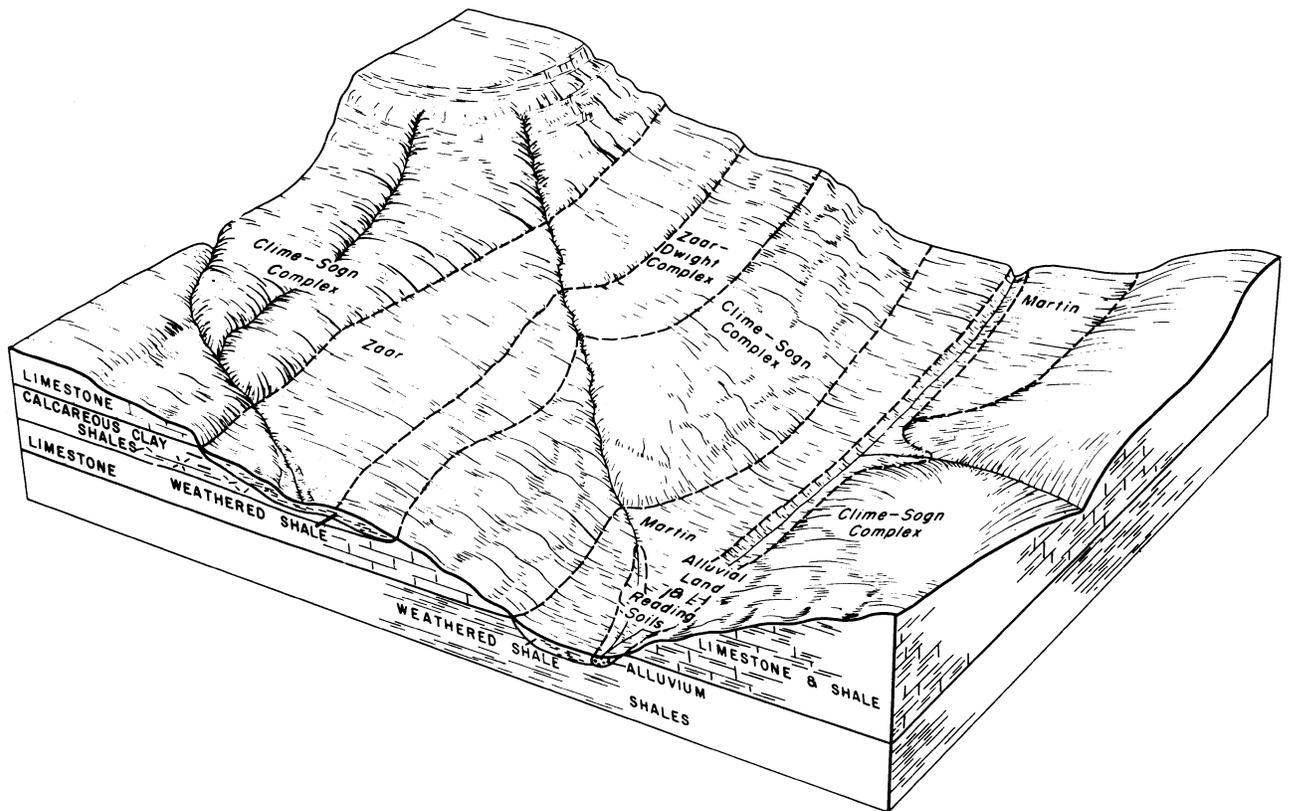


BLOCK DIAGRAMS FOR SOIL SURVEY INTERPRETATIONS



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Block diagrams in soil survey reports can serve a number of purposes. You can make a block diagram with a pencil, a piece of paper, and knowledge of a survey area. In a good diagram you can show the surface features of the landscape and their relation to the underground structure. A block diagram gives us a 3-D look at the landscape. In addition, the surface view and the underlying structural view are placed properly with regards to each other. The reader of your report can see how, in many cases, the topography and soils are determined by the geology of the area.

The best block diagrams are simple. They do not attempt to show all the details of a map. You use only those elements to which you wish to draw attention and that are necessary to get your points across. In this, they are inaccurate since they do not tell the story. They are just as accurate as generalized statements about yield, water supply, or, in some cases, depth, texture, and permeability.

Each major soil area occurring in a county lends itself to a block diagram. Major soil areas are sometimes called soil association areas. I have found that the description of these major soil areas can be condensed by as much as one half by the use of block diagrams.

What is a block diagram? A block diagram is a drawing of an imaginary block cut from a selected part of the landscape. The top of the block shows what a camera would see on the landscape but cutting out unnecessary details. The sides of the block give a view to the underlying structure insofar as you wish to go into details. Block diagrams are helpful only insofar as they tell your readers in picture the things that you either have difficulty in expressing in words or the things that it takes so many words to describe that the reader will not understand what you want to get across. They are another means of communication.

All block diagrams should be drawn with lines. Shading and colors add too much to the cost of reproduction. A good block diagram is shown on page 418 of the Soil Survey Manual. To start with, draw your complete block in pencil, then ink it with india ink so that it can be reproduced. Keep an eraser handy, because you probably won't like the first lines you put in.

The diagram should be drawn to approximately four times the size you wish in the printed soil survey report. Imperfections become less conspicuous when the diagrams are reduced for publication.

A good legend should be attached to the diagram or printed on it. Be concise and don't try to tell all about the soil area in your legend. Try to lead the reader to your written material if he wants more details.

Don't expect your first attempt to be a masterpiece. After you have studied this booklet, you should be able to draw an acceptable diagram that can be used in your soil survey report. If you are not satisfied with your drawings, the skilled artists of the Cartographic Division can make many improvements on a rough sketch. But you must have the proper location and sequence of the things you want shown. Remember you know more about your survey area than anyone else, and any method you use to communicate this knowledge to others will make your soil survey report more useful.

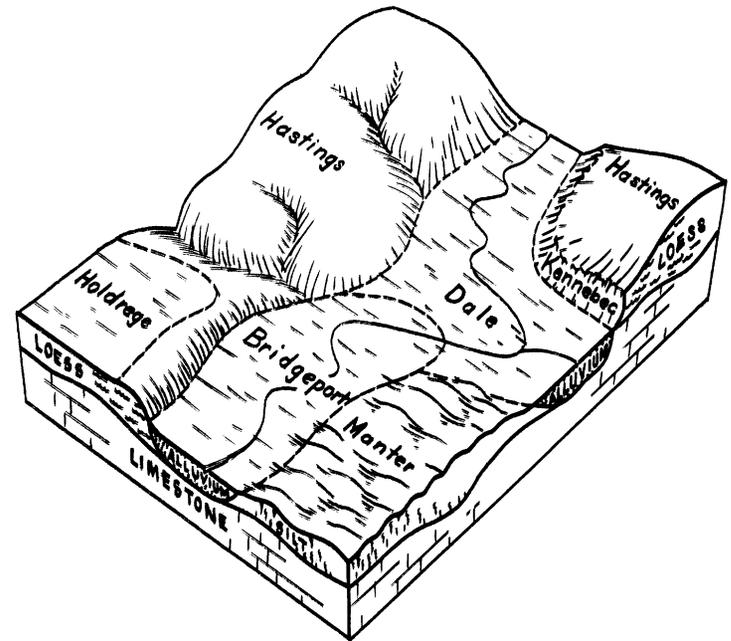
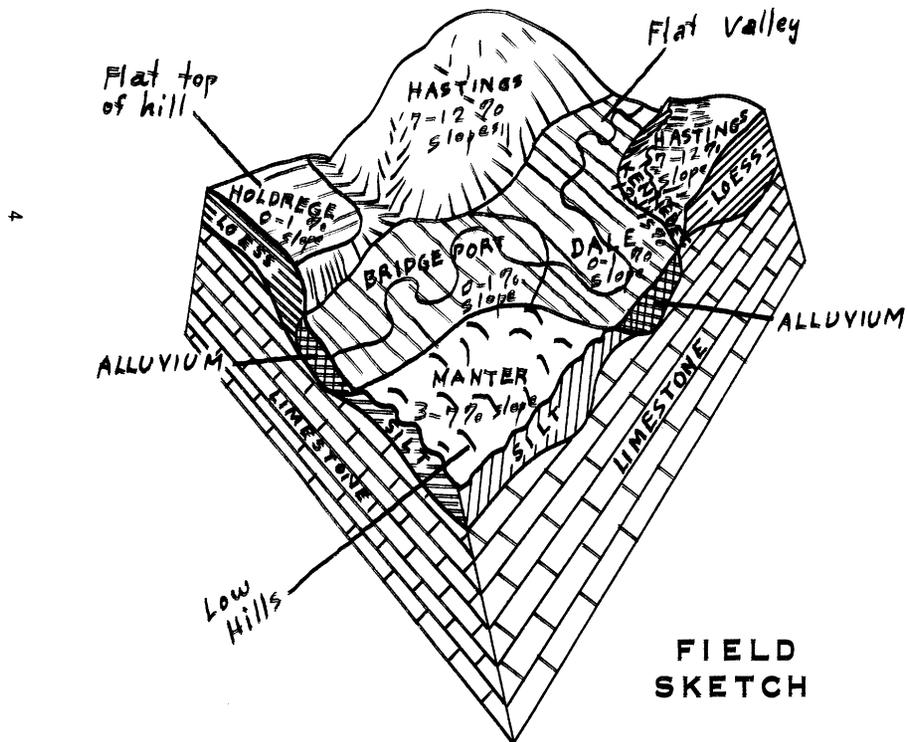
I am deeply appreciative of the courtesy of John Wiley and Sons, Inc., New York, New York, allowing the reproduction of the selected pages from their book, Block Diagrams and Other Graphic Methods Used in Geology and Geography, by Armin K. Lobeck.

PARENT MATERIAL SYMBOLS FOR BLOCK DIAGRAMS

SAND		SHALE	
ALLUVIUM		GLACIAL TILL	
GRAVEL		PLEISTOCENE (Pliocene-Ogallala)	
COLLUVIUM		LIMESTONE	
SILT		SANDSTONE	
LOAM		LACUSTRINE	
LOESS (Peorian)		CLAY	
LOESS (Loveland)		PEAT	

WRONG

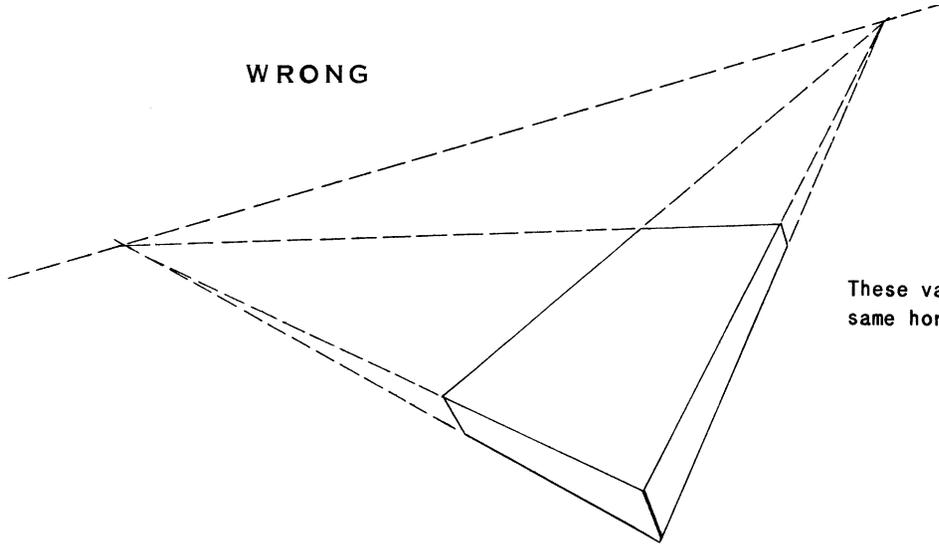
RIGHT



FIELD SKETCH

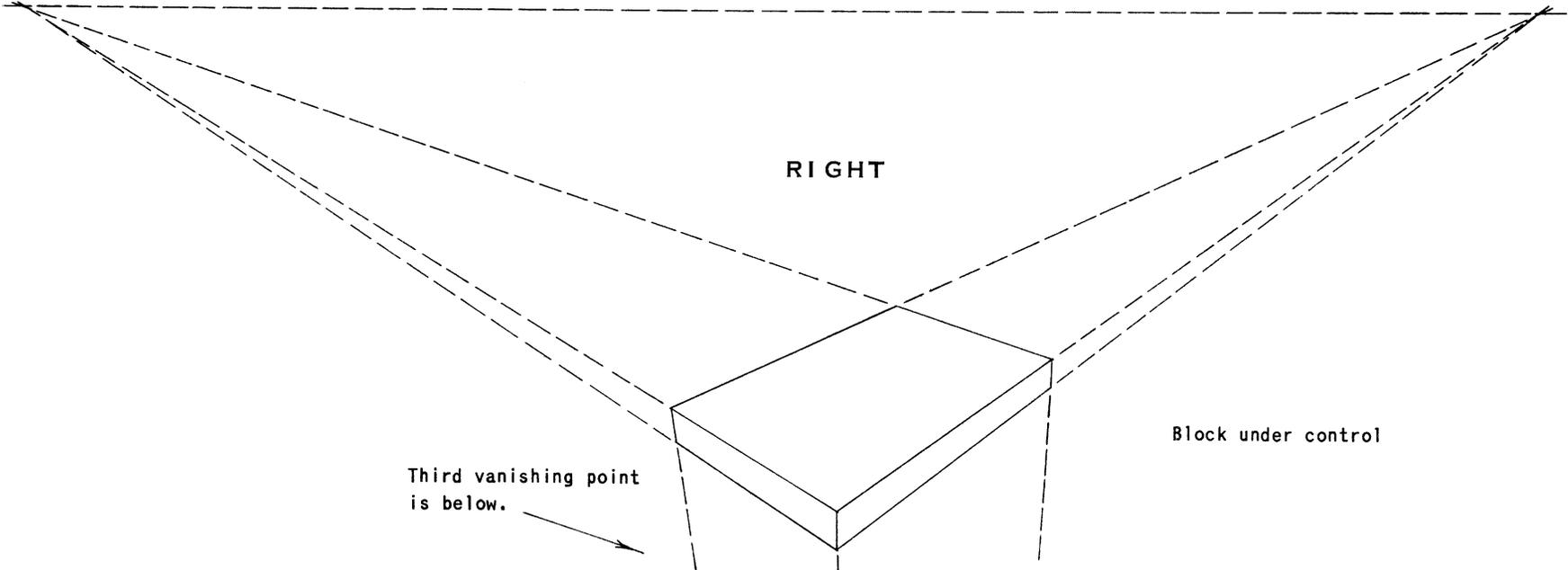
CORRECTED & SIMPLIFIED

WRONG



These vanishing points not on the same horizon. Block is twisted.

RIGHT

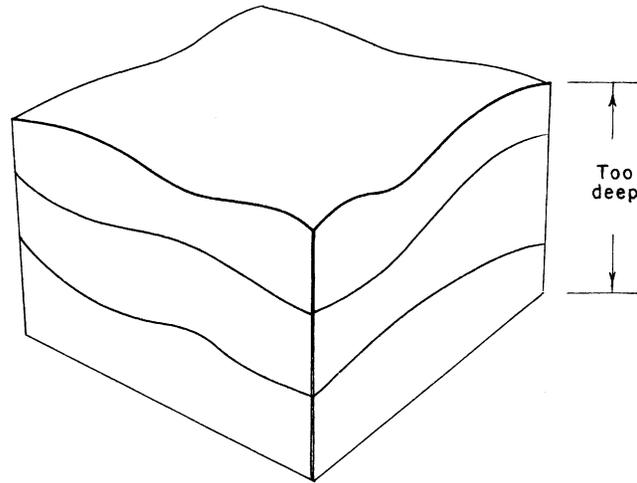


Block under control

Third vanishing point is below.

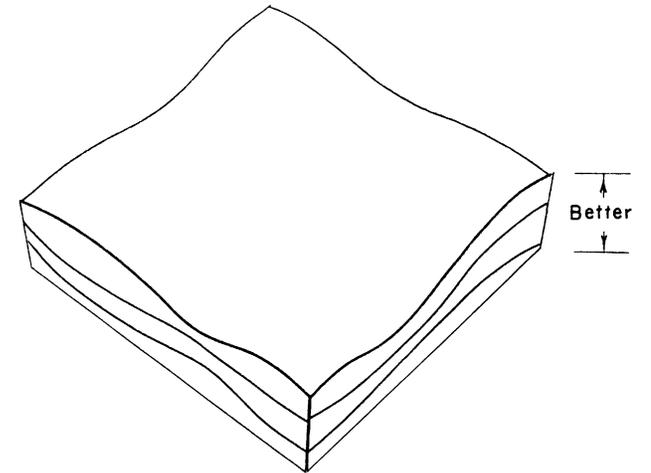


WRONG



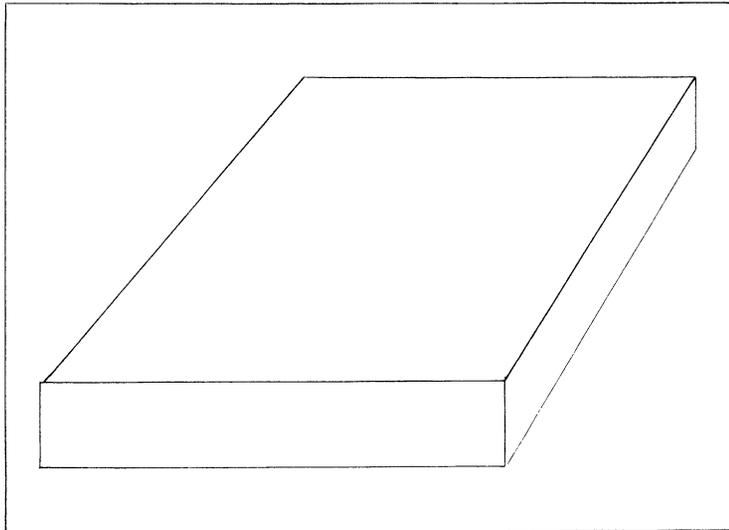
Too much parent material belittles topsoils.

RIGHT

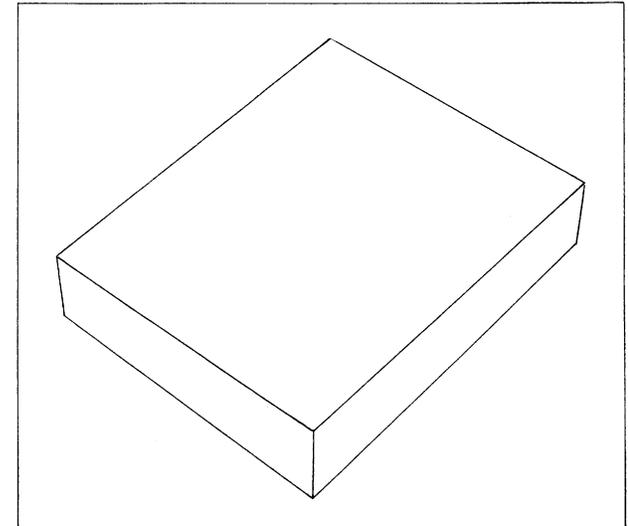


Show more of topsoils and less thickness of parent material.

9

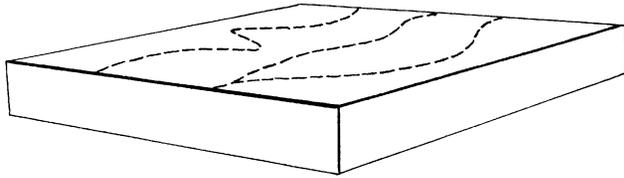


Lines blend in with page and confuse the eye.
Also block is distorted perspective.



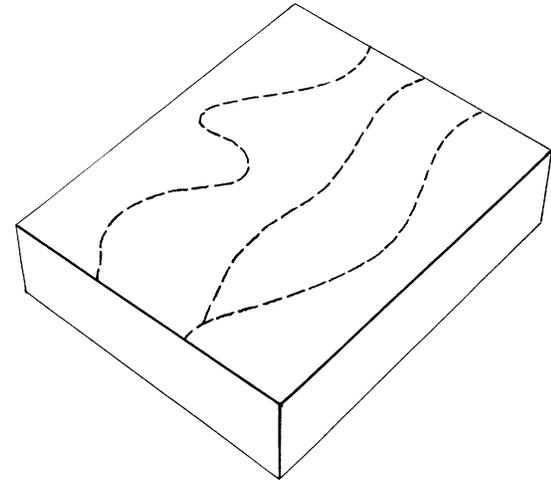
No lines parallel to any sheet edge.
Diagram stands out from page.

WRONG



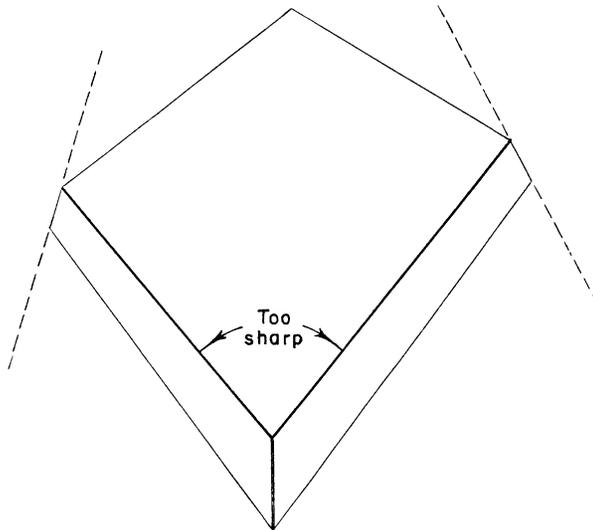
Horizon too low. Can't see top soils clearly.

RIGHT

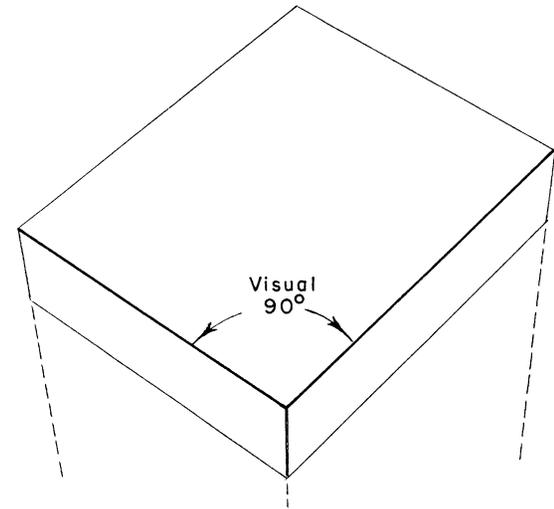


Show high view to see more of topsoils.

