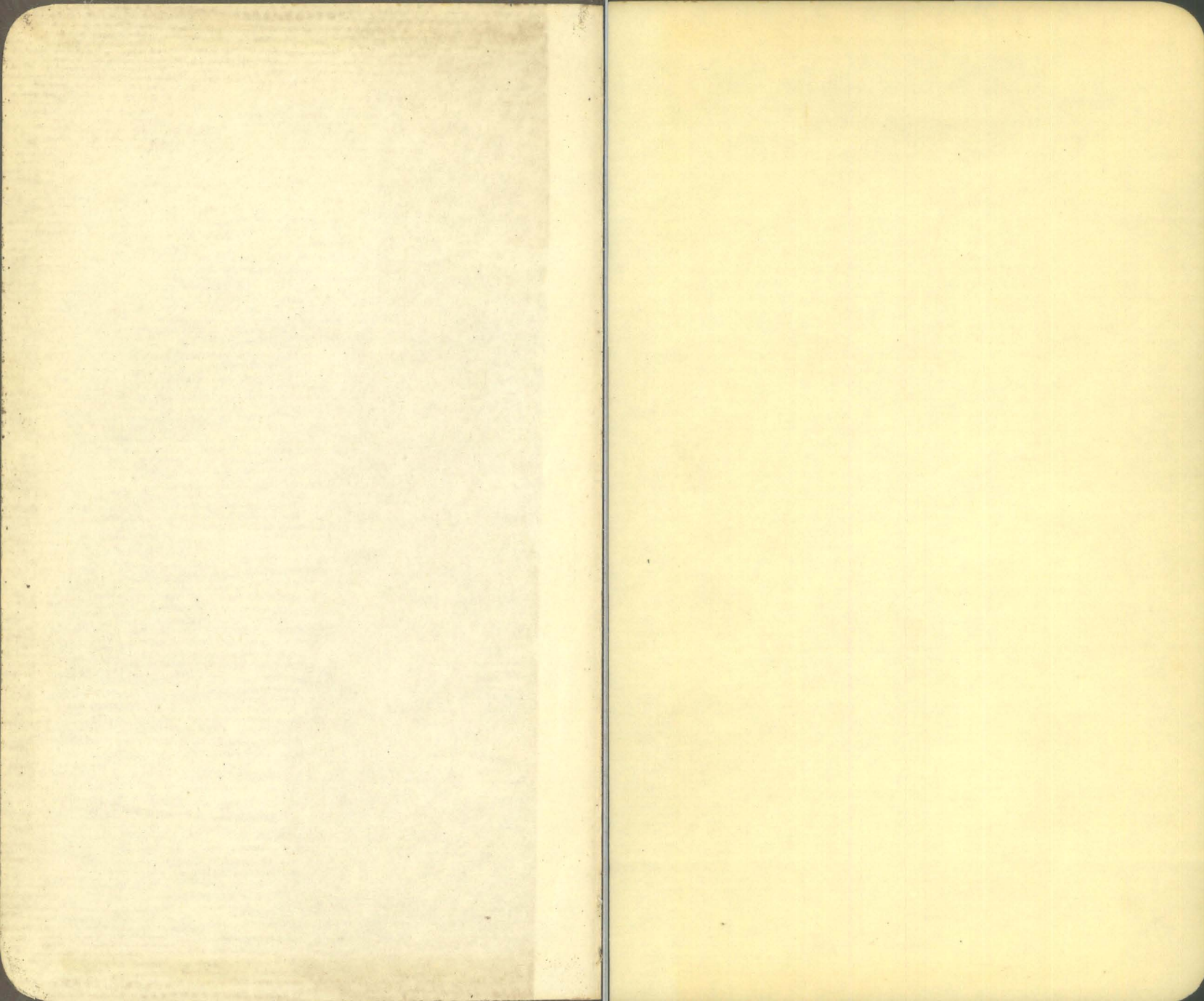
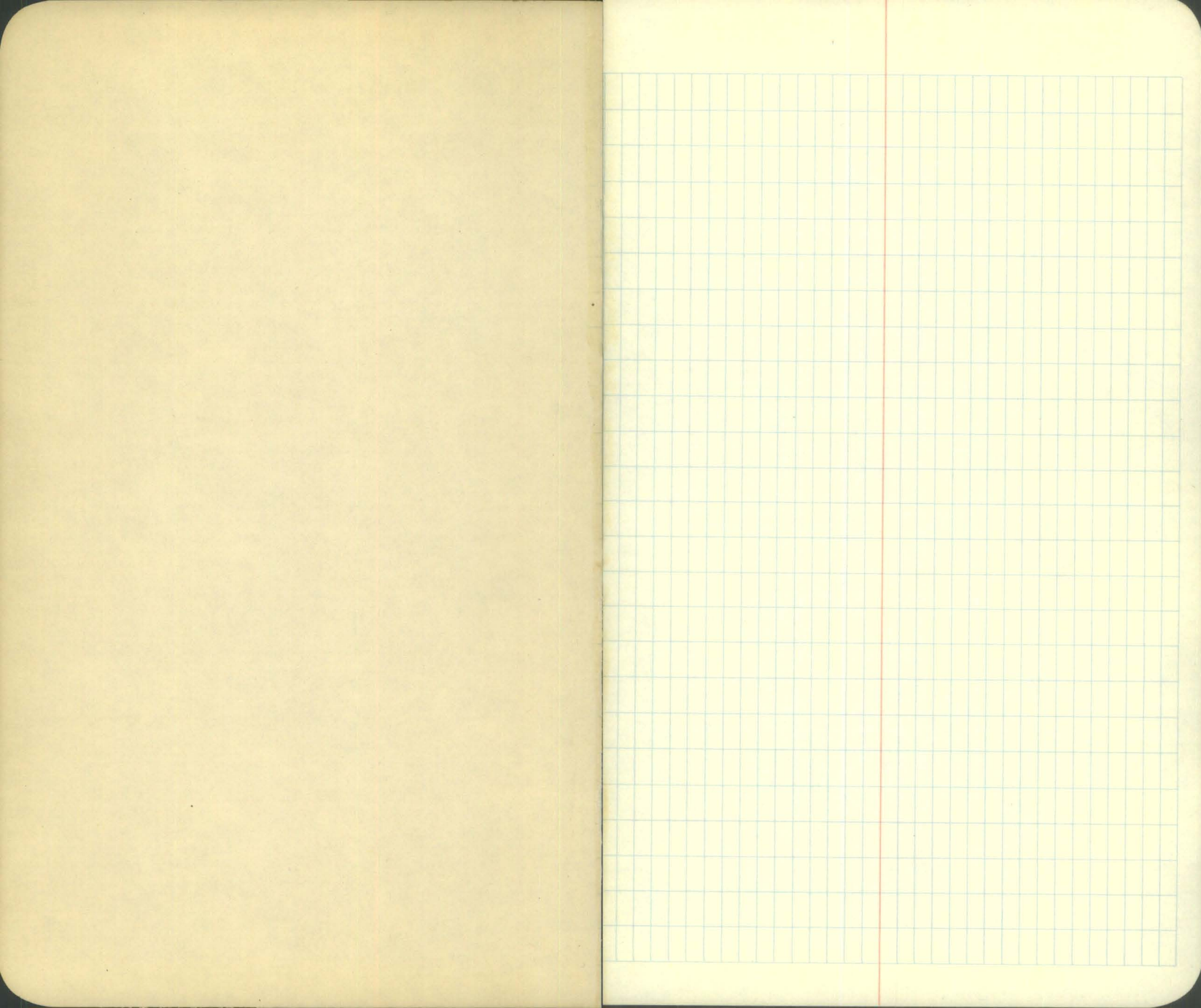


oil Density + Procter Density 1966
Ridgeway + Schrock
City 19th to V37

yr. 1966

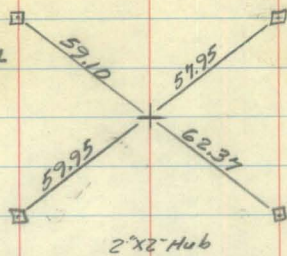
1226



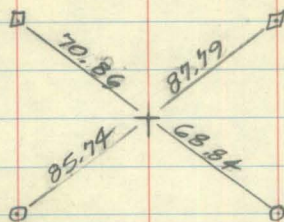


X Ties for Cor on L 2677
2"x2" Hub

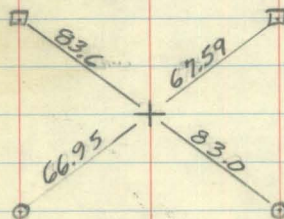
S 1/4 Cor 35-89-14



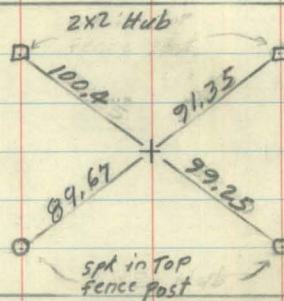
N.E. Cor.
3-88-14



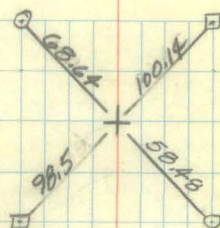
S.E. Cor.
35-89-14



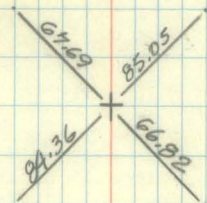
N 1/4 Cor
2-88-14



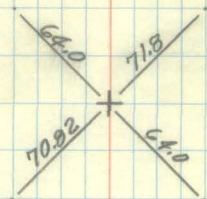
S 1/4 Cor.
36-89-13



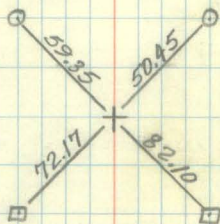
N.E. Cor
2-88-14



S.E. Cor
36-89-14



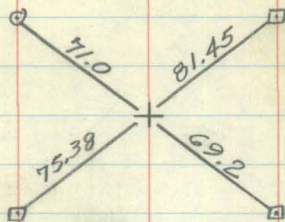
N 1/4 Cor
1-88-14



X Ties for Cor. on 2677

S 1/4 Cor.

31-89-13



N.E. Cor.

35-88-13

+

X Ties for Cor. on L 438

N 1/4 Cor

34-88-13

+

N 1/4 Cor

36-88-13

+

X Ties North of Proj N. 29-430 Cedar

N.E. Cor

34-88-13

+

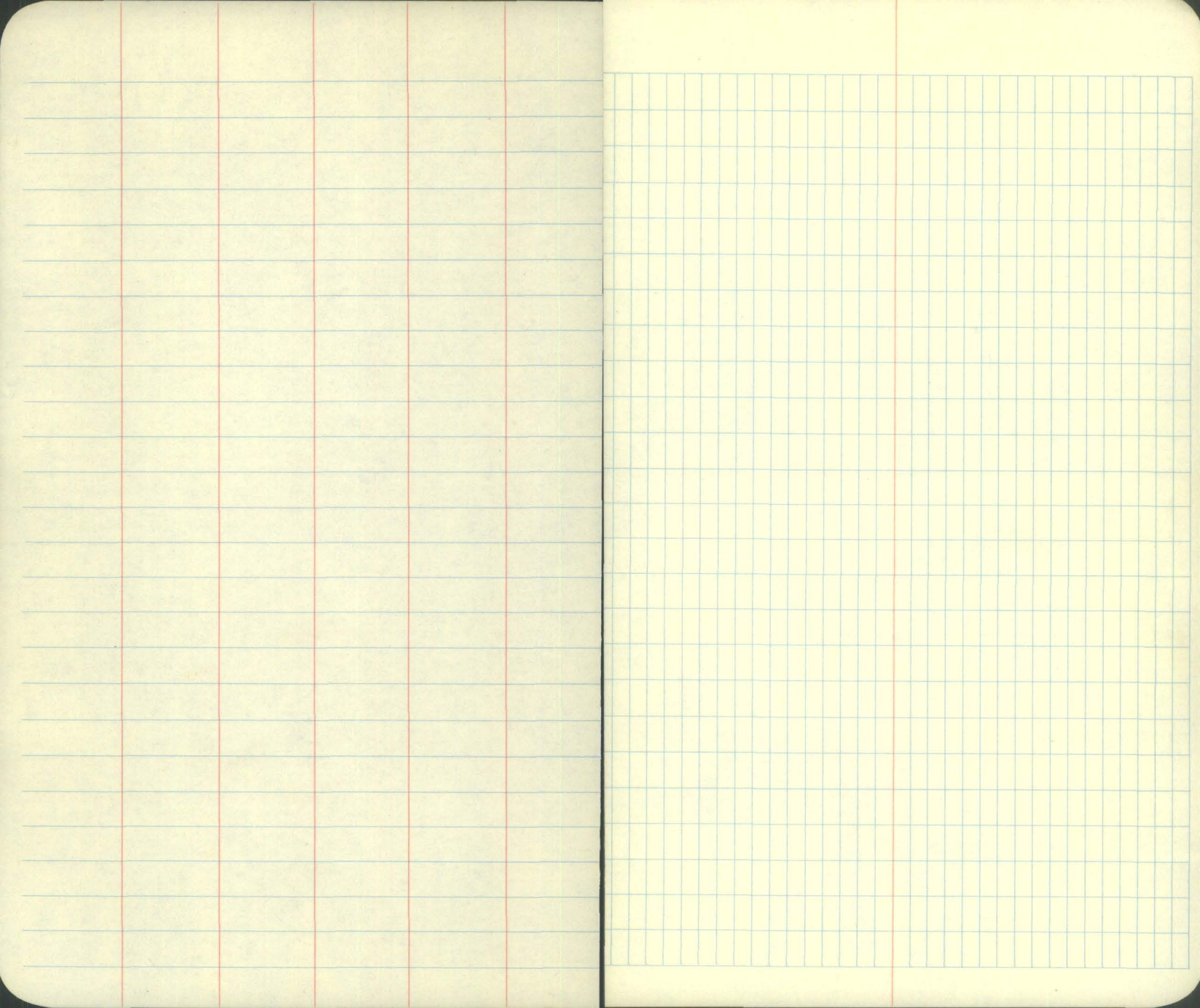
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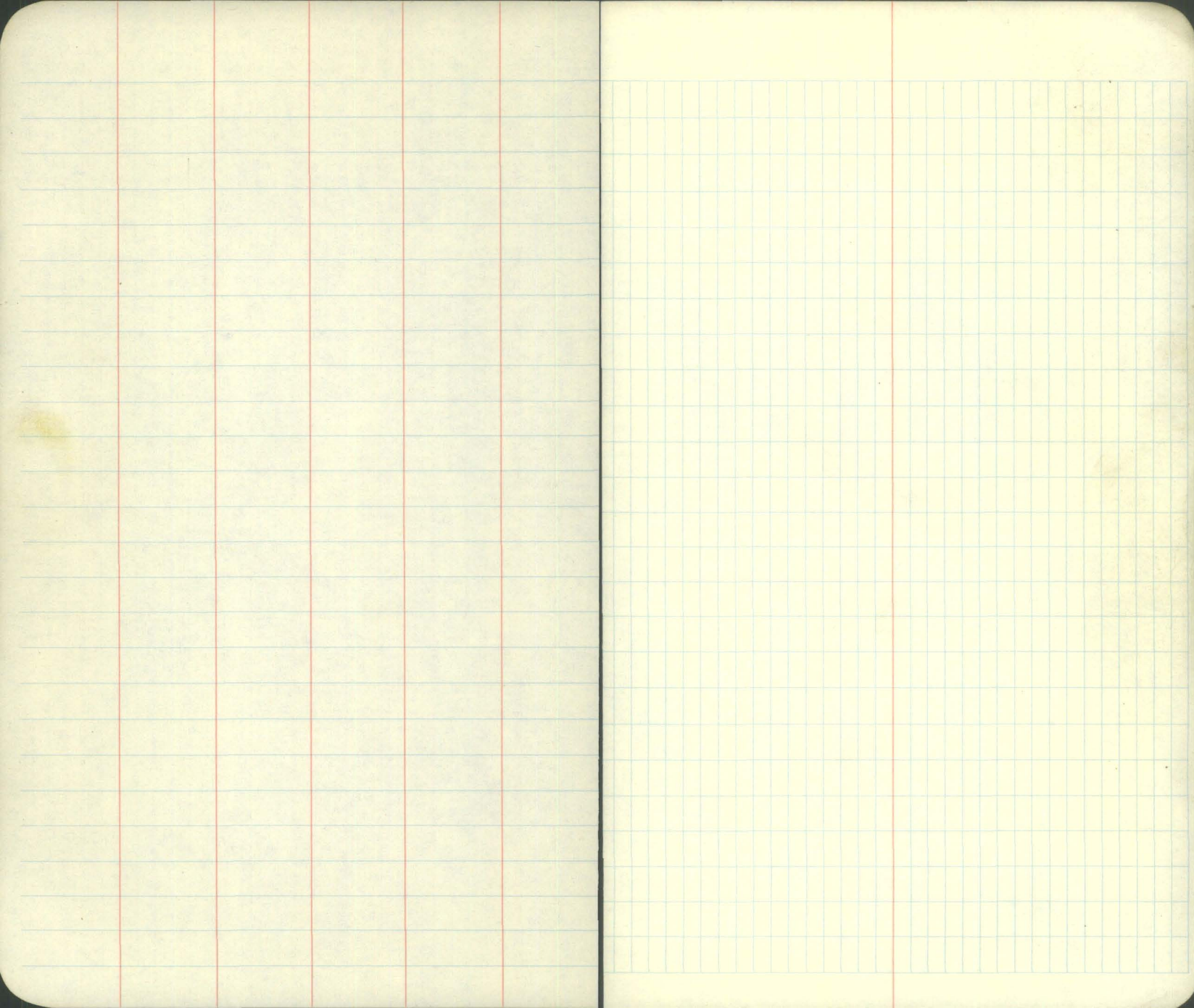
N 1/4 Cor

35-88-13

+

+





Proj No.

Date

Station

Location

from &

Hole #

Depth

Wet Weight

of Sample

Dry Weight

of Sample

Loss

% H₂O

Oil Bottle

No.

Full

Weight

after

Weight

Weight

used

oil

Temp.

Corr.

Factor

corr.

Volume

Sp. Gr.

Proctor

95% of Proc.

% of Proc.

$$\text{Crown Pit} \quad \frac{\text{weight used}}{\text{Corr. Factor}} = \text{Corr. Volume}$$

$$\text{" Lt} \quad \frac{\text{Dry Weight}}{\text{Corr. Volume}} = \text{Sp. Gr.}$$

L-438

L-438

5/2/66					5/3/66				
269.00	275.00	280.50	286.00	291.00	296.00	300.50	306.00	311.00	317.00
10' LT.	6' LT.	4	5' RT.	10' RT.	8	6' LT.	6' RT	6' LT.	4' RT.
1	2	3	4	1	2	3	1	2	3
4 1/2"	4"	4"	4"	4"	4"	4"	4"	4"	4 1/2"
2003.2	1419.1	1143.2	1370.2	1380	1080	1288	1411	1466	1856
1647	1325	1053	1293	1284	1033	1203	1290	1356	1726
156	94	90	87	96	47	85	121	110	130
8.4%	7.1%	8.6%	6.8%	7.5%	4.5%	7.07%	9.4%	8.1%	7.5%
1.6	2	4	5	1	2	3	1	2	3
2474.3	1237.6	1256.9	1252.9	1195	1202	1173	1256	1265	1286
1656.7	676.8	796.2	714.2	625.7	778.1	663.2	727	704	679
817.6	560.8	460.7	538.7	569.3	423.9	509.8	529	561	607
44°	42°F	48°F	50°F	52°F	64°	73°	74°	43°	46°
0.8817	0.8795	0.8788	0.8760	0.8738	0.8704	0.8700	.8813	.8802	.8795
927	638	524	615	651	487	586	600	637	691
1.992	2.08	2.01	2.09	1.97	2.12	2.05	2.15	2.13	2.50
2.10				2.10		2.10	2.15	2.15	2.15
1.995				1.99		1.995	2.04	2.04	2.04
94.8%	92.0%	95.7%	92.5%	93.8%	101%	97.6%	100%	99.1%	116.3%

See
next
PageSee
next
Page

L-438

L-438

5/4/66

322+00 327+00 291+00 317+00 332+00 337+50 343+00 348+00 353+00 358+00

E 10'LT. 3RT. 4'RT. 8'LT. 11'LT. E 5'RT. 8'LT. Q

4 5 1 2 3 4 5 1 2 3

4" 4" 4" 4"

1185 1471 1460 1631 1719 1362 1788 1621 1277 1574

1081 1365 1360 1534 1607 1274 1670 1515 1147 1460

104 106 100 97 112 88 118 106 130 114

9.6% 7.8% 7.4% 6.3% 7.0% 6.9% 7.1% 7.0% 11.3% 7.8%

4 5 1 2 3 4 5 1 2 3

1221 1183 1258 1246 1248 1270 1251 1219 1209 1261

740 624 686 647 564 725 585 597 681 669

481 559 572 599 684 545 666 622 528 592

49° 52° 63° 68° 69° 68° 68° 70° 76° 80°

8791 8780 8742 8722 8719 8722 8722 8716 8694 8679

547 637 654 687 784 625 764 714 607 682

1.98 2.14 2.08 2.23 2.05 2.04 2.19 2.12 1.89 2.14

2.15 2.15 2.10 2.15 2.15 2.15 2.15 1.95 1.95 1.95

2.04 2.04 1.99 2.04 2.04 2.04 2.04 1.85 1.85 1.85

92.1% 99.5% 96.7% 103.7% 95.3% 95.0% 101.9 108.7 97.0 109.7

L-938

L-938

~~5-5-66~~

5-5-66 5-6-66

363+00	368+00	374+00	381+00	386+00	391+00	396+00	401+50	406+50	412+00
7' RT.	6' L.T.	£	6' RT.	6' LEFT.	£	6' Right	6' LEFT	£	6' RIGHT
4	5	1	2	3	4	5	1	2	3
4"	4"	4"	4"						
1290	1537	1282	1093	1414	1207	1264	1502	1228	1502
1196	1434	1204	989	1229	1117	1192	1414	1149	1421
94	103	78	104	185	90	72	88	79	81
7.9%	7.2%	6.5%	10.5%	15.1%	8.1%	6.0%	6.2%	6.9%	5.7%
4	5	1	2	3	4	5	1	2	3
1228	1227	1227	1222	1225	1195	1201	1210	1202	1219
677	610	751	812	693	731	709	632	716	648
⁵⁵¹ 65+	617	476	410	532	464	492	598	486	571
79°	79°	64°	66°	97°	96°	96°	58°	58°	60°
.8683	.8683	.8738	.8730	8619	8622	8622	.8759	.8759	.8752
⁶³⁵ 749	710	545	470	617	538	571	682	555	652
^{1.88} 1.60	2.02	2.20	2.10	1.99	2.07	2.09	2.07	2.07	2.18
1.95	1.95	1.95	1.95	2.09	2.09	2.09	2.09	2.09	2.09
1.85	1.85	1.85	1.85	1.99	1.99	1.99			
96.9%	103.6%	113.0%	107.7%						

N 29830 Cedar
L-438

N 29830
Cedar

5-6-66 5/6/66

May 7, 66

May 7-66

417+00	423+00	64	59	53	48	43	36	29+00	22+00
8' LEFT	£	£	6' LEFT	6' Right	£	8' LEFT	6' Right	£	6' LT.
4	5	1	2	3	4	5	1	2	3

1350	1325	1302	1340	1311	1333	1409	1230	1377	1317
1299	1254	1171	1215	1219	248	1318	1136	1242	1205
51	71	131	125	92	85	91	94	135	112
3.9%	5.7%	11.2%	10.3%	7.5%	6.8%	6.9%	8.3%	10.9%	9.3%

4	5	1	2	3	4	5	1	2	3
1198	1216	1208	1219	1223	1219	1229	1228	1222	1212
681	731	680	688	728	722	681	735	666	675
517	485	528	531	494	497	548	493	556	537
61°	62°	70°	76°	78°	84°	80°	54°	55°	56°
8748	8745	8716	8694	8687	8665	8679	8723	8770	8766
591	555	606	611	569	574	631	562	634	613
2.20	2.26	1.93	1.99	2.14	2.17	2.09	2.02	1.96	1.97

2.09	2.09	2.10	2.10	2.10	2.10	2.10	2.04	2.04	2.04
		2.00	2.00	2.00	2.00	2.00	1.94	1.94	1.94

In
Corecut

Correction Rd.
John Deere

L-2677

-N 29430

Cedar

windy &
cool

5-7-66	5-7-66	5/18/66	5-18-66	5-18-66	5-18-66	5-18-66	5-19-66	5-19-66	5-19-66
15+50	7+00	218+00	223+00	228+00	233+00	238+00	243+00	248+00	253+00
6' RT.	♀	10' LT.	♀	8' RT.	9' LT	♀	10' RT.	♀	8' LT
4	5	1	2	3	4	5	1	2	3
		4"	4"	4"	4"	4"	4"	4"	4"
1479	1325	1169	1469	1315	1292	1202	1454	1195	1401
1332	1206	1054	1307	1182	1172	1057	1312	1111	1323
147	119	115	162	133	120	145	142	84	78
9.4%	10.1%	9.2%	8.1%	8.9%	9.8%	13.7%	10.8%	7.6%	5.9%
4	5	1	2	3	4	5	1	2	3
1210	1216	1237	1229	1237	1262	1228	1231	1238	1234
611	700	764	650	706	745	730	655	731	662
599	516	573	579	531	517	498	576	507	572
58°	60°	63°	62°	64°	64°	64°	54°	69°	69°
8759	8752	8742	8745	8738	8738	8738	8773	8719	8719
684	590	655	662	608	592	570	657	581	656
1.95	2.04	1.61	1.97	1.94	1.98	1.85	2.00	1.91	2.02
2.04	2.04	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
1.94	1.94	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95

✓
see
over
two
pages
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5-17-66	5-19-66	5-20-66	5-20-66	5-20-66	5-20-66	5-20-66	5-20-66	5-20-66	5-20-66
258+100	264+100	279+100	284+100	289+100	295+100	300+100	305+100	310+100	315+100
8' RT	9	9' LT	8' RT	9	9' LT	9' RT	9	10' LT	10' RT
4	5	1	2	3	4	5	1	2	3
4"	4"	4"	4"	4"	4"	4"	4"	4"	4"
1231	1203	1326	1341	1329	1380	1426	1259	1310	1299
1159	1081	1245	1218	1201	1234	1284	1152	1198	1212
82	122	81	123	128	146	142	107	112	87
7.1%	11.3%	6.5%	10.1%	10.7%	11.8%	11.9%	9.3%	9.3%	7.2%

4	5	1	2	3	4	5	1	2	3
1258	1238	1220	1215	1200	1231	1229	1217	1243	1223
755	726	682	681	650	670	647	705	724	702
503	512	538	534	550	561	582	512	519	521
70°	68°	58°	58°	62°	63°	63°	72°	71°	70°
87116	8722	8759	8759	8745	8742	8742	8708	8712	8716
577	587	614	610	629	642	666	588	596	598
2.01	1.84	2.03	2.00	1.91	1.92	1.93	1.96	2.01	2.03
2.05	2.05	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99
1.95	1.95	1.89	1.89	1.89	1.89	1.89	1.89	1.89	1.89
1.95									

