We then dug a hole, and set a
pipe at point located that is 4 1/2 ft.
long by 1 1/2 in. dia. with 2 1/2 ft. in the
ground, and anchored by 1/2 in. by 12 in.
anchor rod, then pipe near the bottom,
and has a steel cap with 2 1/4 in.
face marked.

T 139

27/26

34/35

R 25

from which

A cedar, 5 1/2 ins. dia., bears N 23° E,
71.2 ft. dist., which I scribbled

T 139 N R 25 W S 26 B.T.

A balsam, 5 1/4 ins. dia., bears S 44 1/2° E,
41.2 ft. dist., which I scribbled

T 130 N R 25 W S 35 B T
A black spruce, 8 1/2 ins dia, bears
S 30 1/2° W, 39 ft. dist. which I scribed

T 130 N R 25 W S 34 B T
A black spruce, 7 ins. dia, bears
N 64° W, 10.9 ft. dist. which I scribed

T 130 N R 25 W S 27 B T
I had figured before looking
for the evidence that I would
find the corner appx. 46.4 ft. east
and 135 ft. north from the
appx. corner set on the section
line. Actually the corner was
95.4 ft. east and 121 ft. north
from the position of the
approximate corner.

The iron pipe now set
immediately west of a logging
road running N 25.

Restoration of corner monument
to 14.5.16-21 T139N Row 5PM.

Found a 2 in. square stone
2 1/2 ft. out of ground marked.

14.516 on north side

14.521 on south side

Setting in swamp 198 ft east
from edge of swamp

from which

A white pine wind fall bears $S 82^{\circ} 45' W$
220 ft. dist., showing blazed face
with vague evidence of marking.

A white pine stump, rotten, bears
 $S 70^{\circ} 30' W$, 303 ft. dist.

Determined position of stone
by 1/2 ft. measurement to temporary
point, dug hole and set 4 1/2 ft.
iron pipe, 1 1/2 in. dia., 2 1/2 ft. in
ground with anchor rod that has
steel cap with 2 1/4 in. face

marked T139

16

21

R26

Completed

Weather: Warm, clear

Oct. 14, 1937

Harold C. Wilson

Arthur J. Shuster

T. Ferguson

Reel No. 1350

Staff Compass

100 ft. steel tape

A tam. 6^{3/4} ins. dia. bears S 62° W,
31.6 ft. dist. which I scribed.

1 1/2 S. B.T.

A tam. 5^{3/4} ins. dia. bears N 38° W,
51.4 ft. dist. which I scribed.

1 1/2 S. B.T.

Set old stake alongside
win. pipe.

Found old section with point
of old stake in great sagside
shooting stake.

Re-orientation of corner monument to
5-63. 9-10-16 & 15. T139 N R25W 5PM

Went to above described location
and found a windfall, tam approx
10 ins. dia. with face up by 109
toward the east with base alongside
the stump. It had been cut open to
show the workings.

T129. 5

The windfall had been cut away.
Also an old rotten wind fall to
the southeast of tam rack spoke
that showed an indentation with
a curved portion of the B and the
T showing where the pitch had
filled the scire marks.

Storsted and I determined
the position of the corner by
that measurement from the stump
of the above described trees, set
a point and found that

The tam approx. 10 ins. dia. bears
S 47° W, 215 ft. dist. to stump
with line arc marked and
called T129. 5

Weather. Cloudy Cool Oct. 21, 1937

W. wind

Harold C. Wilson

Kenneth E. Esser

Arthur J. Storsted

5 ft. H. Compass

log H. steel tape

A iron stump, bears $S37^{\circ}E$, 29 ft.
distant, with raised portion of Band
T. showing in the reverse position.

A iron stump, bears $N42^{\circ}E$, 10.5 ft.
distant.

No indication of northwest B.T.

At proper position at corner
Stewart and I set an iron pipe,
4 1/2 ft. long with 2 1/2 ft. in the ground
with arched rod that has a steel
cap with 2 1/4 in. face mangled.

T 139

9 | 10

16 | 15

R 25

from which

A balsam, 6 1/2 ins. dia., bears $N32^{\circ}E$, 22.6
ft. dist., which I scribed T139 N R25 W 510 B.T.

A bl. sp., 5 1/2 ins. dia., bears $S85^{\circ}E$, 100.9 ft. dist.,
which I scribed T139 N R25 W 515 B.T.

A balsam, 4 3/4 ins. dia., bears $S68^{\circ}W$, 83.3 ft.
dist., which I scribed T139 N R25 W 516 B.T.

A birch, 5 1/4 ins. dia., bears $N40^{\circ}W$, 74.7 ft. dist.,
which I scribed T139 N R25 W 519 B.T.

Random corner which I destroyed was
60.8 ft. No. and 13.5 ft. west.

Restoration of corner monument
to 1/4 sec. 9-16 T32N R25W 5PM.

Found in ground a section of
slate 11 1/2 ft. long, about 2 1/2 ins. dia.
with sharpened point in good state
of preservation due to presence of
water.

from which
A farn, dead & standing, approx. 5 ins.
dia., bears S 29 1/2° W, 4.6 ft. dist.,
marked 1/4" 5, did not open to
see remainder.

A farn stub, 3 ft. high, bears N 11 1/2° E,
11.4 ft. dist., with point in at T
showing in standing stub and 1/4
sec. part of tree lying on ground.

Strinsstad and I set a 4 1/2 ft.
pipe, 1 1/2 ins. dia., at point located
in ground with 2 1/2 ft. buried with
anchors and thru pipe near bottom
that has a steel cap with 2 1/4
in. face marked.

T 139

9

16

R 25

Weather: Cloudy, cool
no wind

Kent's & Esser
Staff Compass
100 ft. steel tape

Oct. 24, 1937

Harold C. Wilson

Arthur J. Strinsstad

from which:
A bl. sp. 5 1/2 ins. dia., bears N 37 1/2° E,
23.7 ft. dist., which I scribbled

1/4 S. B. T.

A bl. sp. 4 1/2 ins. dia., bears S 13 1/2° W,
15.7 ft. dist., which I scribbled

1/4 S. B. T.

Appr. 1/4 cor. on random line was

81 ft. north and 15 1/2 ft. west

from which
A bl.sp. 5 1/2 ins. dia, bears $N37\frac{1}{2}^{\circ}E$,
237 ft. dist. which I scribbled

114.5 B.T.

A bl.sp. 4 1/2 ins. dia, bears $S13\frac{1}{2}^{\circ}W$,
157 ft. dist. which I scribbled

114.5 B.T.

Appr. 14 cor. on garden line was
81 ft. north and $15\frac{1}{2}$ ft. west

Restoration of corner monument
to $1\frac{1}{4}$ S 16-15 T139 N R25 W 5PM

Found at above described location
a spruce stub, standing, approx.
 $6\frac{1}{2}$ ins. dia. marked $1\frac{1}{4}$ S. B.T. and
a tan, approx. 10 ins. dia. standing that
had been squared on four sides.

I determined present day
bearing from tree marked and with
the distance given in the notes, set
a point. I looked for evidence of the
bearing tree for sec. 16, but could
find no evidence of it.

I set a pipe, 46 $\frac{1}{2}$ in. long, $1\frac{1}{2}$ ins.
dia. at the determined point for the
restoration monument to the corner
that is buried 2 $\frac{1}{2}$ ft. in the ground
with anchor rod through pipe near
bottom and anchored additionally with
four green stakes in the peat. The
pipe has a 2 $\frac{1}{4}$ in. steel cap upon
which I marked with steel dies

T 139

16/15

R 25

from which

Weather: Warm, Clear

Harold C. Wilson
Arthur J. Stronstad

Kou Maki & Esser

Oct. 22, 1937

Statt Compass
100 ft. steel tape.

A balsam, $6\frac{1}{2}$ ins dia. bears $N56^{\circ}W$,
39.7 ft. dist. which I scribed
14.5 B.T.

Acedon, 9 ins dia. bears $S36^{\circ}E$,
26.8 ft. dist. which I scribed
14.5 B.T.

The pipe now stands on the north
side of the squared towerack stub.

Restoration of corner monument to
1/4 S 16-21 T139N R25W 5 P.M.

Found a post squared 4 sides
to 2 in face standing

from which

A tan stump with bore wind blown
to the south, bears $59^{\circ}E$, 25.1 ft.

dist., with scribe marks showing

1/4. Remainder was not revealed and
scribe face had been cut down
to with an axe.

A tan stump with 12 ins. dia. wind blown
hole to the east, bears $N56^{\circ}E$, 21.8 ft.
dist., also marked and old face showing
but with scribings obliterated.

Started to remove stake for
digging hole but it broke off at
ground. Dug hole found point of
stake and set in proper position
on iron pipe, 4 1/2 ft. long, 1 1/2 ins. dia.,
2 1/2 ft. in the ground with another
rod through pipe near bottom which
I anchored with 4 additional green
sticks in the post. The pipe has a
cap with 2 1/4 in steel bar upon

Weather: Warm, clear Oct. 22, 1937

Harold G. Nilson

Kent H. Esser

Arthur J. Stronstad

Staff Compass

100 ft. steel tape.

which I stamped with steel dies

T 139

16

21

R 25

from which

A balsam, 6 $\frac{1}{2}$ ins. dia, bears N 53° E,

23.8 ft. dist, which I scribed 145 B.T.

A balsam, 7 ins. dia, bears S 14° E,

21.5 ft. dist, which I scribed 145 B.T.

Tie to temp. stake set on random
line is 141 ft. south and 130 ft. east.

Restoration of corner monument
to N45 17-16 T139N R25W 5P.M.

Found a tam. stump, 15 ins. dia.,
2 ft. high and sawed off that had
been opened to show the marks B.T.

A tam. windfall to the east
alongside stump that has been
opened and bears on the face
the scribe marks 15, with the
remainder obliterated.

I determined a position by
flat measurement from the original
accessories and found that the
point caused both B.T. to be in
319. Bearings from this point did
not coincide at all close with the
original bearings.

I then set a point from the
northeast B.T. using the given
distance, and computed present
day bearing, and found that the
southwest B.T. distance from
the point coincided with the
one to the northeast B.T.

I then concluded that a

Weather: Warm, Acloudy Oct. 25, 1937

Harold C. Nilson

Richard Sebeck

Kouffel's Esser

Staff Compass

100 ft. steel tape.

mistake had been made by the original surveyor, and concluded to set the point from the northeast B.T.

At the point I set an iron pipe $4\frac{1}{2}$ ft long by $1\frac{1}{2}$ ins. dia. buried $2\frac{1}{2}$ ft. in the ground with anchor rod thru pipe near the bottom.

The pipe has a steel cap with $2\frac{1}{4}$ in. face area which I stamped

T139

17/16

R25

from which
Original B.T. at iron stump, bears
N $16\frac{1}{4}^{\circ}$ E, 15.2 ft. dist. marked B.T.
Original B.T. at iron windfall, bears
 575° W., 15.2 ft. dist. to stump, with
hole bearing the marks 15, the
remainder being obliterated.

The position of the faces on
the B.T.s as they were when standing
face both to the iron pipe I set.
A balsam, $5\frac{1}{2}$ ins. dia. bears N 62° E,
14.85 ft. dist., which I scribbled
1/4 S.B.T.

A balsam, 6 ins. dia, bears $580\frac{1}{2}$ W,
10.45 H. dist. to center, which I
scr. bed. 14 S. B.T.

Restoration of corner monument to
Secs. 8-9-17 and 16 T139N R25W 5PM.

Found stumps remaining of
4 tan. bearing trees, and a 5th
section of a 4 in. dia. tamarack
with the name W. BENSON Aug. 16
carved thereon with knife.

I determined true position
of corner by lat measurement
from the 4 bearing trees, dug a
hole and found the point at
the stake upon which Benson had
carved in the ground at the position
I had determined.

I set in ~~iron~~ iron pipe 4 1/2 ft.
long by 1 1/2 in. dia. with 2 1/2 ft.
buried in the ground that is
secured by an anchor rod thru
the pipe near the bottom, and that
is additionally anchored with
4 green sticks around pipe in
the peat. The pipe has a steel
cap with 2 1/4 in. face upon which
I stamped with steel dies

Weather: Warm, A. Cloudy

Oct. 25, 1937

Ken Hol & Esser

Harold C. Nilson

Stall Compass

Richard Schenck

100 ft. steel tape

T139

8/9

17/16

R25

from which

A tan stump, approx 7 ins dia, bears
N55°E, 19.1 ft. dist marked R25W

T139N5 partially obliterated

A tan stump, 3 ft. high, bears S30°E,
13.8 ft. dist, showing axe marks

A tan stump, rotten, bears S32½°W,
9.5 ft. dist, showing raised B.T. on
inside of bark.

A tan stump, 4 ins dia, bears N57½°W,
13.9 ft. dist with its bole lying on-
ground showing iron marks.

A tan, 8½ ins dia, bears N80°E,
216.6 ft. dist which I scribed

T139N R25W 59 B.T.

A tan, 9½ ins dia, bears S94½°E, 204.5 ft.
dist. which I scribed T139N R25W 516 B.T.

A birch, 3½ ins dia, bears S66°W, 69.8 ft.
dist, which I scribed T139N R25W 517 B.T.

A balsam, 6¾ ins dia, bears N45½°W, 175.9
ft. dist, which I scribed T139N R25W 58 B.T.
Tie to app stake - 165.4 ft. north & 143 ft. west.

T. 139 N.
R. 26 W. 25/30
26+90 Set Appr. quarter corner 3" birch-blazed
26+35 - offset on 2 sides.

22+00 Type change to Hazel brush

11+27 Road intersects line N.W.

6+65 Road turns N.E. and
leaves line.

0+00 Started N. from

25/30
36/31

139-26

139-27

Jackpine
Var. 5.5°

February 1, 1959

Party:

Michaelson - in charge

Bennis

Anderson

Ramsay

Riggs

FOUND: A set

2" Aspen Post

at 26+35. No scribe,
but blazed on
2 sides. Possibly
a $\frac{1}{4}$ cor. placed
by re-survey party.

Jackpine

Magnetic bearing N. 5.5° W.

True line

Jackpine

FOUND:

14" Jackpine S. 58° W.

Distance - 255'

16" Jackpine N. 39° E.

Distance - 135'

Cor. in middle of road.

7' error in 260

24/10
25/30

52+80 Set approx. Sec. corner -
a squared 3" white birch.

50+45 Type change from flooded
area to SW and SC. St. and
balsam poplar.

44+54 Type change from SW to
flooded area (sc. cat-tail)
and numerous muskrat
houses for $\frac{1}{4}$ mile or
more to the S.W. & N.E.

39+35 cross creek (4-6' wide) leading
E-W thru SW island

VOID

10' error results in 92.5' error
in dist. of 1 mile.

LOOK FOR:

TAM 9" - N41°E - 14748

TAM 6" - S40°W - 14264

TAM 8" - N27°W - 1378

VOID
cross creek

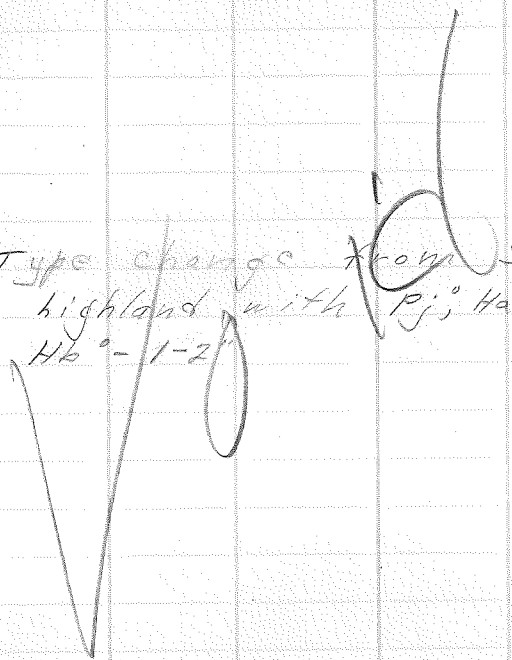
27+50 Type change to Swamp Willow

26+40 CONT. N. from $\frac{1}{4}$ cor. 25/30 13027

SWAMP Willow

Hazel brush

20+00 Type change from SW to
highland with Pj°, Ha°, and
Hb° - 1-2'



8+00 Reached extreme East edge
of Ha' type 2-6" Willow
lowland to the east $\frac{1}{4}$
mi. to spruce-cedar swamp.

0+00 started N. from $\frac{24}{25}$ - marked by a squared post - a 3" Hb.

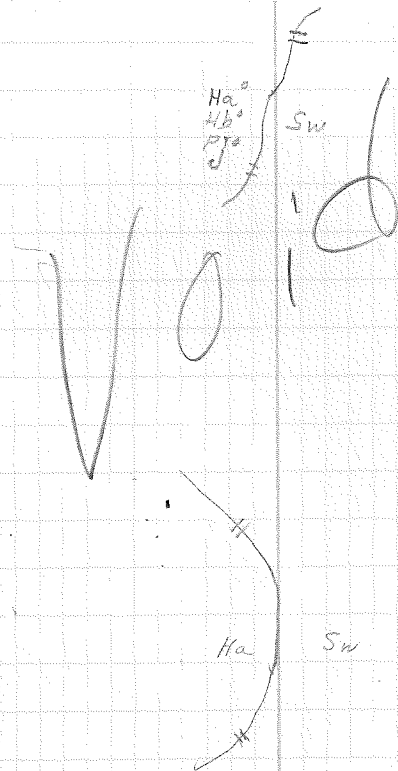
20+00 - 29.7 ch. 2530
creek - 11.5 - 53.4 ch. 2537
Tan. SW - 65 ch.

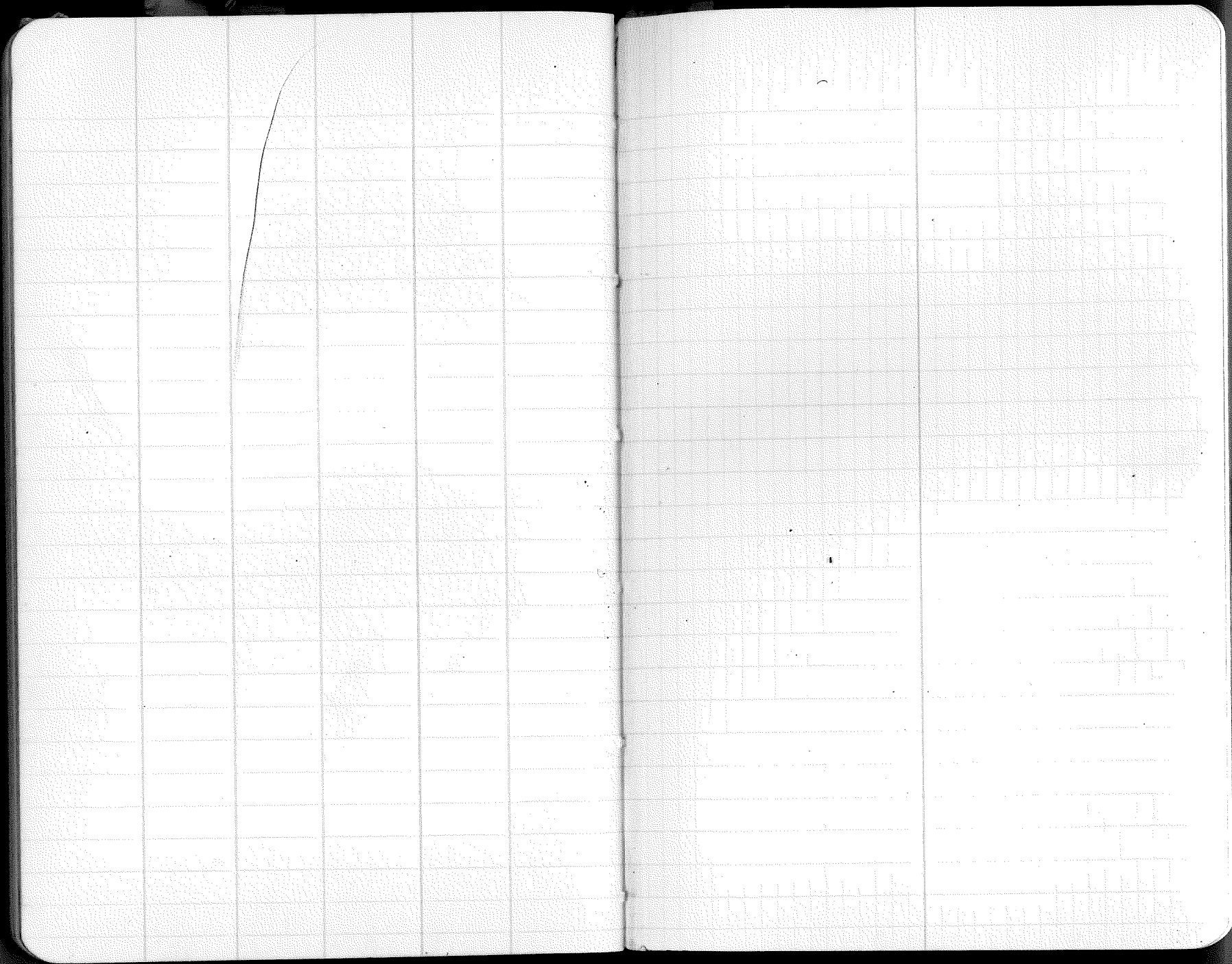
Feb. 2, 1939

$\frac{1}{4}$ cat. evidence -

bet far: 7" Ha S. 130° E. 147 lbs

8" pine S. 89° W. 96 lbs





T. 139 N. R. 26-27 W. Sec. 19 9 24
26+40 Set picket in creek and
26+35 crossed same creek

22+64 cross same creek again

19+10 cross creek again
Type change to lowland Sw. Sd.

