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# Photographic Interpretation Handbook, United States Forces: Section 07 Interpretation Aids

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**SECTION 7**  
**INTERPRETATION AIDS**

7.01 — 7.99

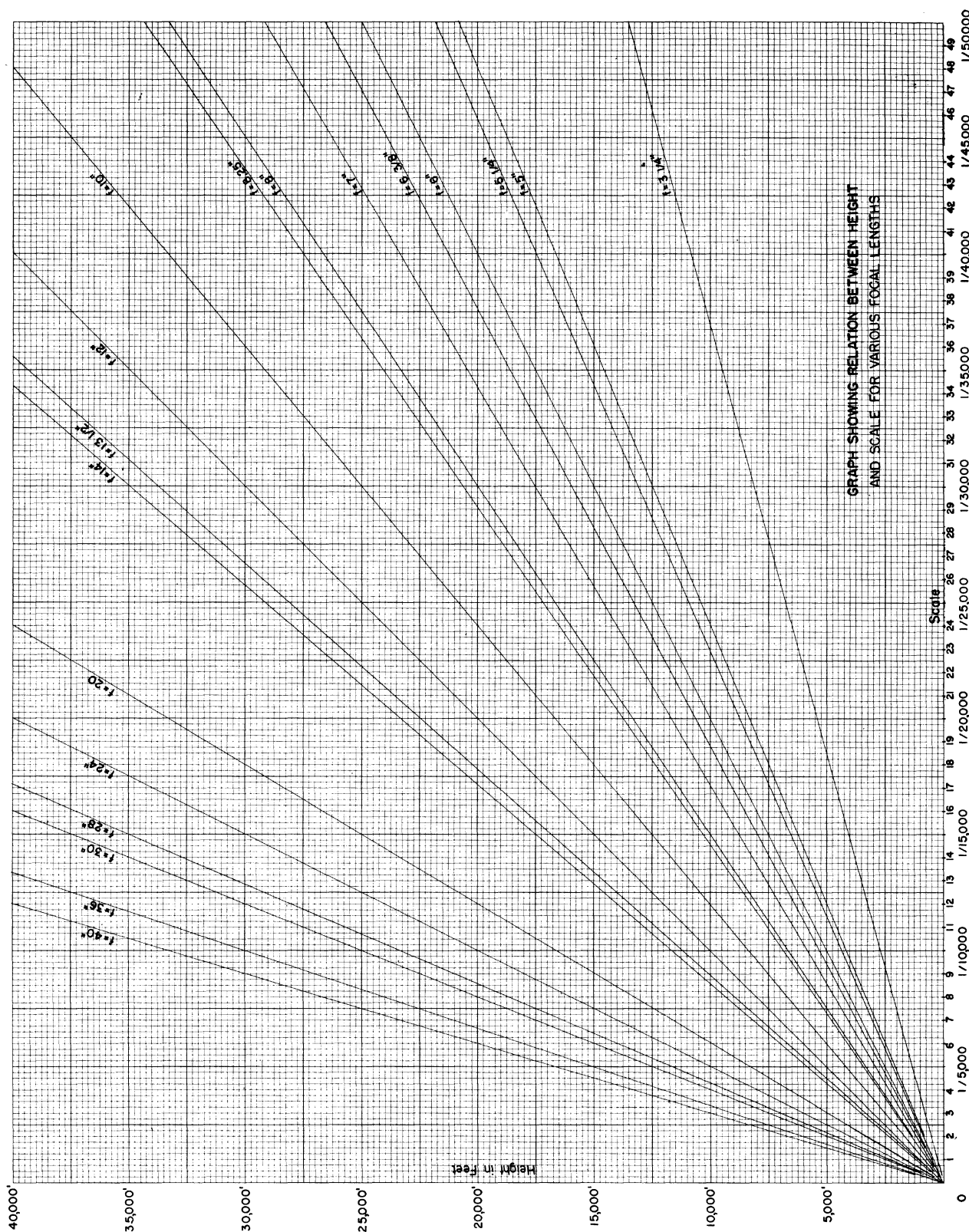
PHOTO SCALES FROM HEIGHT AND FOCAL LENGTH

