DISTANCE COMPUTER

(Based on the Graphic Method to determine the great circle distance between two given points on or near the surface of the earth. The geographical coordinates (latitude and longitude) are known.)

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WITH the increase of aviation, it is becoming more necessary for the quick and accurate determination of the shortest distance between two points. The shortest distance between two points on the surface of the earth is represented mathematically by the shortest arc of the great circle joining the two given points.

Of the various methods used to obtain the arc of the great circle, the graphic method answers the need where speed and accuracy is essential.

By the method of spherical trigonometry formula: For determining the length of the arc sought to any desired degree of accuracy, the result being derived by the regular solution of the spherical triangle wherein two sides and the included angle are known. The unknown third side of the triangle represents the distance requested. This method is accurate, but slow.

Geographical maps may give a fair result for distances not exceeding five hundred miles, but for greater distances the error becomes too great for the following reasons:

(1) The surface of the earth, being spherical, cannot be represented on a plane exactly in proportion, and all geographic maps represent the true outline with more or less distortion. The degree of distortion depends upon the choice of the projection. Unfortunately, the majority of maps and atlases seldom indicate the system of projection used, although such datum is, in fact, just as important as that of the scale.

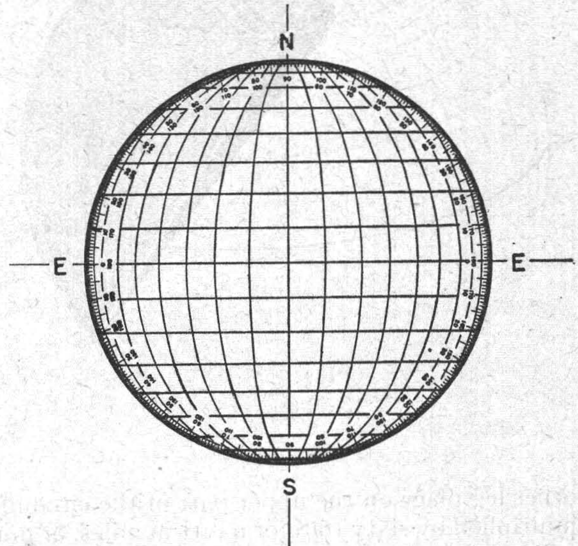
(2) The scale on the map is not constant and generally speaking, varies from one point to another. The scale along one, or some, lines—meridians, parallels or certain other curves—is the same as the scale used for decreasing the globe as the basis of the projection, called the Principle Scale and in all other directions, the scales are smaller or larger than the Principle Scale. Such scales are called the Particular Scale. The smaller the difference between the Principle and any Particular Scale, the more perfect the projection.

(3) The shortest distance between the two points on the surface of the earth (an arc of the connecting great circle) will usually not correspond to the straight line drawn on the map between two given points, but will be represented on the map by a curve (the sole exception being the maps compiled on central perspective projections).

Distance Computer

Graphic Method. (Latitude and longitude given.)

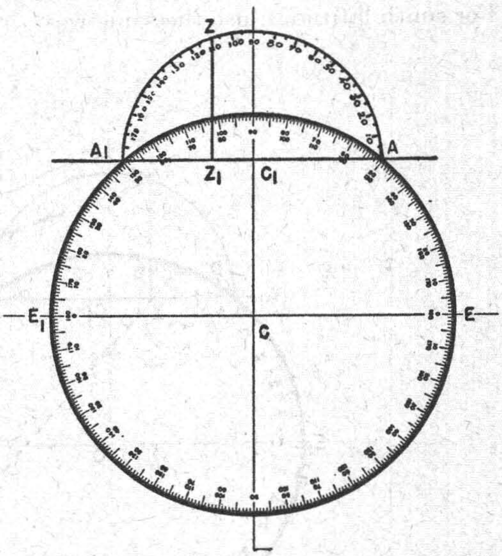
As a working plane, use a circle of any radius, preferably a seven inch radius, graduated in degrees and subdivided into minutes. This plane will represent the great circle plane passing through the center of the earth and the north and south poles. Draw a line on this plane through the center of the earth at zero representing the equator, and a line perpendicular to the equator passing through the north and south pole.