16+60 Reach center of creek bed.
Type change to stream
bottom Elm, balsam poplar.

13+20 Set picket marked to cor.

6+00 Leave hdwd. and enter highland
Ha° and "Pj"

3+50 Enter hdwd. swamps, mostly Bl. ash.

0+00 started south from iron pipe
cor. 18-19-13-24 T. 139 N. R. 26-27 W.

- Line running south.
marked to cor.

Feb. 3, 1939

Party: Morse
Michaelson
Bennett
Anderson
Riggs
Ramsey.

Creek

Ha
Pj

hdwd.
swamp

Ha-1"

Random line run $5\frac{1}{2}^\circ$ variation.

13 | 18

24 | 19

52780 Enter flooded area (muskrat
houses) and leave SW
lowland.

set picket keeled 52780
south of corner.

47732 set picket (Keeled)

Flooded
Area II

Sw.

Date: Feb. 8, 1939

Party: Morse
Michaelsen
Bennis
Anderson
Coolidge
Iverson.

Weather: Cold; clear

-15° F.

T. 139 N. R. 26-27 W.

S. 25 + 30.

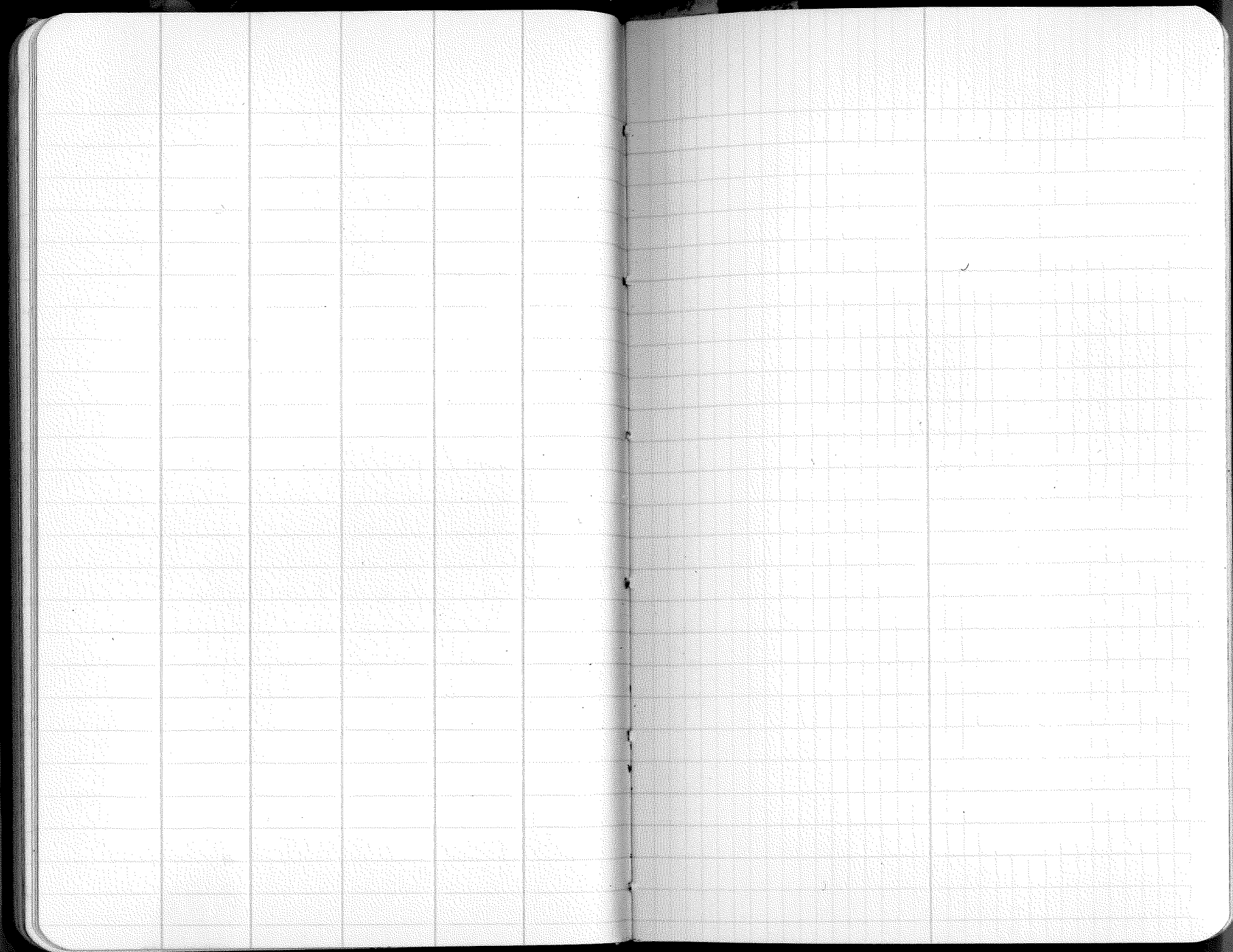
10+00 Set picket marked 10+00
(changed S. to this pt.)

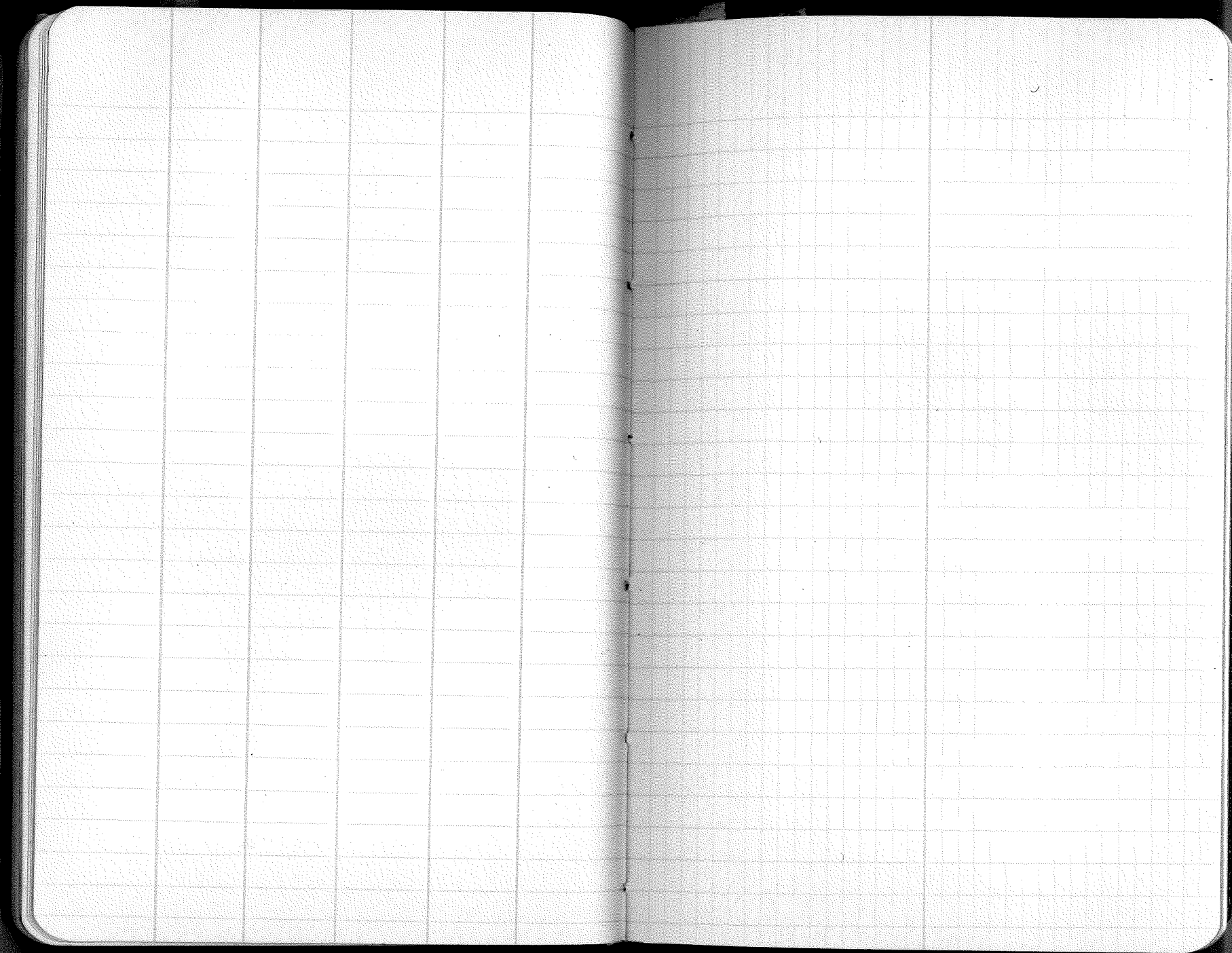
6+20 Enter SW lowland type and
leave open flooded area with
numerous muskrat houses.

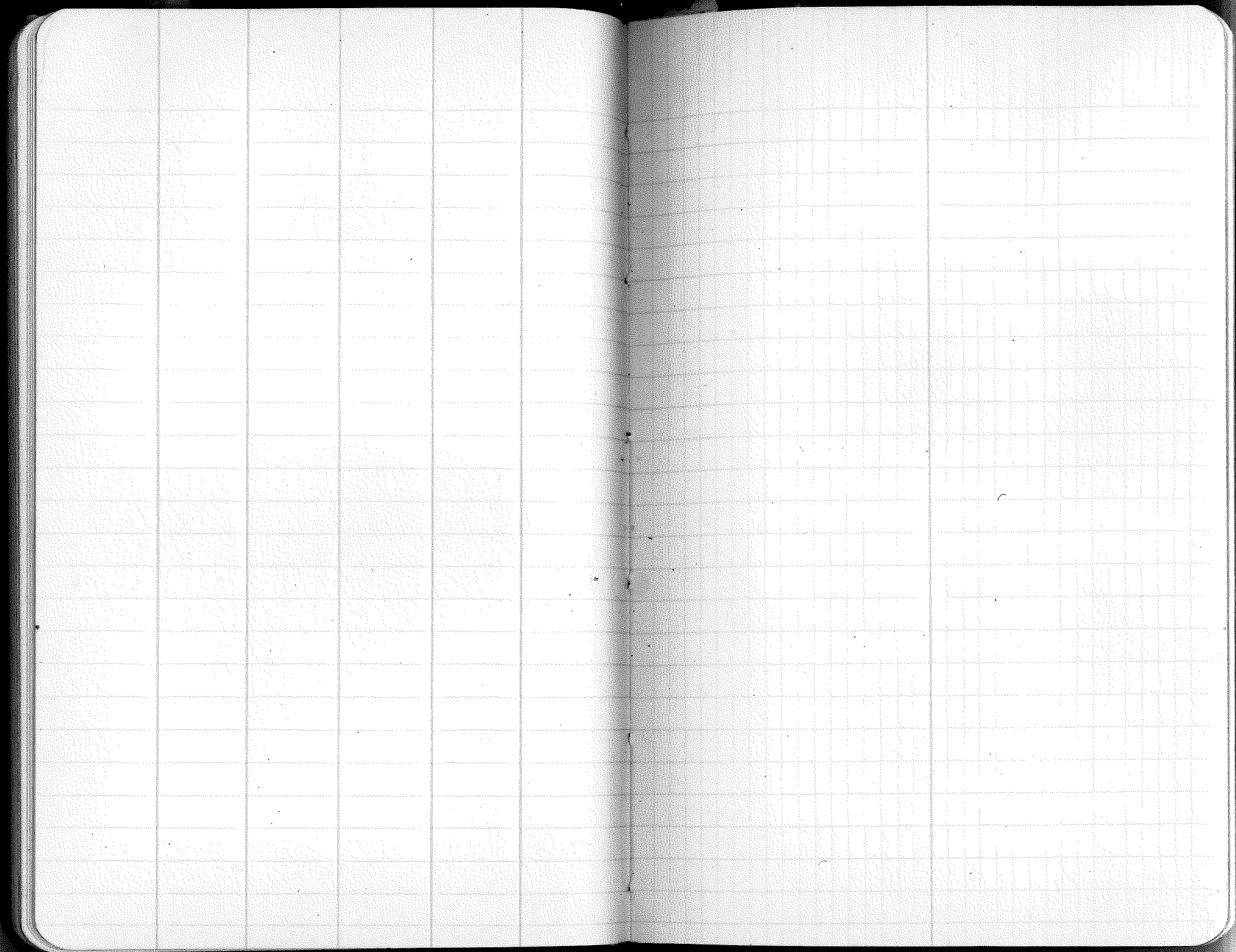
0+00 Started S. from 52780 picket marking
Sec. corner (Approx.)
52780
52780

SW
lowland

Flooded area.







T. 139 R27

| | | | | | |
|----|----|----|----|----|----|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

26+40 WAS IN CREEK SO I SET
¼ COR AT 26+13 6 FT W OF OUR LINE
26+40 CROSSED CREEK

24 | 13 139-27

23+27 CROSSED CREEK

19+38 CROSSED CREEK

16+60 CREEK

14+76 LEFT CLEAR SPOT ENT. WILLOWS
+ ASPEN

8+36 LEFT ASPEN ENT. CLEAR SPOT

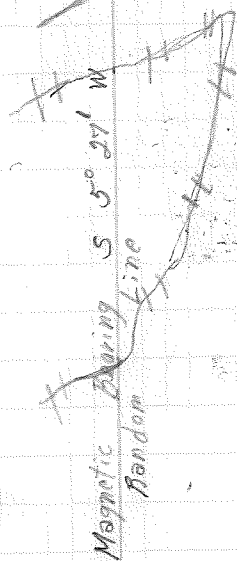
0+00 STARTED IN ASPEN
started south from I.P. for 13 | 24 | 139-27

139-27

DATE APR. 9 - 1940

PARTY
BACKER
LAU
FOIGER
PROCHNOW
CARDNER

LOOK FOR
PINE 8" S 89 W 96 LKS
ASPEN 7" S 13 E 147 LKS
Distance. 2640'



5° 27' VAR

52780

SET SEC 5 FEET
OF LINE

25 |
30 | 139-27

LOOK FOR

TAM 8" N 7 W 174 IKS?

TAM 9" N 11 E 147 IKS

TAM 6" S 88 W 142 IKS

DIST 5280

No tree in S. 30.

DATE

PARTY

BACKER

LAU

ROIGER

PROCHNOW

CARDNER

FOUND

TEMP SEC COR

157 FEET W. OF

OUR LINE

26740 Cont'd. South on same line 24 139-27

5° 27' Var.

26+40 SET TEMP
1/4 cot.

25/ 139-27

23+20 LEFT WILLOWS + SW. ENT ASPEN High
LAND

11+77 SMALL CREEK

5+16 ENT. WILLOWS + SW.

1+00 CROSSED CREEK + ENT SW
0+00 Start South from 24/ 25/ 139-27

DATE Aug. 10-1940

PARTY
DACKER
LAU
ROIGER
MINNERATH
HESSE

3

LOOK FOR:

Y. PINE 14" N37E 24 IKS

Y. PINE 13" S27E 44 IKS

2640' dist.

44 IKS

SW.

SW

Var. 5° 27'

52480 SET TEMP SEC COR $\frac{25}{36}$ 139-27
 51496 LEFT CLEAR SPOT ENT. J. PINE

40400 LEFT ASPEN ENT. CLEAR SPOT ^{TREES ALL CUT}
 39416 SMALL ROAD
 38463 LEFT J. PINE ENT. ASPEN

28462 LEFT ASPEN ENT. J. PINE
 26440 CONTD SOUTH ON SOME $\frac{25}{36}$ LINE

DATE: APR -10-1940

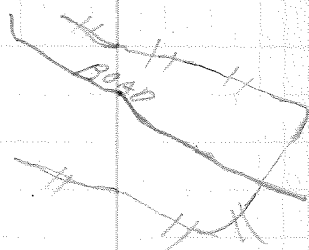
PARTY:

BACKER
 LAU
 ROIGER
 MINNERATH
 NESSE

④

LOOK FOR

J. PINE 91°N45°W 37-1KS
 " " 12°N24°E 30-1KS
 Y. PINE 20°S28°E 29-1KS
 SPR. 7°S20°W 72-1KS



Var. 5°27'

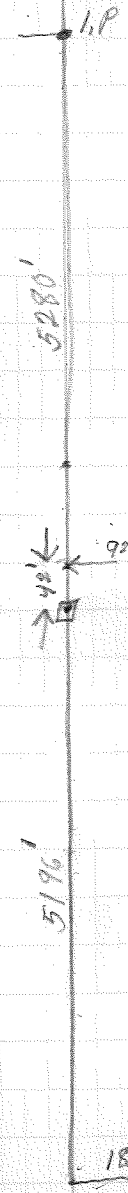
T. 139
R. 27

T. 139
R. 26

Sec.
24

Sec.
19

Post marked 5280'
on picket line



Sec.
25

Sec.
30

185'

139-27

The image shows an open notebook with two blank, grid-lined pages. The pages are white with a light gray grid pattern. The notebook has a dark cover visible around the edges. The pages are slightly aged and show some minor blemishes. The grid lines are evenly spaced and cover the entire surface of both pages. The notebook is open to a spread of two pages, with the binding visible in the center. The pages are numbered '139-27' at the top center of the left page.

139-27

137-26

The image shows an open notebook with two blank, lined pages. The pages are white with light blue horizontal ruling. The notebook has a dark cover visible around the edges. There are small handwritten numbers at the top of the pages: '139-27' on the left and '137-26' on the right. The pages are otherwise empty of any text or drawings.

139-2

139-26

The image shows an open notebook with two blank, lined pages. The pages are white with horizontal ruling lines. The notebook has a dark cover visible around the edges. The pages are slightly aged and show some minor blemishes. The binding is visible in the center crease.

139-2

137-26

The image shows an open notebook with two pages. Both pages are ruled with a grid pattern. The left page has a vertical margin line on the left side, creating a narrow left margin. The right page also has a vertical margin line on the left side, creating a narrow left margin. The pages are otherwise blank. There are some small, faint marks on the right page, possibly from a previous page or a pen nib. The notebook is bound in the center, and the dark cover is visible on the left and right edges.

139-2

137-26

| | | | | | |
|----|----|----|----|----|----|
| 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 7 | 8 | 21 | 22 | 23 | 24 |
| | | | | | |
| | | | | | |

137-26 139-26

26740 SET APPROX 1/4 COR

DATE - 4-11-1940 1.
PARTY:

BACKER
LAU
ROIGER
PROCHNOW
GARDNER

LOOK FOR

Y. PINE 18" NS2W 50' KS

MAPLE 8" S 80E 61' KS

2640

Found:

1+00 ENT. ASPEN.
0+00 Started North from
OFF SET 14 FEET W.

| | |
|----|----|
| 16 | 15 |
| 21 | 22 |

139-26

4091

~~ROAD~~

58+80 SET APPROX SEC COR

LOOK FOR

W. PINE 24" N 68 W 92 IKS

Y. PINE 17" S 29 W 92 IKS

MAPLE 12" N 78 E 36 IKS

MAPLE 12" S 40 E 8 IKS

52 90

PARTY
BACKER
LAU
ROIGER
PROCHNOW
GARDNER

26+40 CONTD. NORTH ON SAME LINE

4091

137-20 139-2

3.

137-96 139-21

4.

The image shows an open notebook with two blank, lined pages. The pages are white with horizontal ruling lines. The notebook has a dark cover visible around the edges. At the top center, there is a small piece of tape with the handwritten numbers "137-96" and "139-21". In the top right corner of the right page, there is a small handwritten number "4.". The pages are otherwise empty of any text or drawings.

137-96 139-2

5.

137-20 139-21

6.

137-46 139-26
26+40 SET APPROX ^{Temp.} 1/4 COR stake. $\frac{18}{19}$ 139-26

24+06 LEFT FARM LAND ENT. ASPEN

18+88 FARM LAND

5+67 ROAD TRUNED

ROAD ON N. SIDE OF LINE

1+00 ASPEN ON S. SIDE OF LINE

0+00 Started East from I.P. at $\frac{18}{19}$ 139-26

DATE 4-12-40 7

PARTY
BACKER
LAU
ROIGER
PROKHNOW
GARDNER

Look for: ~~11~~
12' Y. Pine, N55W, 21ks.
13' W. Pine, S60E, 31ks.
Dist. 2640'

FOUND:

ROAD
MAGNETIC BEARING N SIDE
RONDON LINE

137-26 139-26
This corner set by double prope-
52+80 set our temp. stake.-
52+50.5 Crossed the N+S line, $\frac{18}{19} \frac{17}{20}$ 139-26

48+76 ROAD

43+41 LEFT CLEAR SPOT ENT. ASPEN

41+06 LEFT ASPEN ENT CLEAR SPOT

26+43 CONT'D. E. FROM $\frac{1}{4}$ COR.

tion method on
following page.

