GEOGRAPHY 100
EXERCISE 9
THE UNITED STATES PUBLIC LAND SURVEY SYSTEM
AND
TOPOGRAPHIC MAPS

Public land survey system

The public land survey system was established by congress in 1785. This survey system is primarily known as **cadastral** , meaning the determination and laying out of boundaries of plats of land parcels so that its individual ownership and tax assessments can be established. Excluding the original thirteen states and nineteen other areas where the French long -lot or Spanish and Mexican land grants predated the adoption of the Public Land Survey System, the Public land survey system (PLSS) has divided up the U.S. into a number of mapped units. Within each mapped unit, spacial locations are reckoned from a primary parallel of latitude and a primary meridian of longitude. These reference lines are called **base lines and principal meridians** respectively. Thirty one pairs of these base lines and meridians exist in the lower U.S. and three more in Alaska and are numbered consecutively from east to west (see attached base lines and meridians map).

Starting at a series of predetermined initial points, surveyors drew principal meridians and base lines to serve as primary coordinates for subdivision. The base lines and meridians create an arrangement of rows of blocks called **townships**. The townships are each 6 miles long by 6 miles wide and constitute an area of 36 square miles and are numbered by rows (see figure 1). An east-west row is designated as a **tier**, the tiers are numbered from the base line north and south hence T.1N or T.1S. Townships are also numbered with respect to the column in which they are located. A column of townships is called a **range**. The numbering of ranges is east or west of the Principal Meridian, hence R.1E or R.1W. The shaded township in fig.1(A) would be designated as T3S, R.3W. If this township were located in Montana it would be described as **T3S, R.3W, Montana Principal Survey Meridian, County , State of Montana.**

Townships are also subdivided into square blocks of land that are 1 mile long by 1 mile wide and constitute an area of 1 square mile in size. These blocks of land are called **sections** and are systematically numbered from 1 to 36 as illustrated diagram B figure 1. A section of land contains an area of 640 ac (acres). Sections such as 13 in fig. 1 may be subdivided into smaller units by dividing the section in to quarters each containing an area of 160 acres and designated as **NE 1/ 4, NW 1/ 4, SE 1/ 4, and SW 1/ 4** of section 13. The quater sections may be further subdivided into quarters each of which contains 40 acres. In fig.1 the SE 1/ 4 of section 13 is subdivided in smaller quarters each of 40 acres as observed in diagram D.

Suppose that you lived in the State of Montana and owned the SW 1/ 4 plat of land shown in diagram D of fig. 1. The legal description (deed) to your land would be described as: **40 acres, SW 1/ 4, SE 1/ 4, Section 13, T3S, R.3W, Montana Principal Survey Meridian, County , State of Montana.** No other plat of land in the U.S. would have this description.

Because of the fact that meridians converge at the poles, an additional set of auxiliary lines had to be developed to compensate for the convergence. These auxiliary lines are referred to as **correction lines** and are spaced every 4 townships or 24 miles apart. These corrections appear on topographic maps as offsets or deviations in the north-south section roads, or in partial sections which are shown as having more or less than 1 square mile in area. The township and range lines are shown in red color along the neat lines (margins) of the map and are grid coordinates for the centers of townships appearing on the map.

Topographic maps

Topographic maps are also called **quadrangles**. A quadrangle map represents an area bound by 1/ 4 degree of latitude by 1/ 4 degree of longitude. A quarter degree of latitude or longitude is equal to 15 minutes of latitude or longitude (1 = 60 min.). Therefore quadrangles are named as a 15 minute series map.