7

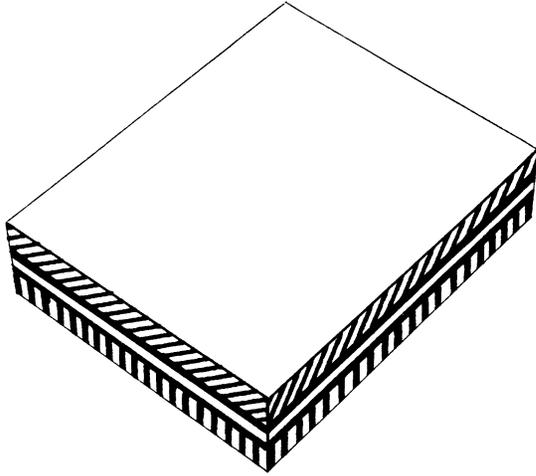


Perspective points too close together give bad angles to block. Vertical lines don't vanish to lower vanishing point.



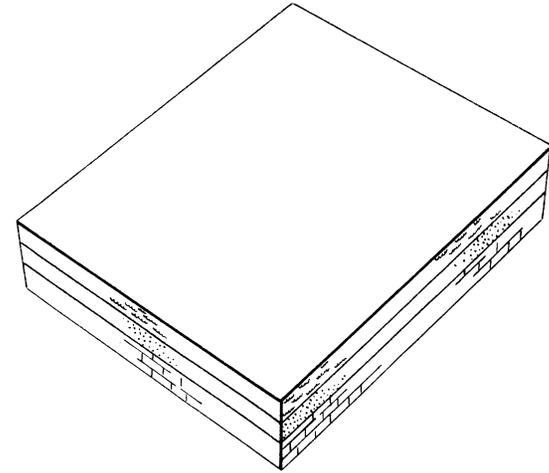
Visual right angles to block corners. Third vanishing point is below.

WRONG



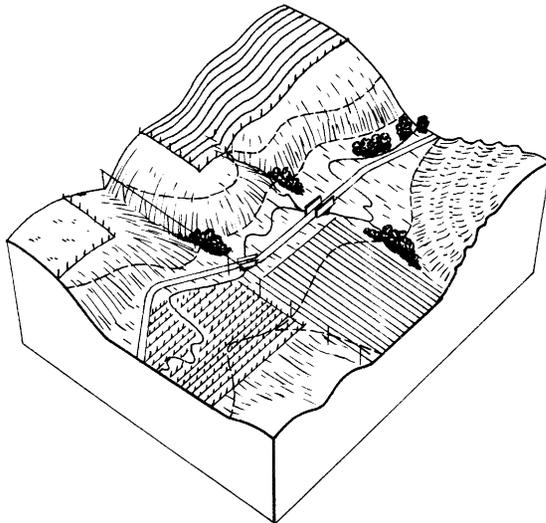
Too intensive pattern of parent material steals attention from topsoils.

RIGHT

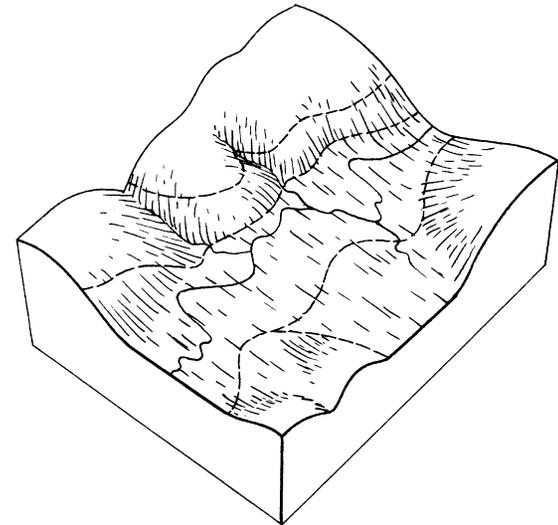


Need only symbolic hint of parent texture. Blank spots are reflected light.

8

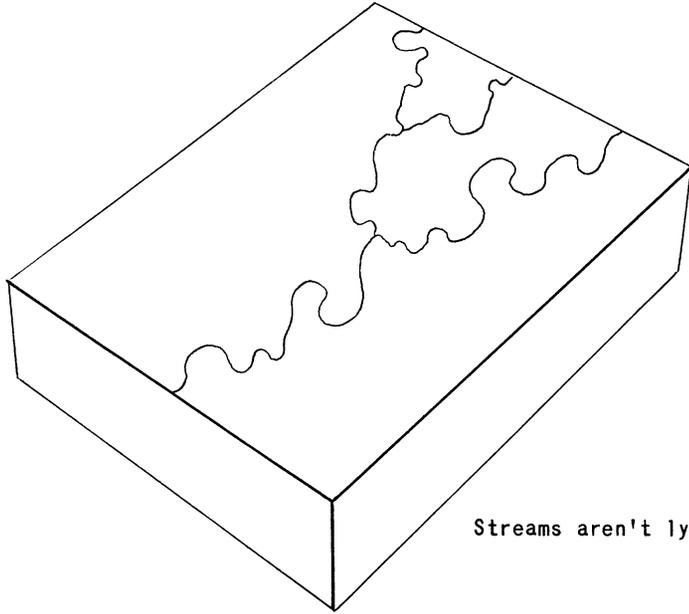


Too much detail and unneeded sketching. Should not be artistic landscape, but a diagram.



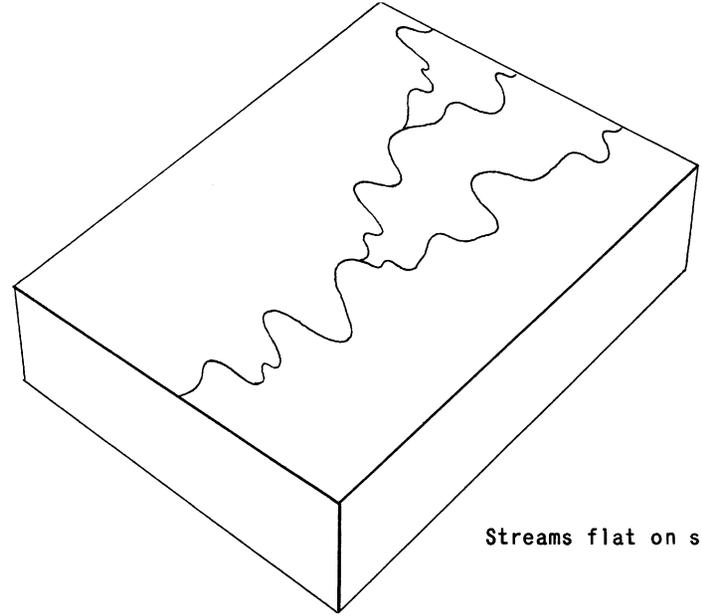
Need only a few simple well-chosen lines.

WRONG



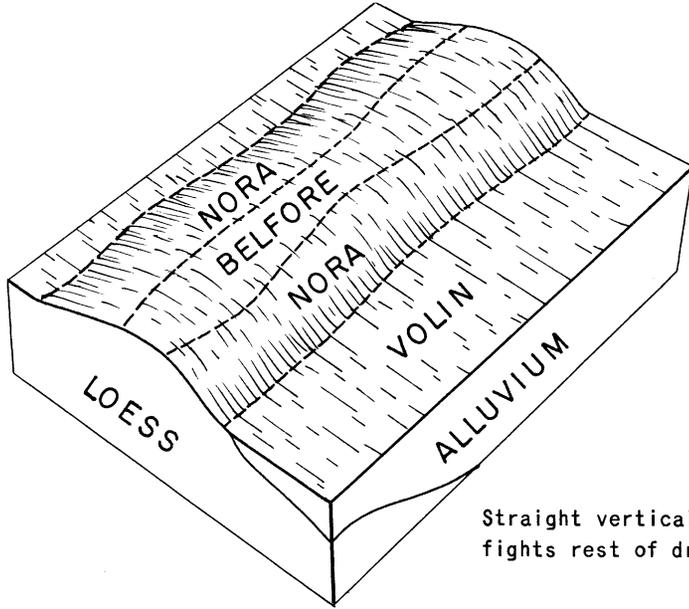
Streams aren't lying down

RIGHT

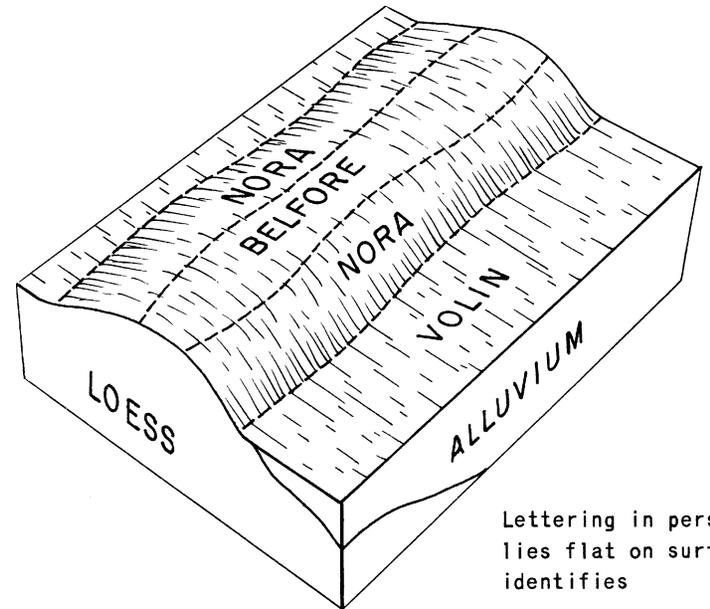


Streams flat on surface

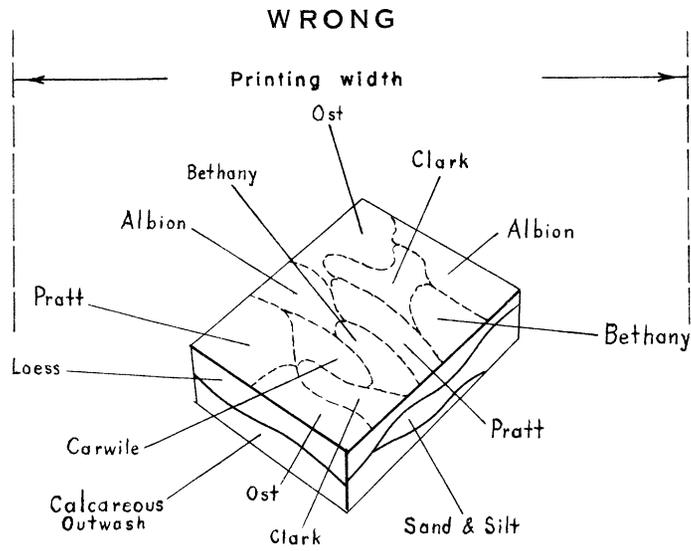
6



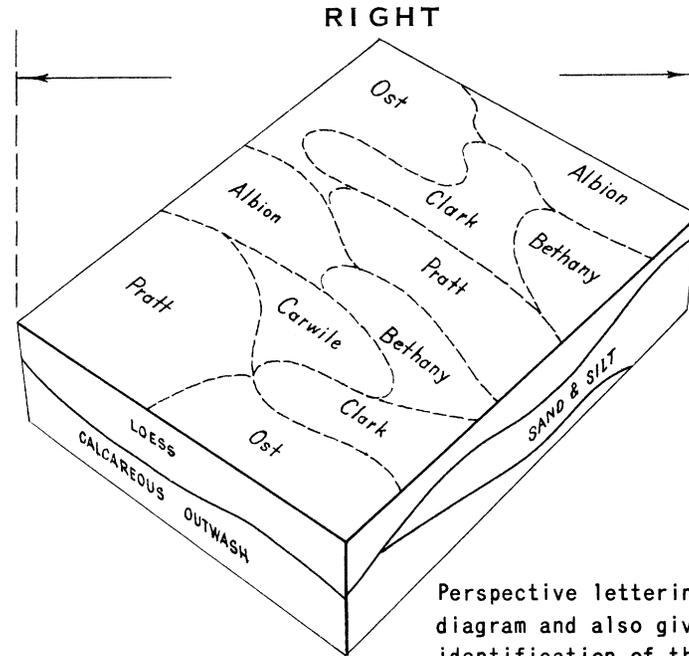
Straight vertical lettering fights rest of drawing



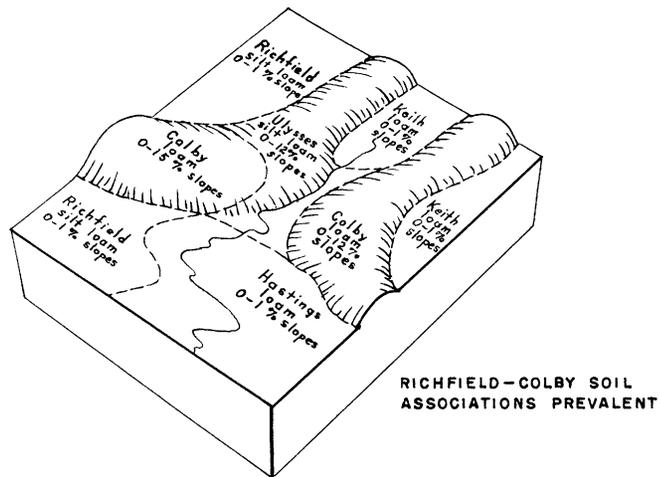
Lettering in perspective lies flat on surface it identifies



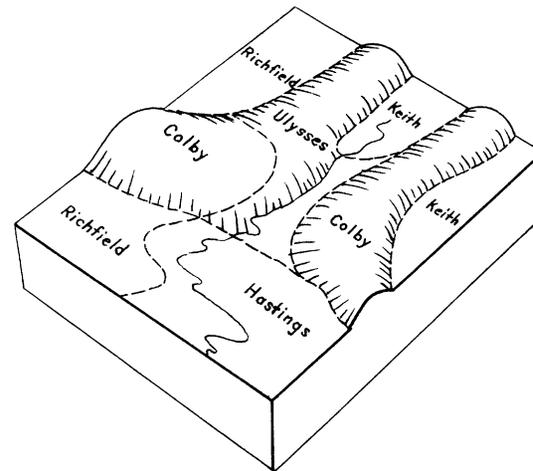
Eyes do much traveling to follow leader lines.
Diagram takes extra space to include lettering.



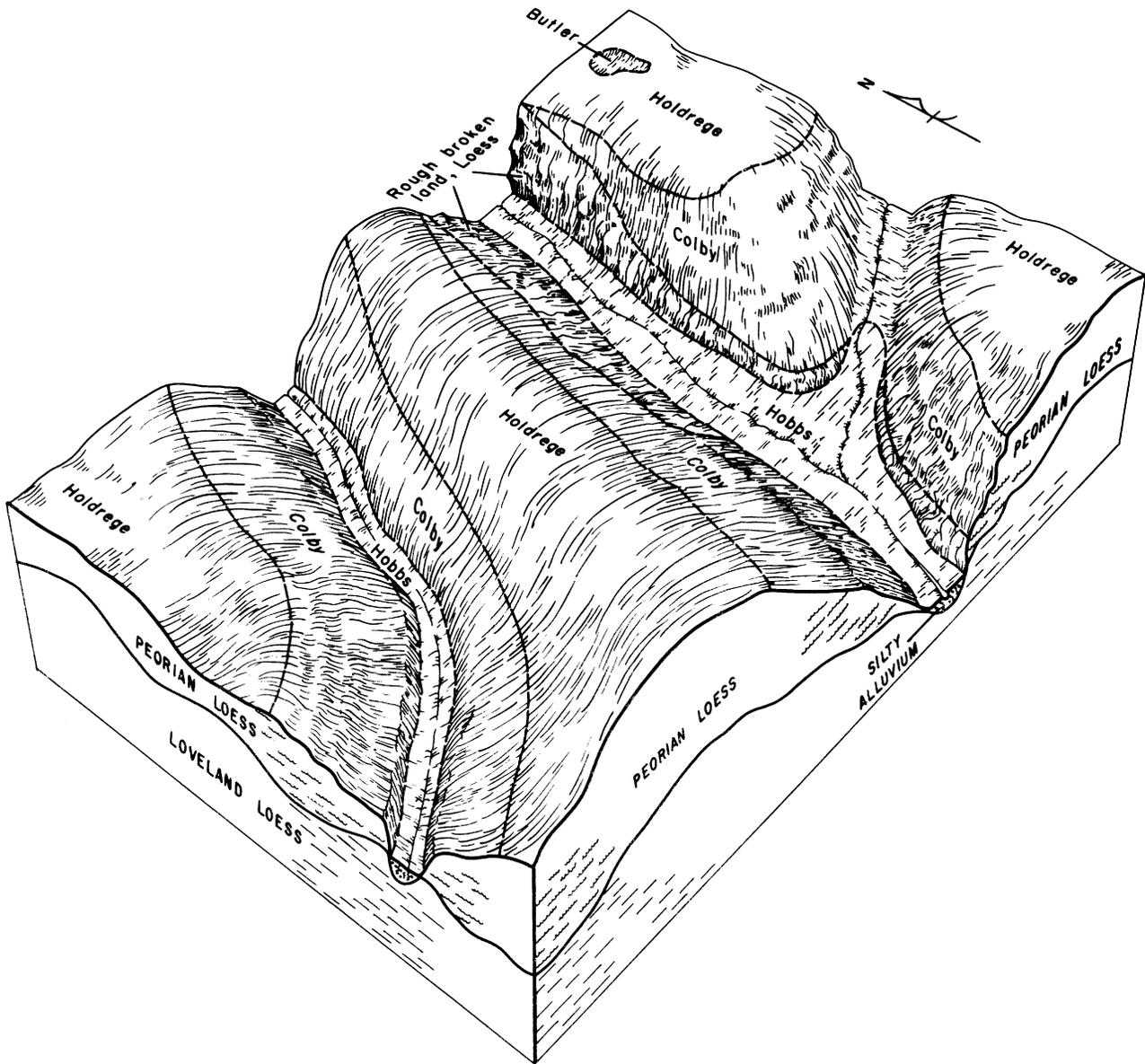
Perspective lettering helps the
diagram and also gives instant
identification of the area.

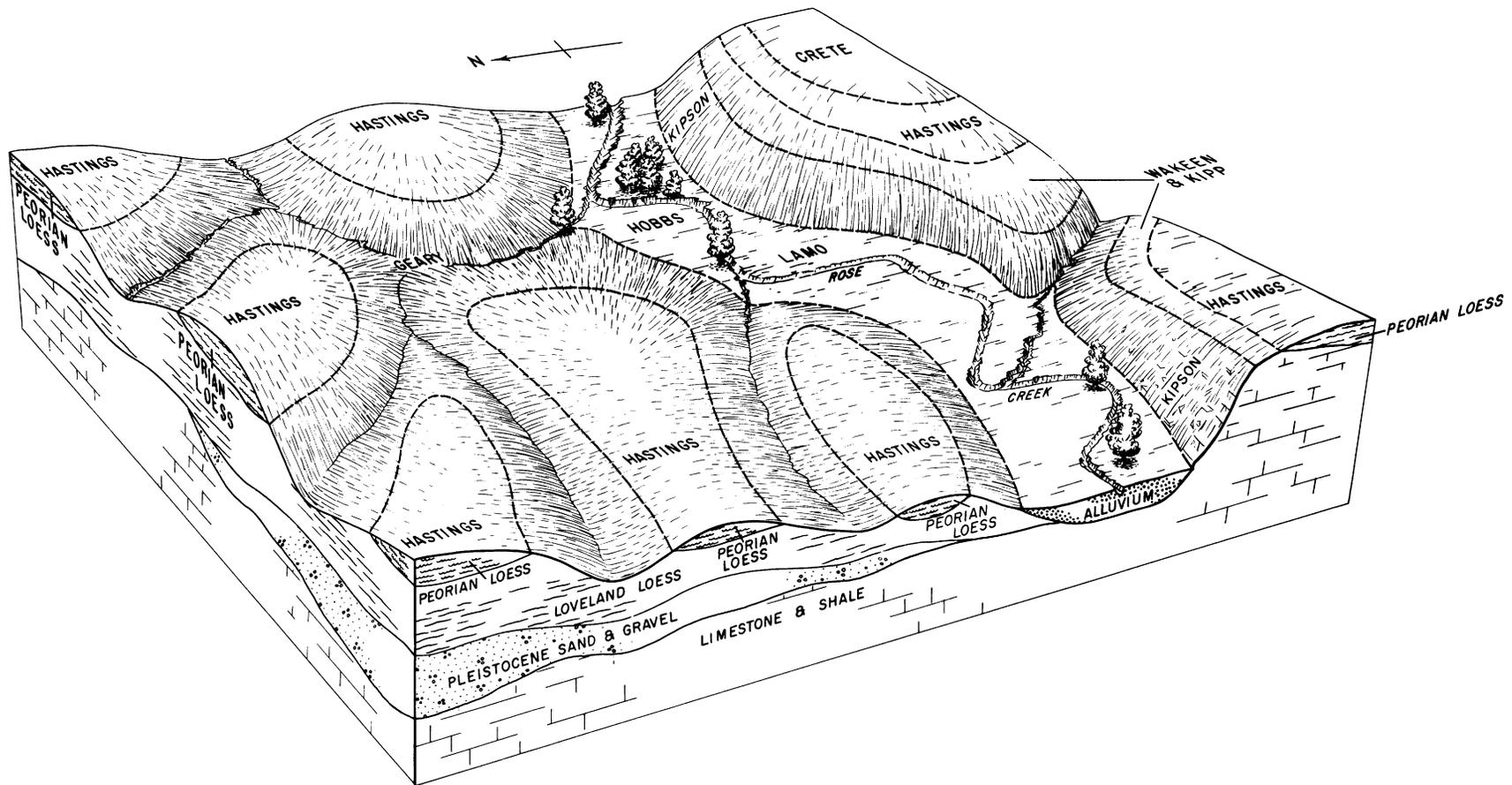


Too much lettering, soil description, slope
percentages, etc. Titles will be type-set
by publisher.



Show only general soil series names.