Height	6"	8½"	12"	20"	24"	36"	40"
1,000	1/2000	1/1455	1/1000	1/600	1/500	1/333	1/300
2,000	1/4000	1/2909	1/2000	1/1200	1/1000	1/667	1/600
3,000	1/6000	1/4364	1/3000	1/1800	1/1500	1/1000	1/900
4,000	1/8000	1/5818	1/4000	1/2400	1/2000	1/1333	1/1200
5,000	1/10000	1/7273	1/5000	1/3000	1/2500	1/1667	1/1500
6,000	1/12000	1/8727	1/6000	1/3600	1/3000	1/2000	1/1800
7,000	1/14000	1/10182	1/7000	1/4200	1/3500	1/2333	1/2100
8,000	1/16000	1/11636	1/8000	1/4800	1/4000	1/2667	1/2400
9,000	1/18000	1/13091	1/9000	1/5400	1/4500	1/3000	1/2700
10,000	1/20000	1/14545	1/10000	1/6000	1/5000	1/3333	1/3000
11,000	1/22000	1/16000	1/11000	1/6600	1/5500	1/3667	1/3300
12,000	1/24000	1/17455	1/12000	1/7200	1/6000	1/4000	1/3600
13,000	1/26000	1/18909	1/13000	1/7800	1/6500	1/4333	1/3900
14,000	1/28000	1/20364	1/14000	1/8400	1/7000	1/4667	1/4200
15,000	1/30000	1/21818	1/15000	1/9000	1/7500	1/5000	1/4500
16,000	1/32000	1/23273	1/16000	1/9600	1/8000	1/5333	1/4800
17,000	1/34000	1/24727	1/17000	1/10200	1/8500	1/5667	1/5100
18,000	1/36000	1/26182	1/18000	1/10800	1/9000	1/6000	1/5400
19,000	1/38000	1/27636	1/19000	1/11400	1/9500	1/6333	1/5700
20,000	1/40000	1/29091	1/20000	1/12000	1/10000	1/6667	1/6000
21,000	1/42000	1/30545	1/21000	1/12600	1/10500	1/7000	1/6300
22,000	1/44000	1/32000	1/22000	1/13200	1/11000	1/7333	1/6600
23,000	1/46000	1/33455	1/23000	1/13800	1/11500	1/7667	1/6900
24,000	1/48000	1/34909	1/24000	1/14400	1/12000	1/8000	1/7200
25,000	1/50000	1/36364	1/25000	1/15000	1/12500	1/8333	1/7500
26,000	1/52000	1/37818	1/26000	1/15600	1/13000	1/8667	1/7800
27,000	1/54000	1/39273	1/27000	1/16200	1/13500	1/9000	1/8100
28,000	1/56000	1/40727	1/28000	1/16800	1/14000	1/9333	1/8400
29,000	1/58000	1/42182	1/29000	1/17400	1/14500	1/9667	1/8700
30,000	1/60000	1/43636	1/30000	1/18000	1/15000	1/10000	1/9000
31,000	1/62000	1/45091	1/31000	1/18600	1/15500	1/10333	1/9300
32,000	1/64000	1/46545	1/32000	1/19200	1/16000	1/10667	1/9600
33,000	1/66000	1/48000	1/33000	1/19800	1/16500	1/11000	1/9900
34,000	1/68000	1/49455	1/34000	1/20400	1/17000	1/11333	1/10200
35,000	1/70000	1/50909	1/35000	1/21000	1/17500	1/11667	1/10500
36,000	1/72000	1/52364	1/36000	1/21600	1/18000	1/12000	1/10800
37,000	1/74000	1/53818	1/37000	1/22200	1/18500	1/12333	1/11100
38,000	1/76000	1/55273	1/38000	1/22800	1/19000	1/12667	1/11400
39,000	1/78000	1/56727	1/39000	1/23400	1/19500	1/13000	1/11700
40,000	1/80000	1/58182	1/40000	1/24000	1/20000	1/13333	1/12000
41,000	1/82000	1/59636	1/41000	1/24600	1/20500	1/13667	1/12300
42,000	1/84000	1/61091	1/42000	1/25200	1/21000	1/14000	1/12600
43,000	1/86000	1/62545	1/43000	1/25800	1/21500	1/14333	1/12900
44,000	1/88000	1/64000	1/44000	1/26400	1/22000	1/14667	1/13200
45,000	1/90000	1/65455	1/45000	1/27000	1/22500	1/15000	1/13500