1. How many degrees would be represented on a 7.5 minute series map ? _____

2. How many degrees would be represented by a 60 minute series map ? _____

3. The following questions pertain to the Billings East Quadrangle.

   a) What is the longitude of the eastern margin of the map ? _____

   b) If this map is a 7.5 minute series, what should be the longitude of the western margin of the map ? _____ Does the map show agreement ? _____

   c) What is the latitude of the southern margin of the map ? _____

   d) What should be the latitude of the northern margin of the map ? _____ Does the map show agreement ? _____

   e) What are the names of the eight surrounding quadrangles?

   f) Along the east margin of the map find T.1N. and T.1S this is the base survey line for the State of Montana. Along the southern margin of the map find R.26E and R.27E, an follow the range line northward to where it intersects with the base survey line. This intersection is the boundary of a survey township as indicated by the two sections 1, and 6.

   g) What two types of scales are shown on the map?_____and_____

   h) What is the magnetic declination on this map? _____

Map Scales

A map scale establishes the numerical relationship or ratio between measurements on the map and the corresponding measurements on the earth's surface. Map scales are expressed in on of three ways; verbal, graphic, representative fraction or ratio scale. The **verbal scale** is a simple statement such as " one inch equals one mile ". The **graphic scale** is shown as a bar or linear scale, a line divided into conventional units such as feet, yards, meters, kilometers, or miles. The **representative fraction scale** expresses the scale as a fraction such as 1/ 63,360, or a ratio such as 1:63,360. Map distances are generally measured in inches, therefore, a map scale would read as i inch on the map equals some number of inches on the ground surface. Since there are 63,360 inches per mile, a map ratio scale would be expressed as 1: 63,3600.

Calculation of a map scale is a relatively simple procedure. The scale is map distance

divided by ground distance. Suppose that the map distance between two points is 1.2 miles and the ground distance between the same two points is miles, the map scale would be:

scale = 1.2 inches/ 2 miles

eliminate the units by converting miles to inches (1 mile = 63,360 inches). Therefore miles = 126,720 inches.

scale = 1.2/ 126,720

dividing both the denominator and numerator by 1.6 because map scales are always expressed in units of 1.

scale = 1/ 105,600
or
scale = 1: 105,600

Scale conversion problems

4. The number of inches in a mile are _____

5. Convert the following ratio scales into verbal scales:

a) 1: 24,000 one inch equals _____ feet

b) 1: 24,00 one inch equals _____ miles

c) 1: 62,500 one inch equals _____ miles

d) 1: 125,000 one inch equals _____miles

e) 1: 250,000 one inch equals _____ miles

6. The following questions refer to the Billings West Quadrangle.

a) What is the length of the map? _____ miles

b) What is the width of the map? _____miles

c) What is the area of the map? _____square miles

d) Locate section 11, T.1S, R. 25E on the map. What is the distance across the section? _____feet, _____miles

e) What is the length of the north oriented runway at Logan International Airport? _____miles.

f) What is the contour interval of this map? _____

g) Identify the feature located in the SE 1/ 4, SW 1/ 4, section 24, T.1N, R.25E.

7. The following questions refer to the Alpine,Mt. Quadrangle.

a) What is the scale of this map? _____

b) What is the contour interval of this map? _____ Why did they not use a 20 foot contour interval?

c) What is the highest elevation on this map? _____

d) What is the lowest elevation on this map? _____

e) Arch Lake has a stream on each end of it. What is the direction of flow of the stream that functions as the outlet for Arch Lake? _____

f) What is the elevation of Rainbow Lake? _____

g) What type of feature is shown by the blue colored contour lines in the NE 1/ 4. NW 1/ 4, section 9, T.8S, R.17E.? _____

