A COURSE OF LABORATORY STUDIES
IN GEOGRAPHY
FOR SENIOR SECONDARY SCHOOLS

by

ARISTOTLE GEORGE JUBILEE GOLF
3195532
B.Ed., University of British Columbia, 1959

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF EDUCATION

in the Department
of
Social Studies

We accept this thesis as conforming
to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA
September, 1970
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Department of Education

The University of British Columbia
Vancouver 8, Canada

Date Oct. 22, 1970
Current literature emphasizes the need to attempt new approaches in the teaching of Social Studies. Jerome S. Bruner in his book *The Process of Education* (1961), claims that the main objective of a school must be to "present subject matter effectively, - that is with due regard not only for coverage but also for structure." Only by teaching the fundamental structure of a subject is that subject comprehensible to the student. Bruner says:

"Intellectual activity anywhere is the same, whether at the frontier of knowledge or in a third grade classroom. What a scientist does at his desk or in his laboratory .... is the same order as what anybody does when he is engaged in like activity if he is to achieve understanding. The difference is in degrees, not in kind. A schoolboy learning physics is a physicist, and it is easier for him to learn physic behaving like a physicist than by doing something else."

Professional geographers advocate the inductive method of teaching so that pupils discover the structure of geography in the same way as it is understood by the professional geographer. The teaching then should be experimental and intellectually stimulating, leading from geographical data supplied to reach the desired principles and generalizations.

To-day children at various levels of efficiency, learn the inductive method in their study of chemistry, biology, and similar sciences. In theory - if not always in practice- they study in laboratories, consider hypotheses, analyze examples, draw tentative conclusions, and make cautious generalizations. Similar inductive procedures have increasingly marked the work
of professional geographers, sociologists and political scientists. In short, pupils should be taught to become amateur geographers, performing similar (not identical) tasks of those scholars working on the frontiers of knowledge.

Paraphrasing Jerome Brune, "If children are going to learn geography, they must do things the way geographers do them." This is the whole essence of the laboratory approach - it is a successful way to teach geography because it is essentially the way geographers operate.

During the last four years I have conducted a continuing experiment into the development of an approach to better geographic teaching. This experiment has attempted to evaluate the relative effectiveness of a laboratory approach to the teaching of geography.

The word "laboratory" suggests exploration and adventure on a rather direct, personal basis. Thus, the laboratory approach provides the opportunity for active study at first-hand basis and direct involvement of the students. It makes provision for the students to do something on their own - using their thinking ability and with their own hands. This is the basis of inquiry-oriented approaches and the new strategies, now being increasingly used in the domain of social studies. But this direct experience does not mean that the laboratory approach in social studies education ignores reading and highly symbolic abstract experiences. The laboratory approach offers much more to the students than listening to the teacher.
or studying the textbook. It represents a significant means for communicating non-verbal experiences and knowledge to the students. For example, laboratory methods train individuals to develop their observational power, and help them acquire skills. Along with these, the atmosphere in the laboratory promotes the desire to share experiences. It develops the ability of working together, provides for individual, creative activity and heightens pupil motivation.

Studies of instructional practices suggest that teaching processes and materials should be coordinated in a systematic manner. We should, as teachers, spend a great deal of time and effort in planning to that teaching materials are directly related to a systematic study of a problem. In recent years, considerable emphasis has been placed on individualization of learning. The laboratory approach maximizes the opportunity for individualization of learning, provides for creativity, and originality. The use of laboratory strategies and materials other than dry words and textbooks are significant in making social studies education real and concrete.

The laboratory approach is not a panacea but it offers an opportunity to make the teaching of geography more interesting and exciting. It has proven possible in courses in physical science to have students perform simple experiments in order to come closer to understanding the methods of science. I see no conceivable reason why this can't be done in social science.
In the Laboratory Approach students and teachers plan together and share materials, an important part of learning - teaching process. Besides fostering the achievement of the cognitive and effective objectives of teaching social studies the Laboratory Approach develops various kinds of skills - communicative, creative, acquisitive, organizational and manipulative.

This course is based on the view that the traditional emphasis on expository teaching of Geography by lecture and rote memorization must be replaced by an emphasis on the use of inductive methods through which students learn to use the materials and modes of thought of geographers. In the course itself, the inductive approach is used, laboratory type studies are used throughout in which principles are applied to materials in the structuring of lessons.

The uses of aerial photos described here are desirable in that the tool, the photo, is considered a means not an end. The exercises force the student to face situations which require him to generalize. He must make an orderly study of the land use of the area shown in the photograph and then organize the data for the purpose of generalization.

The student also gains an appreciation of the problems of the map maker as well as a better understanding of the cultural and physical patterns of the area included in the photograph. This learning logically provides motivation for seeking similar patterns in the areas contiguous to that studied as well as to distant areas.
The elements of geography teaching emphasized in this experimental work are the elements of geographic field study: observation and recording of information, selection of required data from that which has been observed and recorded and then analyzation, synthesization and interpretation of all this selected data in order to formulate a generalization.

The ideas offered here are merely samples of kinds of experiments possible in the social studies Laboratory Approach. A flexible approach and a capitalizing on what takes place in both the classroom and the community may develop entirely different ways to involve the student in acting and reacting.

"New frontiers" in any category of academic disciplines emerge from territory already explored.

Those time-tested and solid foundations of the social studies which have served well in the past obviously must not be cast aside in favor of untested educational programs and designs. What are "new frontiers" for some, accordingly, may be old and comfortable territory for others. Some of the concepts and observations set forth in this paper, therefore, are not necessarily new, although many school systems for one reason or another may not have given them consideration or trial.
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LETTERING, COMPOSITION, AND DRAFTING OF MAPS.

The function of lettering on maps is the identification of data and locations. The lettering on maps provides the reader with an intellectual context for viewing the map. In some cases, notably small scale maps, the reader's reaction is first to the lettering. The two basic requirements of good map lettering then are readability and unobtrusiveness or clarity, i.e. the lettering does not obscure the base detail. Several considerations must be made before a map is lettered.

1. **Size of lettering** - choice based on size of feature and space available.
   - Note the size of letters indicates their relative importance.

2. **Orientation of lettering** - letters designed to be read in the horizontal form.
   - Note exceptions. (e.g.)

3. **Style of lettering** - square mechanical looking or subtle curves, etc.

4. **Distinction and contrast between names.**

5. **Harmony of effect** - alphabets on map should harmonize with map detail.
Procedure:

For our purpose in freehand lettering we will require a penholder and a B4, B5, C3, C4, speedball nibs. Remember to sit erect and comfortably. Below is a guide to the use of B and C speedball pens.

B pens – hold pen straight.

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b) strokes

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letter a, b – 3 strokes

C pens – hold pen at 45° angle.

a) shape

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letter g – 4 strokes

Be sure to use a scrap of paper to practice on and to get rid of the surplus ink. Never push the speedball nib upward!
GENERAL SPACING RULES

Word examples

1. Greatest space between upright strokes.
   M N D

2. Medium space between upright strokes and curved strokes.
   DNO

3. Least space between curved strokes.
   OOC

4. No space between.
   LT VA WS LO FN
CARTOGRAPHY

LETTERING, CARTOGRAPHIC DRAWING

Laboratory Exercise

I. Freehand Lettering (use the B5 or B4 and C4 or C3 nibs)

1. Draw, on a sheet of ruled paper, 4 rows of vertical strokes about 3/8" long and spaced about 1" apart. Alternate your pens. Start and stop the stroke at the ruling of the paper.

2. Follow the same procedure, but make the vertical strokes 5/8" long.

3. On the second row of lines, draw horizontal strokes of the same length across the tops of the verticals.

4. Draw two rows of crescents to the left and two rows of crescents to the right, one row with each nib.

5. Draw two rows of circles. (i.e.) the joining of crescents to the left and right. One row with B nib, the other C nib.

II. Lettering - Pencil, go over in ink.

1. On an unlined sheet of paper, lightly rule a series of lettering guidelines, spaced approximately as shown:

   A  b  p

   3/16"  5/16  3/16

   1/16" between rows.
2. Using the illustrations provided as a guide, letter the upper case and lower case alphabet and numerals 0-9, repeating each letter or numeral as necessary to attain an acceptable result. Use upright lettering, with strokes in the proper sequence. Use a C4 nib for upper case and a B5 nib for lower case.

III. Spacing

Using the appropriate pen size, B6 and/or C5, letter horizontally, with proper spacing, the following:

Use upright capitals and capitals with lower case.

Geography

LEGEND

Scale of Miles

Vancouver

BLOOMINGTON.
LETTERING: MECHANICAL, PRE-PRINTED

Procedure:

Mechanical lettering

Leroy sets are available in a wide range of sizes and faces. For our purposes, however, the Geography lab. sets will be found quite adequate. Each set supplied should contain the following:

- templates
- scribes (with scribes rest)
- penholder
- pens

Check to be sure your set is complete.

With reference to the printed instructions accompanying lettering set, attempt some experimental lettering using different pen sizes and templates.

Laboratory Exercise

1. Using a clean sheet of drawing paper, letter the following names in upright all caps, caps and lower case, caps and small caps, using any convenient range of templates and pen sizes: Canada, British Columbia, Vancouver, Bloomington. Directly below these words letter each again with a B pen nib using visual spacing as your guide. Write a brief comment describing the results of mechanical spacing versus visual.

2. Using a Leroy penholder and #1 or #3 pen, print the following names freehand (upright lettering caps and l.c.). Adopt a lettering size commensurate with pen size: Yukon, Quebec, New York, Vancouver.
Procedure:

**Pre-printed Lettering**

Letraset – This is a relatively crude form of stick-up lettering in that names must be composed from pre-printed alphabets, and the variety of faces and sizes is limited. Its great advantage is comparatively low cost.

**Laboratory Exercise**

From the sample sheets, letter the following:

River, scale, isotherm, map, water, legend, Canada.
LABORATORY EXERCISE

Assume you wish to prepare a map of Vancouver Island to illustrate a research paper. The purpose of this particular map is to show the outline and shape of Vancouver Island, its hydrography, its absolute location and location relative to the adjacent mainland, and the location and names of major settlements. No representation of terrain is to appear, nor are transportation and communication routes to be shown. The map is to be designed to convey its message (relative to the above purpose) as clearly and as effectively as possible.

Prepare such a map according to the following specifications:

1. Overall page format 8½ x 11".
2. Projection - any projection appropriate to the purpose.
3. Scale - any scale appropriate to the page format.
4. Generalization of linework - as necessary to achieve the purpose for which the map is desired.
5. Nomenclature - as necessary to achieve the purpose - hand lettering only. (B or C nibs).
6. No colour to be used on the map.
7. Directional sign.

Do not trace a map from your atlas.

Use the interpolation method of meridians and parallels for producing a suitable outline map of Vancouver Island.
LABORATORY EXERCISE

Reference information portrayed on the Major Resource Development maps of The Bank of Nova Scotia Review

Dec 1966 - The Ontario Economy
Jan 1967 - The Prairie Provinces
Feb 1967 - British Columbia
Mar 1967 - Quebec.

Prepare a map of your own making to show the same information.

Specifications

1. Format 8½ x 11" layout to suit.

2. Base date - use any appropriate base map; generalize to suit the purpose.

3. Nomenclature - make a selection of lettering appropriate to the purpose; use either freehand or Leroy lettering or Rapidograph Pen.

4. Use black and white and colour; the letter may be attained by use of Prisma-colour (or other coloring pencils) or coloured inks, but not tempera (poster type) paints.
EMPLEOYMENT OF COLOUR

Laboratory Exercise

On the outline map provided, select appropriate colours to emphasize the most important aspects of the map. Use the Agricultural Map of Canada p. 9 in the Canadian Oxford Atlas as a guide in your colour selection.

Write a brief paragraph to justify your choices of colours on your completed map.
MAP PROJECTIONS

For a picture of the world as a whole, a map is only a poor substitute for a globe. The first lesson in map-making is the fact that the surface cannot simply be peeled off the globe and flattened into a map. The surface must be torn or stretched before it will flatten out. This is precisely what is accomplished by scientific map projection. Distortions are distributed under mathematical control to maintain accuracy in some areas at the sacrifice of accuracy in others. In a few special maps distortion is relieved by cutting or interrupting the less-important areas. Because no map can tell the whole truth, each map tells only the truth which is useful to those who must use it.
LABORATORY EXERCISE I  Measurement of the Earth

Eratosthenes' Method

Man has been concerned about the earth on which he lives for many centuries. During very early times this concern was limited, naturally, to the immediate vicinity of his home; later it expanded to the distance of markets or exchange places; and finally, with the development of means of transportation man became interested in his whole world. Much of this early "world interest" was evidenced by speculation concerning the size, shape, and composition of the earth.

The early Greeks, in their speculation and theorizing, ranged from the flat disc advocated by Homer to Pythagoras' spherical figure - an idea supported one hundred years later by Aristotle. Pythagoras was a mathematician and to him the most perfect figure was a sphere. He reasoned that the gods would create a perfect figure and therefore the earth was created to be spherical in shape. Anaximenes, an early Greek scientist, believed strongly that the earth was rectangular in shape.

Since the spherical shape was the most widely supported during the Greek Era, efforts to determine its size followed. Plato determined the circumference of the earth to be 40,000 miles while Archimedes estimated 30,000 miles. Plato's figure was a guess and Archimedes' a more conservative approximation. Meanwhile, in Egypt, a Greek scholar and philosopher, Eratosthenes, set out to
He had observed that on the day of the summer solstice, the midday sun shone to the bottom of a well in the town of Syene (Aswan). At the same time, he observed the sun was not directly overhead at Alexandria; instead, it cast a shadow with the vertical equal to 1/50th of a circle (7° 12'). To these observations, Eratosthenes applied certain "known" facts: (1) that on the day of the summer solstice, the midday sun was directly over the line of the summer Tropic Zone (Tropic of Cancer) - Syene was therefore concluded to be on this line; (2) the linear distance between Alexandria and Syene was 500 miles; (3) Alexandria and Syene lay on a direct north-south line.

**Question:**

1. If the sun's distance from the earth is very great, and therefore its incoming rays to earth are parallel, what is the circumference of the earth in miles? (Assume a spherical earth.)

2. It is remarkable that such accuracy was obtained in view of the fact that most of the "known" facts and his observations were incorrect. Explain.
ERATOSTHENES' METHOD FOR DETERMINING THE SIZE OF THE EARTH

$50 \times 500 = 25,000$ MILES

7°12' OR 1/50 OF A CIRCLE
LABORATORY EXERCISE 2

Illustration of Curvature of Earth's Surface and Determination of Horizontal Distance

An early Mediterranean navigator sailing from the island of Rhodes to the harbour of Alexandria, Egypt, could sight from a distance offshore the great marble beacon of the lighthouse on the Island of Pharos (one of the seven "wonders" of the ancient world) at the entrance to the harbour. Assume that the top of the beacon stood 120 feet above mean sea level, that the ship's deck was 10 feet above the waterline and that the weather was clear. (Distance offshore = 1.317 feet high).

1. At what distance from shore could the top of the lighthouse just be discerned above the horizon? Assume calm sea conditions and no refraction effects.

2. If, on closer approach, the vertical angle from a point 10 feet above the base to the top of the lighthouse was observed from the ship to be 10°, approximately how far was the ship off the island? Ignore the effects of atmospheric refraction.