DATE -4-12-40 8.

PARTY
BACKER
CAU
BOISER
DROCHNOW
GARDNER

Look for:

Dist. for mile-5280

ROAD

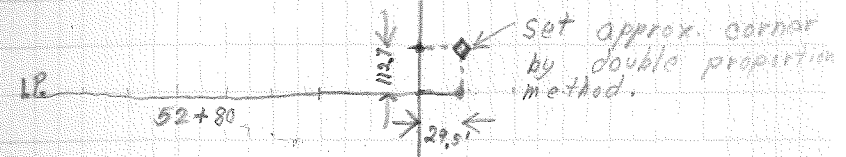
MAGNETIC BEARING N. 84 $\frac{1}{2}$ ° E
MONDRIAN LINE

Setting the Sec. Cor. N

April 12, 1940

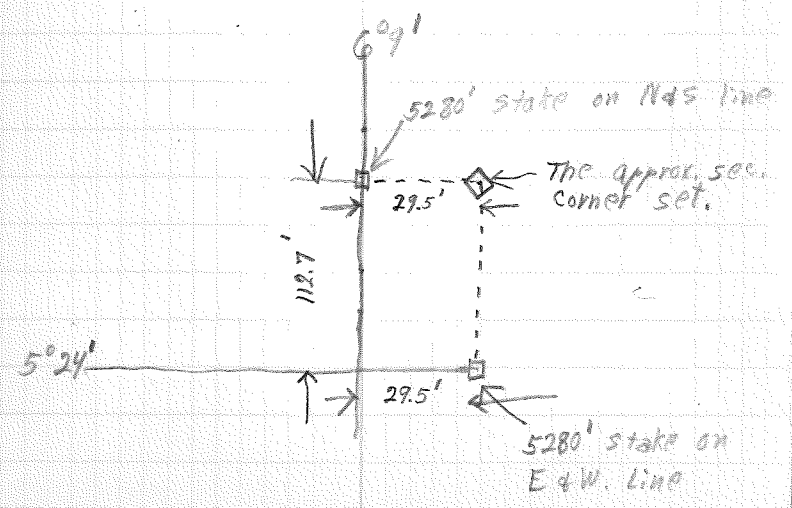
for cor. $\frac{18}{19} | \frac{17}{20}$ 139-26

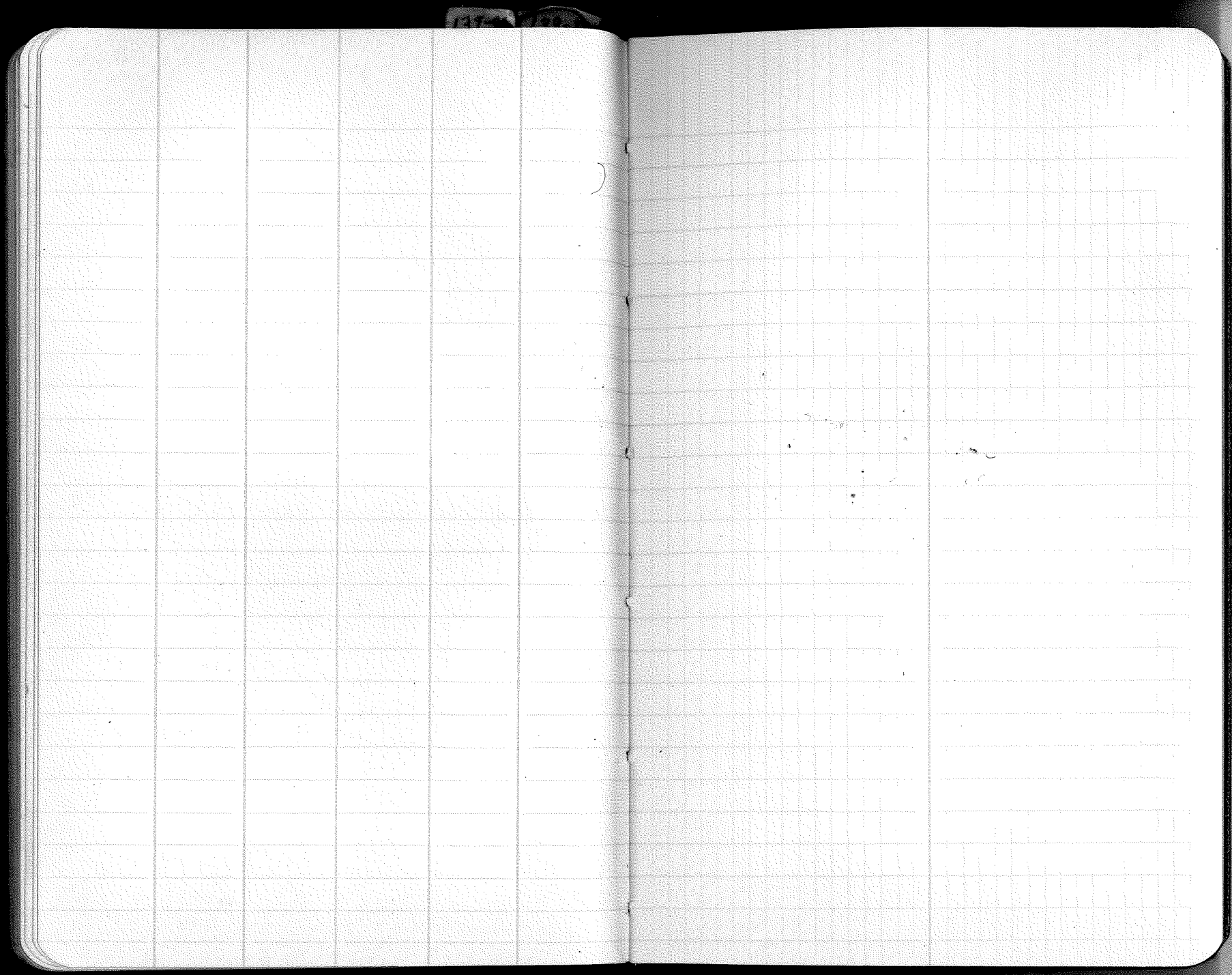
g.l.p

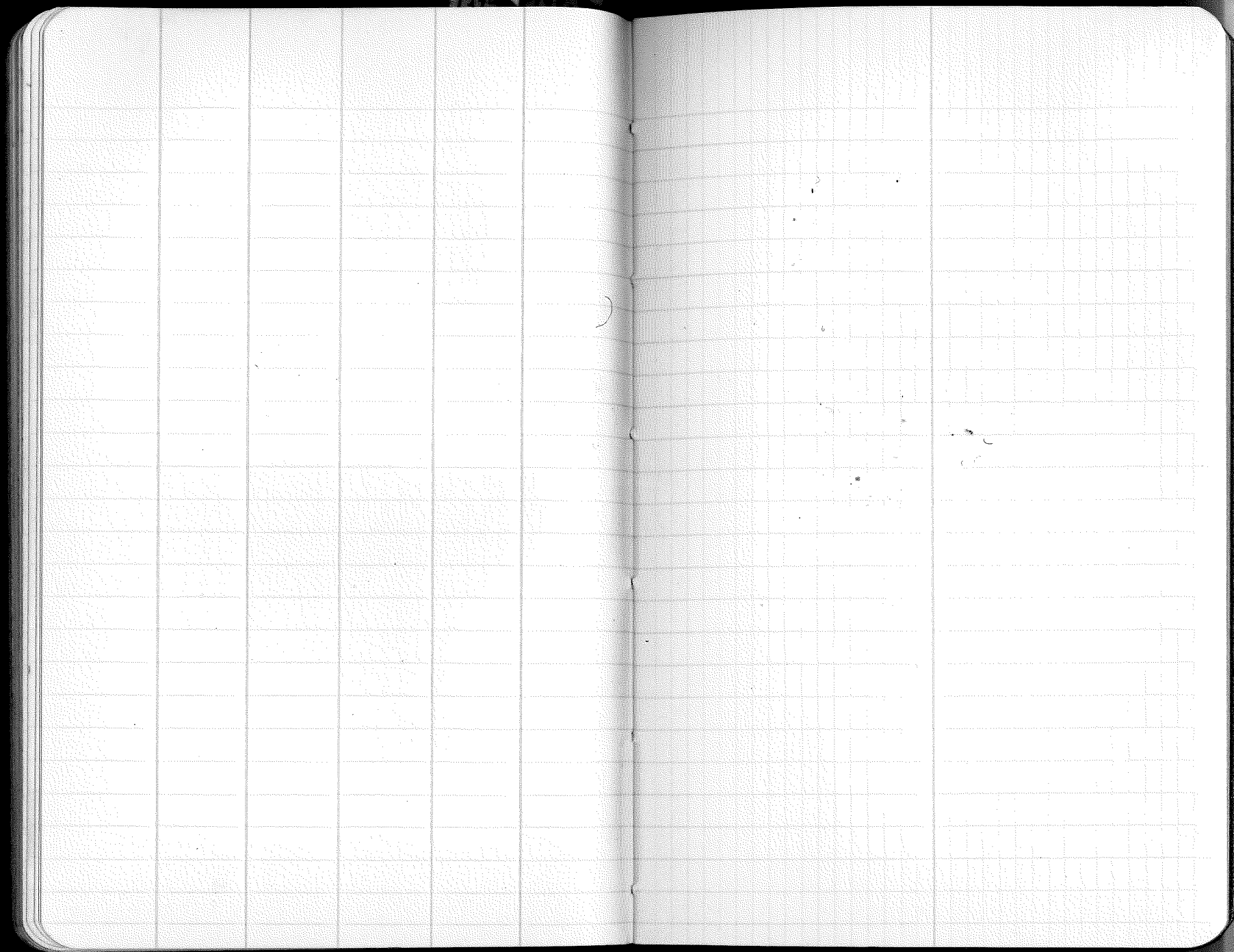


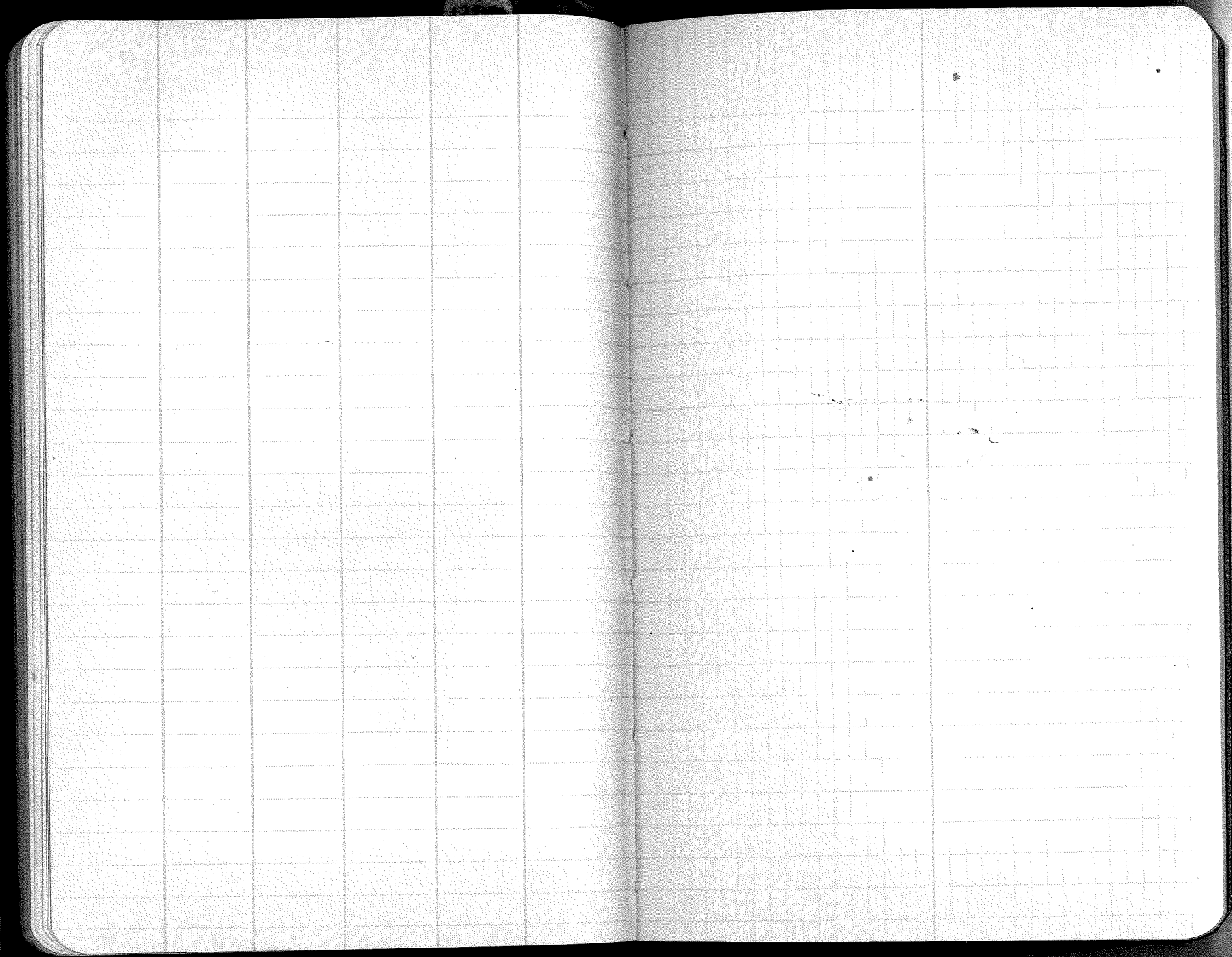
Line going East crossed the N+S line at ~~5280'~~