# INTERPRETATION AIDS

## PHOTO SCALES (CONT.)

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## PLANNING SCALES

TABLE OF PHOTO SCALES FOR USE IN PLANNING RECONNAISSANCE MISSIONS

Object	Scale at which a good detailed interpretation may be made.	Smallest scale at which objects may usually be recognized.
Aircraft (large)	1:10000	1:20000
Aircraft (small - less than 40')	1:8000	1:12000
Airdromes (including facilities)	1:15000	1:30000
Ammunition Dumps	1:10000	1:20000
Anti-Aircraft Guns		
Light (including .50 cal M/G)	1:4000	1:10000
Heavy	1:12000	1:20000
Barbed Wire	1:5000	1:8000
Buried Communication Lines	1:8000	1:20000
Bomb damage	1:5000	1:20000
Coast defense guns	1:15000	1:30000
Convoys (open sea)	1:16000	1:30000
Decoy airdromes	1:10000	1:20000
Harbors and Ports (including shipping and facilities)	1:12000	1:30000
Highways	1:10000	1:40000
Industries (general)	1:8000	1:20000
Invasion barges	1:6000	1:15000
Machine gun positions	1:5000	1:15000
Marshalling yards	1:14000	1:30000
Military Camps	1:15000	1:40000
Naval Vessels (open sea)	1:10000	1:20000
Oil Refineries	1:8000	1:20000
Power houses (Hydro)	1:12000	1:60000
Power houses (Thermal)	1:12000	1:20000
Power transmission lines	1:10000	1:24000
Radar	1:5000	1:12000
Radio Towers	1:8000	1:18000
Seaplane bases	1:12000	1:30000
Searchlights	1:2000	1:5000
Submarine bases	1:10000	1:20000
Tank farms	1:15000	1:40000
Transformer stations	1:10000	1:20000
Trenches	1:14000	1:25000

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# INTERPRETATION AIDS

## LINEAR COVERAGE

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LINEAR COVERAGE, IN FEET, OF VERTICAL PHOTOGRAPHS

Altitude	Focal Length of Lens					
	6"	8 1/4"	12"	20"	24"	36"
5" on a side						
1000'	833	606	417	250	208	139
2000'	1667	1212	833	500	417	278
3000'	2500	1818	1250	750	625	417
4000'	3333	2424	1667	1000	833	556
5000'	4167	3030	2083	1250	1042	694
6000'	5000	3636	2500	1500	1250	833
7000'	5833	4242	2917	1750	1458	972
8000'	6667	4848	3333	2000	1667	1111
9000'	7500	5455	3750	2250	1875	1250
10000'	8333	6061	4167	2500	2083	1389
20000'	16667	12121	8333	5000	4167	2778
30000'	25000	18182	12500	7500	6250	4167
40000'	33333	24242	16667	10000	8333	5556
7" on a side						
1000'	1167	848	583	350	292	194
2000'	2333	1697	1167	700	583	389
3000'	3500	2545	1750	1050	875	583
4000'	4667	3394	2333	1400	1167	778
5000'	5833	4242	2917	1750	1458	972
6000'	7000	5091	3500	2100	1750	1167
7000'	8167	5939	4083	2450	2041	1361
8000'	8333	6788	4667	2800	2333	1556
9000'	10500	7636	5250	3150	2625	1750
10000'	11667	8485	5833	3500	2917	1944
20000'	23333	16970	11667	7000	5833	3889
30000'	35000	25455	17500	10500	8750	5833
40000'	46667	33939	23333	14000	11667	7778
9" on a side						
1000'	1500	1091	750	450	375	250
2000'	3000	2182	1500	900	750	500
3000'	4500	3273	2250	1350	1125	750
4000'	6000	4364	3000	1800	1500	1000
5000'	7500	5455	3750	2250	1875	1250
6000'	9000	6545	4500	2700	2250	1500
7000'	10500	7636	5250	3150	2625	1750
8000'	12000	8727	6000	3600	3000	2000
9000'	13500	9818	6750	4050	3375	2250
10000'	15000	10909	7500	4500	3750	2500
20000'	30000	21818	15000	9000	7500	5000
30000'	45000	32727	22500	13500	11250	7500
40000'	60000	43636	30000	18000	15000	10000