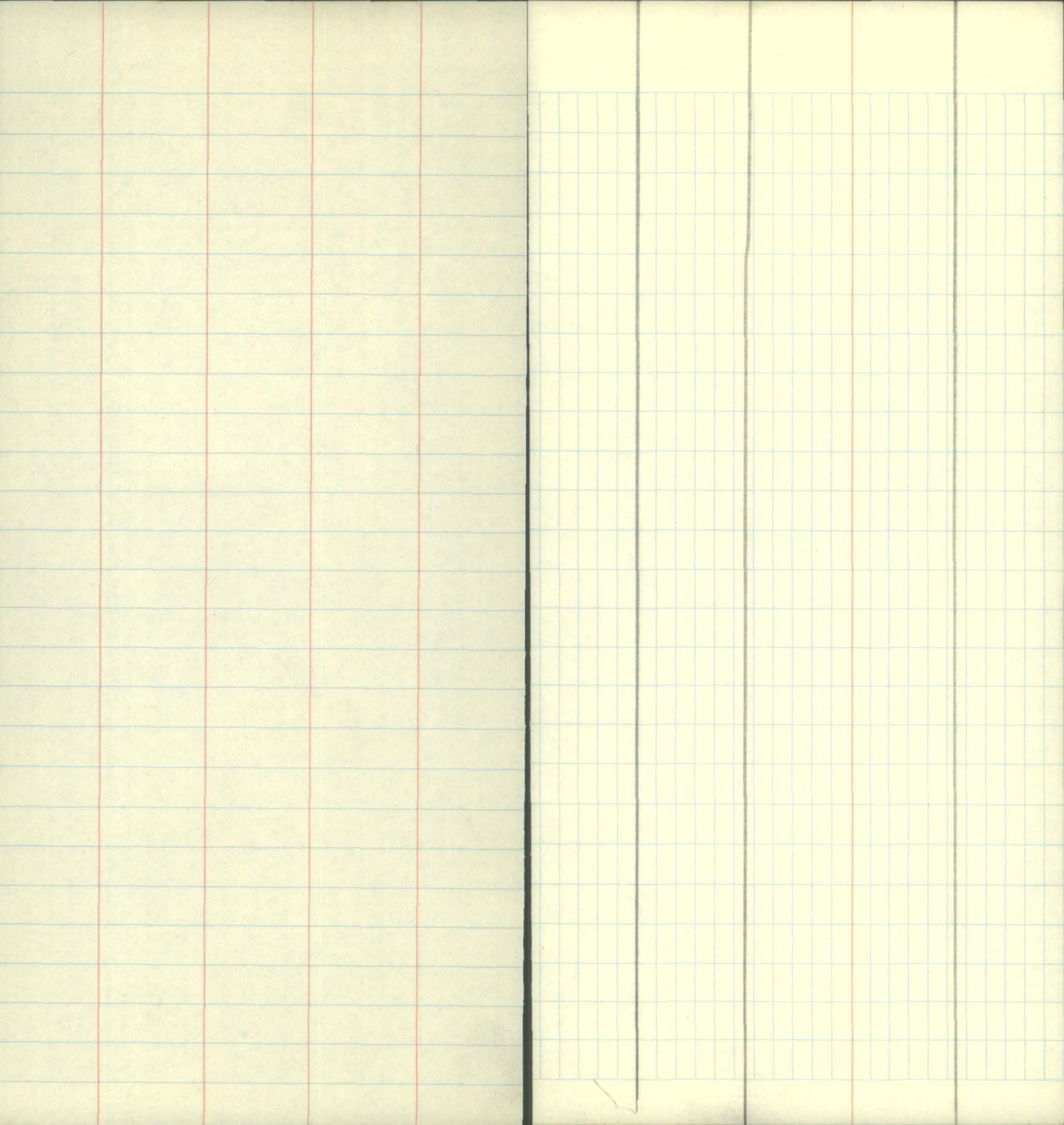
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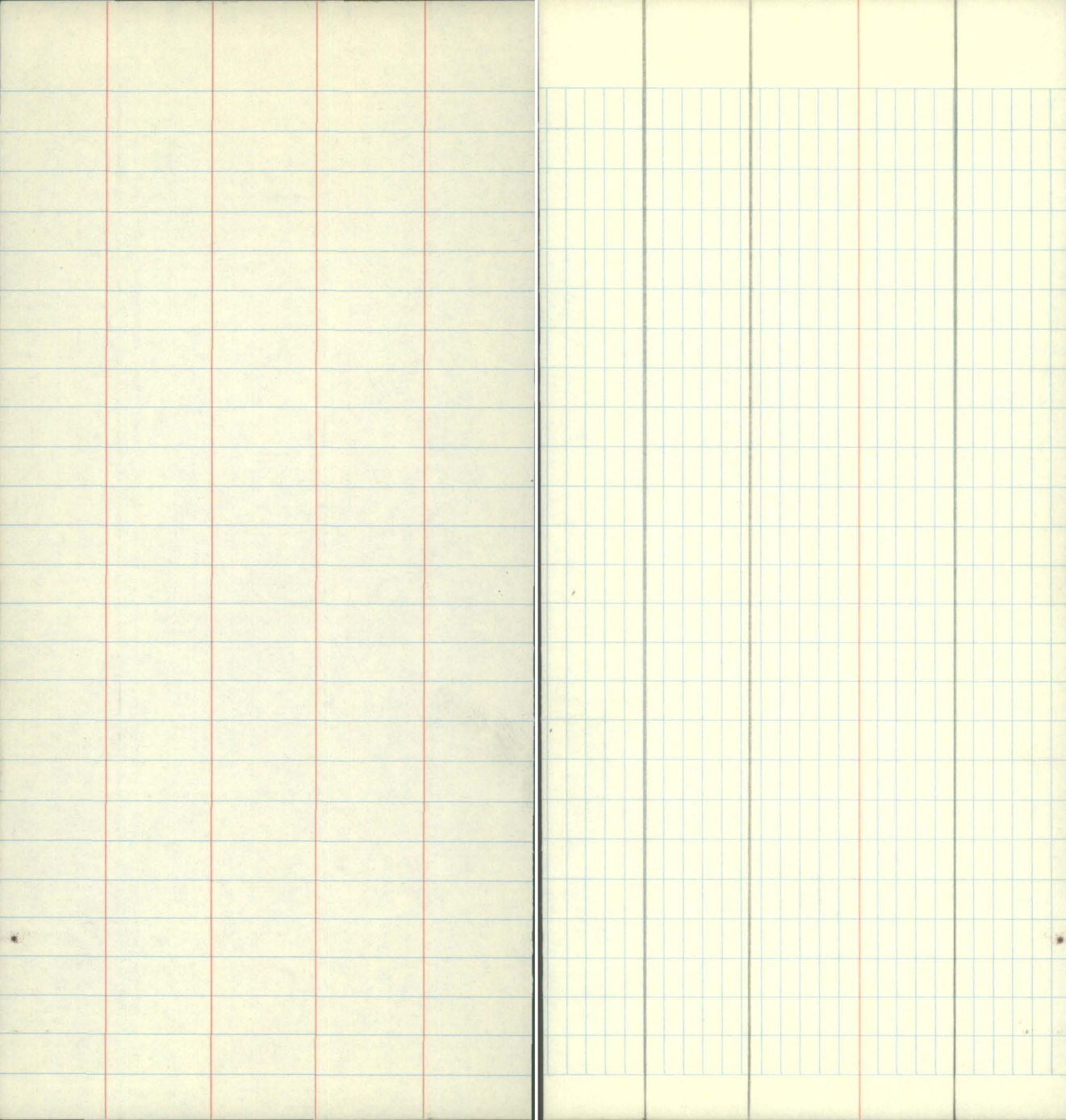
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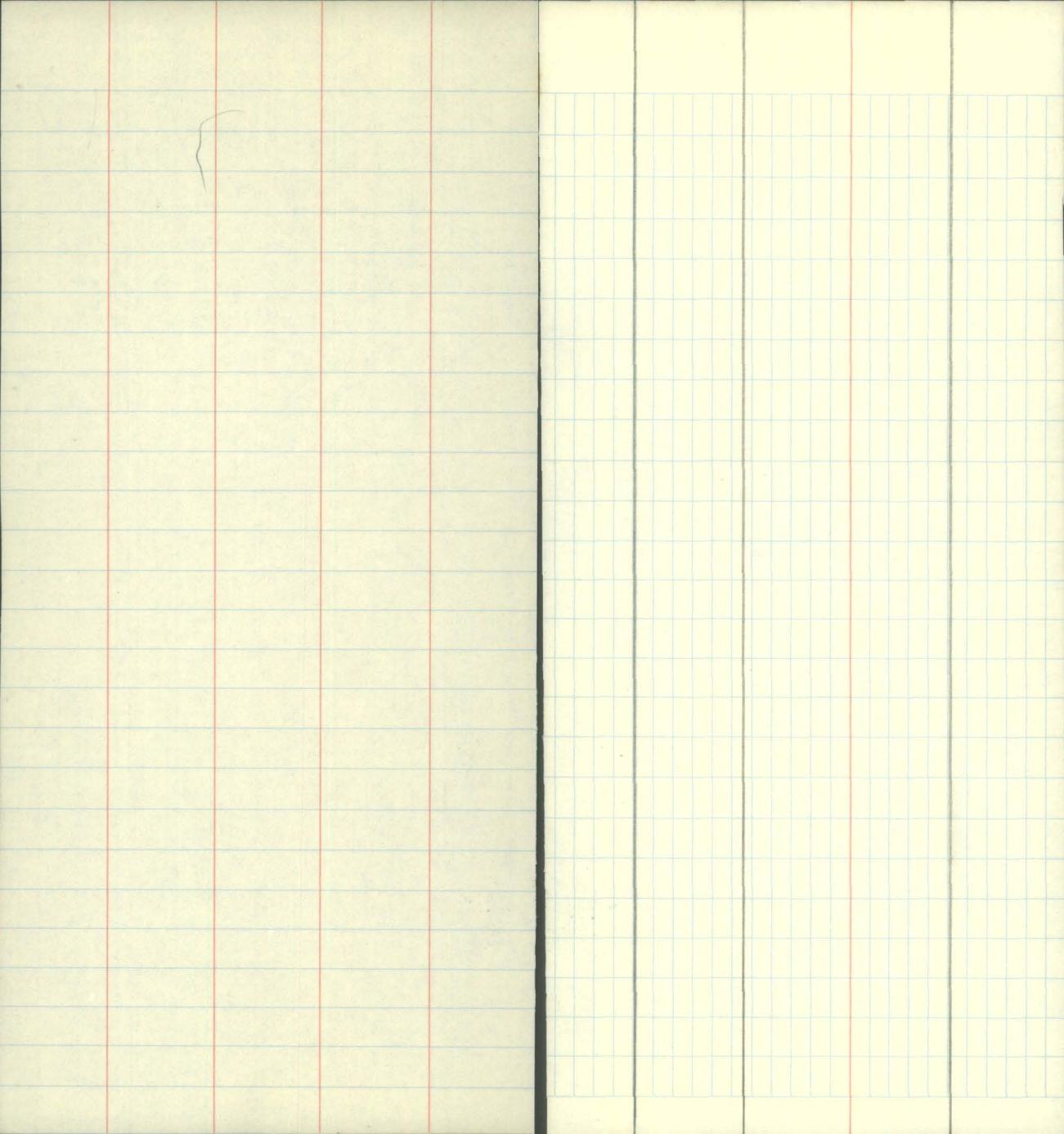
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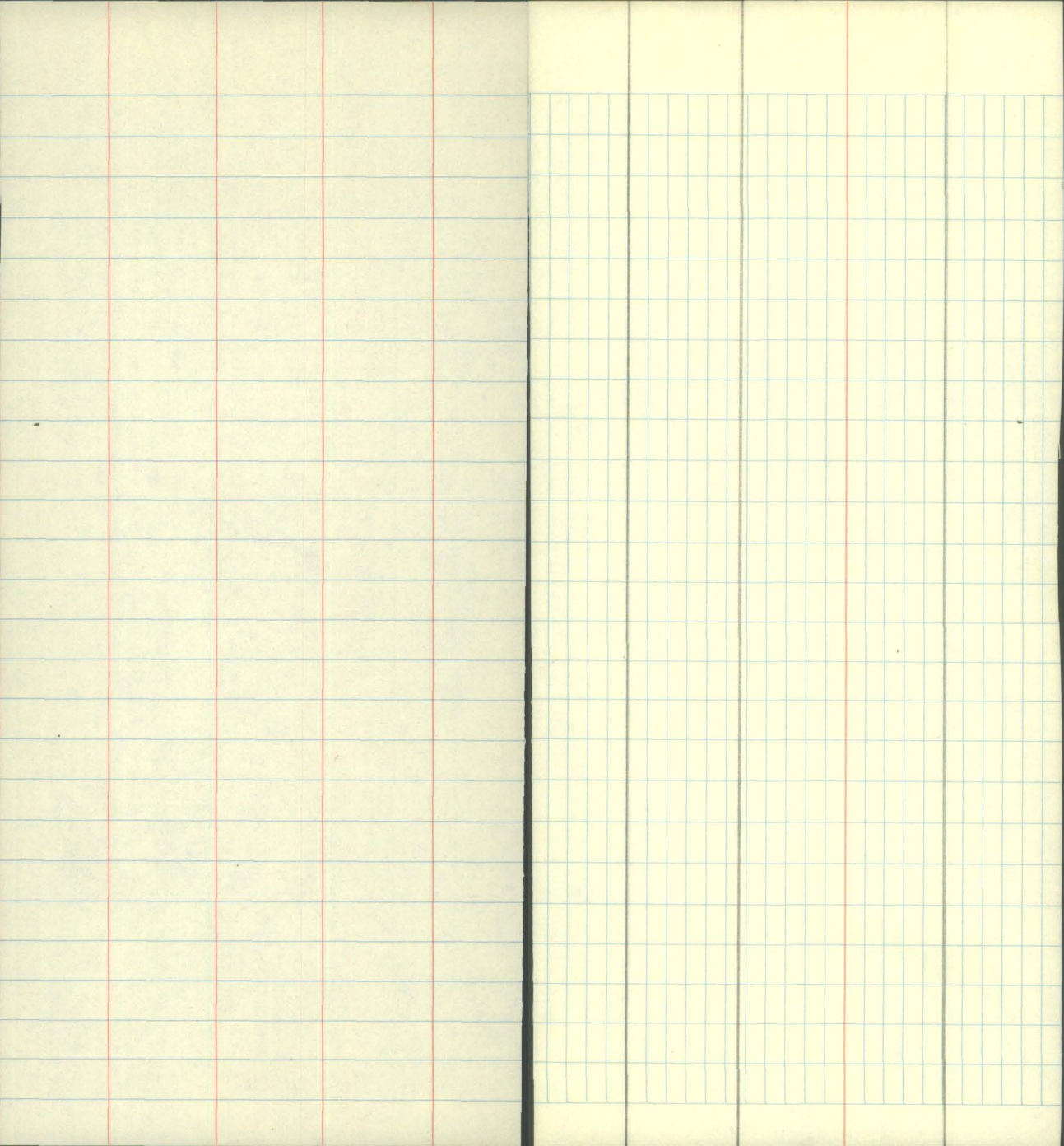
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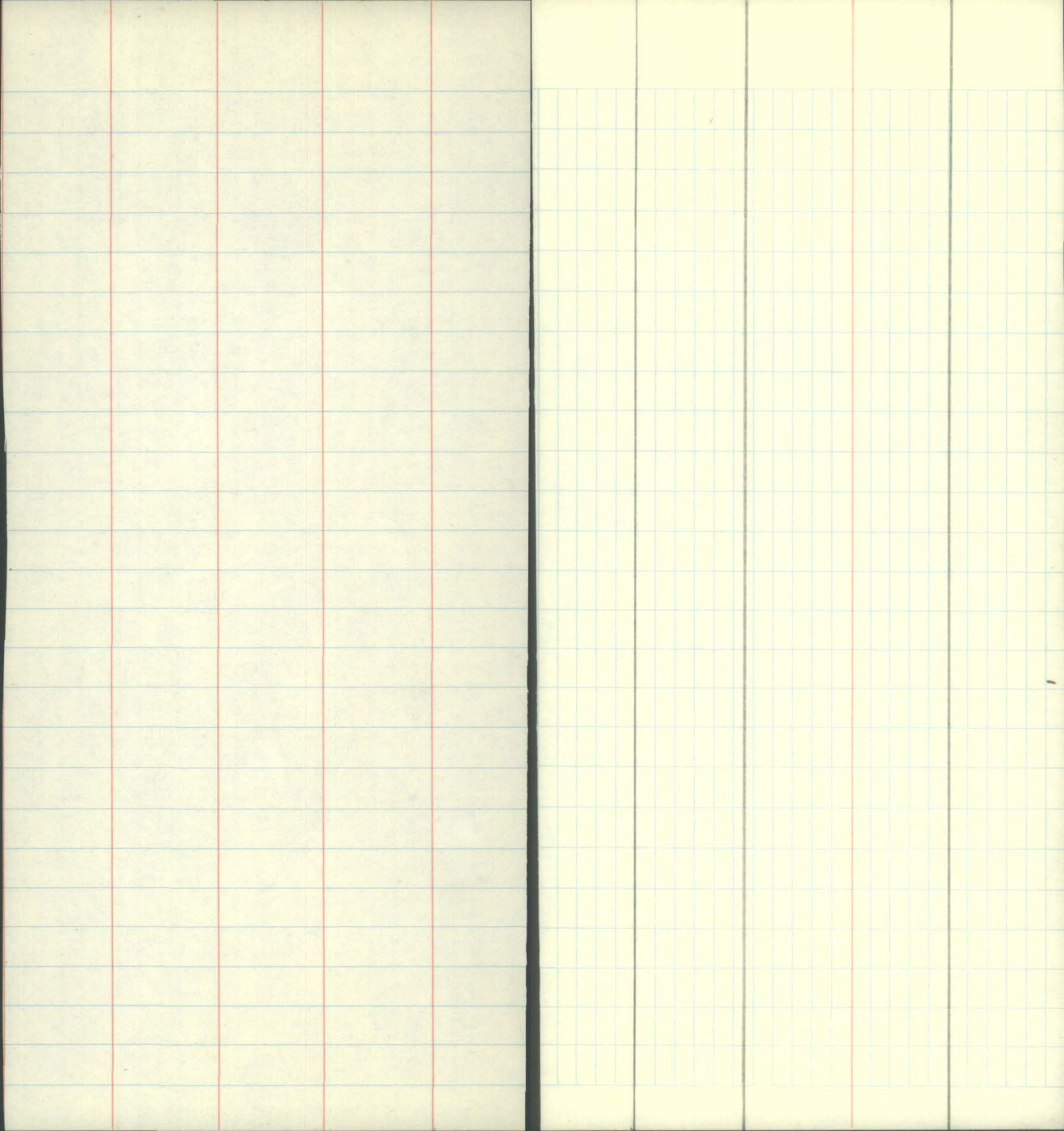
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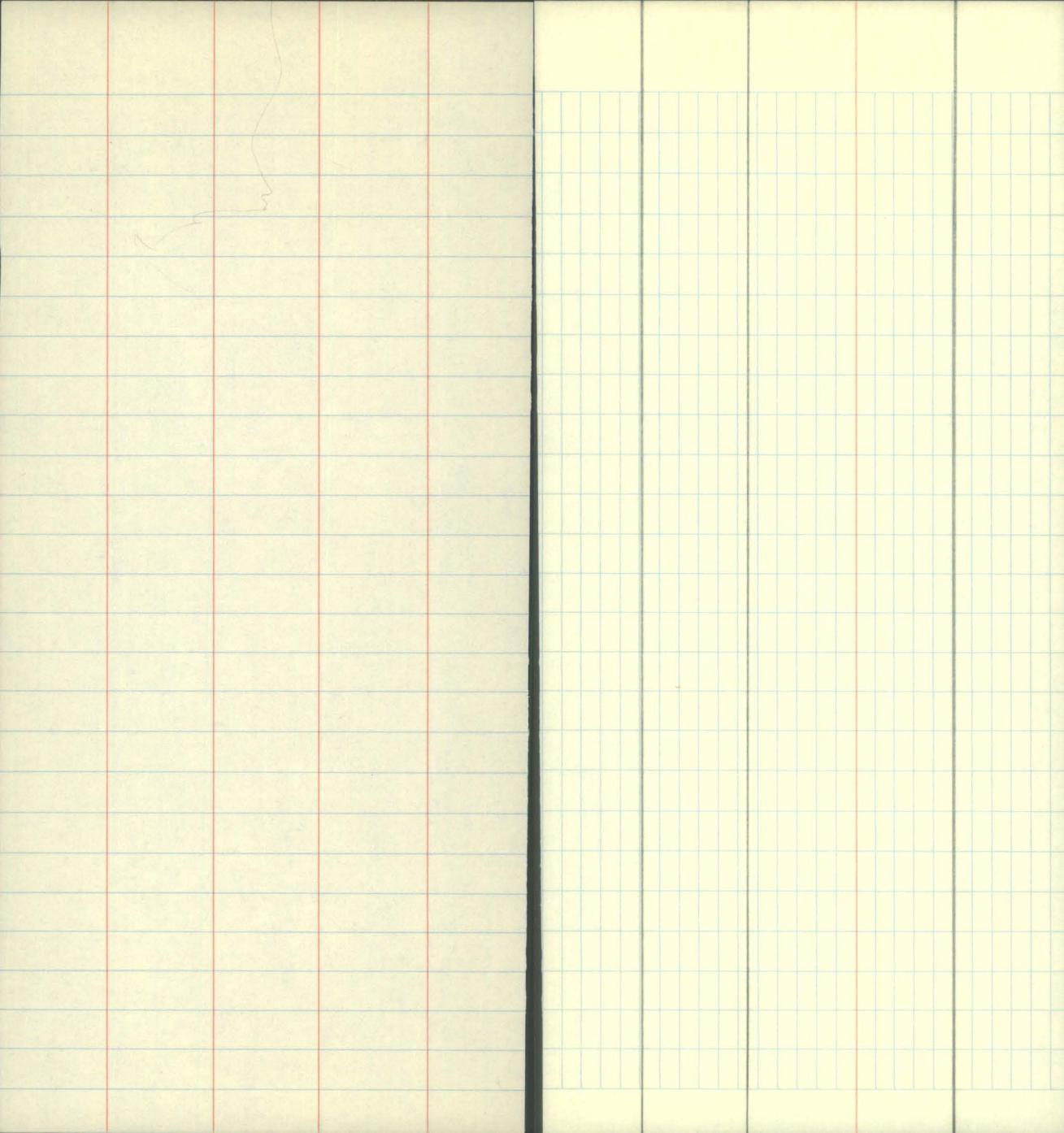