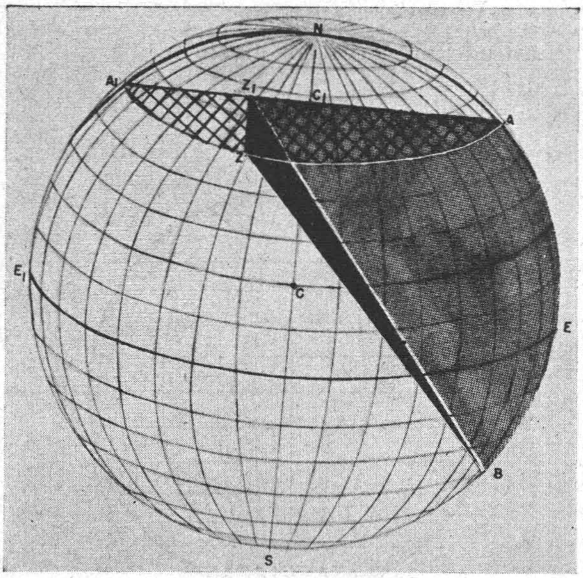


This plane corresponds to one of the meridians passing through one of the points to be plotted.

Subtract the differences of longitude of the two points, representing the difference between the meridians.

(1) Draw a line (A_1-A) parallel to the equator at the degrees of latitude representing one of the coordinates. On this parallel representing the degree of latitude, we describe a semicircle with a radius of half the distance of the line intersecting the plane. On that circumference, we protract an arc equal to the difference of the longitude of the two given points ($A-Z$), and from the end of the protracted arc (Z), draw a perpendicular to the diameter of the above-mentioned semi-circumference (Z_1).





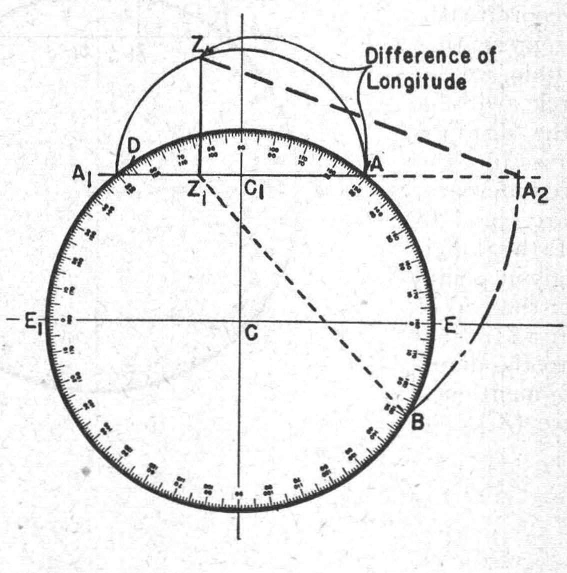
(2) Using the compass, measure the distance on the working plane, from the degree of latitude of the second given point of latitude (B) to the foot of the perpendicular (Z_1). Retaining one point of the compass on (Z_1), place its other point (rotating the compass in any direction) on the diameter of the second circumference (A_1-A) or its extension (A_2). Keeping the leg of the compass on this point (A_2), place its other leg on the head of the perpendicular (Z).

(3) Carefully retaining the opening of the compass, place one of its legs on zero degrees on the plane, its other leg place on the upper part of the circumference. This number in degrees, multiplied by sixty (60) for nautical miles, or multiplied by 69.1 for statute miles will give the shortest distance between two given points.

It follows that when a point is established on the working plane, innumerable distances can be computed from there with lightning rapidity.

It also follows that the larger the circle plane graduated into degrees and minutes, the greater the degree of accuracy.

For south latitudes, use the same way—reverse the poles.



Example:

To determine the distance between two points, A and B.

Coordinates of point A—equals latitude 50°N. and longitude 85°W.

Coordinates of point B—equals latitude 30°S. and longitude 25°E.

(1) Draw a line (A_1-A) parallel to the equator (E_1-E) corresponding to the latitude of point A (50°N.) (latitude of starting point).

(2) On this parallel (A_1A) describe a semi-circle with a radius of half the distance of the line $=(A-C_1)$.

a. On that circumference, protract the arc $A-Z$ (from the point A towards the point A_1) equal to 110° (85°W.+25°E. equals 110°) equivalent to the difference of longitude.

b. Through the point of the arc marked Z, draw (Z_1-Z) perpendicular to (A_1-A).

(3) Place one leg of the compass at the point B (30°S.) (latitude of destination), the other leg of the compass at Z_1.