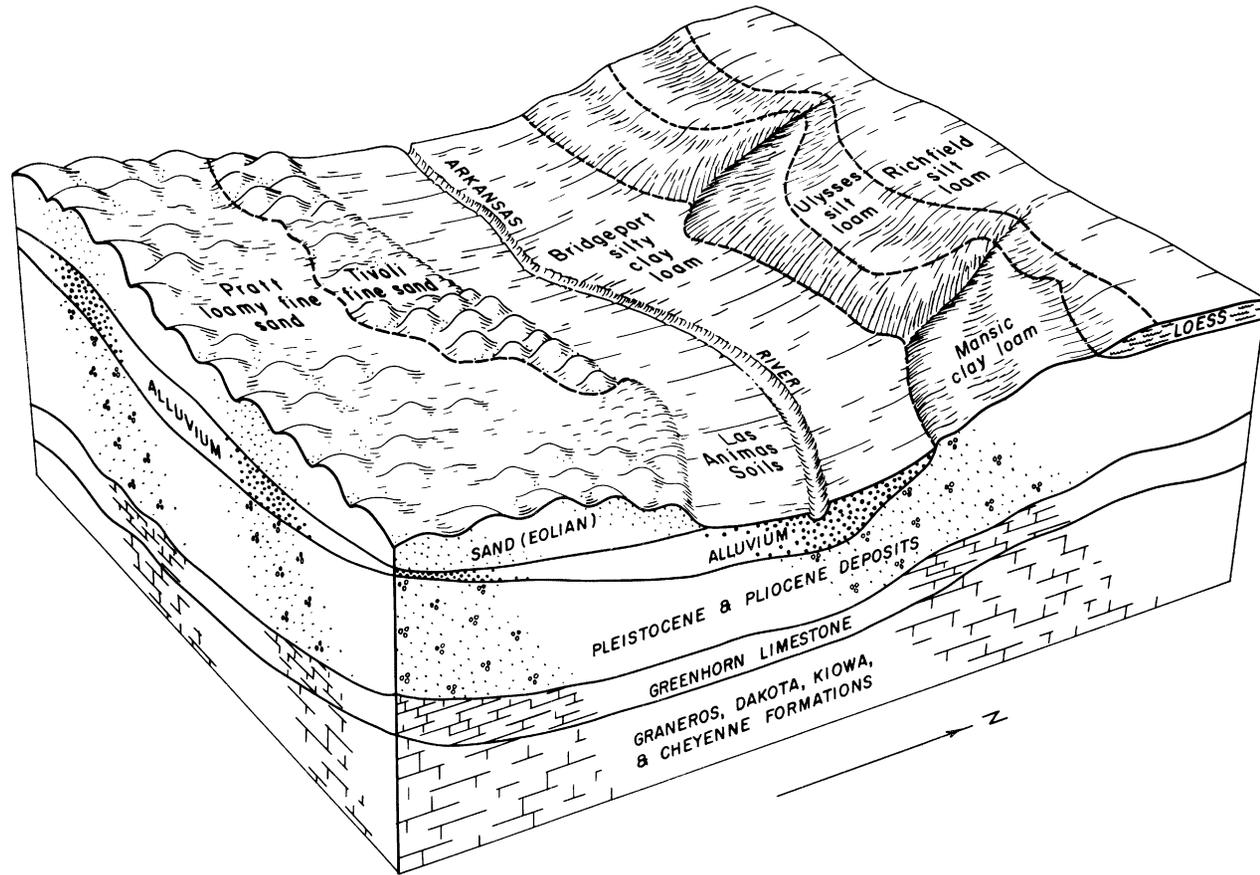
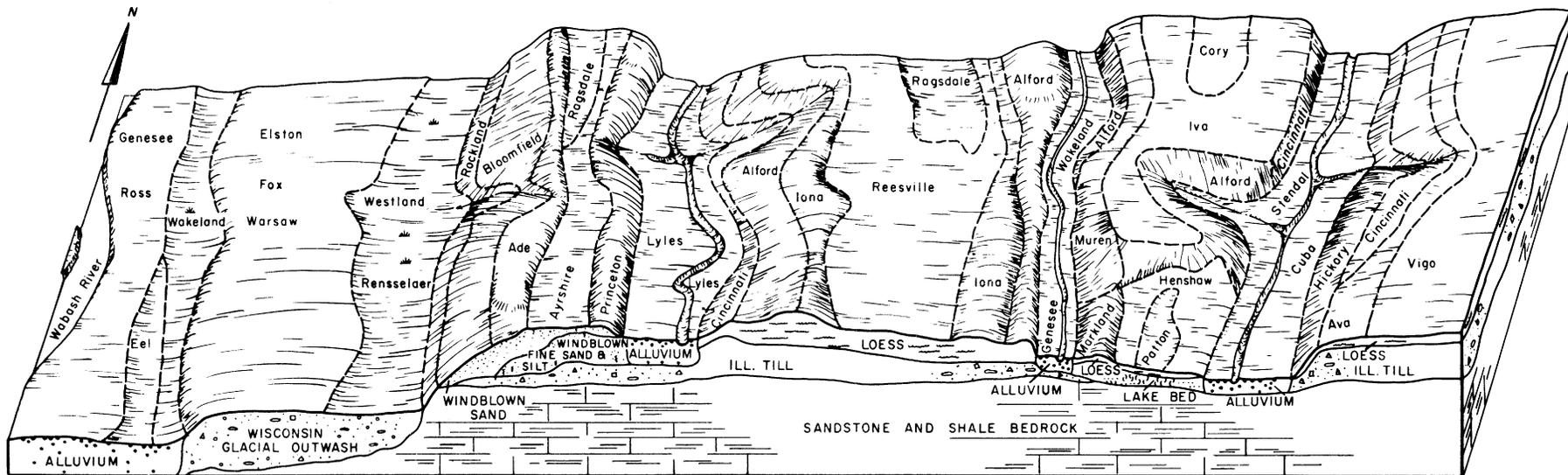
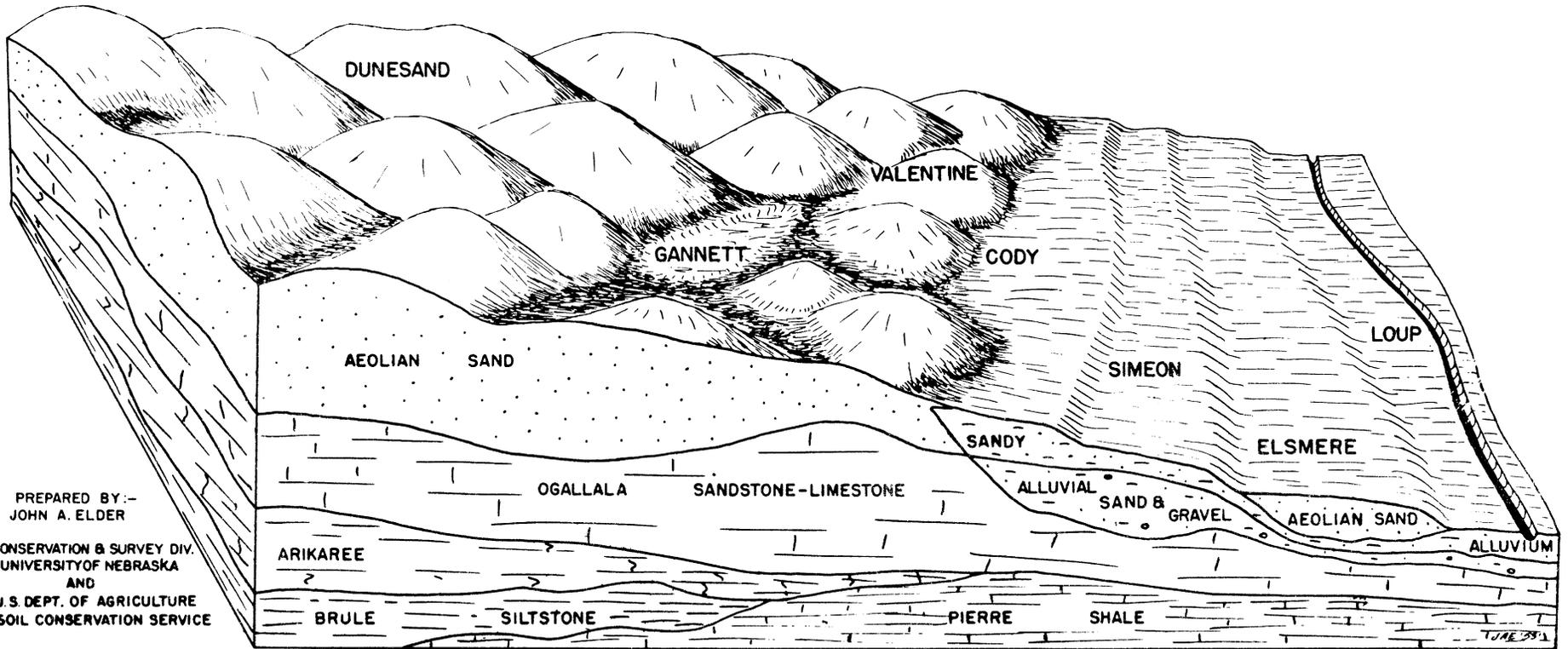
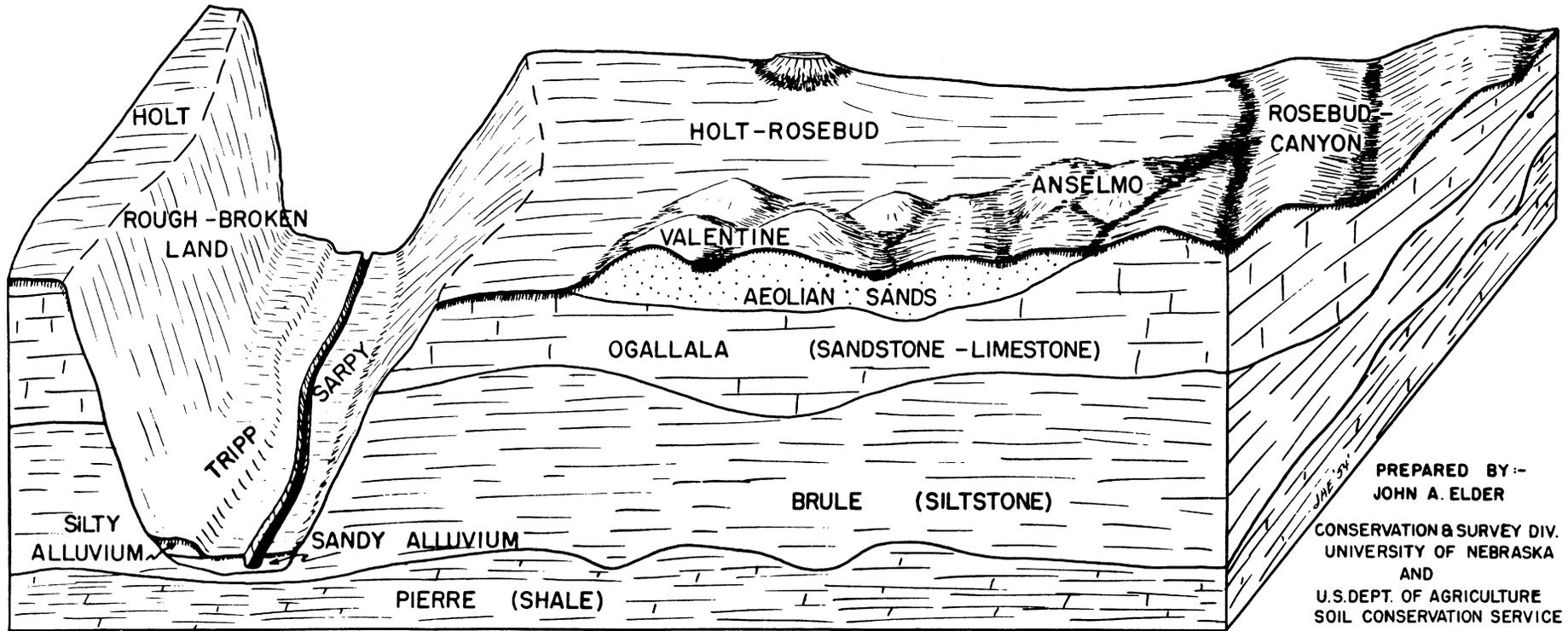


DIAGRAM OF THE PRATT-TIVOLI SOIL ASSOCIATION AND CROSS SECTION OF PART OF THE VALLEY OF ARKANSAS RIVER





PREPARED BY:-
 JOHN A. ELDER
 CONSERVATION & SURVEY DIV.
 UNIVERSITY OF NEBRASKA
 AND
 U.S. DEPT. OF AGRICULTURE
 SOIL CONSERVATION SERVICE



PREPARED BY:-
 JOHN A. ELDER
 CONSERVATION & SURVEY DIV.
 UNIVERSITY OF NEBRASKA
 AND
 U.S. DEPT. OF AGRICULTURE
 SOIL CONSERVATION SERVICE

ONE-POINT PERSPECTIVE

6. A simple rule.—For many purposes, a very satisfactory block may be drawn simply by making the back of the block narrower than the front. It is obvious that if the sides of the block are drawn parallel with each other the perspective effect is not produced and the result is unnatural in appearance (Fig. 6, block *A*). The block

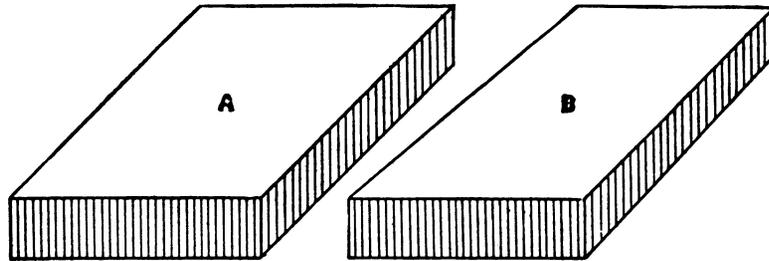


FIG. 6.—Two blocks. Block *A* is incorrectly drawn; block *B* is correctly drawn. In block *A* the lines of each set are drawn parallel to each other. In block *B* the lines at the sides converge in going away from the observer. This illustration is to show that for simple drawings hardly any knowledge of perspective is necessary. Only draw the back of the block narrower than the front.

seems to be spreading out in the distance. By allowing the side lines to converge gradually in going away from the observer, a better effect is secured (Fig. 6, block *B*).

7. A precaution.—It is well to note, however, that the drawing of the back line of the block shorter than the front

line is a rule to be universally followed only if the front of the block faces the observer squarely. It frequently happens that, in the case of a block which has the corner pointing toward the observer, the line farther away is longer than the corresponding line near the front of the drawing, though both represent lines of the same length in the object itself. Thus, in Fig. 7, the line *AB* in each block is longer than the line *CD* in the same block, whereas in each case *AB* equals *CD* in the object. Blocks placed in this position, not facing directly toward the observer, should therefore be drawn with close regard for the principles of perspective, because it is otherwise difficult to draw the various lines to their correct relative lengths. The drawing of blocks in this position is explained under Section 22.

8. Some simple blocks.—Observing now the simple formula of drawing the back of the block narrower than the front of the block in case one end of it faces squarely toward the observer, let us present an array of simple blocks thus drawn (Fig. 8). Each of these blocks looks natural when used alone. But it will be noted that if two of them are used together, as if they represented adjacent regions, a certain awkwardness is apparent (Fig. 9). In this figure, block *L* seems to be tilted up at a higher angle than block *K*.

9. A rearrangement.—If the miscellaneous array of blocks shown in Fig. 8 is rearranged so that all of the blocks

BLOCK DIAGRAMS OF LAND FORMS

seem to be parts of one great plane, as in Fig. 10, it will be noted then that their bounding lines, in tapering backward, all seem to converge toward one point in the distance.

10. One-point perspective defined.—A system of perspective in which one set of lines converges toward a distant point, and the other lines are horizontal or vertical,

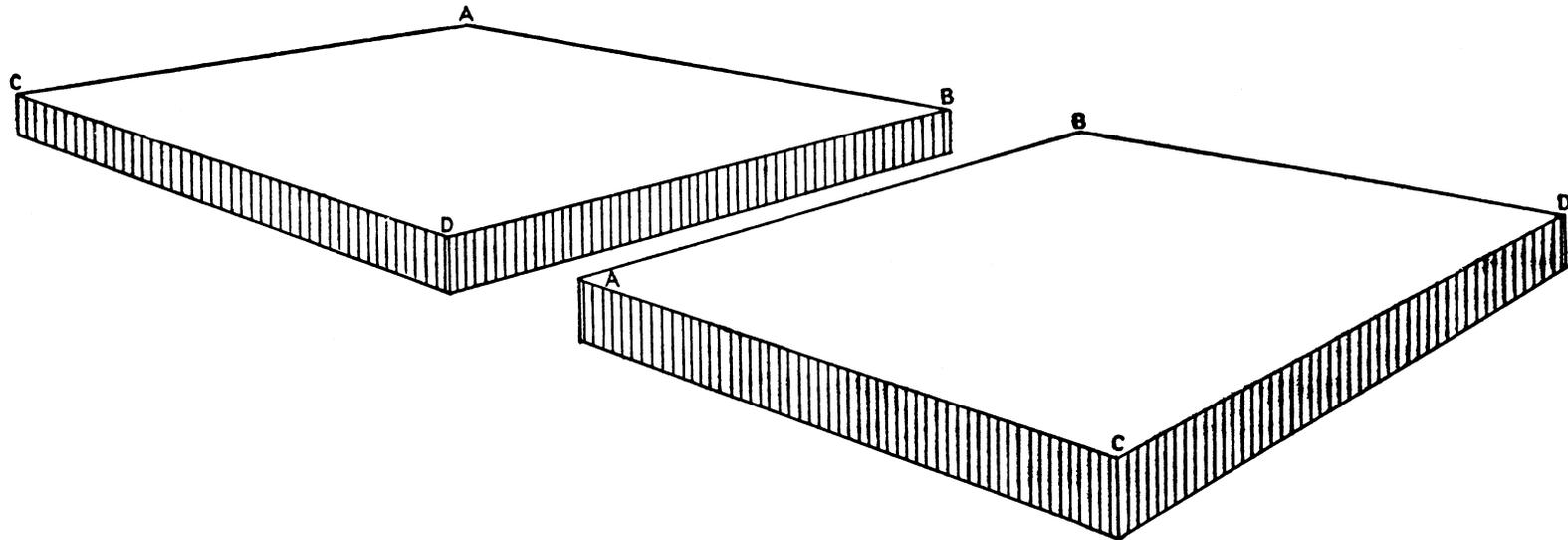


FIG. 7.—Two blocks in perspective to show that the side of a rectangular block farthest away from the observer is not always drawn shorter, as was done in Fig. 6. In each of the blocks in Fig. 7 the line *AB* is longer than the line *CD* of the same block, though in each case it is farther away

is termed the one-point system or one-point perspective. There is only one vanishing point.

11. Drawing a rectangular block in one-point perspective.—To draw a block in one-point perspective, select some point near the top of the sheet of paper. From this point, with pencil and ruler, draw two radiating lines

downward (Fig. 11, *A*). Then complete the front and back of the block by drawing horizontal lines *LM* and *NO* (Fig. 11, *B*). For the front end of the block draw another horizontal line *PQ* (Fig. 11, *C*), and complete by drawing the vertical edges *NP* and *OQ* (Fig. 11, *D*). To draw the side of the block that is visible to the observer, draw its

from the observer. This is often true in the case of blocks having a corner pointing to the observer. Hence the drawing of such blocks must follow certain rules of perspective, whereas in drawing blocks with one end facing squarely toward the observer, this is not always necessary.

bottom edge from the point *Q* to the vanishing point in the distance, and complete by dropping a vertical line from the point *M* to represent the farther corner of the block (Fig. 11, *E*).

12. Drawing several blocks in one-point perspective.—A single block like the one just drawn is essentially a part

ONE-POINT PERSPECTIVE

of a much larger block, such as Fig. 12. The larger block, however, may be cut up into any number of pieces by means

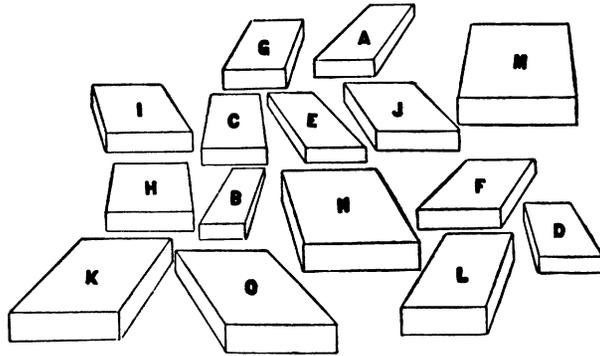


Fig. 8.—An array of rectangular blocks, all having one end facing directly toward the observer and drawn according to the principle that the back of the block should be narrower than the front. This principle is all right when applied to single blocks, but other rules are necessary when a number of blocks are drawn and all are supposed to be lying in the same plane. The blocks shown above seem to be sloping at various angles.

of lines drawn to the vanishing point in the distance and other lines drawn horizontally, as in Fig. 13.

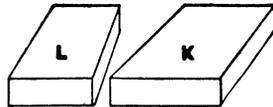


Fig. 9.—Two blocks selected from Fig. 8. Each of these blocks taken separately makes a satisfactory impression, but they do not go well together. At least they do not look as if they were cut out from the same horizontal plane. Block *L* seems to be tilted up more than block *K*.

It will be evident that each of the blocks, *A* and *C*, which lie to the left and to the right of the center, has two faces

visible, in addition to the top surface. In each case, one full end face is provided without any distortion, in addition to the side face, which is considerably foreshortened, owing to the perspective. Blocks of this type, that is, blocks lying to the left or right of the center (Fig. 13, *A* and *C*), are therefore more useful than those which lie in the middle (Fig. 13, *B*), and which therefore present only one end of the block to

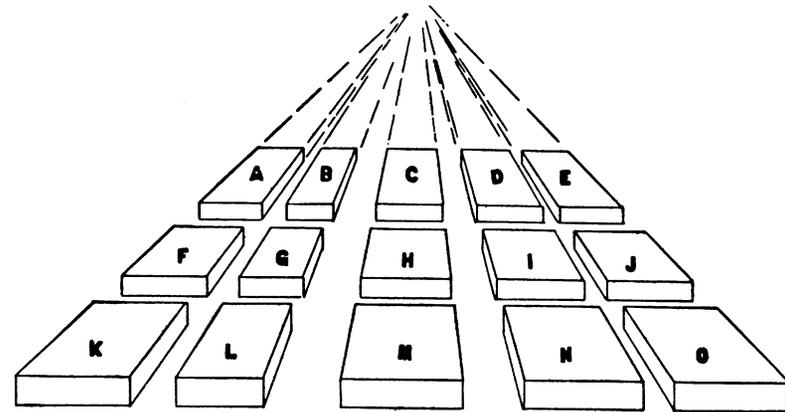


Fig. 10.—The blocks represented in Fig. 8 have been rearranged so that they seem to lie in one plane. When this is done it is noted that their bounding lines, in tapering backward, converge toward one point in the distance, the so-called vanishing point. Only when this is true do the blocks seem to lie flat and in the same plane.

view. When we remember that one of the objects of a block diagram is the presentation of underground structure by means of a cross-section, it is obvious that the blocks farthest toward the sides are the most useful. Thus, in Fig. 14, block *A* is more serviceable than block *B* because the side face of block *A* presented to the observer is larger and less distorted than is the side face of block *B*.