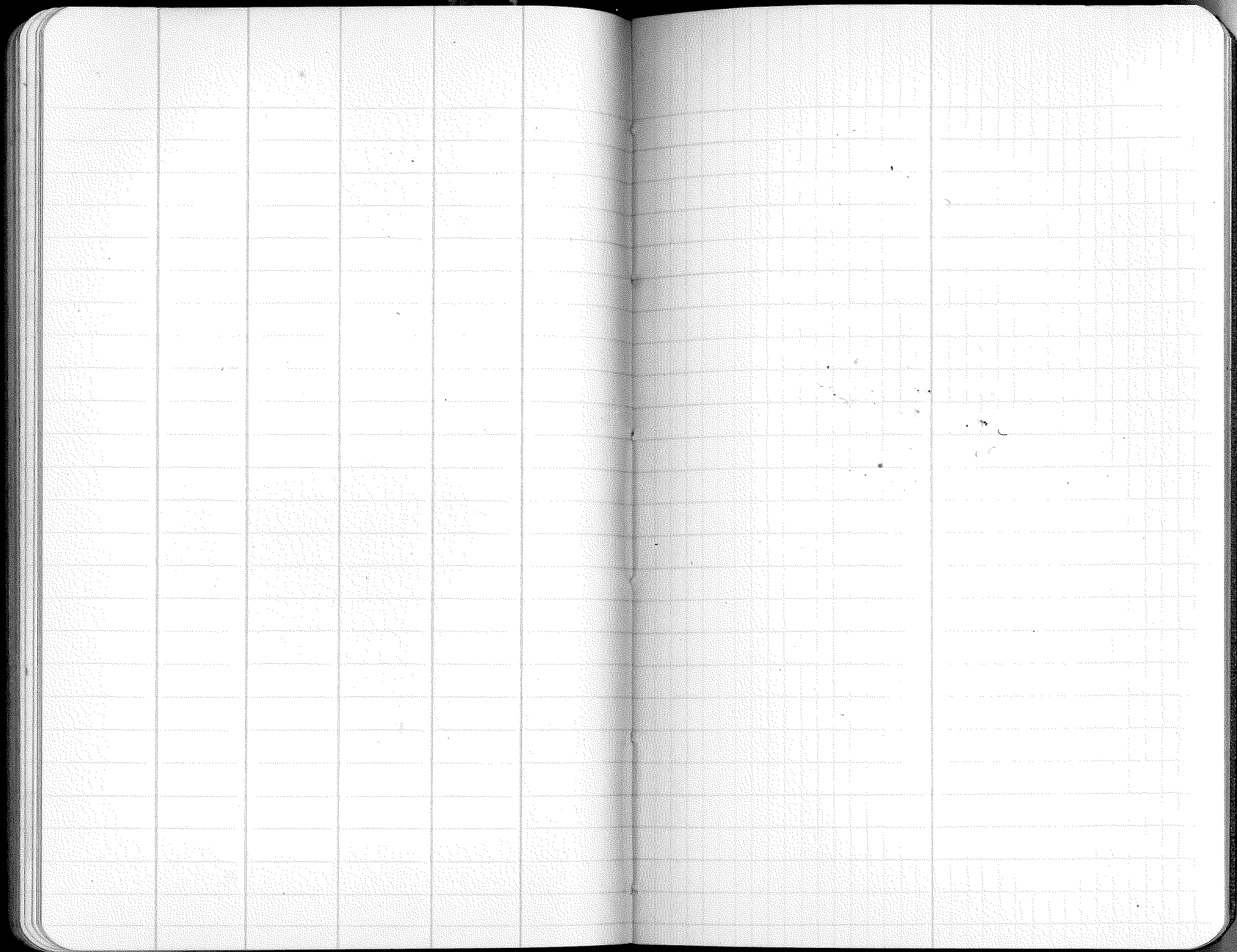
5280
112.7
5392.7

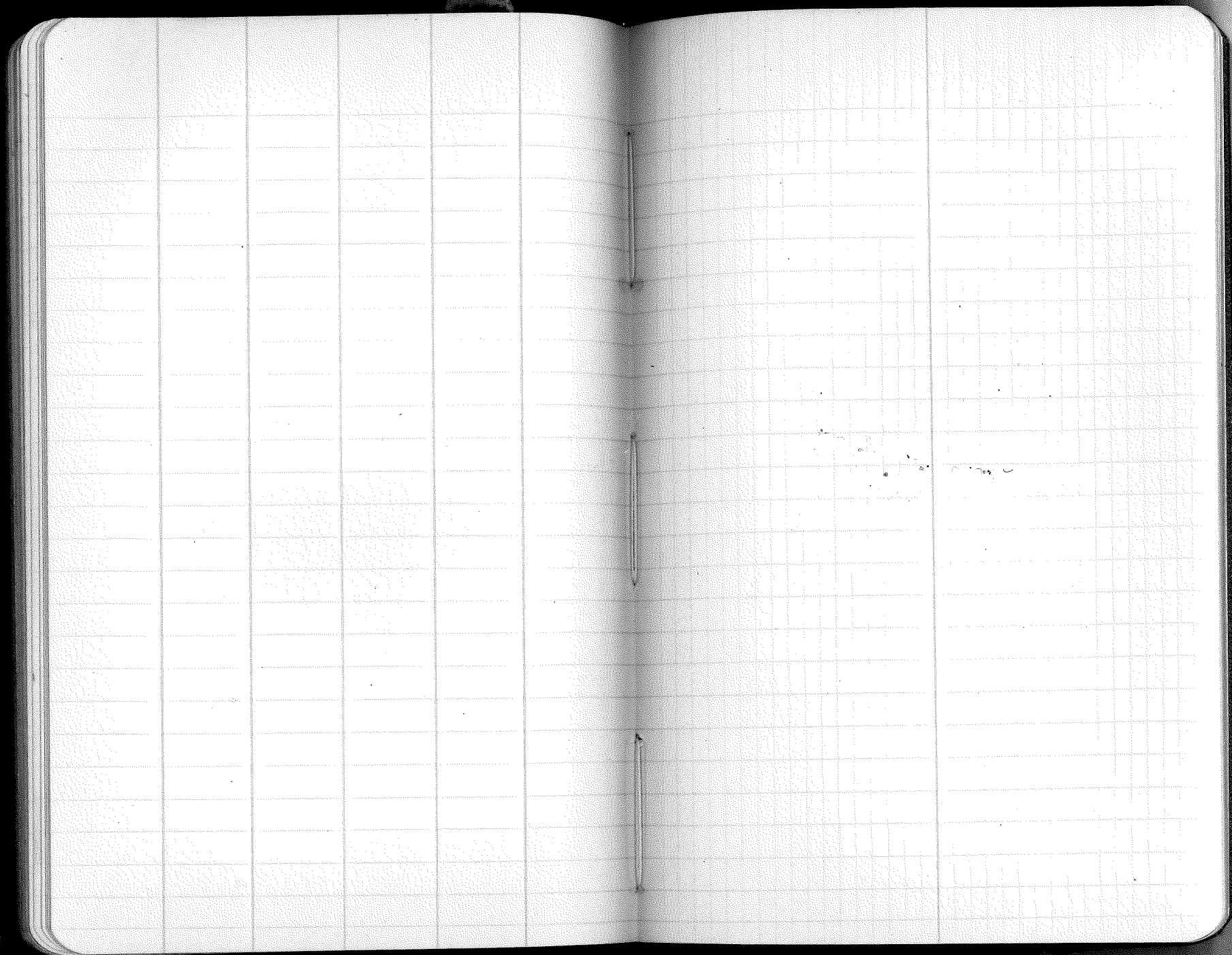


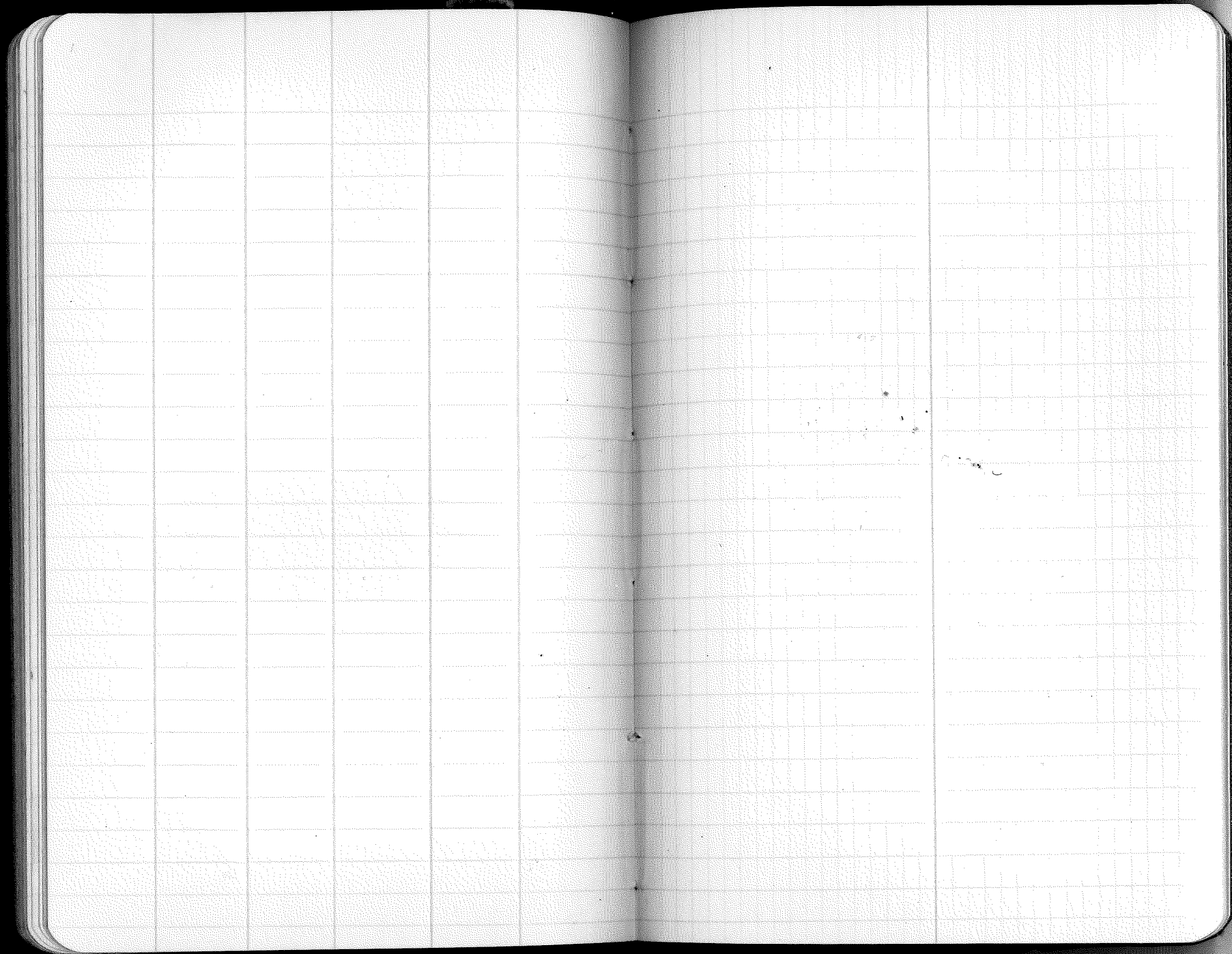


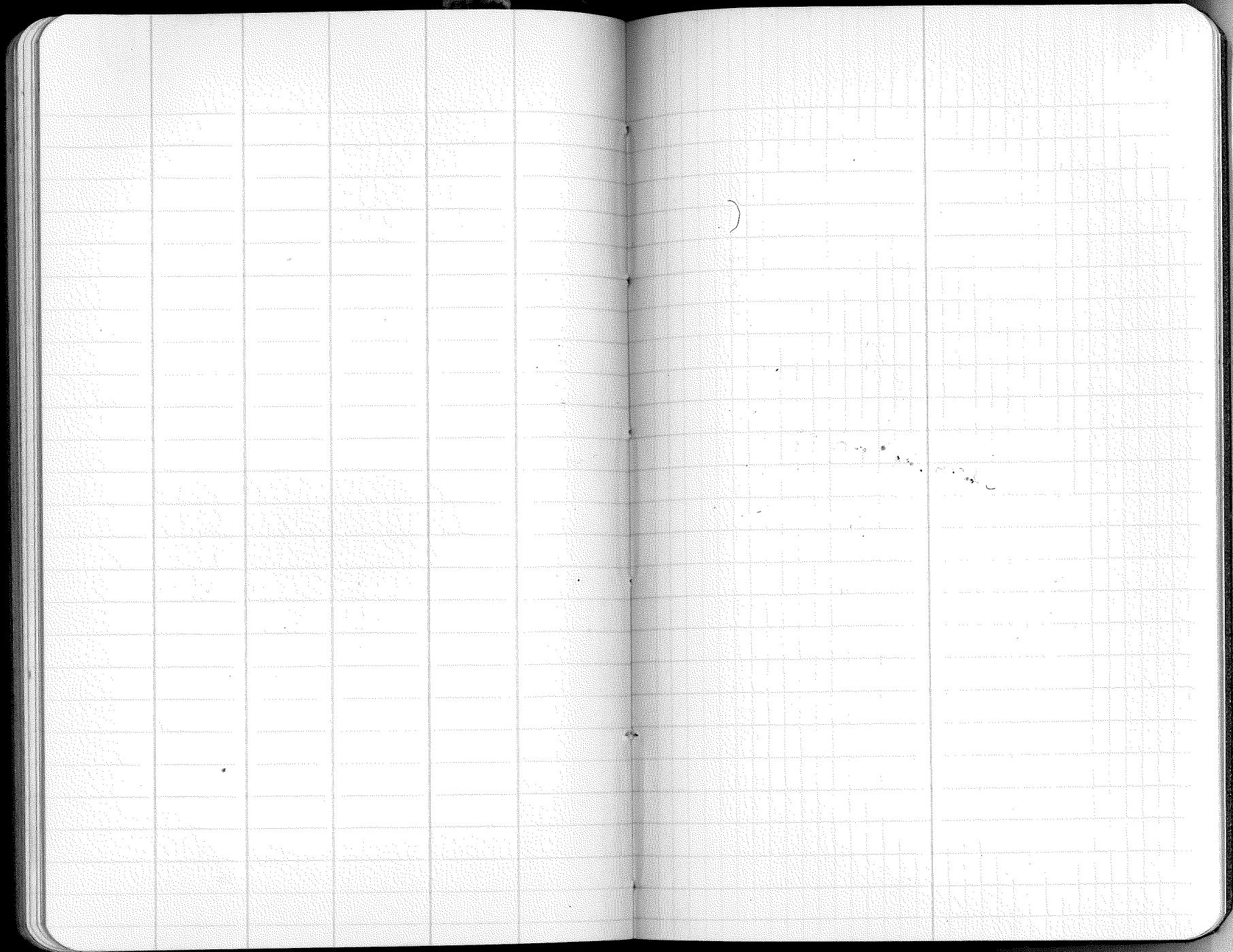


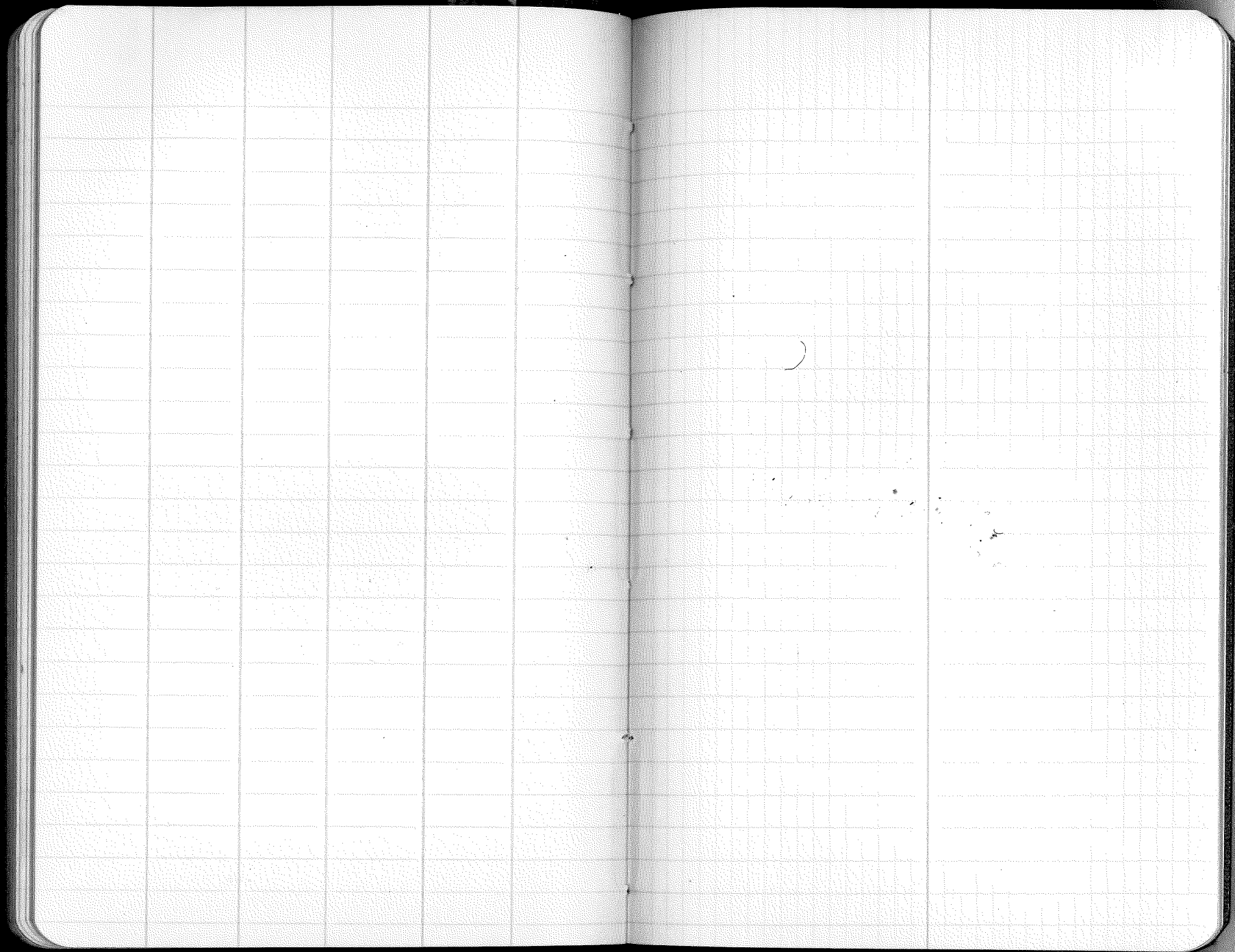


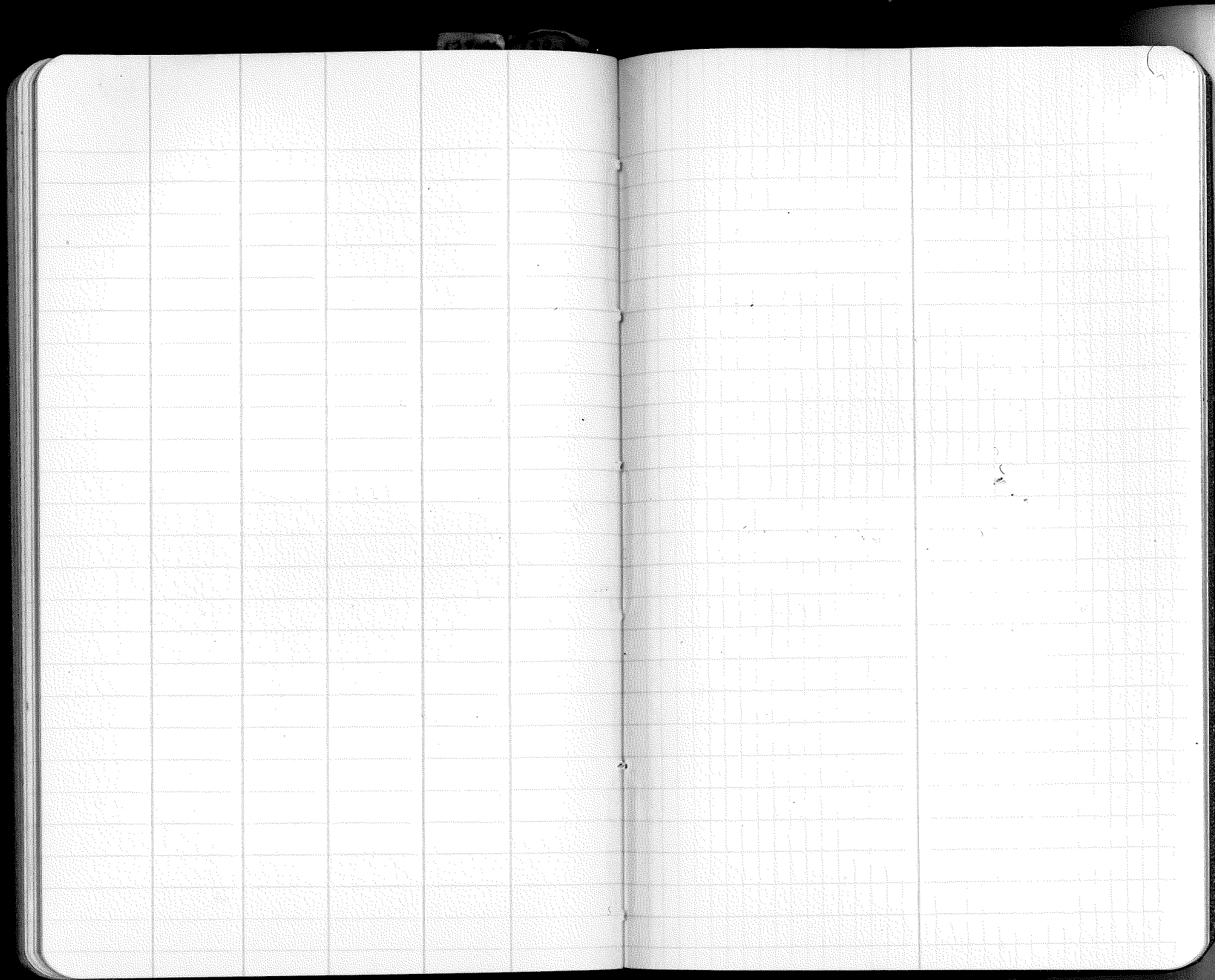


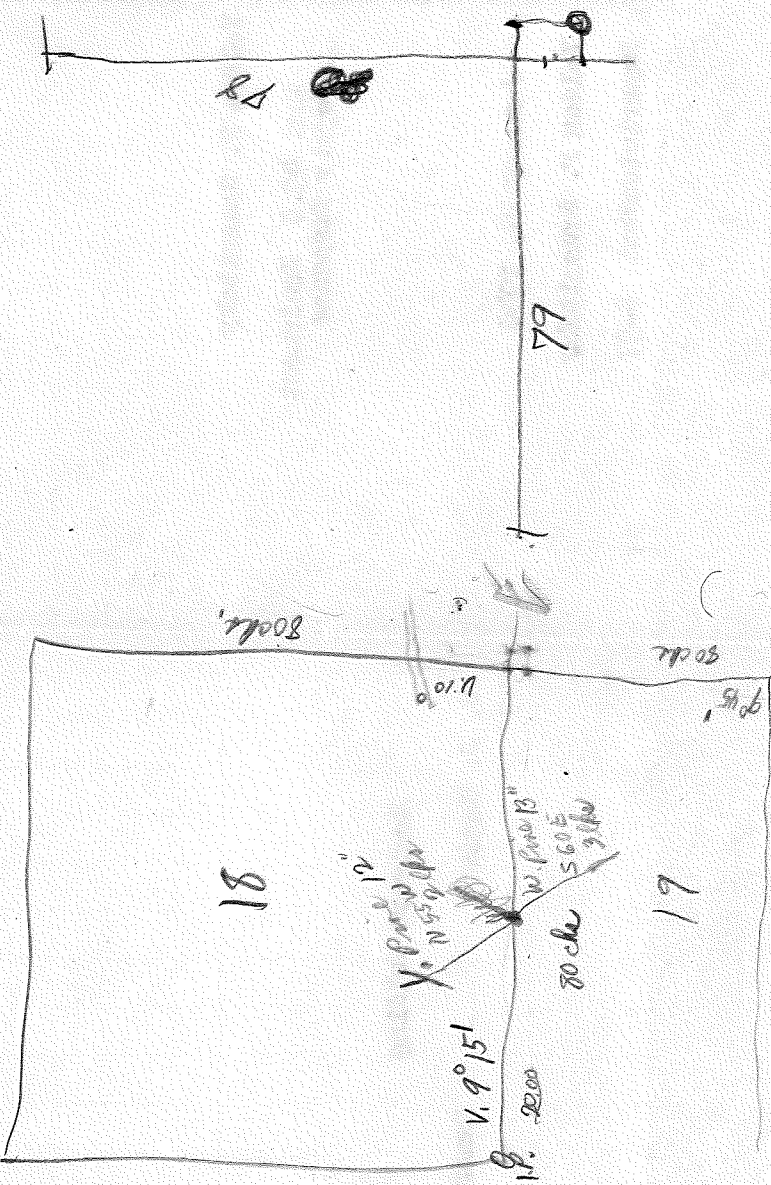












30 24
 30 51
 70 75

Veldon P. Sausitzky

Act. 49.C Equipment
Repair Suspense

January 24, 1940

Veldon P. Sausitzky
Superintendent 5-97

Brainerd Welding

W. J. Magdon

Owner

5280
295
5350.5

DIRECTIONS FOR USE OF TABLES

TABLE No. 1.

Distance of slope stake from side or shoulder stake for any width roadway, slope $1\frac{1}{2}$ to 1. If ground is nearly level, the cut or fill at side stake is located by the double entry method in left column and top row. The number in body of table in same row and column gives distance from side stake to slope stake. If ground is not level estimate the difference in elevation between the side stake and slope stake, lower target by this amount if cut, elevate if fill. Add this amount to cut or fill and find distance in table. Set up rod at this point, and line of sight should cut target. If it does not make the slight adjustment necessary.

TABLE No. 9.

To find Tangent and External for curve of any other degree, divide by degree of curve and add correction found in column of corrections.

Degree of curve with a given I may be found by dividing tangent, (or external), opposite I by given tangent, (or external).

The distance from a point on the tangent to the curve is very nearly the square of the tangent length divided by twice the radius.

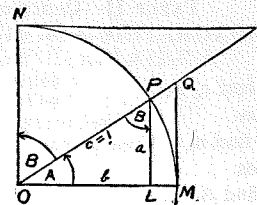


TABLE II
TRIGONOMETRIC FORMULÆ.

$$\angle A = \angle MOP \quad \angle B = \angle PON = \angle OPL$$

$$R = OB = c = 1$$

$$\sin A = \frac{a}{c} = \frac{a}{1} = a = \cos B = LP$$

$$\cos A = \frac{b}{c} = \frac{b}{1} = b = \sin B = OL$$

$$\tan A = \frac{a}{b} = \frac{MQ}{OM} = \frac{MQ}{1} = MQ = \cot B = MQ$$

$$\cot A = \frac{NT}{ON} = \frac{NT}{1} = NT = \tan B = NT$$

$$\sec A = \frac{OQ}{OM} = \frac{OQ}{1} = OQ = \csc B = OQ$$

$$\csc A = \frac{OT}{ON} = \frac{OT}{1} = OT = \sec B = OT$$

$$\text{vers } A = \frac{LM}{OP} = LM = \text{covers } B \#$$

$$\text{covers } A = \frac{OP - LP}{OP} = OP - LP = \text{vers } B$$

$$\text{exsec } A = PQ = \text{coexsec } B$$

$$\text{coexsec } A = PT = \text{exsec } B$$

$$\sin \frac{1}{2} A = \sqrt{\frac{1 - \cos A}{2}} \quad \cos \frac{1}{2} A = \sqrt{\frac{1 + \cos A}{2}}$$

$$\sin 2A = 2 \sin A \cos A \quad \cos 2A = \cos^2 A - \sin^2 A$$

$$\text{Law of Lines} \quad \frac{\sin A}{a} = \frac{\sin B}{B} = \frac{\sin C}{C}$$

$$\text{Law of Cosines} \quad c^2 = a^2 + b^2 - 2ab \cos C$$

$$\text{Law of Tangents} \quad \frac{a+b}{a-b} = \frac{\tan \frac{1}{2}(A+B)}{\tan \frac{1}{2}(A-B)}$$

TABLE II—Continued
TRIGONOMETRIC FORMULAE (continued)

In any triangle:

Given a, b, C; to find c, B, A.