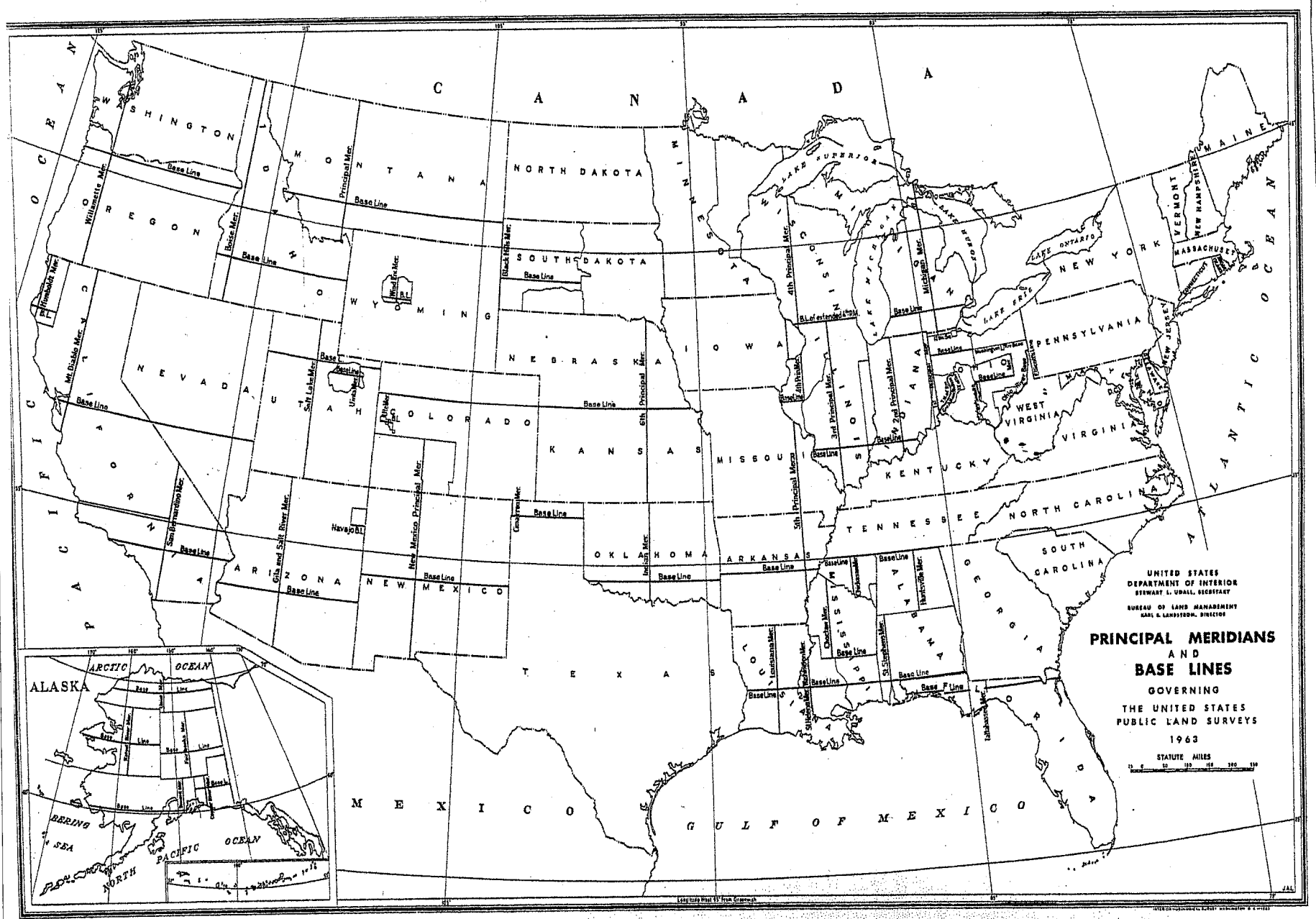
h) Calculate the straight line distance between Shepard Mountain and Mystic Mountain. _____miles

i) The contour lines in area of Prairieview Mountain and Saddleback Mountain are spaced further apart than those in the stream drainages of the West Rosebud creek and Phantom creek on either side. How can you account for this?

j) Notice the horse shoe shapped contour lines around Little Arch Lake. Looking around the map one can find many more of these features. What is the proper name of these types of features? _____

k) A small glacier exists to the north of Mount Inabnt. North of this glacier is an area containing numerous brown dots. What type of feature do these brown dots represent?