BLOCK DIAGRAMS OF LAND FORMS

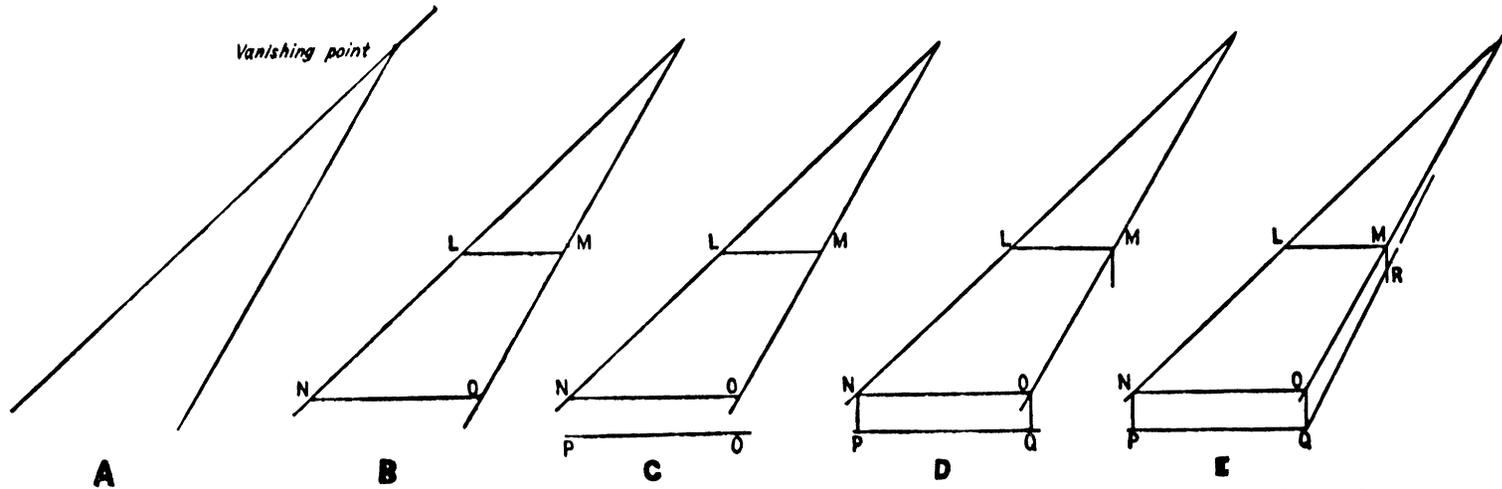


FIG. 11.—Several stages in drawing a block in one-point perspective. The different steps are fully explained under Section 11 of the text.

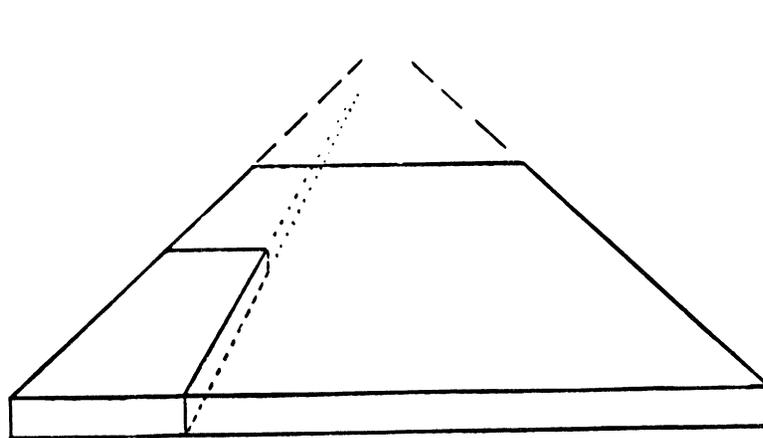


FIG. 12.—Drawing to show that a block like *E* of Fig. 11 can be considered as part of a much larger block.

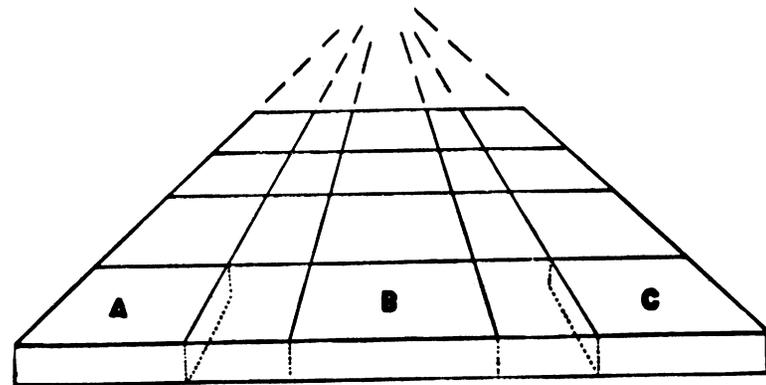


FIG. 13.—Drawing to illustrate the fact that a large block like that in Fig. 12 can be cut up into a number of smaller blocks, *A*, *B*, and *C*, all parts of the same one-point perspective system. This drawing also shows that the two blocks *A* and *C* have two side faces visible besides the top and are consequently apt to be more useful where structural cross-sections are to be shown than blocks like *B*, which presents but one end to the observer owing to its position just under the vanishing point.

ONE-POINT PERSPECTIVE

13. Drawing the geological cross-section.—When the geological cross-sections are to be drawn upon blocks like those shown in Fig. 14, it will be noted that a block like *A* proves to be a much more satisfactory selection than a block like *B*. The drawing of the section on the end face of the block, in full view, offers no difficulty; the section is drawn

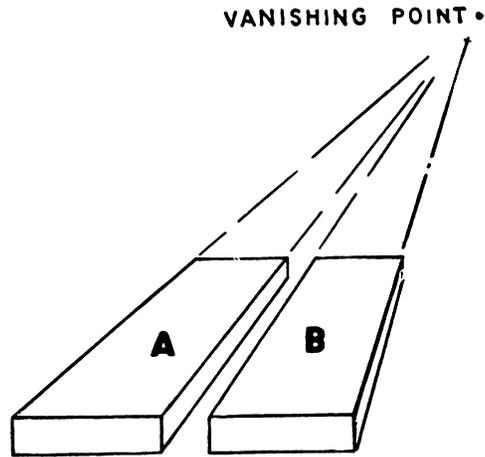


FIG. 14.—Two blocks in one-point perspective. Block *A* is more useful than block *B* because it is farther over to one side of the vanishing point and therefore presents a wider cross-section on its side than block *B* does.

quite in the ordinary way. On the distorted side face of the block, however, the section is drawn as it would appear in perspective. For instance, imagine in Fig. 15 that the geological section *ab* is to be drawn on the end of the block and that section *bc* is to be drawn on the side of the block. Section *ab* is transferred outright without any change. If necessary, it may be reduced or enlarged, but its details are not altered in their relative

positions. Section *bc* is carried over in the manner shown. The procedure consists in subdividing the side of the block *BC* into parts corresponding to *l, m, n, o, p, q* on the cross-section. Although this procedure ignores the principle that in perspective equal distances become successively smaller in the distance, nevertheless it is an eminently practicable method. In case it is necessary or desir-

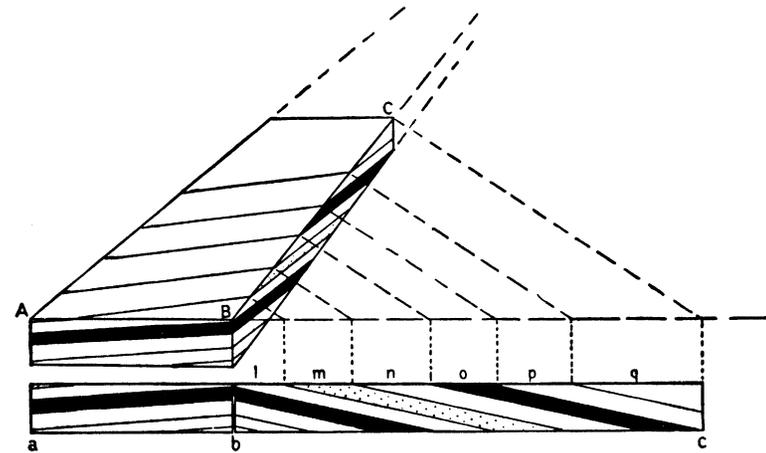


FIG. 15.—Block drawing to show how the geological cross-sections *ab* and *bc* may be transferred to the faces *AB* and *BC* of the perspective block.

able to make allowance for the differences due to perspective, slight changes may readily be made in the dimensions determined in the manner just indicated. On top of the block, then, the geological boundaries may readily be drawn in.

Horizontal beds drawn in cross-section on the side of the block should converge toward the vanishing point, as in Fig. 16, *X*. Short lines forming the symbol for a shale

BLOCK DIAGRAMS OF LAND FORMS

formation are treated similarly. If horizontal beds are not drawn so as to converge toward the vanishing point, they do not appear to be horizontal. Thus, in Fig. 16, *Y*, the lines separating the different beds shown as horizontal in the true cross-section, *bc*, are drawn parallel to each other

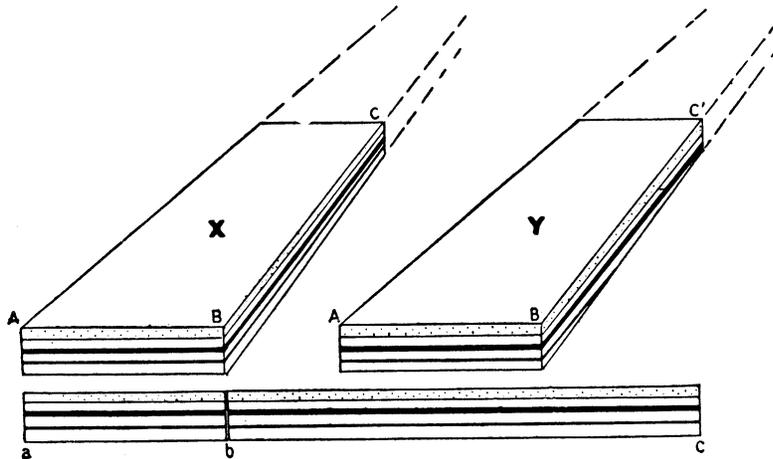


FIG. 16.—Two blocks to illustrate method of drawing geological cross-sections of horizontal rocks on the sides of the block. The short section *ab* is transferred without distortion to *AB* on block *X*; the section *bc* to the side *BC* of block *X*, by allowing the lines to converge toward the vanishing point. In block *Y* the lines of the section on the side *B'C'* do not converge toward the vanishing point and the formations therefore do not seem to lie horizontally. *X* is correctly drawn, *Y* is incorrectly drawn.

and to the top of the block, with the result that some of the beds seem to dip away from the observer.

Beds of limestone are represented in the true cross-section as though made up like a brick wall. When these are drawn in perspective at the side of the block (Fig. 17, *X*), the vertical lines should be drawn vertical, following the

universal rule of perspective that all lines which are vertical in the object always appear vertical in the drawing. The correct manner is shown in Fig. 17, *X*. If these short lines are drawn perpendicular to the bedding planes in the perspective view an effect like section *B'C'* in Fig. 17, *Y*, is produced, again giving the feeling that the beds are not horizontal.

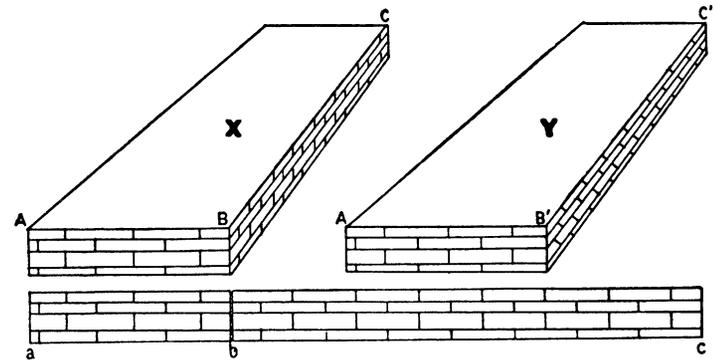


FIG. 17.—Correct method (block *X*) and incorrect method (block *Y*) of representing horizontal limestone beds on the side of the block. It is essential that the partitions between the limestone bricks be drawn vertical.

Folded beds in cross-section must be carefully drawn, to preserve their correct attitude in perspective. Thus, take a series of symmetrical folds having their axial planes vertical, as in the true section *bc*, Fig. 18. To draw these in perspective, the position of the axial planes *l, m, n, o, p, q, r* should first be indicated by similar vertical lines on the perspective block and the folds then drawn in as shown in Fig. 18, *X*. When this is done, the dip of the strata on each side of the axial plane appears to be equal and the desired effect is produced. This is true even though dis-

ONE-POINT PERSPECTIVE

tances like NF in the perspective view, are much less than NE although these two distances are the same in the true cross-section. An incorrect rendering is shown in Fig. 18, Y , where the folds of the true cross-section are transferred to the perspective drawing without materially altering their form, but instead of appearing symmetrical they appear strongly overturned.

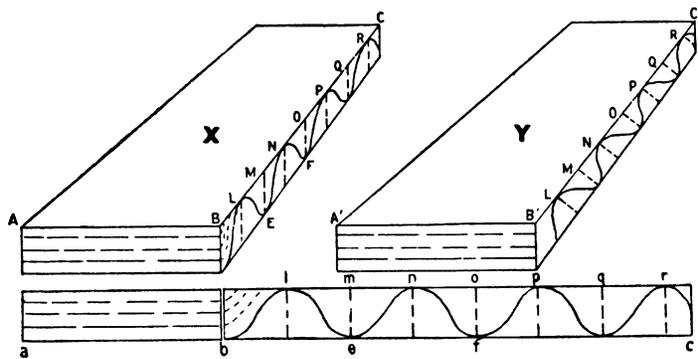


FIG. 18.—Correct method (block X) and incorrect method (block Y) of representing symmetrical folds on the side of the block. It is essential that the axial planes of the folds be kept vertical.

Unsymmetrical folds or overturned folds of any kind may readily be transferred by indicating first the position of the axial plane. Thus, in Fig. 19, X , the side of the block BC represents the perspective appearance of the overturned folds shown in the geological cross-section bc . The axial planes l, m, n, o, p, q, r have been transferred from the undistorted section bc to the distorted one, BC , after the manner of Fig. 15, thus facilitating the representation of the folds. Fig. 19, Y , shows another convenient symbol which may be used to represent schists or very intimately

folded beds. Note that in the side face, $B'C'$, the axial planes maintain a vertical position in accordance with the section $b'c'$.

14. Representing geological structure on the surface of the block.—Geological structures may be represented upon the plane surface of the block without suggesting any

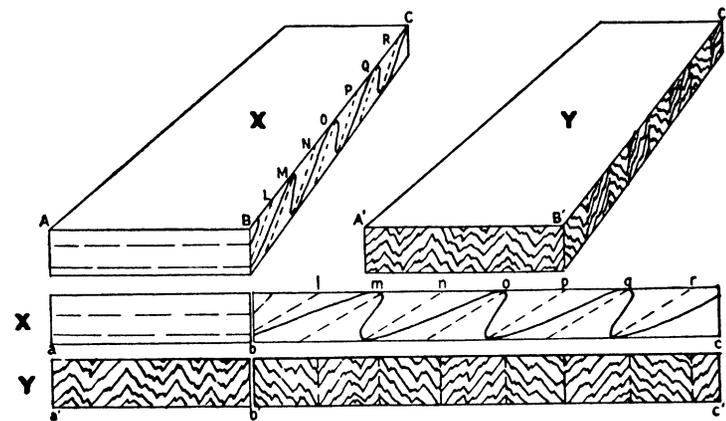


FIG. 19.—In block X the face BC indicates the correct method of representing the geological section of overturned folds shown below in the cross-section bc . Block Y utilizes another symbol for close folding. In these cases it is essential that guide lines such as the axial planes l, m, n, o, p, q, r , be transferred properly to the face of the block, following the method of Fig. 15.

topography. This renders an important service in showing the relation between surface geology and underground cross-sections, as shown in Fig. 20. Where faulting is involved, this method of presentation may help materially in clarifying the situation. The representation of structural subjects, however, is usually better accomplished by some form of isometric drawing, as explained under Section 110.

BLOCK DIAGRAMS OF LAND FORMS

Isometric perspective permits all lines that are parallel in the object to be drawn parallel, and it allows measurements to be made to scale throughout the drawing.

15. Trimming the block by eliminating useless corners.

—It was noted in Section 12 that the blocks farthest to the right and farthest to the left, in a system of blocks drawn in one-point perspective, are in general the most useful, because they present the largest cross-sections of the side faces to the observer. For purposes of publication, how-

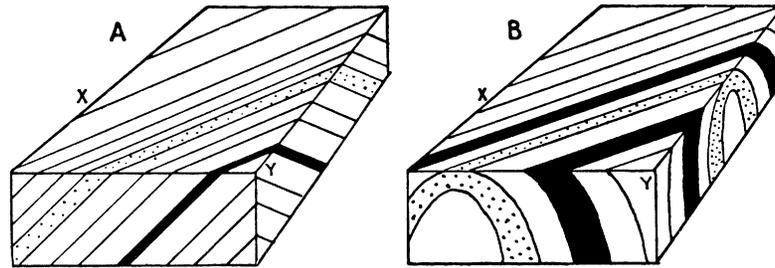


FIG. 20.—Blocks showing structural sections along the sides and formational outcrops on the top of the block.

ever, such blocks are very wasteful of space, on account of the long acute corners at the right and left, Fig. 21, *A*. These corners may be eliminated as shown in Fig. 21, *B*, and the waste space materially reduced. All four corners may be eliminated if desired. One method of doing so is shown in Fig. 22. The surface of the block is divided into nine equivalent parts, as in Fig. 22, *A*. This is done by dividing the front of the block into three parts and extending lines therefrom toward the vanishing point. In a similar manner the block is divided from front to back into three parts by

horizontal lines. Diagonals are then drawn across the corner sections, and the edges of the block are completed as shown in Fig. 22, *B*. This may be done with a block of any shape and usually results in a more compact drawing without any material loss of desirable information.

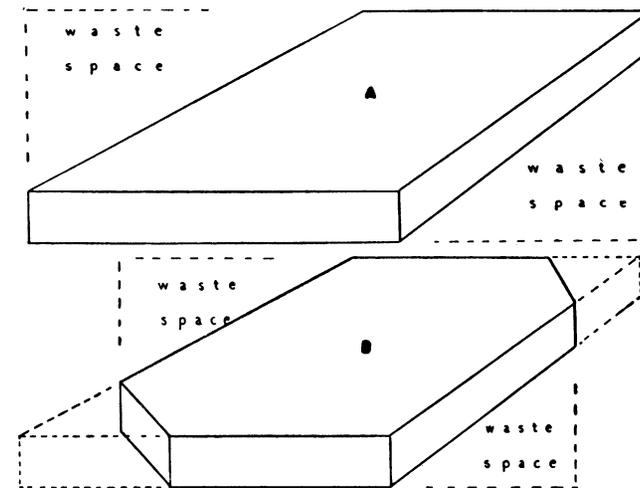


FIG. 21.—Block *A*, drawn in one-point perspective, illustrates what a large part of the printed page is taken by the pointed corners at the right and left and the waste space that results. In block *B* the corners have been cut off to save room and the waste space has been reduced to one-half. Very little of the block is thus lost, but it is made much more compact.

16. Sections cut out of a block.—A section may be cut out of a block along any line, by proceeding as follows: In block *A*, Fig. 23, it is desired to show structural cross-sections along the lines *ST*, and *XY*. This has been done in block *B*. At *S* and *T* (block *B*, Fig. 23), drop vertical lines until they meet the bottom of the block at *P* and *R*. Join *P* and *R*. The face *STPR* represents the cross-section.

ONE-POINT PERSPECTIVE

tion. Then, on the top face of the block, in front of the cross-section but far enough away from it to leave the entire surface of cross-section $STPR$ open to view, draw the line JK parallel to PR . At K drop a vertical line to the bottom of the block. Erase the unnecessary lines JS and TK , and

considerable strip of territory. It is to be avoided, if possible, because a cross-section is usually put through at some vitally interesting place where it is highly desirable to retain all the adjacent topography. To avoid losing any part of the block, one may cut it through, as it were,

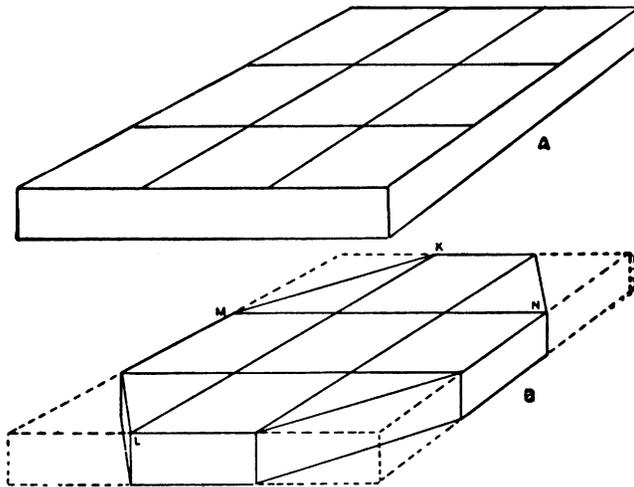


FIG. 22.—Block *A*, a block in one-point perspective, divided into nine parts, corresponding to the net of meridians and parallels on the U. S. topographic maps. Block *B*, the same with each corner eliminated in order to gain compactness, to introduce new cross-sections, or to provide variety in presentation.

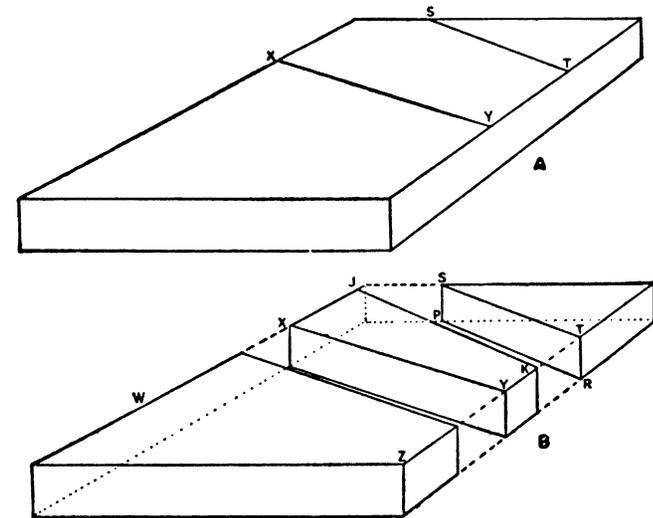


FIG. 23.—Block *A* is an ordinary block with two lines indicated, ST and XY , along which it is desired to show cross-sections. In block *B* this is done by removing sections of the block to permit a view of the vertical planes passed through these lines.

other construction lines. A similar section has been put through at XY .