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# INTERPRETATION AIDS

## FLIGHT PLANNING

### PREREQUISITE INFORMATION

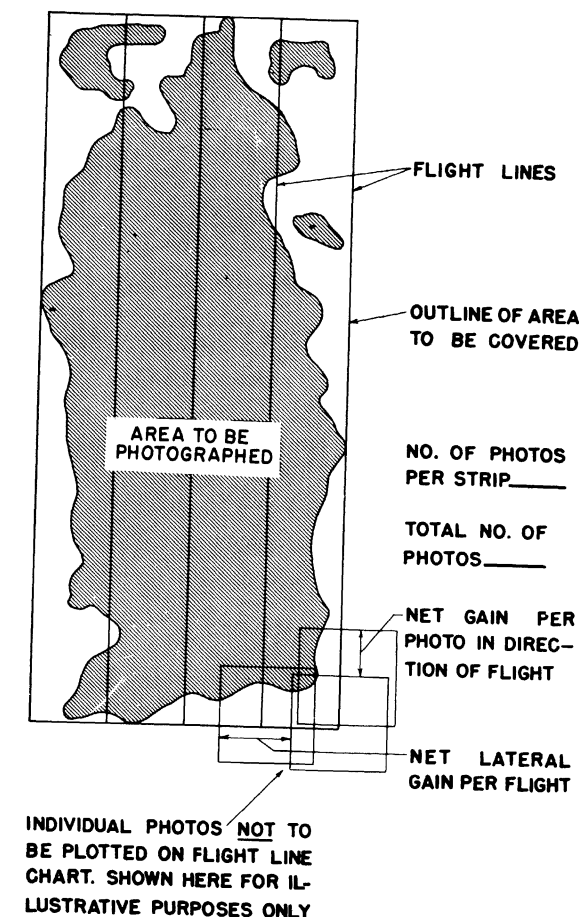
1. Area desired covered by photography.
  2. Altitude of flight.
  3. Camera to be used.
  4. Overlap desired both in line of flight and between flights.
  5. Ground speed of photographic plane.
- The above factors are dependent upon the object of the mission, scale desired, weather and expected enemy opposition.

### INFORMATION TO BE FURNISHED PILOT AND PHOTOGRAPHER

1. Overlay of most suitable chart showing proposed flight lines.
2. Number of photos per strip and the total number of photos.
3. Intervalometer setting.

### PROCEDURE TO BE FOLLOWED:

1. Make an overlay of the general area.
2. Block in the area to be covered photographically.
3. Get dimensions of this area (in feet).
4. Determine dimensions of area covered by one photograph (in feet).
5. Determine net lateral gain per flight (in feet) for lateral overlap specified.
6. Divide width of area to be covered by net lateral gain per flight (5). If the quotient is not a whole number, make it the next highest whole number, unless it is not more than .2 over a whole number. To this value add one to get the number of flight lines.
7. Place one flight line along each of the longer edges of the blocked-in area and space the others evenly across the area.
8. Determine the net gain per photograph in direction of flight (in feet).
9. Divide length of area by net gain in (8). Add .2 to the nearest (larger) whole number to get the number of photos per strip.
10. Multiply (9) by (6) to get the total number of photos. (Assuming rectangular area)
11. Calculate ground speed of plane in ft.p.sec.
12. Divide (8) by (11) to get intervalometer setting.
13. Indicate on flight plan the number of photos per strip (9) and the total number of photos needed.



### INDEX PLOTTING

For plotting photo coverage on a map of a different scale, the following method may be used for determining size of template:

$$\text{length of template} = \frac{\text{length of photo} \times \text{map scale}}{\text{photo scale}}$$

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## SCALE INDICATOR

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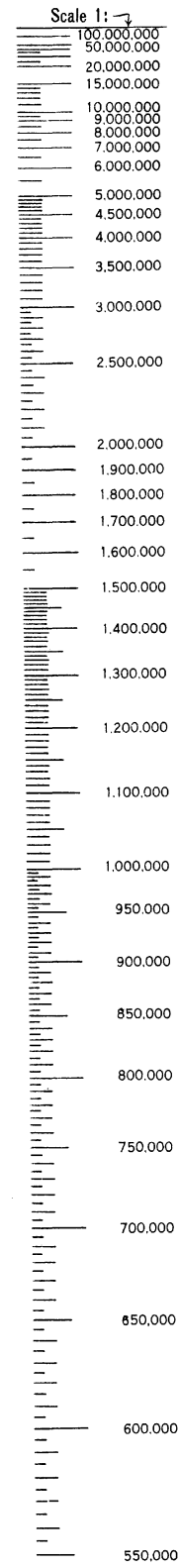
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# INTERPRETATION AIDS