Illustrate your answers with sketches.
LABORATORY EXERCISE - Mercator Map Construction

We wish to construct a Mercator map of Vancouver Island bounded by longitudes 123°W and 129°W, and by latitudes 48°N and 51°N; and that the scale along the equator is to be 1° = 1 inch. Using drawing paper draw a line to represent the most southerly latitude (48°N) and using the equatorial scale divide it into the appropriate number of intervals (in this case 1 inch intervals) to correspond with the lines of longitude from 123°W to 129°W. At the intervals marked erect meridians as perpendicu­lars and label each one. To find the distance of the other parallel north of 48° proceed as follows.

Look up in the table following the figures corresponding to 48° and 49°, take the difference and multiply thus:

\[ 49° - 48° \]

\[ (3364.456 - 3274.173) \times \frac{1}{60} \times 1 = 1.504 \text{ inches}. \]

Similarly complete the computations for the other parallels.

<table>
<thead>
<tr>
<th>Degrees</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>3274.173</td>
</tr>
<tr>
<td>49</td>
<td>3364.456</td>
</tr>
<tr>
<td>50</td>
<td>3456.581</td>
</tr>
<tr>
<td>51</td>
<td>3550.654</td>
</tr>
<tr>
<td>52</td>
<td>3646.787</td>
</tr>
</tbody>
</table>

By referring to an atlas, plot the approximate outline of Vancouver Island. You may use the completed map outline in the completion of the map Structure and Design lab exercise.
LABORATORY EXERCISE - Mercator Map Route Plotting

Mercator, in his famous Carta Marina of 1569, introduced to the world a projection that has become a standard for marine charts. In designing the projection named after him, Mercator incorporated attributes that make it well suited for use in marine navigation. Principal among these are:

(i) A rectangular projection grid with straight-line parallels and meridians, so that north can be measured from any meridian.

(ii) Meridians and parallels intersect at right angles (facilitating route plotting).

(iii) A parallel spacing such that scale is constant about any point and hence directions are true from any point.

(iv) Loxodromes are straight lines.

Construction:

We wish to construct a Mercator projection between 40°N and 60°N and between 0° and 80°W longitude. Since the paper format allows 10" to cover 80° of longitude, (with 1/2" on either margin of the projection) 1° of longitude will be represented by 1/8".

Draw a line toward the lower margin of the paper sheet (about 1 1/2" above the margin) to represent the 40th parallel. Since it covers 80° longitude, it will be 10" long. Divide it into 5/8" lineal units (since grid interval is to be 5°). Rule in the meridians as parallel straight lines intersecting and to the 40th parallel.
To find the distance of the next parallel (45°N), from the 40th parallel already drawn, proceed as follows:

Look up in the table of meridional parts the figures corresponding to 40° and 45°, take the difference and multiply thus:

\[(3013.4 - 2607.7) \times \frac{1}{60} \times \frac{1}{8} = \text{inches.}\]

(Since, at projection scale, 1° of longitude = 1/8" and the table of meridional parts is given in minutes of equatorial arc.)

| TABLE: 1 Distances of Parallels from the Equator |
|------|----------------------------------|
| 40°  | 2607.683                        |
| 45°  | 3013.427                        |
| 50°  | 3456.581                        |
| 55°  | 3948.830                        |
| 60°  | 4507.133                        |

Because the distance between meridians on all parallels is made the same as that on the equator, the remainder of the process is similar to that outlined above.

1. By reference to an atlas, plot the approximate coastlines of Great Britain, France, Spain and Portugal, Newfoundland, Nova Scotia, and Massachusetts.

2. Using a globe, plot the coordinate points of a great circle route from Cape Clear, Ireland, to Sable Island. Transfer the chosen points to the Mercator projection and join them with straight lines.

3. Starting from Cape Clear, what are the first three courses a ship would have to steer to approximate the great circle route to Sable Island?

4. Why would you not use the Gnomonic projection for route plotting, in lieu of the Mercator?
LABORATORY EXERCISE - Reduction and Enlargement

The Method of Squares

The original map is covered with a grid of unit squares, either by ruling faint lines on the map itself, or by laying over it a suitably ruled piece of tracing-paper, or a celluloid grid can be used. The closer the grid, obviously the more accurate will be the result; a one-inch map could carry a quarter-inch grid. Rule another network of squares, enlarged or reduced as desired, and copy the detail, square by square, by eye on to the drawing-paper, noting particularly any important intersections of detail with the grid lines.

It is, of course, the change of scale of the side of the square that produces the desired amount of enlargement or reduction. To enlarge three times, for example, the side of the square on the drawing-paper will be increased three times, that is, the area will be enlarged nine times.
Exercise:

1. Draw a 1" grid on the outline map of Bowen Island.

2. Another grid with square sides equivalent to a scale of 1/100,000 should be drawn on a separate sheet of plain paper. The detail should then be drawn by copying exactly where the outline of the Island intersects the grid lines.
LABORATORY EXERCISE

The Construction of the Cylindrical Equal-Area Projection

Orient a sheet of drawing paper with the long axis horizontal and draw a circle, with a radius of 2", about 1" from the left hand side of the paper. From its center draw a horizontal line extending the diameter of the circle and to the far margin of the paper to represent the equator. Draw a line at __ to the equator to represent the polar axis. Using a protractor mark off in 15° intervals, angles from the center. Draw a line tangent to the circle at the equator.

Draw lines at 15° intervals parallel to the tangent line to represent the meridians from 165°W to 60°W. These lines should be 1/2" apart. Draw lines parallel to the equator intersecting the circle at points A, B etc. to represent the parallels of latitude at 15° intervals. Extend the parallels through 165° to 60°W longitude. Label each of the lines of latitude and longitude carefully.

Complete the projection by referring to an atlas and plotting
the outline of North America and South America.

Compare the shape of Alaska on this projection with its shape on a Mercator projection.
LABORATORY EXERCISE

The Construction of the Polar Stereographic Projection

Construction:

Orient a sheet of drawing paper with the long axis vertical and draw a circle, 3" diameter, with its center about 3" above the lower edge of the sheet and midway between the sheet margins. From its center, draw a vertical line through the center (XA) and extend it upward to the upper margin of the sheet. Draw a tangent and extend it to the right and left hand sheet margins. Using a protractor mark off 30°, 60° angles from the center of the circle.

[Diagram showing the construction process]

Draw lines from A through the points B, C and D to intersect the tangent.

[Diagram showing intersecting lines]

Draw a second circle tangent to X, (with a radius equal to XG). Within this circle draw other circles representing
the 30° and 60° parallels of latitude with radii of XE, and XF respectively. Complete the larger circle with radial lines representing the meridians. Using your atlas transfer the coordinates (latitude and longitude) of a sufficient number of points to establish a map of North America. Complete the exercise by lettering with the appropriate speedball nibs. Label carefully.
LABORATORY EXERCISE

The Construction of the Polar Azimuthal Projection

Construction:

Orient a sheet of drawing paper with the long axis vertical and draw a circle with a 2" radius, about 4" above the lower edge of the sheet, and midway between the margins. From its center draw a horizontal line extending the diameter of the circle. Draw a tangent parallel to the horizontal line and extend it to the Right and Left margins of the sheet. Using a protractor mark off 0°, 30°, 60° and 90° angles from the center of the circle, and label them M, L, N and X respectively.

From point X join XN, XL and XM. Draw a circle tangent at X, using XM as the radius of the 0° parallel. Similarly using XL and XN draw circles (within the larger one) representing the 30° and 60° parallels. Draw in the meridians and label them. Using your atlas plot a map of North America on the finished projection.
LABORATORY EXERCISE

The Construction of the Polar Zenithal Orthographic Projection

Construction:

Orient a sheet of drawing paper with the long axis vertical and draw a half circle, with a radius of 3" about 1/2" above the lower edge of the sheet and midway between the sheet margins. From its center (P) draw a horizontal line ER extending the diameter of the circle. Draw a tangent parallel (AB) to the horizontal line (ER) and extend it to the Right and Left margins of your paper. Draw a circle with radius of EP tangent to line AB. Using a protractor mark off in 15° intervals angles from center P. From horizontal line ER draw perpendicular lines extending to the upper margin of the sheet, which bisect the upper circle at 15°, 30°, 45°, 60°, 75° and at the point of tangency (Y). Complete the construction as shown below.

Using your atlas plot the approximate coastlines of North America, South America, Greenland, Europe and USSR. Locate several capital cities on your drawing. Complete in ink and label carefully all meridians and parallels.
Question:

Draw a line from Vancouver to Murmansk. Plot the coordinates of this line onto an overlay of a Mercator Projection. Comment on the results.
LABORATORY EXERCISE

The Construction of the Simple Conic Map Projection

Procedure:

Orient a sheet of drawing paper with the long axis vertical and draw a semi-circle, 1 3/4" radius, with its center about 1" above the lower edge of the sheet and midway between the sheet margins. From its center draw a vertical line through the circle and extend it upward to the upper margin of the sheet. Extend the equatorial axis E, E' to the Right and Left hand sheet margins.

We wish to make the projection tangent at the 45° parallel with its apex directly over the north pole. Using a protractor mark off 45° from the equator for both segments of the semi-circle. Draw a line tangent at 45° to cut the extended equatorial and polar axis at A and P. Extend a line at 45° parallel to E, E' to represent the standard parallel. Using your protractor mark off the remaining parallels, at 15° intervals, from 0° to 90° along line A, P. About 2" from the top of the drawing sheet draw a semi-circle with radius AP centered at Y to represent the 0° parallel. At point Y extend a line at right angles to XY, to the Right and Left margins of the sheet. The other parallels are drawn as concentric circles with center Y and radii equal to PB, PC etc.

Make the line XY the 30°E meridian and from point Y use a protractor to draw in the other meridians at 15°
intervals. To complete the projection draw in the meridians as straight lines radiating from point Y. Using as many coordinate points as necessary complete the outline of Europe, Africa and Asia on the projection. Comment on the results of your map projection as compared to the results shown on the Polar Zenithal Orthographic Projection.
HISTORICAL MAPS

Long before recorded history, men were drawing maps on the sand, in the snow or on dried animal skins. Tahitians used wood to make relief maps and aborigines of the Marshall Islands made charts out of bamboo that showed ocean currents as well as islands. The Babylonians of 400 B.C. believed their kingdom was in the center of a round world surrounded by brine and they recorded it that way on a clay tablet. Egyptians put charts into coffins to guide the dead in the nether world.

Long before the explorers 'discovered' Canada, the Indians and Eskimos were making their own maps of the country, and later they did so for the explorers. The 'good people' of the Algonkin village of Lachine in 1541, it is recorded, laid 'certain little stickes' on the ground to give a picture of the Ottawa and the upper St. Lawrence rivers. An Indian chief on Georgian Bay used charcoal to sketch his country on tree bark for Champlain in 1615. More recent Eskimo maps, drawn on animal skins, show elaborate coast lines with wood carvings attached to represent islands.

Maps have always been a pleasure to look at, although cartographers have not always subordinated decoration to information. Early map-makers decorated their sheets with pictures of howling winds, fearsome monsters, and geographical features that came straight out of their own heads. 'To some cartographers,' wrote Dr. Glyndwr Williams of the University of London, 'a blank space on a map was an admission of failure.' So they put in islands, rivers, even whole continents. 'They
made the map attractive in appearance,' Dr. Williams wrote in
The Beaver magazine, 'and (this) often helped it to sell more
quickly than the works of less inspired cartographers.'

The following selection of maps represent the visible ex-
pression of man's knowledge about the known world (Ecumene) at
various times throughout history. You will see how slowly and
progressively man learned to symbolize the earth's surfact on
maps.

LABORATORY EXERCISE 1

Homer's World - 500 B.C.  Fig. 1
1. What countries did the Greeks trade with during
   this time?
2. Which part of the map seems to be most accurate? Why?
3. The Greeks of Homer's time believed the world to be
   flat, and disc-shaped, bounded by an endless ocean.
   Verify this statement by studying figure 1.
4. Determine the importance of each of the centers shown
   on the map.
5. Explain the significance of the body of water around
   the periphery of the map.

Ptolemy's Map - 150 A.D.  Fig. 2.
1. What continents are not represented on this map?
2. Which continent is most accurately drawn?
3. Which part of Europe was still unexplored?
4. Identify the large island of Taprobana. This mis-
   placed island appears on the first maps of the
   Renaissance 1300 years later.
5. Identify the seas and oceans that were explored by the Greeks of Ptolemy's day.

6. What is the difference in longitudinal extent of the Mediterranean Basin on the Ptolemy map as compared to a modern map of the same area?
LABORATORY EXERCISE

Hereford Map - 1285

1. The Hereford map is one of the best examples of a T-in-O map. Study the map to explain the origin of this term.

2. Why are Jerusalem and Paradise so conspicuous on this map of the Dark Ages?

3. With reference to a present day atlas, prepare a list of the concepts which map makers of this period possessed. Use the headings; correct concepts, incorrect concepts and unknown concepts.

Anonymous Medieval Map - 1485

1. Compare this map to the world map of Ptolemy.

2. How does the map show the medieval Christian beliefs of this period?

3. Identify the parts into which the world of this period was divided.

4. How are mountains symbolized on the map?

5. Attempt to identify the peninsula Engrovelant.

Waldseemüller's Map - 1507

1. What important discoveries are mapped on Waldseemüller's map as compared to Ptolemy's and the map of 1485?

2. What was known of Canada's coastline in 1507?

3. What region of the earth had not been mapped at this time?
Anonymous Medieval Map Circa 1500.

MAPS (continued)

PTOLEMY'S MAP, WITH ACCURATE DETAIL ON EUROPE, WAS BEST FOR 1,300 YEARS.
1. Compare Ribero's map and Waldseemüller's map. List the major differences.

2. Why is the western coastline of the Americas shown as a dotted line?

3. What continent is still not shown on maps up to this period?

4. Ribero shows the world on a map of its full 360° circumference. What explorer's discoveries probably influenced the drawing of this map?

5. Compare the Ptolemaic picture of Asia with that of Ribero's. How do they differ?
Fig. 5

WALDSEEMÜLLER'S MAP IS "BIRTH CERTIFICATE" OF THE NEW WORLD

Fig. 6

BERO'S MAP ESTABLISHED OUTLINES OF WORLD, WAS FIRST TO SHOW PACIFIC
LABORATORY EXERCISE

When Pierre Desceliers was making maps of Canada in the 16th century, cartographers added imaginary beasts like unicorns as well as real animals, and drew in unexplored areas as they'd like them to appear.

1. Note the confusions in representation in the western portion, based upon fragmentary Indian reports and mythical explorations.

2. Write a brief comparison and contrast of this map and the Blaeuw 1630 (Fig. 8) in terms of symbolization and map content.
This is Guilielmus Blaeuw's 1630 version of Mercator's projection, great navigation map because all its compass directions are true. Vertical line cutting tip of Brazil is Pope's Line, by which Alexander VI in 1493 halved the world between Portugal (east) and Spain (west). Note polar projections, correcting polar distortion.
THE TOPOGRAPHIC MAP

The topographic map is an accurate and scientific portrait of a portion of the earth's surface. Of all documents it most nearly portrays all the visible landscape phenomena with which we are commonly associated. It shows things as they exist together in their differing varieties of patterns and distributions. The skill of the cartographer brings out many elements which can be identified separately or seen in their mutual interrelations.

The topographic map has many uses for many people but for the geographer and geography teacher it is an indispensable document. However, its many-sided reference is only valuable in so far as the user can interpret it intelligently. In essence it uses the language of symbols and a systematic analysis of the groups of symbols quickly reveals the simplicity of the methods of graphic representation. A knowledge of scale is essential for the interpretation of dimension. Given the ability to read a map, i.e., being conversant with the symbolic language, scale and direction, geographical interpretation can be attempted.