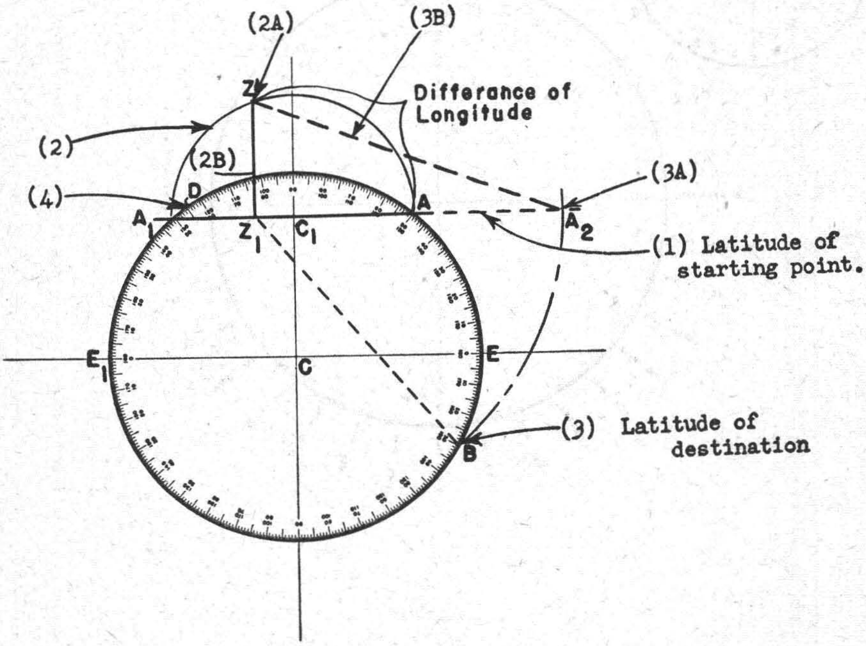
a. Leaving one leg on Z_1, rotate the compass until the point of its other leg meets the diameter (A_1A) or its extension, at point A_2. (Strike arc BA_2.)

b. Retaining the point of the compass at A_2, place the other leg of the compass at Z, this hypotenuse $(Z-A_2)$ is the arc desired.

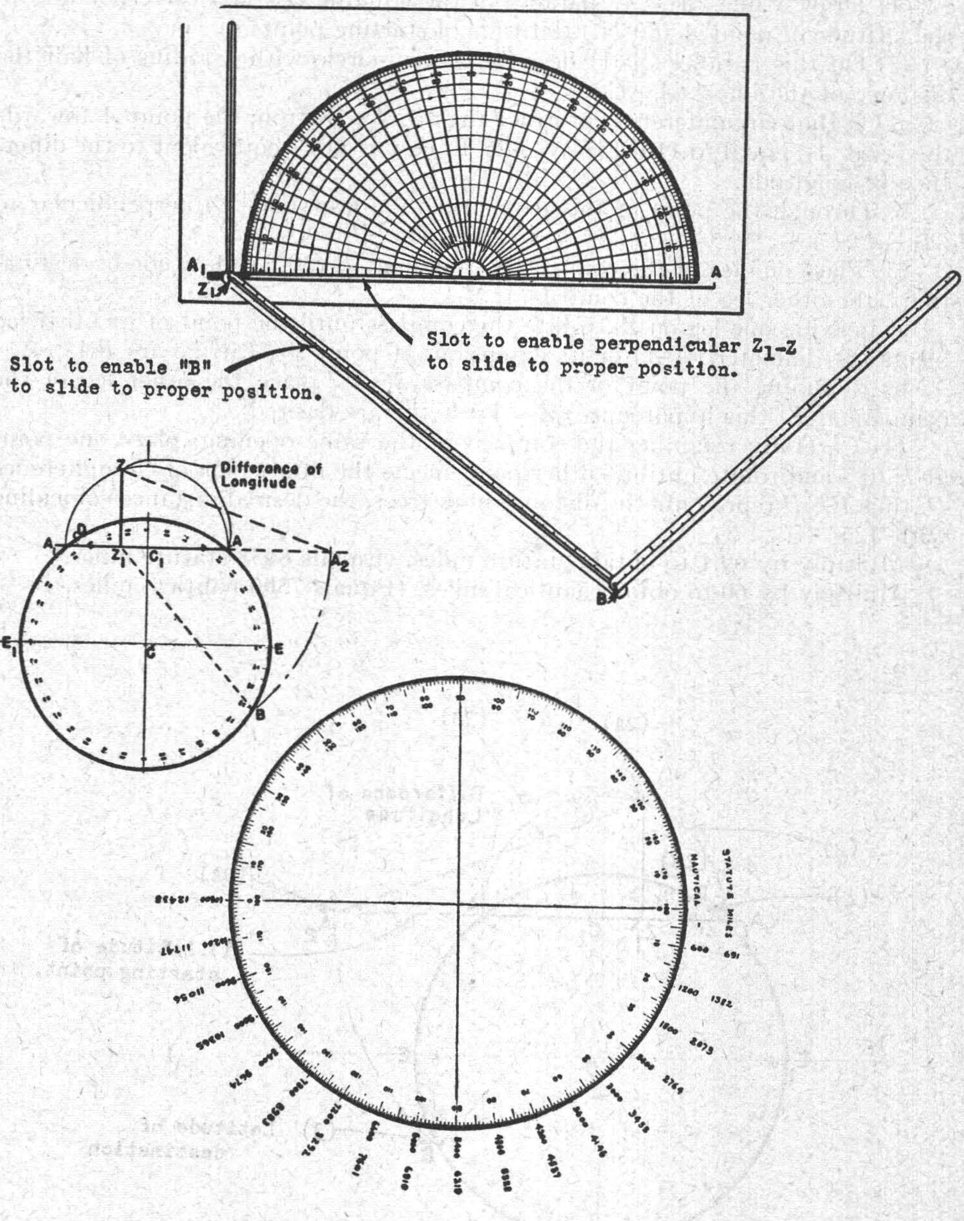
(4) Carefully retaining the compass at the same opening, place one point at E (0°) and rotate until its other point meets the upper part of circumference D, thus $E-D$ represents the distance in degrees, the desired distance coinciding with 125°.