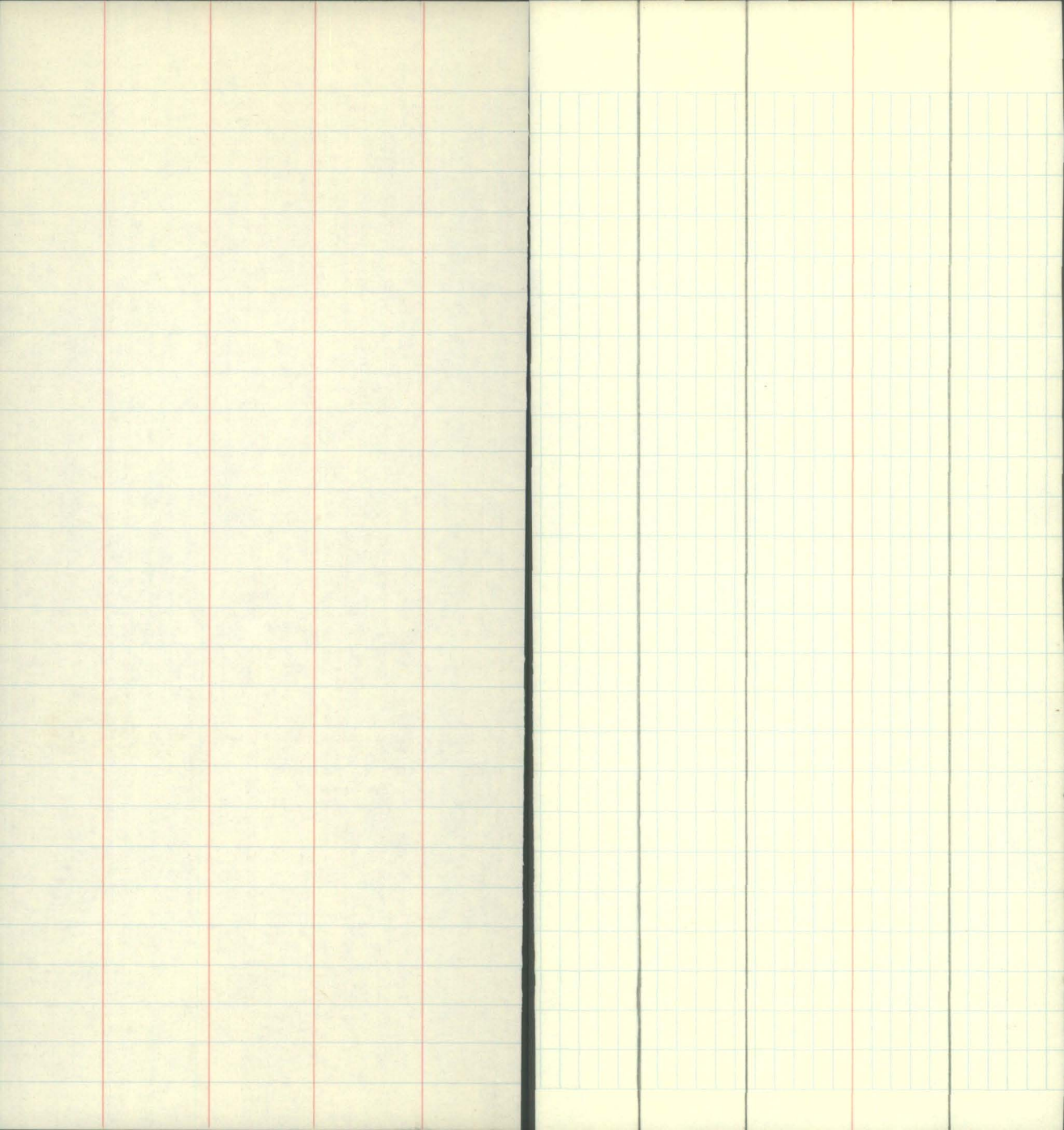


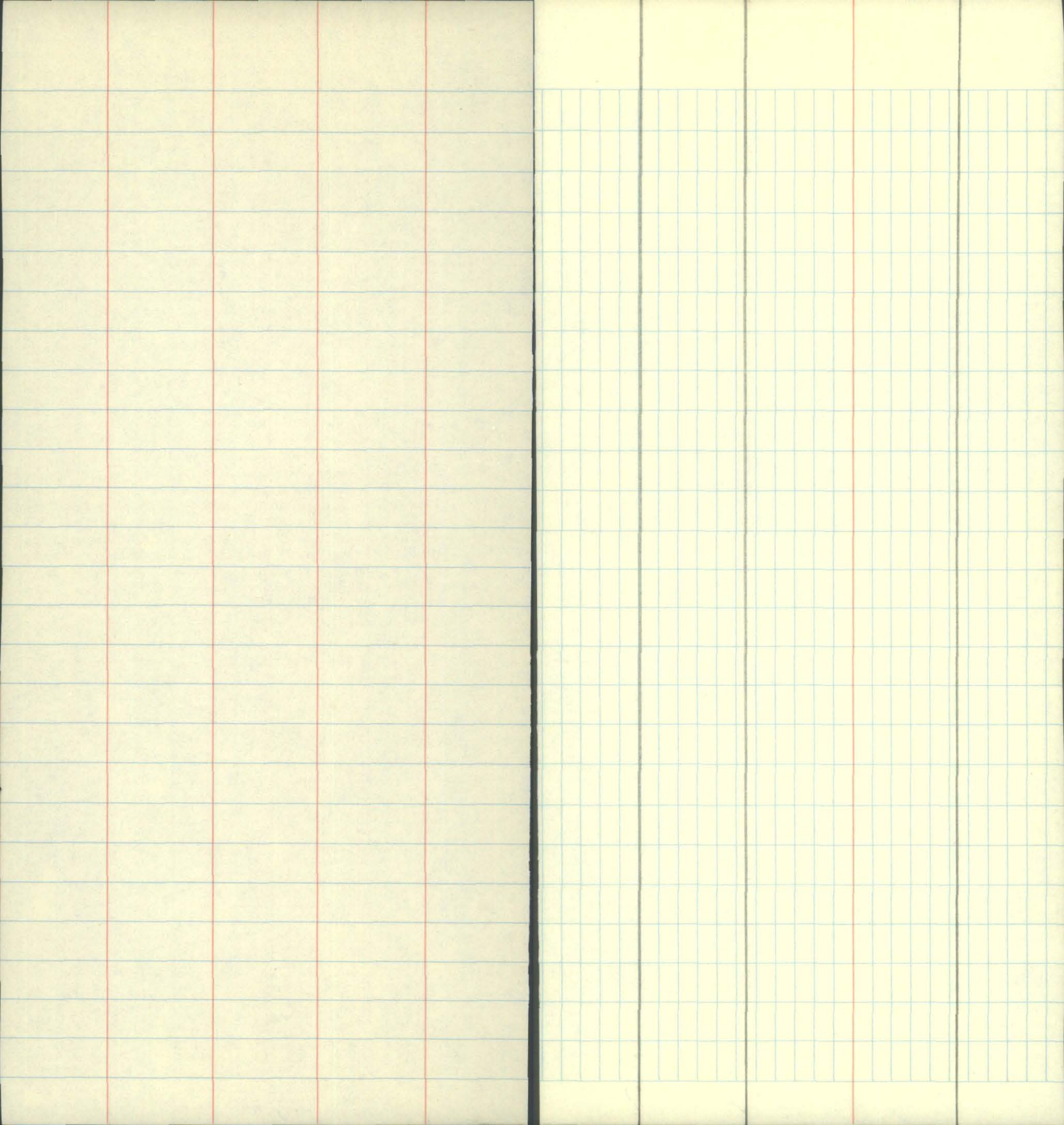


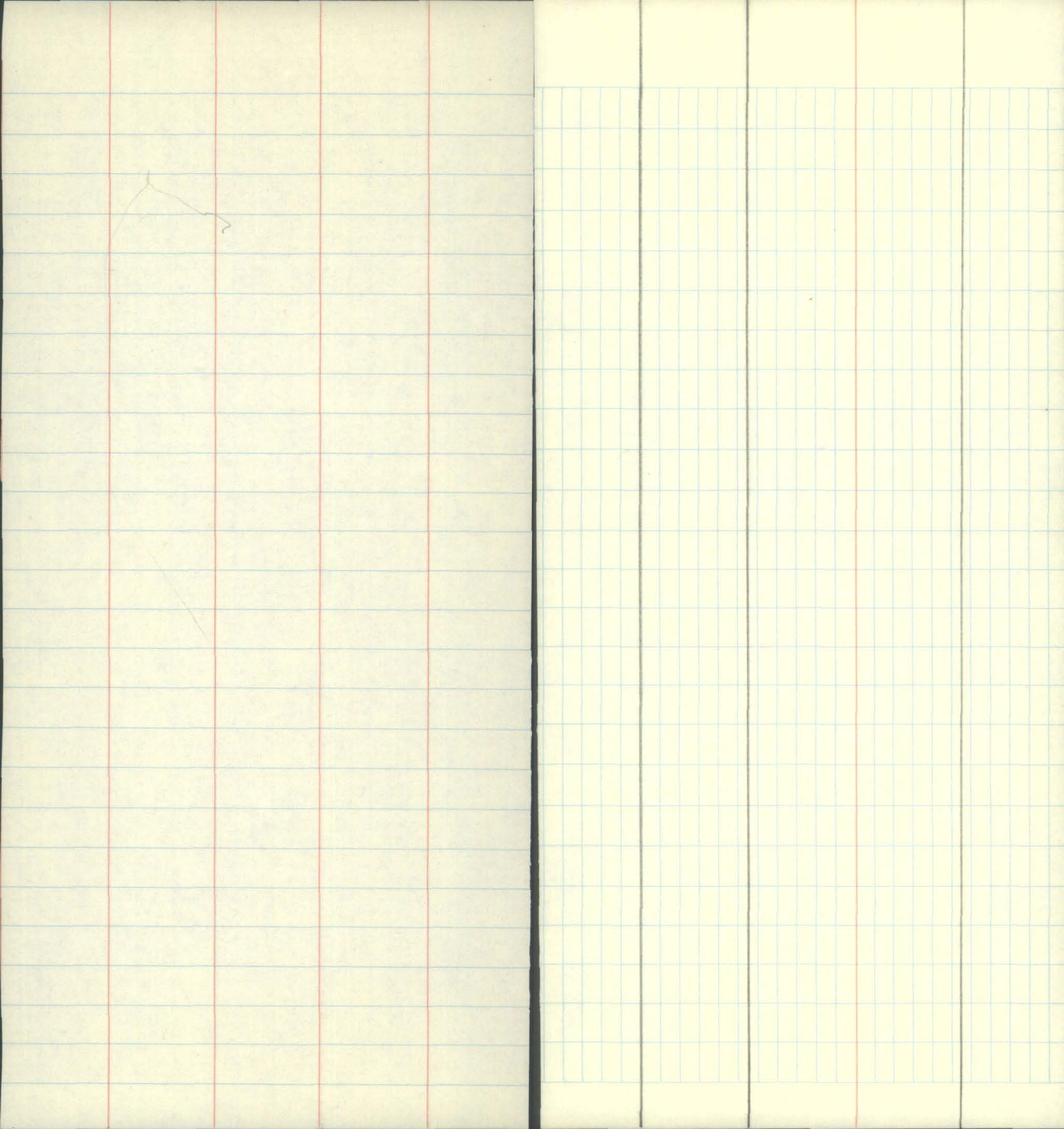


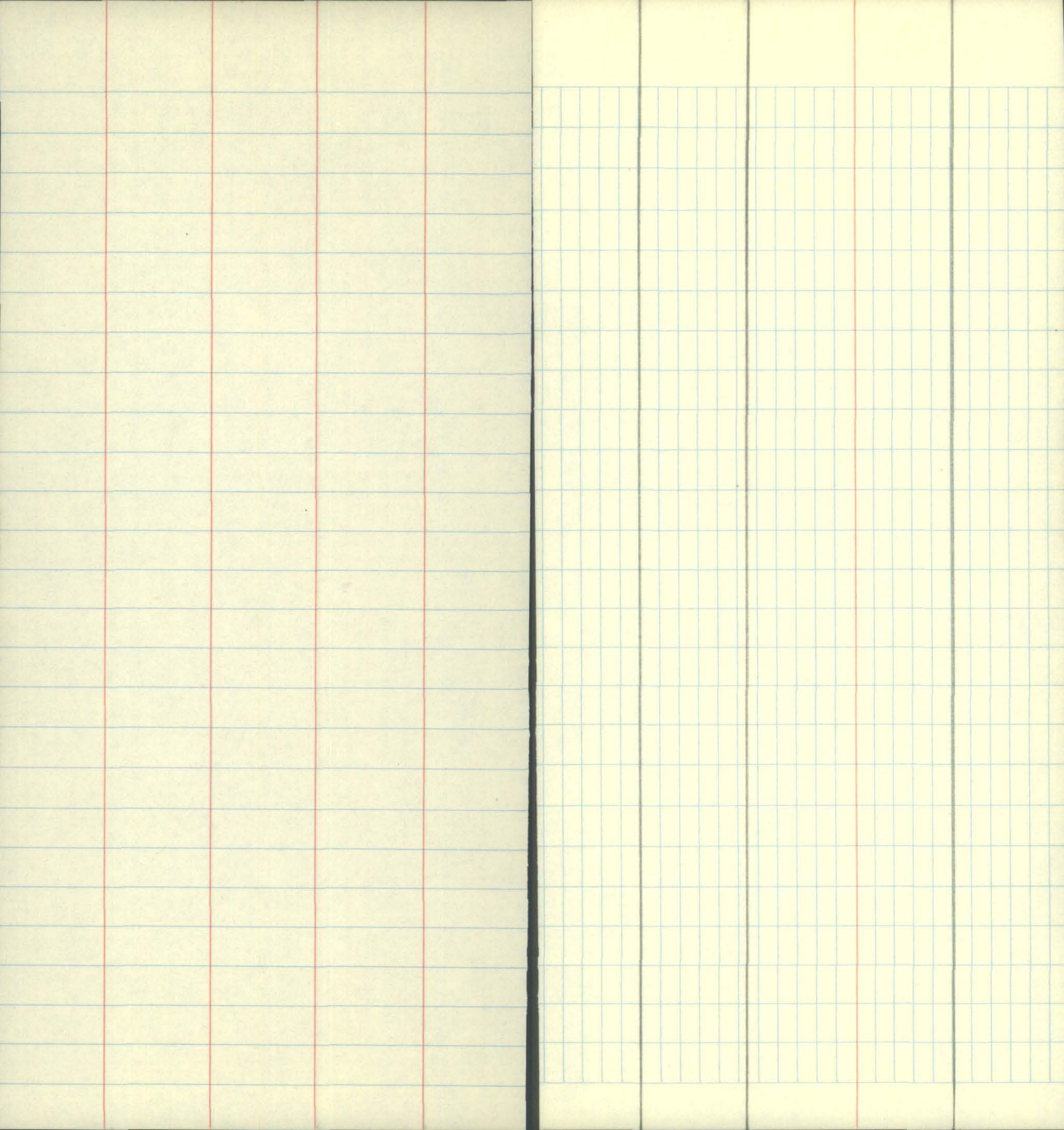


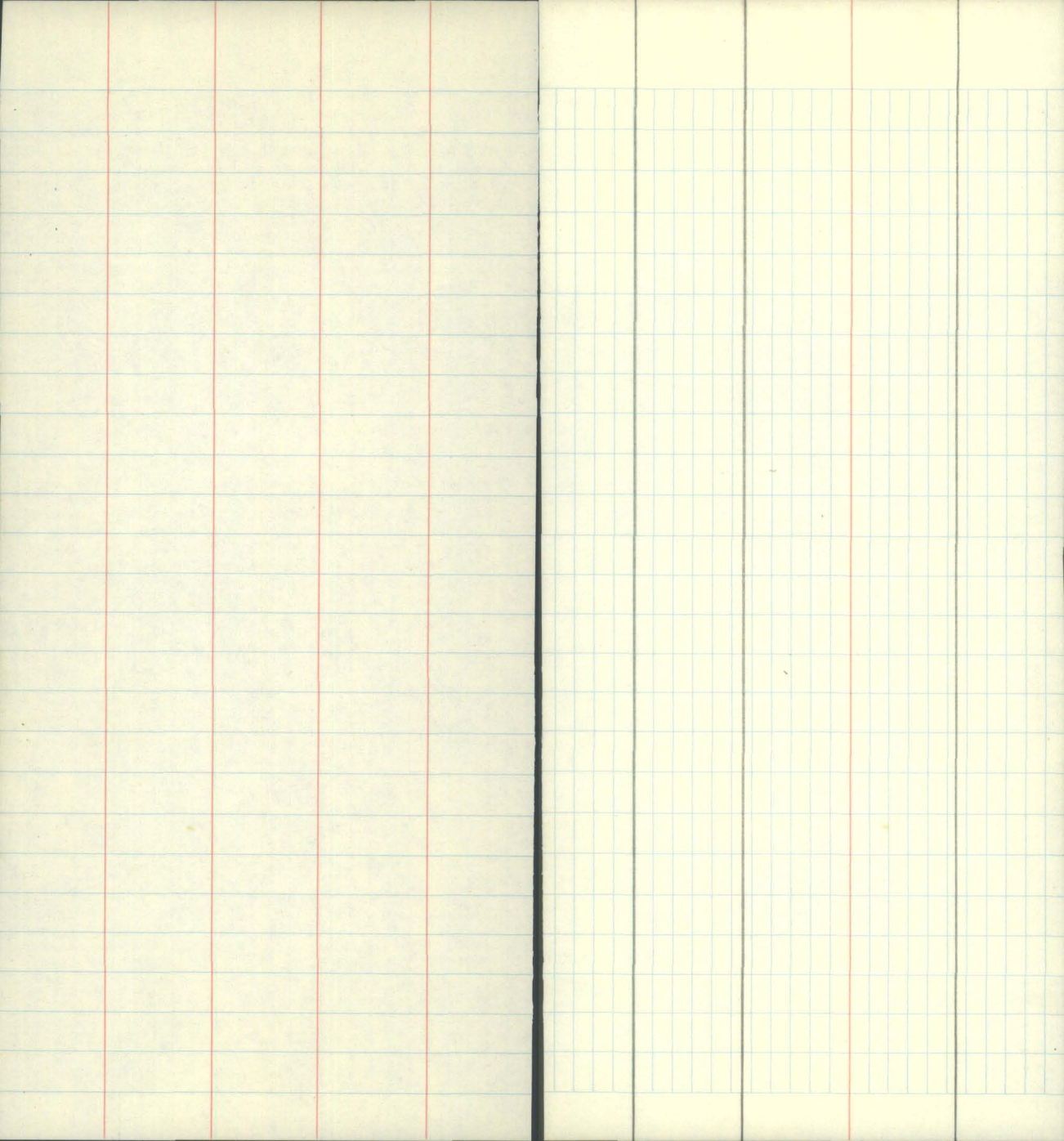


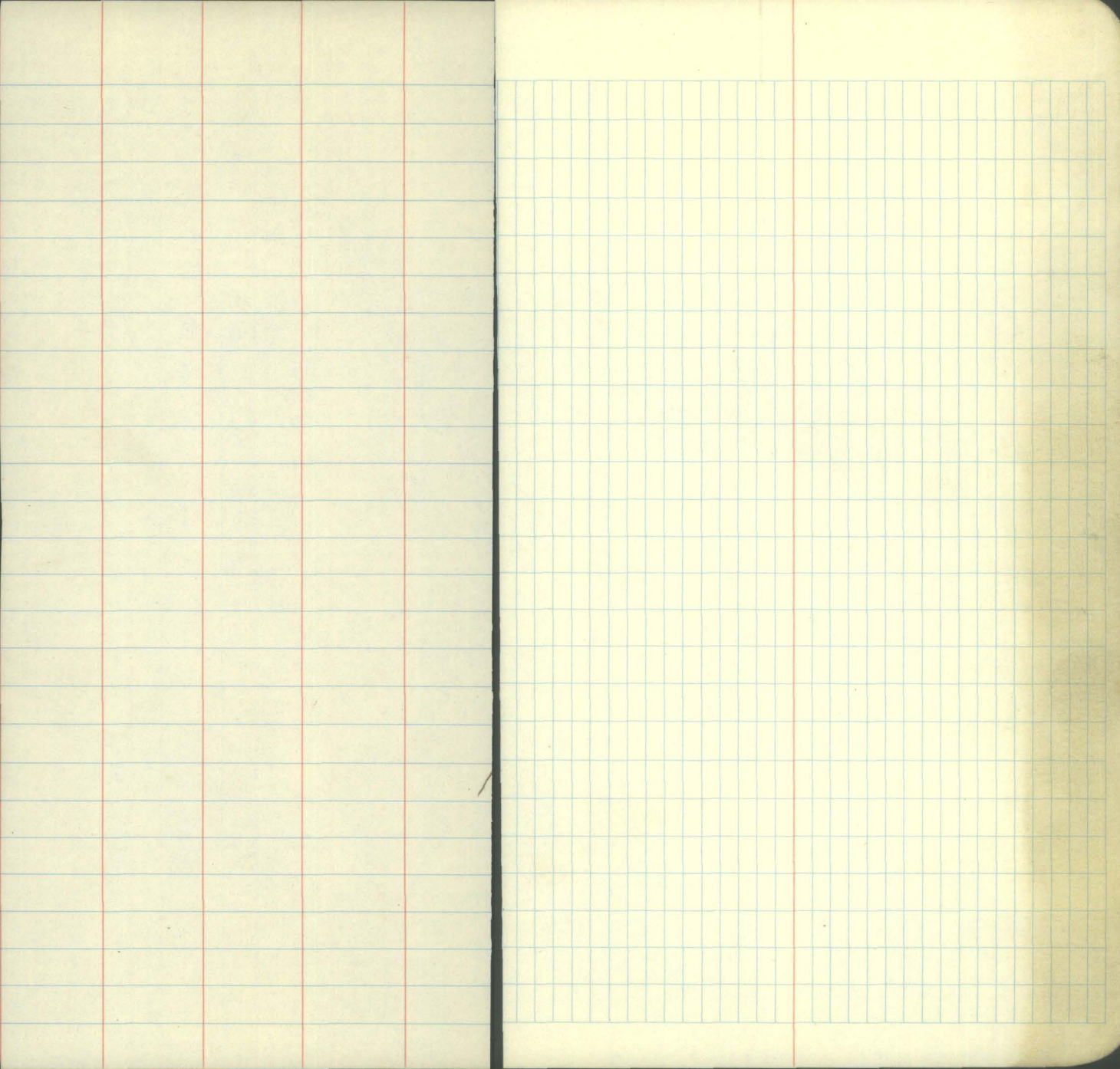


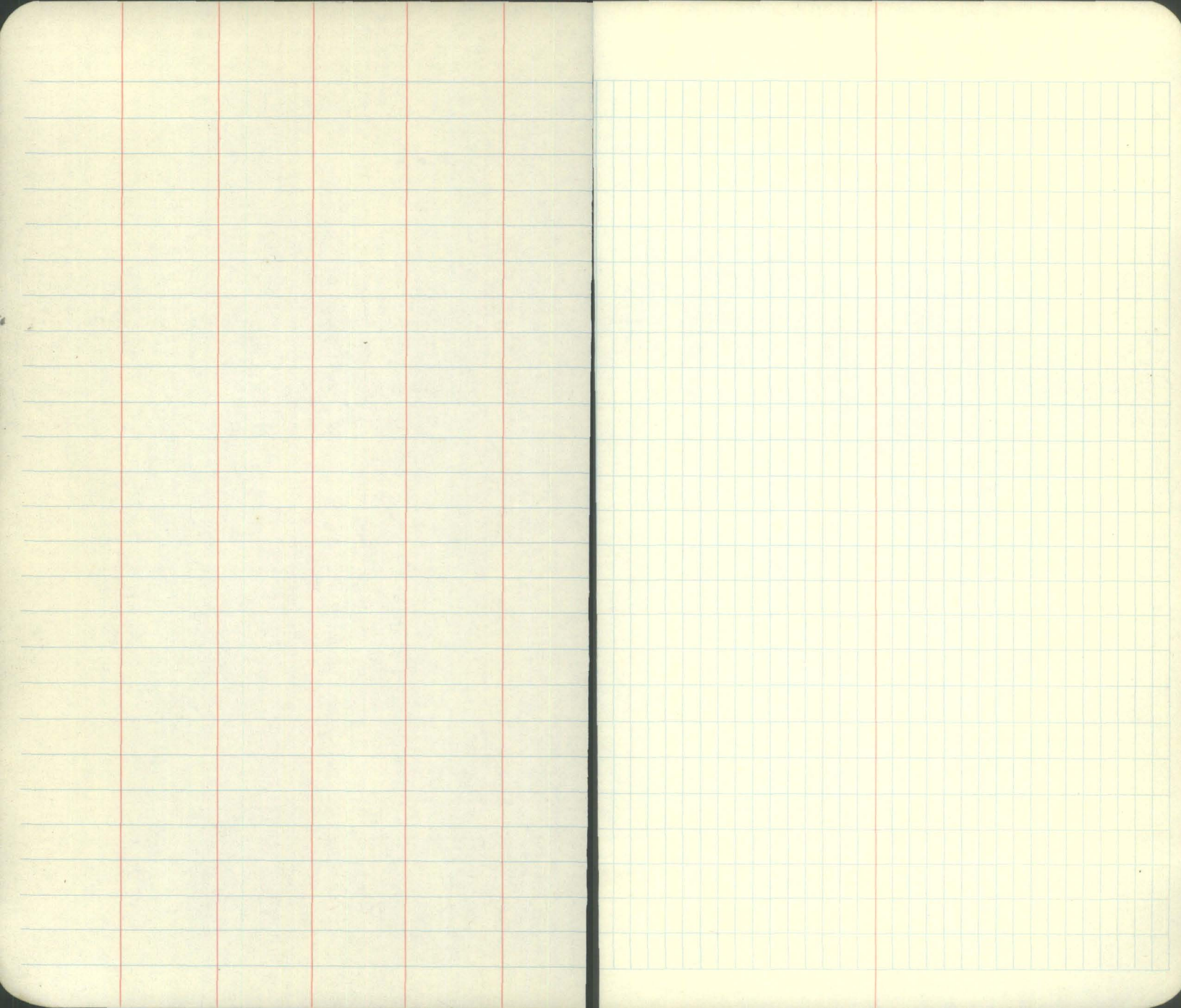


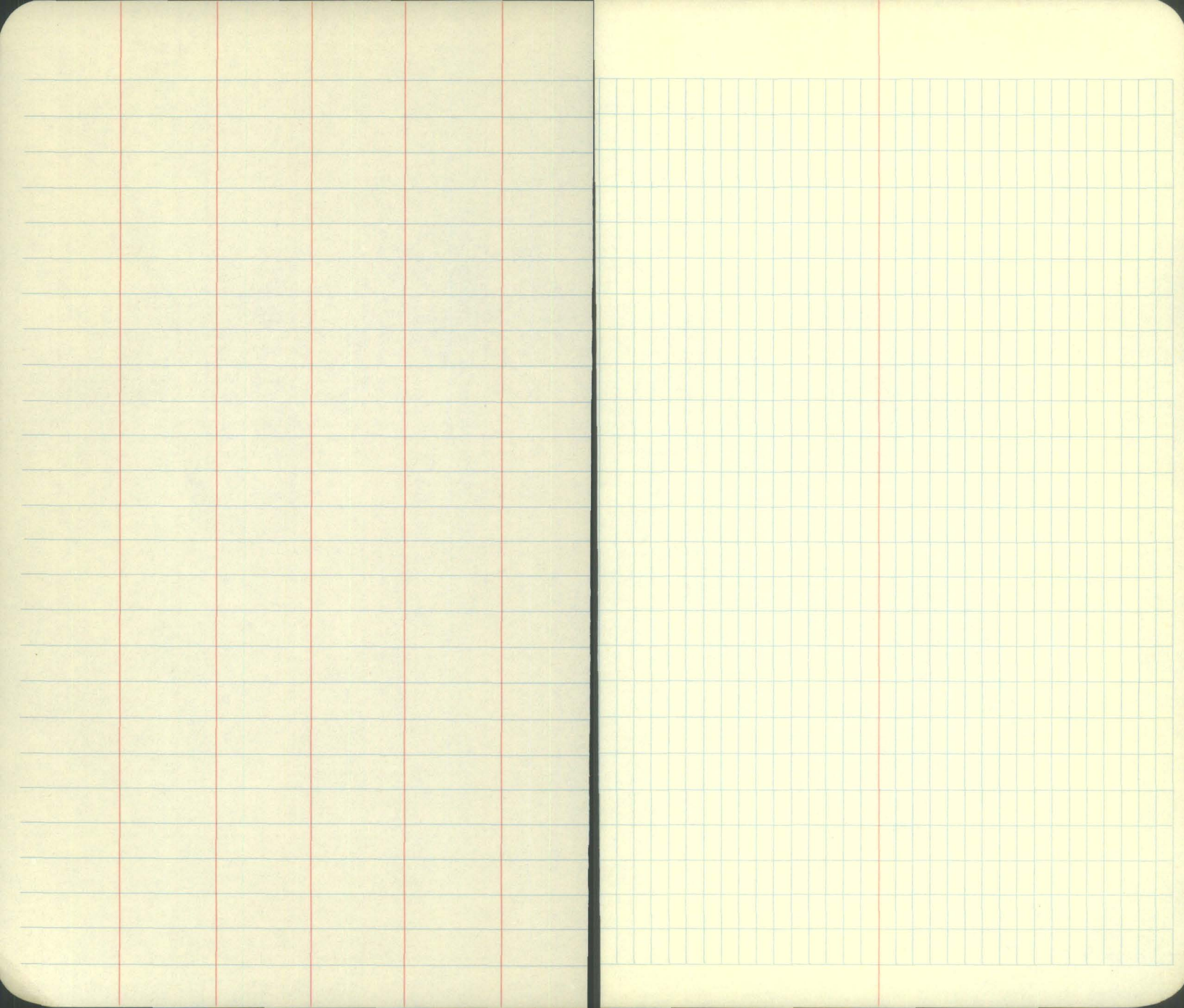


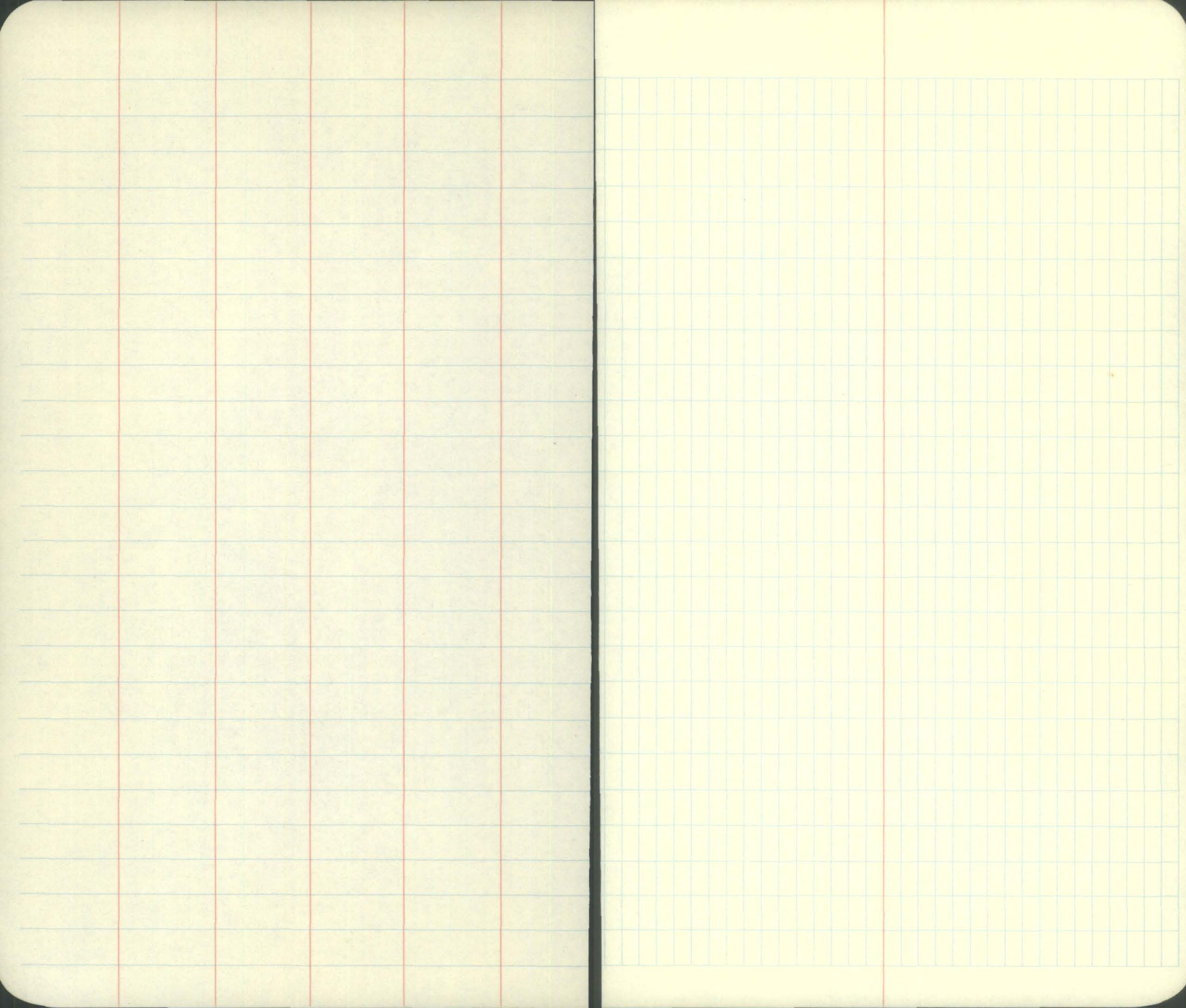


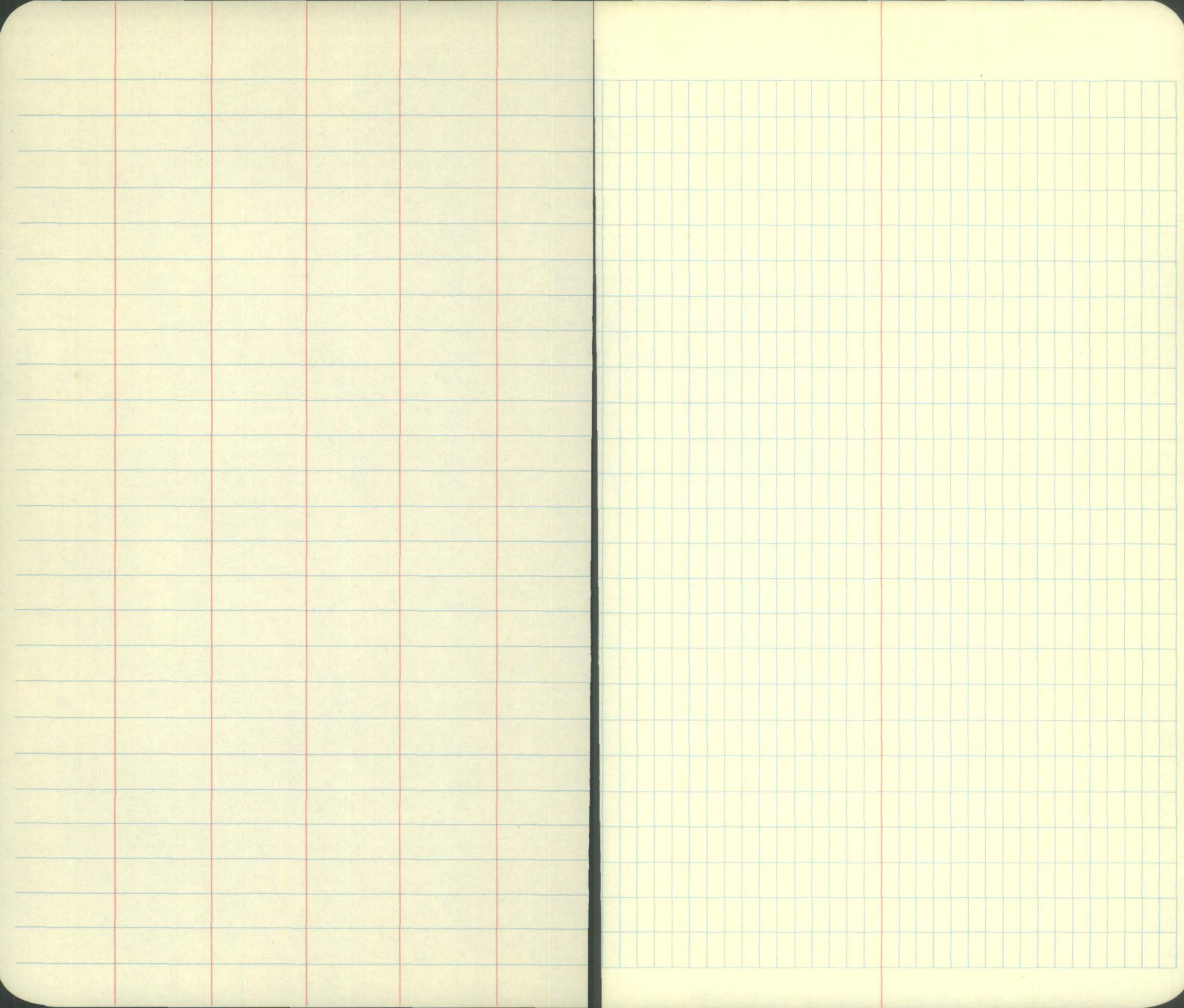


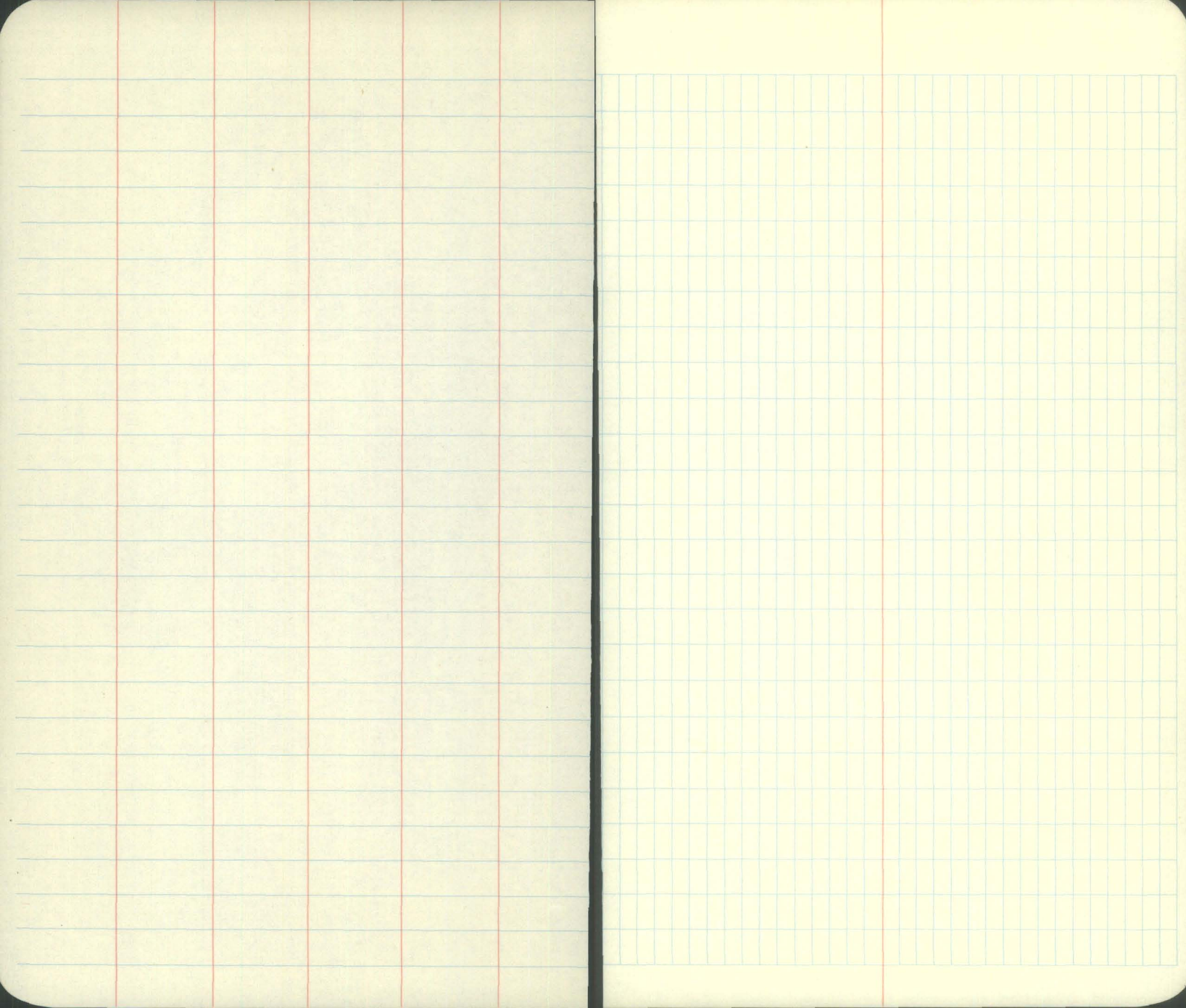