17. Pulling a block apart along a section.—The drawing of a cross-section through the middle of a block, in the manner just described, removes a portion of the block. It is like cutting a trench through the block and throwing away the piece. This necessitates the elimination of a

and pull one part away from the other. Thus, in Fig. 24, the block used in Fig. 23 has been pulled apart so as to expose the section ST . This pulling apart may be done most effectively by imagining the smaller piece to be moved parallel to one of the faces of the block. Thus, in Fig. 24, *A*, the small corner is pulled sidewise in the direction EG , and in Fig. 24, *B*, the small corner is pushed back along the

BLOCK DIAGRAMS OF LAND FORMS

line *FG*. Either of these methods is satisfactory and is preferable to moving the small triangle out at some oblique angle, because its relation to the rest of the block would, in the latter case, be less evident. In general, it may be said that the method adopted in Fig. 24, *B*, is preferable to that

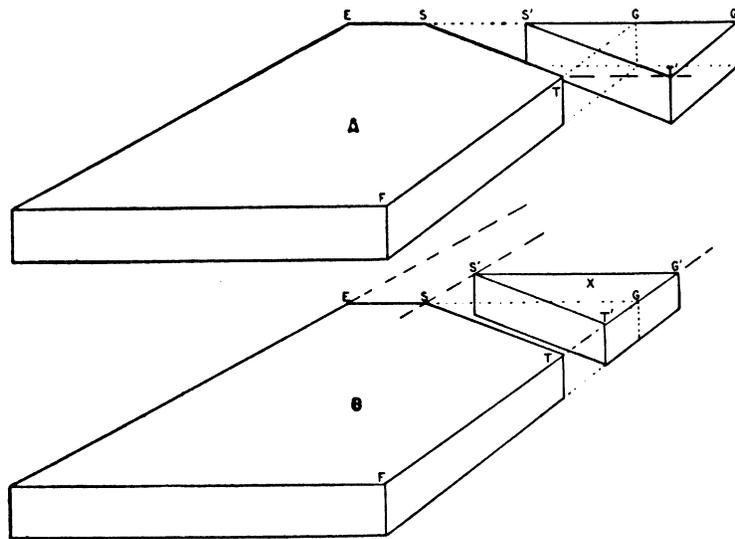


FIG. 24.—Methods of separating a block to show cross-section along the line *ST*. Block *B* is to be preferred to block *A* because it preserves a continuous cross-section along *FG'* whereas block *A* has an offset at *T*. Neither of these methods loses any of the surface of the block such as occurs when sections are cut out, as in Fig. 23.

used in Fig. 24, *A*, because the former preserves a continuous geological cross-section along *FG* whereas the latter produces an offset at *T*. If the lower left-hand corner of the block is to be shifted, then the horizontal shifting is more desirable, as in Fig. 25, *A*, because this preserves a continuity along *FH* whereas if the piece were shifted

forward the continuity would be interrupted as at *J*, Fig. 25, *B*. Either method, however, may be used with advantage, depending upon circumstances.

18. Drawing topographic quadrangles in one-point perspective. The representation of a single topographic

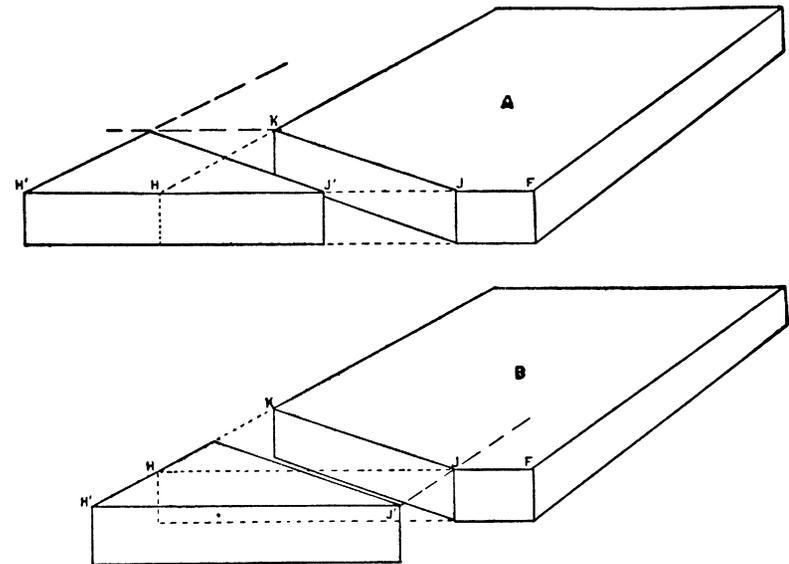


FIG. 25.—Methods of separating a block to show cross-section along the line *JK*. Block *A* is to be preferred to block *B* in that it preserves a section in one plane along the front of the block without any offset such as occurs at *J* in block *B*. However, in block *A* the topography on the surface would be thrown more out of position than in block *B*.

map, or a group of maps, as a single block is often highly desirable when the structure and the topography of the maps in question are to be explained. It necessitates first the drawing of the block with a network of meridians and parallels, to facilitate the putting in of the details. The

ONE-POINT PERSPECTIVE

block and network may be drawn with definite regard for the principles of perspective in every detail and all dimensions properly measured, but this entails unnecessary expense of time and little is to be gained by such accuracy. Instead, a block representing a single topographic map may be drawn, as in Fig. 26, in which the apparent length from front to back is greater than the width of the block. Most topographic maps of the U. S. Geological Survey are divided into nine smaller rectangles by meridians and parallels.

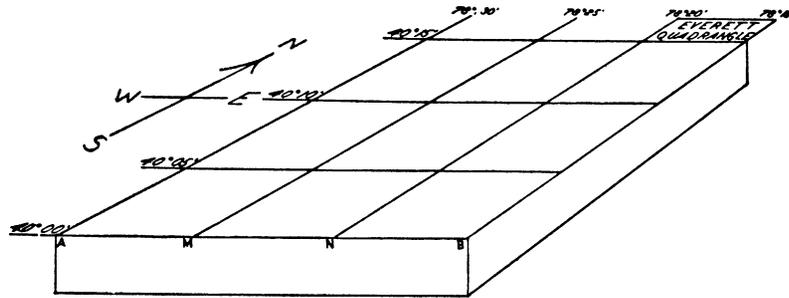


FIG. 26.—Outline of block for representation of topographic quadrangle in one-point perspective. The network of meridians and parallels is drawn to serve as a guide in locating the topographic forms.

These are at 5-minute intervals when the scale is 1: 62,500, at 10-minute intervals when the scale is 1: 125,000, and at 20-minute intervals when the scale is 1: 250,000. This division is accomplished on the block, as shown in Fig. 26, by dividing the line *AB* into three equal parts and drawing the meridian lines from *M* and *N* toward the vanishing point. The parallels are then drawn as horizontal lines, the spaces between them being equal, or successively shorter toward the rear of the block.

The position shown in Fig. 26 is probably the most

natural one in which to place the block representing the topographic map, because north is away from the observer. Other positions may be selected, however, as in Fig. 27, if, for instance, it is desired to show the structural section at the west side of the block. In Fig. 27, if it were desirable to show the north end face of the block instead of the southern end for use as a cross-section, the vanishing point should be selected to the left instead of to the right of the block.

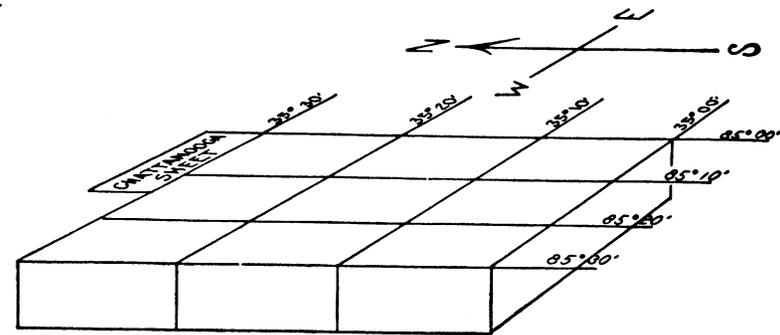


FIG. 27.—Outline of block for representation of topographic quadrangle in one-point perspective. The block is placed so that the western side faces the observer in order that the structural cross-section on that side may be visible.

The representation of a group of maps as a block is done in a similar manner (Fig. 28) or the blocks may be separated along their edges to permit of structural cross-sections as in Fig. 29; or corners and parts of the blocks may be removed entirely or pulled partly away (Fig. 30).

19. Drawing large areas in one-point perspective.—Maps of large areas, such as the British Isles, may be changed into block form by observing the above methods. The

ONE-POINT PERSPECTIVE

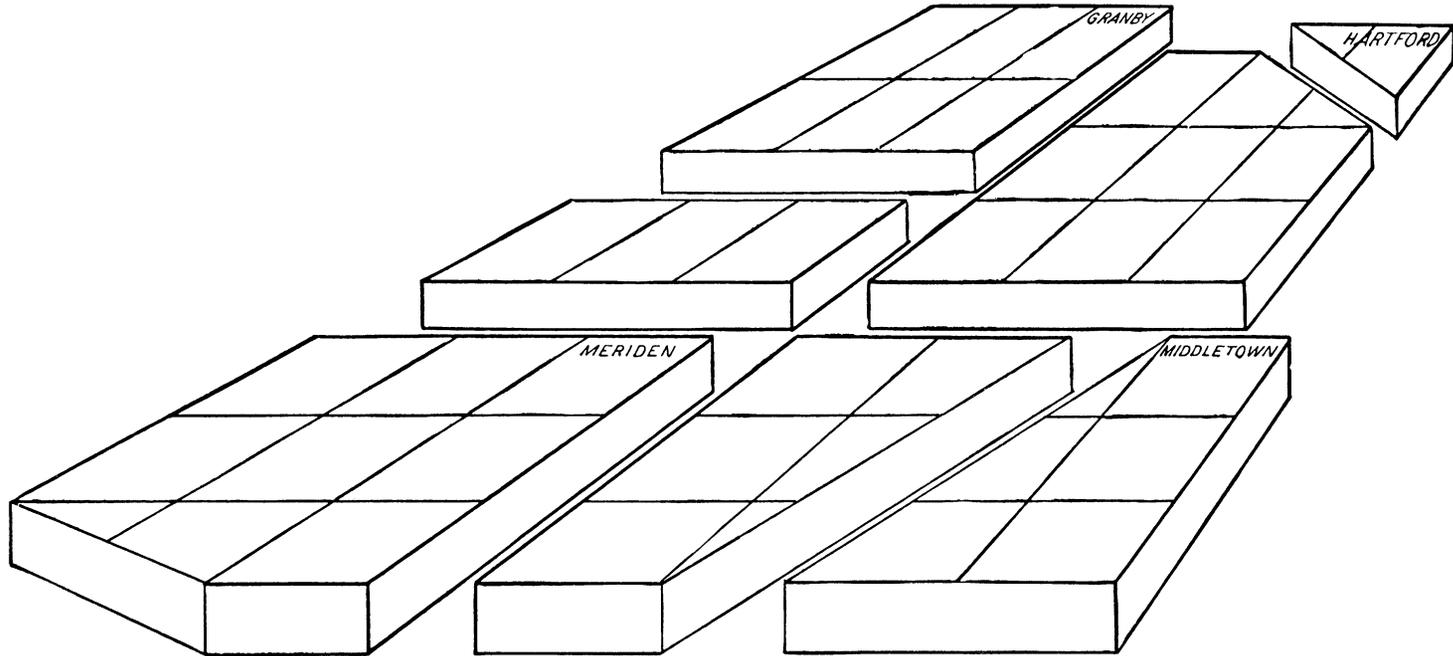


FIG. 30.—The same as Fig. 29 with the introduction of cross-sections and other changes.

net on the top plane of the block may represent the meridians and parallels, as in Fig. 31, or any other net may be used which will facilitate transferring the map to the block. A large block of this type may then be cut apart in order to show structural sections at critical places.

A strong criticism may be made against blocks of this type. The distortion due to perspective is very readily noted in areas like the one represented in Fig. 31, which have acquired a certain familiarity of form to most people in their work with maps. It is therefore suggested that the map itself can frequently be used as a base upon which the topography may be drawn. This is further discussed under Section 129.

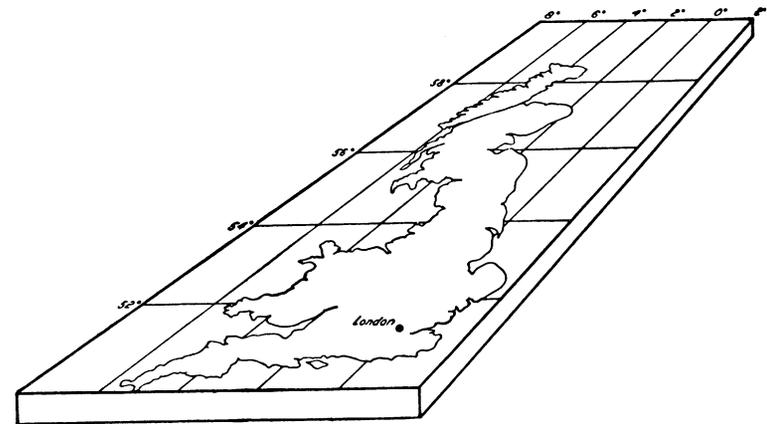


FIG. 31.—Great Britain represented on a block in one-point perspective.

BLOCK DIAGRAMS OF LAND FORMS

20. Simple geometrical forms in one-point perspective.— Thus far, attention has been directed to the representation of the block upon which the topographic forms are to be placed. The representation of these topographic forms

forms and to suggesting devices which may be found useful in drawing topographic details. In Fig. 32, some simple geometrical blocks are represented in one-point perspective, in order to show that such forms are easily drawn, and that

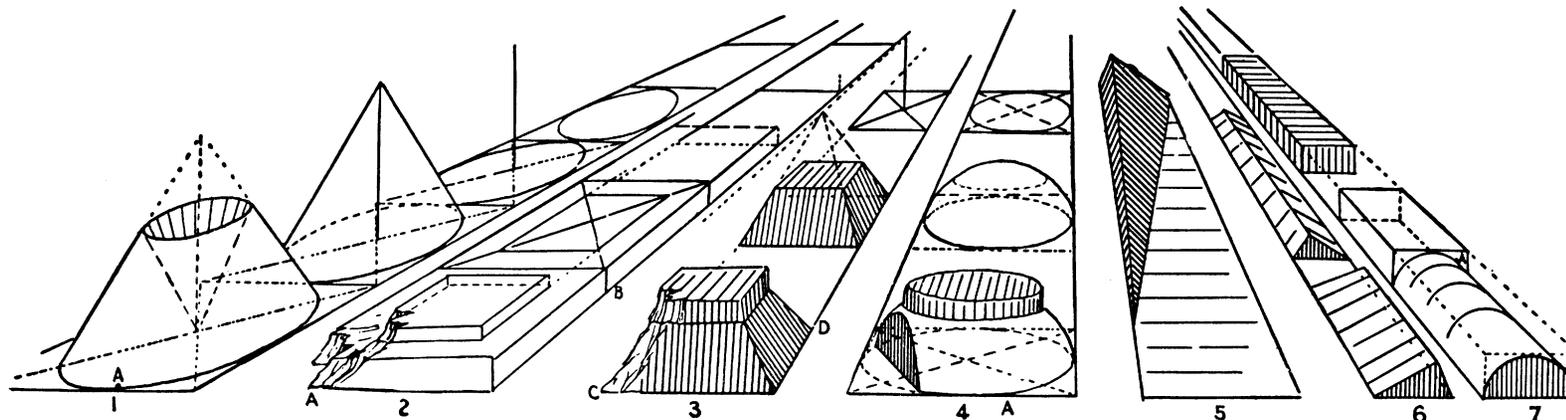


FIG. 32.—Series of geometrical blocks drawn in one-point perspective. Series 1 suggests the successive operations in the drawing of a cone. First, in the back of the drawing, lay off a rectangular base, inscribe a circle, erect a perpendicular at the center to any height desired, then draw lines from the apex of the cone tangent to the circle at its base; finally truncate the top of the cone and introduce an inverted cone to simulate possibly the crater of a cinder cone. Series 2 suggests that a number of rectangular blocks may be placed on top of each other, later to have the corners trimmed off in order to develop a mesa or plateau. Series 3 illustrates the several steps in drawing a pyramid, truncating it, and placing on top a

rectangular block. Series 4 shows a sphere which may be truncated and surmounted with a disk, or cut in half as if it were a hill partly eaten away by waves along the coast. No. 5 shows a wedge-shaped block which might simulate the tapering splinter-like end of a block mountain. No. 6 shows two triangular blocks, the farther one having slopes so gentle that both the back and front are visible, the nearer one presenting but one slope to the observer. No. 7 shows that a cylinder may be derived from a rectangular block. Note that the line *AB* is not along the crest of the cylinder, nor is it at the bottom; it is a line tangent to the two circles representing the ends of the cylinder.

must next be considered. This can best be accomplished by analyzing them and thinking of them as made up of simple geometrical lines and solids, which are more readily drawn in perspective than complicated landscapes having apparently no particular shape which can be analyzed. Much of this book will be devoted to this analysis of land

the principles of perspective, such as the use of a vanishing point, can be applied to the drawing of pyramids, cones, triangular blocks, and cylinders, as well as to the rectangular blocks already discussed.

21. Slope lines and shading on geometrical blocks.— Slope lines are drawn on the sides or the top of solid forms,

ONE-POINT PERSPECTIVE

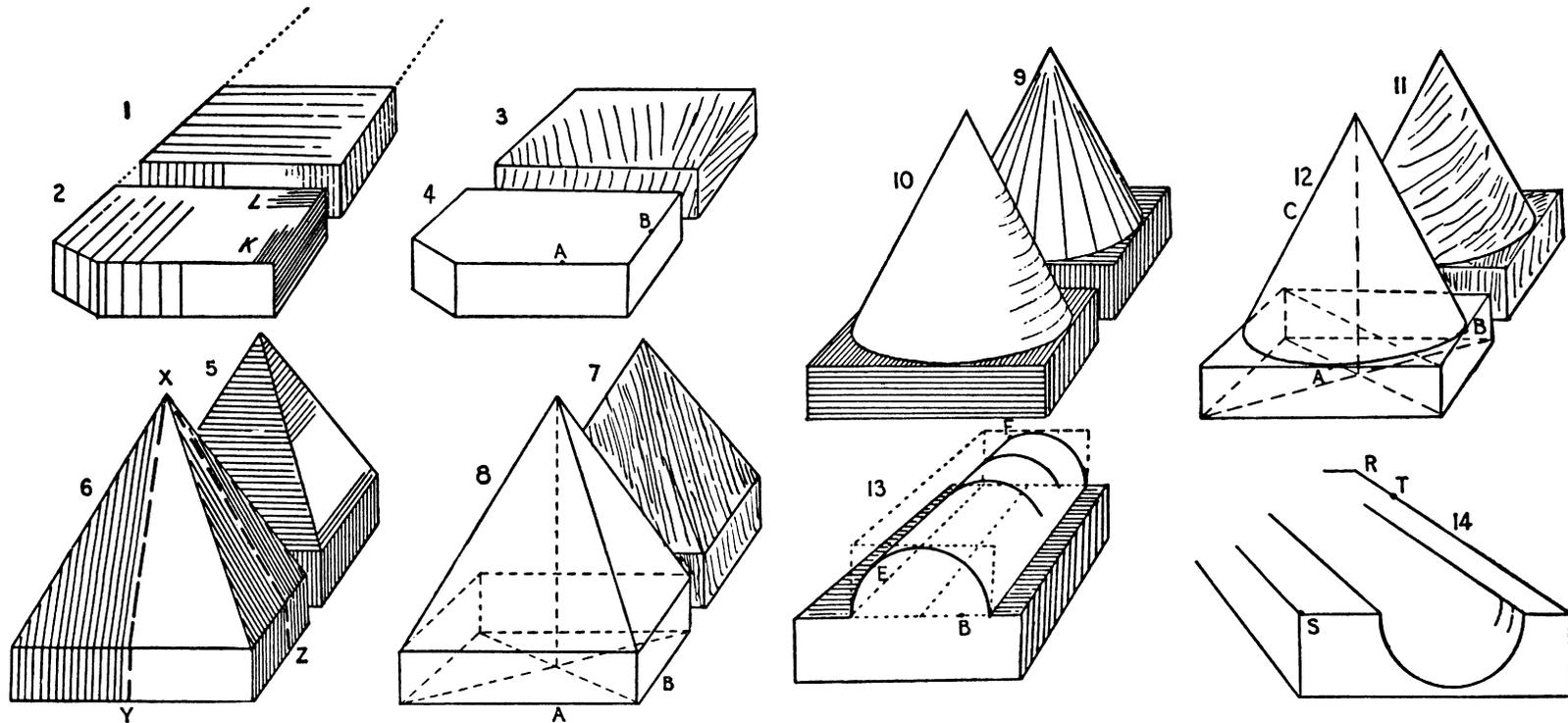


FIG. 33.—A series of blocks to illustrate methods of shading or of drawing slope lines to emphasize the different planes. Note that blocks 1 and 2 have been shaded properly, block 3 improperly. In block 1 the vertical sides of the block have been shaded with vertical lines drawn either free-hand or with a ruler. In block 2 horizontal shading has been used at one end. Such lines should, of course, converge toward the vanishing point. The shading on top of the block may converge toward the vanishing point as on the left side of block 2, or may be made up of horizontal lines as on top of block 1. The shading on top, however, should not run in the same direction as the shading on the side, as at *K*, but rather as at *L*, in order to accentuate the different planes. If the shading on all the vertical sides of the block is made up of vertical lines as in block 1, it is well to draw the corners of the block with a heavier line, and also to space the strokes on

the retreating side of the block nearer together than on the front of the block. In block 3 several of the principles mentioned have been violated. Study of the four pyramids shows that 5 and 6 are correctly shaded. No. 7 is improperly done. No. 8 has been left blank for the student to work on. On block 5 horizontal lines have been used on the sloping sides of the pyramid. On block 6 slope lines are used. The direction of these lines is determined by drawing lines *XZ* and *XY* from the apex to the middle points along the base. The slope lines are made parallel to these lines. In cones 9 and 10 suitable methods have been used, slope lines in No. 9, horizontal lines in No. 10 which appear as ellipses in perspective. Block 11 is poorly drawn. In block 13 the slope lines on the cylinder are circles which are tangent to the line *EF*.