l) What do the areas of green color represent? _____



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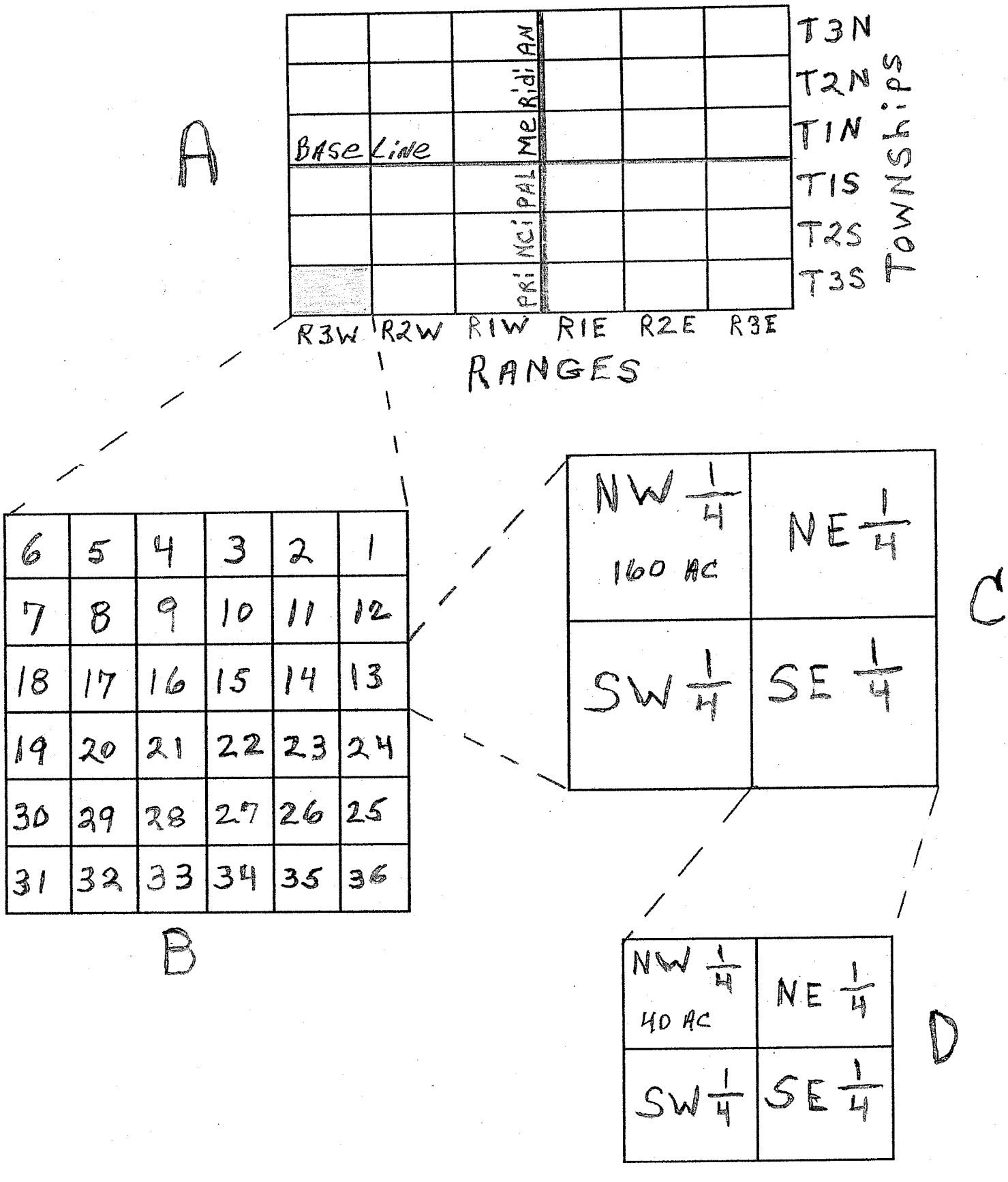

FIGURE 1. The Public Land Survey System