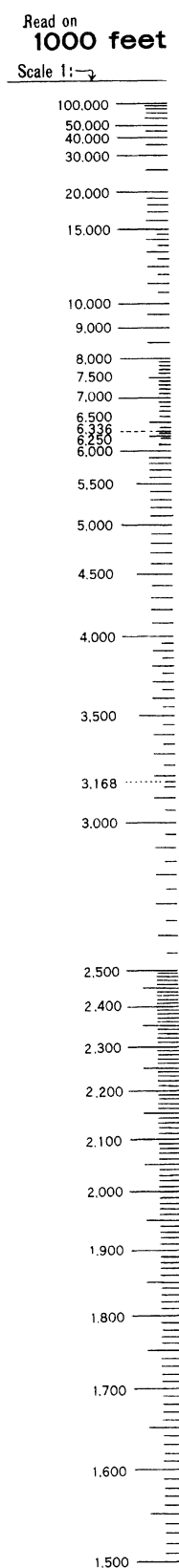
## SCALE INDICATOR (CONT.)

### NATURAL SCALE INDICATOR (CONT.)

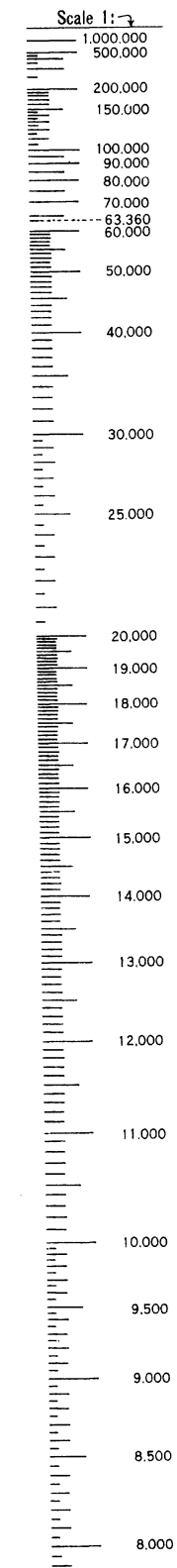
[A]  
Read on  
1° latitude



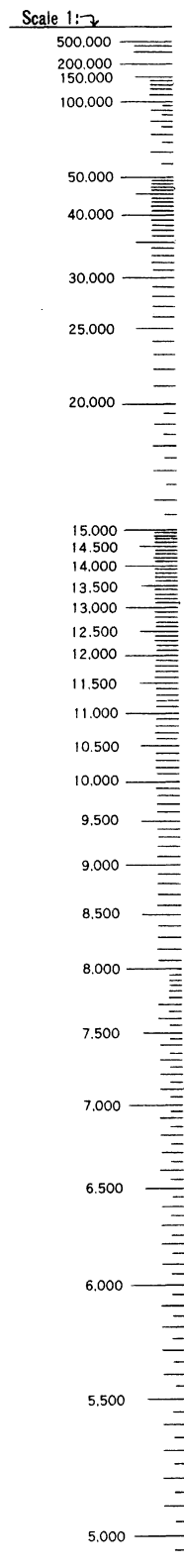
[B]  
Read on  
1000 feet



[C]  
Read on  
1 statute mile



[D]  
Read on  
1 kilometer



### PRINCIPAL USES OF THE FOUR SCALES

The natural scale indicator may be used:

- To ascertain the natural scale of any map on which parallels of latitude, or one or more graphic scales of linear distances, are shown;
- To lay out a graphic linear scale, either in kilometers, statute miles, or feet, for any map of known natural scale.

### THE NATURAL SCALE OF A MAP

The simplest and the most widely accepted method of stating the scale of a map is to indicate it in terms of the "Natural Scale" or "Representative Fraction" ("R. F."). Regardless of differences of language, and of units of measure, the natural scale is equally intelligible to all who read the same numerals, as, for instance, the Arabic numerals. To state that the scale of a map is 1:100,000 (also written  $\frac{1}{100,000}$  or  $\frac{1}{100,000}$ ) is to say that one unit of measure on the map (as 1 inch, or 1 centimeter) is equal to 100,000 of the same units of linear measure on the surface of the earth.