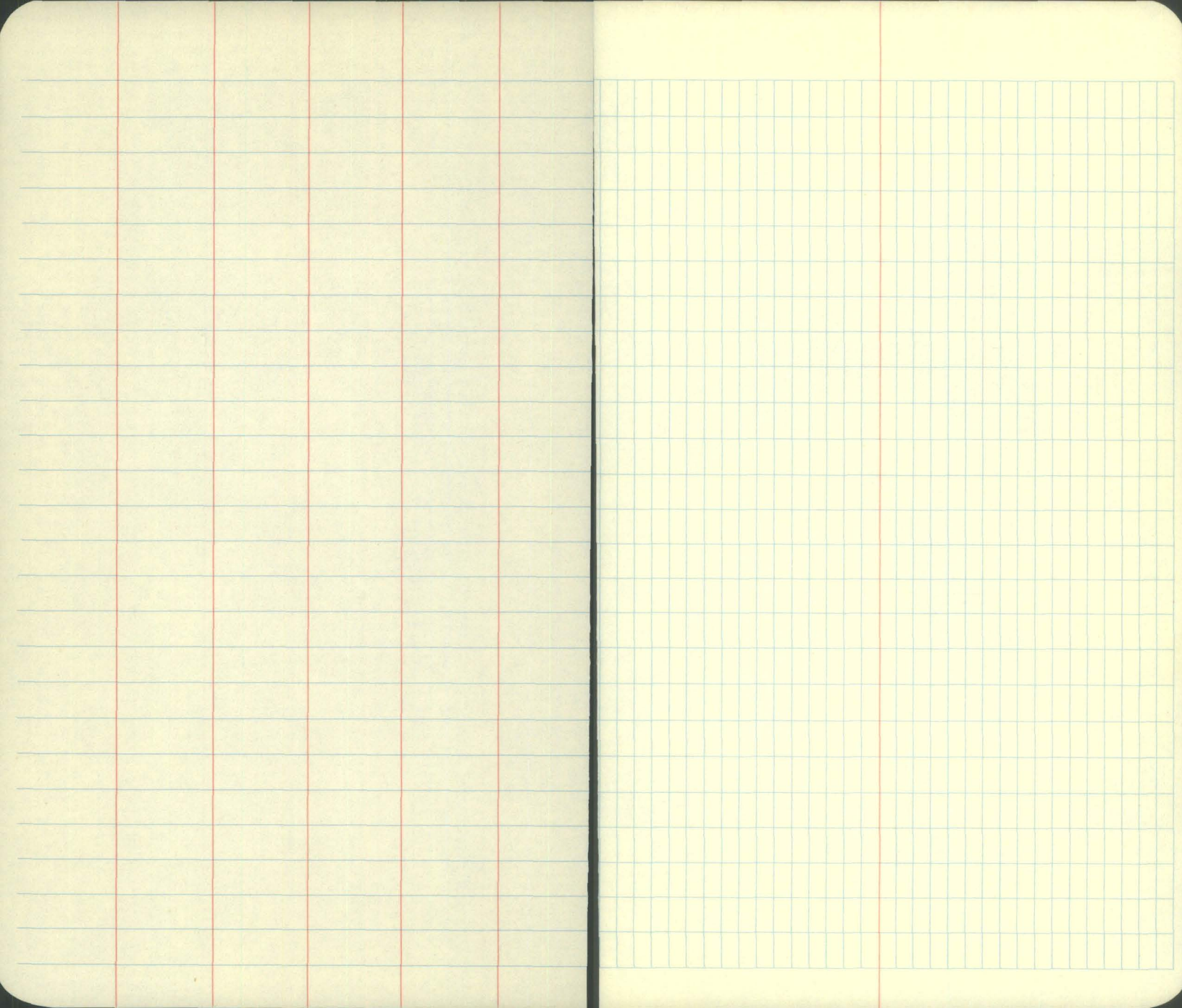


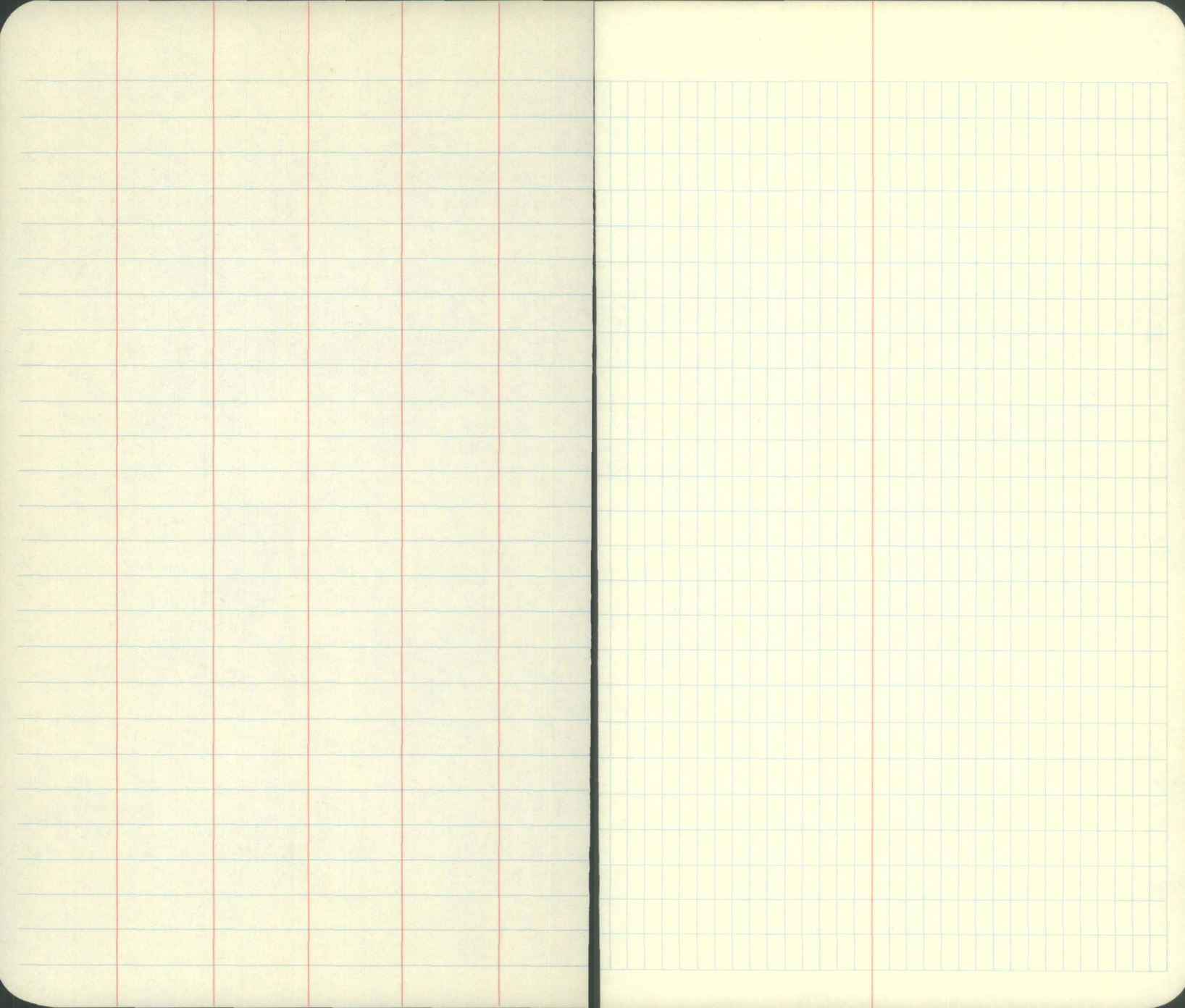


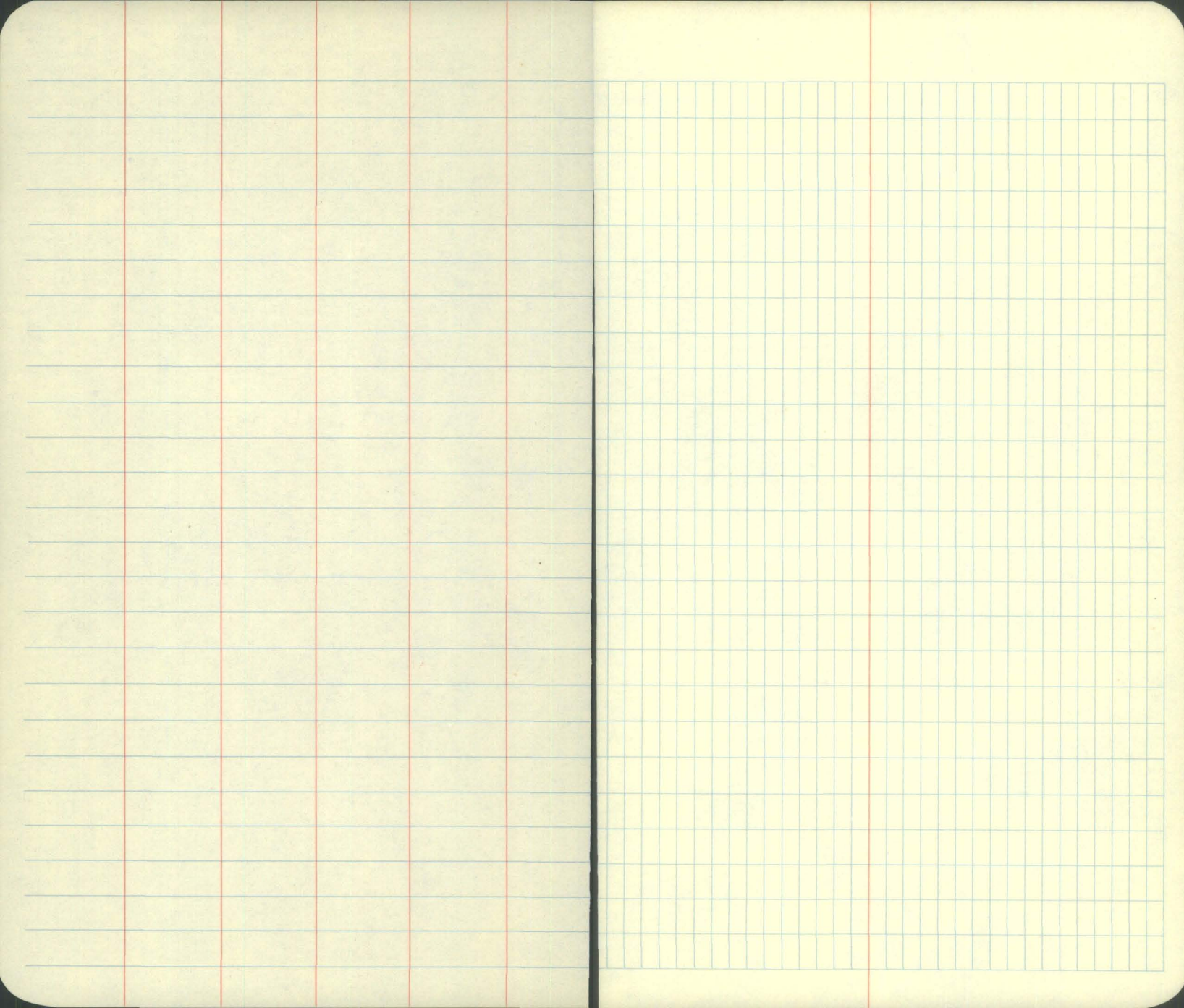


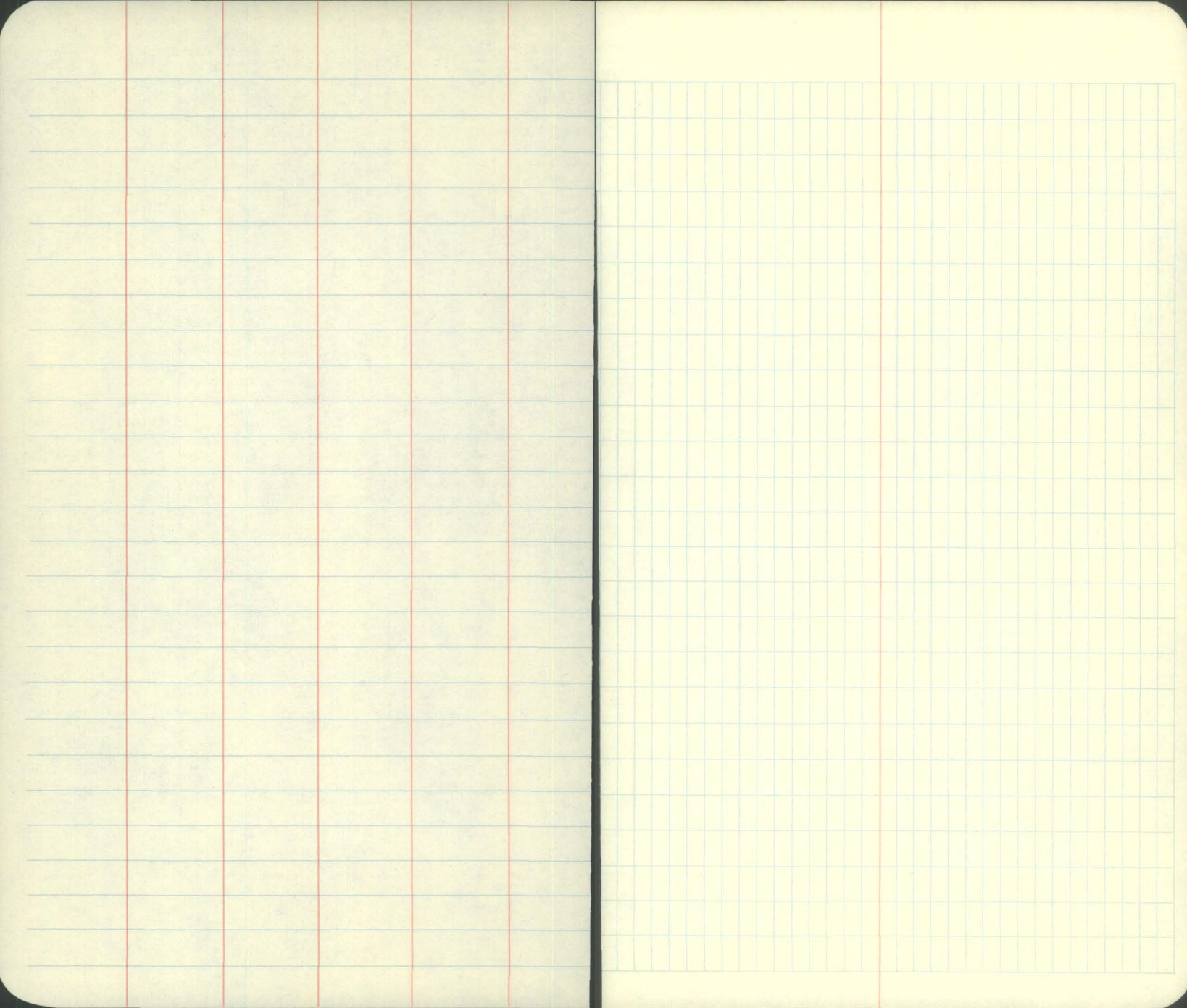


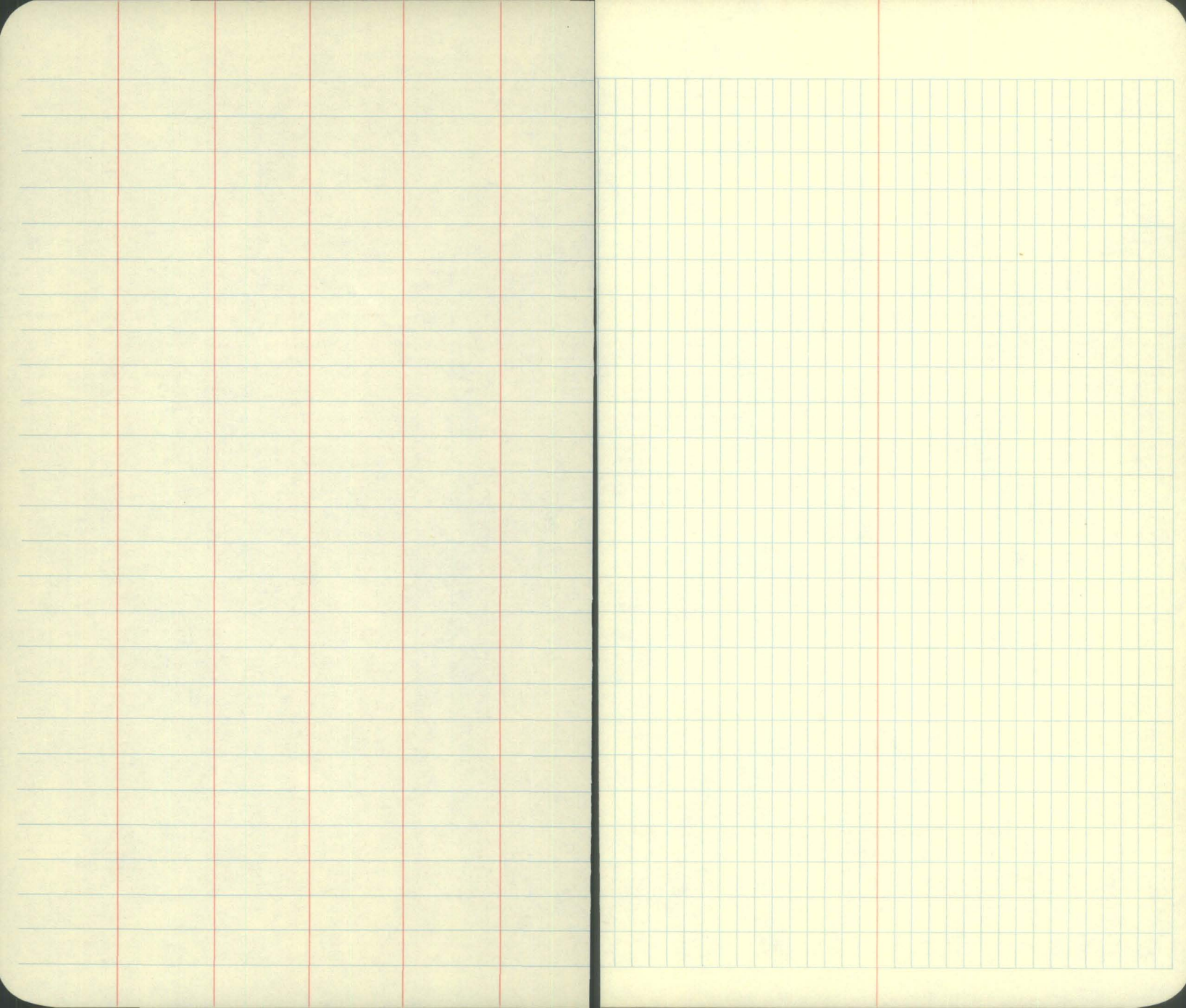


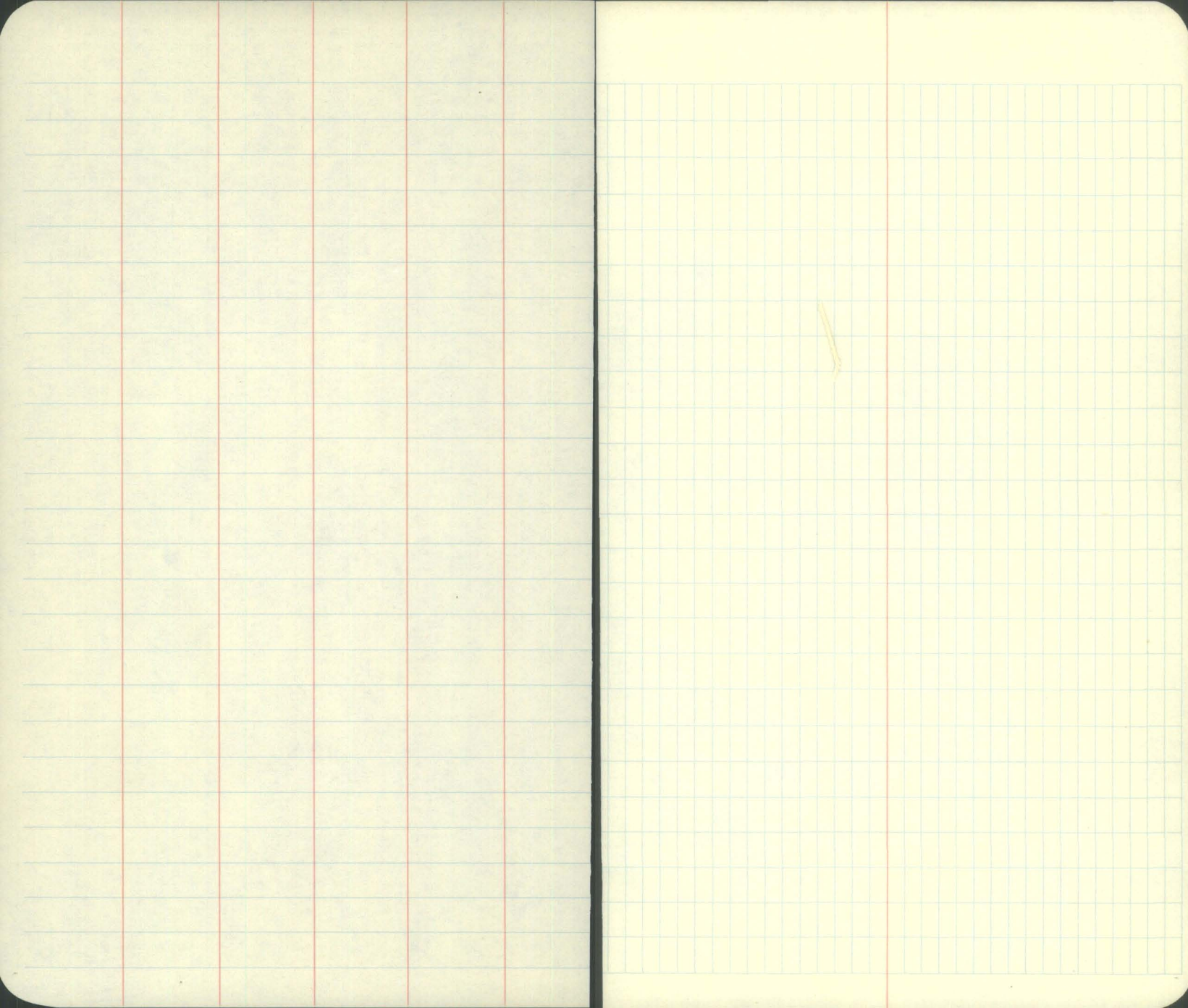


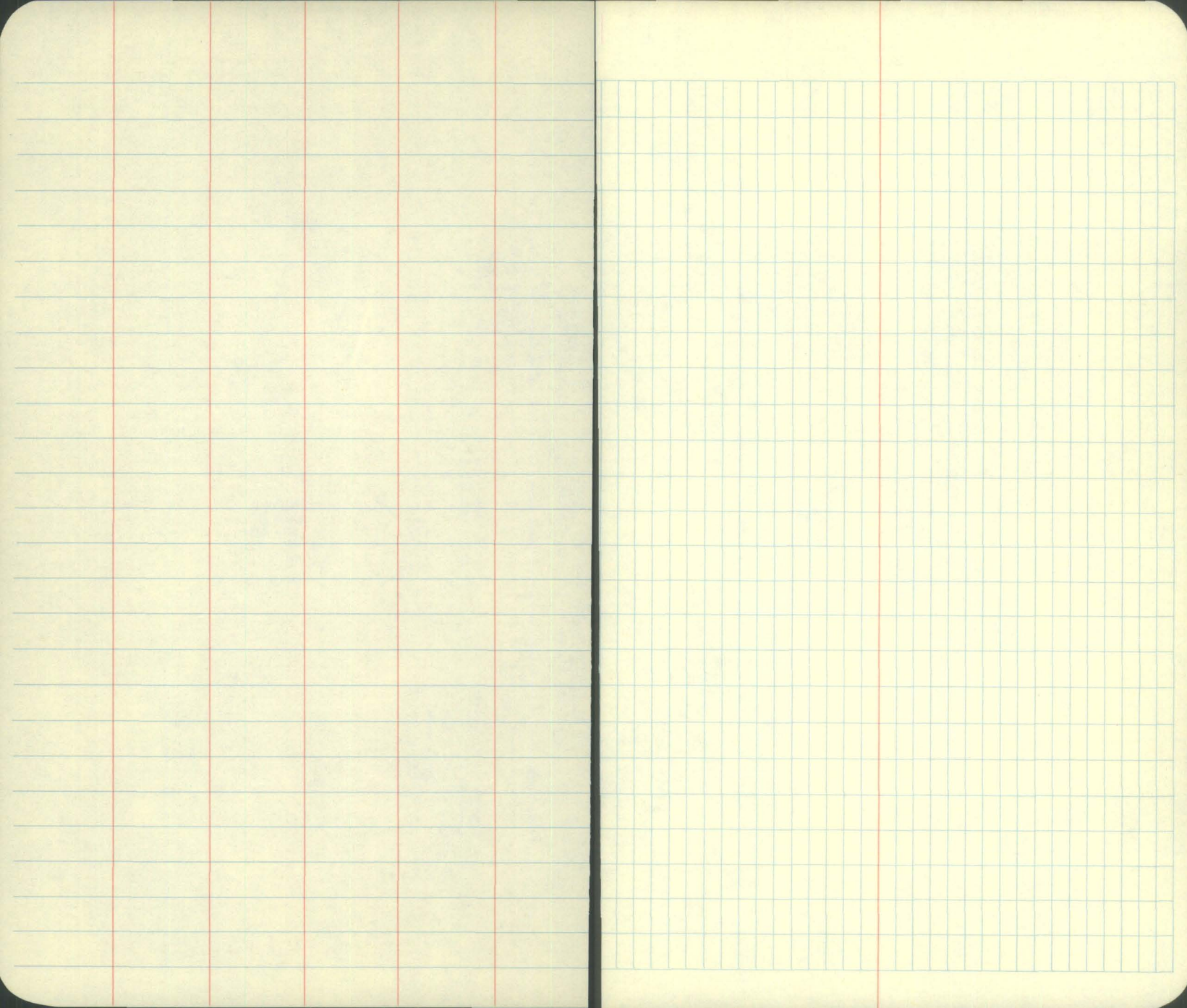


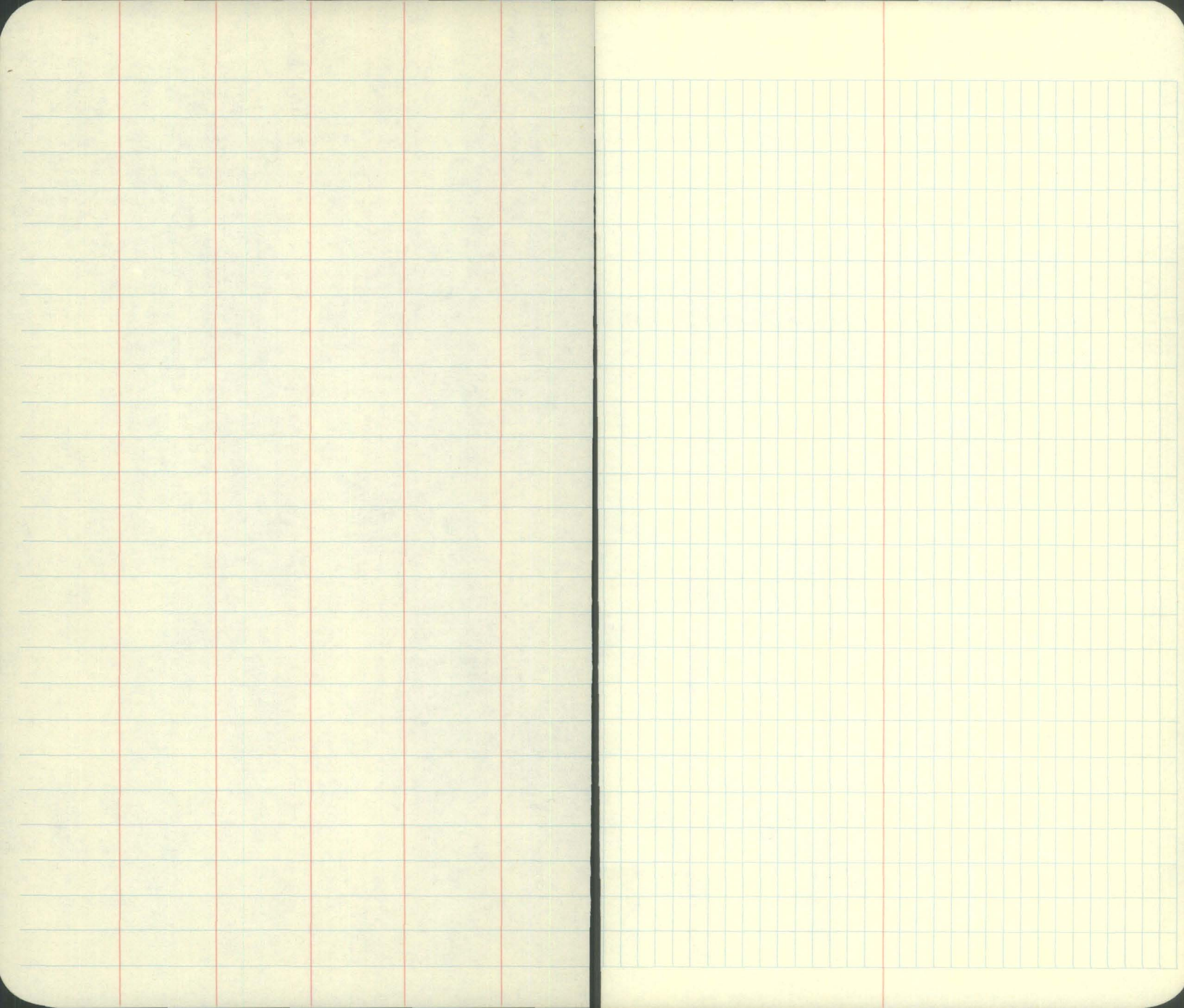


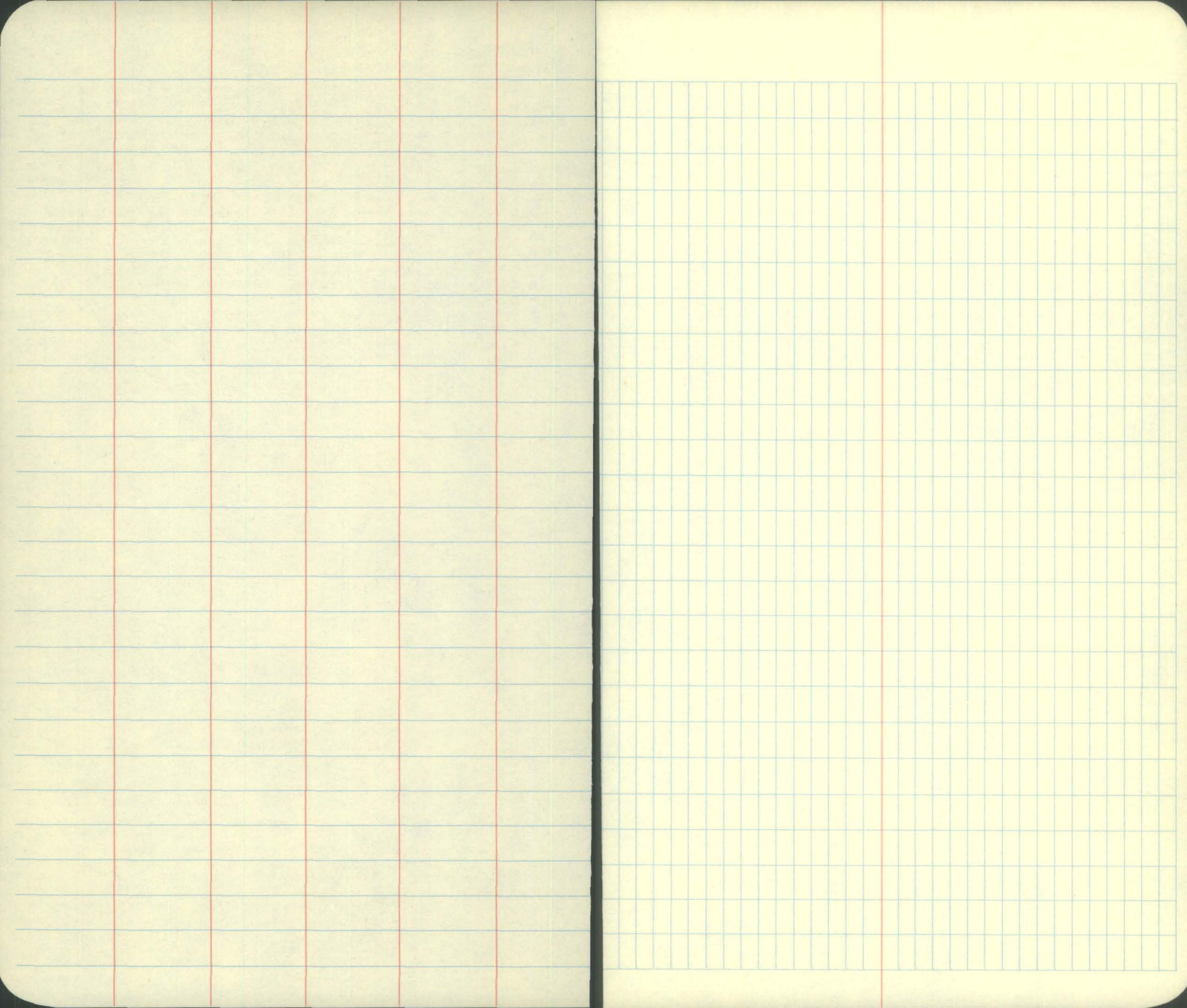


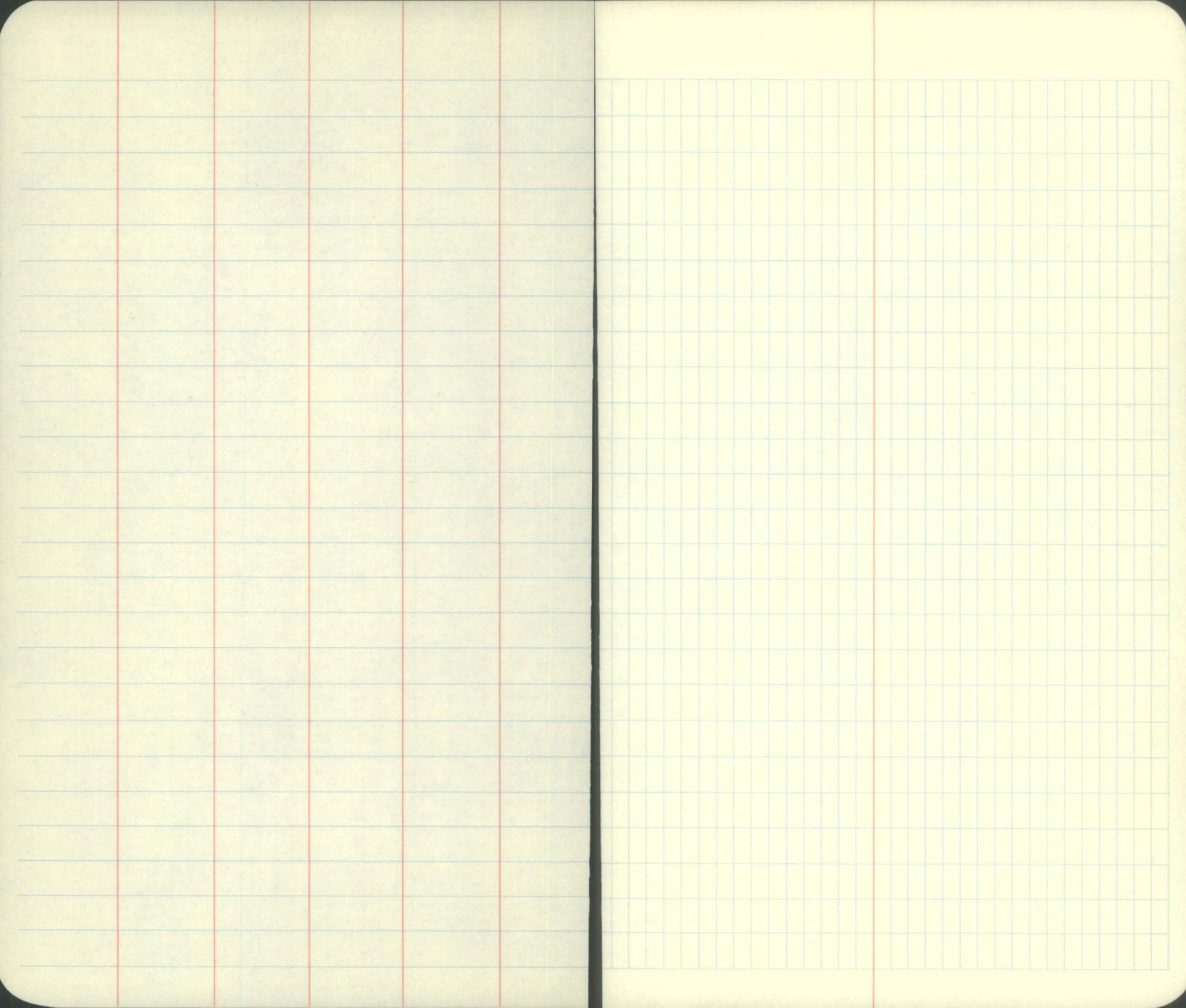


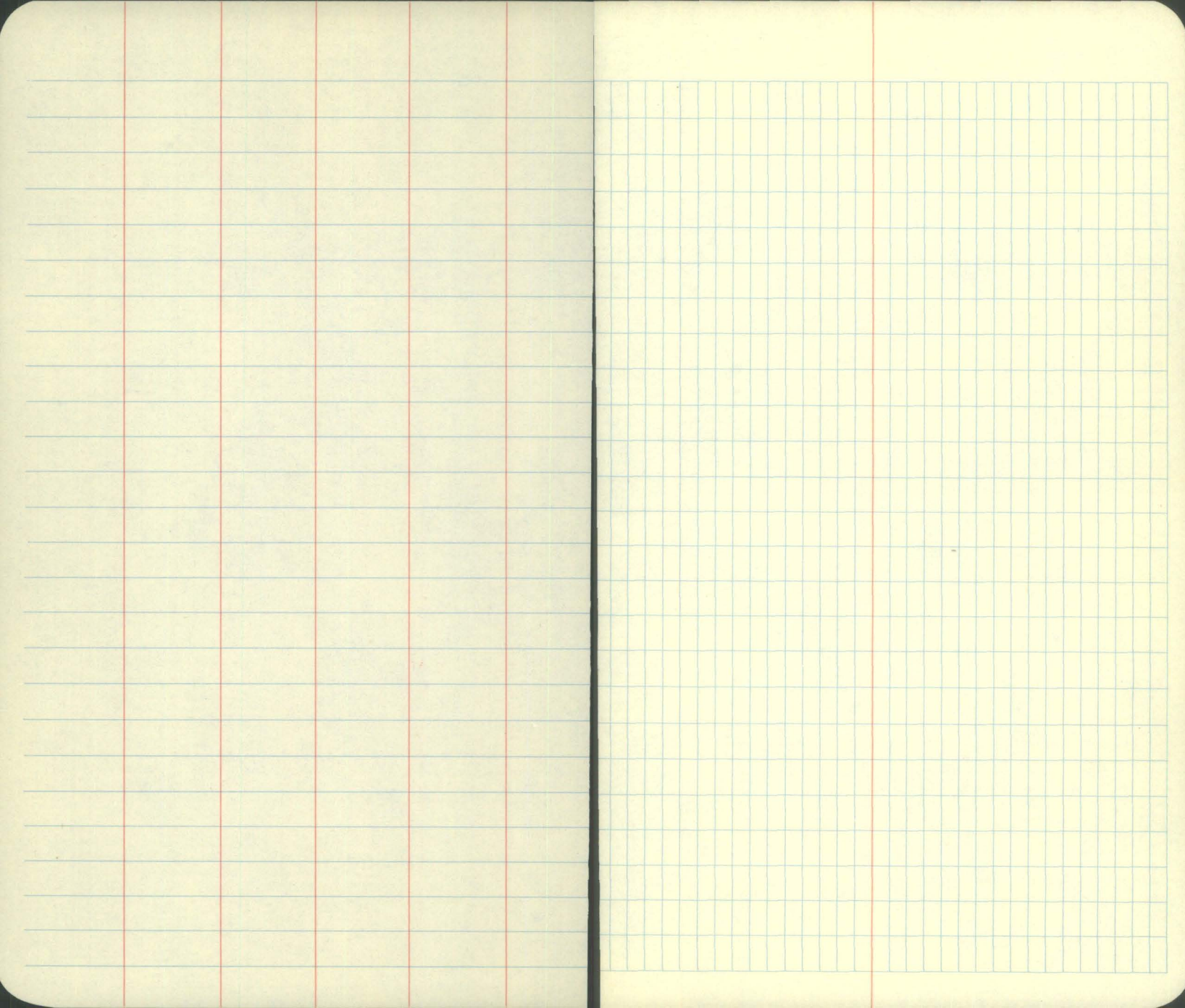