BLOCK DIAGRAMS OF LAND FORMS

to aid the reader in distinguishing the different planes which bound the solid, and to help him to appreciate quickly the attitude or slope of each plane. Two principles are to be followed in drawing such lines. First, slope lines should run directly down the slope, not across. An exception to this is made in the case of shading consisting of horizontal lines

crossing the plane, but these lines are strictly not slope lines. A second principle requires that all slope lines on a given plane be parallel with each other; that is, in perspective they all converge toward the same vanishing point. Fig. 33 and the accompanying description should now be examined.

EXERCISES

BASED UPON THE ILLUSTRATIONS IN CHAPTER II

NOTE.—The student should provide himself with a medium pencil, about a 2H, which is easily erased; a soft eraser, such as artgum; a knife to keep the pencil sharp; a sandpaper pad for pointing up the pencil; carbon paper; sheets of good typewriting paper, or drawing paper, and some tracing paper. Cheap, thin typewriting paper will be very satisfactory as a substitute for tracing paper. A small, inexpensive drawing board, about 12 by 18 inches or even smaller; a small T-square; a triangle; a ruler; thumb tacks and pins, will be needed from time to time. For finished work on drawings to be published, there will also be needed penholder and medium to small sharp-pointed pens but not necessarily crowquill pens, black India ink, penwiper, blotter, and ruling pen, which should be kept very clean and handled carefully. Some harder pencils may also be required, in order that drawings may be completed and nicely penciled in before inking.

Exercise 1. Trace the outline of block *A* in Fig. 6, and then modify it by shortening the back line until it resembles block *B*. Experiment until you find out how much shorter the back line must be to make the block look well.

Exercise 2. On Fig. 7, mark off on the line *AB* of each block, the length of *CD* of the same block, in order to show the relative length of these lines.

Exercise 3. Trace part of Fig. 10 and draw additional blocks on all sides, to the left, right, front, and back of all the lettered blocks; that is, add twenty blocks to the drawing.

Exercise 4. On Fig. 13, complete several other blocks back of blocks *A*, *B*, and *C*. Label each of the blocks in Fig. 13 with the words "top surface," "front face," and "side face." Can a block in one-point perspective show two side faces?

Exercise 5. On blocks *A* and *B* in Fig. 14, draw cross-sections of horizontal bedding similar to block *X* in Fig. 16.

Exercise 6. On block *X* in Fig. 16, introduce the limestone symbol below the sandstone layer represented.

Exercise 7. On block *X* in Fig. 16, draw diagonal cross-section from *A* to *C*, thus cutting the block in half. Represent the structure on this cross-section.

Exercise 8. On block *X* in Fig. 17, draw diagonal cross-section from *A* to *C*, thus cutting the block in half. Represent the limestone structure on this cross-section.

Exercise 9. On block *X*, Fig. 18, draw a cross-section from *A* to *C* and show the structure. The folds are symmetrical and without any pitch.

Exercise 10. On block *X*, Fig. 19, draw diagonal cross-section from *A* to *C*, thus cutting the block in half. Represent the structure of the overturned folds on this section.

Exercise 11. On blocks *A* and *B* in Fig. 20, draw diagonal cross-sections *XY*, thus cutting off the front part of the blocks. Represent the structure on these cross-sections.

TWO-POINT PERSPECTIVE

22. Simple rule not always safe.—In one-point perspective, a simple rule advised drawing the sides of the block so that they would taper toward the rear. This is done in two-point perspective also, but a precaution must be observed in doing it.

Two-point perspective is used when the rectangular block stands with its corner toward the observer. The result is that the two sets of lines which are at right angles to each other in the object appear to taper in two directions, one set meeting at the right in one so-called vanishing point upon the horizon, the other set meeting at the left in a second vanishing point, also upon the horizon, as in Fig. 34, *Y*. The precaution to be observed is that the two vanishing points shall be upon the same horizontal line. Note in Fig. 34, *X*, that this has not been done, and that the line connecting the two vanishing points is not horizontal. The resulting block, therefore, does not seem to lie flat upon the page. The whole figure must be turned until the line *AB* becomes horizontal, as in Fig. 34, *Y*.

Because it is difficult to judge the exact position of a vanishing point when drawing a block freehand, it is therefore more than doubly difficult to draw the block when two points have to be kept in mind and when both points have to be upon the same horizontal line. It is consequently more

necessary, in adopting two-point perspective, to make use of the required construction lines, whereas these may be dispensed with when the more simple one-point method is followed.

23. Draw the block small, then enlarge it.—Because the two vanishing points must actually be used in constructing the picture of the block in two-point perspective, a very large piece of paper must be used to draw a block out carefully; if an ordinary-sized piece of paper is used the block will be too small for most purposes. The remedy for this is to draw the block small and enlarge it afterward. This gives opportunity to draw experimentally a number of blocks in different positions and afterward select the one that appears most suitable. The one selected may then be enlarged. Imagine, in Fig. 35, *X*, that a number of blocks have been drawn and *ABCD* has been selected as a suitable one for the purpose in mind. *ABCD* is too small, however, and should be three times as large. This enlargement is conveniently made by laying the sheet of paper containing *ABCD* upon another sheet, and pricking through the three corners, *ABC*, with a pin or using any other method of transferring. This gives Fig. 35, *Y*. Then draw *BAK* (Fig. 35, *Z*) so that *BK* equals three times *AB*, and *BCL* so that *BL* equals three times *BC*. In similar manner at *K*

TWO-POINT PERSPECTIVE

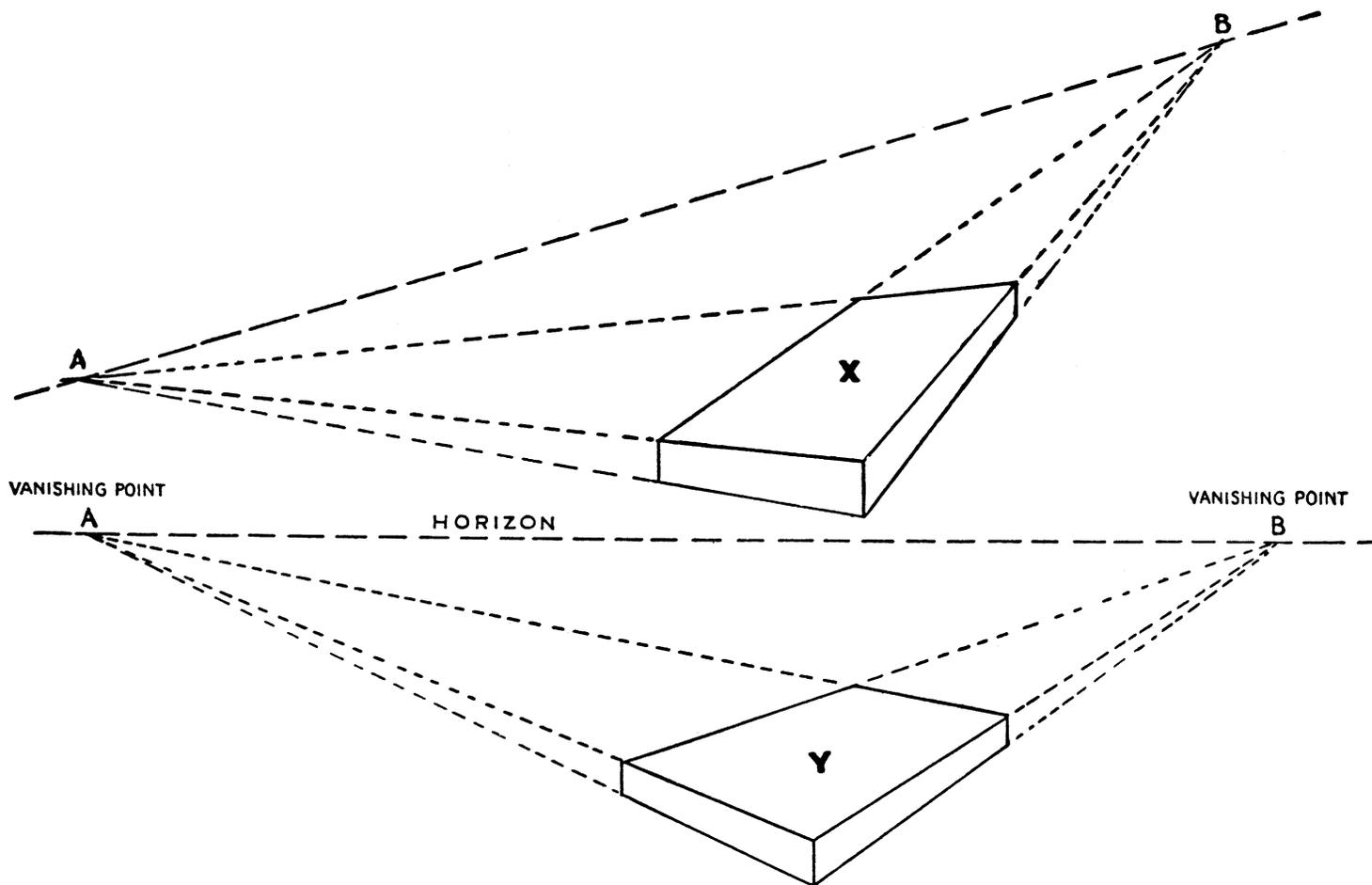
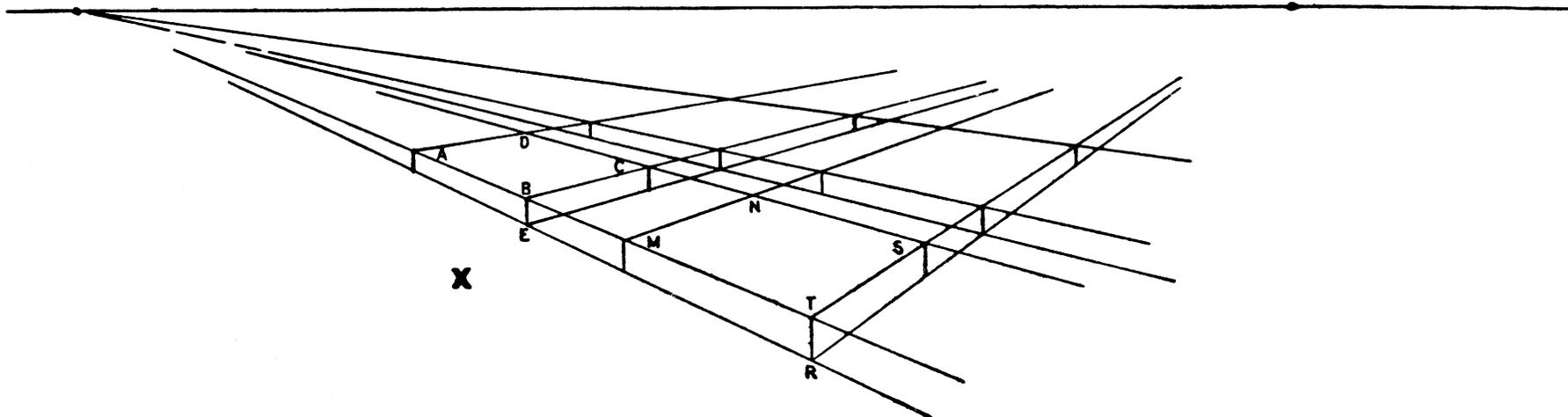


Fig. 34.—Correct method (Y) and incorrect method (X) of drawing blocks in two-point perspective. The correct method requires that the two vanish-

ing points, A and B, be on the same horizontal line. In block X the line AB is not horizontal.

BLOCK DIAGRAMS OF LAND FORMS



34

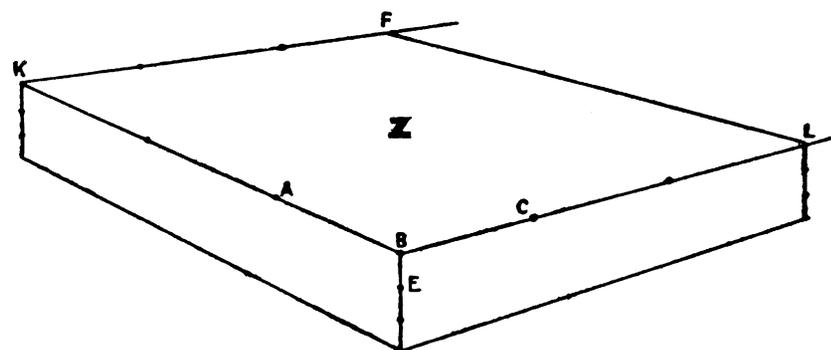
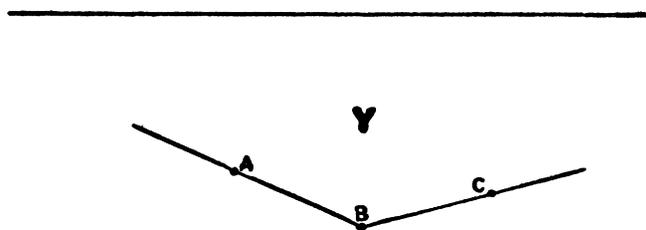


FIG. 35.—Method of enlarging a block. In *X* a number of blocks have been drawn in the two-point perspective system. Block *ABCD* has been selected and in *Z* has been enlarged to three times its original size. *Y* rep-

resents the first step in which the angle *ABC* is carried over from the smaller block, the lines *BA* and *BC* then being extended to three times their former length to form the sides of the large block *Z*.

TWO-POINT PERSPECTIVE

transfer the angle BAD and at L the angle BCD . Complete the block.

A convenient method of transferring angles is shown in Fig. 36. The angle ABD is to be transferred. Take a piece of paper. Place one edge against the line AB as

convenient when small drawings prepared on paper are to be reproduced upon the blackboard on a much larger scale.

24. Selection of the most suitable block.—In Fig. 37 a series of blocks is presented. It will be noted that only a

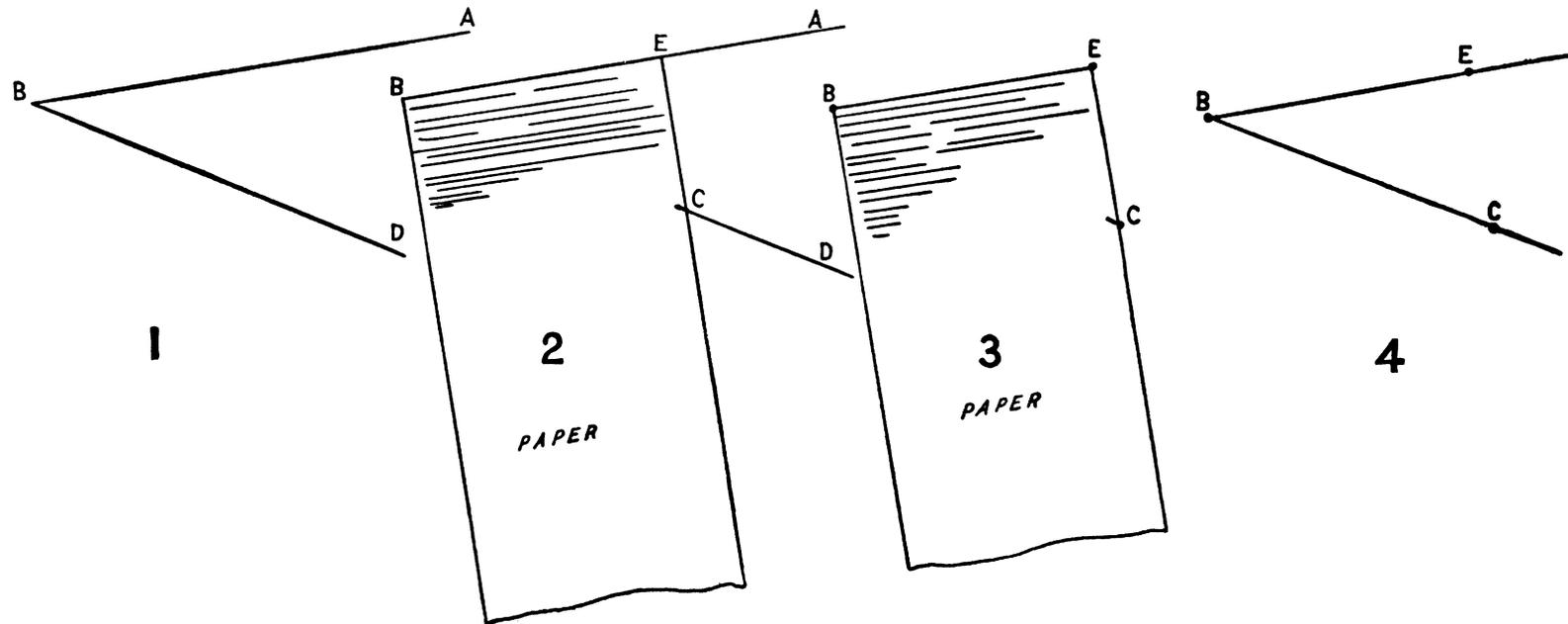


FIG. 36.—Device for transferring angles.

shown. Mark the point C upon the paper where the line BD , extended if necessary, emerges from under the paper. Then lay the same sheet of paper in similar position upon the point of the larger drawing where the angle is to be transferred. Mark C and E upon the paper beneath. Connect BE and BC . This method of transferring is extremely

few of these blocks, lying near the center of the figure, are really satisfactory. Let us criticize the others. The blocks lying in the upper part of the drawing are so much foreshortened that very little surface is represented, and their utility is thus limited. The blocks in the foreground are so near the observer that they have an awkward and

BLOCK DIAGRAMS OF LAND FORMS

unnatural appearance. Those far to the right and left present, upon one side of the block, a sectional view too small to be of any value. The blocks marked X are therefore most satisfactory.

sentation of topographic maps in two-point perspective are done in much the same manner as has been explained for one-point perspective under Sections 16, 17, 18 and 19. The accompanying figures illustrate some specific examples

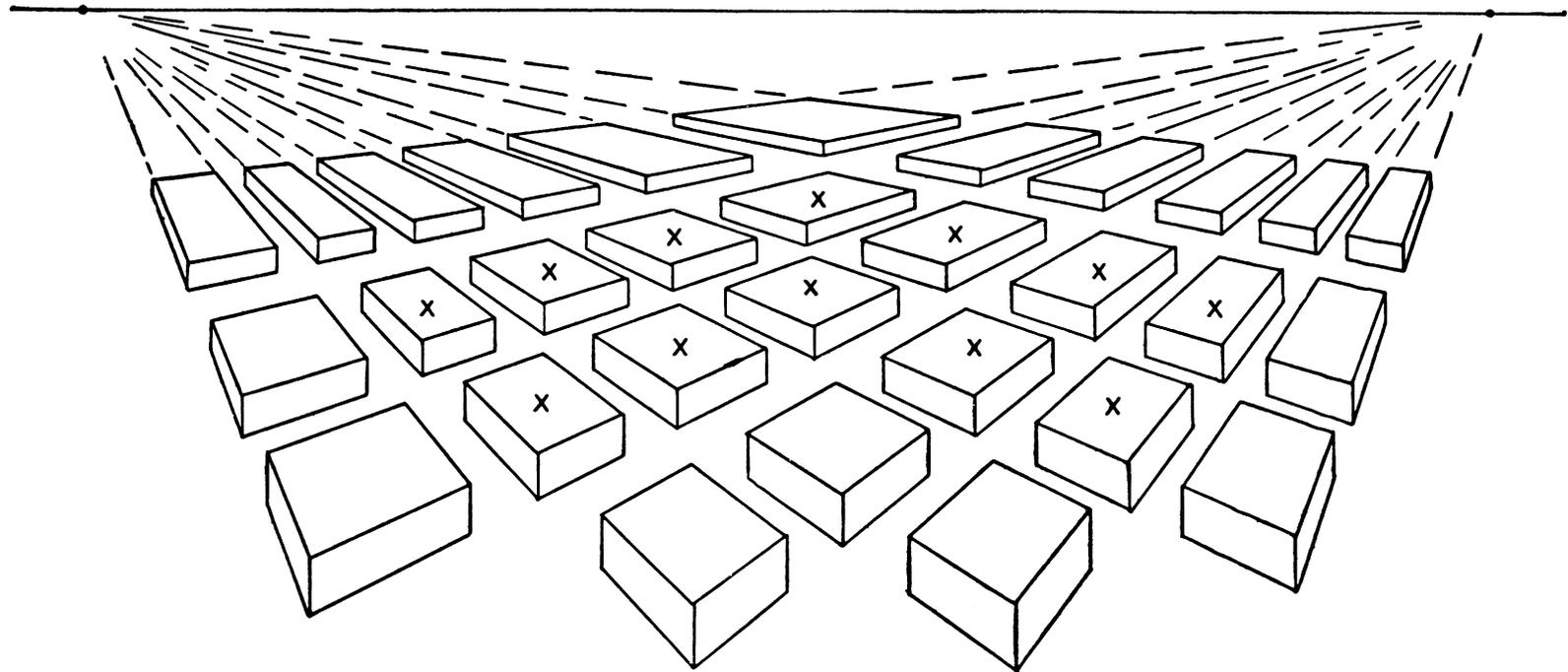


FIG. 37.—Set of blocks drawn in the two-point system. Only the blocks marked X near the center are satisfactory. Those near the top are too much foreshortened and present little upper surface. Those far to the

right and left show poor cross-sections on one side. Those in front are awkward in appearance.