The following notes should assist in developing an understanding of the methods of representation on a topographic map.

GENERAL

1. Every topographic map contains four essential elements -- a title (usually the name of the most well-known locality on the map); a direction; a scale, and a reference (some-
times called 'key' or 'legend').

2. Each topographic map is one of a series of a particular material survey. The representation of features is the same as on every sheet in a series. Each sheet is identified by its title and a series number.

3. Some map sheets carry an overlay grid. The grid bears no relation to latitude and longitude and is merely an artificial device placed on the map for the purpose of reference. Grids are sometimes in 1000 yard squares or kilometre squares. When giving a good reference always state the 'easting' before the 'northing'. The graticules in the map border relate to divisions of latitude and longitude.

4. There are normally five distinctly different colours used on topographic maps - brown, blue, green, black and red - to represent the mapped features. Brown, blue and green are used for the representation of natural (non-human) features, and black and red for cultural (man-made) features. However, this division does not always hold true, for instance, orchards (man-made) may be coloured green and man-made lakes are shown in blue. The colours brown, blue and green are generally drawn in softer tones than the harsher, stronger colours of black and red in order to facilitate more readily the differentiation between the natural and cultural landscapes.
Brown: Relief features - contours.
Blue: Water features - sea, lakes, rivers, swamp, ice.
Green: Vegetation - natural (forest, scrub, etc.) and cultural (orchards, plantations).
Red: Important roads, built-up urban areas, subdivisions lines.
Black: Railways, roads, buildings of all kinds, names, boundaries.

SCALE:

Scale is a reduction, a proportion or a ratio. A map scale signifies the proportion which a length on the map bears to the actual distance on the ground. Every map must indicate the scale.

Map scales may be shown -

1. By a statement - 'one inch to one mile' or 'ten chains to one inch'.

2. By a representative fraction (R.F.) - the numerator indicating the length on the map (in any unit, inch or centimetre) and the denominator the corresponding distance on the ground. The R.F. 1 \( \frac{1}{63,360} \), invariably shown as 1:63,360, is a scale to the proportion of one inch on the map representing 63,360 inches (or one mile) on the ground. If only the R.F. of a map is given, conversion to any unit is easy, e.g., 1:40,000 is one inch on the map to 40,000 inches (.67 miles) on the ground, or, one centimetre on the map represents 40,000 centimetres (400 metres) on the ground.
3. **By linear scales**

On the basis of scale, maps may be divided into three groups -

1. **Chorographic Maps.** Small-scale maps of large areas as are found in atlases. Generally the R.F. is from 1:2,000,000 to 1:80,000,000.

2. **Topographic Maps.** Maps of smaller areas on a larger scale. The division between 'large-scale' and 'small-scale' maps is very arbitrary. Some authorities accept 1:250,000 as a dividing line.

3. **Cadastral Maps.** Very large-scale maps or plans usually showing property divisions, individual holdings and boundaries. These are surveyors' maps.

**RELIEF**

The corrugations of the land surface are the most difficult of topographic features to show on a map. At different times many attempts have been made to make the surface configuration 'stand up' on a flat map. There is a two-fold problem - to show the actual height of all parts of an area above sea level and also the distinctive nature of slopes. No universally satisfactory system has yet been devised by cartographers and the best maps incorporate a number of the systems, analysed below, depending on map scale, detail, nature of the terrain and information available.
Early mapmakers used purely conventional methods of representing surface form. Hill features were shown diagramatically, usually profile drawings alike in outline and size irrespective of differences in height and slope. Another rudimentary method - 'hairy caterpillars' showed relief features in plan, at least in theory. These crude methods can still be seen today in some school texts and atlases.

Spot-Heights and Trigonometrical Points.

These show the actual height of the position above sea level. The points chosen are generally on the summits of hills, ridges, mountains or a prominent relief feature. Spot heights are not marked on the ground and are noted on maps to identify a summit or feature which could not otherwise be represented by contours. Trigonometrical points are marked on the ground being used in basic survey.

Hachures

The method of hachuring has been widely used since the end of the eighteenth century and is used today in some of the best European maps. Hachures are lines of varying thickness drawn directly down the slopes where the gradient is steepest. They indicate on the map the direction which running water would follow on the ground. The thickness of the hachures is proportional to the steepness of the slope - heavily drawn where slopes are steep and fine where they are gentle. Graphically they
are one of the most satisfactory methods of showing relief particularly in areas of bold relief. However, spot heights and contours must be used in conjunction with hachures for an accurate map.

**Hill Shading**

Hill-shading maps show relief by a gradational shading of all slopes, the depth of shading varying with the steepness of the slope. In maps with *Oblique* hill-shading a shadow is assumed to be thrown over the area by an imaginary light to the northwest at an angle of 45°. The light illuminates northwesterly, northerly and westerly slopes being in the deepest shadows. Some maps employ *Vertical* hill-shading in which case a light is assumed to fall directly on the map surface illuminating near-flat areas and casting shadows on slopes, the steeper the slope the darker the shadow.

As with hachures, hill-shading cannot be used alone if an accurate map is required.

**Contours**

The best single method of showing relief on the flat surface of a map. A contour line is a line of constant altitude joining all places at the same elevation above mean sea level. A form line (sometimes called 'form contour') is similar in appearance to a contour line but is sketched, not a surveyed, contour. Form lines give only a rough impression of the relief and are more commonly used for inaccessible areas.
The difference in height between two successive contours is called the **Vertical Interval (V.I.)**. The vertical interval can be compared to the rise of a step, in which case the tread of the step is the **Horizontal Equivalent (H.E.)**. The vertical interval is constant on any one map but may vary from map to map in any one series depending on the nature of relief in different areas. The effectiveness of contours in showing relief depends largely on the V.I. used.

A series of contour lines with a carefully chosen V.I. gives direct information about altitude and the nature of the slopes. Spot heights are frequently used in interpolation. In better maps, hachuring and/or hill-shading is used for graphic effect and ready comprehension.

**Layer Colouring**

This method of showing relief is dependent upon and auxiliary to contours. The area between any two selected contours is tinted according to a colour scheme modified from the spectrum. The method is more satisfactory for areas of varied relief.

**Direction**

The top of the topographic map faces north. There are three 'norths' to note:

1. **True North**

   The direction of the North Pole from the observer's position.
2. **Grid North**
   Where there is a grid on a map, grid north is the direction of the grid lines from the bottom to the top of the map.

3. **Magnetic North**
   The direction of the compass needle.
   A reference is always made to the annual declination of the compass needle.
LABORATORY EXERCISE: An Introduction to the Topographic Map

Use any standard topographic map.

Refer to the diagram which appears in the map margin showing the directions for setting a map.

1. Explain briefly:
   a) Grid north (G.N.)
   b) Magnetic North (M.N.)
   c) True North (T.N.).

2. Draw a diagram (use a protractor) showing the relationship of T.N., G.N., and M.N.

3. What is meant by "magnetic declination"?

4. What is the annual magnetic change on your map?

5. What would be the difference between G.N. and M.N. TODAY as indicated on your map?

6. Write down grid locations (CO-ORDINATES) for 5 features on your map. (e.g.) gravel pit, railway bridge, lighthouse, marsh, cemetery, highway intersection, mountain peak, etc.

7. Using the graph paper provided complete a cross-section of an "interesting" section of your map. Be sure to compute the vertical exaggeration on your cross-section and indicate the vertical and horizontal scales.

8. Indicate T.N. bearings of the features in question 6. Setting the map. With the map on a flat surface line up the compass axis with a north-south grid line. Do not move the map when taking the bearings.
LABORATORY EXERCISE: Topographic Map Interpretation

Materials: Vancouver, B.C. 92G.

1. What is the map scale?
2. What is the contour interval?
3. What is the highest point on Gambier Island?
4. What is the highest point in Garabaldi Park?
5. What is the highest point south of the Fraser River?
6. What is the distance from:
   a) Departure Bay to Horseshoe Bay?
   b) Horseshoe Bay to Squamish?
   c) New Westminster to Abbotsford?
7. Name six islands in the Fraser River.
8. How many miles of harbour are there in Burrard Inlet, measuring from Point Atkinson to Point Grey?
9. Name ten smaller communities on the north side of the Fraser River.
10. What are the two largest lakes shown on the map?
11. List the services at Gibson's Landing.
12. How many Indian Reserves are there on the Sea-Schelt Penn.?
13. What is the prospect of Boundary Bay becoming a deep-sea port?
LABORATORY EXERCISE: Mitchell Island Topographic Map Analysis

Materials: Topographic Map 92 G/3h

1. State the contour interval.
2. State the highest contour in the southern part of the map.
3. State the highest contour on the map.
4. What indication of elevation is shown on Lulu Island?
5. How far is it from the school to the highest point of land shown on the map?
6. In what general direction are you travelling through the Deas Island Tunnel?
7. If you were playing golf at Fraserview Golf Course, could you see a 45° launch in Graveside Beach?
8. What indicates that parts of Lulu Island produce early fruit and vegetables?
9. Name two forms of entertainment on Lulu Island.
10. Within what municipality does Mitchell Island lie?
11. State the elevation of Oakridge Shopping Centre.
12. Name the chief land use of eastern Lulu Island.
13. Why are there no contours on Lulu Island?
14. Why would a dyke surround Lulu Island?
15. What is the date of the map? What changes might have occurred in the southern half of the map since its printing?
16. What kinds of industry are found on the map? Why is the greatest concentration of industry found on the north bank of the North Arm of the Fraser River?
17. How many parks are shown on the map? Which is the largest in area? Why?

18. Draw a generalized sketch of the map on 8½ x 11 inch paper. Indicate the various forms of land use on the map. (Be sure to indicate the new and old residential areas). Include only the major transportation routes.
LABORATORY EXERCISE: Topographic Map Analysis- Meath Park, Sask.

1. State the grid references for the following:
   a) Meath Park Post Office.
   b) Meath Park School.
   c) Cemetery south of Meath Park.
   d) Janow Corners School.

2. Identify the following features:
   a) 161741.
   b) 225770.

3. What is the elevation of the feature at 215793?

4. What is the highest spot height shown on the map?

5. Measure the distance from the Post Office at Meath Park to the feature at 215793.

6. Estimate the population of Meath Park.

7. Give evidence from the map to indicate the function of Meath Park.

8. List four evidences from the map to support the statement that Meath Park is located on the Prairies.
LABORATORY EXERCISE: Topographic Map Interpretation - Cheyenne, Wyoming

1. Locate the highest point of land on the map.

2. In what direction does the land slope?

3. What is the latitude of the area shown?

4. Notice the great number of windmills. Give reasons for their location.

5. What is the prevailing wind direction likely to be?

6. What is the position of this area in respect to large bodies of water?

7. Is the rainfall heavy or light? Give reasons for answer.

8. What kind of natural vegetation is in this area?

9. What is the main use of land in this area?

10. What evidence indicates on the map what crops are grown?

11. In this area which came first, the railways, the roads or the settlers? Give your reasons for your answer.

12. Is the population density heavy or light?

13. A number of the settlements are in similar locations. What are the kinds of locations?

14. Why has the city of Cheyenne developed where it is?

15. What are the industries likely to be in the towns?

16. At what season of the year would the city of Cheyenne be busiest?
17. What type of mining or quarrying, if any, is there in the area?

18. Draw a sketch map to show the location of Cheyenne in relation to the Great Plains Region.
LABORATORY EXERCISE: Picture and Large Scale Map (Banff, Alta)

1. What is the main source of income for this region?

2. Which physical region of North America is this region located in?

3. What 5 recreational activities are available in this area? (Give evidence from either picture or map to support answers).

4. What is the elevation above sea level of Tunnel Mountain? ________________

5. What is the relative elevation of Tunnel Mountain? ________________

6. How many horizontal feet do you travel in the Gondola ride to the top of Sulphur Mountain? ________________

7. State in feet the rise in elevation that occurs as you travel up the Gondola Lift? ________________

8. What is the actual length of the Gondola ride up Sulphur Mountain? ________________

9. List four forms of transportation. (Evidence must be given).
10. What is the distance in air miles from the Picnic Shelter in Sundance Canyon to the nearest edge of the Buffalo Paddock?

11. What is the major form of natural vegetation?

12. Which peak was the picture likely taken from?

13. How were the valleys formed that are shown in the picture?
LABORATORY EXERCISE: Topographic Map Analysis (Canada)

We are to study a series of topographic maps for the purpose of gaining experience in describing and interpreting the features and patterns evident on the particular sheets. The maps have been divided into five categories for study.

1. Landforms
2. Drainage (select one map from each category)
3. Industry
4. Settlement (select four maps from each category)
5. Agriculture

Students are to study one map from each of the first three categories.

For categories 4 and 5, students are to select one map from each of the four subdivisions. e.g. Maritimes, Ontario and Quebec, the Prairies, British Columbia.

The Assignment

1. Landforms-

Describe briefly the relief and vegetation. Be sure to include a bibliography of all your reference material. Comment on the effects of glaciation and explain any prominent land features. Construct a cross-section of an interesting section of your map.

Note the minimum, maximum and average elevations.
2. **Drainage-**

Describe the general distribution of drainage features on the map. Draw a sketch map of the map area showing the main drainage features. Explain any prominent drainage features.

3. **Industry-**

Write a brief description of the industry located on your map. Note sources of nearby power and comment on the transportation network as it is related to the industry. Note the source of the industry's raw materials. Draw a sketch map to show the relationship of the industry to other similar industries in Canada. Suggest what are the basic requirements common to all industry and industrial regions.

4. **Settlement-**

Compare and contrast the settlement pattern as evidenced from your study of the map. Draw sketch maps to show the relationship between the settlement patterns of each region and their natural environment. Indicate the reason for the location of the main city and relate it to its natural environment.

5. **Agriculture-**

Write a brief abstract discussing the interdependence of relief, climate, vegetation and soil in each of the four sub-regions. Show how these factors
have contributed to the agricultural economy of each region. Include in your essay climate graphs and sketch maps where applicable. Discuss the larger region rather than the specific.
LABORATORY EXERCISE: U. S. Topographic Map Analysis

The following U. S. topographic maps have been divided into four categories. (i.e.) Landforms, Settlement, Industry and Agriculture for study.

You are to choose one map from each category for analysis and interpretation.

The Assignment

1. Landforms
   Describe briefly the relief and vegetation. Note the minimum, maximum and average elevations of your sheet. Explain any prominent land features. Construct a cross-section of an interesting section of your map.

2. Settlement
   Comment on the settlement pattern of your map. Draw a sketch map to show the relationship between the settlement pattern and the natural environment.

3. Industry
   Write a brief description of the industry located on your map. Note sources of nearby power and comment on the transportation network as it is related to the industry. Note the source of industry's raw materials. Draw a map to show the relationship of the industry to other similar industries in North America.

4. Agriculture
   Write a brief essay discussing the interdependence of relief, climate, vegetation and soil on your map.
as it relates to the agricultural activity. Include in your essay climate graphs and sketch maps relating to the agriculture of this region.