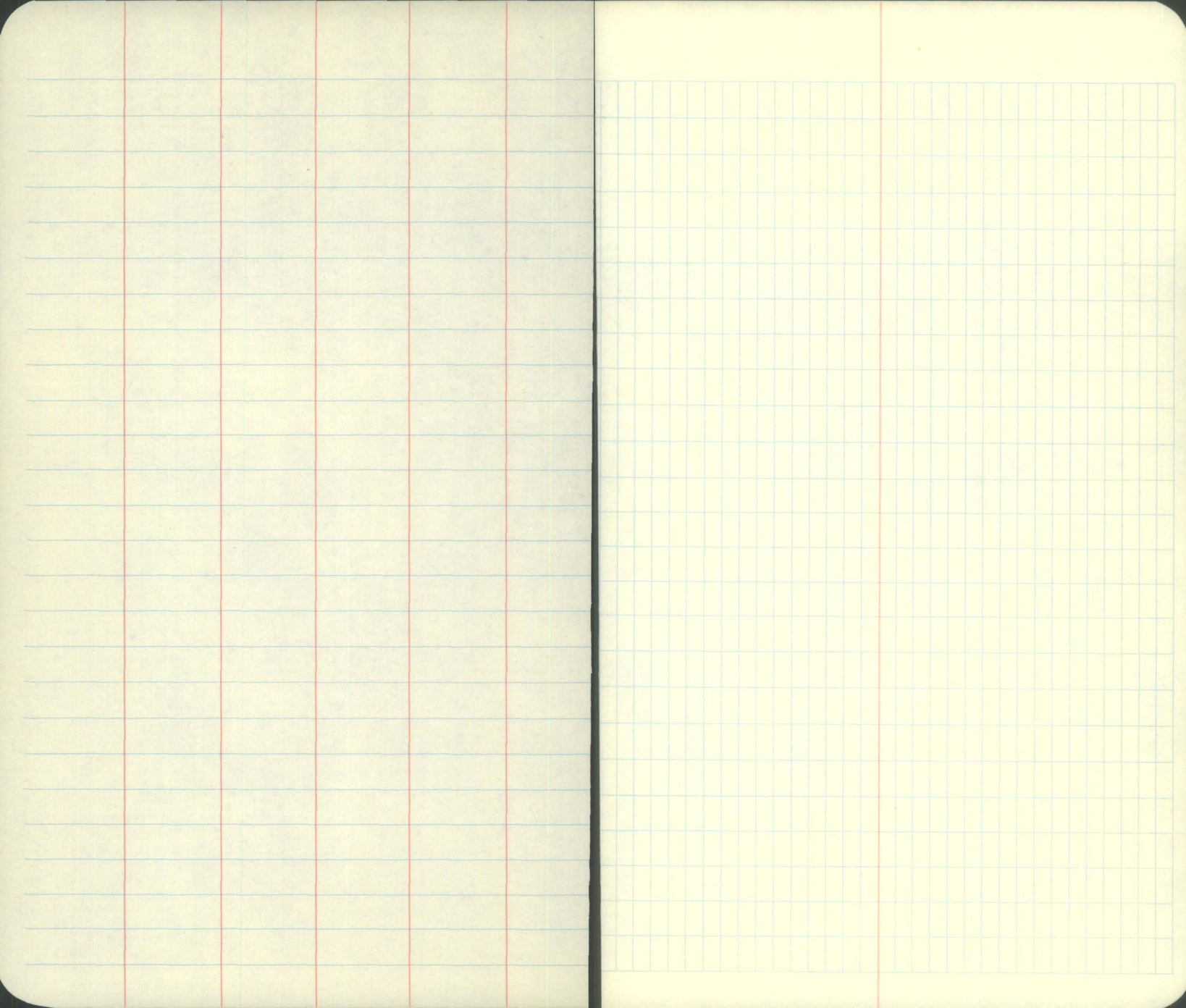


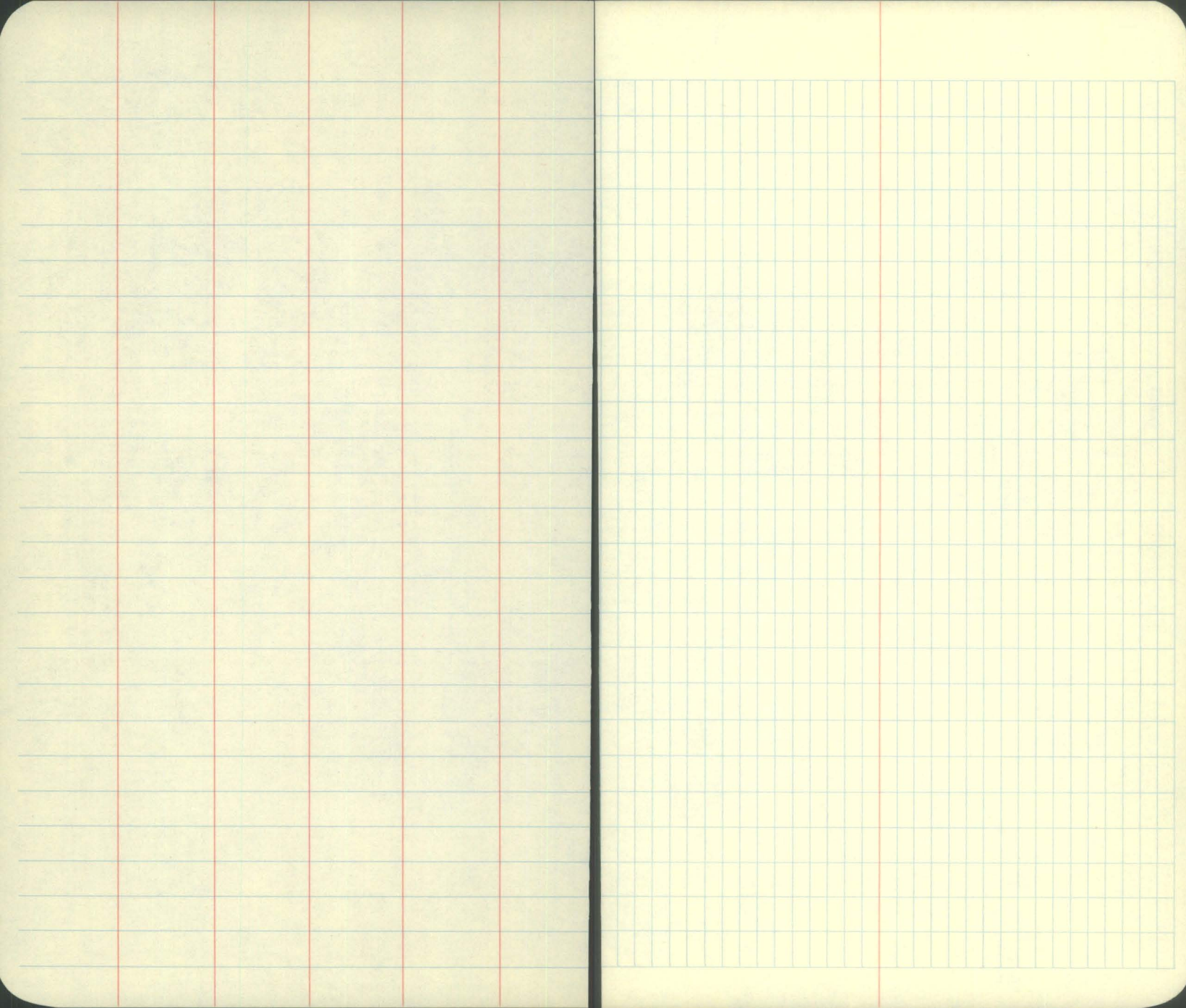


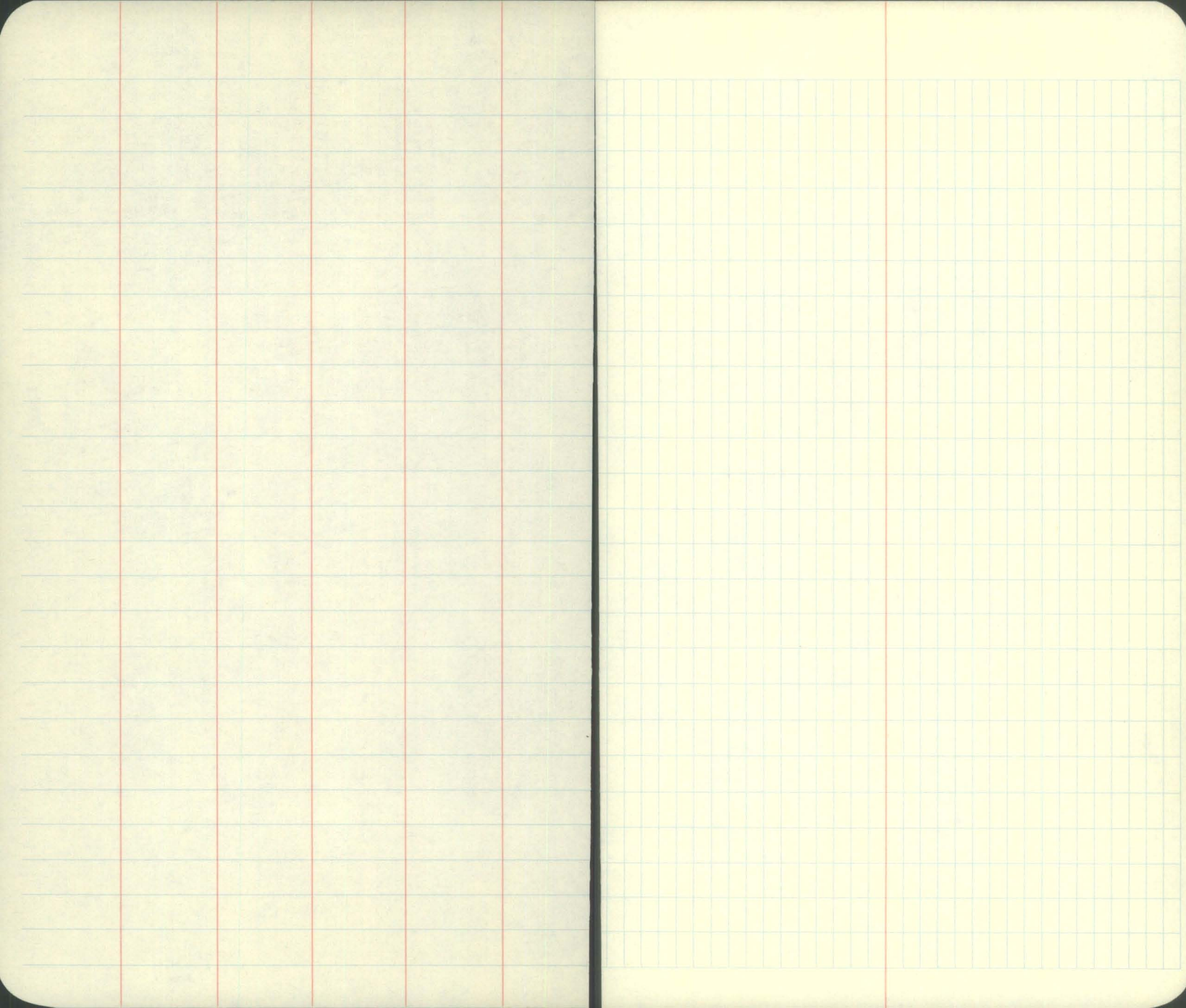


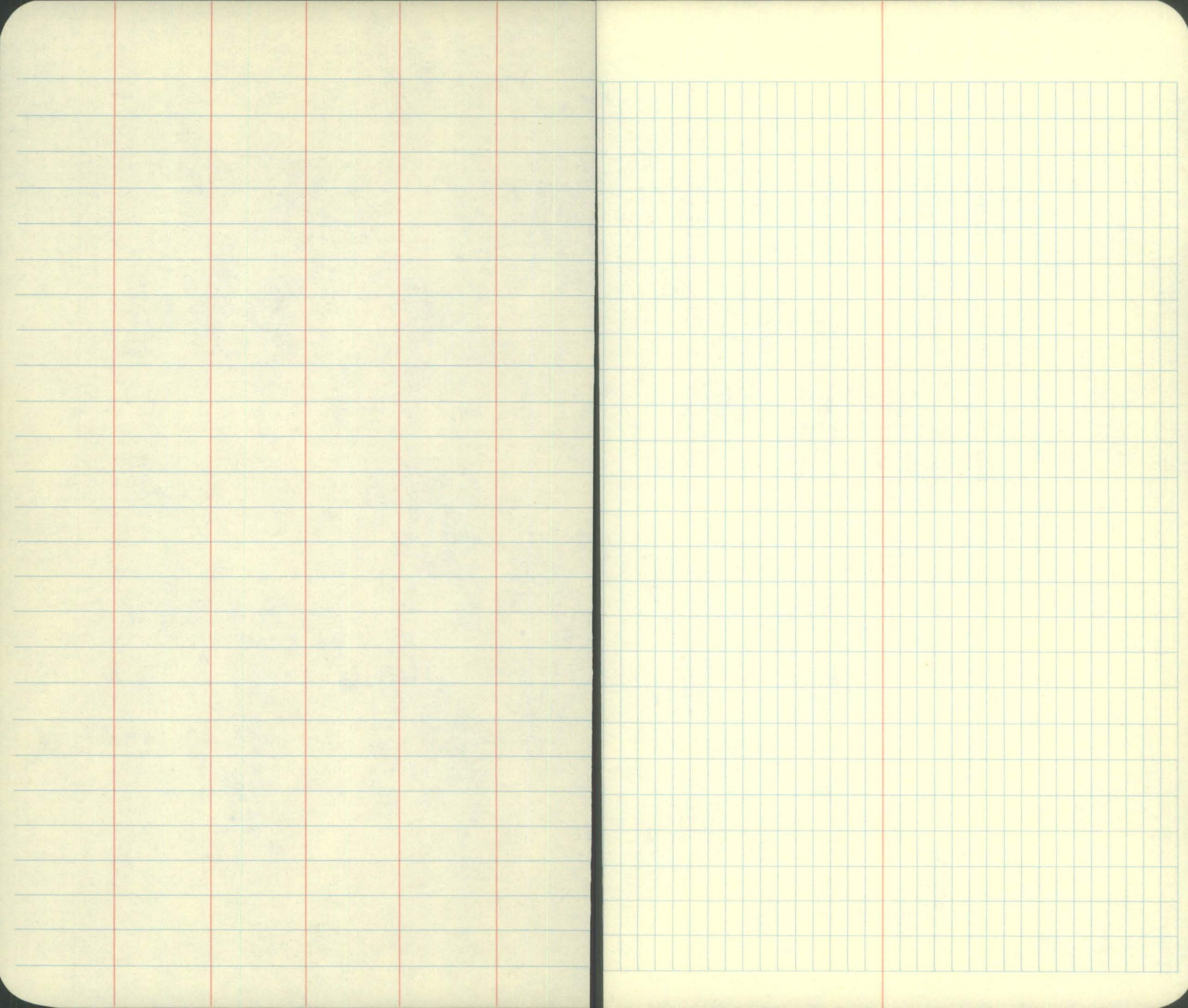


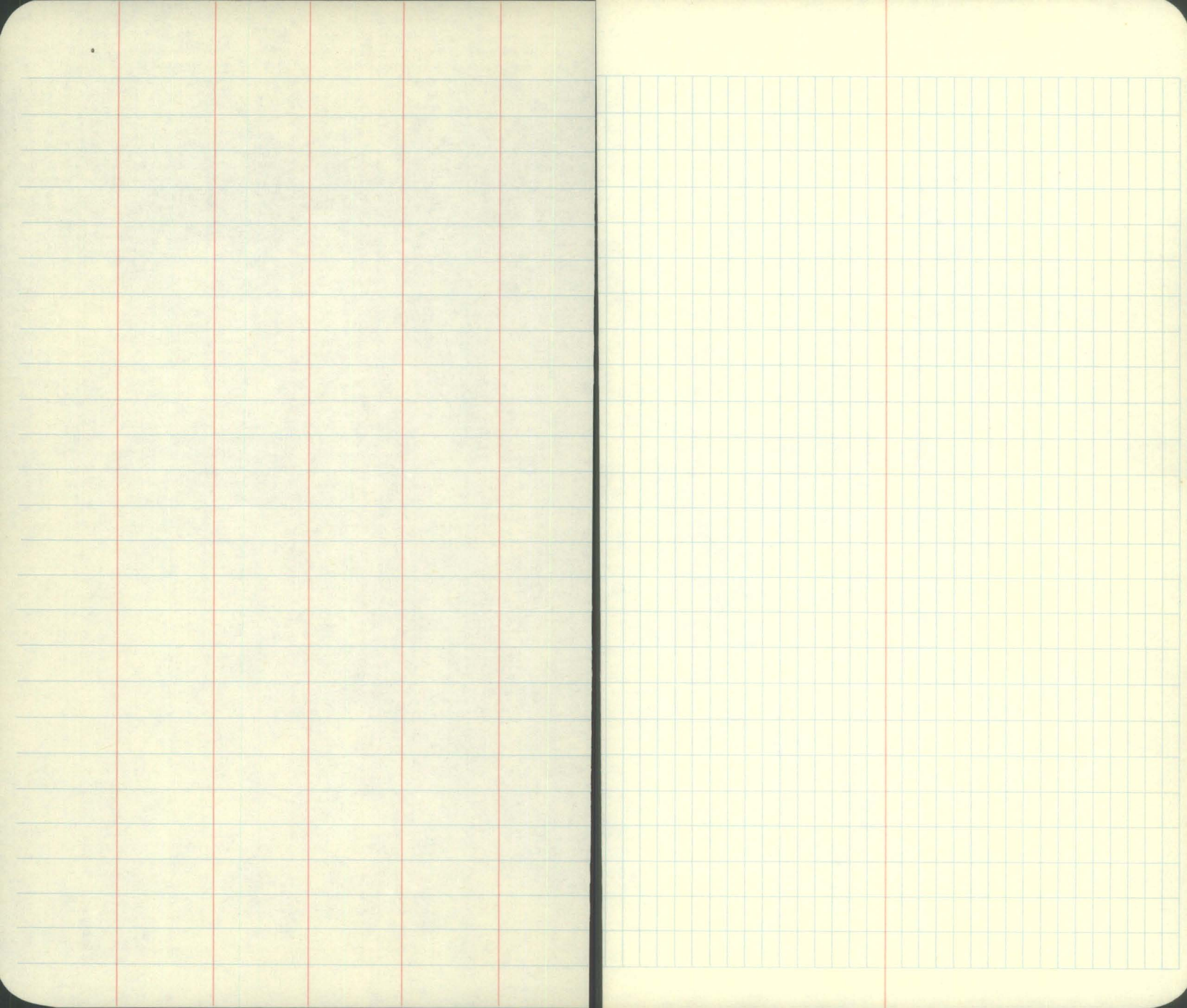


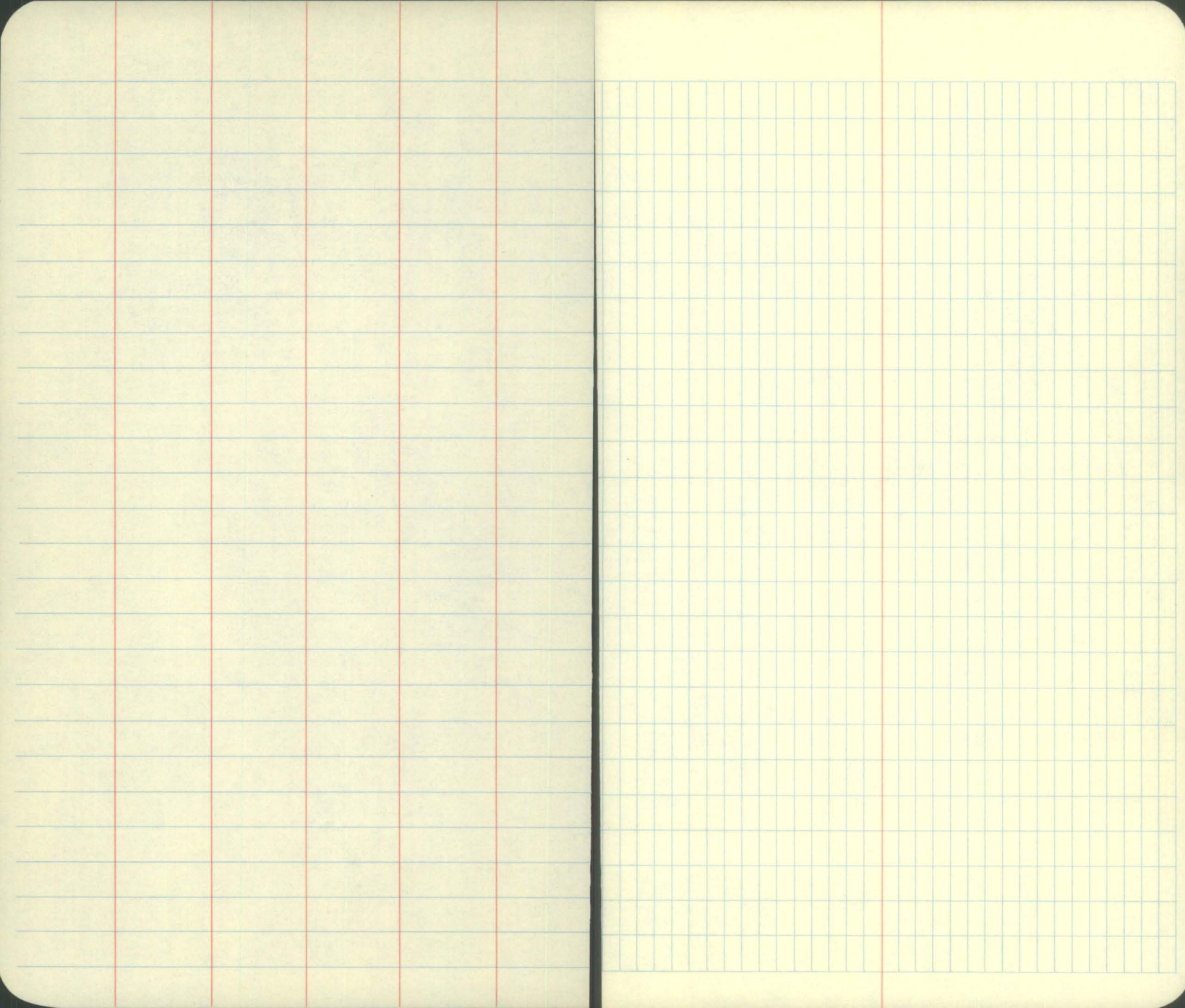


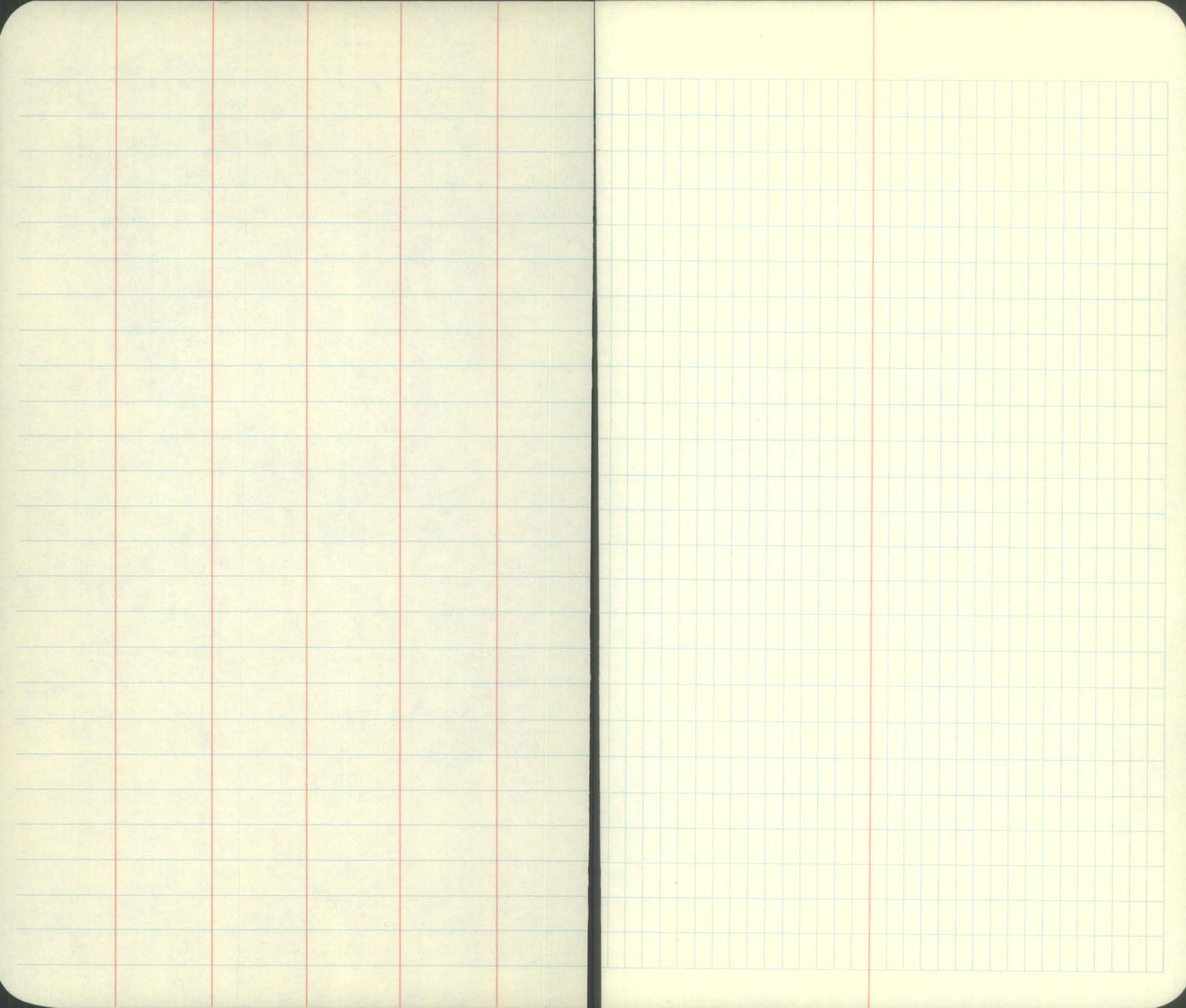


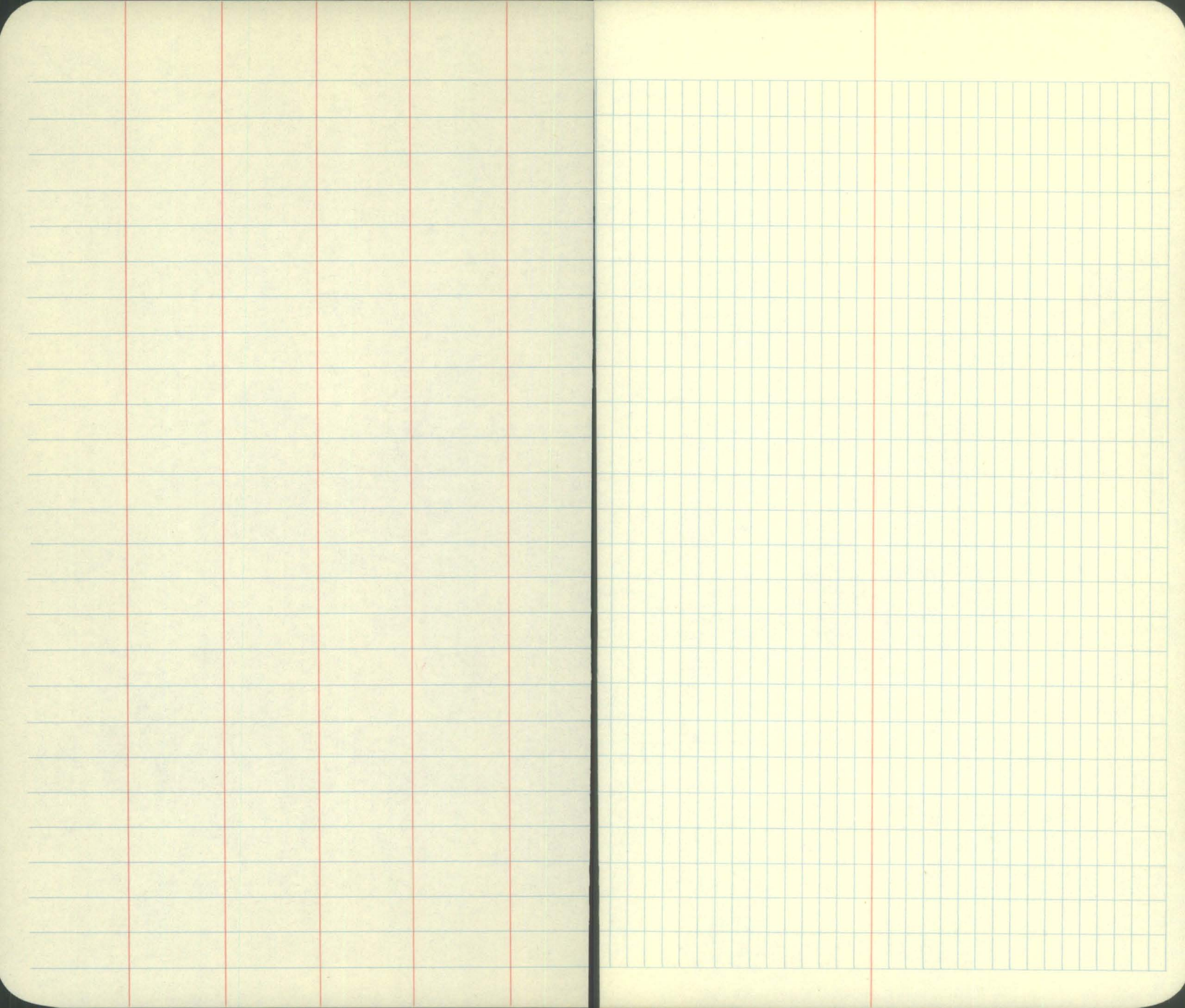


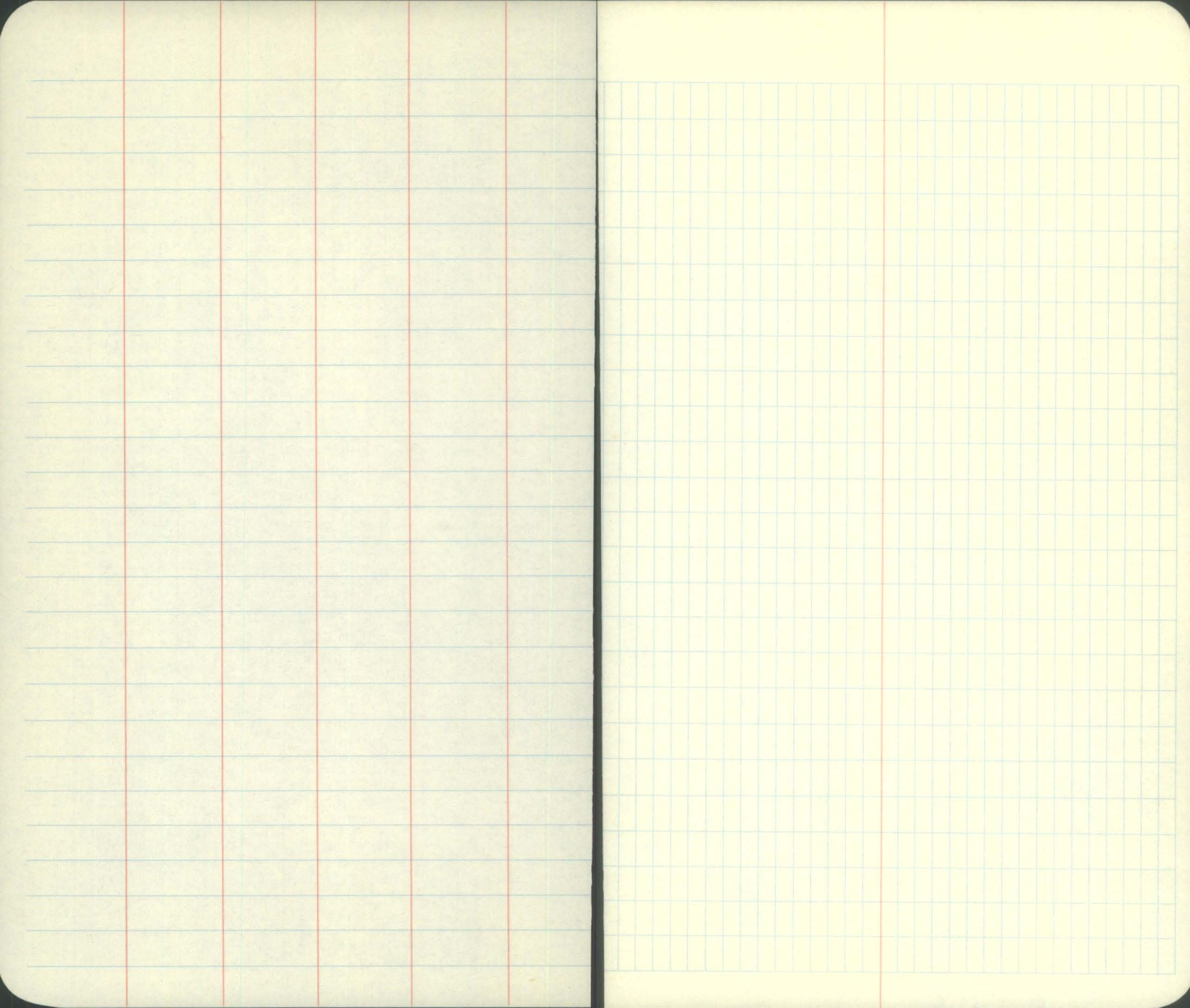


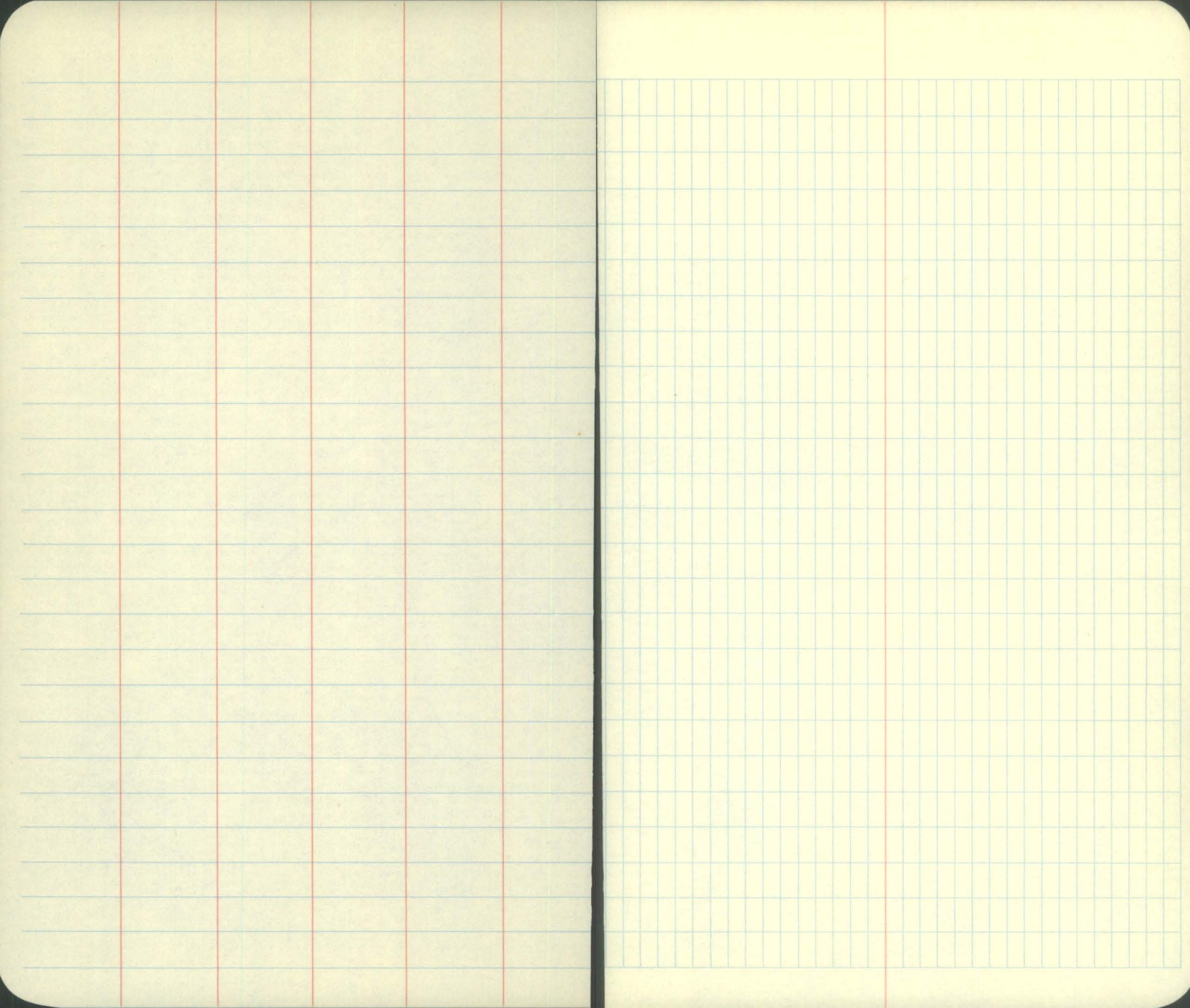


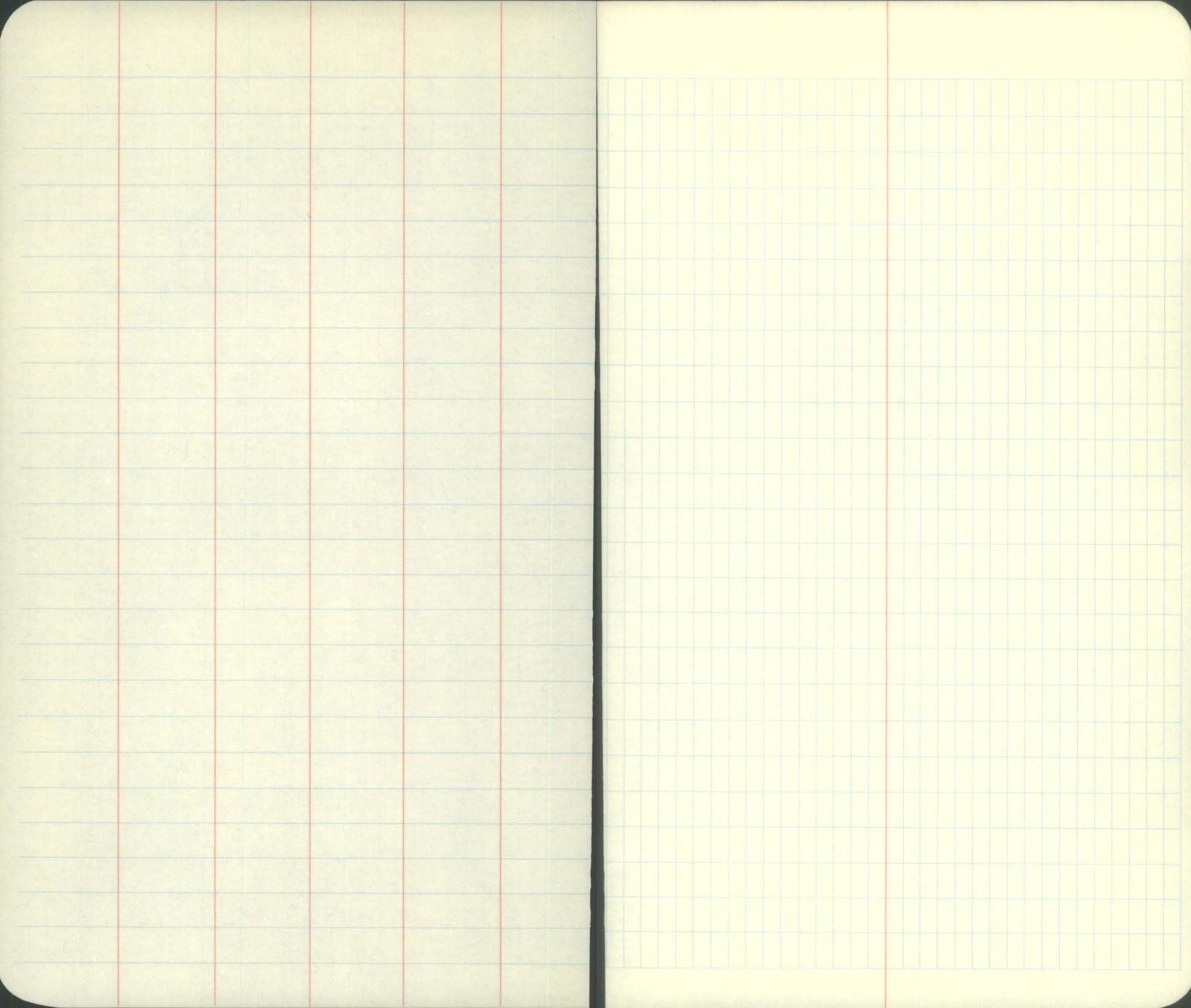