Multiply by 69.1 to obtain statute miles. (Equals 8638 statute miles.)

Multiply by 60 to obtain nautical miles. (Equals 7500 nautical miles.)

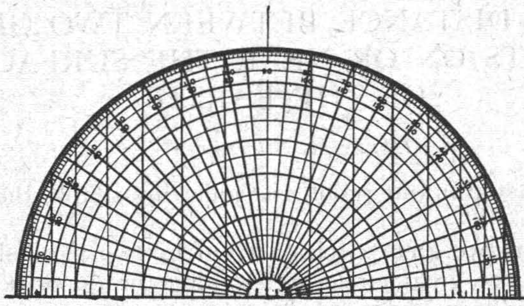


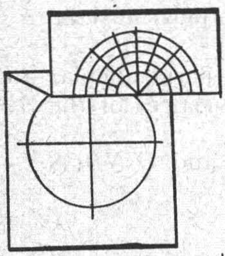
Template to Be Used with a Circle of the Same Diameter



Distance Computer

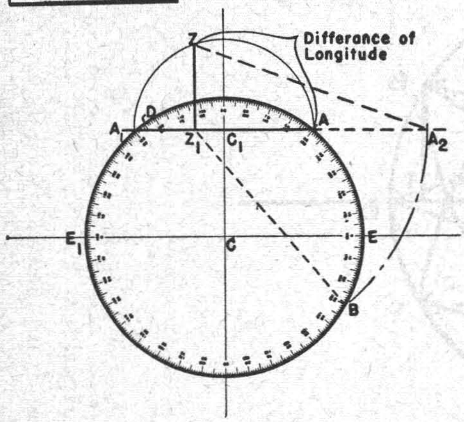
Graphic Method. (Latitude and longitude given.)



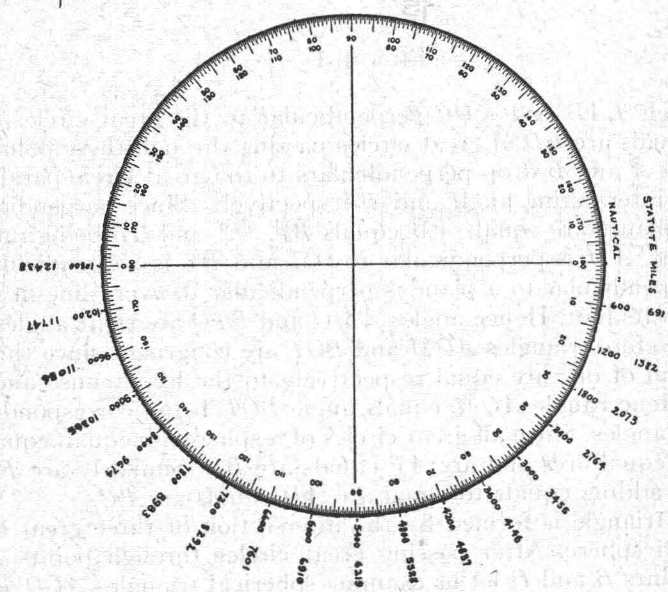


(1) Fold and center semi-circle on the large circle, to the highest latitude of one of the locations desired, parallel to the equator (equivalent to $A_1 - A$).

(2) On the semi-circle that intersects the large circle, protract the difference of the longitudes of the two locations (equivalent to Z). Draw a perpendicular to the diameter (equivalent to Z_1).



(3) Using the compass, measure the distance on the large circle, from the degree of latitude of the second given location (equivalent to B) to the foot of the perpendicular (equivalent to Z_1). Retaining one point on the foot of the perpendicular, place its other point (rotating the compass in any direction) on the diameter of the semi-circle or its extension (equivalent to A_2). Retaining one point on the semi-circle, place its other leg at the head of the perpendicular (equivalent to Z).



(4) Carefully retaining the opening of the compass, place one of its legs on 0° on the large circle; its other leg place on the lower part of the circumference. This point will give the nautical or statute miles.

For south latitudes use the same method, reversing the poles.