### List of U.S. Topographic Maps

#### 1. Landforms

<table>
<thead>
<tr>
<th>Location</th>
<th>Scale</th>
<th>Location</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:62,500</td>
<td>1:24,000</td>
<td>Leaburg, Ore.</td>
<td>Ventura, Calif.</td>
</tr>
<tr>
<td>Bray, Calif.</td>
<td>Menominee, Ill.-Iowa</td>
<td>Utica, N.Y.</td>
<td>Sumdum, Alaska</td>
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<td></td>
<td></td>
<td></td>
<td>Sheep Mountain,</td>
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<td></td>
<td></td>
<td></td>
<td>Table, S. Dak.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chief Mountain, Mont</td>
</tr>
</tbody>
</table>

#### 2. Settlement

<table>
<thead>
<tr>
<th>Location</th>
<th>Scale</th>
<th>Location</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheyenne, Wyo.</td>
<td>Indiana, Pa.</td>
<td>Manchester, N.H.</td>
<td>Ocean City, M.D.</td>
</tr>
<tr>
<td>1:62,500</td>
<td>1:24,000</td>
<td>Biloxi, Miss.</td>
<td>Galveston, Texas</td>
</tr>
<tr>
<td>Porter, Ind.</td>
<td>Boling, Texas</td>
<td>Joneboro, Ill.-Mo.</td>
<td>Terra Haute, Ind.</td>
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<td></td>
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<td></td>
<td>Portsmouth, N.H.-Me.</td>
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<td>New Bedford South, Mass.</td>
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<td>Fond du Lac, Wis.</td>
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<td></td>
<td>Brooklyn, N.Y.</td>
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<td>Augusta, Me.</td>
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<td></td>
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<td>Jacksonville, Fla.</td>
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</tbody>
</table>

#### 3. Industry

<table>
<thead>
<tr>
<th>Location</th>
<th>Scale</th>
<th>Location</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield, Calif.</td>
<td>Arkadelphia, Ark.</td>
<td>Toledo, Ore.</td>
<td>Point Comfort, Texas</td>
</tr>
<tr>
<td>Grand Coulee Dam, Wash.</td>
<td>Watauga Dam, Tenn.</td>
<td>Chippa, Tenn.</td>
<td>Chattanooga, Tenn.</td>
</tr>
<tr>
<td>Malvern, Ark.</td>
<td>Shasta Dam, Calif.</td>
<td>Ventura, Calif.</td>
<td>Texas City, Texas</td>
</tr>
<tr>
<td>Corpus Christi, Texas</td>
<td>Texas City, Texas</td>
<td>Galveston, Texas</td>
<td>Boling, Texas</td>
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<td></td>
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<td>Terra Haute, Indiana</td>
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<td>Santa Rita, N. Mex.</td>
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<td>Whiting, Ind.</td>
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<td></td>
<td></td>
<td></td>
<td>Beaumont East, Tex.</td>
</tr>
</tbody>
</table>
4. Agriculture

Bakersfield, Calif.) Allegan, Mich. )
Provencal, La. ) 1:62,500 Frankfort, Mich. ) 1:62,500
Wiggins, Miss.) Wheatland, Calif.)
Arkadelphia, Ark.)
Friant, Calif.)
Tracy, Calif.) 1:24,000
Ventura, Calif.)
Traverse City, Mich.)
Crowder, Miss.)
Empire, Mich.)
LABORATORY EXERCISE: Land Use Map Interpretation

Study the British Land Use maps available (i.e.) Cardiff, Portsmouth and Kirby Moorside, and also refer to the proposed Land Use of Bellingham, Washington (Jan. 1967), to discover a system of land use classification. Develop your own modification of these schemes for showing land use.

We are going to attempt to classify land use using map overlays.

Each student will choose one topographic map from the list given and attempt to classify land use under the following headings.

Prepare a map overlay (complete with color scheme) legend to illustrate the present land use of your map sheet.

* Use the list below as a guide.

1. Residential  
   (a) low density  
   (b) medium density  
   (c) high density

2. Commercial 
   (a) local  
   (b) central

3. Industrial 
   (a) light  
   (b) heavy

4. Parkland and open space

5. Rural land - agricultural

6. Transportation 
   (a) road  
   (b) rail  
   (c) air  
   (d) water

7. Unused land

Prepare a second overlay to illustrate your proposals for
Prepare a short abstract supporting your proposals for future land use on your map sheet.

**List of Topographic Maps**

1. Saint John 21 O/8a
2. Halifax 11 D12/h
3. St. John's 1 N/10ba
4. Quebec 21 L/14b
5. Niagara Falls 30 M/3a
6. Medicine Hat 72 L/2b
7. Ottawa 31 G/5g
8. Lachine 31 H/5g
9. Ste.-Anne-De-Bellevue 31 H/5e
10. Fredericton 21 O/15g
11. Bedford Basin 11 D/12g
12. Dundas 30 M/5d
13. Ste. Foy 21 L/14c
14. Grimsley 30 M/4h
15. Glace Bay 11 J/4e
16. Beamsville 30 M/3e
17. Verdun 31 H/5h
18. Outremont 31 H/12a
19. West Toronto 30 M/11e
20. Victoria 92 B/6W
21. Laval 31 H/12e
22. Toronto 30 M/11W
LABORATORY EXERCISE: Leduc and Ft. Saskatchewan
Land Use Map Analysis

1. In both maps of land use, what two functions stand out as the most prominent users of space?

2. Describe the general location of the rest of the town in relation to the rail line through both towns.

3. In relation to the railway through town, which way does the main street of Leduc and the main street of Ft. Saskatchewan run?

4. In both towns, what type of land use is there near the rail lines? Why would you expect this? What does this tell you about the main function of the town?

5. Comment on the road pattern of the two towns. e.g. Do they have through routes? New suburbs etc.

6. Compare the area of the two towns.

7. In both towns, describe the location of superior and inadequate residential areas in relation to the rail line. Why is this a general pattern that is found in many towns and cities all over the world?

8. What features appear to be limiting the area into which Leduc can expand? into which Ft. Saskatchewan can expand?

9. If you did not know, what feature would enable you to guess that Ft. Saskatchewan was a prairie town?

10. What does the term 'urban land use' mean?
LEDUC, land use (pop. 2,846)

Source: Edmonton Regional Planning Commission and Field Survey, June 1964.
FORT SASKATCHEWAN, land use. (pop. 3,766).

LABORATORY EXERCISE: Urban Master Plan Report

A Master Plan is a statement of policy prepared as a guide to future physical development. Such a plan outlines what the community wants in the future and suggests how present and future improvements and land uses should be related.

The Master Plan should be based on a study of resources, problems, needs, and potentials of the community.

Usually the Master Plan is set forth in a series of maps and proposals for future improvements. One or more of these maps indicate areas suitable for industry, business, homes, farming, recreation, and other uses. For example:

(a) A land-use map of the entire area, indicating the general location and amounts of land to be allocated for residential, commercial, industrial, public transportation and agricultural purposes.

(b) A circulation plan, showing the location and types of major routes required for the efficient movement of people and goods into, about and through the local area.

The Comprehensive or Master Plan should also consist of a statement of community objectives and needed explanatory materials. Consideration should be given to public and private financial resources. The plan suggested for the future should be feasible!

Study the British Land Use maps available (i.e.) Cardiff, Portsmouth and Kirby Moorside, and also refer to the proposed Land Use of Bellingham, Washington (Jan. 1967) to discover a
system of land use classification. Develop your own modification of these schemes for showing land use.

Assignment:

From the urban topographic maps available select one and be prepared to orally account for the distribution of the present land use. You will be required also to produce an overlay of a master plan for the town or city you have selected.

Use the following questions to assist you in the preparation of your oral presentation.

1. Account for the site location of the city chosen. (e.g.) historical, transportation center, etc.

2. Write a brief historical sketch of the city.

3. In your discussion of present land use, what functions stand out as the most prominent users of space?

4. Describe the general location of the rest of the town in relation to the major transportation routes.

5. What features appear to be limiting the area into which the town can expand?

6. What type of land use is there near the rail lines? Why would you expect this? What does this tell you about the town?

7. In your town, describe the location of superior and inadequate residential areas in relation to the major transportation routes. Why is this a general pattern?
that is found in many towns and cities all over the world?

The following questions are to be used as a guide in the formulation of your master plan and statement of community objectives:

1. What are the needs of the people in your city? Show how these needs have been considered in drawing up your master plan.

2. How will this town plan make the life of the people in the city better?

3. Is your master plan really a plan for the future? Justify its use in 1980! Speculate as to the changes in modes of transportation and housing types which might be available in 1980. On this basis, evaluate your master plan of the future.
LABORATORY EXERCISE: The Layer Contour Model Construction

From a topo sheet select the landforms which you wish to illustrate. Base the model on the map of this landscape.

Simplify and enlarge the contour pattern of the chosen feature. Trace and cut out the shapes of successive contours at selected intervals. Use stiff card, strawboard, plywood or other suitable material. The vertical interval is governed by the thickness of the material used and this is a matter of personal choice depending on the area covered and the complexity of the contouring. For layer models it is usually better not to over-exaggerate the vertical scale. Superimpose the shapes upon one another and fix with an adhesive under pressure. Clamp the bottom layer to a firm base of blockboard to prevent twisting as the layers dry out. If the 'steps' are to be filled in to give the natural slope, the vertical scale should be increased. In this case, Polyfilla or Pyruma make good fillers. Smooth down the filling with fine sandpaper so that the edges of the layers just peep through.

Before applying colour fill the pores of the material with a good solution of size.

From the models made in this manner, note:
1. The relationship between contour, slope and shape.
2. The relationship between the component features of landforms and the pattern of a landscape as a whole.
3. The terms of physical geography associated with landscape structure, viz. dip-slope, scarp slope, spur, re-entrant, col, saddle, etc.
THE INTERPRETATION OF SOIL MAPS

The immediate object of a soil survey is the classification and mapping of the soils of an area according to their inherent physical and chemical characteristics. The interpretation of the characteristics of the different soil units in terms of productivity and adaptability for use is also an important feature of any agricultural program.

List of Soil Maps and References

1. Soil Survey Maps

(a) North East Sheet #12, sheet 3
(b) South East Sheet #12, sheet 4
(c) North West Sheet #12, sheet 2
(d) Regina 72 I East
(e) Regina 72 I West
(f) Prince Albert North Carrot River #13
(g) Swift Current

(a) St. Stephen Sheet
(b) Penfield - Fredericton Junction
(c) McAdam - Canterbury
(d) Moncton - Tormentine - Albert
(e) Codys - Petitcodiac
(f) Saint John - Sussex

2. References:

(a) The Canada Land Inventory - ARDA 1966
(b) Soil Survey Report #12, Southern Saskatchewan
(c) Soils of the Regina Map Area 721
(d) Soil Erosion by Water - Publication #1083
(e) Guide to Farm Practice in Saskatchewan 1966
(f) Saskatchewan Farm Business Summary #13, 1966
(g) Soil Zones of Alberta
(h) Soil Zones of Saskatchewan
(i) A Guide to Understanding Saskatchewan Soils
(j) Soil Survey Bulletins

1) Andover - Plaster Rock, New Brunswick
11) Woodstock, N.B.
iii) Southwestern N.B.
iv) Southeastern N.B.
LABORATORY EXERCISE: Soil Map Comparison

Select one soil sheet from the Prairies Region and one from the Maritimes Region for interpretation.

1. Determine the dominant soil types in both areas (i.e. patterns) and describe their main characteristics.

2. Using the legend, attempt to determine the most favorable agricultural areas on each map sheet. Is there any relationship between soils and agricultural practices?

3. Using the reference material listed, write a general description of each map sheet. Mention the topography, climate and any other factors which may have influenced the development of the soils and which may have a bearing on the agricultural activities in each area.
LABORATORY EXERCISE: Soil and Topographic Map Interpretation

Each student is to attempt the interpretation of one of the following exercises.

A. Willow Bunch Lake - 724 Saskatchewan Soil Map

Willow Bunch Lake - 72 H/SE Topographic Map

1. Prepare a soil overlay of the topo map to illustrate the types of soil found in the map area. Construct a legend to indicate the type of crops that could be grown in the various soil zones of the map.

2. On the topo map mark the best areas for agriculture.

3. List any physical and cultural features which are not shown on the topo map but appear on the soil map.

4. Is there any relationship between the location of soil types and relief? Explain.

5. Determine the map coordinates of Willow Bunch on both maps.

6. What soil type is found at coordinates 590746 of the topo map?

7. Determine the gradient of the railway from Willow Bunch to coordinates 638638.

8. Is there any specific soil type associated with poor drainage?
9. List the limitations on agriculture you have discovered in the topo map area.

10. Construct an annotated cross-section across the center of the topo map and illustrate (using color) the different soil types found along your cross-section and main features of land use.

B. Melville - 62L Saskatchewan Soil Map

Lemberg - 62L/11E Topographic Map.

1. Do questions 1 - 4 as the Willow Bunch assignment.

2. What cultural features are shown on the topo map that are not shown on the soil map in the towns of Neudorf and Lemberg.

3. What does the word "Pheasant" on the topo map refer to?

4. Is there any indication on either map as to what has caused the many small lakes on the topo map?

5. Determine the map coordinates of Neudorf on both maps.

6. What soil type is found at topo map coordinates 363064?

7. Determine the gradient of the railroad bed from Neudorf to Lemberg.

8. Construct an annotated cross-section across the center of the topo map and illustrate (using color) the different soil types found along your cross-section and main features of land use.
9. List the limitations on agriculture you have discovered in the topo map area.

C. **Hudson Bay** - 63D Saskatchewan Soil Map

**Crooked River** - 63D/13E Topographic Map

1. Do questions 1 - 4 as per the Willow Bunch exercise.

2. Determine the map coordinates of Peesane on both maps.

3. What soil type is found at topo map coordinates 884486?

4. Determine the gradient of the railroad bed from Peesane to Crooked River.

5. List the limitations on agriculture you have discovered in the topo map area.

6. Is there any specific soil type associated with poor drainage?

7. Construct an annotated cross-section across the center of the topo map and illustrate (using color) the different soil types found along your cross-section and main features of land use.

D. **Cypress** - 72F Soil Map

**Shaunavon** - 72F/9E Topographic Map

1. Do questions 1 - 4 as per the Willow Bunch exercise.
2. Determine the map coordinates of Scotsguard on both maps.

3. What soil type is found at topo map coordinates 881112?

4. Determine the gradient of the railroad bed from Admiral to Scotsguard.

5. Is there any specific soil type associated with poor drainage?

6. List the limitations on agriculture you have discovered in the topo map area.

7. Construct an annotated cross-section across the center of the topo map and illustrate (using color) the different soil types found along your cross-section and main features of land use.

E. Kitchener - 40P-0 Saskatchewan Soil Map

Guelph - 40P/9E Topographic Maps

1. Do questions 1 - 4 as per the Willow Bunch exercise.

2. Determine the map coordinates of Acton on both maps.

3. What soil type is found at topo map coordinates 291698?

4. Determine the gradient of the railroad bed from Guelph to Acton.
5. List the limitations on agriculture you have discovered in the topo map area.