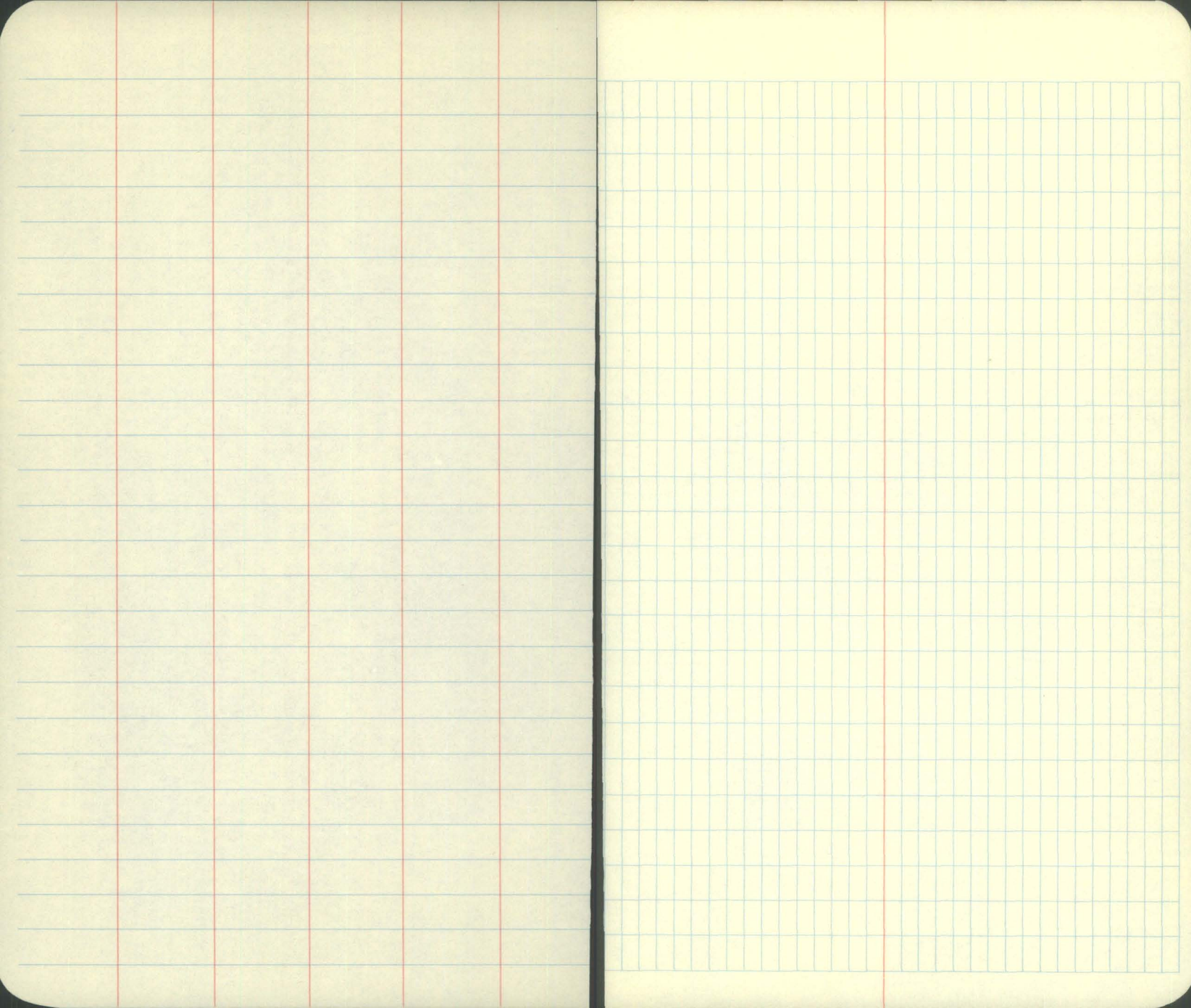


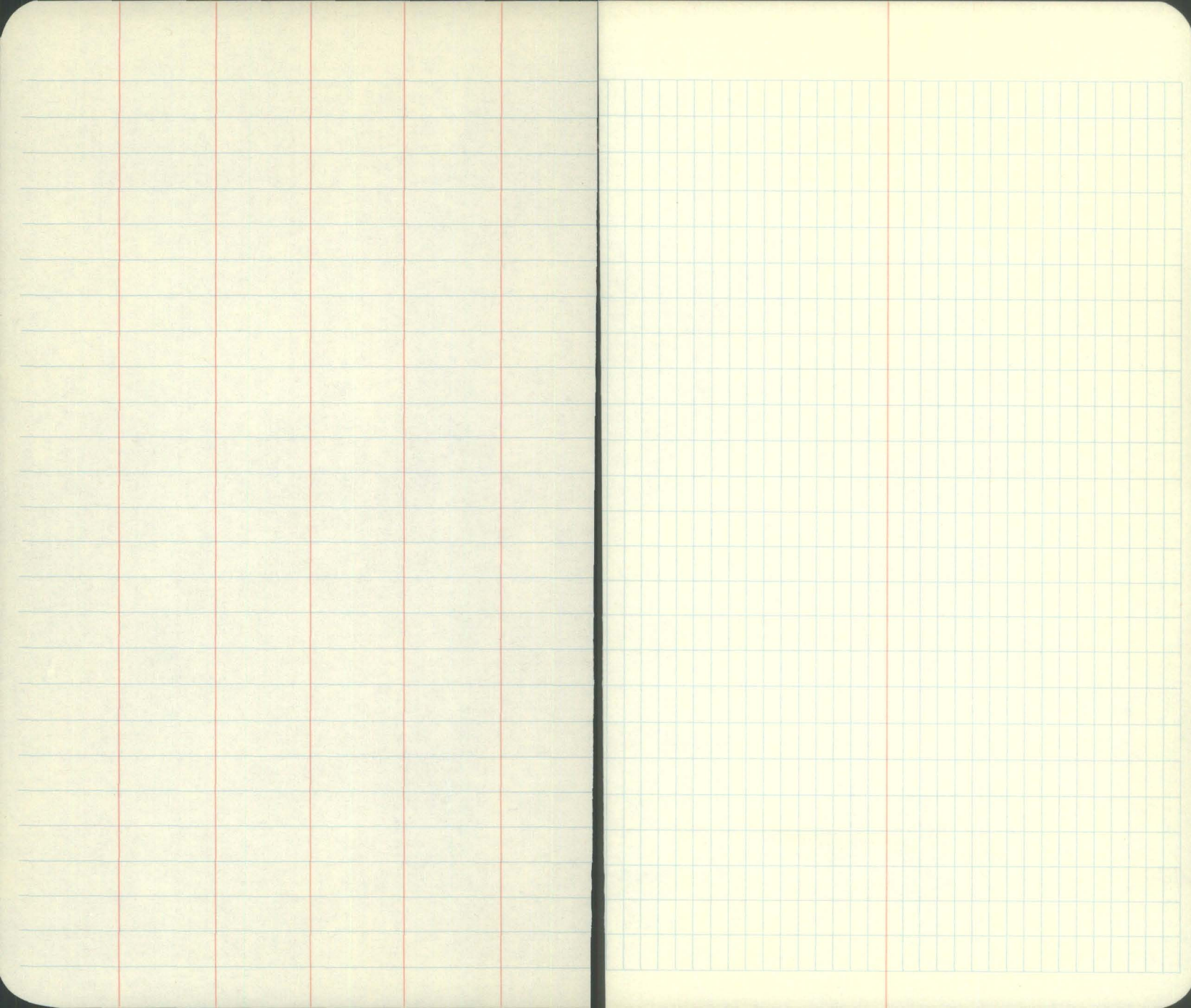


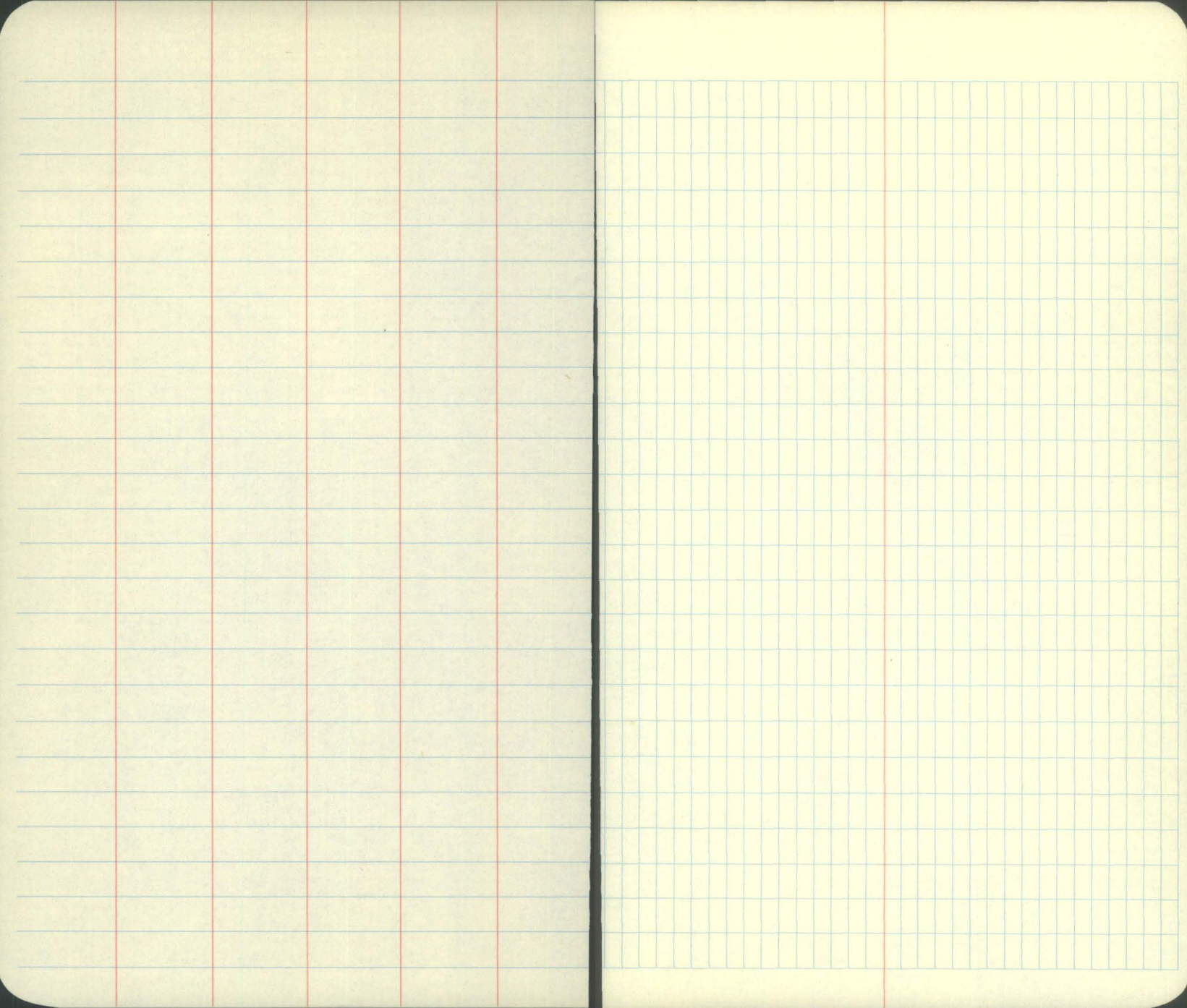


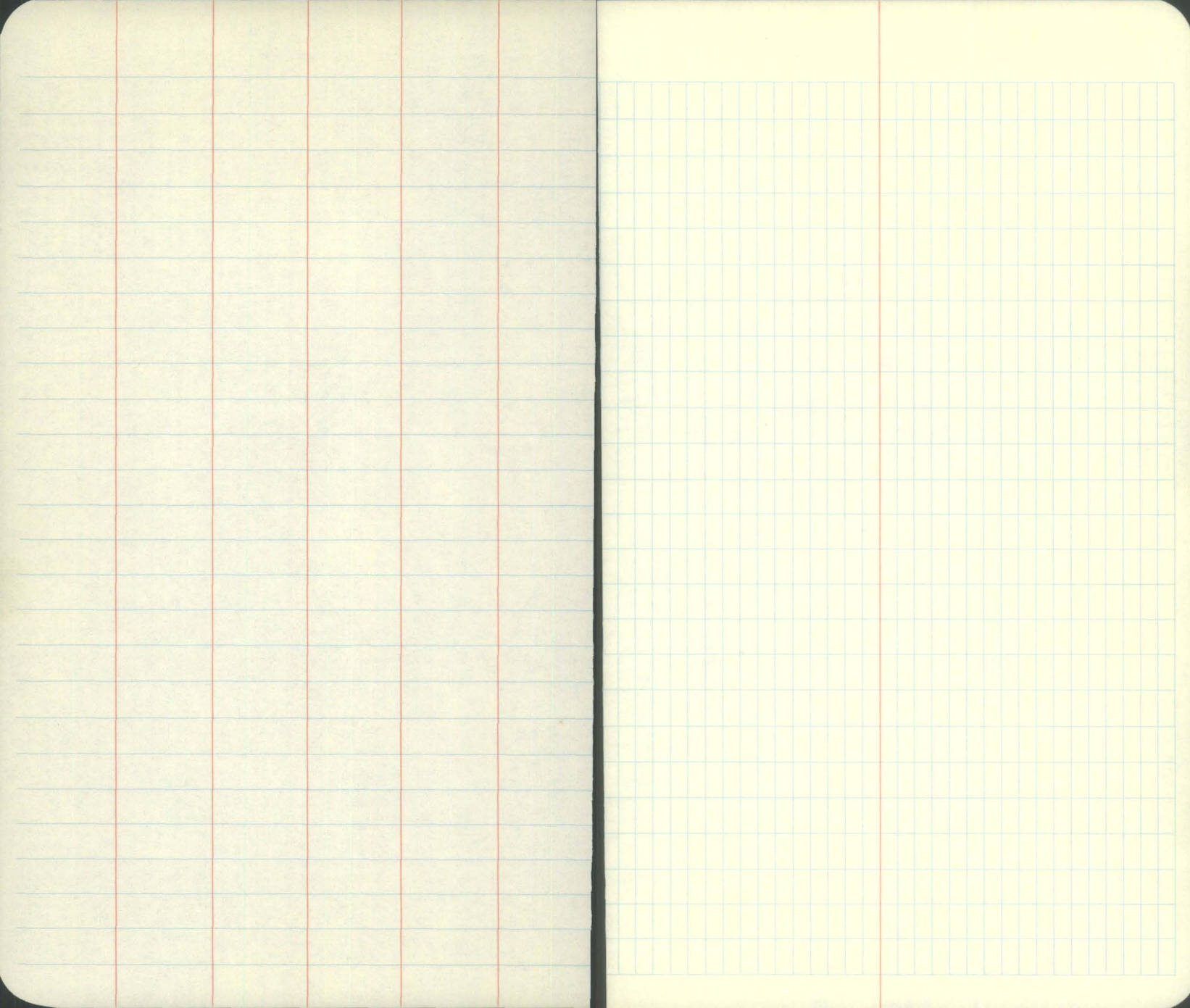


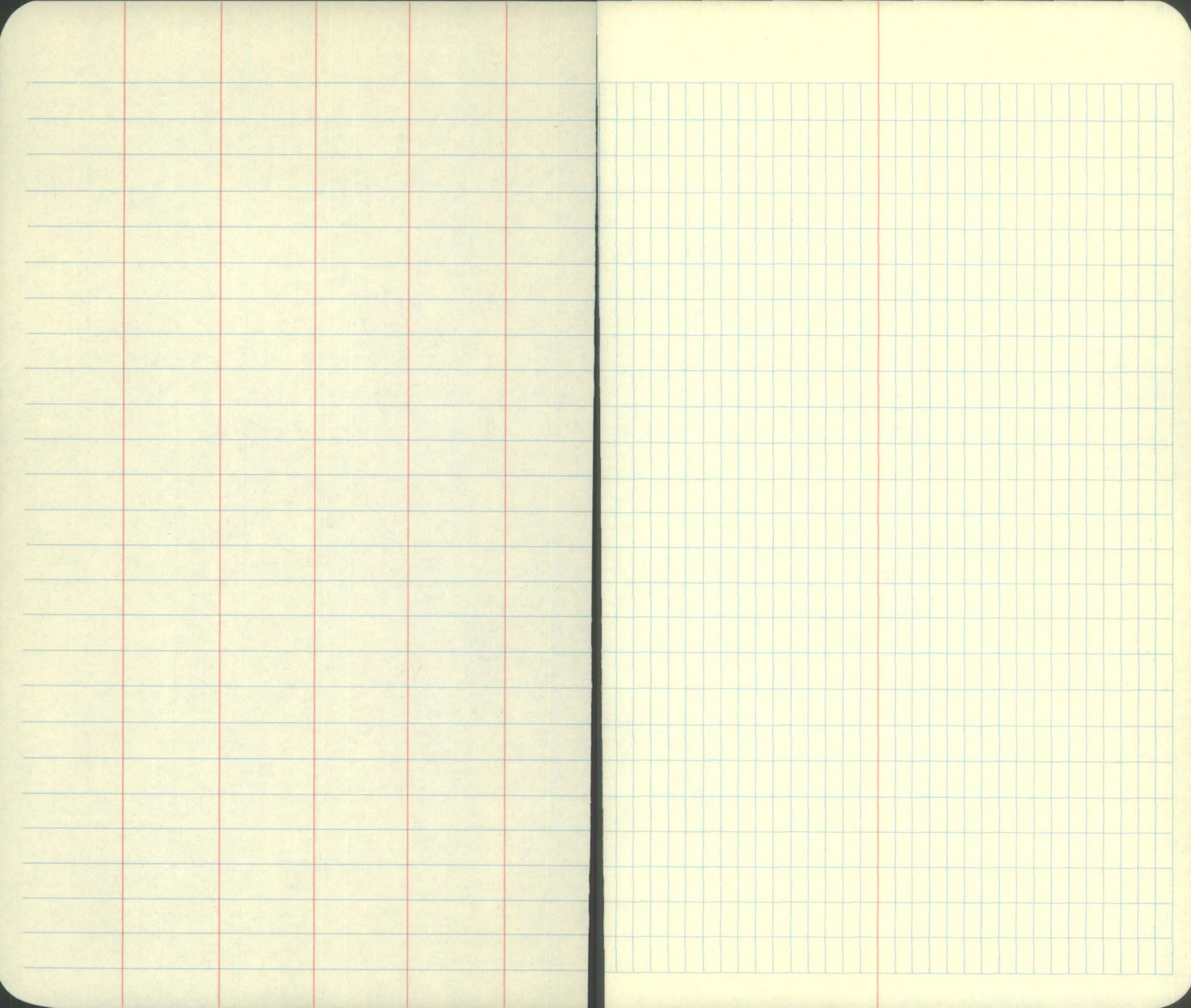


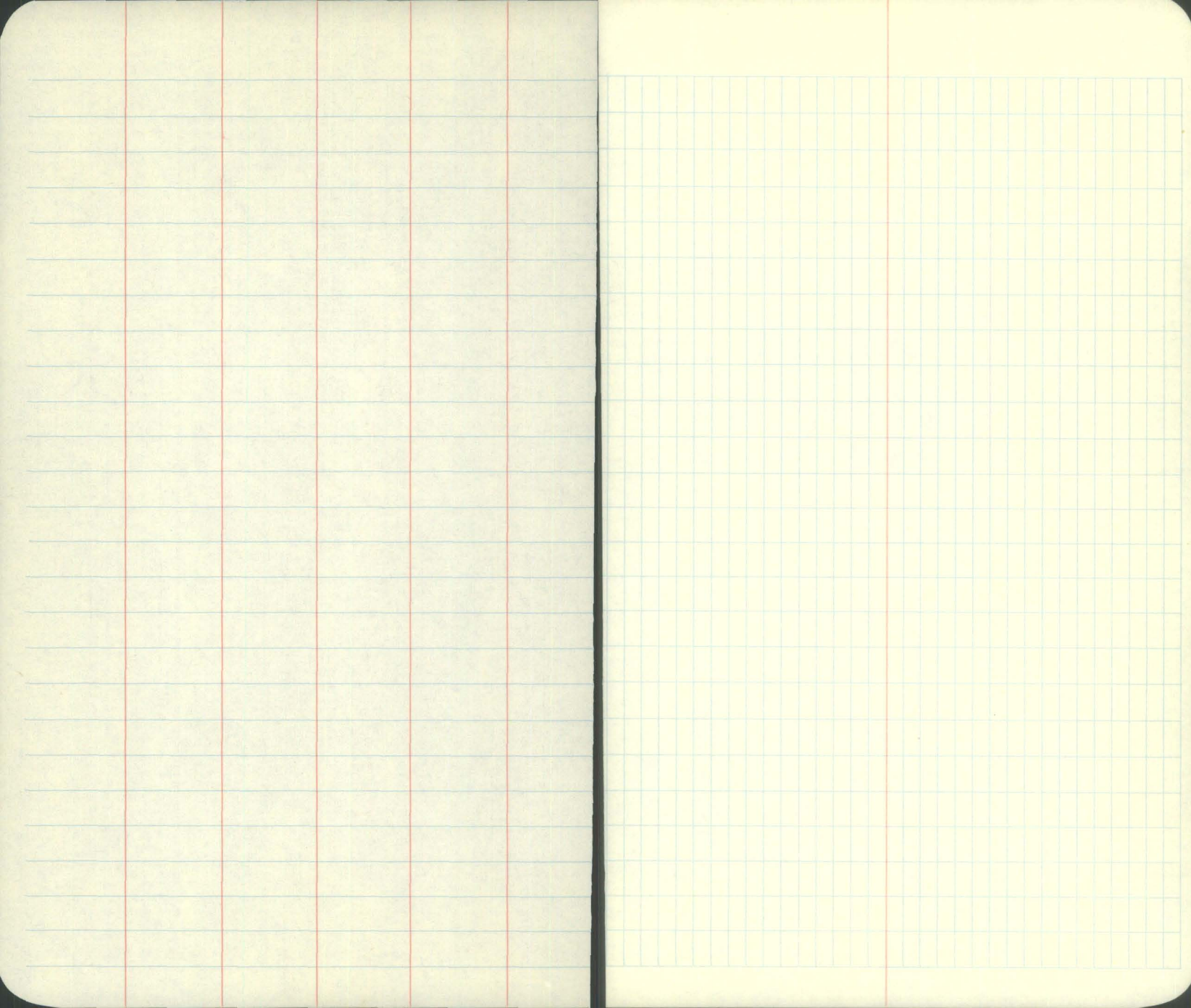


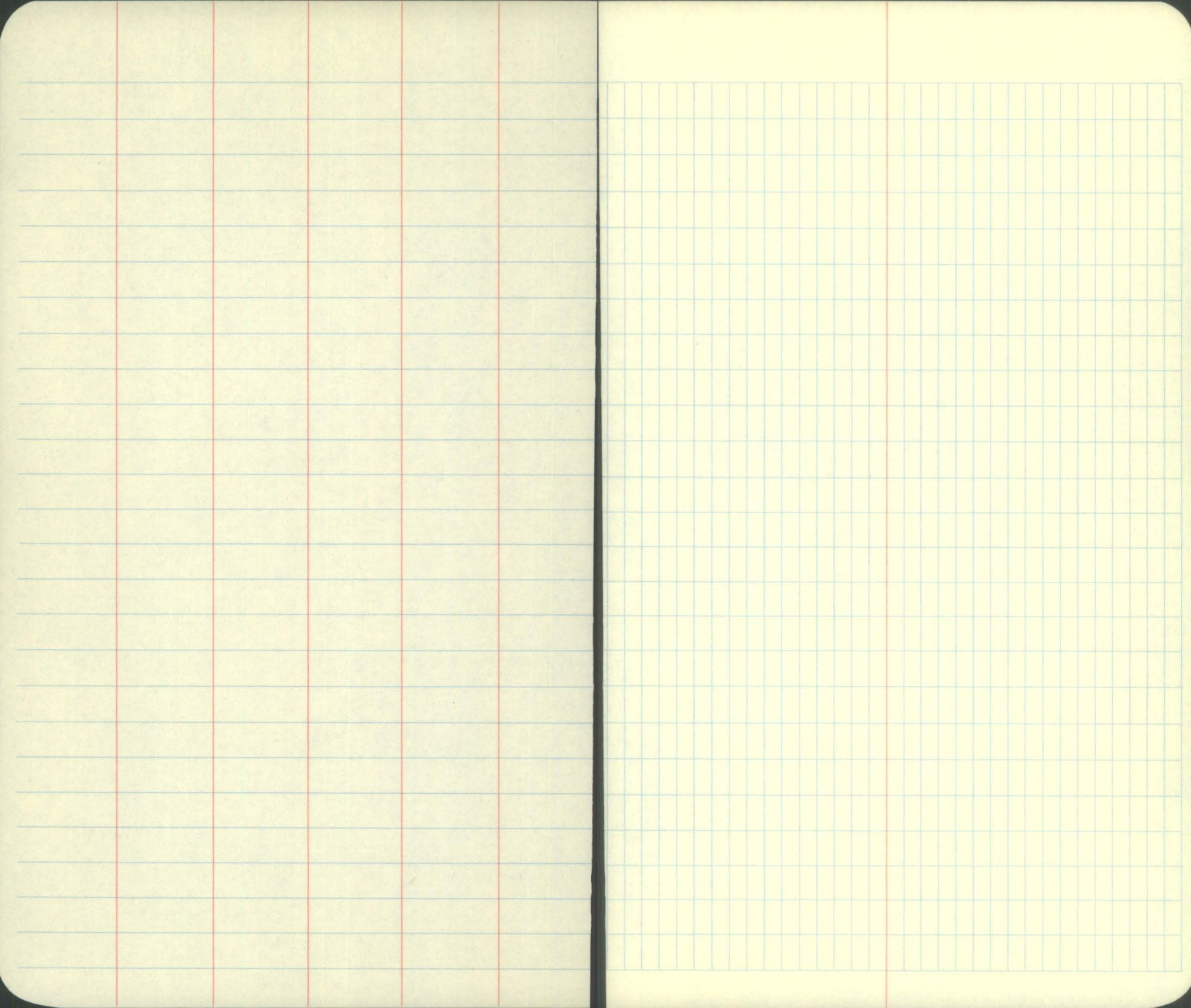


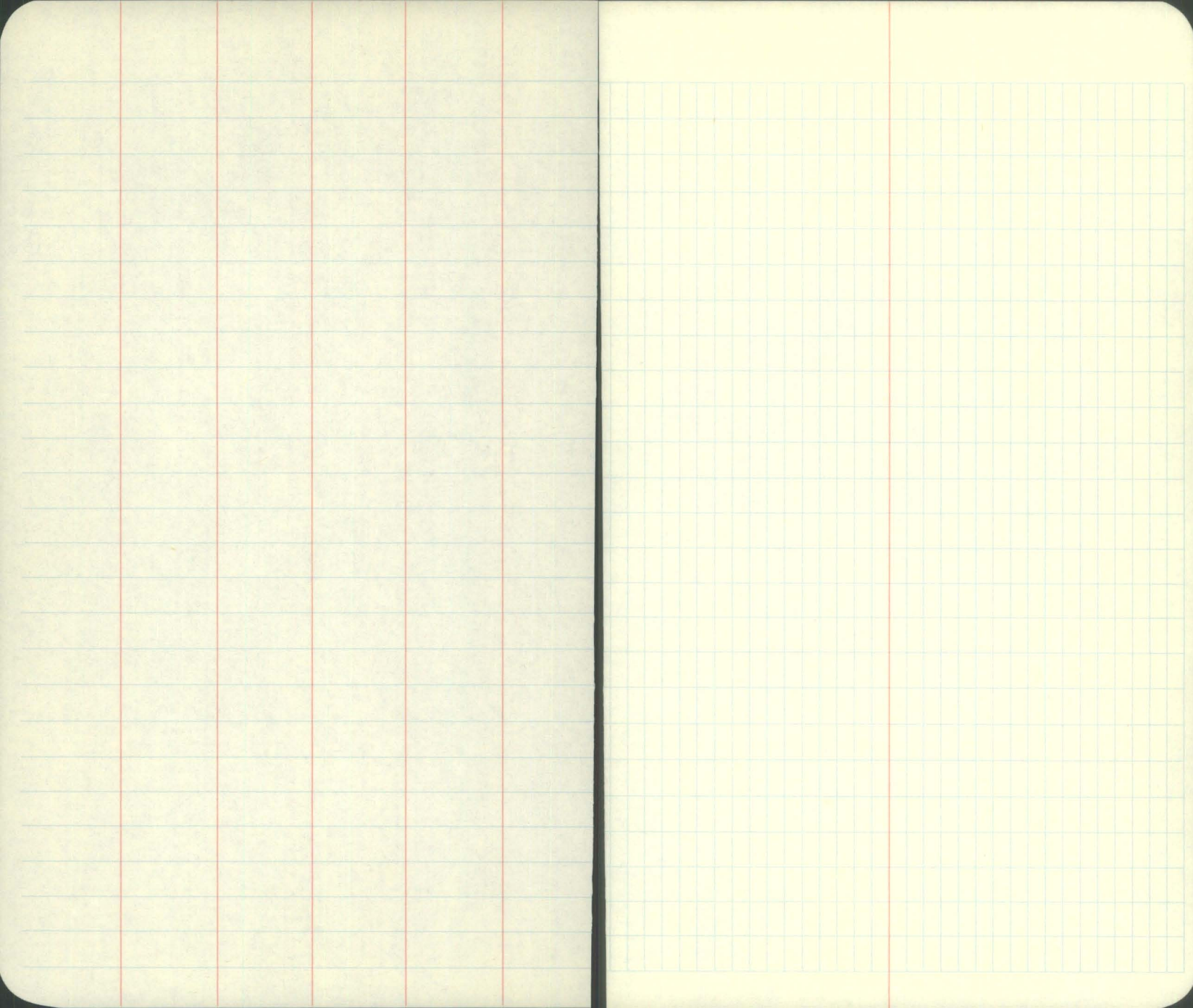


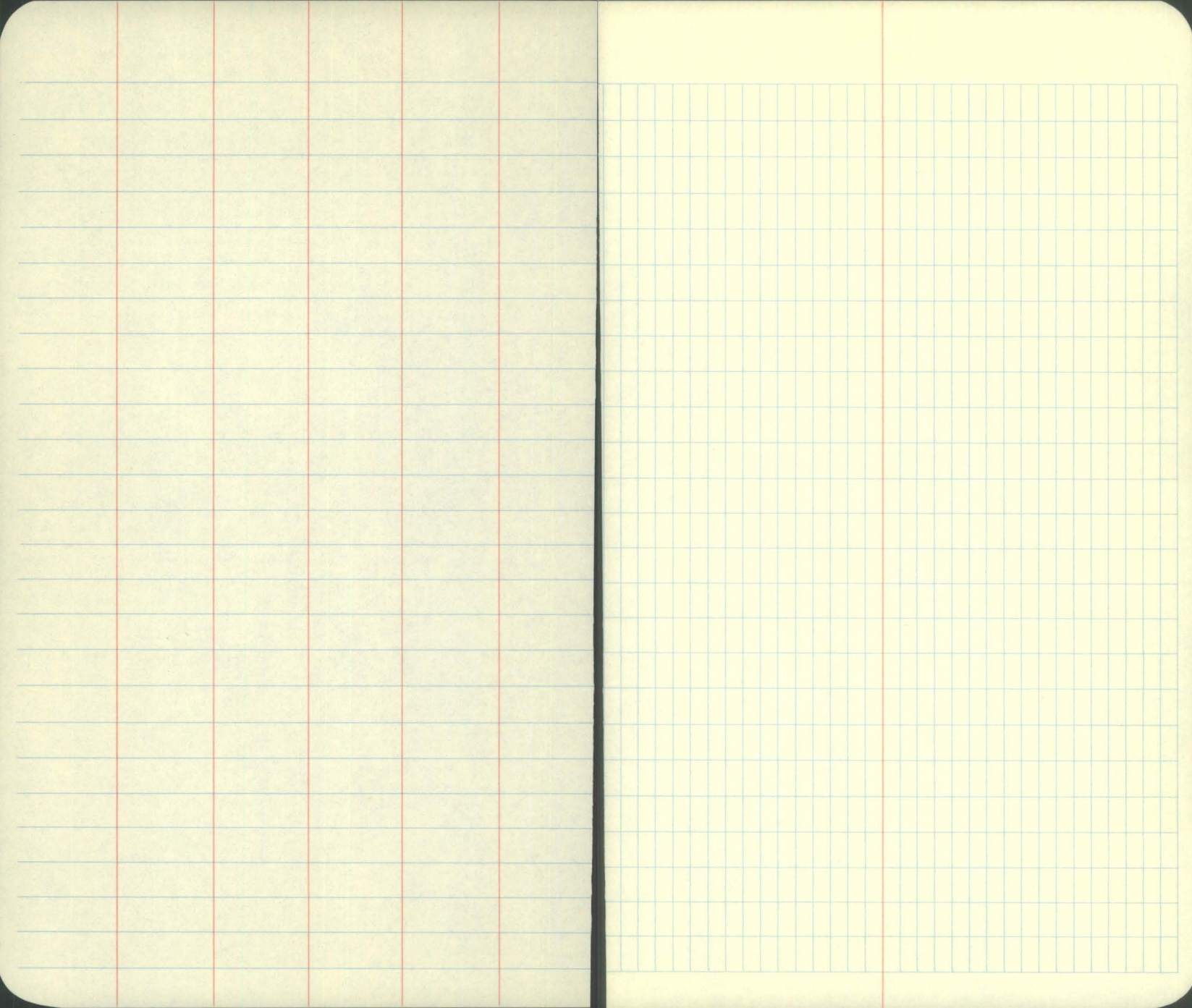


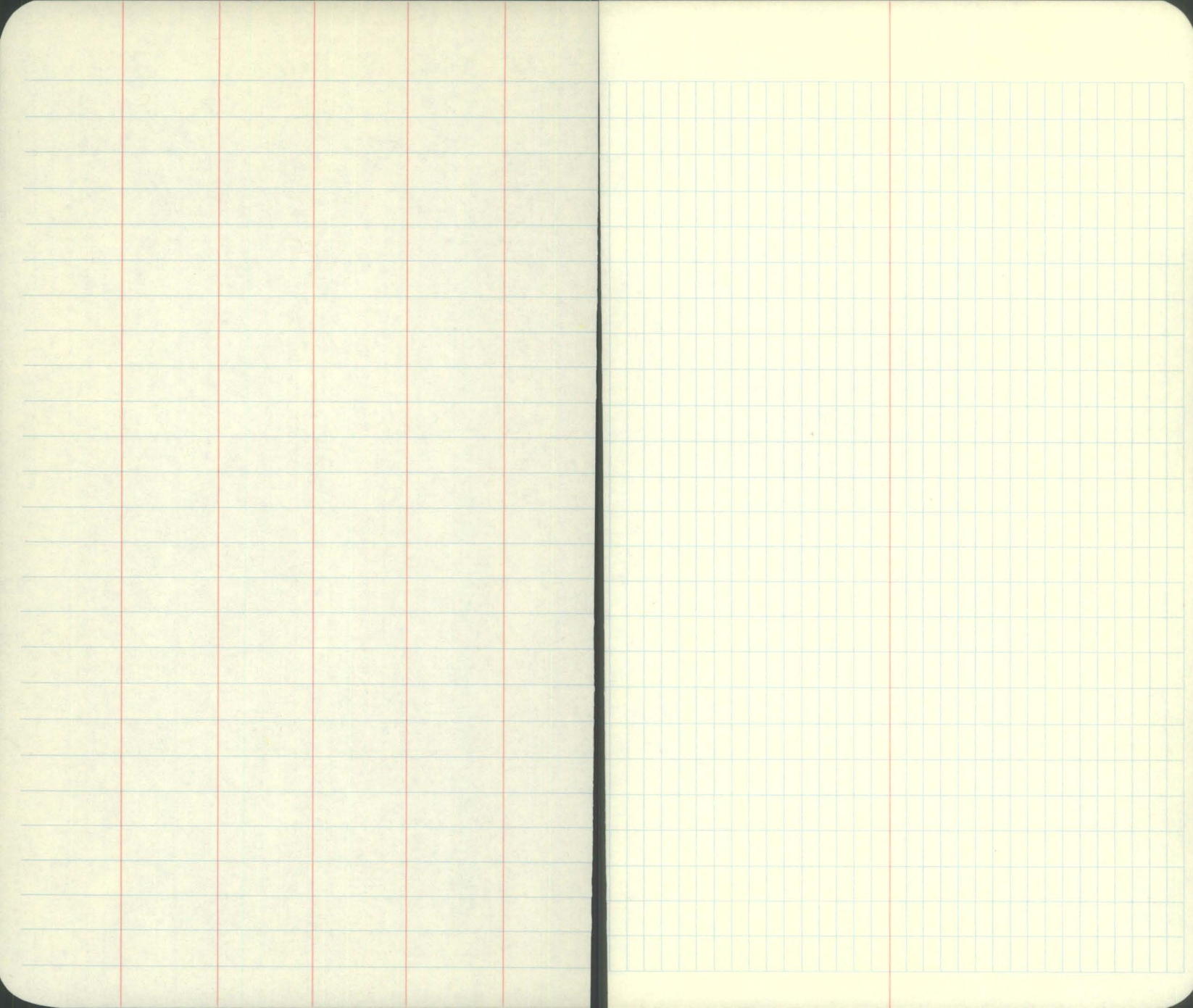