25. Geological cross-sections and modifications of the block.—The drawing of geological cross-sections, the trimming off of corners, the cutting of sections out of the block, the pulling apart of a block along a section, and the repre-

of the same problems applied to blocks in two-point perspective. Fig. 38 represents four topographic quadrangles in block form ready for the topography and the structural sections. In Fig. 39, covering the same region as Fig. 38,

TWO-POINT PERSPECTIVE

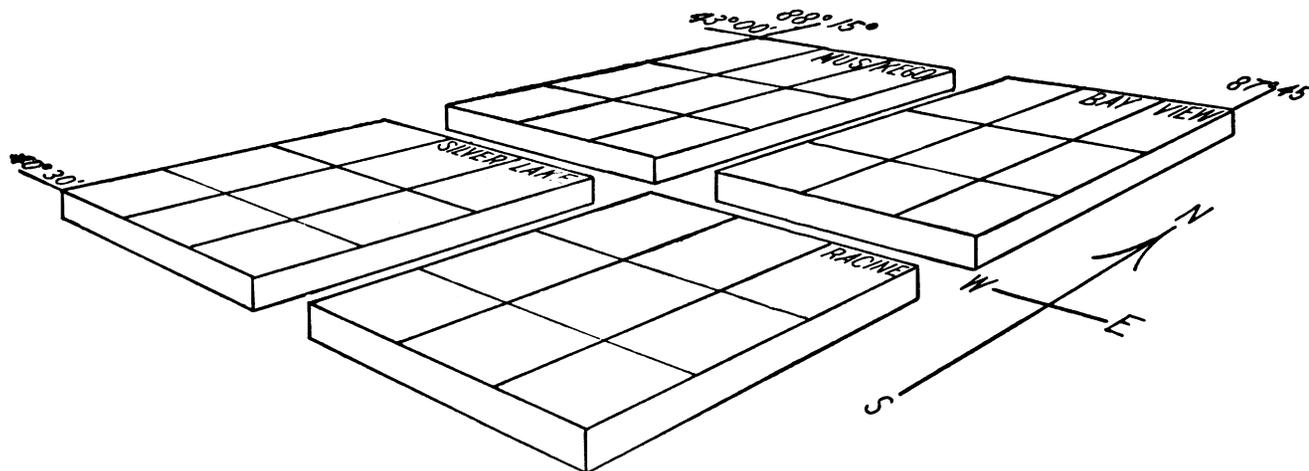


FIG. 38.—Blocks for the representation of topographic maps drawn in two-point perspective.

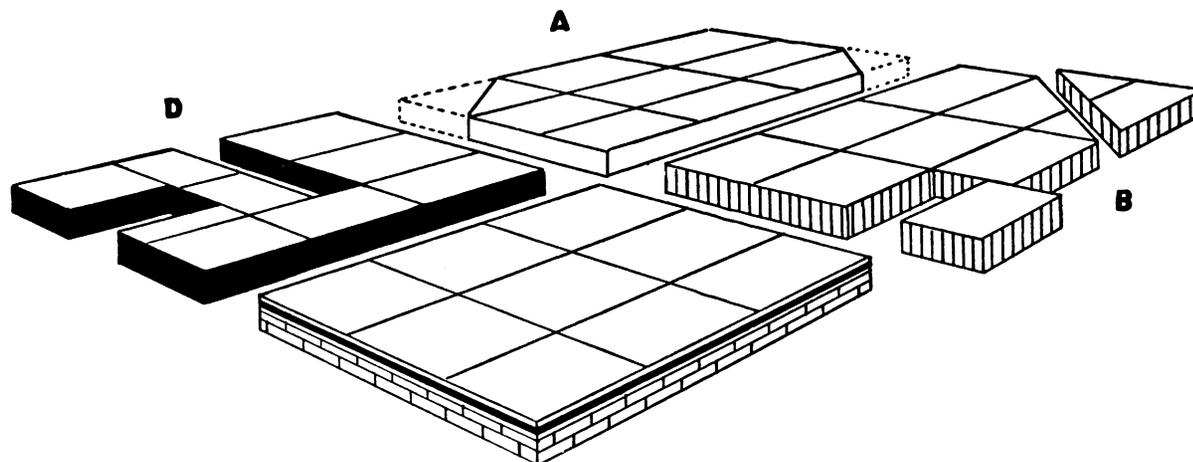


FIG. 39.—Four blocks in two-point perspective altered in various ways to introduce geological sections or to save space by removing corners.

BLOCK DIAGRAMS OF LAND FORMS

block *A* has been trimmed to a more convenient shape by the elimination of two sharp corners; block *B* has been separated along two lines and the corners have been pulled away from the rest of the block in order to reveal the cross-sections; block *C* shows simple structural sections of hori-

zontal bedding; and *D* represents a block from which two trench-like areas have been removed in order to present vertical sections for the display of structure. In all of these blocks the two vanishing points are well off the paper.

EXERCISES

BASED UPON THE ILLUSTRATIONS IN CHAPTER III

Exercise 1. In Fig. 34, *Y*, draw additional blocks to the right and left of block *Y*, using the construction lines already drawn.

Exercise 2. Determine the position of the two vanishing points for block *Z* in Fig. 35. On block *Z* draw in a smaller block which will be twice the size of *ABCD* instead of three times.

Exercise 3. On block *Z*, Fig. 35, draw lines to the vanishing points from the points *A*, *C*, etc., to divide the block into nine parts, like a topographic map.

Exercise 4. On block *Z*, Fig. 35, cut off a triangular corner at *L* and move it away from the block along the direction *BL*. (See Fig 24, *B*.)

Exercise 5. On block *Z*, Fig. 35, cut off a triangular corner at *K* and move it away from the block along the direction *BK*.

Exercise 6. On block *Z*, Fig. 35, cut off the front corner along the line *AC*.

Exercise 7. On block *Z*, Fig. 35, remove a block from the front corner, having an area *ABCD* equal to the small block at *X*.

Exercise 8. On Fig. 35, enlarge the block *MNTS* to a size half as large again.

Exercise 9: On Fig. 38, add one more block to the west of the Muskego sheet, but detached from it as the others are.

Exercise 10. On Fig. 39, remove the front rectangle of block *C* and slide it a little to the left in a manner similar to the treatment of the front corner of block *B*. Draw in the geological structure thus exposed.

Exercise 11. In block *C*, Fig. 39, cut out a north-south cross-section along one of the meridians. Show structure thus exposed.

Exercise 12. Draw in two-point perspective a series of flat rectangular blocks piled on top of each other, similar to block 2 in Fig. 32; also a pyramid, a truncated pyramid surmounted by a flat rectangular block, a triangular block showing front and back slopes, a triangular block showing but one slope, and a hemisphere lying on its flat side. Draw in slope lines, or shade each of these forms appropriately according to methods used in Fig. 33.

Exercise 13. (a) Draw in two-point perspective a block entirely above the horizon. (b) Enlarge it to twice its linear dimensions. (c) On the enlarged block show by dotted lines the edges which are invisible. (d) Cut off a triangular corner from the enlarged block and shift it along one of the major sets of lines. (e) Represent a sectional trench cut through the enlarged block.

PLAINS AND PLATEAUS

26. A simple, unbroken plain crossed by a stream.—

We come now to the representation of relief upon the surface of the block. In its unaltered form the block, whether drawn in one-point or in two-point perspective, may be thought of as representing the simplest type of topography, an undissected plain. A plain of this kind may be diversified by the presence of streams meandering across it. The drawing of such meandering streams is readily accomplished by imagining these streams as made up of parts of circles joined to each other. The task then is to draw these circles in perspective. This is facilitated by first drawing on top of the block the perspective view of squares and then inscribing the circles in them. Thus in Fig. 40, *A*, such a network has been laid out and circles have been inscribed. The circles in perspective appear, of course, as ellipses. Parts of these circles have been drawn heavier so as to suggest the continuous course of a stream and its tributaries. Fig. 40, *B*, illustrates the stream thus drawn without the accompanying circles. In Fig. 40, *C*, a freer rendering has been adopted. In this case the stream is drawn by sweeping the pencil to the right and left across the paper, with a slow advance forward. This tends to compact the curves of the stream and produces the foreshortened effect which is desired.

Throughout this whole procedure the idea has been to flatten the original circle and give it a shorter dimension from front to back, that is, to foreshorten it. This causes the river to “lie down” on the plain. If this is not done the stream seems to be arching up and down over the plain like a bent wire, touching its surface only here and there. This incorrect representation is shown in Fig. 40, *D*.

27. Specific example: representation of stream with single line. A very young plain. Fargo quadrangle N. D.—Minn.—Figure 41 is a simple rendering of the Fargo quadrangle. The streams are small and are cut very little below the level of the plain. No topography is shown on this diagram, as the country is so nearly flat. The streams are represented by single lines, and their irregularities are expressed with considerable freedom. A few of the railroads and one or two towns are also shown. A diagram of this kind used in connection with the map will aid the beginner in visualizing some such description as follows:

The area represented here is a part of the old bed of Lake Agassiz, a shallow lake of great extent which covered much of North Dakota, Minnesota, and Manitoba in glacial time because the Red River, which drained this region, was barricaded at the north by the ice sheet. The Red River and its tributaries now flow on the old lake floor. Because

BLOCK DIAGRAMS OF LAND FORMS

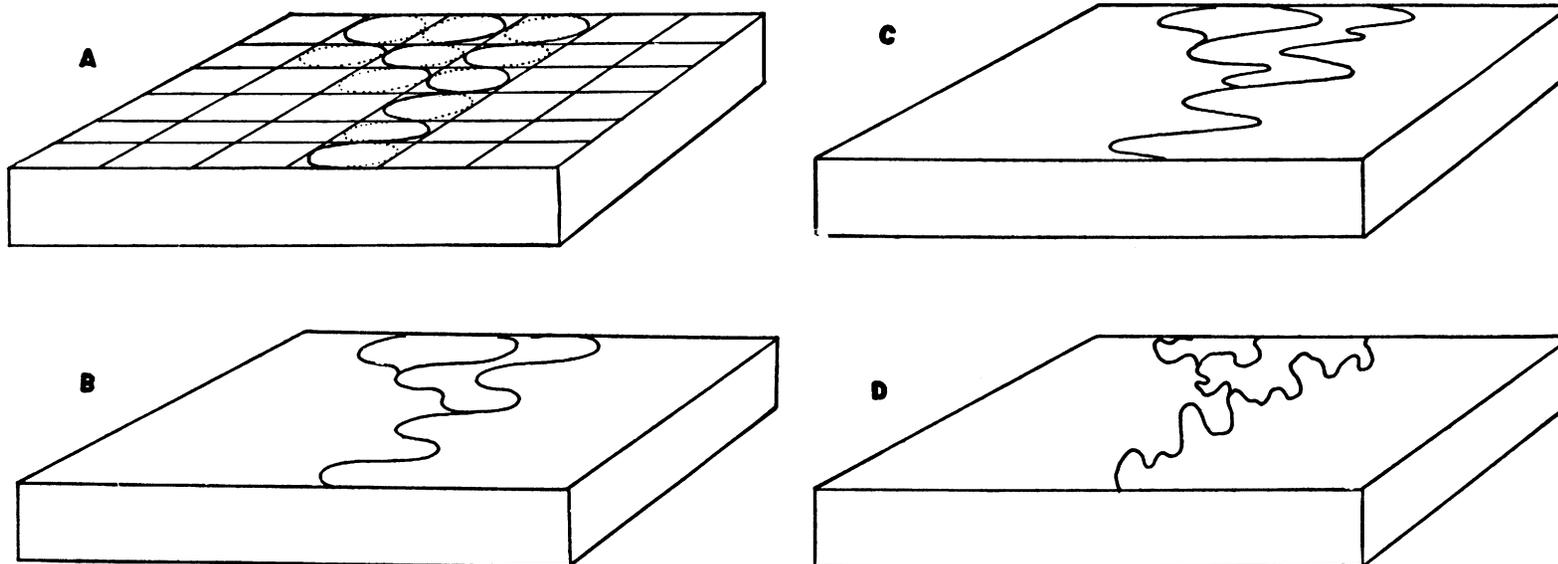


FIG. 40.—The representation of a stream on a flat plain. In block *A* the surface of the plain is laid off in rectangles with inscribed circles which appear as ellipses in perspective. In block *B* parts of different ellipses are joined. In block *C* a freer rendering is effected, thus simulating a simple stream

swinging across the plain. In block *D*, which is incorrectly drawn, the foreshortening of the curves was not attained and the stream does not “lie down” on the plain.

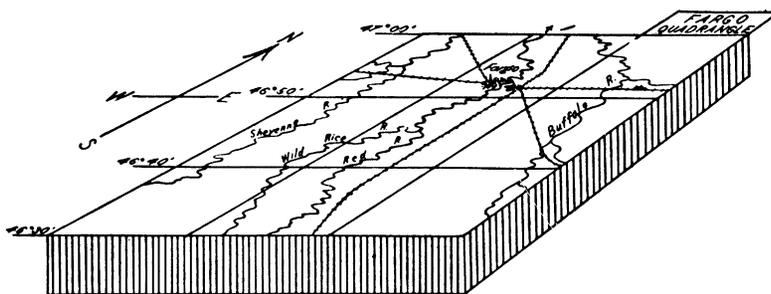


FIG. 41.—Block diagram of Fargo quadrangle, North Dakota. A very young plain.

this floor is so level the rivers have very little gradient and are unable to cut down very rapidly. The streams, although very young, have developed many small meanders. Such streams are technically young, but it is not amiss to say that they also have many of the characteristics of maturity. These streams, at birth, finding themselves upon an almost level plain, assumed a meandering course, and these meanders are now being cut slightly below the level of that plain. The extreme levelness of the country is suggested also by the straight railroads.

PLAINS AND PLATEAUS

28. Representation of wide streams with a double line.—
When the stream is represented by means of a double

Fig. 42. Here the distance from bank to bank seems less
than at a point *M* where the course of the stream is directed

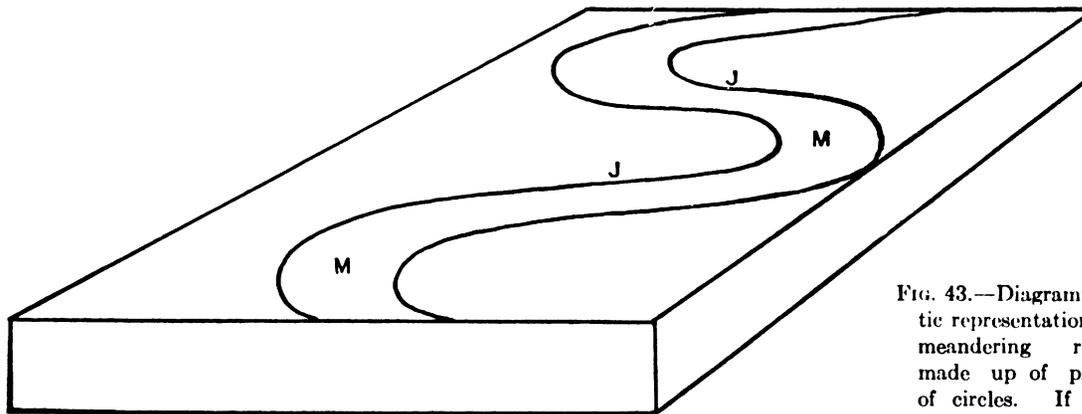


FIG. 42.—Block diagram showing wide river swinging across a flat plain, to illustrate foreshortening at *J*.

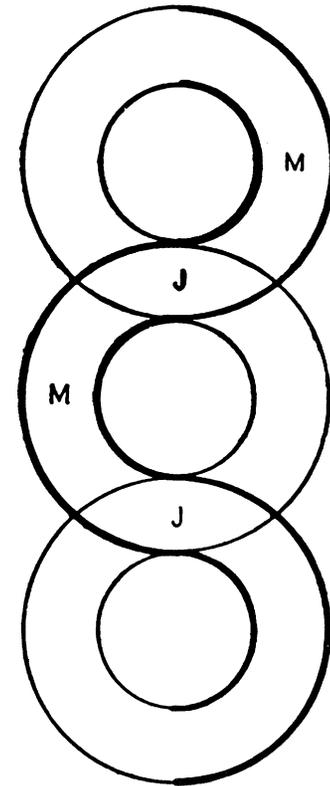


FIG. 43.—Diagrammatic representation of meandering river made up of parts of circles. If the figure is viewed from a low angle with the page held almost on a level with the eye, the effect represented by Fig. 42 is produced.

instead of a single line, the two lines should be drawn close together where they run to the right and left across the drawing, that is, transverse to the direction of sight, as at *J* in

toward the observer. At *J* the width of the stream is foreshortened. The same effect may be noted by viewing Fig. 43 from a low angle with the page held almost level

BLOCK DIAGRAMS OF LAND FORMS

with the eye. This figure purports to be the map of such a river, the curves being true circles. When viewed from a low angle the circles appear as ellipses, and the effect is like that in Fig. 42.

29. A river cut very slightly below a plain.—To represent a river flowing slightly below the level of a broad, flat flood plain, the sweeping curves of the river are first drawn as in Fig. 42. These lines, unlike those used in previous examples, represent not the river itself but the top of the river bank. From these lines then are drawn short vertical

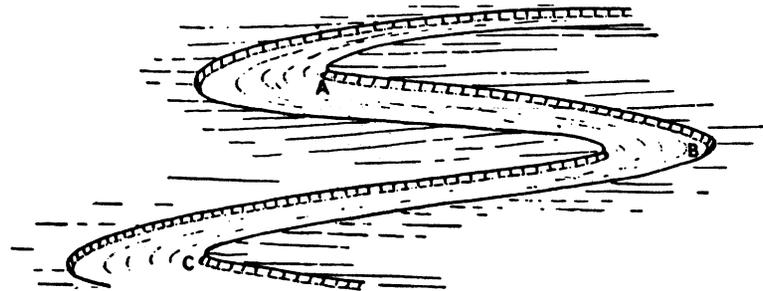


FIG. 44.—Representation of meandering river flowing slightly below level of flood plain.

or almost vertical lines which represent the low cliff bordering the river, as in Fig. 44. The short lines are drawn only on the far side of the river, because, unless the observer is looking across the stream, he is unable to see the river bank. Thus, between the points *A* and *B* the cliff is visible, but at *B* it disappears from view and is invisible between *B* and *C*. At *B*, therefore, no short vertical lines should be drawn beyond the point where they become tangent to the river bank. In Fig. 45 the incorrect method is shown and the result is unsatisfactory and meaningless.

30. Meander spurs.—A stream having large, sweeping curves or meanders usually shows steep undercut slopes on the upstream side and gentle slip-off slopes on the downstream side of the meander spur. These two features, the

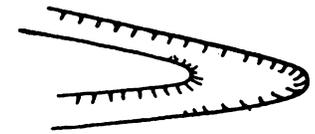


FIG. 45.—Incorrect method of representing river bank, properly done at *B* in Fig. 44.

slip-off slope and the undercut slope, are difficult to represent in the same picture if the observer is looking directly upstream or downstream as in Fig. 44; but they may be represented rather easily if the observer is off at one side of the river, as in Fig. 46.

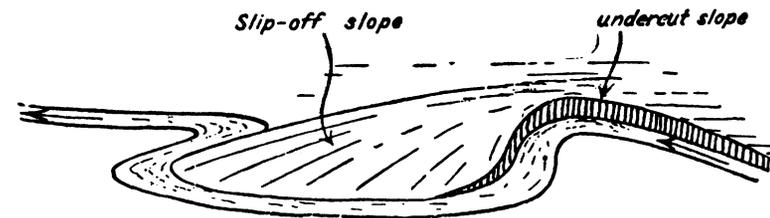


FIG. 46.—A meander spur, showing undercut and slip-off slopes; best represented by viewing the feature from across the stream instead of looking directly upstream or downstream.

31. A plain "creased" by a stream.—The most common type of topography is a plain below which streams have cut to only a slight degree. To produce this "quilted" effect, represent the streams coursing across the plain in the usual fashion, Fig. 47 *A*. Then, tangent to the apex of each curve

PLAINS AND PLATEAUS

(as at *X*, Fig. 47 *B*), draw a line curving upward and flattening out to a horizontal position. These lines represent the profiles of the spurs around which the stream is flowing. Therefore, if, as at the point *Y*, Fig. 47 *C*, and *Y*, Fig. 47 *D*, these spur profiles overlap part of the stream, this portion of the stream should be removed as it is out of sight. But if,

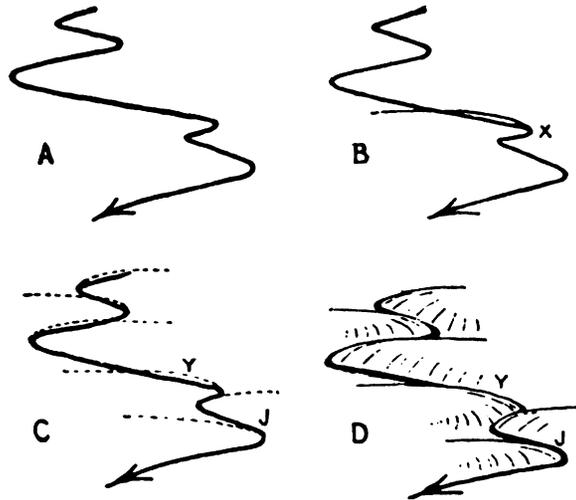


FIG. 47.—The representation of valleys cut slightly below a plain. The spur profiles are tangent to the curves as at *X* in sketch *B*, and flatten out at the top where they meet the surface of the plain.

as at *J*, Fig. 47 *C* and *D*, there is no overlapping, then this part of the stream remains in view. The drawing thus prepared may be further enhanced by shading the hill slopes as in Fig. 47, *D*. These shading lines should be drawn as if running directly down the slope, as hachures do on a map.

32. Shallow trenching and deep trenching.—Streams may be represented as but slightly intrenched if very slight

curvature is given to the spur profiles as in Fig. 48, *A* and *B*. When, however, deep trenching is to be indicated the spur profiles should curve strongly as in *C* and *D* of Fig. 48. When this is done it will be noticed that the spurs overlap each other, and this in consequence causes the lower parts of the spurs to be hidden by spurs nearer to the observer. In other words, when the trenching is deep the stream is out of sight

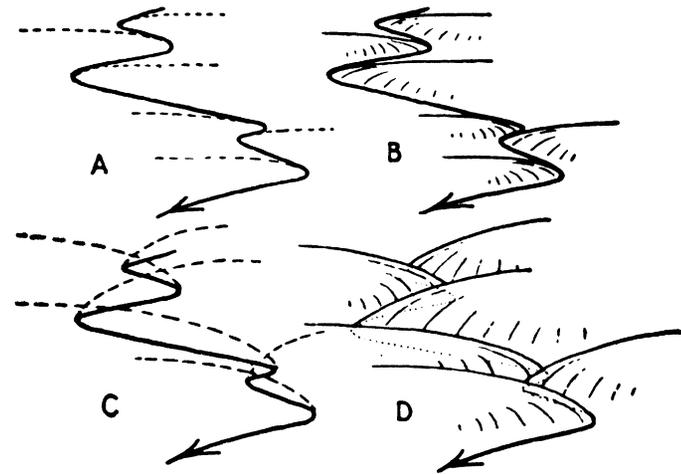


FIG. 48.—Shallow trenching is represented by the flat profiles in Figures *A* and *B*; deep trenching by the strongly curved profiles in *C* and *D*.

(Fig. 48, *D*), but when the trenching is shallow parts of the stream are visible (Fig. 48, *B*).