6. Is there any specific soil type associated with poor drainage?

7. Construct an annotated cross-section across the center of the topo map and illustrate (using color) the different soil types found along your cross-section and main features of land use.
THE MEASUREMENT OF SCALE IN AERIAL PHOTOGRAPHY

The scale of an aerial photograph is the relation between a distance on the photograph and the corresponding distance on the ground.

\[
\text{SCALE} = \frac{\text{Distance on the Photograph}}{\text{Distance on the Ground}}
\]

For example: Assume that the length of a pipeline on the ground is 10,000 feet and the measured length of the pipeline on the vertical photograph is 6 inches. The scale of the photograph is found as follows:

\[
S = \frac{\text{Photo distance}}{\text{Ground distance}} = \frac{6 \text{ inches}}{10,000 \text{ ft.}} = \frac{0.5 \text{ ft.}}{10,000 \text{ ft.}} = 0.00005
\]

Similarly, the scale of a photograph can be determined from the relation between the focal length \(f\), of the camera above the ground.

\[
\text{SCALE} = \frac{\text{focal length}}{\text{Height above ground}}
\]

For example: Focal length of the camera that took the photograph is 12 inches and was flown at an altitude of 20,000 feet.

\[
S = \frac{f}{H} = \frac{12 \text{ inches}}{20,000 \text{ ft.}} = \frac{1 \text{ ft.}}{20,000 \text{ ft.}} = 0.00005
\]

Note: most aerial cameras have lengths of 6', 8.25" or 12" (.5', .6875, 1.0')

Principal point

Terrain
LABORATORY EXERCISE: Scale and Photo Measurement

Solve the following problems using the formulas outlined.

1. The length of a pipeline measures 5.50 inches on an aerial photograph. The scale of the photograph is given as 1:6000 (500 ft. per inch). Solve for the length of the pipeline on the ground.

2. Two points along a railway are known to be exactly one mile apart. If the corresponding photo distance is .330 feet, what is the scale of the photograph?

3. An Aerial camera has a focal length of 6 inches. The aircraft is flying at an elevation of 6,500 feet above mean sea level over average ground elevations of 1,500 feet. Determine the scale of the photograph.

4. Express 4 inches to one mile as a scale in figures.

5. Express 1:1,000,000 as so many miles to an inch.

6. The distance between two farm houses on a topographic map measures two inches. The map scale is known to be 1:24,000. The same distance on an aerial photograph is measured at 4.80 inches. What is the scale of the aerial photograph?

7. Refer to the City Planning Photograph of Little Mountain. Measure the dimensions of several accessible features on the photo and convert these to ground distances. Then, check these distances by actual field measurement. Compare.
LABORATORY EXERCISE: Basic Photographic Interpretation

Materials: Aerial Photograph - A17796-82

1. The landscape shown on the photo can be divided into two regions. On a sketch map show the boundary between the agricultural and the non-agricultural land. List the basic differences between the two areas.

2. On your sketch map of the aerial photo also indicate the following:
   i) the cultivated fields
   ii) farm buildings
   iii) pasture lands
   iv) rock outcrops
   v) wooded areas
   vi) swamps
   vii) lakes
   viii) main roads.

3. Determine North from the time of day and the shadows on the air photograph and indicate it on your sketch map.
LABORATORY EXERCISE: Determining Coordinate Points

Materials: Stereogram #18
Pecan, Mississippi

Using your stereoscope determine the coordinates of the following:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Stereogram Left Coordinates</th>
<th>Stereogram Right Coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pecan orchards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Terraced Fields</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sawmills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Drive-in theatre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pole treating plant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Railway car (on siding)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PECAN

Stereogram No. 18
LABORATORY EXERCISE: Comparing Aerial Photographs

Materials: Topographic maps: Yamaska River - A 12809 -123
New Glasgow - A 13865 -128

1. Compare the two areas under the headings:
   (i) relief
   (ii) farming and vegetation
   (iii) settlement pattern, size and number of houses.

2. What additional types of maps do you feel you need in order to form a reasonably accurate perspective of the processes operating in the areas which have produced the diverse cultural impressions upon them?

3. Using photograph A 13865 - 128, draw a sketch-map of the layout of a farm. Label the farm buildings, the farm house, and other associated features.
LABORATORY EXERCISE: Construction of a Topographic Map from a Stereogram

Materials: Stereogram #218

Cedar City, Michigan

Using the stereogram construct a topographic map of the hill located within the coordinates C.45 - 2.55 and C.95 -1.85. Draw the hill complete with contour lines and all cultural features. Begin your outline of the hill at a contour level of 100 feet, using a contour interval of 25 feet. The highest elevation of the hill is 738 feet.
LABORATORY EXERCISE: Meandering River

Materials: Topographic map: B.C. 5234 - 099 and 100
Stereogram: Fort Nelson River Lowlands

1. The surface of Fort Nelson Lowland slopes gently northward (down the picture). Give reasons to support this statement.

2. What is the broad area called through which the river flows?

3. Why does the river meander in such loops? What part do meanders play in the widening of river valleys? Supplement this answer by means of a number of diagrams.

4. Study the river course. What are the white patches? Are they on the inside or the outside of the river bends? Where is the deep water channel in meanders usually found?

5. Determine whether or not the area has been glaciated. State evidence.

6. What do the tree covered areas on the photo suggest about the drainage pattern of the stereogram?

7. On an outline map of North America, mark in and name four major meandering rivers.

8. In some instances meander loops become very pronounced and may even be cut off from the river. These are called oxbow lakes. Prepare a transparent overlay or a sketch of the stereogram to show the flood plain of the river, the river and the oxbow lakes.
LABORATORY EXERCISE: Agricultural Patterns in the Maritimes

Materials: Topographic map: Berwick 21 H/12E
Lakeville, Nova Scotia - A3619-88 (1" = 1320')

1. What are the possible uses made of water stored in the lake?
2. What type of climate do you think occurs here? Give evidence to support your answer.
3. Describe the shape of the land. Why is the topography suited to an agricultural economy? Why would this be a good agricultural region?
4. Suggest, using evidence from the picture, the major crops grown in this area. State your reasons clearly.
5. Draw a sketch map of the aerial photo to divide the map area into agricultural and non-agricultural land.
6. Compare and contrast this photo with the Beamsville aerial photo (A 4701-47) with the particular reference to
   a) the approximate percentage of unimproved land;
   b) approximate percentage of land in orchard;
   c) what other crops appear prominently?
   d) compute the approximate population density per square mile using an average of 4 persons per rural household.
LABORATORY EXERCISE: Agricultural Patterns in the St. Lawrence Lowlands

Materials: Topographic map: 31H/15W
Aerial photo: St. David - d'Yamaska, Quebec

Prepare a transparent overlay of the aerial photograph.

1. As before, locate and identify the following on your overlay:
   a) the built-up area of the town
   b) drainage
   c) former ox-bow lakes
   d) transportation routes
   e) a sawmill
   f) a church
   g) hospital
   h) 50, 75 and 100 foot contours
   i) several spot heights (where contours cross roads)
   j) use an arrow to indicate the direction the river is flowing.

2. Determine the scale of the air photo.

3. Describe the relief of the area shown on your aerial photograph.

4. Suggest two reasons why the town developed at its present location. Compare its site with that of Clyde, Alberta (A-14899-78).

5. Compare the pattern of farmstead distribution with that of Clyde. Do you detect any site preference shown by the average farmer in each area?

6. Do the maps and air photos supply any criteria which will aid you in appraising the comparative future potential growth of the two areas (Clyde and St. David d'Yamaska)?

7. The type of farming shown in the aerial photograph is of an intensive nature. Explain where in Canada is
arable farming practiced on 'extensive' lines? What are the main differences between the two methods?

8. Determine by research what types of farming are carried on in this part of Quebec.
LABORATORY EXERCISE: Agricultural Patterns in Manitoba

Materials: Topographic map: 64H/4E

Aerial photograph - Altona - A16614-151

Prepare a transparent overlay of the aerial photograph.

1. As before, locate and identify the following on your overlay:
   a) main roads
   b) drainage ditch
   c) intermittent streams
   d) farmsteads
   e) ploughed land
   f) shelter belts
   g) an overpass
   h) the 825 foot contour line.

2. Farms in the Prairies are usually measured in terms of sections. If each square contained between the main roads is a section or 640 acres in size, determine:
   a) the scale of the aerial photo
   b) the average size of farms in this part of Manitoba.

3. Construct a table to compare the information you derived from question 2(b) with that of the information pertaining to the size of farms in Clyde, Niagara and St. David d'Yamaska photographs. Are there any basic differences between the areas? Why?

4. Attempt to identify the feature running diagonally across the aerial photo. Is this feature shown on the topographic map? Why, or, why not?

5. Attempt by research, to determine the crops grown on the farms in this area.

6. Draw a 4" x 4" enlargement of the farm buildings on one of the farms shown on the aerial photo.
LABORATORY EXERCISE:  Agricultural Patterns in Alberta

Materials:  Topographic map:  831/45

Aerial photo:  Westlock (Clyde), Alberta A14899-78

Prepare a transparent overlay of the aerial photograph.

1. As before, locate and identify the following on your overlay:
   a) the built-up area of the town
   b) main transportation routes
   c) a school
   d) post office
   e) grain elevators
   f) marsh area south of the town
   g) ploughed land
   h) wooded land
   i) main planted crop (type)
   j) the 2150 and 2175 foot contours.

2. Describe the relief of the aerial photograph.

3. State the type of vegetation shown. Give reasons for its location.

4. Draw a cross-section of your overlay map to show the nature of the relief. Mark all the principal natural and cultural features which appear along your cross-section.

5. Suggest why the town of Clyde has grown up in this particular location.

6. What is the possible future of the town likely to be?

7. Mark off an area of 3 square miles west of Clyde on the map. Trace each building and habitation in this area. Estimate the number of farmsteads in the area you have delimited. How far apart are they? Compare this distribution of settlement carefully with the settlement patterns shown on the St. David d'Yamaska map and photo and the Niagara photo (A 4701-47) and map.

8. Account for the difference in the size and shape of the average farm in each area?
LABORATORY EXERCISE: Agricultural Patterns in the Lower Fraser Valley

Materials: Topographic map: Coquitlam, B.C. 9207/b
Aerial photo: Pitt River, B.C. A13245-8

Prepare a transparent overlay of the aerial photograph.
The photograph was taken 25 miles east of Vancouver.

1. As before, locate and identify the following on your overlay:
   a) Pitt River
   b) Alouette River
   c) The area of Pitt Polder
   d) Addington Point
   e) Sheridan Hill
   f) forested areas
   g) Haney
   h) Loon Lake
   i) area of reclaimed land
   j) Barnston Island.

2. What portion of the aerial photo is shown on the map?

3. Four types of terrain are clearly distinguishable on the photograph. What difficulties would man encounter here?

4. What evidence is there that much of the land is very flat?

5. The Pitt Polder appears as a distinct area on the photograph. What country in Europe has extensive polder lands?

6. Determine the heights of (a) Sheridan Hill, (b) Loon Lake, (c) mountains on west side of Pitt River.

7. Are the bridges on the air photo shown on the map?

8. What is the probable destination of the log booms in the photograph?

9. How are the sand bars in the river shown on the map?

10. What evidence is there on the map to indicate that some of the land in this area has been reclaimed?
11. Suggest a reason for the intensive cultivation shown on the aerial photograph.

12. Determine by research what types of crops are grown in this part of the Fraser Valley.
LABORATORY EXERCISE: Aerial Photograph and Soil Map Interpretation in the Prairies

Materials: Topographic map: Lumsden, Sask. 72I/10W
Aerial photo: Craven, Sask. A17297-84
Soil map: Regina, Sask. 72I East

1. Determine the scale of the aerial photograph.
2. Is the river valley used for agricultural purposes? State your proof.
3. Draw an overlay of the area of the topo map shown on the air photo. Indicate only those physical and cultural features which are shown on the air photo but not on the map.
4. Why has the route of Highway 20 been changed?
5. What has determined the location of the town of Craven?
6. Draw an enlarged sketch of Craven and indicate the elevator, the post office, school, the water tank, the dam and the highway. Compare your map with the town of Clyde, Alberta. Why do they have similar services?
8. Prepare an overlay of the soil map to the same scale as the topo map to show the variety of soils in the area. Draw on the contours at 100 foot intervals. Use your overlay to determine how many different soil types are shown on the air photo. Use a legend.
9. Can the boundaries of the Prairie Levels be determined from the soil map? Explain.
10. Explain the linear nature of the distribution of some soils.

11. What is the possible source of the green colored soils on the map?

12. According to your soils overlay determine first, second and third choices of the best agricultural land on the air photo. Mark these on your overlay.

13. Prepare a list of the major crop hazards to grain production in the Regina soils map region.

14. Using the topo sheet construct a profile from X to X. Sketch the features from the photo onto the profile.
LABORATORY EXERCISE: The Use of Coordinate Points in the study of a Pulp and Paper Mill


The overall landform on the photograph is typical of the lower east Gulf Coastal Plain. A portion of a drowned river valley and the meandering river channel is clearly shown.

This exercise is to familiarize students with the use of coordinate points and the layout and facilities of a pulp and paper mill.

The following TABLE A is a list of features shown on the stereogram. TABLE B is a list of coordinate points which correspond to the features in Table A. In the space provided to the right of Table A place the correct coordinates for each feature.

TABLE A

<table>
<thead>
<tr>
<th>Feature</th>
<th>Coordinate Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Administration and office buildings</td>
<td></td>
</tr>
<tr>
<td>2. Pulpwood piles</td>
<td></td>
</tr>
<tr>
<td>3. Crane used to pile pulpwood</td>
<td></td>
</tr>
<tr>
<td>4. Wood supplies (received by truck, rail and barge)</td>
<td></td>
</tr>
<tr>
<td>5. Chemical waste pond</td>
<td></td>
</tr>
<tr>
<td>6. Discharge of chemical waste into river</td>
<td></td>
</tr>
<tr>
<td>7. Surge basin</td>
<td></td>
</tr>
<tr>
<td>8. Paper making machine</td>
<td></td>
</tr>
<tr>
<td>9. Public school</td>
<td></td>
</tr>
<tr>
<td>10. Canal (furnishing fresh water to the plant)</td>
<td></td>
</tr>
<tr>
<td>11. Canal crossed by stream</td>
<td></td>
</tr>
<tr>
<td>12. Pecan orchards</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1.</td>
<td>B.25 - 2.47</td>
</tr>
<tr>
<td>2.</td>
<td>A.00-4.95</td>
</tr>
<tr>
<td>3.</td>
<td>B.05-3.17</td>
</tr>
<tr>
<td>4.</td>
<td>B.10-2.80</td>
</tr>
<tr>
<td>5.</td>
<td>B.65-3.56</td>
</tr>
<tr>
<td>6.</td>
<td>A.80-2.49</td>
</tr>
<tr>
<td>7.</td>
<td>B.35-2.88</td>
</tr>
<tr>
<td>8.</td>
<td>B.03-2.82</td>
</tr>
<tr>
<td>9.</td>
<td>A.9-2.30</td>
</tr>
<tr>
<td>10.</td>
<td>A.60-2.05</td>
</tr>
<tr>
<td>11.</td>
<td>A.85-2.80</td>
</tr>
<tr>
<td>12.</td>
<td>B.40-3.51</td>
</tr>
</tbody>
</table>
LABORATORY EXERCISE: A Paper Mill in the Maritimes

Materials: Topographic map: 2 D/13E
Aerial photo: A18601-95

1. Newfoundland's economic development has been restricted by geographical limitations. Foundation of the economy is the exploitation of natural resources. Grand Falls was the first paper mill built in Newfoundland. What advantages does Grand Falls have for the development of this industry?

2. What climatic factors favor forest growth in this area?

3. Draw a sketch map of the paper plant to show the following:
   a) log storage area.
   b) Large quantities of water are required for paper-making. Locate the dam, powerhouse and switchyard.
   c) The first stage of paper-making consists of breaking the logs into small pieces. Locate the storage area of these chips.
   d) Locate the conveyors used to move the log chips to the paper machines.
   e) Paper is made by paving a mixture of pulp fibres and water onto a long moving belt. Locate the buildings which house these machines.
   f) Identify the type of transportation used to send the paper to world markets.