Use Law of Lines.

Given A, B, c; to find a, b, C.

Use Law of Lines.

Given a, b, c; to find A, B, C.

$$\text{Let } \frac{a+b+c}{2} = s, \sqrt{\frac{(s-a)(s-b)(s-c)}{s}} = r$$

$$\cos \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}$$

$$\tan \frac{1}{2} A = \frac{r}{s-a}$$

$$\tan \frac{1}{2} B = \frac{r}{s-b}$$

$$\tan \frac{1}{2} C = \frac{r}{s-c}$$

Area of a triangle:

$$\text{Area} = \frac{1}{2} ab \sin C$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

PRISMOIDAL FORMULA.

$$\text{Vol.} = \frac{h}{6} (B+b+4M)$$

h = altitude; b, B = bases; M = midsection

TABLE III
INCHES AND FRACTIONS OF AN INCH IN DECIMALS OF A FOOT

| | | | | | | | | | | | | | |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| $\frac{1}{16}$ | .0052 | .0885 | .1719 | .2552 | .3385 | .4219 | .5052 | .5885 | .6719 | .7552 | .8385 | .9219 | $\frac{1}{8}$ |
| $\frac{1}{8}$ | .0104 | .0938 | .1771 | .2604 | .3438 | .4271 | .5104 | .5938 | .6771 | .7604 | .8438 | .9271 | $\frac{3}{16}$ |
| $\frac{3}{16}$ | .0156 | .0990 | .1823 | .2656 | .3490 | .4323 | .5156 | .5990 | .6823 | .7656 | .8490 | .9323 | $\frac{1}{4}$ |
| $\frac{1}{4}$ | .0208 | .1042 | .1875 | .2708 | .3542 | .4375 | .5208 | .6042 | .6875 | .7708 | .8542 | .9375 | $\frac{5}{16}$ |
| $\frac{5}{16}$ | .0260 | .1094 | .1927 | .2760 | .3594 | .4427 | .5260 | .6094 | .6927 | .7760 | .8594 | .9427 | $\frac{3}{8}$ |
| $\frac{3}{8}$ | .0313 | .1146 | .1979 | .2813 | .3646 | .4479 | .5313 | .6146 | .6979 | .7813 | .8646 | .9479 | $\frac{7}{16}$ |
| $\frac{7}{16}$ | .0365 | .1198 | .2031 | .2865 | .3698 | .4531 | .5365 | .6198 | .7031 | .7865 | .8698 | .9531 | $\frac{1}{2}$ |
| $\frac{1}{2}$ | .0417 | .1250 | .2083 | .2917 | .3750 | .4583 | .5417 | .6250 | .7083 | .7917 | .8750 | .9583 | $\frac{9}{16}$ |
| $\frac{9}{16}$ | .0469 | .1302 | .2135 | .2969 | .3803 | .4635 | .5469 | .6302 | .7135 | .7969 | .8802 | .9635 | $\frac{5}{8}$ |
| $\frac{5}{8}$ | .0521 | .1354 | .2188 | .3021 | .3854 | .4688 | .5521 | .6354 | .7188 | .8021 | .8854 | .9688 | $\frac{11}{16}$ |
| $\frac{11}{16}$ | .0573 | .1406 | .2240 | .3073 | .3906 | .4740 | .5573 | .6406 | .7240 | .8073 | .8906 | .9740 | $\frac{3}{4}$ |
| $\frac{3}{4}$ | .0625 | .1458 | .2292 | .3125 | .3958 | .4792 | .5625 | .6458 | .7292 | .8125 | .8958 | .9792 | $\frac{7}{8}$ |
| $\frac{7}{8}$ | .0677 | .1510 | .2344 | .3177 | .4010 | .4844 | .5677 | .6510 | .7344 | .8177 | .9010 | .9844 | 1 |
| 1 | .0729 | .1563 | .2396 | .3229 | .4063 | .4896 | .5729 | .6563 | .7396 | .8229 | .9063 | .9896 | |
| | .0781 | .1615 | .2448 | .3281 | .4115 | .4948 | .5781 | .6615 | .7448 | .8281 | .9115 | .9948 | |
| | .0833 | .1667 | .2500 | .3333 | .4167 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 | 1.000 | |
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |

TABLE IV
USEFUL RELATIONS.

| | | |
|---------------|----------------------|----------------|
| Lineal feet | ×.00019 | = miles |
| Lineal yards | ×.0006 | = miles |
| Square inches | ×.007 | = square feet |
| Square feet | ×.111 | = square yards |
| Square yards | ×.0002067 | = acres |
| Acres | ×4840 | = square yards |
| Cubic inches | ×.00058 | = cubic feet |
| Cubic feet | ×.03704 | = cubic yards |
| Links | ×.22 | = yards |
| Links | ×.66 | = feet |
| Feet | ×1.5 | = links |
| 360° | = 21600' | = 1296000" |
| Radius | = arc of 57.2957790° | |
| Arc of 1° | (radius = 1) = | .017453292 |
| Arc of 1' | (radius = 1) = | .000290888 |
| Arc of 1" | (radius = 1) = | .000004848 |

$$\pi = 3.141592654$$

$$\sqrt{\frac{1}{\pi}} = 0.564190$$

$$\frac{\pi}{4} = 0.785398163$$

$$\sqrt[3]{\frac{6}{\pi}} = 1.240700982$$

$$\frac{\pi}{6} = 0.523598776$$

$$\pi^2 = 9.869604401$$

$$\sqrt{\frac{4}{\pi}} = 1.128379167$$

$$\frac{1}{\pi^2} = 0.101321184$$

$$\frac{\pi}{6} = 0.523598776$$

$$\sqrt{\pi} = 1.772453851$$

$$\frac{4\pi}{3} = 4.188790205$$

$$\frac{1}{\pi} = 0.3183099$$

Curvature of Earth's surface = about 0.7 feet in 1 mile

Curvature in feet = 0.667 (Dist. in miles)²

Difference between arc and chord length, 0.05 feet in 11½ miles

$$\text{Probable error of a single observation} = 0.6754 \sqrt{\frac{Mv^2}{n-1}}$$

Error in chaining of 0.01 feet in 100 feet:

Due to—

1. Length of tape error of 0.01 feet
2. Alignment. One end 1.4 feet out of line
3. Sag of tape at centre of 0.61 feet.
4. Temperature difference of 15°
5. Difference of pull of 15 lbs.

STADIA REDUCTION FORMULAE.

Horizontal Distance = R - R sin² a + C cos a

Vertical Distance = R ½ sin 2 a + C sin a

R = Reading × $\frac{\text{distance from Object glass to cross hairs}}{\text{distance between cross hairs}}$

C = distance from Object glass to cross hairs + distance from Object glass to center of instrument.

a = angle of elevation for mid Reading

TABLE VI (continued)
SINES, COSINES, TANGENTS, COTANGENTS (continued)

| deg | sin 0' | tan 0' | sin 10' | tan 10' | sin 20' | tan 20' | sin 30' | tan 30' | sin 40' | tan 40' | sin 50' | tan 50' | deg |
|-----|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-----|
| 46 | 7193 | 1.0355 | 7214 | 1.0416 | 7234 | 1.0477 | 7254 | 1.0533 | 7274 | 1.0599 | 7294 | 1.0661 | 43 |
| 47 | 314 | .0724 | 333 | .0786 | 353 | .0850 | 373 | .0913 | 392 | .0977 | 412 | .1041 | 42 |
| 48 | 431 | .1106 | 451 | .1171 | 470 | .1237 | 490 | .1303 | 509 | .1369 | 528 | .1436 | 41 |
| 49 | 547 | .1504 | 566 | .1571 | 585 | .1640 | 604 | .1708 | 623 | .1778 | 642 | .1847 | 40 |
| | | | | | | | | | | 1.2203 | | | |
| 50 | 660 | 1.1918 | 7679 | 1.1988 | 7698 | 1.2059 | 7716 | 1.2131 | 7735 | .2647 | 7753 | 1.2276 | 39 |
| 51 | 771 | .2349 | 790 | .2423 | 808 | .2497 | 826 | .2572 | 844 | .3111 | 862 | .2723 | 38 |
| 52 | 880 | .2799 | 898 | .2876 | 916 | .2954 | 934 | .3032 | 951 | .3597 | 969 | .3190 | 37 |
| 53 | 986 | .3270 | 8004 | .3351 | 8021 | .3452 | 8039 | .3514 | 8056 | .4106 | 8073 | .3680 | 36 |
| 54 | 8090 | .3764 | 107 | .3848 | 124 | .3934 | 141 | .4019 | 158 | .4641 | 175 | .4193 | 35 |
| 55 | 192 | .4281 | 208 | .4370 | 225 | .4460 | 241 | .4550 | 258 | .5204 | 274 | .4733 | 34 |
| 56 | 290 | .4826 | 307 | .4919 | 323 | .5013 | 339 | .5108 | 355 | .5798 | 371 | .5301 | 33 |
| 57 | 387 | .5399 | 403 | .5497 | 418 | .5597 | 434 | .5697 | 450 | .6426 | 465 | .5900 | 32 |
| 58 | 480 | .6003 | 496 | .6107 | 511 | .6212 | 526 | .6319 | 542 | .7090 | 557 | .6534 | 31 |
| 59 | 572 | .6643 | 587 | .6753 | 601 | .6864 | 616 | .6977 | 631 | | 646 | .7205 | 30 |
| 60 | 660 | 1.7321 | 8675 | 1.7437 | 8689 | 1.7556 | 8704 | 1.7675 | 8718 | 1.7797 | 8732 | 1.7917 | 29 |
| 61 | 746 | .8040 | 760 | .8165 | 774 | .8291 | 788 | .8418 | 802 | .8546 | 816 | .8676 | 28 |
| 62 | 829 | .8807 | 843 | .8940 | 857 | .9074 | 870 | .9210 | 884 | .9347 | 897 | .9486 | 27 |
| 63 | 910 | .9626 | 923 | .9768 | 936 | .9912 | 949 | 2.0057 | 962 | 2.0204 | 975 | 2.0353 | 26 |
| 64 | 988 | 2.0503 | 9001 | 2.0655 | 9013 | 2.0809 | 9026 | .0965 | 9038 | .1123 | 9051 | .1283 | 25 |
| 65 | 9063 | .1445 | 075 | .1609 | 088 | .1775 | 100 | .1943 | 112 | .2113 | 124 | .2286 | 24 |
| 66 | 135 | .2460 | 147 | .2637 | 159 | .2817 | 171 | .2998 | 182 | .3183 | 194 | .3369 | 23 |
| 67 | 205 | .3559 | 216 | .3750 | 228 | .3945 | 239 | .4142 | 250 | .4342 | 261 | .4545 | 22 |
| 68 | 272 | .4751 | 283 | .4960 | 293 | .5172 | 304 | .5386 | 315 | .5605 | 325 | .5826 | 21 |
| 69 | 336 | .6051 | 346 | .6279 | 356 | .6511 | 367 | .6746 | 377 | .6985 | 387 | .7228 | 20 |
| 70 | 397 | 2.7475 | 9407 | 2.7725 | 9417 | 2.7980 | 9426 | 2.8239 | 9436 | 2.8502 | 9446 | 2.8770 | 19 |
| 71 | 455 | .9042 | 465 | .9319 | 474 | .9600 | 483 | .9887 | 492 | 3.0178 | 502 | 3.0475 | 18 |
| 72 | 511 | 3.0777 | 520 | 3.1084 | 528 | 3.1397 | 537 | 3.1716 | 546 | .2041 | 555 | .2371 | 17 |
| 73 | 563 | .2709 | 572 | .3052 | 580 | .3402 | 588 | .3759 | 596 | .4124 | 605 | .4495 | 16 |
| 74 | 613 | .4874 | 621 | .5261 | 628 | .5656 | 636 | .6059 | 644 | .6470 | 652 | .6891 | 15 |
| 75 | 659 | .7321 | 667 | .7760 | 674 | .8208 | 681 | .8657 | 689 | .9136 | 696 | .9617 | 14 |
| 76 | 703 | 4.0108 | 710 | 4.0611 | 717 | 4.1126 | 724 | 4.1653 | 730 | 4.2193 | 737 | 4.2747 | 13 |
| 77 | 744 | .3315 | 750 | .3897 | 757 | .4494 | 763 | .5107 | 769 | .5736 | 775 | .6382 | 12 |
| 78 | 781 | .7046 | 787 | .7729 | 793 | .8430 | 799 | .9152 | 805 | .9894 | 811 | 5.0658 | 11 |
| 79 | 816 | .1446 | 822 | 5.2257 | 827 | 5.3093 | 833 | 5.3955 | 838 | 5.4845 | 843 | .5764 | 10 |
| 80 | 9848 | 5.6713 | 9853 | 5.7694 | 9858 | 5.8708 | 9863 | 5.9758 | 9868 | 6.0844 | 9872 | 6.1970 | 9 |
| 81 | 877 | 6.3138 | 881 | 6.4348 | 886 | 6.5606 | 890 | 6.6912 | 894 | .8269 | 899 | .9682 | 8 |
| 82 | 903 | 7.1154 | 907 | 7.2687 | 911 | 7.4287 | 914 | 7.5958 | 918 | 7.7704 | 922 | 7.9530 | 7 |
| 83 | 925 | 8.1443 | 929 | 8.3450 | 932 | 8.5555 | 936 | 8.7769 | 939 | 9.0098 | 942 | 9.2553 | 6 |
| 84 | 945 | 9.5144 | 948 | 9.7882 | 951 | 10.078 | 954 | 10.385 | 957 | 10.711 | 959 | 11.059 | 5 |
| 85 | 962 | 11.430 | 964 | 11.826 | 967 | 12.250 | 969 | 12.706 | 971 | 13.197 | 974 | 13.727 | 4 |
| 86 | 976 | 14.300 | 978 | 14.924 | 980 | 15.605 | 981 | 16.350 | 983 | 17.169 | 985 | 18.075 | 3 |
| 87 | 986 | 19.081 | 988 | 20.206 | 989 | 21.470 | 990 | 22.903 | 992 | 24.542 | 993 | 26.432 | 2 |
| 88 | 994 | 28.636 | 995 | 31.242 | 996 | 34.368 | 997 | 38.189 | 997 | 42.964 | 998 | 49.104 | 1 |
| 89 | 9998 | 57.290 | 9999 | 68.750 | 9999 | 85.940 | 9999 | 114.58 | 1.000 | 171.88 | 1.000 | 343.77 | 0 |
| deg | 60' | 60' | 50' | 50' | 40' | 40' | 30' | 30' | 20' | 30' | 10' | 10' | deg |
| cos | cot | cos | cot | cos | cot | cos | cot | cos | cot | cos | cot | cos | cot |

TABLE VII
RODS IN FEET AND INCHES

| Rods | Feet Inches | Rods | Feet Inches | Rods | Feet Inches | Rods | Feet Inches | Rods | Feet Inches |
|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|
| 1 | 16-6 | 21 | 346-6 | 41 | 676-6 | 61 | 1006-6 | 81 | 1336-6 |
| 2 | 33-0 | 22 | 363-0 | 42 | 693-0 | 62 | 1023-0 | 82 | 1353-0 |
| 3 | 49-6 | 23 | 379-6 | 43 | 709-6 | 63 | 1039-6 | 83 | 1369-6 |
| 4 | 66-0 | 24 | 396-0 | 44 | 726-0 | 64 | 1056-0 | 84 | 1386-0 |
| 5 | 82-6 | 25 | 412-6 | 45 | 742-6 | 65 | 1072-6 | 85 | 1402-6 |
| 6 | 99-0 | 26 | 429-0 | 46 | 759-0 | 66 | 1089-0 | 86 | 1419-0 |
| 7 | 115-6 | 27 | 445-6 | 47 | 775-6 | 67 | 1105-6 | 87 | 1435-6 |
| 8 | 132-0 | 28 | 462-0 | 48 | 792-0 | 68 | 1122-0 | 88 | 1452-0 |
| 9 | 148-6 | 29 | 478-6 | 49 | 808-6 | 69 | 1138-6 | 89 | 1468-6 |
| 10 | 165-0 | 30 | 495-0 | 50 | 825-0 | 70 | 1155-0 | 90 | 1485-0 |
| 11 | 181-6 | 31 | 511-6 | 51 | 841-6 | 71 | 1171-6 | 91 | 1501-6 |
| 12 | 198-0 | 32 | 528-0 | 52 | 858-0 | 72 | 1188-0 | 92 | 1518-0 |
| 13 | 214-6 | 33 | 544-6 | 53 | 874-6 | 73 | 1204-6 | 93 | 1534-6 |
| 14 | 231-0 | 34 | 561-0 | 54 | 891-0 | 74 | 1221-0 | 94 | 1551-0 |
| 15 | 247-6 | 35 | 577-6 | 55 | 907-6 | 75 | 1237-6 | 95 | 1567-6 |
| 16 | 264-0 | 36 | 594-0 | 56 | 924-0 | 76 | 1254-0 | 96 | 1584-0 |
| 17 | 280-6 | 37 | 610-6 | 57 | 940-6 | 77 | 1270-6 | 97 | 1600-6 |
| 18 | 297-0 | 38 | 627-0 | 58 | 957-0 | 78 | 1287-0 | 98 | 1617-0 |
| 19 | 313-6 | 39 | 643-6 | 59 | 973-6 | 79 | 1303-6 | 99 | 1633-6 |
| 20 | 330-0 | 40 | 660-0 | 60 | 990-0 | 80 | 1320-0 | 100 | 1650-0 |

TABLE VIII
LINKS IN FEET AND INCHES

| Links | Feet Inches | Links | Feet Inches | Links | Feet Inches | Links | Feet Inches | Links | Feet Inches | Links | Feet Inches |
|-------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|-------------|
| 1 | 0-7.92 | 18 | 11-10.56 | 35 | 23-1.20 | 52 | 34-3.84 | 69 | 45-6.48 | 86 | 56-9.12 |
| 2 | 1-3.84 | 19 | 12-6.48 | 36 | 23-9.12 | 53 | 34-11.76 | 70 | 46-2.40 | 87 | 57-5.04 |
| 3 | 1-11.76 | 20 | 13-2.40 | 37 | 24-5.04 | 54 | 35-7.68 | 71 | 46-10.32 | 88 | 58-0.96 |
| 4 | 2-7.68 | 21 | 13-10.32 | 38 | 25-0.96 | 55 | 36-3.60 | 72 | 47-6.24 | 89 | 58-8.88 |
| 5 | 3-3.60 | 22 | 14-6.24 | 39 | 25-8.88 | 56 | 36-11.52 | 73 | 48-2.16 | 90 | 59-4.80 |
| 6 | 3-11.52 | 23 | 15-2.16 | 40 | 26-4.80 | 57 | 37-7.44 | 74 | 48-10.08 | 91 | 60-0.72 |
| 7 | 4-7.44 | 24 | 15-10.08 | 41 | 27-0.72 | 58 | 38-3.36 | 75 | 49-6.00 | 92 | 60-8.64 |
| 8 | 5-3.36 | 25 | 16-6.00 | 42 | 27-8.64 | 59 | 38-11.28 | 76 | 50-1.92 | 93 | 61-4.56 |
| 9 | 5-11.28 | 26 | 17-1.92 | 43 | 28-4.56 | 60 | 39-7.20 | 77 | 50-9.84 | 94 | 62-0.48 |
| 10 | 6-7.20 | 27 | 17-9.84 | 44 | 29-0.48 | 61 | 40-3.12 | 78 | 51-5.76 | 95 | 62-8.40 |
| 11 | 7-3.12 | 28 | 18-5.76 | 45 | 29-8.40 | 62 | 40-11.04 | 79 | 52-1.68 | 96 | 63-4.32 |
| 12 | 7-11.04 | 29 | 19-1.68 | 46 | 30-4.32 | 63 | 41-6.96 | 80 | 52-9.60 | 97 | 64-0.24 |
| 13 | 8-6.96 | 30 | 19-9.60 | 47 | 31-0.24 | 64 | 42-2.88 | 81 | 53-5.52 | 98 | 64-8.16 |
| 14 | 9-2.88 | 31 | 20-5.52 | 48 | 31-8.16 | 65 | 42-10.80 | 82 | 54-1.44 | 99 | 65-4.08 |
| 15 | 9-10.80 | 32 | 21-1.44 | 49 | 32-4.08 | 66 | 43-6.72 | 83 | 54-9.36 | 100 | 66-0.00 |
| 16 | 10-6.72 | 33 | 21-9.36 | 50 | 33-0.00 | 67 | 44-2.64 | 84 | 55-5.28 | 101 | 66-7.92 |
| 17 | 11-2.64 | 34 | 22-5.28 | 51 | 33-7.92 | 68 | 44-10.56 | 85 | 56-1.20 | 102 | 67-3.84 |