### HOW TO USE THE SCALES

Each scale is constructed for use directly on the interval indicated at the top (1° latitude, 1 statute mile, etc.). If that interval may not be read conveniently on the map, note instead the reading at any convenient multiple of that interval, and MULTIPLY THE READING by the number of units on which it is read. (It is necessary to multiply, not to divide, because the scales are reciprocal scales, the significant number being the denominator of a fraction whose numerator is 1.) Thus, if on scale (A) the reading on 10° of latitude is 2,500,000, the natural scale of the map is 1:25,000,000, because the reading at 1° latitude would be 10 times the reading at 10° latitude. Similarly, if the reading on one-half statute mile, on scale (C), is 40,000, the natural scale of the map is 1:20,000, because the reading at 1 mile would be only one-half as much as the reading at one-half mile.

### SPECIAL NOTE ON THE USE OF SCALE (A)

To ascertain the natural scale of a map from an interval of latitude, it should be taken from the average reading of 1° of latitude on the map. The reading should be made on a straight meridian; on many maps the only straight meridian is to be found in the center of the map. The reading should not be made along the borders of the map.

Due allowance must be made, in some instances, for the map projection. In general, in determining the scale of any map of the entire globe, or of a major part such as a hemisphere or a continent, it is necessary to take into account the mathematical properties of the particular projection which is used.

Thus, to find the approximate equatorial scale of a map on the Mercator projection, read 1° of longitude. To find the approximate scale of a map on Gall's stereographic projection, on the 45° parallel, multiply the reading of 1° of longitude by 0.71. To find the approximate scale of a map on Mollweide's homolographic projection, multiply by 10 the reading of the interval between 35° and 45° latitude (either north or south), or multiply the 0°-10° latitude reading by 11.1.

Prepared in the office of the Geographer, Department of State.  
Printed by the U. S. Geological Survey, Department of the Interior, 1935.

NOTE: These scales, as reproduced, may not be absolutely accurate, but are sufficiently exact for use with aerial photos and overlays.

### LAYING OUT GRAPHIC LINEAR SCALES

The use of the scales for making a graphic linear scale may be most readily explained by illustration.

Example 1. Suppose it is desired to make a graphic linear scale of statute miles for a map on the natural scale of 1/50,000. Use scale (C), which is made for use on 1 statute mile. The interval from the top line down to 50,000 is the exact length of 1 statute mile, and may therefore be laid out direct on the desired linear scale; that distance may, of course, be spaced off for any number of miles. To check a long linear scale of miles at 1:50,000, it should be noted that the linear scale for 2 miles equals the reading at 25,000; that the linear scale for 5 miles equals the reading at 10,000; etc.

Example 2. Suppose it is necessary to make a graphic linear scale of kilometers for a map which is on the natural scale of 1:5,000,000. Use scale (D), which is made to use on 1 kilometer. It will be noted that 5,000,000 does not appear on the scale, therefore a convenient decimal fraction should be used. Thus the interval at 500,000 equals 10 kilometers on the 1:5,000,000 scale, the interval at 50,000 equals 100 kilometers, the interval at 25,000 equals 200 kilometers, etc.

If it is desired to make a graphic linear scale (e. g., in kilometers) for a map having some other graphic scale (e. g., in miles, or in feet), it is therefore necessary simply to ascertain the natural scale of the map (if not indicated), and at that natural scale to lay out the required second graphic linear scale.

### SCALE IN MILES PER INCH

The scale of a map in statute miles per inch may readily be computed from the natural scale by the use of the following table:

Natural scale	Miles per inch	Natural scale	Miles per inch
1:1,000,000	15.782828	1:6,000,000	94.696969
1:2,000,000	31.565656	1:7,000,000	110.479797
1:3,000,000	47.348484	1:8,000,000	126.262626
1:4,000,000	63.131313	1:9,000,000	142.045454
1:5,000,000	78.914141		

Example: Suppose it is desired to determine the scale in statute miles per inch of a map on the natural scale of 1:3,750,000. Simply add the factors taken from the above table, using the proper decimals thereof, as follows:

Natural scale	Miles per inch
1:3,000,000 =	47.34848
1: 700,000 =	11.04798
1: 50,000 =	.78914
1:3,750,000 =	59.18560

Similarly, the natural scale may be computed from a known scale of statute miles per inch, by using the following table:

Miles per inch	Natural scale	Miles per inch	Natural scale
1	63,360	6	380,160
2	126,720	7	443,520
3	190,080	8	506,880
4	253,440	9	570,240
5	316,800		

Example: Suppose it is desired to determine the natural scale of a map which is on the scale of 48 statute miles per inch. The factors from the above table, using proper decimals or multiples thereof, should be added, as follows:

Miles per inch	Natural scale
40 =	2,534,400
8 =	506,880
48 =	3,041,280

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