4. Is there any evidence of pollution control of waste liquids from the power plant?
5. Has the establishment of the paper mill attracted any other industries to Grand Falls?

6. The population of Grand Falls, when the map was printed, was 6,606. Guesstimate the population today. Does the street pattern of the community reflect several distinct periods of growth? Illustrate your answer with a sketch. Include the following on your sketch:
   a) business core
   b) new residential areas i) shopping center ii) schools
   c) newest residential areas not shown on the map.

7. Examine the various street patterns and see how many different ones can be identified. Classify them as rectangular, hexagonal, concentric, or combinations of these. Use a rough sketch to illustrate your answer.
LABORATORY EXERCISE: A Paper Mill in Michigan

Materials: Topographic map: Kalamazoo, Michigan
          Stereogram: #307 - Bryant Pond

1. Determine the stereogram coordinates of the Allied Paper Company at Kalamazoo, Michigan. What evidence is there of this type of industry?

2. Describe the manner in which the city of Kalamazoo has built up around the plant.

3. What is the height of Bryant Pond?

4. Account for the fact that Bryant Pond (C.8-3.8) is light-toned in color on the stereogram.

5. What man-made feature present in the photo indicates that the Kalamazoo River is not navigable (that is large ships cannot use it).

6. If the left-hand side of the stereogram is south, what direction does the Kalamazoo River flow toward?

7. Locate and label the following features on both map and stereogram:
   a) major roads and railroads
   b) drainage features
   c) waste treatment plants
   d) the feature at C.8 - 1.6
      the feature at A.5 - 3.1
      the feature at B.7 - 1.0
   e) the older and newer parts of the city
   f) a small commercial area.
LABORATORY EXERCISE: Photo Interpretation of an Oil Deposit

Materials: Topographic map: Beaumont East, Texas
Stereogram: #312 - Spindle Top, Texas

Spindle Top, one of the first known salt domes of the Gulf Coast, is located near Beaumont, Texas. Oil was first discovered here in 1900, and has produced more wealth than any area of similar size in the world. The dome is centered near C.7-2.40. Large tank farms on two sides of the dome provide bulk oil storage and pipelines can be seen within the area.

1. Identify the circular feature just north of Zummo on the stereogram, and the features found at A.10-2.0, C.1.0-3.5, D.15-1.75, and B.40-1.36.
2. Suggest the probable function of the rectangular and circular water areas.
3. Determine the height of Spindle Top. What advantages does this area have for the activities taking place here?
4. On a sketch or overlay, locate and label the following features on both the map and stereogram:
   a) radio tower  f) built up area of Beaumont
   b) McFadden Bend Cutoff  g) pipelines
   c) main highways
   d) main railroads
   e) main drainage features
5. Construct a profile from Spindle Top School to the bench mark near Gladys. Mark all the natural and cultural features which appear along the section.
LABORATORY EXERCISE: An Oil Refinery

Materials: Topographic map: Whiting 7.5'
Stereogram: #301 - Cities Service Refinery

1. Note the area on the stereogram that is being developed into a ship turning basin. Locate this area on the map.
2. What is the height of the road across the Lake George Canal?
3. What major interchange is evident on the stereogram? Is this a good location for this highway?
4. Locate the Cities Service Refinery on the map and stereogram. Why is this a good location for this industry?
5. Oil is the main cargo in this area. Are there imports or exports? How does the oil get from the ships to the storage tanks?
6. Is there any way of making better use of this industrial area?
7. Locate the following patterns on the map and stereogram:
   a) Outline the built-up areas having urban characteristics.
   b) Mark the major land and water transportation lines passing through the area shown on the stereogram. What is the main hindrance to rail transport in this area?
   c) Outline the principal industrial sites and mark the probable locations of light industrial establishments.
   d) Land primarily used for oil storage.
CITIES SERVICE REFINERY
East Chicago, Illinois, U.S.A.
August 20, 1959
RF = 1:23,700   H = 9,800 ft.

Stereogram No. 301
Prepared by the
University of Illinois
Committee on Aerial Photography
LABORATORY EXERCISE: Photo Interpretation of an Open Pit Mine

Materials: Topographic map: Santa Rita 7.5
Stereogram: #304

Prepare an overlay of the stereogram:

a) shade in the area which has been, or is being mined.
b) the area where mine waste is being dumped
c) the mine buildings and townsite.

1. Determine the surface height of the mine and its approximate depth.

2. What two types of mining are evident on the stereogram?

3. Give the stereogram coordinates of all water towers shown.

4. What are leaching ponds?

5. Why are few of the rail lines shown on the map not shown on the stereogram?

6. Is the ore processed at the mine site? Explain.

7. What evidence is there to indicate the type of climate found in this area?

8. Try to estimate the vertical exaggeration of the stereogram.

9. Consult a reference book to determine whether or not this is an area of important mining activity.
SANTA RITA
Grant County, New Mexico, USA
January 14, 1937
RF = 1:38,500   H = 14,800

Stereogram No. 304
Prepared from USDA-SCS photography
by the University of Illinois
Committee on Aerial Photography.
LABORATORY EXERCISE: Photo Interpretation of a Gold Mine

Materials: Topographic map: Wheatland, California
Stereogram: #302

1. What type of mine is located at Hammonton?
2. How does it differ from the mine at Santa Rata? Which mine would require the smallest initial capital outlay?
3. Determine the approximate height of the mine tailings.
4. Determine the percentage of the mine tailings shown on the stereogram compared to the total shown on the map.
5. Why are there no contour lines in the area of the mine tailings?
6. Account for the different shape of the mine tailings at Santa Rita and Hammonton.
7. Identify the dredge which is working a new face. Why is the other dredge reworking an old spoil bank?
8. There is no evidence of bulk handling facilities on the stereogram or map. Why is this so?
9. Hammonton can be seen in the upper part of the stereogram. Compare its location with that of the Santa Rita town site.
10. Give evidence to suggest the type of climate found in the area of the map sheet.
HAMMONTON
Yuba County, California
September 1, 1937
RF = 1:21,000  H (feet) 14,400

Stereogram No. 302
Prepared from USDA-AAA photography
by the University of Illinois
Committee on Aerial Photography
LABORATORY EXERCISE: Thermal Plant

Materials: Topographic map: Spillway, Michigan
Stereogram # 16

This is a photograph of a large thermal electric plant on the Kalamazoo River. Prepare a sketch of the photograph identifying the following features:

1. Dam
2. Spillway
3. Transformer yard
4. Coal pile
5. Tall chimneys
6. Boiler house
7. Mark with an X the location of the discharge point of heated coolant water from the plant.
LABORATORY EXERCISE: Thermal Plant

Materials: Topographic map: Ten Dolphins, Illinois
Stereogram # 14

The Central Illinois Power Company thermal electric power plant on the Illinois River near Meredosia, Illinois, is shown.

Identify the following features from the table of coordinates:

1. A.9-2.10
2. B.25-2.15
3. A.7-2.40
4. C.15-2.150
5. A.3-1.50
6. C.25-1.90
7. A.9-1.85
8. C.31-1.90.
TEN DOLPHINS
Morgan County, Illinois
May 30, 1962
RF = 1:15,840       H = 7,920 feet

Stereogram No. 14
Prepared by the
University of Illinois
Committee on Aerial Photography
LABORATORY EXERCISE: Hydro Electric Dam

Materials:
Topographic map: The W.A.C. Bennett Dam, B.C.
Stereogram: BC 5273-002,003

The harnessing of the Peace River and Columbia River for electric power puts British Columbia into the big leagues of hydro development.

Now completed, the Peace Project will have a capacity of some 2,950,000 kilowatts at two sites, almost equal to the capacity of all the power developments in the province at the present time.

Prepare a transparent overlay of the stereogram and locate the features mentioned in the following description.

The W.A.C. Bennett Dam is 600 feet high, half a mile thick at the base, and stretches for 1\frac{1}{2} miles across the valley. Sixty million cubic yards of gravel, sand, and rock were transported by a specially designed conveyor a distance of four miles from a glacial moraine to the damsite and fed through the processing plant. The conveyor has now been dismantled, but the processing plant and piles of unused material can be seen upstream from the dam at left center. Locate the processing plant and piles of unused material on your overlay.

Of the diversion tunnels shown in this stereogram, only the one at the extreme left remains open and the flow of water can be seen at the tunnel outlet. This tunnel has been closed since this photography was exposed and the reservoir is filling. Locate the diversion tunnels and tunnel outlets on your overlay.

Ultimately the reservoir will cover an area of 600 square
miles and will flood 75 miles west to Finlay Forks, then 70 miles south and 80 miles north from the forks. Draw a sketch map to show the location and extent of Bennett Dam in its regional setting.

Upstream at the left flank of the dam the control gate towers of the ten penstocks are shown under construction. Locate the penstocks on your overlay. These penstocks will conduct the water to the turbines of the power house which is housed in an underground cavern, 67 feet wide and 890 feet long, and located 500 feet below bed rock. When all the turbines have been installed, the ultimate generating capacity will be 2.3 million kilowatts. How will the installed capacity of Bennett Dam compare with other major hydro-electric dams in North America?

Downstream from the left flank of the dam, at the bottom of the cliff, can be seen the excavation for the tailraces, which returns the water to the river after passing through the power house. Locate these on your overlay.

At the right flank of the dam the spillway channel, provided to discharge excess floodwater, has been excavated and work continues on the gates at the upstream end. Locate the spillway channel on your overlay.

The switchyard, for the transmission of power, is shown under construction at the top of this cliff. Locate the switchyard on your overlay.

The camp for the construction workers is seen in the upper left of the stereogram. Locate the camp on your overlay.
1. Draw a cross-section diagram to illustrate how a hydro-electric dam works.

2. What types of power exist other than hydro-electrical?

3. What are the ideal geographical factors necessary for the generation of hydro-electric power? What major regions of the world have some or all of these factors?

4. Using the Canada Year Book construct a horizontal bar graph to show the amount of available and developed water power in British Columbia, the Prairies, Ontario, the Maritimes, Newfoundland, Quebec and the Northwest Territories. Use the following questions to help you interpret your graph:
   a) What province leads Canada in developed water power?
   b) Estimate the proportion of Canada's developed water power possessed by this province.
   c) What province ranks second in developed water power?
   d) What proportion of the nation's developed water power is possessed by the two provinces that you have named a) and c)? (In what geographic region is most of the water power of these provinces found? In addition there are three major centers in the St. Lawrence Lowlands. Name them.)
   e) What province leads Canada in available potential water power? What province ranks second, by a small margin?
   f) Note the large potential existing in the Prairie Provinces, Newfoundland and the Yukon. Are any of these potential sites being developed at present?
   g) What great source has recently been developed in the Prairie Provinces?
   h) On a map of Canada, locate the major hydro-electric dams in Canada.
LABORATORY EXERCISE: Photo Interpretation in the study of Aluminum Industry

Materials: Topographic maps: Kitimat - 103I/2E
Arvida - 22D/6E

Aerial photo: A17579-39

Stereograms: B.C. 5083-101 Kitimat townsite) Scale 1"=2640'
B.C. 5083-071 Kitimat Smelter

References: The Canadian Landscape - Blair p 119-121
Regional Geography of Canada - Scarfe & Tompkins p. 182 - 86

Using the stereograms and air photo, refer to the check list below, of features and write down as many items as you can identify. Following the name of each feature, indicate a level of confidence for the identification (i.e.) positive, probably or possible.

Four lane, divided highway
Two lane, paved roads
Non-surfaced roads
Woods, roads or trails
Dwelling houses
Apartment houses
Schools
Churches and cemeteries
Drive-in movies
Race track
Golf course
Athletic Fields
Rock quarries
Power lines
Fire lookout towers
Oil storage tanks
Traffic circles and interchanges
Overpasses - underpasses
Railroads
Business Districts

Bridges
Dams
Swamps or marshes
Floodplains or deltas
Coniferous forests
Hardwood forests
Orchards
Vineyards
Shipyards and drydocks
Boat docks and piers
Bathing benches
Resorts and hotels
Blast furnaces
Large chimneys
Transformer yards
Questions:

1. What evidence can you find to indicate that there is a difference in the climate of Kitimat and Arvida?

2. Why was the Kitimat site chosen for a smelter? In what ways does it differ or parallel Arvida's site?

3. List the important features that you think make Arvida and Kitimat planned towns. State any differences that would occur from each being an unplanned town such as Pictou, Nova Scotia.

4. In what direction is Kitimat most likely to expand? Explain the disadvantages of expanding in the other directions.

5. Using the stereograms of Kitimat and the aerial photo of Arvida, prepare transparent overlays of each. Locate by number the following features:
   a) Shopping plaza or business core
   b) multiple dwellings
   c) single family dwellings
   d) hospital
   e) transformer substation
   f) transmission lines
   g) pot lines
   h) sewage disposal plant.

6. Plot the city schools of Kitimat and Arvida on tracing paper. How are they located in relation to the residential districts?

7. Why was the smelter at Arvida not built at Port Alfred?

8. Draw a sketch map to show how Kitimat and Arvida receive their power supply.

9. What advantages does Kitimat have over Arvida as an aluminum producing center?
10. Consider and illustrate how both Kitimat and Arvida are situated in relation to the source of raw materials.
LABORATORY EXERCISE: Photo Interpretation in Industry

Materials: Topographic map: Copper Cliff 41 I/6E
Air photo: A 17975 -142

1. Carefully study the aerial photograph of Copper Cliff. Draw a rectangle around the area on the topographic sheet illustrated by the photograph. How many square miles does the photograph cover? At what time of day was the photograph taken?

2. Describe the relief and drainage in the area.

3. The Sudbury-Copper Cliff area is an important mining area. Since 1921, its population has grown continually. When the mineral deposits have become exhausted a major decline in population will result, followed hopefully by an adjustment to a new economic base. Where could expansion of the town take place? What other industries might locate in the area?

4. Prepare a transparent overlay of the aerial photo. Locate and identify the following features on your overlay, using correct cartographic techniques:
   a) major road and rail lines
   b) pipeline and storage tanks
   c) tailings dump
   d) smelter buildings
   e) refinery buildings
   f) lakes
   g) chimneys,

5. Many small steps are followed under the general heading of smelting. After the ore has been ground up into fine sand, it is placed in large tanks. The ground-up rock
that stays at the bottom of the tank is called tailings. This waste material is carried away through a pipeline and dumped in an area called a tailings dump. Locate these features on your overlay.

6. Two of the smokestacks at the Copper Cliff smelter are over 500 feet tall. Why must they be so tall?

7. Obviously there is some problem of air pollution in this area. If you had to live in Copper Cliff, where would be the most desirable location? The least desirable location? Which way was the wind blowing when the photo was taken? Is there any indication that this is the wind direction most of the year?

8. Make two lists under the headings of contrasts and similarities, comparing Copper Cliff and Ft. Saskatchewan (e.g. site, buildings, facilities, number of employees).

9. As a source of information what advantage does the map have over the photograph? The photograph over the map?
LABORATORY EXERCISE: An Industrial Slum

Materials: Topographic map: 92 G6/a

Aerial photo: B.C. 5175-137/138 (Scale 1" = 2640')

False Creek originally was a shallow inlet from English Bay to Vernon Drive. Large portions have been reclaimed over the years west to Main Street and along the shores. Between 1886 and 1888 the railways started False Creek's development as a transportation and industrial area utilizing the water and rail facilities. These uses continue today in far from optimal conditions.