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

| I | T | E | I=10° | I | T | E | I=20° | I | T | E | I=30° |
|-----|--------|--------|--------|-----|--------|--------|--------|-----|--------|--------|--------|
| 1° | 50.00 | .218 | + | 11° | 551.70 | 26.500 | + | 21° | 1061.9 | 97.577 | + |
| 10' | 58.34 | .297 | 5° C. | 10' | 560.11 | 27.313 | 5° C | 10' | 1070.6 | 99.155 | 5° C |
| 20' | 66.67 | .388 | T | 20' | 568.53 | 28.137 | T | 20' | 1079.2 | 100.75 | T |
| 30' | 75.01 | .491 | T | 30' | 576.95 | 28.974 | T | 30' | 1087.8 | 102.35 | T |
| 40' | 83.34 | .606 | .03 | 40' | 585.36 | 29.824 | .06 | 40' | 1096.4 | 103.97 | .10 |
| 50' | 91.68 | .733 | E | 50' | 593.79 | 30.686 | E | 50' | 1105.1 | 105.60 | E |
| 2° | 100.01 | .873 | .001 | 12° | 602.21 | 31.561 | .006 | 22° | 1113.7 | 107.24 | .013 |
| 10' | 108.35 | 1.024 | | 10' | 610.64 | 32.447 | | 10' | 1122.4 | 108.90 | |
| 20' | 116.68 | 1.188 | | 20' | 619.07 | 33.347 | | 20' | 1131.0 | 110.57 | |
| 30' | 125.02 | 1.364 | | 30' | 627.50 | 34.259 | | 30' | 1139.7 | 112.25 | |
| 40' | 133.36 | 1.552 | | 40' | 635.93 | 35.183 | | 40' | 1148.4 | 113.95 | |
| 50' | 141.70 | 1.752 | | 50' | 644.37 | 36.120 | | 50' | 1157.0 | 115.66 | |
| 3° | 150.04 | 1.964 | 10° C. | 13° | 652.81 | 37.070 | 10° C. | 23° | 1165.7 | 117.38 | 10° C. |
| 10' | 158.38 | 2.188 | T | 10' | 661.25 | 38.031 | T | 10' | 1174.4 | 119.12 | T |
| 20' | 166.72 | 2.425 | .06 | 20' | 669.70 | 39.006 | .13 | 20' | 1183.1 | 120.87 | .19 |
| 30' | 175.06 | 2.674 | E | 30' | 678.15 | 39.993 | E | 30' | 1191.8 | 122.63 | E |
| 40' | 183.40 | 2.934 | .003 | 40' | 686.60 | 40.992 | .011 | 40' | 1200.5 | 124.41 | .025 |
| 50' | 191.74 | 3.207 | | 50' | 695.06 | 42.004 | | 50' | 1209.2 | 126.20 | |
| 4° | 200.08 | 3.492 | | 14° | 703.51 | 43.029 | | 24° | 1217.9 | 128.00 | |
| 10' | 208.43 | 3.790 | | 10' | 711.97 | 44.066 | | 10' | 1226.6 | 129.82 | |
| 20' | 216.77 | 4.099 | | 20' | 720.44 | 45.116 | | 20' | 1235.3 | 131.65 | |
| 30' | 225.12 | 4.421 | | 30' | 728.90 | 46.178 | | 30' | 1244.0 | 133.50 | |
| 40' | 233.47 | 4.755 | | 40' | 737.37 | 47.253 | | 40' | 1252.8 | 135.35 | |
| 50' | 241.81 | 5.100 | 15° C. | 50' | 745.85 | 48.341 | 15° C. | 50' | 1261.5 | 137.23 | 15° C. |
| 5° | 250.16 | 5.459 | T | 15° | 754.32 | 49.441 | T | 25° | 1270.2 | 139.11 | T |
| 10' | 258.51 | 5.829 | .09 | 10' | 762.80 | 50.554 | .19 | 10' | 1279.0 | 141.01 | .29 |
| 20' | 266.86 | 6.211 | E | 20' | 771.29 | 51.679 | E | 20' | 1287.7 | 142.93 | E |
| 30' | 275.21 | 6.606 | .004 | 30' | 779.77 | 52.818 | .017 | 30' | 1296.5 | 144.85 | .038 |
| 40' | 283.57 | 7.013 | | 40' | 788.26 | 53.969 | | 40' | 1305.3 | 146.79 | |
| 50' | 291.92 | 7.432 | | 50' | 796.75 | 55.132 | | 50' | 1314.0 | 148.75 | |
| 6° | 300.28 | 7.863 | | 16° | 805.25 | 56.309 | | 26° | 1322.8 | 150.71 | |
| 10' | 308.64 | 8.307 | | 10' | 813.75 | 57.498 | | 10' | 1331.6 | 152.69 | |
| 20' | 316.99 | 8.762 | | 20' | 822.25 | 58.699 | | 20' | 1340.4 | 154.69 | |
| 30' | 325.35 | 9.230 | | 30' | 830.76 | 59.914 | | 30' | 1349.2 | 156.70 | |
| 40' | 333.71 | 9.710 | 20° C. | 40' | 839.27 | 61.141 | 20° C. | 40' | 1358.0 | 158.72 | 20° C. |
| 50' | 342.08 | 10.202 | T | 50' | 847.78 | 62.381 | T | 50' | 1366.8 | 160.76 | T |
| 7° | 350.44 | 10.707 | .13 | 17° | 856.30 | 63.634 | .26 | 27° | 1375.6 | 162.81 | .39 |
| 10' | 358.81 | 11.224 | E | 10' | 864.82 | 64.900 | E | 10' | 1384.4 | 164.86 | E |
| 20' | 367.17 | 11.753 | .006 | 20' | 873.35 | 66.178 | .022 | 20' | 1393.2 | 166.95 | .051 |
| 30' | 375.54 | 12.294 | | 30' | 881.88 | 67.470 | | 30' | 1402.0 | 169.04 | |
| 40' | 383.91 | 12.847 | | 40' | 890.41 | 68.774 | | 40' | 1410.9 | 171.15 | |
| 50' | 392.28 | 13.413 | | 50' | 898.95 | 70.091 | | 50' | 1419.7 | 173.27 | |
| 8° | 400.66 | 13.991 | | 18° | 907.49 | 71.421 | | 28° | 1428.6 | 175.41 | |
| 10' | 409.03 | 14.582 | | 10' | 916.03 | 72.764 | | 10' | 1437.4 | 177.55 | |
| 20' | 417.41 | 15.184 | 25° C. | 20' | 924.58 | 74.119 | 25° C. | 20' | 1446.3 | 179.72 | 25° C. |
| 30' | 425.79 | 15.799 | T | 30' | 933.13 | 75.488 | T | 30' | 1455.1 | 181.89 | T |
| 40' | 434.17 | 16.426 | .16 | 40' | 941.69 | 76.869 | .32 | 40' | 1464.0 | 184.08 | .49 |
| 50' | 442.55 | 17.065 | E | 50' | 950.25 | 78.264 | E | 50' | 1472.9 | 186.29 | E |
| 9° | 450.93 | 17.717 | .007 | 19° | 958.81 | 79.671 | .028 | 29° | 1481.8 | 188.51 | .065 |
| 10' | 459.32 | 18.381 | | 10' | 967.38 | 81.092 | | 10' | 1490.7 | 190.74 | |
| 20' | 467.71 | 19.058 | | 20' | 975.96 | 82.525 | | 20' | 1499.6 | 192.99 | |
| 30' | 476.10 | 19.746 | | 30' | 984.53 | 83.972 | | 30' | 1508.5 | 195.25 | |
| 40' | 484.49 | 20.447 | | 40' | 993.12 | 85.431 | | 40' | 1517.4 | 197.53 | |
| 50' | 492.88 | 21.161 | | 50' | 1001.7 | 86.904 | | 50' | 1526.3 | 199.82 | |
| 10° | 501.28 | 21.887 | 30° C. | 20° | 1010.3 | 88.389 | 30° C. | 30° | 1535.3 | 202.12 | 30° C. |
| 10' | 509.68 | 22.624 | T | 10' | 1018.9 | 89.888 | T | 10' | 1544.2 | 204.44 | T |
| 20' | 518.08 | 23.375 | .19 | 20' | 1027.5 | 91.399 | .39 | 20' | 1553.1 | 206.77 | .59 |
| 30' | 526.48 | 24.138 | E | 30' | 1036.1 | 92.924 | E | 30' | 1562.1 | 209.12 | E |
| 40' | 534.89 | 24.913 | .008 | 40' | 1044.7 | 94.462 | .034 | 40' | 1571.0 | 211.48 | .078 |
| 50' | 543.29 | 25.700 | | 50' | 1053.3 | 96.013 | | 50' | 1580.0 | 213.86 | |

T = R tan 1/2 I

E = R exsec 1/2 I

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

| I | T | E | I=40° | I | T | E | I=50° | I | T | E | I=60° |
|-----|--------|-------|--------|-----|--------|-------|--------|-----|--------|-------|--------|
| 31° | 1589.0 | 216.3 | + | 41° | 2142.2 | 387.4 | + | 51° | 2732.9 | 618.4 | + |
| 10' | 1598.0 | 218.7 | 5° C. | 10' | 2151.7 | 390.7 | 5° C. | 10' | 2743.1 | 622.8 | 5° C. |
| 20' | 1606.9 | 221.1 | T | 20' | 2161.2 | 394.1 | T | 20' | 2753.4 | 627.2 | T |
| 30' | 1615.9 | 223.5 | T | 30' | 2170.8 | 397.4 | T | 30' | 2763.7 | 631.7 | T |
| 40' | 1624.9 | 226.0 | .13 | 40' | 2180.3 | 400.8 | .17 | 40' | 2773.9 | 636.2 | .21 |
| 50' | 1633.9 | 228.4 | E | 50' | 2189.9 | 404.2 | E | 50' | 2784.2 | 640.7 | E |
| 32° | 1643.0 | 230.9 | .023 | 42° | 2199.4 | 407.6 | .037 | 52° | 2794.5 | 645.2 | .056 |
| 10' | 1652.0 | 233.4 | | 10' | 2209.0 | 411.1 | | 10' | 2804.9 | 649.7 | |
| 20' | 1661.0 | 235.9 | | 20' | 2218.6 | 414.5 | | 20' | 2815.2 | 654.3 | |
| 30' | 1670.0 | 238.4 | | 30' | 2228.1 | 418.0 | | 30' | 2825.6 | 658.8 | |
| 40' | 1679.1 | 241.0 | | 40' | 2237.7 | 421.4 | | 40' | 2835.9 | 663.4 | |
| 50' | 1688.1 | 243.5 | | 50' | 2247.3 | 425.0 | | 50' | 2846.3 | 668.0 | |
| 33° | 1697.2 | 246.1 | 10° C. | 43° | 2257.0 | 428.5 | 10° C. | 53° | 2856.7 | 672.7 | 10° C. |
| 10' | 1706.3 | 248.7 | T | 10' | 2266.6 | 432.0 | T | 10' | 2867.1 | 677.3 | T |
| 20' | 1715.3 | 251.3 | .26 | 20' | 2276.2 | 435.6 | .34 | 20' | 2877.5 | 682.0 | .42 |
| 30' | 1724.4 | 253.9 | E | 30' | 2285.9 | 439.2 | E | 30' | 2888.0 | 686.7 | E |
| 40' | 1733.5 | 256.5 | .046 | 40' | 2295.6 | 442.8 | .075 | 40' | 2898.4 | 691.4 | .112 |
| 50' | 1742.6 | 259.1 | | 50' | 2305.2 | 446.4 | | 50' | 2908.9 | 696.1 | |
| 34° | 1751.7 | 261.8 | | 44° | 2314.9 | 450.0 | | 54° | 2919.4 | 700.9 | |
| 10' | 1760.8 | 264.5 | | 10' | 2324.6 | 453.6 | | 10' | 2929.9 | 705.7 | |
| 20' | 1770.0 | 267.2 | | 20' | 2334.3 | 457.3 | | 20' | 2940.4 | 710.5 | |
| 30' | 1779.1 | 269.9 | | 30' | 2344.1 | 461.0 | | 30' | 2950.9 | 715.3 | |
| 40' | 1788.2 | 272.6 | | 40' | 2353.8 | 464.8 | | 40' | 2961.5 | 720.1 | |
| 50' | 1797.4 | 275.3 | 15° C. | 50' | 2363.5 | 468.4 | 15° C. | 50' | 2972.1 | 725.0 | 15° C. |
| 35° | 1806.6 | 278.1 | T | 45° | 2373.3 | 472.1 | T | 55° | 2982.7 | 729.9 | T |
| 10' | 1815.7 | 280.8 | .40 | 10' | 2383.1 | 475.8 | .51 | 10' | 2993.3 | 734.8 | .63 |
| 20' | 1824.9 | 283.6 | E | 20' | 2392.8 | 479.6 | E | 20' | 3003.9 | 739.7 | E |
| 30' | 1834.1 | 286.4 | .070 | 30' | 2402.6 | 483.4 | .116 | 30' | 3014.5 | 744.6 | .168 |
| 40' | 1843.3 | 289.2 | | 40' | 2412.4 | 487.2 | | 40' | 3025.2 | 749.6 | |
| 50' | 1852.5 | 292.0 | | 50' | 2422.3 | 491.0 | | 50' | 3035.8 | 754.6 | |
| 36° | 1861.7 | 294.9 | | 46° | 2432.1 | 494.8 | | 56° | 3046.5 | 759.6 | |
| 10' | 1870.9 | 297.7 | | 10' | 2441.9 | 498.7 | | 10' | 3057.2 | 764.6 | |
| 20' | 1880.1 | 300.6 | | 20' | 2451.8 | 502.5 | | 20' | 3067.9 | 769.7 | |
| 30' | 1889.4 | 303.5 | 20° C. | 30' | 2461.7 | 506.4 | 20° C. | 30' | 3078.7 | 774.7 | 20° C. |
| 40' | 1898.6 | 306.4 | T | 40' | 2471.5 | 510.3 | T | 40' | 3089.4 | 779.8 | T |
| 50' | 1907.9 | 309.3 | .53 | 50' | 2481.4 | 514.3 | .68 | 50' | 3100.2 | 784.9 | .84 |
| 37° | 1917.1 | 312.2 | E | 47° | 2491.3 | 518.2 | E | 57° | 3110.9 | 790.1 | E |
| 10' | 1926.4 | 315.2 | .093 | 10' | 2501.2 | 522.2 | .151 | 10' | 3121.7 | 795.2 | .225 |
| 20' | 1935.7 | 318.1 | | 20' | 2511.2 | 526.1 | | 20' | 3132.6 | 800.4 | |
| 30' | 1945.0 | 321.1 | | 30' | 2521.1 | 530.1 | | 30' | 3143.4 | 805.6 | |
| 40' | 1954.3 | 324.1 | | 40' | 2531.1 | 534.2 | | 40' | 3154.2 | 810.9 | |
| 50' | 1963.6 | 327.1 | | 50' | 2541.0 | 538.2 | | 50' | 3165.1 | 816.1 | |
| 38° | 1972.9 | 330.2 | | 48° | 2551.0 | 542.2 | | 58° | 3176.0 | 821.4 | |
| 10' | 1982.2 | 333.2 | 25° C. | 10' | 2561.0 | 546.3 | 25° C. | 10' | 3186.9 | 826.7 | 25° C. |
| 20' | 1991.5 | 336.3 | T | 20' | 2571.0 | 550.4 | T | 20' | 3197.8 | 832.0 | T |
| 30' | 2000.9 | 339.3 | .67 | 30' | 2581.0 | 554.5 | .85 | 30' | 3208.8 | 837.3 | .85 |
| 40' | 2010.2 | 342.4 | E | 40' | 2591.0 | 558.6 | E | 40' | 3219.7 | 842.7 | E |
| 50' | 2019.6 | 345.5 | .117 | 50' | 2601.1 | 562.8 | .139 | 50' | 3230.7 | 848.1 | .283 |
| 39° | 2029.0 | 348.6 | | 49° | 2611.2 | | | | | | |

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

| I | T | E | I=70° | I | T | E | I=80° | I | T | E | I=90° |
|-----|--------|--------|--------|-----|--------|--------|--------|-----|--------|--------|--------|
| 61° | 3375.0 | 920.2 | + | 71° | 4086.9 | 1308.2 | + | 81° | 4893.6 | 1805.3 | + |
| 10' | 3386.3 | 925.9 | 5° C. | 10' | 4099.5 | 1315.6 | 5° C. | 10' | 4908.0 | 1814.7 | 5° C. |
| 20' | 3397.5 | 931.6 | T | 20' | 4112.1 | 1322.9 | T | 20' | 4922.5 | 1824.1 | T |
| 30' | 3408.8 | 937.3 | .25 | 30' | 4124.8 | 1330.3 | .30 | 30' | 4937.0 | 1833.6 | .36 |
| 40' | 3420.1 | 943.1 | E | 40' | 4137.4 | 1337.7 | E | 40' | 4951.5 | 1843.1 | E |
| 50' | 3431.4 | 948.9 | .080 | 50' | 4150.1 | 1345.1 | .110 | 50' | 4966.1 | 1852.6 | .149 |
| 62° | 3442.7 | 954.8 | 10° C. | 72° | 4162.8 | 1352.6 | 10° C. | 82° | 4980.7 | 1862.2 | 10° C. |
| 10' | 3454.1 | 960.6 | T | 10' | 4175.6 | 1360.1 | T | 10' | 4995.4 | 1871.8 | T |
| 20' | 3465.4 | 966.5 | .51 | 20' | 4188.5 | 1367.6 | .61 | 20' | 5010.0 | 1881.5 | .67 |
| 30' | 3476.8 | 972.4 | E | 30' | 4201.2 | 1375.2 | E | 30' | 5024.8 | 1891.2 | E |
| 40' | 3488.3 | 978.3 | .159 | 40' | 4214.0 | 1382.8 | .220 | 40' | 5039.5 | 1900.9 | .299 |
| 50' | 3499.7 | 984.3 | T | 50' | 4226.8 | 1390.4 | T | 50' | 5054.3 | 1910.7 | T |
| 63° | 3511.1 | 990.2 | 15° C. | 73° | 4239.7 | 1398.0 | 15° C. | 83° | 5069.2 | 1920.5 | 15° C. |
| 10' | 3522.6 | 996.2 | E | 10' | 4252.6 | 1405.7 | E | 10' | 5084.0 | 1930.4 | E |
| 20' | 3534.1 | 1002.3 | .76 | 20' | 4265.6 | 1413.5 | .86 | 20' | 5099.0 | 1940.3 | .92 |
| 30' | 3545.6 | 1008.3 | T | 30' | 4278.5 | 1421.2 | T | 30' | 5113.9 | 1950.3 | T |
| 40' | 3557.2 | 1014.4 | .240 | 40' | 4291.5 | 1429.0 | .332 | 40' | 5128.9 | 1960.2 | .450 |
| 50' | 3568.7 | 1020.5 | E | 50' | 4304.6 | 1436.8 | E | 50' | 5143.9 | 1970.3 | E |
| 64° | 3580.3 | 1026.6 | 20° C. | 74° | 4317.6 | 1444.6 | 20° C. | 84° | 5159.0 | 1980.4 | 20° C. |
| 10' | 3591.9 | 1032.8 | T | 10' | 4330.7 | 1452.5 | T | 10' | 5174.1 | 1990.5 | T |
| 20' | 3603.5 | 1039.0 | .76 | 20' | 4343.8 | 1460.4 | .86 | 20' | 5189.3 | 2000.6 | .92 |
| 30' | 3615.1 | 1045.2 | E | 30' | 4356.9 | 1468.4 | E | 30' | 5204.4 | 2010.8 | E |
| 40' | 3626.8 | 1051.4 | .240 | 40' | 4370.1 | 1476.4 | .332 | 40' | 5219.7 | 2021.1 | .450 |
| 50' | 3638.5 | 1057.7 | T | 50' | 4383.3 | 1484.4 | T | 50' | 5234.9 | 2031.4 | T |
| 65° | 3650.2 | 1063.9 | 25° C. | 75° | 4396.5 | 1492.4 | 25° C. | 85° | 5250.3 | 2041.7 | 25° C. |
| 10' | 3661.9 | 1070.2 | E | 10' | 4409.8 | 1500.5 | E | 10' | 5265.6 | 2052.1 | E |
| 20' | 3673.7 | 1076.6 | .76 | 20' | 4423.1 | 1508.6 | .86 | 20' | 5281.0 | 2062.5 | .92 |
| 30' | 3685.4 | 1082.9 | T | 30' | 4436.4 | 1516.7 | T | 30' | 5296.4 | 2073.0 | T |
| 40' | 3697.2 | 1089.3 | .240 | 40' | 4449.7 | 1524.9 | .332 | 40' | 5311.9 | 2083.5 | .450 |
| 50' | 3709.0 | 1095.7 | E | 50' | 4463.1 | 1533.1 | E | 50' | 5327.4 | 2094.1 | E |
| 66° | 3720.9 | 1102.2 | 30° C. | 76° | 4476.5 | 1541.4 | 30° C. | 86° | 5343.0 | 2104.7 | 30° C. |
| 10' | 3732.7 | 1108.6 | T | 10' | 4489.9 | 1549.7 | T | 10' | 5358.6 | 2115.3 | T |
| 20' | 3744.6 | 1115.1 | .76 | 20' | 4503.4 | 1558.0 | .86 | 20' | 5374.2 | 2126.0 | .92 |
| 30' | 3756.5 | 1121.7 | E | 30' | 4516.9 | 1566.3 | E | 30' | 5389.9 | 2136.7 | E |
| 40' | 3768.5 | 1128.2 | .240 | 40' | 4530.4 | 1574.7 | .332 | 40' | 5405.6 | 2147.5 | .450 |
| 50' | 3780.4 | 1134.8 | T | 50' | 4544.0 | 1583.1 | T | 50' | 5421.4 | 2158.4 | T |
| 67° | 3792.4 | 1141.4 | 35° C. | 77° | 4557.6 | 1591.6 | 35° C. | 87° | 5437.2 | 2169.2 | 35° C. |
| 10' | 3804.4 | 1148.0 | E | 10' | 4571.2 | 1600.1 | E | 10' | 5453.1 | 2180.2 | E |
| 20' | 3816.4 | 1154.7 | .321 | 20' | 4584.8 | 1608.6 | .445 | 20' | 5469.0 | 2191.1 | .603 |
| 30' | 3828.4 | 1161.3 | T | 30' | 4598.5 | 1617.1 | T | 30' | 5484.9 | 2202.2 | T |
| 40' | 3840.5 | 1168.1 | .240 | 40' | 4612.2 | 1625.7 | .332 | 40' | 5500.9 | 2213.2 | .450 |
| 50' | 3852.6 | 1174.8 | E | 50' | 4626.0 | 1634.4 | E | 50' | 5517.0 | 2224.3 | E |
| 68° | 3864.7 | 1181.6 | 40° C. | 78° | 4639.8 | 1643.0 | 40° C. | 88° | 5533.1 | 2235.5 | 40° C. |
| 10' | 3876.8 | 1188.4 | T | 10' | 4653.6 | 1651.7 | T | 10' | 5549.2 | 2246.7 | T |
| 20' | 3889.0 | 1195.2 | .76 | 20' | 4667.4 | 1660.5 | .86 | 20' | 5565.4 | 2258.0 | .92 |
| 30' | 3901.2 | 1202.0 | E | 30' | 4681.3 | 1669.2 | E | 30' | 5581.6 | 2269.3 | E |
| 40' | 3913.4 | 1208.9 | .240 | 40' | 4695.2 | 1678.1 | .332 | 40' | 5597.8 | 2280.6 | .450 |
| 50' | 3925.6 | 1215.8 | T | 50' | 4709.2 | 1686.9 | T | 50' | 5614.2 | 2292.0 | T |
| 69° | 3937.9 | 1222.7 | 45° C. | 79° | 4723.2 | 1695.8 | 45° C. | 89° | 5630.5 | 2303.5 | 45° C. |
| 10' | 3950.2 | 1229.7 | E | 10' | 4737.2 | 1704.7 | E | 10' | 5646.9 | 2315.0 | E |
| 20' | 3962.5 | 1236.7 | .321 | 20' | 4751.2 | 1713.7 | .445 | 20' | 5663.4 | 2326.6 | .603 |
| 30' | 3974.8 | 1243.7 | T | 30' | 4765.3 | 1722.7 | T | 30' | 5679.9 | 2338.2 | T |
| 40' | 3987.2 | 1250.8 | .240 | 40' | 4779.4 | 1731.7 | .332 | 40' | 5696.4 | 2349.8 | .450 |
| 50' | 3999.5 | 1257.9 | E | 50' | 4793.6 | 1740.8 | E | 50' | 5713.0 | 2361.5 | E |
| 70° | 4011.9 | 1265.0 | 50° C. | 80° | 4807.7 | 1749.9 | 50° C. | 90° | 5729.7 | 2373.3 | 50° C. |
| 10' | 4024.4 | 1272.1 | T | 10' | 4822.0 | 1759.0 | T | 10' | 5746.3 | 2385.1 | T |
| 20' | 4036.8 | 1279.3 | .76 | 20' | 4836.2 | 1768.2 | .86 | 20' | 5763.1 | 2397.0 | .92 |
| 30' | 4049.3 | 1286.5 | E | 30' | 4850.5 | 1777.4 | E | 30' | 5779.9 | 2408.9 | E |
| 40' | 4061.8 | 1293.6 | .240 | 40' | 4864.8 | 1786.7 | .332 | 40' | 5796.7 | 2420.9 | .450 |
| 50' | 4074.4 | 1300.9 | T | 50' | 4879.2 | 1796.0 | T | 50' | 5813.6 | 2432.9 | T |