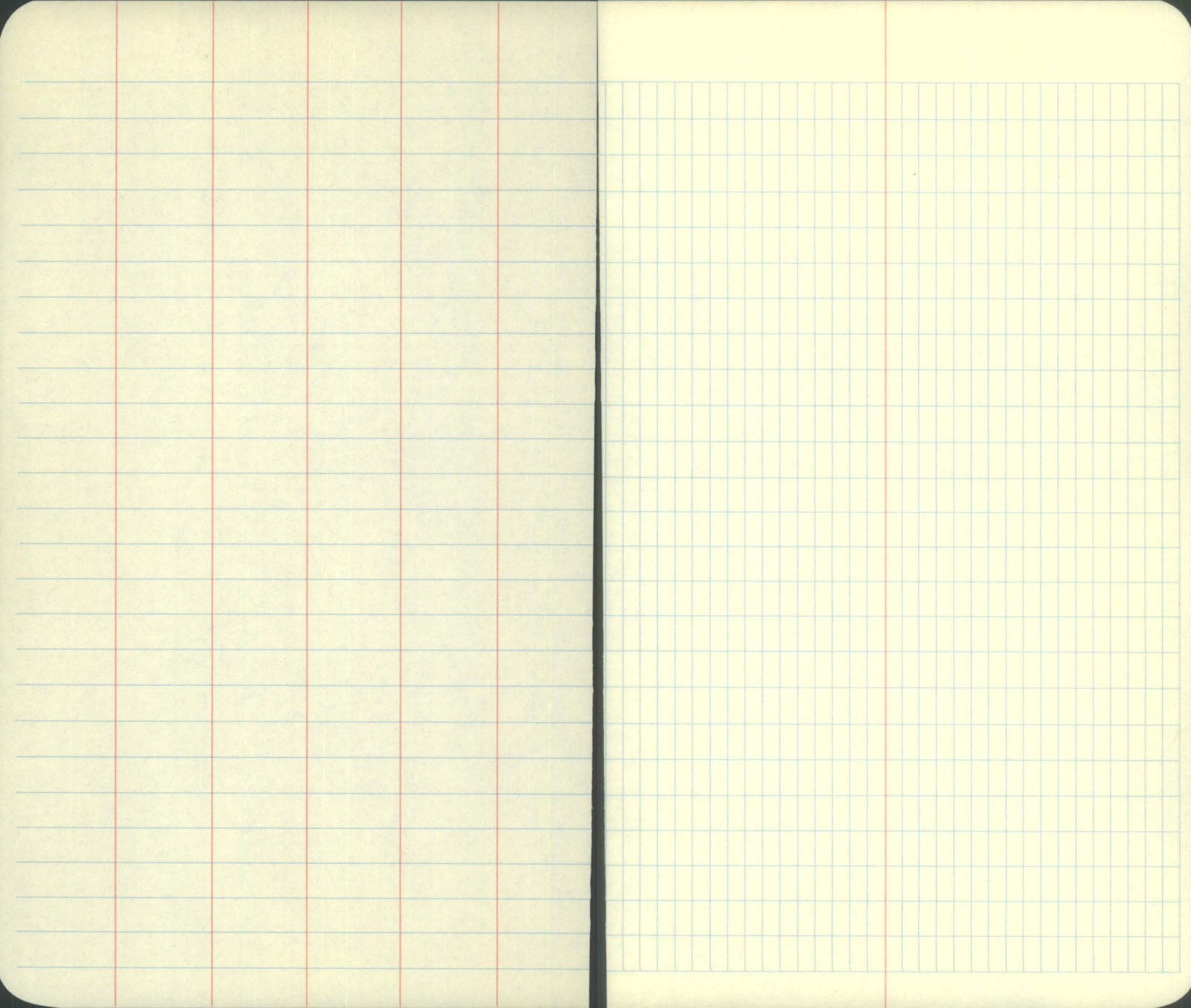


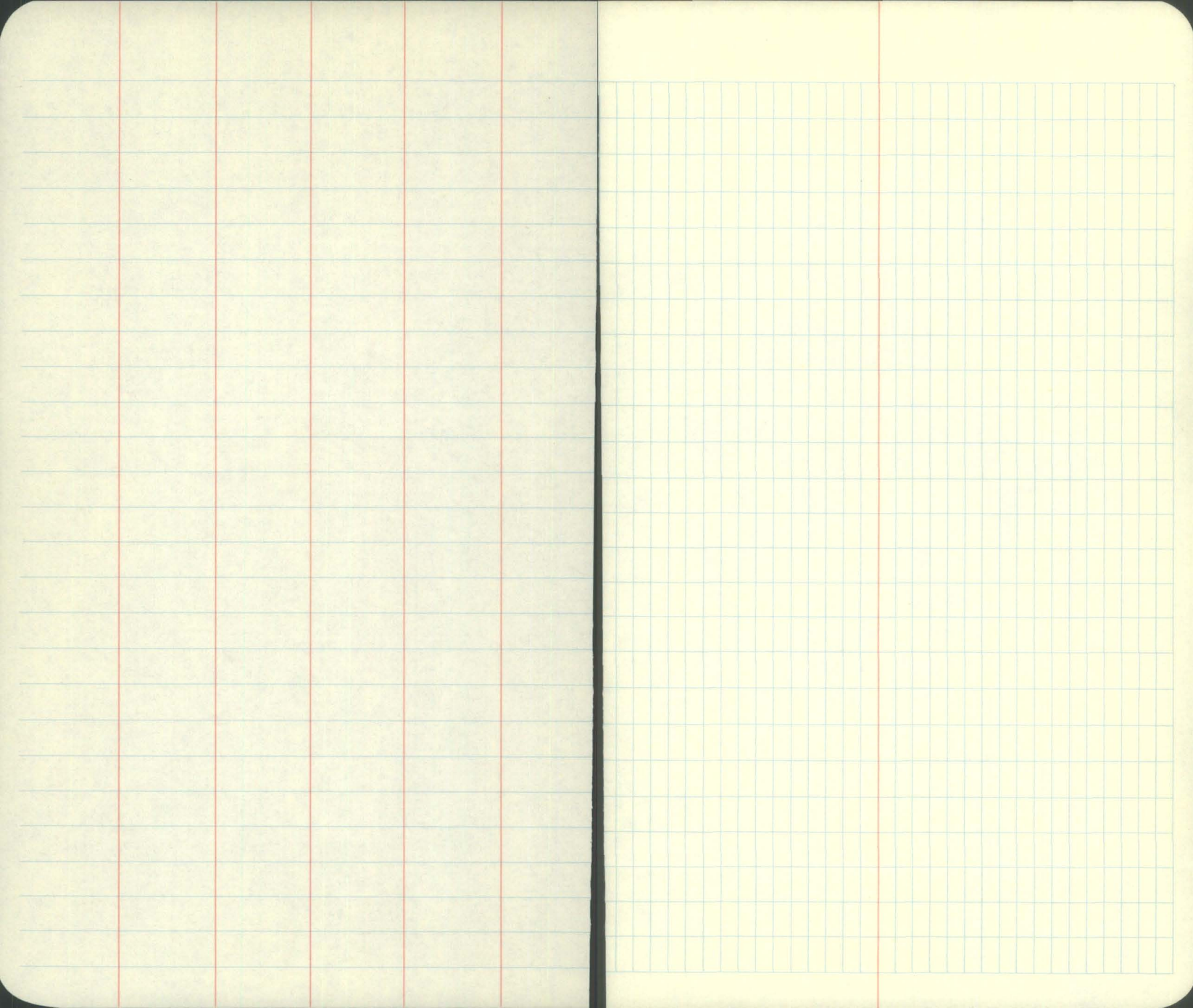


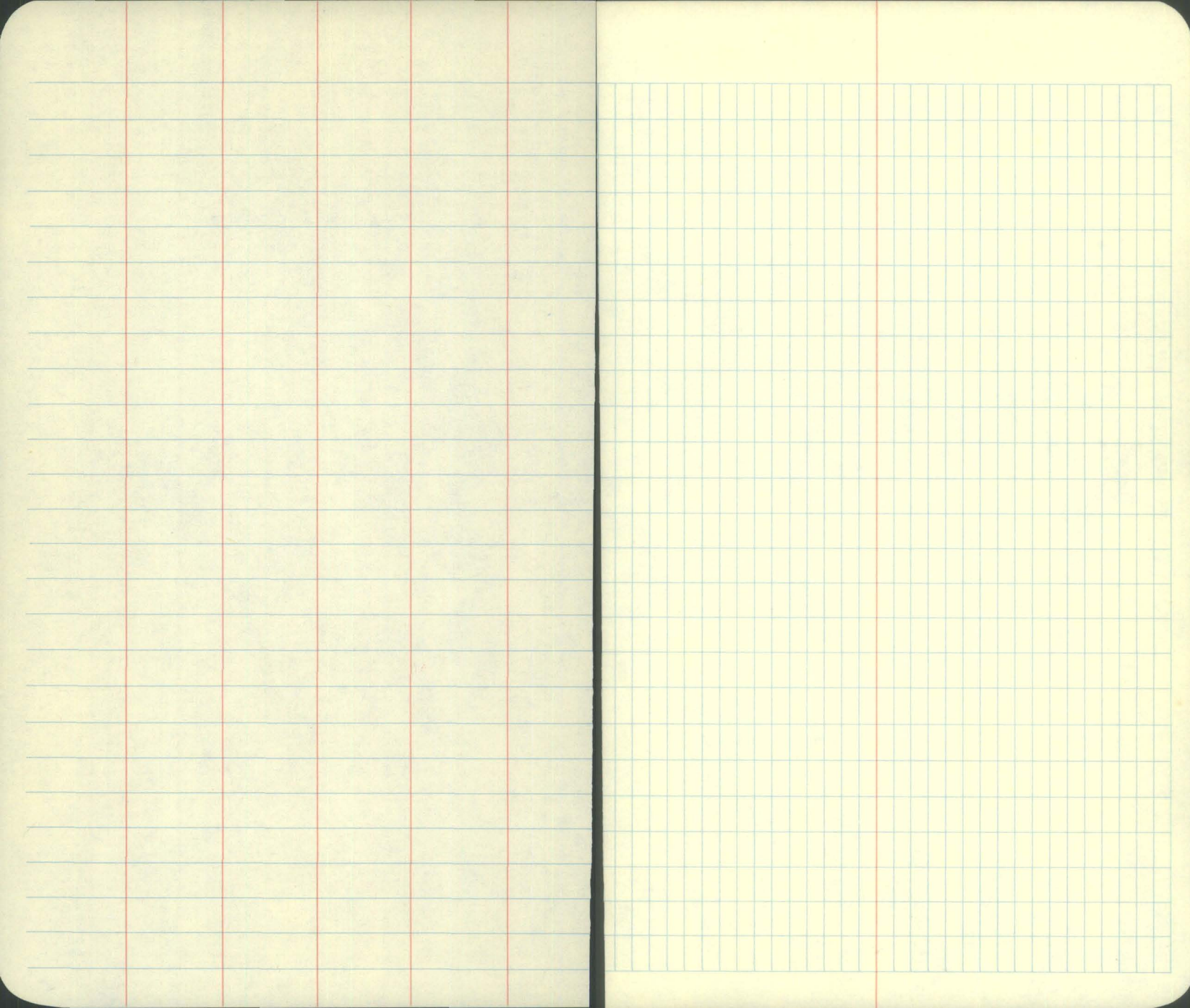


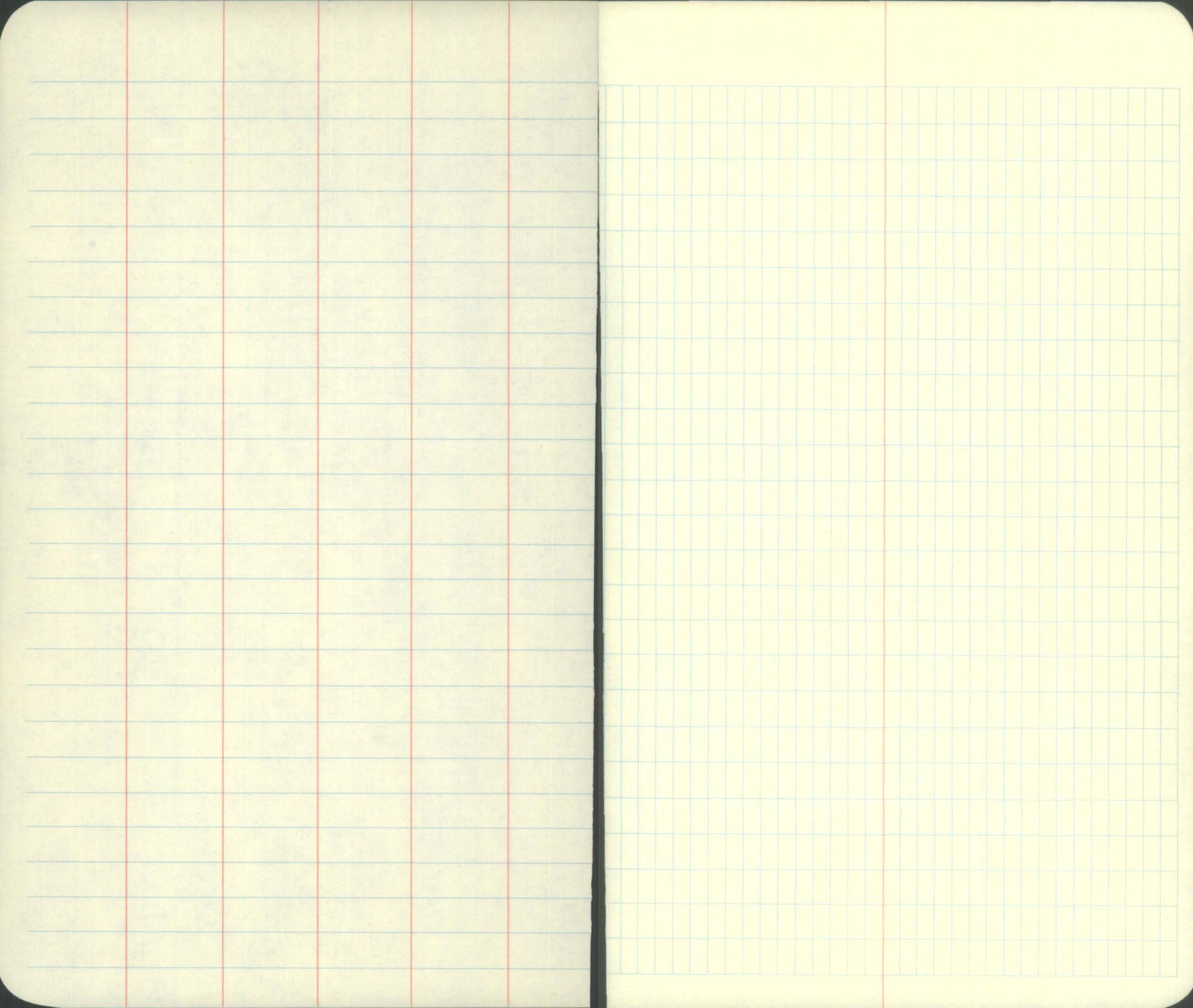


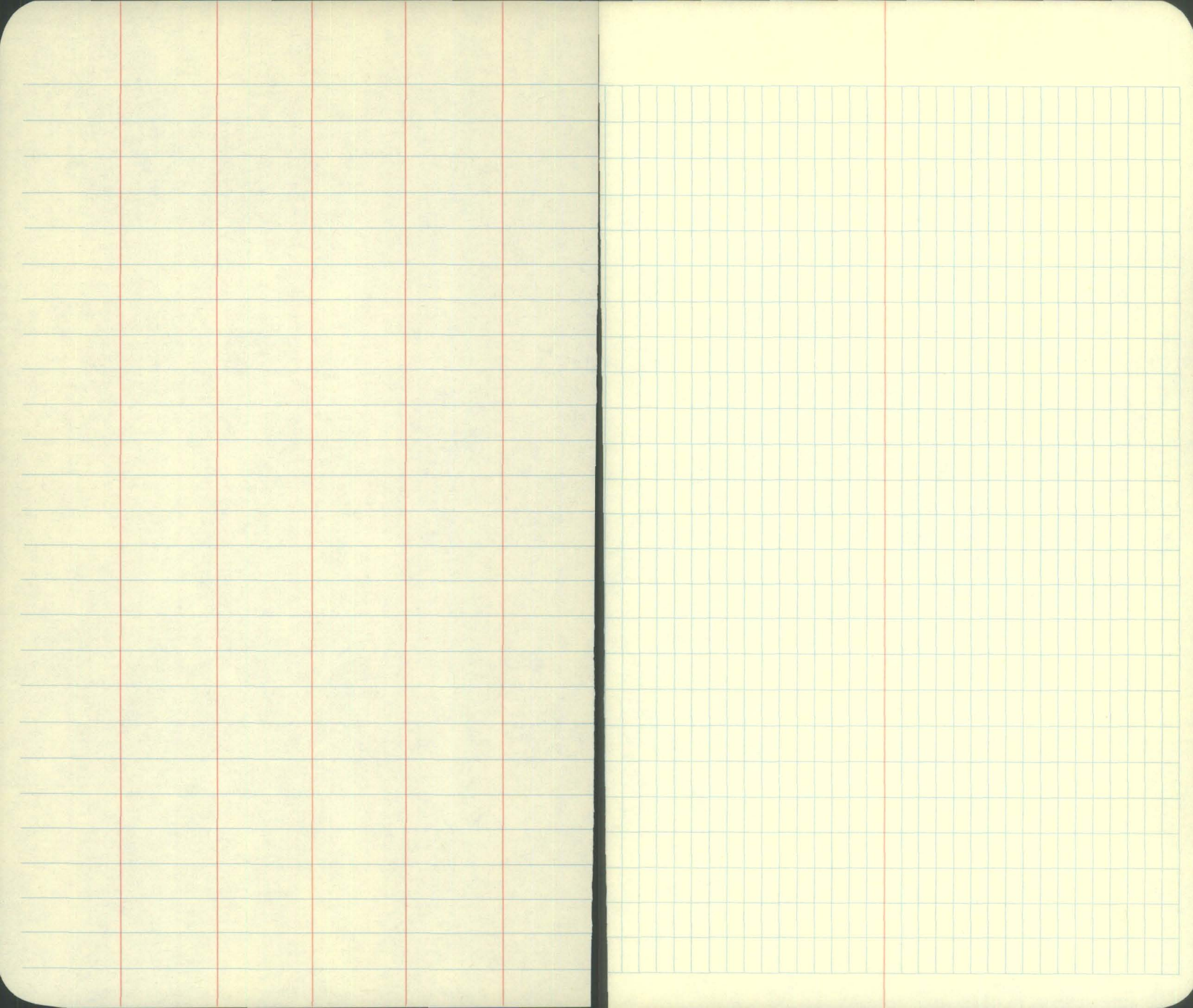


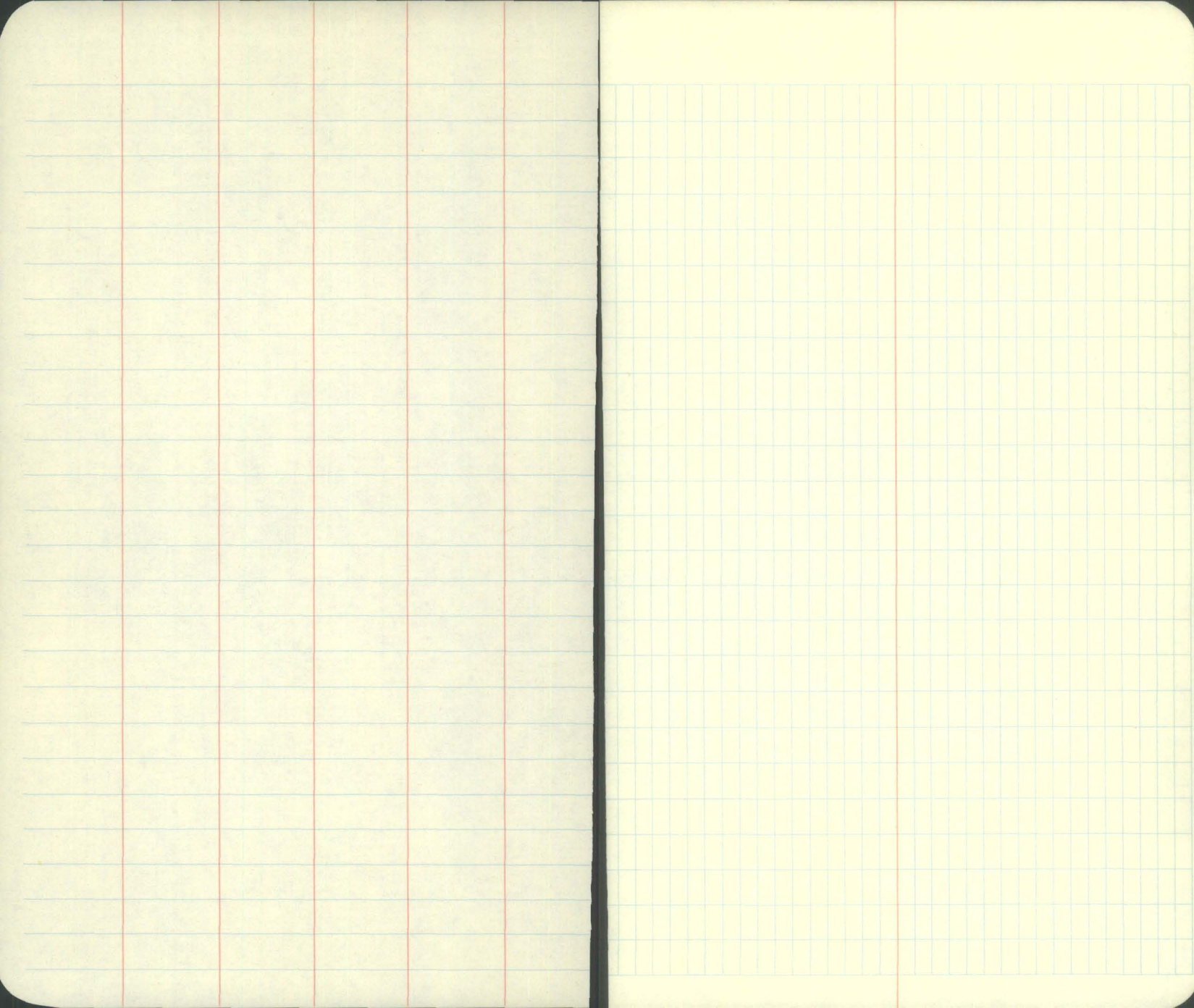


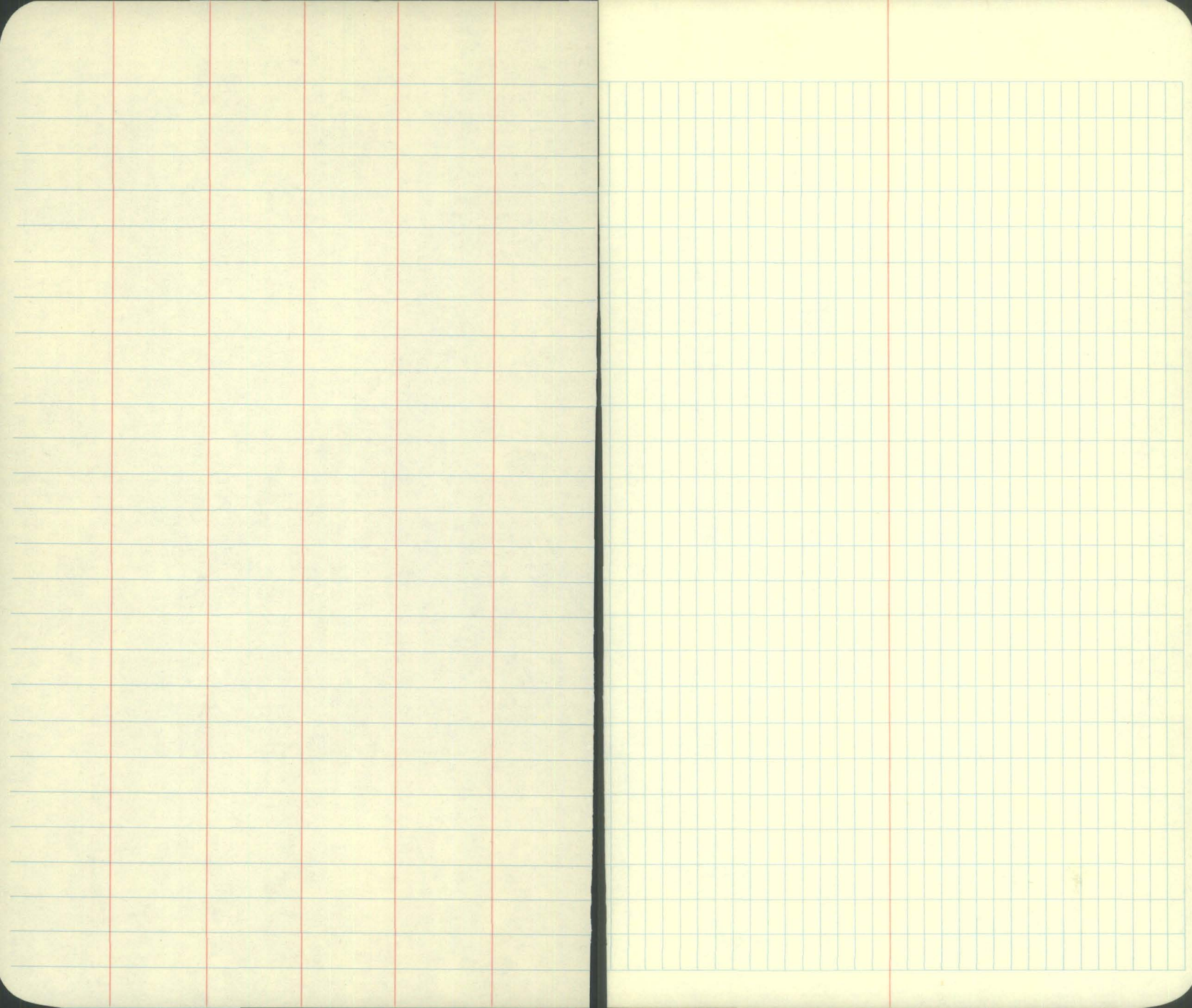


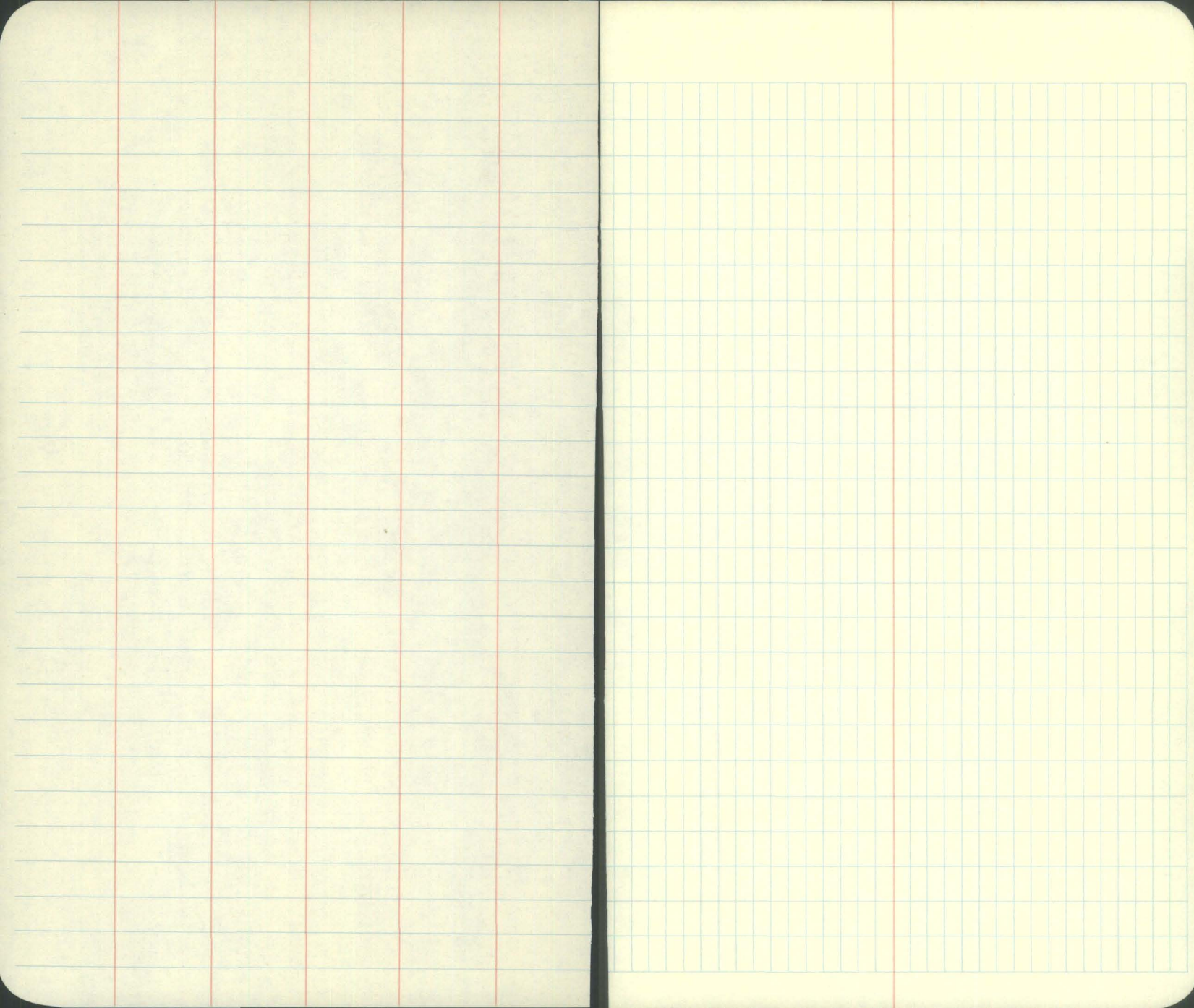


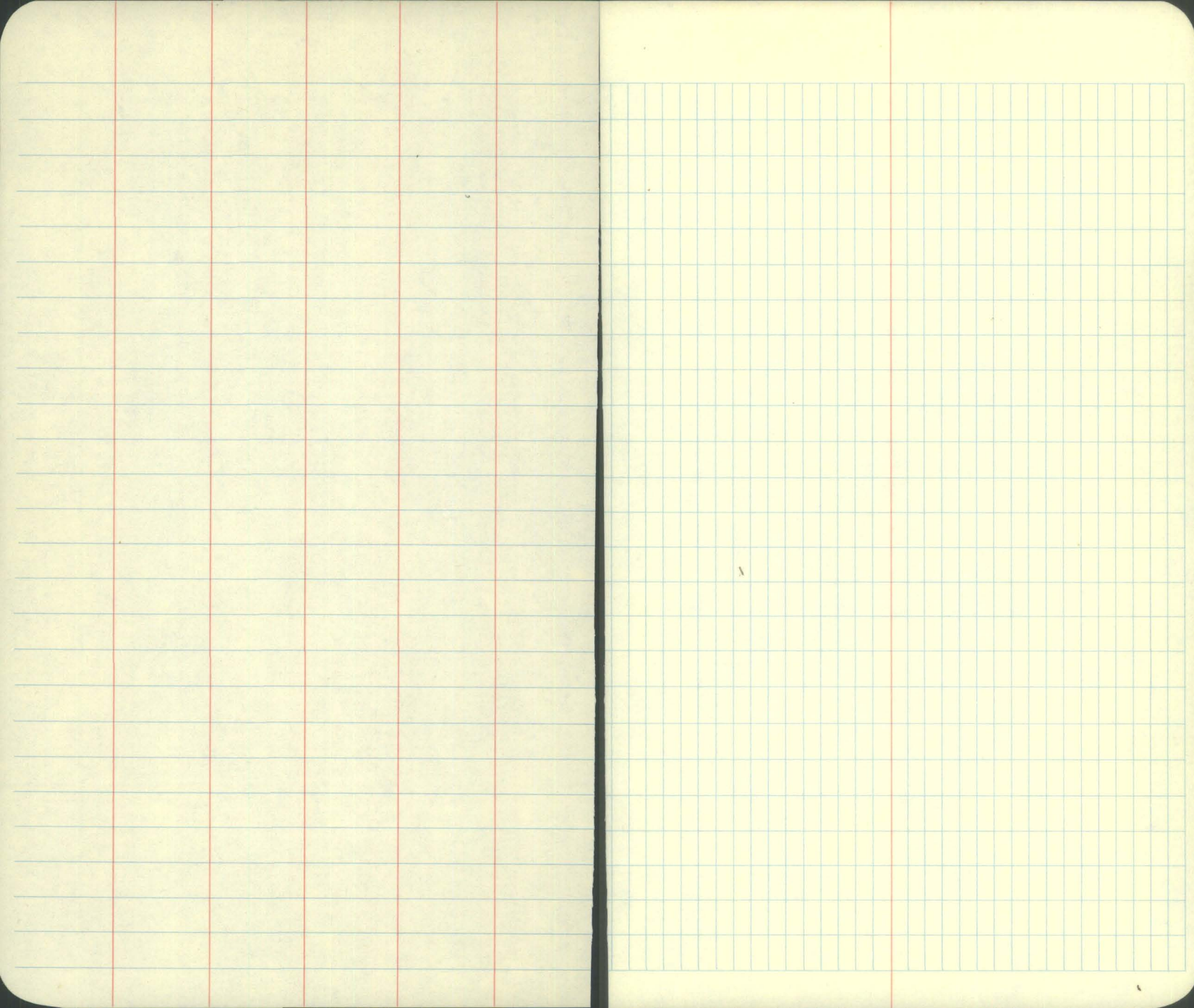


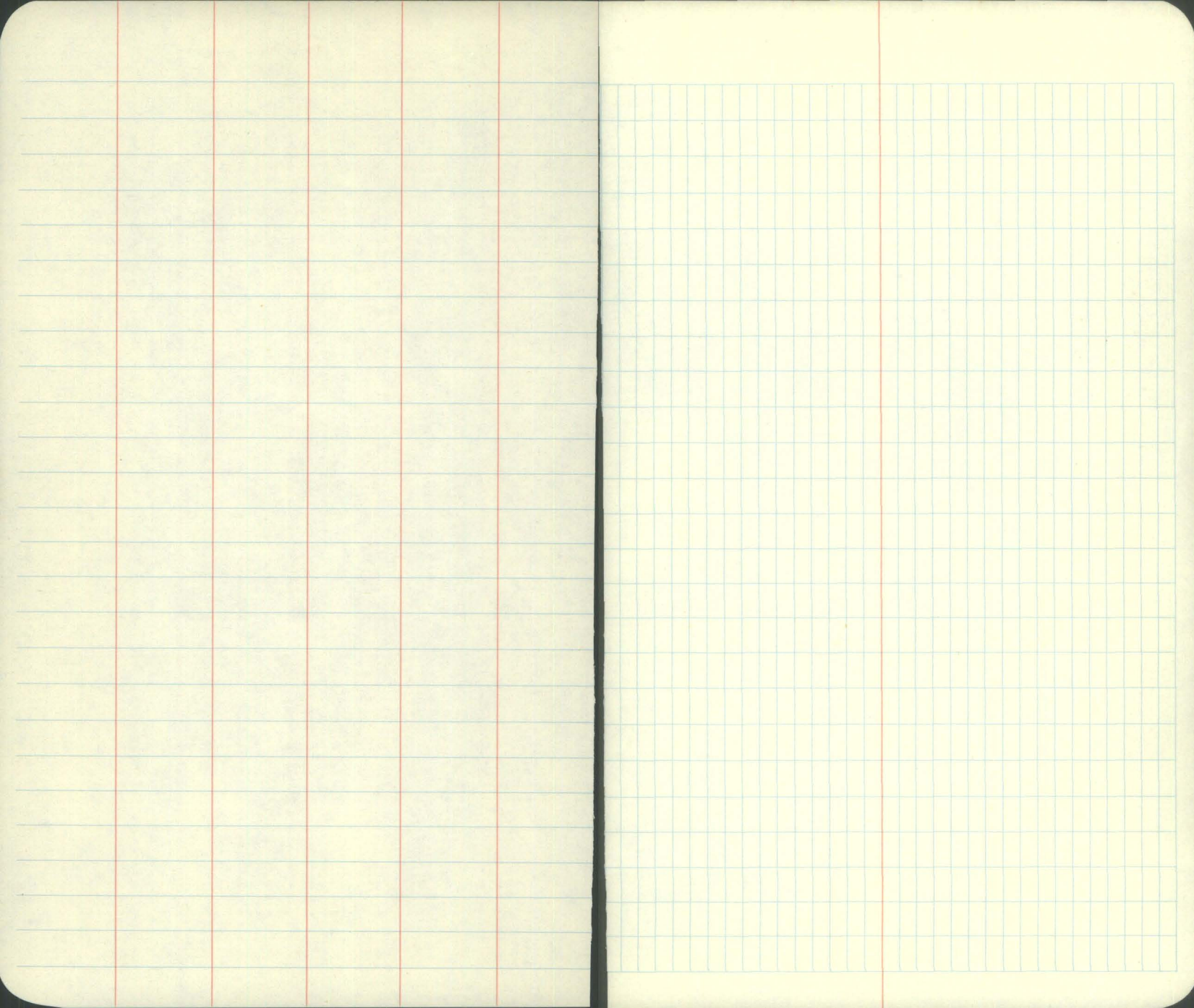












STA 316+00 To 397+45

5-21-66 Correction RD.