1. Four bridges span the inlet. Account for their locations.
2. Convert the scale of the stereogram to a representative fraction.
3. What type of industries are evident along both sides of the inlet? Give evidence from the stereogram. Why do you think they are located here?
4. Small boats are visible near one end of the Burrard Street Bridge. What are the boats used for?
5. Give evidence from the stereogram to support the statement that the Granville Street Bridge carries more traffic than the other bridges. Why should this be so?
6. What evidences can you find to show that the physical features of the land have influenced man-made features?
7. Draw a generalized sketch of the stereogram. Label the following on your sketch:
   a) four bridges
   b) C.P.R. Rail Yard
c) C.N.R. Rail Yard  
d) Granville Island  
e) Downtown area  
f) Georgia Viaduct  
g) Underdeveloped land areas.

8. All the industries in False Creek are on the wane because this is not the best place for them. Support this statement from evidence on the stereogram.

9. The False Creek area comprises 596 acres of land presently zoned for heavy and light industry. What do you think the land use acreage should be? Include residential, governmental, industrial, etc.

10. Because Vancouver is now almost completely developed, physical change to accommodate its expanding economy and rising population will come mainly through redevelopment. Specify how you would redevelop the land surrounding False Creek with a sketch map.
LABORATORY EXERCISE: Fort Saskatchewan, Alberta - an example of Industrial Development in the Prairies

MATERIALS: Topographic map: 83 H/11g
Aerial photo: A 17361-107

1. Prepare a transparent overlay of the aerial photograph and identify the following:
   a) Ross Creek
   b) the provincial jail
   c) the grain elevators
   d) the recreational areas
   e) the Sherritt Gordon Nickel Refinery
   f) the Dow Chemical Plant
   g) the central commercial core of the town
   h) the 2025 foot contour (which corresponds to the valley edge)
   i) the trailer park
   j) a gas well
   k) the gas pipeline
   l) the C. N. railway line
   m) settling ponds.

2. From the shadow of the water tower (146') determine whether the photo was taken before or after noon.

3. Has Ross Creek had any effect on the built-up area of the town?

4. Prepare an overlay to show:
   a) the periods of city expansion
   b) the city schools
   c) the areas into which the built-up area of the town is most likely to expand in the future.

5. How are the city schools located in relation to the residential districts?

6. The extremely tall stack is characteristic of all refineries and is used to dispense noxious fumes and smoke. Locate it
on your first overlay. Is it likely that air pollution will become a problem to the town? Why or why not?

7. What raw materials are used at the refinery? Where do they come from? How do they get to the refinery?

8. The centers of employment are not concentrated in one central area as in many towns, but are distributed in several zones. Locate these areas of governmental, industrial and commercial employment. Describe their position in relation to each other.

9. What reasons probably prompted the two major companies to locate their industries in the Fort Saskatchewan area?
LABORATORY EXERCISE: A Planned Industrial Estate.

Materials: Topographic map: 92 G/2c
Aerial photo: B.C. 5042 54/55

Early in 1953 Grosvenor Estates, giant British landowning
and development organization, bought a drab, three-mile-long
sand bar in the Fraser River and announced plans to turn it into
a unique multi-million-dollar industrial project.

The "sand bar" was Annacis Island, a hitherto somewhat ne­
glected piece of real estate just below New Westminster which
had received its name 125 years earlier from a Hudson's Bay
Company fur trader.

Grosvenor proposed to turn the island - 1200 acres of what
appeared to be low-lying, poor quality farmland - into a plush
landscaped industrial estate complete with paved streets, under­
ground utility services and all the amenities of modern life.

This was to be Annacis Industrial Estate, a 30-year
planned industrial development project envisaging an expenditure
of $225 million to create a silk purse from the proverbial sow's
ear.

Prepare a transparent overlay of one-half of the stereogram.
Using the topographic map provided complete the following assign­
ment by locating the features on your overlay.

a) Fraser River          g) Annacis Channel
b) Poplar Island        h) the C.N. Railway
 c) Lulu Island          i) sawmill on Lulu Island
d) Annacis Island        j) subdivision of Elsona
e) Queensborough        k) subdivision of Annieville
f) the 50 foot contour  l) Planned Industrial Estates.
Questions:

1. The scale of the stereogram is 1" = 2640 feet. Convert this to a representative fractional scale.

2. Determine the areas in square miles of:
   a) the portion of Lulu Island shown on the stereogram.
   b) the planned industrial estates on Annacis Island.

3. What is the height of Poplar Island?

4. Determine the direction of the wind.

5. Why was the location of the Queensborough Bridge a good choice? Explain.

6. Why was the bridge built?

7. Are there any other places where a crossing of the Fraser River is presently being constructed? Illustrate your answer with a sketch map.

8. Draw a cross-section from the park north of Elsona to the park southeast of Annieville. Comment on the relief of this area as depicted on your cross-section. Use a vertical scale of 1" = 100'.

9. Draw on an overlay, the gross land use of the stereogram. Use the legend below for your analysis:

   Residential - R
   Commercial - C
   Industrial - N
   Transportation - T
   Open Land Improved - P
   Open Land Unimproved - V

10. Explain how the islands have developed.
LABORATORY EXERCISE: Use of Coordinate Points for location of urban features.

Materials: Stereogram #310

Diamond Head, Island of Oahu, Hawaii

A large part of Honolulu, Oahu, Hawaii is shown on the photograph.

This exercise is to familiarize students with the use of coordinate points and location of urban features.

Table A is a list of coordinate points on the stereogram. Identify the features in Table B, listing them opposite the points.

<table>
<thead>
<tr>
<th>TABLE A</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. B.2-3.10</td>
<td></td>
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<tr>
<td>2. B.6-2.3</td>
<td></td>
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<tr>
<td>3. A.1-3.10</td>
<td></td>
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<tr>
<td>4. A.8-1.20</td>
<td></td>
</tr>
<tr>
<td>5. D.0-290 to D.5-2.10</td>
<td></td>
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<tr>
<td>6. A.92-2.96</td>
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<td>7. A.9-2.40</td>
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<td>8. B.1-1.70</td>
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<td>9. B.7-2.80</td>
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<tr>
<td>10. A.1-3.10</td>
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<tr>
<td>11. A.3-1.30</td>
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<td>12. C.9-1.90</td>
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<tr>
<td>1</td>
<td>Golf course</td>
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<tr>
<td>2</td>
<td>A small cloud</td>
</tr>
<tr>
<td>3</td>
<td>St. Louis College</td>
</tr>
<tr>
<td>4</td>
<td>Waikiki Beach Hotels</td>
</tr>
<tr>
<td>5</td>
<td>Diamond Head volcanic cone (center)</td>
</tr>
<tr>
<td>6</td>
<td>A park</td>
</tr>
<tr>
<td>7</td>
<td>Swimming pool on Waikiki Beach</td>
</tr>
<tr>
<td>8</td>
<td>Tunnel providing access into the crater</td>
</tr>
<tr>
<td>9</td>
<td>Coral reefs</td>
</tr>
<tr>
<td>10</td>
<td>Cloud shadow</td>
</tr>
<tr>
<td>11</td>
<td>A race track</td>
</tr>
<tr>
<td>12</td>
<td>A very low cone (overgrown by the city).</td>
</tr>
</tbody>
</table>
LABORATORY EXERCISE: A Settlement on the Boundary of the Canadian Shield

Materials: Topographic map - The Pas, Manitoba
Aerial photograph - A 12939-413

Prepare a transparent overlay of the aerial photograph. Do not attempt to show each building on your overlay, rather show only those buildings which are commonly found on topographic maps. (e.g.) schools, post offices, etc. If possible use a color scheme to identify probable land use on the aerial photo, (e.g. residential, industrial, commercial). If not, explain the difficulties you would encounter in determining the land use patterns of The Pas. Do not attempt to include contour lines on your overlay. Your completed overlay should include the following:

a) a directional sign
b) a scale- 1" = 1350'
c) a legend
d) correct topographic map symbols
e) correct cartographic lettering
f) land use classified.

1. The Pas was originally a center of trapping and fur trading. Today, it is the most important transportation node in Northern Manitoba. Research evidence to support these statements.

2. Does the street pattern of this community reflect several distinct periods of growth? Illustrate your answer with a sketch.

3. Is there any evidence to suggest why the town of The Pas
should have been built on the southern rather than the
northern bank of the river?

4. In the lumber yard to the east of the town there are
large stacks of sawn lumber. Why are these stacks some-
times left outside for months? What other method of
doing the same thing is often used?

5. What possible future does The Pas have? Is there evidence
of new industries and/or subdivisions, etc.?
LABORATORY EXERCISE: Coastal Settlement in the Maritimes

Materials: Aerial photograph - A-14724-131

Topograph map - 21 A/8W- Lunenburg, Nova Scotia

Prepare a transparent overlay of the aerial photo.

1. Locate and identify the following features on your overlay, using correct cartographic techniques:
   a) surrounding bodies of water
   b) the major transportation patterns
   c) the built-up areas of the town
   d) school, golf-course, race track
   e) the 50, 100, and 150 foot contours.

2. Draw a cross-section of your aerial photo to show the nature of the relief. Describe it briefly. Label major physical features on it.

3. Give evidence from the photo to indicate what is the principal occupation of the populous.

4. Determine the area of Lunenburg harbour. Why was the town located on this harbour and not on Back Harbour?

5. Draw a rough sketch map to show the location of Lunenburg in relation to its regional setting.

6. Explain the map symbol along the coast between Mosher Head and Spindler Cove.

7. Lunenburg has two main sections, the Old Town and the New Town. Identify these two areas on your overlay. Explain the difference in the street patterns of these two areas.

8. How do the farms in the Lunenburg area differ from those in the Clyde or Altona air photographs?
9. The coastal area has been slightly submerged so the ocean waters have invaded the lower valleys giving rise to buoys or estuaries. This is called an irregular coastline. How does this part of the Nova Scotia coast compare with the British Columbia coast?

10. Is there any evidence of glaciation in the area?

11. The population of Lunenburg in 1866 was 3,091. Today it is 3,056. Why has Lunenburg never become a large port?
LABORATORY EXERCISE: Settlement Patterns of Coastal Newfoundland

Materials: Topographic sheet – Heart's Content IN/14E
Air photo – Broad Cove, Newfoundland

Prepare a transparent overlay of the aerial photograph.

1. As before, locate and identify the following on your overlay:
   
a) built-up area of the town
b) post office.
c) cemetery
d) Broad Cove Pond
e) transportation routes
f) the 50, 100, 150, 200, 250, 300, 350 and 400 foot contours
g) woodland areas
h) marsh or swamp areas.

2. Determine the scale of the aerial photo.

3. Draw a cross-section of your completed aerial photo to show the nature of the relief. Describe the relief in a sentence or two.

   Use the formula \[ \text{V.E.} = \frac{\text{Air Photo Scale}}{\text{Vertical graph scale}} \]
   to determine the vertical exaggeration of your cross-section. Use a vertical scale of 1" = 200 feet.


5. Why are the fields irregularly shaped?

6. What do you think came first – the road pattern or the settlements? Which factors seem to have been mostly operative in surveyors' designs of the road pattern?

7. Draw a rough sketch to show the location of Broad Cove
in relation to the rest of the island. What is the
characteristic form of the villages like Broad Cove?

8. Population pattern of Newfoundland is shown to be unique among island communities. Approximately 90% of the people live along the coast and the remaining 10% are largely concentrated in a very few places in the interior. (e.g. Grand Falls). Explain why this pattern has developed.
LABORATORY EXERCISE: Maritimes Port Settlement

Materials: Topographic map 11E/10E

Aerial photo A8462-88 - Pictou, Nova Scotia

1. As before, locate and identify the following on your overlay.
   a) dry dock
   b) built-up area of the town
   c) surrounding bodies of water
   d) race track
   e) orchards
   f) cemetery
   g) post office
   h) railroad
   i) two lane roads only
   j) the 50, 100, and 150 foot contours.

2. Determine the scale of the aerial photo.

3. Describe the relief surrounding the town of Pictou.

4. Give evidence from the photo to suggest the main occupation of the populous.

5. What type of orchard crop might be evident in the aerial photo?

6. Determine the area of Pictou Harbour. Why has the town developed in its present location.

7. Is the town growing in importance? Give evidence to support your answer.

8. Prepare an overlay of the coast as it would appear if the level of the sea rose 100 feet in relation to the land. Show probable sites of settlements along the new coastline and give preference numbers to each.
9. The origin of colonial settlements in the Maritimes were chiefly military and strategic in concept. Two settlement types evolved, oriented toward fishing or agriculture. Town planning on the whole was unimaginative, although site and situation were often most advantageously chosen. Compare Pictou and Lunenburg

(i) In each case which shows the greater proportion of (a) industry (b) commercial and public buildings (c) transport facilities?

(ii) What is the main contrast between these two areas?

(iii) Which area has the larger population?

(iv) Which area is easier to cross by car? Give reasons from the pictures in both cases.
LABORATORY EXERCISE: A Port Settlement in Northern Michigan

           Stereogram #308 Frankfort Light

1. Locate the following patterns on the map and stereogram on a transparent overlay:
   a) Identify the residential and recreational areas within the city.
   b) Outline the primary commercial areas within the city.
   c) Outline principal industrial areas.

2. How can one differentiate the residential and commercial areas of the town?

3. What is the width of the harbour entrance? Compare it to Vancouver.

4. Determine the stereogram coordinates of the North Breakwater lighthouse.

5. Why was it necessary to construct the two breakwaters (seawalls) around the harbour entrance?

6. Determine the height of a) the water tower, b) the hills opposite the town.

7. List two 'pieces of evidence' which show that this location is a 'break-of-cargo' point, that is, that goods are loaded from one type of transportation to another.

8. Draw a sketch map to show the location of Frankfort Light in relation to the rest of Michigan.
LABORATORY EXERCISE: Railway Settlement in the Prairies

Materials: Topographic map: Hanna, Alta. 72m/12W
Aerial photo: A 11188-8

Hanna is located in eastern Alberta about one hundred and thirty miles north of Calgary. It was once a wealthy wheat growing area but it was ruined by drought and only small areas are used for farming now. Most of the land is devoted to grazing and cattle. Hanna is a railway junction and heavy traffic flows through Hanna. The small areas of lakes in the north dry up in the summer.

1. Draw an annotated sketch map of the area shown in the photo using information from the topographic map as well as from the photo to show both the physical and cultural features.

2. Describe the relief of the area shown on the map. (Use both contour lines and bench marks.)

3. Identify the light colored long narrow strips north of the town shown on the air photo.

4. Attempt to describe the function of the buildings north of the town.

5. Make a list of all the features shown on:
   a) both the topo map and air photo
   b) the topo map only
   c) the air photo only.

6. Has any new expansion of the town taken place since the topo map was printed? If not, why not?
7. Attempt to determine the activity taking place immediately south of the race track and across the tracks.
LABORATORY EXERCISE: A Comparison of Settlement Patterns

Materials: Topographic maps: 62 H/10E, 31 H/15W
Aerial photos: A-18689-17 St. Anne, Manitoba
A-12809-123 St. David d'Yomaska

1. Compare and contrast in table form the two aerial photos with particular reference to the following:
   a) relief
   b) river development
   c) average farm size and shape
   d) crops
   e) road network
   f) forest cover
   g) settlement patterns
   h) activities other than agricultural.

2. Describe the plan of the village of St. Anne (A-18689-17). What kind of site is this? Why is there no village site evident on photo A-12809-123?