T = R tan 1/2 I E = R exsec 1/2 I

TABLE IX. TANGENTS AND EXTERNALS TO A 1° CURVE

| I | T | E | I=100° | I | T | E | I=110° | I | T | E | I=120° |
|-----|--------|--------|--------|------|--------|--------|--------|------|--------|--------|--------|
| 91° | 5830.5 | 2444.9 | + | 101° | 6950.6 | 3278.1 | + | 111° | 8336.7 | 4386.1 | + |
| 10' | 5847.5 | 2457.1 | 5° C. | 10' | 6971.3 | 3294.1 | 5° C. | 10' | 8362.7 | 4407.6 | 5° C. |
| 20' | 5864.6 | 2469.3 | T | 20' | 6992.0 | 3310.1 | T | 20' | 8388.9 | 4429.2 | T |
| 30' | 5881.7 | 2481.5 | .43 | 30' | 7012.7 | 3326.1 | .51 | 30' | 8415.1 | 4450.9 | .62 |
| 40' | 5898.8 | 2493.8 | E | 40' | 7033.6 | 3342.3 | E | 40' | 8441.5 | 4472.7 | E |
| 50' | 5916.0 | 2506.1 | .200 | 50' | 7054.5 | 3358.5 | .268 | 50' | 8468.0 | 4494.6 | .360 |
| 92° | 5933.2 | 2518.5 | 10° C. | 102° | 7075.5 | 3374.9 | 10° C. | 112° | 8494.6 | 4516.6 | 10° C. |
| 10' | 5950.5 | 2531.0 | T | 10' | 7096.6 | 3391.2 | T | 10' | 8521.3 | 4538.8 | T |
| 20' | 5967.9 | 2543.5 | .86 | 20' | 7117.8 | 3407.7 | .103 | 20' | 8548.1 | 4561.1 | .125 |
| 30' | 5985.3 | 2556.0 | E | 30' | 7139.0 | 3424.3 | E | 30' | 8575.0 | 4583.4 | E |
| 40' | 6002.7 | 2568.6 | .401 | 40' | 7160.3 | 3440.9 | .536 | 40' | 8602.1 | 4606.0 | .721 |
| 50' | 6020.2 | 2581.3 | T | 50' | 7181.7 | 3457.6 | T | 50' | 8629.3 | 4628.6 | T |
| 93° | 6037.8 | 2594.0 | 15° C. | 103° | 7203.2 | 3474.4 | 15° C. | 113° | 8656.6 | 4651.3 | 15° C. |
| 10' | 6055.4 | 2606.8 | E | 10' | 7224.7 | 3491.3 | E | 10' | 8684.0 | 4674.2 | E |
| 20' | 6073.1 | 2619.7 | .86 | 20' | 7246.3 | 3508.2 | .103 | 20' | 8711.5 | 4697.2 | .125 |
| 30' | 6090.8 | 2632.6 | T | 30' | 7268.0 | 3525.2 | T | 30' | 8739.2 | 4720.3 | T |
| 40' | 6108.6 | 2645.5 | .401 | 40' | 7289.8 | 3542.4 | .536 | 40' | 8767.0 | 4743.6 | .721 |
| 50' | 6126.4 | 2658.5 | E | 50' | 7311.7 | 3559.6 | E | 50' | 8794.9 | 4766.9 | E |
| 94° | 6144.3 | 2671.6 | 20° C. | 104° | 7333.6 | 3576.8 | 20° C. | 114° | 8822.9 | 4790.4 | 20° C. |
| 10' | 6162.2 | 2684.7 | T | 10' | 7355.6 | 3594.2 | T | 10' | 8851.0 | 4814.1 | T |
| 20' | 6180.2 | 2697.9 | .86 | 20' | 7377.8 | 3611.7 | .103 | 20' | 8879.3 | 4837.8 | .125 |
| 30' | 6198.3 | 2711.2 | E | 30' | 7399.9 | 3629.2 | E | 30' | 8907.7 | 4861.7 | E |
| 40' | 6216.4 | 2724.5 | .401 | 40' | 7422.2 | 3646.8 | .536 | 40' | 8936.3 | 4885.7 | .721 |
| 50' | 6234.6 | 2737.9 | T | 50' | 7444.6 | 3664.5 | T | 50' | 8965.0 | 4909.9 | T |
| 95° | 6252.8 | 2751.3 | 25° C. | 105° | 7467.0 | 3682.3 | 25° C. | 115° | 8993.8 | 4934.1 | 25° C. |
| 10' | 6271.1 | 2764.8 | E | 10' | 7489.6 | 3700.2 | E | 10' | 9022.7 | 4958.6 | E |
| 20' | 6289.4 | 2778.3 | .86 | 20' | 7512.2 | 3718.2 | .103 | 20' | 9051.7 | 4983.1 | .125 |
| 30' | 6307.9 | 2792.0 | T | 30' | 7534.9 | 3736.2 | T | 30' | 9080.9 | 5007.8 | T |
| 40' | 6326.3 | 2805.6 | .401 | 40' | 7557.7 | 3754.4 | .536 | 40' | 9110.3 | 5032.6 | .721 |
| 50' | 6344.8 | 2819.4 | E | 50' | 7580.5 | 3772.6 | E | 50' | 9139.8 | 5057.6 | E |
| 96° | 6363.4 | 2833.2 | 30° C. | 106° | 7603.5 | 3791.0 | 30° C. | 116° | 9169.4 | 5082.7 | 30° C. |
| 10' | 6382.1 | 2847.0 | T | 10' | 7626.6 | 3809.4 | T | 10' | 9199.1 | 5107.9 | T |
| 20' | 6400.8 | 2861.0 | .86 | 20' | 7649.7 | 3827.9 | .103 | 20' | 9229.0 | 5133.3 | .125 |
| 30' | 6419.5 | 2875.0 | E | 30' | 7672.9 | 3846.5 | E | 30' | 9259.0 | 5158.8 | E |
| 40' | 6438.4 | 2889.0 | .401 | 40' | 7696.3 | 3865.2 | .536 | 40' | 9289.2 | 5184.5 | .721 |
| 50' | 6457.3 | 2903.1 | T | 50' | 7719.7 | 3884.0 | T | 50' | 9319.5 | 5210.3 | T |
| 97° | 6476.2 | 2917.3 | 35° C. | 107° | 7743.2 | 3902.9 | 35° C. | 117° | 9349.9 | 5226.2 | 35° C. |
| 10' | 6495.2 | 2931.6 | E | 10' | 7766.8 | 3921.9 | E | 10' | 9380.5 | 5242.2 | E |
| 20' | 6514.3 | 2945.9 | .86 | 20' | 7790.5 | 3940.9 | .103 | 20' | 9411.3 | 5258.3 | .125 |
| 30' | 6533.4 | 2960.3 | T | 30' | 7814.3 | 3960.1 | T | 30' | 9442.2 | 5274.5 | T |
| 40' | 6552.6 | 2974.7 | .401 | 40' | 7838.1 | 3979.4 | .536 | 40' | 9473.2 | 5291.5 | .721 |
| 50' | 6571.9 | 2989.2 | E | 50' | 7862.1 | 3998.7 | E | 50' | 9504.4 | 5308.2 | E |
| 98° | 6591.2 | 3003.8 | 40° C. | 108° | 7886.2 | 4018.2 | 40° C. | 118° | 9535.7 | 5325.1 | 40° C. |
| 10' | 6610.6 | 3018.4 | T | 10' | 7910.4 | 4037.8 | T | 10' | 9567.2 | 5342.1 | T |
| 20' | 6630.1 | 3033.1 | .86 | 20' | 7934.6 | 4057.4 | .103 | 20' | 9598.9 | 5359.2 | .125 |
| 30' | 6649.6 | 3047.9 | E | 30' | 7959.0 | 4077.2 | E | 30' | 9630.7 | 5376.5 | E |
| 40' | 6669.2 | 3062.8 | .401 | 40' | 7983.5 | 4097.1 | | | | | |

TABLE X.
MIDDLE ORDINATES OF RAILS
Length of Rail (feet)

| C o / | R Feet | 30 Inch | 28 Inch | 26 Inch | 24 Inch | 22 Inch | 20 Inch | C o | R Feet | 30 Inch | 28 Inch | 26 Inch | 24 Inch | 22 Inch | 20 Inch |
|----------|-----------|------------|------------|------------|------------|------------|------------|--------|-----------|------------|------------|------------|------------|------------|------------|
| 0-20 | 17189 | .08 | .07 | .06 | .05 | .04 | .03 | 8 | 716.8 | 1.88 | 1.64 | 1.42 | 1.20 | 1.01 | .84 |
| 0-40 | 8594 | .16 | .14 | .12 | .10 | .08 | .07 | 9 | 637.3 | 2.12 | 1.84 | 1.60 | 1.35 | 1.14 | .94 |
| 1-0 | 5730 | .24 | .20 | .18 | .15 | .13 | .10 | 10 | 573.7 | 2.36 | 2.05 | 1.78 | 1.50 | 1.27 | 1.04 |
| 1-20 | 4297 | .31 | .27 | .23 | .20 | .17 | .13 | 11 | 521.7 | 2.59 | 2.26 | 1.95 | 1.65 | 1.39 | 1.15 |
| 1-40 | 3438 | .39 | .34 | .29 | .25 | .21 | .17 | 12 | 478.3 | 3.83 | 2.47 | 2.15 | 1.81 | 1.54 | 1.26 |
| 2-0 | 2865 | .47 | .41 | .35 | .30 | .25 | .20 | 13 | 441.7 | 3.05 | 2.66 | 2.30 | 1.96 | 1.66 | 1.36 |
| 2-20 | 2456 | .55 | .48 | .41 | .35 | .29 | .23 | 14 | 410.3 | 3.30 | 2.87 | 2.48 | 2.10 | 1.78 | 1.46 |
| 2-40 | 2149 | .63 | .55 | .47 | .40 | .33 | .27 | 15 | 383.1 | 3.54 | 3.08 | 2.68 | 2.26 | 1.91 | 1.57 |
| 3-0 | 1910 | .71 | .62 | .53 | .45 | .38 | .31 | 16 | 359.3 | 3.76 | 3.28 | 2.83 | 2.40 | 2.04 | 1.67 |
| 3-20 | 1719 | .78 | .68 | .59 | .50 | .42 | .35 | 17 | 338.3 | 4.00 | 3.48 | 3.02 | 2.57 | 2.16 | 1.78 |
| 3-40 | 1563 | .86 | .75 | .65 | .55 | .46 | .38 | 18 | 319.6 | 4.21 | 3.67 | 3.18 | 2.70 | 2.28 | 1.87 |
| 4-0 | 1433 | .94 | .82 | .71 | .60 | .50 | .42 | 19 | 302.9 | 4.45 | 3.89 | 3.36 | 2.86 | 2.41 | 1.98 |
| 4-20 | 1323 | 1.02 | .89 | .77 | .65 | .55 | .45 | 20 | 287.9 | 4.70 | 4.09 | 3.55 | 3.00 | 2.54 | 2.09 |
| 4-40 | 1228 | 1.10 | .96 | .83 | .70 | .59 | .48 | 22 | 262.0 | 5.16 | 4.44 | 3.84 | 3.30 | 2.80 | 2.29 |
| 5 | 1146 | 1.18 | 1.03 | .89 | .75 | .63 | .52 | 24 | 240.5 | 5.64 | 4.92 | 4.20 | 3.59 | 3.04 | 2.50 |
| 6 | 955.3 | 1.41 | 1.23 | 1.06 | .90 | .76 | .62 | 26 | 222.3 | 6.07 | 5.29 | 4.58 | 3.88 | 3.29 | 2.70 |
| 7 | 819.0 | 1.65 | 1.44 | 1.24 | 1.05 | .89 | .73 | | | | | | | | |

TABLE XI.
SHORT RADIUS CURVES

| Radius Feet | Chord Feet | Central Angle | Deflection Angle | Deflection for 1 Foot |
|----------------|---------------|------------------|---------------------|--------------------------|
| 35 | 10 | 16-26 | 8-13 | 49.3 |
| 45 | 10 | 12-46 | 6-23 | 38.3 |
| 50 | 15 | 17-16 | 8-38 | 34.5 |
| 60 | 15 | 14-22 | 7-11 | 28.8 |
| 75 | 15 | 11-30 | 5-45 | 23.0 |
| 100 | 20 | 11-30 | 5-45 | 17.3 |
| 120 | 20 | 9-34 | 4-47 | 14.3 |
| 150 | 20 | 7-39 | 3-49 | 11.5 |
| 190 | 25 | 7-32 | 3-46 | 9.15 |
| 200 | 25 | 7-10 | 3-35 | 8.6 |
| 225 | 25 | 6-25 | 3-12 | 7.7 |
| 240 | 25 | 5-58 | 2-59 | 7.2 |
| 250 | 25 | 5-44 | 2-52 | 6.9 |
| 275 | 25 | 5-12 | 2-36 | 6.2 |
| 288 | 50 | 9-58 | 4-59 | 6.0 |
| 300 | 50 | 9-32 | 4-46 | 5.7 |
| 350 | 50 | 8-12 | 4-06 | 4.9 |
| 376 | 50 | 7-40 | 3-50 | 4.6 |
| 400 | 50 | 7-10 | 3-35 | 4.3 |
| 410 | 50 | 7-00 | 3-30 | 4.2 |

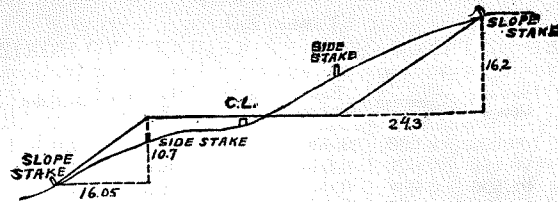
To find length of curve divide angle from P. C. to P. T. by central angle of chord, and multiply by length of chord.