5	4	3	2	1
2113	2141	2130	2100	2055
500	500	500	500	500
447	451	453	454	461
53	49	47	46	39
11.9%	10.9%	10.4%	10.1%	8.5%
1888	1931	1929	1907	1894
124.8	127.6	127.5	126.0	125.2
2.00	2.04	2.04	2.02	2.01

95% 1.94

STA 274+40 To 316+00
52066 CORRECTION RD

253+00 CORRECTION RD
5/18/68

6	5	4	3	2	1	5	4	3	2	1
2077	2087	2072	2046	2009	1978	2213	2216	2192	2127	2045
500	500	500	500	500	500	500	500	500	500	500
442	450	449	450	456	458	463	466	464	471	471
58	50	51	50	44	42	37	34	36	29	29
13.1%	11.1%	11.4%	11.1%	9.6%	9.2%	8.0%	7.3%	7.8%	6.2%	6.2%
1836	1878	1860	1842	1833	1811	2049	2065	2033	2003	1926
121.3	124.1	122.9	121.7	121.1	119.1	135.4	136.4	134.3	132.4	127.3
1.94	1.99	1.97	1.95	1.94	1.92	2.17	2.19	2.15	2.12	2.04

95% 189

95% 208

Correction Rd. John Deere

5-11-66 L-2677

5	4	3	2	1
2151	2143	2121	2090	2035
500	500	500	500	500
450	453	457	461	458
50	47	43	39	42
11.1%	10.4%	9.4%	8.5%	9.2%
1936	1941	1938	1926	1863
127.9	128.3	128.1	127.3	123.1
2.05	2.06	2.05	2.04	1.97

L-29&30 Cedar

Sta 2141 To 38+00

May 7, 1966

4	3	2	1
2125	2131	2096	2029
500	500	500	500
447	453	455	456
51	47	45	44
—	10.4	9.9	9.6
1'	1930	1907	1886
—	127.5	126.0	124.8
—	204	202	2.00

N-29&30 Cedar

Sta 38+00 To 44+00

4	3	2	1
2183	2187	2150	2080
500	500	500	500
452	454	458	464
48	46	42	36
10.6%	10.1%	9.2%	7.8%
1974	1986	1969	1929
130.4	131.2	130.1	127.5
2.09	2.10	2.08	2.04

Sta. 38+00 To Sta. 42+28

Project C-438

5	4	3	2	1
2180	2183	2096	2051	2025
500	500	500	500	500
454	454	459	463	467
46	46	41	37	33
10.1%	10.1%	8.9%	7.8%	7.1%
1980	1983	1925	1902	1890
130.8	131.0	127.2	125.7	124.9
2.09	2.09	2.03	2.01	2.00

2.09

~~253+00~~

346+00 To

386+00

Project C-438

6	5	4	3	2	1
2050	2088	2073	2044	1965	1935
500	500	500	500	500	500
435	440	441	450	452	454
65	60	59	50	48	46
14.9%	13.6%	13.3%	11.1%	10.6%	10.1%
1784	1838	1833	1840	1777	1757
117.9	121.5	121.1	121.6	117.4	116.1
1.89	1.94	1.94	1.95	1.88	1.86

Sta 301+00 To 346+00

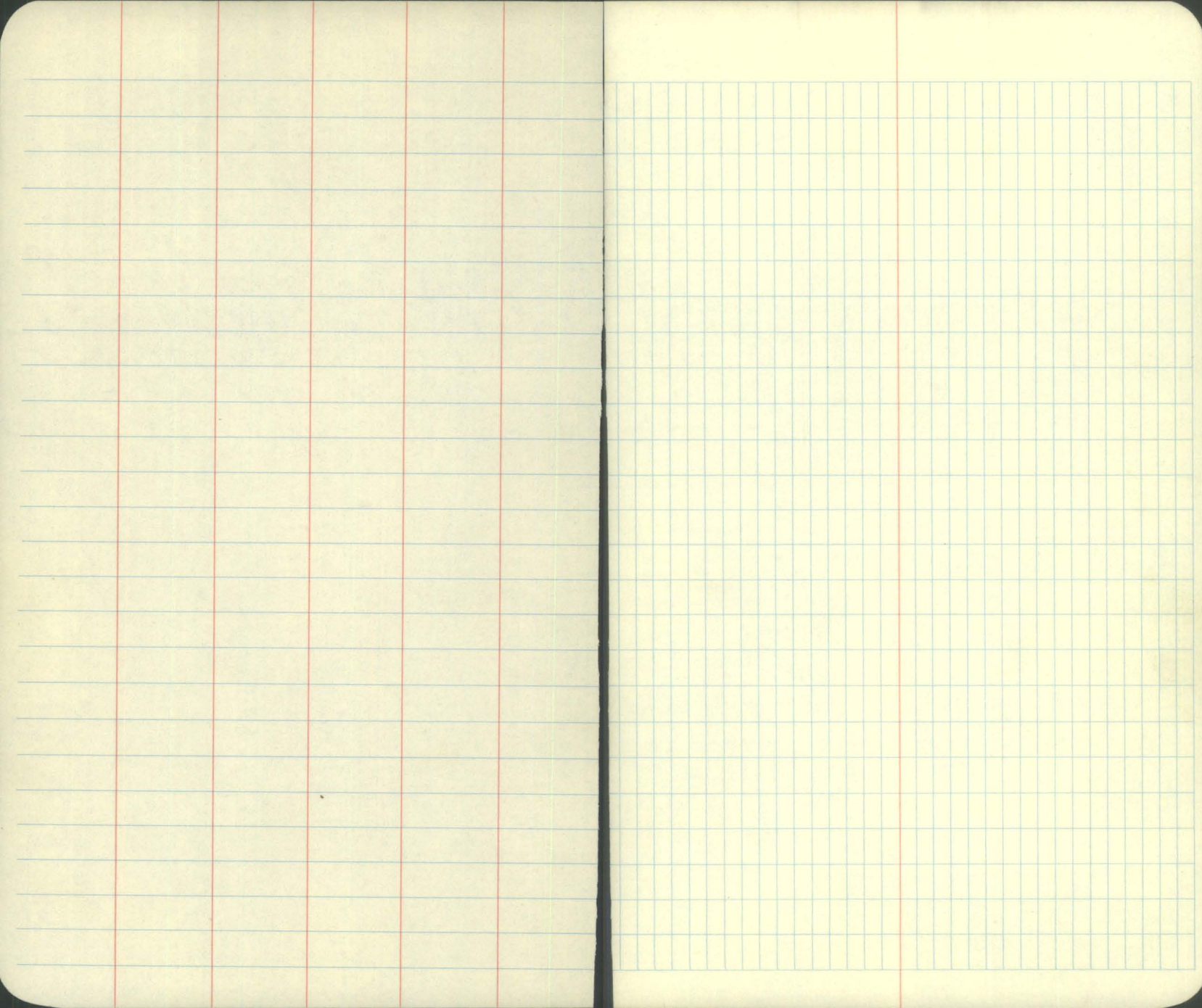
Sta. 266+53 To Sta. 301+00

4	3	2	1
2200	2225	2206	2057
800	800	800	800
723	729	729	744
27	71	71	56
10.7%	9.7%	9.7%	7.5%
1987	2028	2011	1913
131.3	134.0	132.9	126.4
2.10	2.15	2.13	2.03

4	3	2	1	
2180	2185	2095	2076	Wet wt spec.
500	500	500	500	Wet wt.
447	454	452	463	Dry wt.
53	46	48	37	Moist. Loss
10.6%	10.1%	10.6%	8.0%	% Moist.
1972	1985	1894	1922	Calc. Dry wt.
130.3	131.2	125.2	127.0	Dry wt. Per ft.
2.09	2.10	2.00	2.04	Density

Dry wt / ft = Gr Dry Wt x 0.06608

Density = Dry wt / ft x 0.0160



IMPROVED TABLES AND INFORMATION

HORIZONTAL STADIA CORRECTIONS

2°—00' — 0.1	21°—00' — 12.8	33°—00' — 29.7
3°—00' — 0.3	21°—30' — 13.4	33°—15' — 30.1
4°—00' — 0.5	22°—00' — 14.0	33°—30' — 30.5
5°—00' — 0.8	22°—30' — 14.7	33°—45' — 30.9
6°—00' — 1.1	23°—00' — 15.3	34°—00' — 31.3
7°—00' — 1.5	23°—30' — 15.9	34°—15' — 31.7
8°—00' — 1.9	24°—00' — 16.5	34°—30' — 32.1
9°—00' — 2.5	24°—30' — 17.2	34°—45' — 32.5
10°—00' — 3.0	25°—00' — 17.9	35°—00' — 32.9
10°—30' — 3.3	25°—30' — 18.6	35°—15' — 33.3
11°—00' — 3.6	26°—00' — 19.2	35°—30' — 33.7
11°—30' — 4.0	26°—30' — 19.9	35°—45' — 34.1
12°—00' — 4.3	27°—00' — 20.6	36°—00' — 34.6
12°—30' — 4.7	27°—30' — 21.3	36°—15' — 35.0
13°—00' — 5.1	28°—00' — 22.0	36°—30' — 35.4
13°—30' — 5.5	28°—30' — 22.8	36°—45' — 35.8
14°—00' — 5.9	29°—00' — 23.5	37°—00' — 36.2
14°—30' — 6.3	29°—30' — 24.3	37°—15' — 36.6
15°—00' — 6.7	30°—00' — 25.0	37°—30' — 37.1
15°—30' — 7.2	30°—15' — 25.4	37°—45' — 37.5
16°—00' — 7.6	30°—30' — 25.8	38°—00' — 37.9
16°—30' — 8.1	30°—45' — 26.2	38°—15' — 38.3
17°—00' — 8.5	31°—00' — 26.5	38°—30' — 38.7
17°—30' — 9.0	31°—15' — 26.9	38°—45' — 39.1
18°—00' — 9.5	31°—30' — 27.3	39°—00' — 39.6
18°—30' — 10.1	31°—45' — 27.7	39°—15' — 40.0
19°—00' — 10.6	32°—00' — 28.1	39°—30' — 40.5
19°—30' — 11.2	32°—15' — 28.5	
20°—00' — 11.7	32°—30' — 28.9	
20°—30' — 12.3	32°—45' — 29.3	

Chains to Feet

1	66
2	132
3	198
4	264
5	330
6	396
7	462
8	528
9	594
10	660

Feet to Chains

100	1.515
200	3.030
300	4.545
400	6.060
500	7.575
600	9.090
700	10.606
800	12.121
900	13.636
1,000	15.151

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.

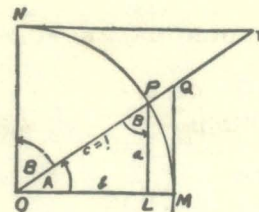


TABLE II
TRIGONOMETRIC FORMULÆ.

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

$$R = OP = c = 1$$

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

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

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

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

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

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

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

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

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

$$\text{coexsec } A = \dot{P}T = \text{exsec } B$$

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

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

Law of Sines $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

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

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

TABLE II—Continued
TRIGONOMETRIC FORMULAE (continued)

In any triangle:

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

Use Law of Sines.

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

Use Law of Sines.

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	$\frac{1}{16}$
$\frac{1}{8}$	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271	$\frac{1}{8}$
$\frac{3}{16}$	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323	$\frac{3}{16}$
$\frac{1}{4}$	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375	$\frac{1}{4}$
$\frac{5}{16}$	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427	$\frac{5}{16}$
$\frac{3}{8}$	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479	$\frac{3}{8}$
$\frac{7}{16}$	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531	$\frac{7}{16}$
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583	$\frac{1}{2}$
$\frac{9}{16}$	.0469	.1302	.2135	.2969	.3803	.4635	.5469	.6302	.7135	.7969	.8802	.9635	$\frac{9}{16}$
$\frac{5}{8}$	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688	$\frac{5}{8}$
$\frac{11}{16}$	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740	$\frac{11}{16}$
$\frac{3}{4}$	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792	$\frac{3}{4}$
$\frac{7}{8}$	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844	$\frac{7}{8}$
$\frac{15}{16}$	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896	$\frac{15}{16}$
1	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948	1
	.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	X.00019	= miles
Lineal yards	X.0006	= miles
Square inches	X.007	= square feet
Square feet	X.111	= square yards
Square yards	X.0002067	= acres
Acres	X.4840	= square yards
Cubic inches	X.00058	= cubic feet
Cubic feet	X.03704	= cubic yards
Links	X.22	= yards
Links	X.66	= feet
Feet	X.15	= links

$$360^\circ = 21600' = 1296000''$$

$$\text{Radius} = \text{arc of } 57.2957790''$$

$$\text{Arc of } 1^\circ (\text{radius} = 1) = .017453292$$

$$\text{Arc of } 1' (\text{radius} = 1) = .000290888$$

$$\text{Arc of } 1'' (\text{radius} = 1) = .000004848$$

$$\pi = 3.141592654$$

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

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

$$\sqrt{\frac{6}{\pi}} = 1.240700982$$

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

$$\pi^2 = 9.869604401$$

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

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

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

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

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

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

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 11 $\frac{1}{2}$ miles

$$\text{Probable error of a single observation} = 0.675 \sqrt{\frac{\sum v^2}{n-1}}$$

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.

$$\text{Horizontal Distance} = R - R \sin^2 a + C \cos a$$

$$\text{Vertical Distance} = R \frac{1}{2} \sin 2a + C \sin a$$

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

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

a = angle of elevation for mid Reading

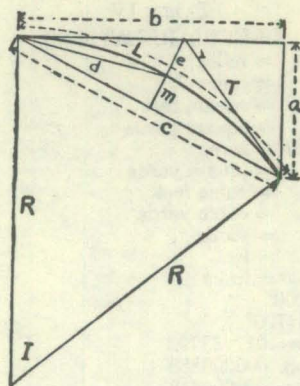


TABLE V
CURVE FORMULAE FOR SIMPLE CURVES
COMPILED BY J. CALVIN LOCKE, C.E.

- (1) $c = \sqrt{2Ra}$ (2) $c = \sqrt{a^2 + b^2}$
 (3) $c = \sqrt{2R(R - \sqrt{(R+b)(R-b)})} = \sqrt{2R(R - \sqrt{R^2 - b^2})}$
 (4) $c = 2\sqrt{m(2R - m)}$
 (5) $c = 2R \sin \frac{1}{2} I$ (6) $c = 2T \cos \frac{1}{2} I$
 (7) $e = R \operatorname{exsec} \frac{1}{2} I$
 (8) $e = R \tan$

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

sin	tan	sin	tan	sin	tan	sin	tan	sin	tan	sin	tan	sin	tan
0'	0'	10'	10'	20'	20'	30'	30'	40'	40'	50'	50'	60'	60'
47	7193	1.0355	7214	1.0416	7234	1.0477	7254	1.0533	7274	1.0599	7294	1.0661	43
48	314	.0724	333	.0786	353	.0850	373	.0913	392	.0977	412	.1041	42
49	431	.1106	451	.1171	470	.1237	490	.1303	509	.1369	528	.1436	41
50	547	.1504	566	.1571	585	.1640	604	.1708	623	.1778	642	.1847	40
51	660	1.1918	7679	1.1988	7698	1.2059	7716	1.2131	7735	1.2203	7753	1.2276	39
52	771	.2349	790	.2423	808	.2497	826	.2572	844	.2647	862	.2723	37
53	880	.2799	898	.2876	916	.2954	934	.3032	951	.3111	969	.3190	37
54	986	.3270	8004	.3351	8021	.3452	8039	.3514	8056	.3597	8073	.3680	36
55	8090	.3764	107	.3848	124	.3934	141	.4019	158	.4106	175	.4193	35
56	192	.4281	208	.4370	225	.4460	241	.4550	258	.4641	274	.4733	34
57	290	.4826	307	.4919	323	.5013	339	.5108	355	.5204	371	.5301	33
58	387	.5399	403	.5497	418	.5597	434	.5697	450	.5798	465	.5902	32
59	480	.6003	496	.6107	511	.6212	526	.6319	542	.6426	557	.6534	31
60	572	.6643	587	.6753	601	.6864	616	.6977	631	.7090	646	.7205	30
61	660	1.7321	8675	1.7437	8689	1.7556	8704	1.7675	8718	1.7797	8732	1.7917	29
62	746	.8040	760	.8165	774	.8291	788	.8418	802	.8546	816	.8676	28
63	829	.8807	843	.8940	857	.9074	870	.9210	884	.9347	897	.9486	27
64	910	.9626	923	.9768	936	.9912	949	2.0057	962	2.0204	975	2.0352	26
65	988	2.0503	9001	2.0655	9013	2.0809	9026	.0965	9038	1.1231	9051	1.1283	25
66	9063	.1445	075	.1609	088	.1775	100	.1943	112	.2113	124	.2286	24
67	135	.2460	147	.2637	159	.2817	171	.2998	182	.3183	194	.3369	23
68	205	.3559	216	.3750	228	.3945	239	.4142	250	.4342	261	.4545	22
69	272	.4751	283	.4960	293	.5172	304	.5386	315	.5605	325	.5828	21
70	336	.6051	346	.6279	356	.6511	367	.6746	377	.6985	387	.7228	20
71	397	2.7475	9407	2.7725	9417	2.7980	9426	2.8239	9436	2.8502	9446	2.8770	19
72	455	.9042	465	.9319	474	.9600	483	.9887	492	3.0178	502	3.0475	18
73	511	3.0777	520	3.1084	528	3.1397	537	3.1716	546	.2041	555	.2371	17
74	563	.2709	572	.3052	580	.3402	588	.3759	596	.4124	605	.4495	16
75	613	.4874	621	.5261	628	.5656	636	.6059	644	.6470	652	.6891	15
76	659	.7321	667	.7760	674	.8208	681	.8657	689	.9136	696	.9617	14
77	703	4.0108	710	4.0611	717	4.1126	724	4.1653	730	4.2193	737	4.2747	13
78	744	.3315	750	.3897	757	.4494	763	.5107	769	.5736	775	.6382	12
79	781	.7046	787	.7729	793	.8430	799	.9152	805	.9894	811	5.0658	11
80	816	1.1446	822	5.2257	827	5.3093	833	5.3955	838	5.4845	843	5.5764	10
81	9848	5.6713	9853	5.7694	9858	5.8708	9863	5.9758	9868	6.0844	9872	6.1970	9
82	877	6.3138	881	6.4348	886	6.5606	890	6.6912	894	.8269	899	.9682	8
83	903	7.1154	907	7.2687	911	7.4287	914	7.5958	918	7.7704	922	7.9530	7
84	925	8.1443	929	8.3450	932	8.5555	936	8.7769	939	9.0098	942	9.2553	6
85	945	9.5144	949	9.7882	951	10.078	954	10.385	957	10.711	959	11.059	5
86	962	11.430	964	11.826	967	12.250	969	12.706	971	13.197	974	13.727	4
87	976	14.300	978	14.924	980	15.605	981	16.350	983	17.169	985	18.075	3
88	986	19.081	988	20.206	989	21.470	990	22.903	992	24.542	993	26.432	2
89	994	28.636	995	31.242	996	34.368	997	38.189	997	42.964	998	49.104	1
90	9998	57.290	9999	68.750	9999	85.940	9999	114.58	1.000	171.88	1.000	343.77	0
60'	60'	50'	50'	40'	40'	30'	30'	20'	20'	10'	10'		
cos	cos	cos	cos	cos	cos	cos	cos	cos	cos	cos	cos		

TABLE VII
RODS IN FEET, 10THS AND 100THS OF FEET

Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet
1	16.50	21	346.50	41	676.50	61	1006.50	81	1336.50
2	33.00	22	363.00	42	693.00	62	1023.00	82	1353.00
3	49.50	23	379.50	43	709.50	63	1039.50	83	1369.50
4	66.00	24	396.00	44	726.00	64	1056.00	84	1386.00
5	82.50	25	412.50	45	742.50	65	1072.50	85	1402.50
6	99.00	26	429.00	46	759.00	66	1089.00	86	1419.00
7	115.50	27	445.50	47	775.50	67	1105.50	87	1435.50
8	132.00	28	462.00	48	792.00	68	1122.00	88	1452.00
9	148.50	29	478.50	49	808.50	69	1138.50	89	1468.50
10	165.00	30	495.00	50	825.00	70	1155.00	90	1485.00
11	181.50	31	511.50	51	841.50	71	1171.50	91	1501.50
12	198.00	32	528.00	52	858.00	72	1188.00	92	1518.00
13	214.50	33	544.50	53	874.50	73	1204.50	93	1534.50
14	231.00	34	561.00	54	891.00	74	1221.00	94	1551.00
15	247.50	35	577.50	55	907.50	75	1237.50	95	1567.50
16	264.00	36	594.00	56	924.00	76	1254.00	96	1584.00
17	280.50	37	610.50	57	940.50	77	1270.50	97	1600.50
18	297.00	38	627.00	58	957.00	78	1287.00	98	1617.00
19	313.50	39	643.50	59	973.50	79	1303.50	99	1633.50
20	330.00	40	660.00	60	990.00	80	1320.00	100	1650.00

TABLE VIII
LINKS IN FEET, 10THS AND 100THS OF FEET

Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet
1	0.66	18	11.88	35	23.10	52	34.32	69	45.54	86	56.76
2	1.32	19	12.54	36	23.76	53	34.98	70	46.20	87	57.42
3	1.98	20	13.20	37	24.42	54	35.64	71	46.86	88	58.08
4	2.64	21	13.86	38	25.08	55	36.30	72	47.52	89	58.74
5	3.30	22	14.52	39	25.74	56	36.96	73	48.18	90	59.40
6	3.96	23	15.18	40	26.40	57	37.62	74	48.84	91	60.06
7	4.62	24	15.84	41	27.06	58	38.28	75	49.50	92	60.72
8	5.28	25	16.50	42	27.72	59	38.94	76	50.16	93	61.38
9	5.94	26	17.16	43	28.38	60	39.60	77	50.82	94	62.04
10	6.60	27	17.82	44	29.04	61	40.26	78	51.48	95	62.70
11	7.26	28	18.48	45	29.70	62	40.92	79	52.14	96	63.36
12	7.92	29	19.14	46	30.36	63	41.58	80	52.80	97	64.02
13	8.58	30	19.80	47	31.02	64	42.24	81	53.46	98	64.68
14	9.24	31	20.46	48	31.68	65	42.90	82	54.12	99	65.34
15	9.90	32	21.12	49	32.34	66	43.56	83	54.78	100	66.00
16	10.56	33	21.78	50	33.00	67	44.22	84	55.44	101	66.66
17	11.22	34	22.44	51	33.66	68	44.88	85	56.10	102	67.32

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	.033
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		40'	839.27	61.141		40'	1358.0	158.72	
50'	342.08	10.202	20° C.	50'	847.78	62.381	20° C.	50'	1366.8	160.76	20° C.
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		20'	924.58	74.119		20'	1446.3	179.72	
30'	425.79	15.799		30'	933.13	75.488		30'	1455.1	181.89	
40'	434.17	16.426		40'	941.69	76.869	.32	40'	1464.0	184.08	.49
50'	442.55	17.065	25° C.	50'	950.25	78.264	E	50'	1472.9	186.29	E
9°	450.93	17.717	.16	19°	958.81	79.671	.028	29°	1481.8	188.51	.065
10'	459.32	18.381	E	10'	967.38	81.092	E	10'	1490.7	190.74	E
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	30° C.	50'	1001.7	86.904	.034	50'	1526.3	199.82	.078
10°	501.28	21.887		20°	1010.3	88.389		30°	1535.3	202.12	
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		40'	1571.0	211.48	
50'	543.29	25.700		50'	1053.3	96.013		50'	1580.0	213.86	

T = R tan ½ I

E = R exsec ½ 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'	2951.0	715.3	
40'	1788.2	272.6		40'	2353.8	464.6		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		30'	2461.7	506.4		30'	3078.7	774.7	
40'	1898.6	306.4	20° C.	40'	2471.5	510.3	20° C.	40'	3089.4	779.8	20° C.
50'	1907.9	309.3	T	50'	2481.4	514.3	T	50'	3100.2	784.9	T
37°	1917.1	312.2	.53	47°	2491.3	518.2	.68	57°	3110.9	790.1	.84
10'	1926.4	315.2	E	10'	2501.2	522.2	E	10'	3121.7	795.2	E
20'	1935.7	318.1	.093	20'	2511.2	526.1	.151	20'	3132.6	800.4	.225
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	.105
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	.189	50'	3230.7	848.1	.283
39°	2029.0	348.6		49°	2611.2	566.9		59°	3241.7	853.5	
10'	2038.4	351.8		10'	2621.2	571.1		10'	3252.7	858.9	
20'	2047.8	354.9		20'	2631.3	575.3		20'	3263.7	864.3	
30'	2057.2	358.1		30'	2641.4	579.5		30'	3274.8	869.8	
40'	2066.6	361.3		40'	2651.5	583.8		40'	3285.8	875.3	
50'	2076.0	364.5		50'	2661.6	588.0		50'	3296.9	880.8	
40°	2085.4	367.7		50°	2671.8	592.3		60°	3308.0	886.4	
10'	2094.9	371.0	T	10'	2681.9	596.6	T	10'	3319.1	892.0	T
20'	2104.3	374.2	.80	20'	2692.1	600.9	1.02	20'	3330.3	897.5	1.27
30'	2113.8	377.5	E	30'	2702.3	605.3	E	30'	3341.4	903.2	E
40'	2123.3	380.8	.141	40'	2712.5	609.6	.227	40'	3352.6	908.8	.340
50'	2132.7	384.1		50'	2722.7	614.0		50'	3363.8	914.5	

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		20'	4112.1	1322.9		20'	4922.5	1824.1	
30'	3408.8	937.3		30'	4124.8	1330.3		30'	4937.0	1833.6	
40'	3420.1	943.1		40'	4137.4	1337.7		40'	4951.5	1843.1	
50'	3431.4	948.9		50'	4150.1	1345.1		50'	4966.1	1852.6	
62°	3442.7	954.8	.080	72°	4162.8	1352.6	.110	82°	4980.7	1862.2	.149
10'	3454.1	960.6		10'	4175.6	1360.1		10'	4995.4	1871.8	
20'	3465.4	966.5		20'	4188.5	1367.6		20'	5010.0	1881.5	
30'	3476.8	972.4		30'	4201.2	1375.2		30'	5024.8	1891.2	
40'	3488.3	978.3		40'	4214.0	1382.8		40'	5039.5	1900.9	
50'	3499.7	984.3		50'	4226.8	1390.4		50'	5054.3	1910.7	
63°	3511.1	990.2	10° C.	73°	4239.7	1398.0	10° C.	83°	5069.2	1920.5	10° C.
10'	3522.6	996.2	T	10'	4252.6	1405.7	T	10'	5084.0	1930.4	T
20'	3534.1	1002.3	.51	20'	4265.6	1413.5	.61	20'	5099.0	1940.3	.72
30'	3545.6	1008.3		30'	4278.5	1421.2		30'	5113.9	1950.3	
40'	3557.2	1014.4		40'	4291.5	1429.0		40'	5128.9	1960.2	
50'	3568.7	1020.5	.159	50'	4304.6	1436.8	.220	50'	5143.9	1970.3	.299
64°	3580.3	1026.6		74°	4317.6	1444.6		84°	5159.0	1980.4	
10'	3591.9	1032.8		10'	4330.7	1452.5		10'	5174.1	1990.5	
20'	3603.5	1039.0		20'	4343.8	1460.4		20'	5189.3	2000.6	
30'	3615.1	1045.2		30'	4356.9	1468.4		30'	5204.4	2010.8	
40'	3626.8	1051.4		40'	4370.1	1476.4		40'	5219.7	2021.1	
50'	3638.5	1057.7	15° C.	50'	4383.3	1484.4	15° C.	50'	5234.9	2031.4	15° C.
65°	3650.2	1063.9	T	75°	4396.5	1492.4	T	85°	5250.3	2041.7	T
10'	3661.9	1070.2	.76	10'	4409.8	1500.5	.91	10'	5265.6	2052.1	1.09
20'	3673.7	1076.6	E	20'	4423.1	1508.6	E	20'	5281.0	2062.5	E
30'	3685.4	1082.9		30'	4436.4	1516.7		30'	5296.4	2073.0	
40'	3697.2	1089.3	.240	40'	4449.7	1524.9	.332	40'	5311.9	2083.5	.450
50'	3709.0	1095.7		50'	4463.1	1533.1		50'	5327.4	2094.1	
66°	3720.9	1102.2		76°	4476.5	1541.4		86°	5343.0	2104.7	
10'	3732.7	1108.6		10'	4489.9	1549.7		10'	5358.6	2115.3	
20'	3744.6	1115.1		20'	4503.4	1558.0		20'	5374.2	2126.0	
30'	3756.5	1121.7		30'	4516.9	1566.3		30'	5389.9	2136.7	
40'	3768.5	1128.2	20° C.	40'	4530.4	1574.7	20° C.	40'	5405.6	2147.5	20° C.
50'	3780.4	1134.8	T	50'	4544.0	1583.1	T	50'	5421.4	2158.4	T
67°	3792.4	1141.4	1.02	77°	4557.6	1591.6	1.22	87°	5437.2	2169.2	1.45
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		30'	4598.5	1617.1		30'	5484.9	2202.2	
40'	3840.5	1168.1		40'	4612.2	1625.7		40'	5500.9	2213.2	
50'	3852.6	1174.8		50'	4626.0	1634.4		50'	5517.0	2224.3	
68°	3864.7	1181.6		78°	4639.8	1643.0		88°	5533.1	2235.5	
10'	3876.8	1188.4	25° C.	10'	4653.6	1651.7	25° C.	10'	5549.2	2246.7	25° C.
20'	3889.0	1195.2	T	20'	4667.4	1660.5	T	20'	5565.4	2258.0	T
30'	3901.2	1202.0		30'	4681.3	1669.2		30'	5581.6	2269.3	
40'	3913.4	1208.9	1.28	40'	4695.2	1678.1	1.53	40'	5597.8	2280.6	1.83
50'	3925.6	1215.8	E	50'	4709.2	1686.9	E	50'	5614.2	2292.0	E
69°	3937.9	1222.7	.403	79°	4723.2	1695.8	.558	89°	5630.5	2303.5	.756
10'	3950.2	1229.7		10'	4737.2	1704.7		10'	5646.9	2315.0	
20'	3962.5	1236.7		20'	4751.2	1713.7		20'	5663.4	2326.6	
30'	3974.8	1243.7		30'	4765.3	1722.7		30'	5679.9	2338.2	
40'	3987.2	1250.8		40'	4779.4	1731.7		40'	5696.4	2349.8	
50'	3999.5	1257.9		50'	4793.6	1740.8		50'	5713.0	2361.5	
70°	4011.9	1265.0	30° C.	80°	4807.7	1749.9	30° C.	90°	5729.7	2373.3	30° C.
10'	4024.4	1272.1	T	10'	4822.0	1759.0	T	10'	5746.3	2385.1	T
20'	4036.8	1279.3	1.54	20'	4836.2	1768.2	1.84	20'	5763.1	2397.0	2.20
30'	4049.3	1286.5	E	30'	4850.5	1777.4	E	30'	5779.9	2408.9	E
40'	4061.8	1293.6		40'	4864.8	1786.7		40'	5796.7	2420.9	
50'	4074.4	1300.9	.485	50'	4879.2	1796.0	.671	50'	5813.6	2432.9	.910

T = R tan ½ I

E = R exsec ½ 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		20'	6992.0	3310.1		20'	8388.9	4429.2	
30'	5881.7	2481.5	T	30'	7012.7	3326.1	T	30'	8415.1	4450.9	T
40'	5898.8	2493.8	.43	40'	7033.6	3342.3	.51	40'	8441.5	4472.7	.62
50'	5916.0	2506.1	E	50'	7054.5	3358.5	E	50'	8468.0	4494.6	E
92°	5933.2	2518.5	.200	102°	7075.5	3374.9	.268	112°	8494.6	4516.6	.360
10'	5950.5	2531.0		10'	7096.6	3391.2		10'	8521.3	4538.8	
20'	5967.9	2543.5		20'	7117.8	3407.7		20'	8548.1	4561.1	
30'	5985.3	2556.0		30'	7139.0	3424.3		30'	8575.0	4583.4	
40'	6002.7	2568.6		40'	7160.3	3440.9		40'	8602.1	4606.0	
50'	6020.2	2581.3		50'	7181.7	3457.6		50'	8629.3	4628.6	
93°	6037.8	2594.0	10° C.	103°	7203.2	3474.4	10° C.	113°	8656.6	4651.3	10° C.
10'	6055.4	2606.8	T	10'	7224.7	3491.3	T	10'	8684.0	4674.2	T
20'	6073.1	2619.7	.56	20'	7246.3	3508.2	.103	20'	8711.5	4697.2	.125
30'	6090.8	2632.6	E	30'	7268.0	3525.2	E	30'	8739.2	4720.3	E
40'	6108.6	2645.5	.401	40'	7289.8	3542.4	.536	40'	8767.0	4743.6	.721
50'	6126.4	2658.5		50'	7311.7	3559.6		50'	8794.9	4766.9	
94°	6144.3	2671.6		104°	7333.6	3576.8		114°	8822.9	4790.4	
10'	6162.2	2684.7		10'	7355.6	3594.2		10'	8851.0	4814.1	
20'	6180.2	2697.9		20'	7377.8	3611.7		20'	8879.3	4837.8	
30'	6198.3	2711.2		30'	7399.9	3629.2		30'	8907.7	4861.7	
40'	6216.4	2724.5		40'	7422.2	3646.8		40'	8936.3	4885.7	
50'	6234.6	2737.9	15° C.	50'	7444.6	3664.5	15° C.	50'	8965.0	4909.9	15° C.
95°	6252.8	2751.3	T	105°	7467.0	3682.3	T	115°	8993.8	4934.1	T
10'	6271.1	2764.8	1.30	10'	7489.6	3700.2	1.56	10'	9022.7	4958.6	1.93
20'	6289.4	2778.3	E	20'	7512.2	3718.2	E	20'	9051.7	4983.1	E
30'	6307.9	2792.0	.604	30'	7534.9	3736.2	.806	30'	9080.9	5007.8	1.09
40'	6326.3	2805.6		40'	7557.7	3754.4		40'	9110.3	5032.6	
50'	6344.8	2819.4		50'	7580.5	3772.6		50'	9139.8	5057.6	
96°	6363.4	2833.2		106°	7603.5	3791.0		116°	9169.4	5082.7	
10'	6382.1	2847.0		10'	7626.6	3809.4		10'	9199.1	5107.9	
20'	6400.8	2861.0		20'	7649.7	3827.9		20'	9229.0	5133.3	
30'	6419.5	2875.0	20° C.	30'	7672.9	3846.5	20° C.	30'	9259.0	5158.8	20° C.
40'	6438.4	2889.0	T	40'	7696.3	3865.2	T	40'	9289.2	5184.5	T
50'	6457.3	2903.1	1.74	50'	7719.7	3884.0	2.08	50'	9319.5	5210.3	2.52
97°	6476.2	2917.3	E	107°	7743.2	3902.9	E	117°	9349.9	5236.2	E
10'	6495.2	2931.6	.809	10'	7766.8	3921.9	1.08	10'	9380.5	5262.3	1.46
20'	6514.3	2945.9		20'	7790.5	3940.9		20'	9411.3	5288.6	
30'	6533.3	2960.3		30'	7814.3	3960.1		30'	9442.2	5315.0	
40'	6552.6	2974.7		40'	7838.1	3979.4		40'	9473.2	5341.5	
50'	6571.9	2989.2		50'	7862.1	3998.7		50'	9504.4	5368.2	
98°	6591.2	3003.8		108°	7886.2	4018.2		118°	9535.7	5395.1	
10'	6610.6	3018.4	25° C.	10'	7910.4	4037.8	25° C.	10'	9567.2	5422.1	25° C.
20'	6630.1	3033.1	T	20'	7934.6	4057.4	T	20'	9598.9	5449.2	T
30'	6649.6	3047.9		30'	7959.0	4077.2		30'	9630.7	5476.5	
40'	6669.2	3062.8	2.18	40'	7983.5	4097.1	2.61	40'	9662.6	5504.0	3.16
50'	6688.8	3077.7	E	50'	8008.0	4117.0	E	50'	9694.7	5531.7	E
99°	6708.6	3092.7	1.02	109°	8032.7	4137.1	1.36	119°	9727.0	5559.4	1.83

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

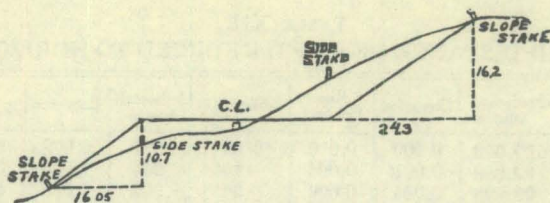
To find length of curve divide angle from P. C. to P. T. by central angle of chord, and multiply by length of chord.

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 00"	.00833	10 30"	.17500	20 30"	.34167	30 30"	.50833	40 30"	.67500	50 30"	.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	13 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 $1\frac{1}{4}$ 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.

$$\begin{array}{r}
 55 \\
 55 \\
 \hline
 275 \\
 3025
 \end{array}$$

$$\begin{array}{r}
 123 \\
 25 \\
 \hline
 615 \\
 246 \\
 \hline
 3075
 \end{array}$$