3. What are the functions of the rural village of St. Anne?

4. How many square miles does each aerial photo cover? Draw a simple square mile grid on tracing paper, using the map scale as a basis.
LABORATORY EXERCISE: Comparing Settlement Patterns with Communication Patterns

Materials: Topographic map: St. Joachim 21 M2/W
Aerial photo: A 17028-5

1. Determine the gradient of the highway from Beaupre to La Miche. Why was this route chosen rather than a coastal one?
2. Determine the depth in feet of the St. Anne-Du-Nord River valley. Is it a fast or slow flowing river?
3. Now study the land use. About what proportion is forested? From the photograph, would you say that the forest is dense or scrubby? Is there any evidence of commercial use of the timber? About how much of the land in the photograph seems to be cultivated?
4. Identify the crops grown in this area and account for their locations.
5. Is there any evidence of hydro-electric development or potential development in the area? Give examples.
6. Does the information on the map or photo suggest any reasons for the situation of St.-Joachim?
7. Locate a sluice on the map and photo. What is its function?
8. Identify the activity taking place north of Highway 15 between Beaupre and St.-Joachim. Give reasons for your decision.
9. Using a sheet of tracing paper make single topic maps to show:
   a) land above 500'
b) the drainage pattern (major streams)
c) principal transportation routes
d) settlement (show towns by solid shading and individual buildings by dots.)

10. Use the four single topic maps to answer the following questions:

a) Describe the settlement pattern between BEAUPRE and RIVIERE-des-ROCHES.

b) What conclusions could you come to about the density of population?

c) What effects does relief have on settlement pattern in this area?

d) What are the effects of relief on communications and transportation routes in the area?

Instructions: Now overlap one tracing sheet on the other.

e) Do you think that transportation and communication routes coincide with patterns of settlement?
LABORATORY EXERCISE:  Urban Area Analysis

Materials:  Stereograph #318 - Aurora North,
Topo Ref. Aurora North, III.

1. Are the following features located on the stereogram:
   Mercyville Sanitarium, Hurds Island?
2. Determine the height of Stolp Island and St. Michaels
   School.
3. State the map and stereo coordinates of Marmion Military
   Academy.
4. Have any new bridges been built across the river since
   the map was printed?  If a new bridge was to be built, where
   would the best location for it be?  Why?
5. Locate the following patterns from the map and stereogram
   on an overlay:  (use appropriate colors and symbols)
   (a) Plot the location of city schools shown on the
       stereogram.  How are they located in relation to
       the residential districts?
   (b) Mark the major land and water transportation lines
       passing through the city.
   (c) Outline the older and newer parts of the city.
   (d) Identify the principal industrial area.
   (e) Outline the central business district.
   (f) Mark the recreational areas.
   (g) Outline sections of the residential area by differing
       characteristics of the residences and lots.
   (h) Mark the principal administrative and governmental
       buildings.
AURORA II
Kane County, Illinois, USA
Date Unknown
RF = 1:24,200  H = 8,000 feet

Stereogram No. 318
Prepared by the
University of Illinois
Committee on Aerial Photography
LABORATORY EXERCISE: Suburban Settlement

Materials: B.C. 5205 211/212 Tunnel - Fraser Lowland

Topographic Map: 92G

Prepare a transparent overlay of one-half of the stereo-gram. Using the topographic provided complete the following assignment by locating the features on your overlay.

a) Deas Slough
b) Shopping center of Ladner
c) Ladner post office
d) Kirkland Island
e) Ladner Slough
f) Dikes on Deas Island
g) Reclaimed land of Ladner
h) Reclaimed land of Deas Island
i) B. C. Ferries Dock
j) A High School.

Questions:

1. Why was a tunnel built in preference to a bridge?
2. In what direction is the river flowing?
3. What industries are evident on the map and aerial photo?
4. What is the height of the Ladner shopping center?
5. What is the purpose of the square pond north of the town?
6. If you were not aware of the title of this stereogram, how would you support the statement that it is located in the Lower Mainland of British Columbia?
7. What induced man to settle in this region of the Lower Mainland?
8. Why did he choose this particular site of all those available?
9. What kind of settlement do you think developed on the original site of Ladner?
10. Does the street pattern of this community reflect several distinct periods of growth? Illustrate your answer with a sketch.

11. List the kinds of services that Ladner provides for the surrounding populace.
LABORATORY EXERCISE: A Commercial District in a Suburban Setting

Materials: Stereogram B.C. 5059: 224/225
Topographic Map: 92G6/b

The stereogram covers the First Narrows of Burrard Inlet and adjacent areas. Draw a generalized sketch and locate the following features on it. Be sure to include a directional arrow on your sketch.

a) Stanley Park  g) Woodland area
b) Capilano River  h) Commercial establishments
c) Railway bridge  buildings
d) River sand bars  i) Parking lots
e) Heliport  j) Railway yards
f) Residential area  k) A school.

1. Given the scale of the stereogram is 1" = 1000', determine the width (in miles) of the First Narrows.

2. Why was a heliport built in this area?

3. In the vicinity of Sentinel Hill, the roads and contours are closely aligned. Discuss the adaptation of roads to relief in the area.

4. Why has the woodland area remained relatively undeveloped?

5. Is the location of the rail line and rail yards a good one? Explain.

6. Is there any evidence to suggest that this area is at tidewater?

7. A large area of the commercial section of the stereogram is used for parking. What commercial activities take place in this area? Why have these commercial establishments located here?
Unlike a map on which only a selected amount of detail is represented, an aerial photograph is an actual picture of the landscape. Make a list of the features which appear on the stereogram, but which are not shown on the topographic map. Now make a list of the features which seem to be more clearly emphasized on the map than on the aerial photo.
LABORATORY EXERCISE: Urban encroachment in The Golden Horseshoe

Materials: A 12511-50 Topographic Map Hamilton West

The photograph A-17511-50 is of a suburban area, near Dundas, Ontario, along the brow of the Niagara Escarpment.

Draw a sketch of the air photograph indicating the following:

a) urban areas
b) rural areas (farmland)
c) the escarpment
d) the railway
e) the highway.

The photo was taken in 1951. Between 1951 and 1956, 2,000 acres of fruitland were lost to urban land uses. At the time of the photo much former farmland had been taken over for residential use. Taxation burdens on farmlands near cities were driving farms out of business.

Prepare an overlay of your sketch and using the topographic map information indicate areas which are presently urban. What percentage of the photograph is still rural farmland?

Analyze the factors which contributed to the urban encroachment shown in this area. In the Lower Fraser Valley today one of the most crucial decisions to be made is whether agriculture and urban development can live side by side.

Draw a rough sketch map of the Lower Fraser Valley and divide the region into urban, rural and areas of urban development.
LABORATORY EXERCISE: The Rural-Urban Fringe

Materials: Vineland, Ontario A4701-47 (1:18720)

Topographic Map: Beamsville, Ontario.

The aerial photograph shows a section of the Niagara Fruit Belt of Ontario. Unparalleled combinations of climate, fertility of soil, and nearness to markets make the Niagara area priceless as an agricultural area.

1. Study the map and the air photo area; find the elevation of the railway, the bench mark (BM), and the highest point in the area. Now draw a section from north to south following the road that crosses Highway No. 8 at the bench mark. Use a vertical scale of 1" = 800 feet. Indicate the escarpment face on your section.

2. Is the land more level above (south of) the escarpment or below (north of) it?

3. Comment on the distribution of woodland and suggest reasons why these areas have not been cleared.

4. Note carefully the distribution of orchards. In which section (above or below the Escarpment) are most of the orchards located?

5. Note the location of the railway and the main roads. Why do they run from east to west? Suggest reasons why they are found north of the Escarpment. Why was the Queen Elizabeth Way probably easy to build?

6. Now study the settlement. Would you call the rural settlement dense or sparse? Which part is more densely settled,
that north or south of the Escarpment? What is most noticeable about the distribution of the houses and farms? Note the many facilities, for a rural area, available in the district covered by the photograph.

7. How wide is the plain between Lake Ontario and the Escarpment? Does it rise gently or steeply from the lake? Note that Highway No. 8 closely follows the 350-foot contour line. Between Vineland and Jordan there is at this level a small, but quite distinct bluff. This represents the old south shoreline of Lake Iroquois. Where is the north shoreline? The land between the shoreline and the Escarpment is known locally as "The Bench". It is a somewhat rolling, elevated terrace of clays, sands, and gravels.

8. Locate the three main villages of the plain. What common factor do you notice in their location? Which village is the largest and most important? What facilities suggest that it is the most important?

9. Trace the course of the Escarpment across the map. Why are the chief north-south roads that cross it found near the eastern and western edges of the map? What evidence is there that the area above the Escarpment is less prosperous and developed than that below it?

10. In such an intensively used area, does any land in the photograph appear to be wasted?

11. Draw a sketch map of the part of the topographic mak represented by the photograph.
LABORATORY EXERCISE:  Field Study:  Compass Traverse

The system is similar to dead reckoning navigation where distances and directions are measured. In performing a traverse, the surveyor starts at a known position with a known azimuth (direction) to another point and measures angles and distances between a series of survey points. With the angular measurements, the direction of each line of the traverse can be computed; and with the measurements of the length of the lines, the position of each control point computed. When the traverse returns to the starting point or another point of known position, it is a closed traverse, otherwise the traverse is said to be open.

Object:  To produce a simple sketch map of a traverse utilizing compass bearings and distance measurements.

Materials:  - sight compass
            - predetermined pace
            - station markers
            - table showing Station, Bearing and Distance.

Procedure:

The use of compass and pace will be demonstrated before the field study is started.

Students are to proceed to the area designated as Station A or 1 and begin the first section of the traverse. In your group of three, two people should be responsible for the compass bearings and the third the distance measurement. This procedure should be alternated at each station. Be sure to check the accuracy of your bearings at each station. Each group must hand in a completed sketch map of the traverse.
<table>
<thead>
<tr>
<th>STATION</th>
<th>BEARING</th>
<th>DISTANCE (FT.)</th>
<th>TRAVERSE</th>
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</thead>
<tbody>
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</table>
LABORATORY FIELD STUDY: Queen Elizabeth Park: Compass Bearings:

Object: To determine the compass bearings of several buildings and topographical features from given points in Queen Elizabeth Park.

Materials: Compass

Procedure:

Point A. From the small bridge above arboretum take compass bearings of the following buildings:

1) B. C. Hydro Building
2) City Hall
3) Marine Building
4) Smoke Stack of the General Hospital
5) Vancouver Hotel

Quarry Garden

Along the stone wall there are brass directional arrows pointing to Mt. Baker, Golden Ears, Mt. Seymour, Grouse Mountain, the Lions, and Hollyburn Ridge. Determine the compass bearings for each of these points.

Point B. Moving to the school ground (somewhere near the soccer field) take bearings of the following:

1) B. C. Hydro Building
2) City Hall
3) Marine Building
4) Smoke Stack of General Hospital
5) Vancouver Hotel
6) Mt. Seymour
7) Grouse Mountain
8) The Lions.
LABORATORY FIELD STUDY: Queen Elizabeth Park

Object: To make an association between sketch maps and the actual landscape using bearings and the plotting of district topographic features.

Materials: Compass

Sketch Map: Queen Elizabeth Park

Procedure:

1. Locate the highest point of land on your map using the symbol.
2. Label the surrounding roads on your map.
3. Sketch in the arboretum and the tennis courts.
4. Locate the Golf Course, by writing 'Golf Course' in the appropriate place on your map.
5. Locate, using the symbol ( ) all buildings in Queen Elizabeth Park.
6. Locate by taking bearings: the Curling Rink and Baseball Stadium.
7. Draw in the 360' and 380' Contour Lines (Colored Pencil).
8. Draw cross-sections from points X to Y and from A to B.
9. Indicate (by line and bearing) the approximate direction of City Hall, and B. C. Hydro Building.

Note: You will need two copies of the map. One for your field work and one for the final copy to be handed in. Be sure to use a legend on your final map. Colors are essential to make your map understandable.

10. Indicate on a sketch map the roads that have been added and those which have been removed.
11. On your map locate 2 large lakes.
Making a Sketch Map of a Traverse

1. Determine your pace.
   A. Mark off a 100' stretch of ground.
   B. Starting each time with toe on line, pace it ten times. Count steps each time, (e.g.) 48 steps, 50 steps, 51 steps, etc.
   C. Find the average number of steps:
      \[
      \frac{502}{10 \text{ times}} = 50 \text{ steps average.}
      \]
   D. Divide 100' by average of steps. This is the length of your pace. \[
   \frac{100'}{50 \text{ steps}} = 2' \text{ pace.}
   \]

2. Proceed to area for mapping. Note degree bearing for direction you walk. Count steps to each landmark and note both. Total steps for each degree bearing.

<table>
<thead>
<tr>
<th>Degree Bearing</th>
<th>Field Notes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>120° starting from wagon road 100 paces 50 paces (200')</td>
<td>stone wall to left</td>
<td></td>
</tr>
</tbody>
</table>

A. Convert steps into footage; 2' (pace) x 100 paces = 200'.
B. Select a map scale. Scale 1" = 200'.
C. Convert footage into map inches

\[
\frac{200'}{200'} = 1 \text{ inch}
\]

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D. D. How to note declination
90° at point B
120° Declination

78 corrected reading for point B.
Select a large sheet of paper for a map. Top side of the paper should point north. Draw vertical lines to serve as meridian lines.

1. Turn the compass housing until your first degree reading (on field notes) is in line with the direction-of-travel arrow on your compass.
2. Place compass on map with orienting arrow parallel to meridian lines.
3. Turn map around slowly until magnetic needle point to N in line with orienting arrow (on compass).
4. Make dot for starting point and draw line along side of compass base. This line is pointing in the direction of
LABORATORY EXERCISE: Plane-table Mapping

Plane-table mapping as the name implies is a method of mapping which uses a flat drawing board mounted on a tripod upon which details of the area to be mapped are sighted and recorded to make a fairly accurate sketch map.

Equipment consists of:

a) a drawing board
b) a tripod
c) a compass
d) an alidade (sight rule)
e) drawing materials (paper, pencil, etc.)

Methods if Surveying With the Plane-table

There are four methods if plane-table mapping:

a) radiation
b) intersection
c) traversing
d) resection.
The Plane-Table Method

1. Orient the table over the station.
2. Set the board to a compass direction, trace compass outline and indicate magnetic north on your sheet.
3. Orient table at each station.
4. Sight with both eyes open.

*Keep the map uncluttered by not drawing the rays full length.

*Level table, If a round pencil doesn't roll off the board it is level enough.

*Tilt the pencil outward away from the rule so that the point is smack against the rule.

*Keep the pencil vertical when drawing lines.

*Don't put pencil holes in the paper.

Intersection - Flag pole

Orient table at A
Sight onto B
Draw line AB-indefinite length
Sight on C
Move table to b counting strides on the way
Mark b according to the map's scale
Orient table at B
Back sight on A.
Set up plane-table in center of field.
Guess its position and place the ruling edge of the alidade on the line joining this estimated position and the most distant of the points.
Orient the table on this most distant point.
Draw in the rays back to your position, a triangle will of error result. This triangle can be reduced in size by re-orientating the table either by turning it clockwise or anti-clockwise.

Orient table and aim shots at the various points around you. After sighting upon them measure their distances and scale these off on the rays.
Closed Traverse with a Plan-table

Orient table at A
Sight on D and B
Count strides to B
Orient table at B
Back Sight on A
Sight on D and C
Stride to C
Orient table at C
Check sight on A, B, and D.
Orient the table at A
Sight on all visible objects
Stride to B
Sight at B to other points for intersection.