TABLE XII.
INCLINED DISTANCE OF 100 FT. REDUCED TO HORIZONTAL

| Slope | Horizontal Distance | Correction | Rise Per Foot | Slope | Horizontal Distance | Correction | Rise Per Foot |
|-------|------------------------|------------|------------------|-------|------------------------|------------|------------------|
| 0°00' | 100.000 | 0.000 | 0.000 | 8°00' | 99.027 | 0.973 | 0.139 |
| 15' | 99.999 | 0.001 | 0.004 | 15' | 98.965 | 1.035 | 0.143 |
| 30' | 99.996 | 0.004 | 0.009 | 30' | 98.902 | 1.098 | 0.148 |
| 45' | 99.991 | 0.009 | 0.013 | 45' | 98.836 | 1.164 | 0.152 |
| 1 00 | 99.985 | 0.015 | 0.017 | 9 00 | 98.769 | 1.231 | 0.156 |
| 15 | 99.976 | 0.024 | 0.022 | 15 | 98.700 | 1.300 | 0.161 |
| 30 | 99.966 | 0.034 | 0.026 | 30 | 98.629 | 1.371 | 0.165 |
| 45 | 99.953 | 0.047 | 0.031 | 45 | 98.556 | 1.444 | 0.169 |
| 2 00 | 99.939 | 0.061 | 0.035 | 10 00 | 98.481 | 1.519 | 0.174 |
| 15 | 99.923 | 0.077 | 0.039 | 15 | 98.404 | 1.596 | 0.178 |
| 30 | 99.905 | 0.095 | 0.044 | 30 | 98.325 | 1.675 | 0.182 |
| 45 | 99.885 | 0.115 | 0.048 | 45 | 98.245 | 1.755 | 0.187 |
| 3 00 | 99.863 | 0.137 | 0.052 | 11 00 | 98.163 | 1.837 | 0.191 |
| 15 | 99.839 | 0.161 | 0.057 | 15 | 98.079 | 1.921 | 0.195 |
| 30 | 99.813 | 0.187 | 0.061 | 30 | 97.992 | 2.008 | 0.199 |
| 45 | 99.786 | 0.214 | 0.065 | 45 | 97.905 | 2.095 | 0.204 |
| 4 00 | 99.756 | 0.244 | 0.070 | 12 00 | 97.815 | 2.185 | 0.208 |
| 15 | 99.725 | 0.275 | 0.074 | 15 | 97.723 | 2.277 | 0.212 |
| 30 | 99.692 | 0.308 | 0.078 | 30 | 97.630 | 2.370 | 0.216 |
| 45 | 99.657 | 0.343 | 0.083 | 45 | 97.534 | 2.466 | 0.221 |
| 5 00 | 99.619 | 0.381 | 0.087 | 13 00 | 97.437 | 2.563 | 0.225 |
| 15 | 99.580 | 0.420 | 0.092 | 15 | 97.338 | 2.662 | 0.229 |
| 30 | 99.540 | 0.460 | 0.096 | 30 | 97.237 | 2.763 | 0.233 |
| 45 | 99.497 | 0.503 | 0.100 | 45 | 97.134 | 2.866 | 0.238 |
| 6 00 | 99.452 | 0.548 | 0.105 | 14 00 | 97.030 | 2.970 | 0.242 |
| 15 | 99.406 | 0.594 | 0.109 | 15 | 96.923 | 3.077 | 0.246 |
| 30 | 99.357 | 0.643 | 0.113 | 30 | 96.815 | 3.185 | 0.250 |
| 45 | 99.307 | 0.693 | 0.118 | 45 | 96.705 | 3.295 | 0.255 |
| 7 00 | 99.255 | 0.745 | 0.122 | 15 00 | 96.593 | 3.407 | 0.259 |
| 15 | 99.200 | 0.800 | 0.126 | 15 | 96.479 | 3.521 | 0.263 |
| 30 | 99.144 | 0.856 | 0.131 | 30 | 96.363 | 3.637 | 0.267 |
| 45 | 99.087 | 0.913 | 0.135 | 45 | 96.246 | 3.754 | 0.271 |

TABLE XIII.
MINUTES IN DECIMALS OF A DEGREE.

| | | | | | | | | | | | |
|-------|--------|---------|--------|---------|--------|---------|--------|---------|--------|---------|---------|
| 0 30' | .00833 | 10' 30' | .17500 | 20' 30' | .34167 | 30' 10' | .50833 | 40' 30' | .67500 | 50' 10' | .84167 |
| 1 00 | .01667 | 11 00 | .18333 | 21 00 | .35000 | 31 00 | .51667 | 41 00 | .68333 | 51 00 | .85000 |
| 30 | .02500 | 30 | .19167 | 30 | .35833 | 30 | .52500 | 30 | .69167 | 30 | .85833 |
| 2 00 | .03333 | 12 00 | .20000 | 22 00 | .36667 | 32 00 | .53333 | 42 00 | .70000 | 52 00 | .86667 |
| 30 | .04167 | 30 | .20833 | 30 | .37500 | 30 | .54167 | 30 | .70833 | 30 | .87500 |
| 3 00 | .05000 | 13 00 | .21667 | 23 00 | .38333 | 33 00 | .55000 | 43 00 | .71667 | 53 00 | .88333 |
| 30 | .05833 | 30 | .22500 | 30 | .39167 | 30 | .55833 | 30 | .72500 | 30 | .89167 |
| 4 00 | .06667 | 14 00 | .23333 | 24 00 | .40000 | 34 00 | .56667 | 44 00 | .73333 | 54 00 | .90000 |
| 30 | .07500 | 30 | .24167 | 30 | .40833 | 30 | .57500 | 30 | .74167 | 30 | .90833 |
| 5 00 | .08333 | 15 00 | .25000 | 25 00 | .41667 | 35 00 | .58333 | 45 00 | .75000 | 55 00 | .91667 |
| 30 | .09167 | 30 | .25833 | 30 | .42500 | 30 | .59167 | 30 | .75833 | 30 | .92500 |
| 6 00 | .10000 | 16 00 | .26667 | 26 00 | .43333 | 36 00 | .60000 | 46 00 | .76667 | 56 00 | .93333 |
| 30 | .10833 | 30 | .27500 | 30 | .44167 | 30 | .60833 | 30 | .77500 | 30 | .94167 |
| 7 00 | .11667 | 17 00 | .28333 | 27 00 | .45000 | 37 00 | .61667 | 47 00 | .78333 | 57 00 | .95000 |
| 30 | .12500 | 30 | .29167 | 30 | .45833 | 30 | .62500 | 30 | .79167 | 30 | .95833 |
| 8 00 | .13333 | 18 00 | .30000 | 28 00 | .46667 | 38 00 | .63333 | 48 00 | .80000 | 58 00 | .96667 |
| 30 | .14167 | 30 | .30833 | 30 | .47500 | 30 | .64167 | 30 | .80833 | 30 | .97500 |
| 9 00 | .15000 | 19 00 | .31667 | 29 00 | .48333 | 39 00 | .65000 | 49 00 | .81667 | 59 00 | .98333 |
| 30 | .15833 | 30 | .32500 | 30 | .49167 | 30 | .65833 | 30 | .82500 | 30 | .99167 |
| 10 00 | .16667 | 20 00 | .33333 | 30 00 | .50000 | 40 00 | .66667 | 50 00 | .83333 | 60 00 | 1.00000 |



DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING.

SLOPE 1½ TO 1. ROADWAY OF ANY WIDTH.

| | 0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| 0 | 0 00 | 0 15 | 0 30 | 0 45 | 0 60 | 0 75 | 0 90 | 1 05 | 1 20 | 1 35 | 0 |
| 1 | 1 50 | 1 65 | 1 80 | 1 95 | 2 10 | 2 25 | 2 40 | 2 55 | 2 70 | 2 85 | 1 |
| 2 | 3 00 | 3 15 | 3 30 | 3 45 | 3 60 | 3 75 | 3 90 | 4 05 | 4 20 | 4 35 | 2 |
| 3 | 4 50 | 4 65 | 4 80 | 4 95 | 5 10 | 5 25 | 5 40 | 5 55 | 5 70 | 5 85 | 3 |
| 4 | 6 00 | 6 15 | 6 30 | 6 45 | 6 60 | 6 75 | 6 90 | 7 05 | 7 20 | 7 35 | 4 |
| 5 | 7 50 | 7 65 | 7 80 | 7 95 | 8 10 | 8 25 | 8 40 | 8 55 | 8 70 | 8 85 | 5 |
| 6 | 9 00 | 9 15 | 9 30 | 9 45 | 9 60 | 9 75 | 9 90 | 10 05 | 10 20 | 10 35 | 6 |
| 7 | 10 50 | 10 65 | 10 80 | 10 95 | 11 10 | 11 25 | 11 40 | 11 55 | 11 70 | 11 85 | 7 |
| 8 | 12 00 | 12 15 | 12 30 | 12 45 | 12 60 | 12 75 | 12 90 | 13 05 | 13 20 | 13 35 | 8 |
| 9 | 13 50 | 13 65 | 13 80 | 13 95 | 14 10 | 14 25 | 14 40 | 14 55 | 14 70 | 14 85 | 9 |
| 10 | 15 00 | 15 15 | 15 30 | 15 45 | 15 60 | 15 75 | 15 90 | 16 05 | 16 20 | 16 35 | 10 |
| 11 | 16 50 | 16 65 | 16 80 | 16 95 | 17 10 | 17 25 | 17 40 | 17 55 | 17 70 | 17 85 | 11 |
| 12 | 18 00 | 18 15 | 18 30 | 18 45 | 18 60 | 18 75 | 18 90 | 19 05 | 19 20 | 19 35 | 12 |
| 13 | 19 50 | 19 65 | 19 80 | 19 95 | 20 10 | 20 25 | 20 40 | 20 55 | 20 70 | 20 85 | 13 |
| 14 | 21 00 | 21 15 | 21 30 | 21 45 | 21 60 | 21 75 | 21 90 | 22 05 | 22 20 | 22 35 | 14 |
| 15 | 22 50 | 22 65 | 22 80 | 22 95 | 23 10 | 23 25 | 23 40 | 23 55 | 23 70 | 23 85 | 15 |
| 16 | 24 00 | 24 15 | 24 30 | 24 45 | 24 60 | 24 75 | 24 90 | 25 05 | 25 20 | 25 35 | 16 |
| 17 | 25 50 | 25 65 | 25 80 | 25 95 | 26 10 | 26 25 | 26 40 | 26 55 | 26 70 | 26 85 | 17 |
| 18 | 27 00 | 27 15 | 27 30 | 27 45 | 27 60 | 27 75 | 27 90 | 28 05 | 28 20 | 28 35 | 18 |
| 19 | 28 50 | 28 65 | 28 80 | 28 95 | 29 10 | 29 25 | 29 40 | 29 55 | 29 70 | 29 85 | 19 |
| 20 | 30 00 | 30 15 | 30 30 | 30 45 | 30 60 | 30 75 | 30 90 | 31 05 | 31 20 | 31 35 | 20 |
| 21 | 31 50 | 31 65 | 31 80 | 31 95 | 32 10 | 32 25 | 32 40 | 32 55 | 32 70 | 32 85 | 21 |
| 22 | 33 00 | 33 15 | 33 30 | 33 45 | 33 60 | 33 75 | 33 90 | 34 05 | 34 20 | 34 35 | 22 |
| 23 | 34 50 | 34 65 | 34 80 | 34 95 | 35 10 | 35 25 | 35 40 | 35 55 | 35 70 | 35 85 | 23 |
| 24 | 36 00 | 36 15 | 36 30 | 36 45 | 36 60 | 36 75 | 36 90 | 37 05 | 37 20 | 37 35 | 24 |
| 25 | 37 50 | 37 65 | 37 80 | 37 95 | 38 10 | 38 25 | 38 40 | 38 55 | 38 70 | 38 85 | 25 |
| 26 | 39 00 | 39 15 | 39 30 | 39 45 | 39 60 | 39 75 | 39 90 | 40 05 | 40 20 | 40 35 | 26 |
| 27 | 40 50 | 40 65 | 40 80 | 40 95 | 41 10 | 41 25 | 41 40 | 41 55 | 41 70 | 41 85 | 27 |
| 28 | 42 00 | 42 15 | 42 30 | 42 45 | 42 60 | 42 75 | 42 90 | 43 05 | 43 20 | 43 35 | 28 |
| 29 | 43 50 | 43 65 | 43 80 | 43 95 | 44 10 | 44 25 | 44 40 | 44 55 | 44 70 | 44 85 | 29 |
| 30 | 45 00 | 45 15 | 45 30 | 45 45 | 45 60 | 45 75 | 45 90 | 46 05 | 46 20 | 46 35 | 30 |
| 31 | 46 50 | 46 65 | 46 80 | 46 95 | 47 10 | 47 25 | 47 40 | 47 55 | 47 70 | 47 85 | 31 |
| 32 | 48 00 | 48 15 | 48 30 | 48 45 | 48 60 | 48 75 | 48 90 | 49 05 | 49 20 | 49 35 | 32 |
| 33 | 49 50 | 49 65 | 49 80 | 49 95 | 50 10 | 50 25 | 50 40 | 50 55 | 50 70 | 50 85 | 33 |
| 34 | 51 00 | 51 15 | 51 30 | 51 45 | 51 60 | 51 75 | 51 90 | 52 05 | 52 20 | 52 35 | 34 |
| 35 | 52 50 | 52 65 | 52 80 | 52 95 | 53 10 | 53 25 | 53 40 | 53 55 | 53 70 | 53 85 | 35 |
| 36 | 54 00 | 54 15 | 54 30 | 54 45 | 54 60 | 54 75 | 54 90 | 55 05 | 55 20 | 55 35 | 36 |
| 37 | 55 50 | 55 65 | 55 80 | 55 95 | 56 10 | 56 25 | 56 40 | 56 55 | 56 70 | 56 85 | 37 |
| 38 | 57 00 | 57 15 | 57 30 | 57 45 | 57 60 | 57 75 | 57 90 | 58 05 | 58 20 | 58 35 | 38 |
| 39 | 58 50 | 58 65 | 58 80 | 58 95 | 59 10 | 59 25 | 59 40 | 59 55 | 59 70 | 59 85 | 39 |
| 40 | 60 00 | 60 15 | 60 30 | 60 45 | 60 60 | 60 75 | 60 90 | 61 05 | 61 20 | 61 35 | 40 |
| 41 | 61 50 | 61 65 | 61 80 | 61 95 | 62 10 | 62 25 | 62 40 | 62 55 | 62 70 | 62 85 | 41 |
| 42 | 63 00 | 63 15 | 63 30 | 63 45 | 63 60 | 63 75 | 63 90 | 64 05 | 64 20 | 64 35 | 42 |
| 43 | 64 50 | 64 65 | 64 80 | 64 95 | 65 10 | 65 25 | 65 40 | 65 55 | 65 70 | 65 85 | 43 |
| 44 | 66 00 | 66 15 | 66 30 | 66 45 | 66 60 | 66 75 | 66 90 | 67 05 | 67 20 | 67 35 | 44 |
| 45 | 67 50 | 67 65 | 67 80 | 67 95 | 68 10 | 68 25 | 68 40 | 68 55 | 68 70 | 68 85 | 45 |
| 46 | 69 00 | 69 15 | 69 30 | 69 45 | 69 60 | 69 75 | 69 90 | 70 05 | 70 20 | 70 35 | 46 |
| 47 | 70 50 | 70 65 | 70 80 | 70 95 | 71 10 | 71 25 | 71 40 | 71 55 | 71 70 | 71 85 | 47 |
| 48 | 72 00 | 72 15 | 72 30 | 72 45 | 72 60 | 72 75 | 72 90 | 73 05 | 73 20 | 73 35 | 48 |
| 49 | 73 50 | 73 65 | 73 80 | 73 95 | 74 10 | 74 25 | 74 40 | 74 55 | 74 70 | 74 85 | 49 |
| 50 | 75 00 | 75 15 | 75 30 | 75 45 | 75 60 | 75 75 | 75 90 | 76 05 | 76 20 | 76 35 | 50 |

Computed by L. Leland Locke.



Standard Engineer's Field Book

Description

| | Size | Rulings |
|----------|---------|---------|
| No. 1307 | 7½ x 4½ | "Level" |
| No. 1308 | " | "Field" |

Specify by Number, the Book desired

Made in U. S. A.

71 - 20 25 (Cours)

81:80 = 1.40
39.7
6.6
8.2

884 = 3000
26.8
26.8

66
11.5

38.5
40.5

80:60 = 40:23.0
400

111.5
66
249.0
249.0
503.0

9.2.5' 1.5

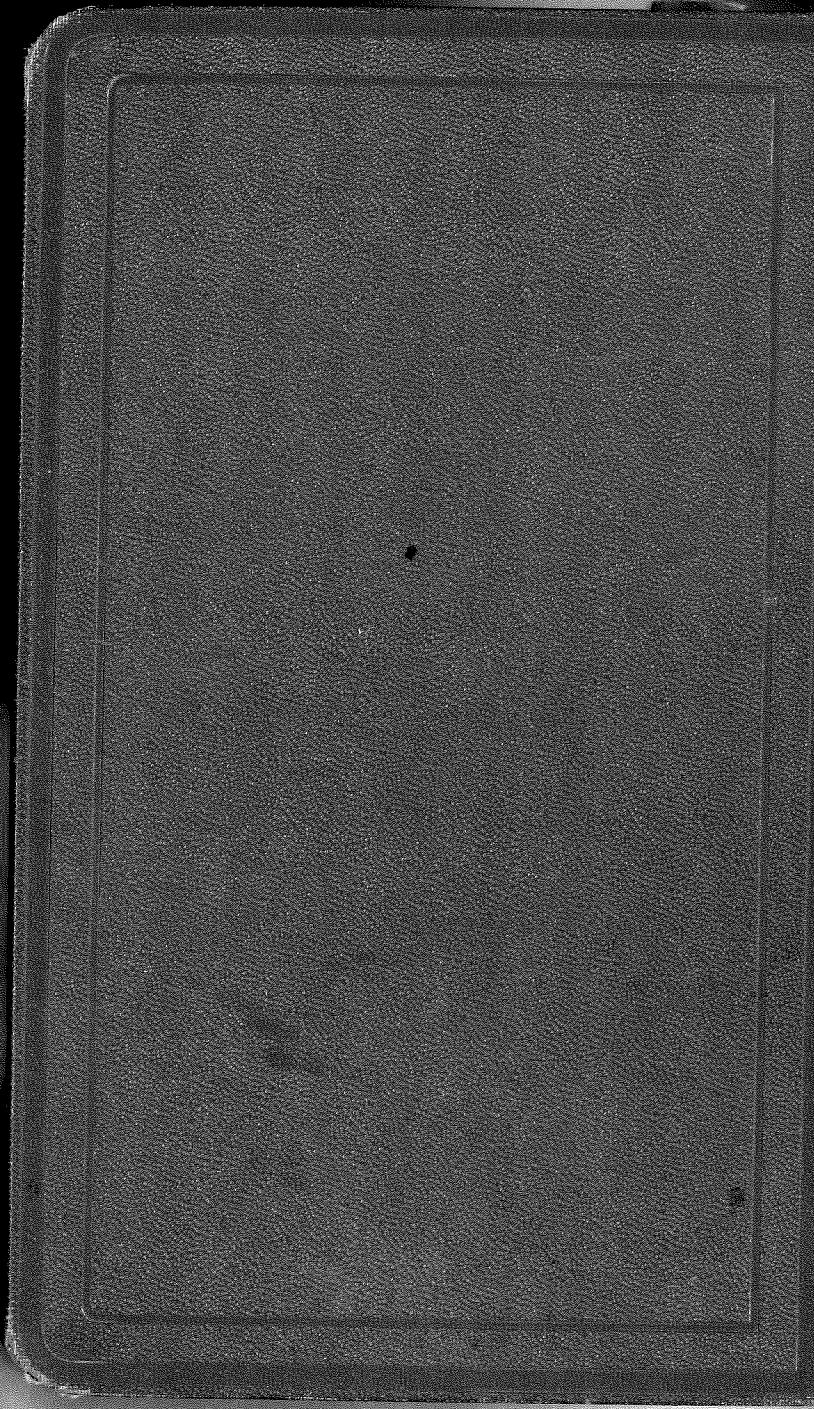
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5280

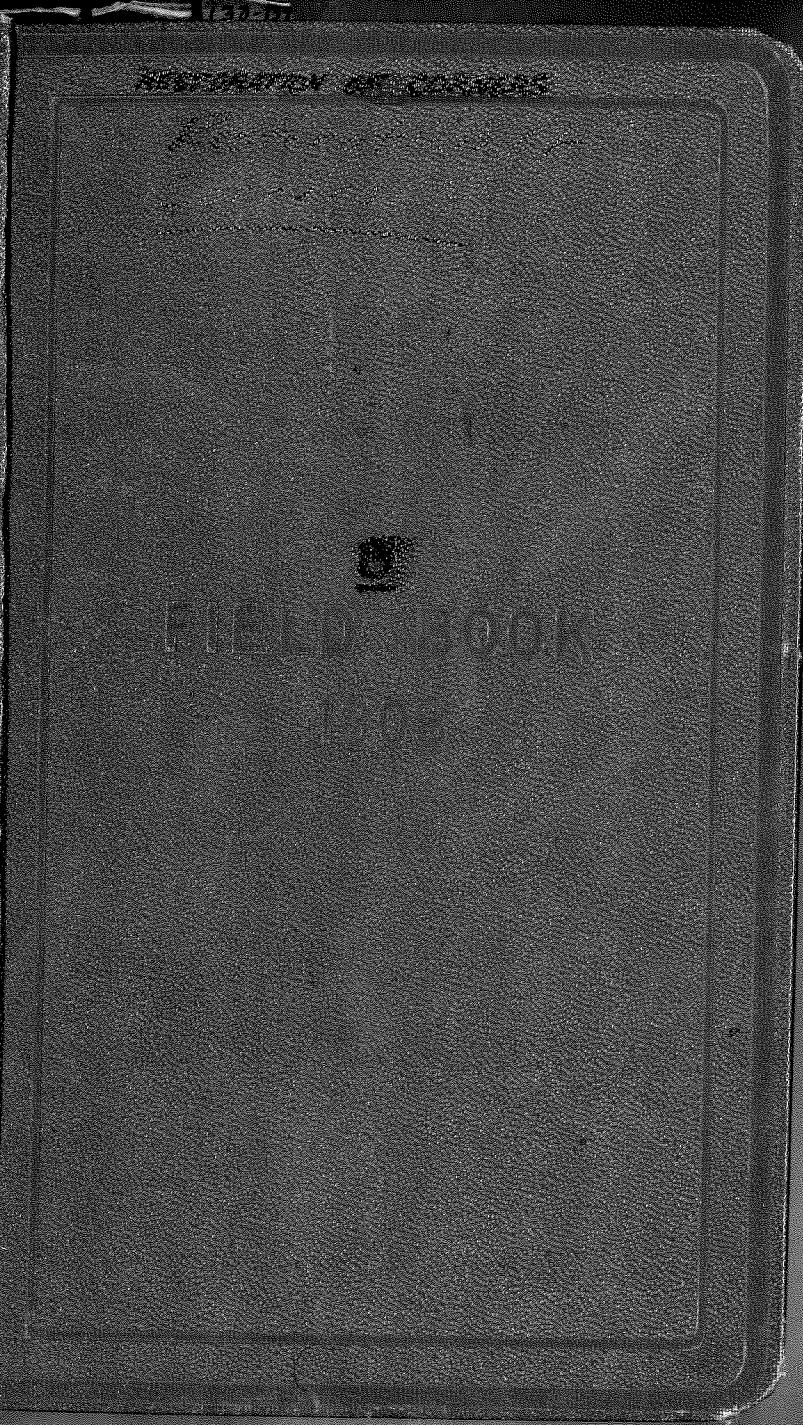
53
140.0
106
34
318
220

5280
76.5
451.5

4.5
7.6' for each 15.0
27.0
9.0
117.0
7
124



001
RESTORATION OF CANNERS



RESTORATION OF CANNERS

FIELD BOOK