33. A young plain.—A plain cut by few streams still preserves most of its original surface. It is a young plain. The number of tributaries is small and much of the surface of the plain remains undrained. The divides are broad. The streams are likewise young, the valleys are narrow, and

BLOCK DIAGRAMS OF LAND FORMS

the walls rather steep. These characteristics are expressed in Fig. 49. But the streams dissecting a young plain may advance so rapidly in development that they become mature before the plain has lost its youthful character. Thus in Fig. 50, *C*, the master stream of the region has a mature character; its valley is wide and it flows in a meandering course through a broad flood plain. Its tributaries are still young, and the plain remains in large part undissected.

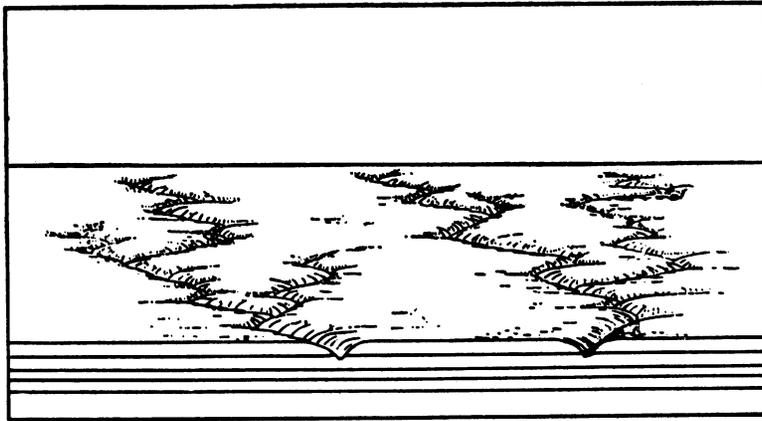


FIG. 49.—A young plain with young valleys.

which might be helpful to the younger student. Such a drawing can readily be placed on the blackboard by the instructor and, in spite of certain crudities and omissions, it gives a touch of life to the lesson. It presents to the beginner a mental picture of what is meant by a young plain. It shows him that a great deal of the plain is still untouched by streams and, studied with the map, it shows that much of the upland surface is so poorly drained as to be marshy.

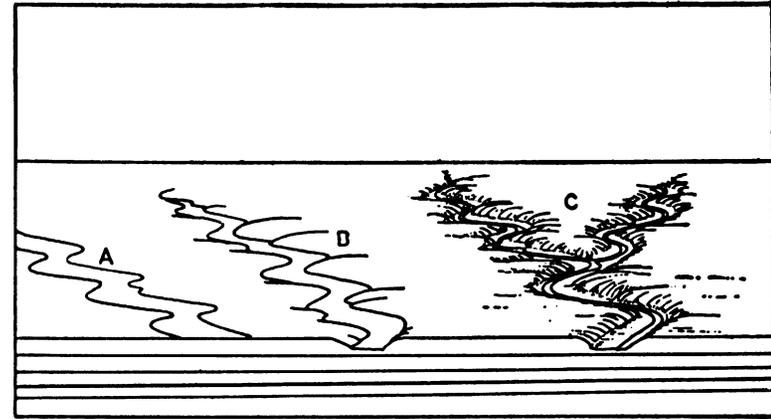


FIG. 50.—A young plain with mature valleys.

The drawing of the mature valley is accomplished in a manner similar to the drawing of a simple stream, except that two lines are first drawn (Fig. 50, *A*), one for each side of the valley. Then each line is treated in the appropriate manner, as shown in Fig. 50, *B*.

34. Specific example: young plain. Trent River quadrangle, North Carolina.—Figure 51 suggests a very simple rendering of this map. It is presented as the type of drawing

Such a condition does not exist where the drainage is more perfectly developed. Another result of this undissected condition is expressed in the straight roads and railroads, one railroad running some fifteen miles across the map without a curve. Such towns and settlements as do exist are on the upland rather than in the stream valleys, because it is on the upland that communication is best developed.

A hint to the teacher upon preparing a drawing of this

PLAINS AND PLATEAUS

kind would be to omit irrelevant details, emphasize the few points that are to be especially stressed, and remember that a block diagram is a device, a tool, which should serve the teacher as he wishes and not make a slave of him by creating an undue respect for details.

35. Specific example: plain in late youth. **Wilson quadrangle, North Carolina.**—The representation of a plain somewhat further advanced in development than that shown in Fig. 51 is represented by the Wilson sheet, Fig. 52. The

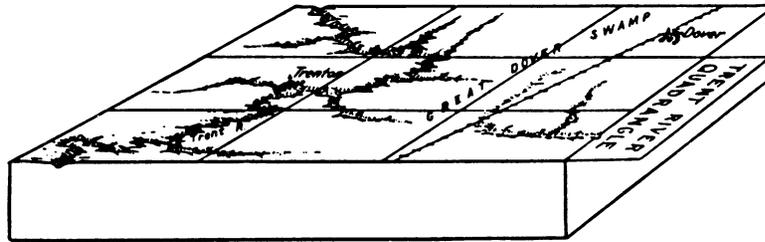


FIG. 51.—Block diagram of the Trent River quadrangle, North Carolina. A young plain.

main stream of the district, Contentnea Creek, has already attained maturity, but most of its tributaries are still young. The plain as a whole is much more dissected than that shown in the Trent River quadrangle, so that much less of the flat upland remains. This may be due to the fact that the Wilson area is a more inland portion of the coastal plain, that it was uplifted first, and has been longer subjected to erosion. Even so, the upland still serves as the site for towns. Railroads and roads select the upland rather than the valleys and are very slightly interrupted in their straight courses by the topography. It will be noted in Fig. 52 that somewhat more freedom has been exercised in representing the

valleys. The process of drawing two wavy lines to represent the two sides of a wide valley, as shown in Fig. 50, was not literally followed, but a similar effect was obtained by having in mind the general character of such a valley.

Most of the maps of the Atlantic coastal plain could be used in drawing block diagrams of young plains: such for instance as the Falkland and Winterville sheets, North Carolina; the Hurlock and Denton sheets, Maryland; and the

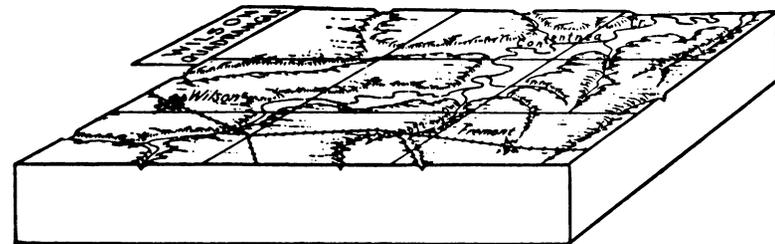


FIG. 52.—Block diagram of Wilson quadrangle, North Carolina. A plain in late youth.

Wicomico sheet, Maryland-Virginia. This last shows a somewhat more advanced stage than the others.

36. A mature plain.—The representation of a mature plain is suggested in Fig. 53. In the right-hand part of the drawing the device used is the same as in Fig. 49, but many more tributaries are introduced. The result is that the plain is thoroughly dissected. All slopes lead toward the streams, and there are no extensive undrained areas as in young plains. At the left in Fig. 53, a simpler, somewhat conventional, and more easily drawn device for representing a maturely dissected plain is presented. The foreground shows the horizontal structure of the plain.

BLOCK DIAGRAMS OF LAND FORMS

37. Specific example: mature plain. Elk Point quadrangle, South Dakota-Nebraska-Iowa.—This region will be found especially suitable as an example of a mapped area

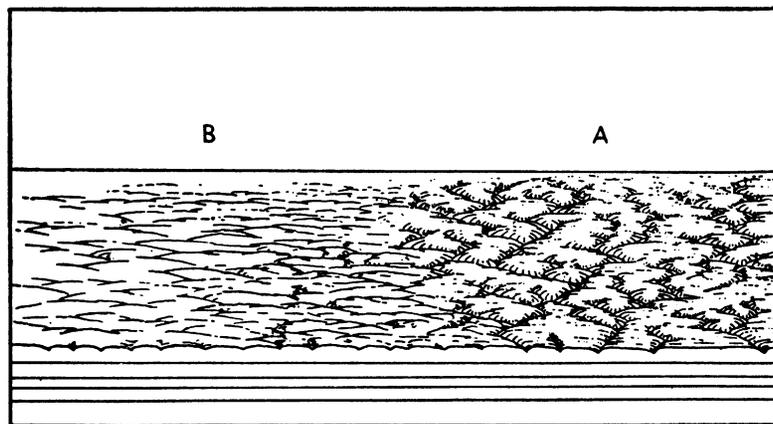


FIG. 53.—Representation of maturely dissected plain, showing two methods of indicating relief.

which may be transformed into a block diagram. In the Elk Point Folio, No. 156, of the U. S. Geological Survey, there are given two cross-sections showing structure. Thus, with the aid of the geological map a very accurate and detailed drawing may be made. In Fig. 54 the structure of this quadrangle with the names of some of the formations is shown, but a larger drawing would make possible still greater detail.

The upland on either side of the Missouri valley is maturely dissected by streams which are still young. The broad valley of the Missouri River, however, is a splendid example of a mature valley and the Big Sioux valley is similar in this respect. It will be noted that the main railroads of the region follow the floors of these broad valleys and the largest towns likewise are located there. Other points of interest are the ox-bow lakes like Lake Goodenough, McCook Lake, and the marsh at Elk Point, representing old meanders of the Missouri River. Worth noting also is the peculiar parallel course of the Big Sioux River on the side of the

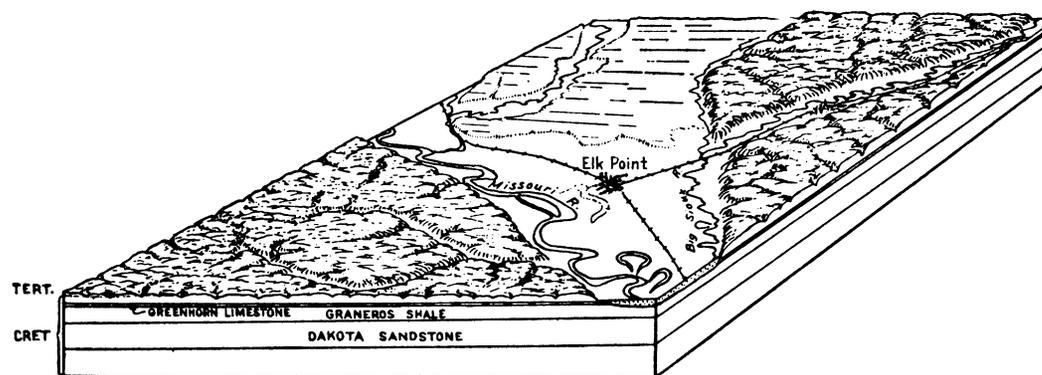


FIG. 54.—Block diagram of Elk Point quadrangle, South Dakota. A plain maturely dissected by youthful streams tributary to mature stream.

PLAINS AND PLATEAUS

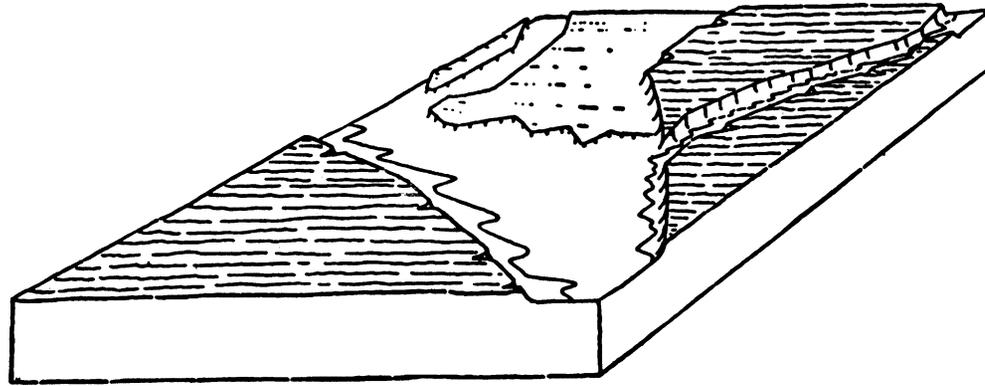


FIG. 55.—Freehand sketch, basis for blackboard illustration of Elk Point quadrangle, more carefully drawn in Fig. 54.

Missouri flood plain. This is due to the fact that, in building up its flood plain, the Missouri River forces its tributaries over to the valley wall in the same way as the Mississippi has done with the Yazoo River.

The teacher wishing to represent hastily a region of this kind upon the blackboard will do well to follow some such method as that advanced in Fig. 55. If the upland outlines are represented in a more or less angular fashion they can be drawn rather quickly, and the whole drawing, in spite of its crudity, will convey to the student a helpful picture. Other maps which will serve as examples of maturely dissected plains are the Iuka, Mississippi-Alabama-Tennessee quadrangle, and the Patuxent, Maryland-District of Columbia quadrangle.

38. An old plain.—It will be noted in Fig. 53 that a mature plain represents the most rugged stage in the dissection of the plain. After this stage is passed the region is worn down again to a rolling lowland in which low hills here and there are the only evidence of the former level. Such a

condition is represented in Fig. 56. Type examples of this stage are difficult to find in nature, because most old plains have later been rejuvenated. Perhaps maps like those of southern Arkansas and adjacent parts of Oklahoma approxi-

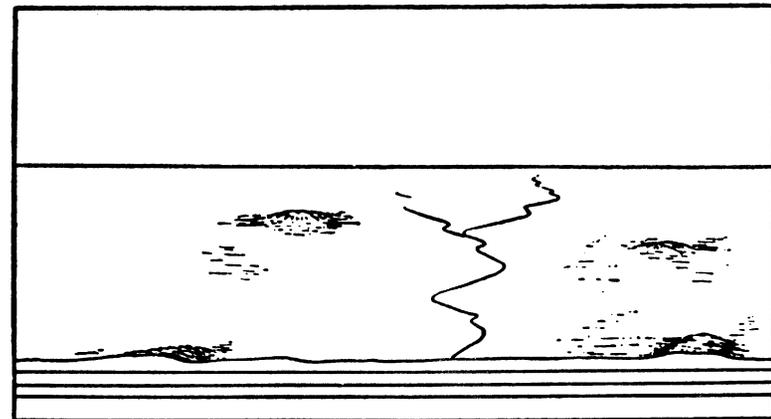


FIG. 56.—An old plain with scattered residuals.

BLOCK DIAGRAMS OF LAND FORMS

mate this condition as closely as any. The Canadian, Oklahoma, sheet may be mentioned as one of them.

39. Plateaus. The use of solid geometrical forms as bases for topographic features.—Plateaus, mesas, and tablelands may be developed from artificial-looking rectangular

square-edged blocks, wedge-shaped blocks, cylinders, cones and spheres, are readily drawn in perspective, whereas a systemless maze of canyons, peaks, and valleys is likely to bewilder the novice. These simple, geometrical forms are then readily elaborated, and by smoothing down the awk-

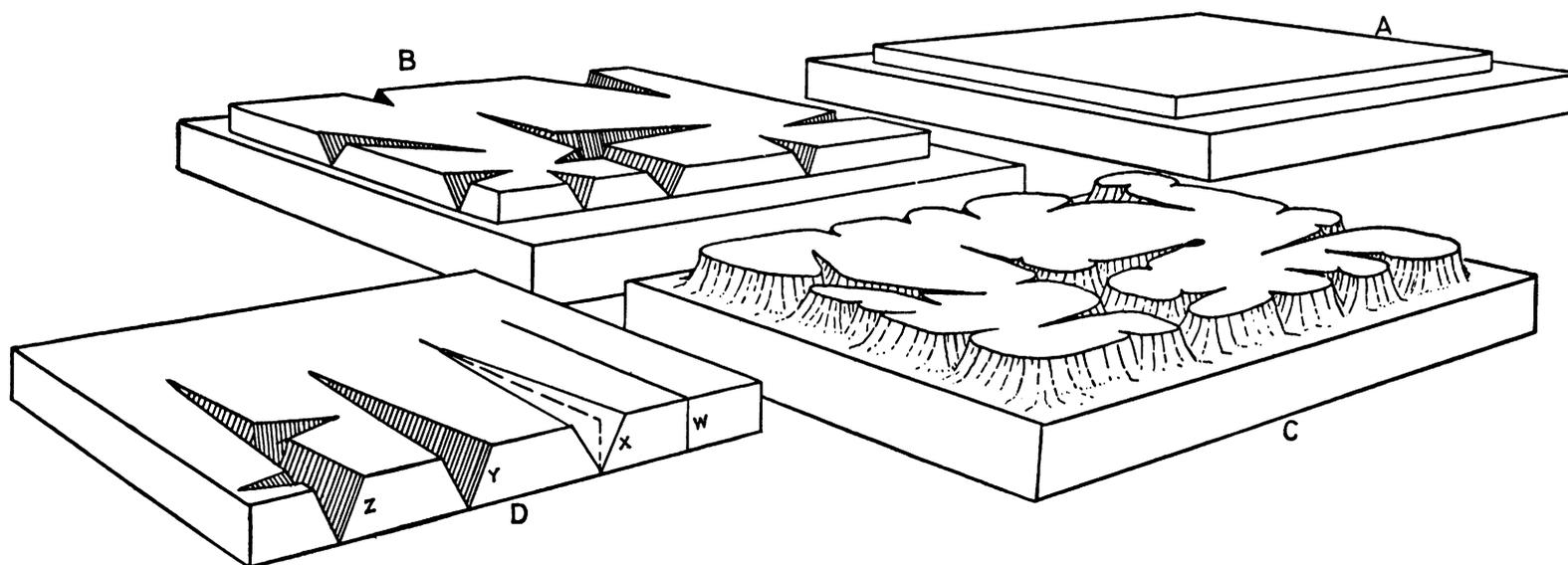


FIG. 57.—Blocks to show several stages in the representation of a dissected tableland. Block A, before dissection; block B, gorges and canyons represented by straight lines; block C, same with corners rounded.

Block D shows how to draw a gorge by drawing the medial line *W*, then the valley walls at *X*, and later shading the slopes.

blocks. In fact, it may be noted here that in the representation of all the land forms which follow—not only plateaus, but dome mountains, folded mountains, block mountains, as well as the apparently disordered features produced by glacial erosion—it will be found advantageous to reduce these forms first to some geometrically simple pattern. Forms common to mechanical drawing, and made up of straight lines,

ward places and adding some detail a certain naturalness is readily imparted to a drawing which a few moments before was quite unconvincing in appearance.

40. A tableland slightly dissected.—A rectangular block serves as the mass out of which may be carved the features of a plateau. In Fig. 57 the several stages in this whittling-out process are shown. Block A represents the undissected

PLAINS AND PLATEAUS

block. Block *B* is the same block notched by a number of gorges, all features being shown mechanically with straight lines. Block *C* represents the same area with some of the angularities rounded off and a few minor details added. As the drawing of streams and notches of this character will be demanded of the student in the representation of many of the succeeding types of land forms, it is worth while to note some of the essential principles of construction. Block *D* in Fig. 57 shows the several stages in the drawing of a single notch. First a single line, *W*, is drawn to represent the medial position of the valley. Then the valley walls are drawn, as at *X*, so that at the mouth of the valley they are equidistant from the medial line. The valley side may then be shaded as shown, and tributaries added, as at *Y* and *Z*. Medial lines for the tributaries are drawn the same as for the main stream. This procedure may seem rather artificial inasmuch as streams never have such regular shapes; but the student will find that, by establishing something uniform and definite in his mind, he will have a tangible picture from which he can readily depart in order to produce the more intricate forms of nature.

41. Young, mature, and old plateaus.—Figure 58, *A*, *B*, *C*, *D*, *E*, *F*, shows simple methods of presenting the characteristics of a plateau in different stages of dissection. Any of these views may be transformed into rectangular block form if desired, without altering the representation of the surface features. The method used here, however, conserves space, whereas the block form, although often more attractive to the student, sometimes requires more room on the page than it is justified in using. The first tier of drawings, *A*, *B*, and *C*, in Fig. 58, represents the stages of a plateau in a more or less arid region where the valleys are canyon-

like with sharply cut walls. The second tier, *D*, *E*, and *F*, represents a more humid region, with the valley walls

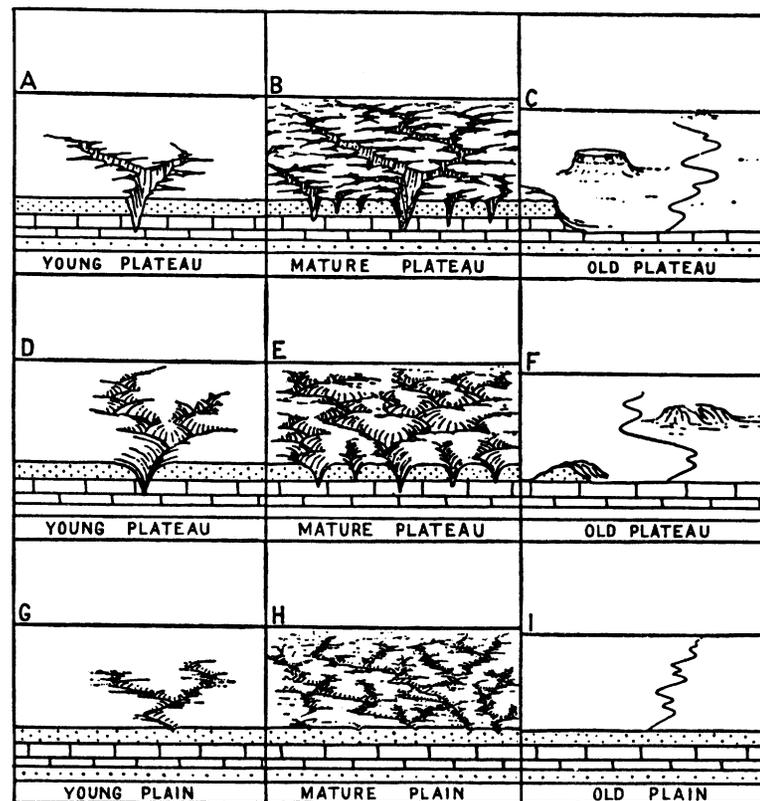


FIG. 58.—Simple method of showing comparison between young, mature, and old plains and plateaus.

rounded. The general aspect of such a country would be quite different because of the more abundant vegetation. In the third tier, *G*, *H*, and *I*, the more gentle features of a plain

BLOCK DIAGRAMS OF LAND FORMS

are shown for comparison, the essential difference between a plain and a plateau being the difference in the depth to which dissection has gone.

The arrangement in Fig. 58 is introduced to show the value of making comparisons. A drawing is more than

which the ambitious student may refer, are to be found in his *Beschreibung der Landformen*: Fig. 23, the development of valley slopes; Fig. 58, the influence of contrasted structures upon the stage of development; Fig. 96, the development of a belted coastal plain; Fig. 188, the development

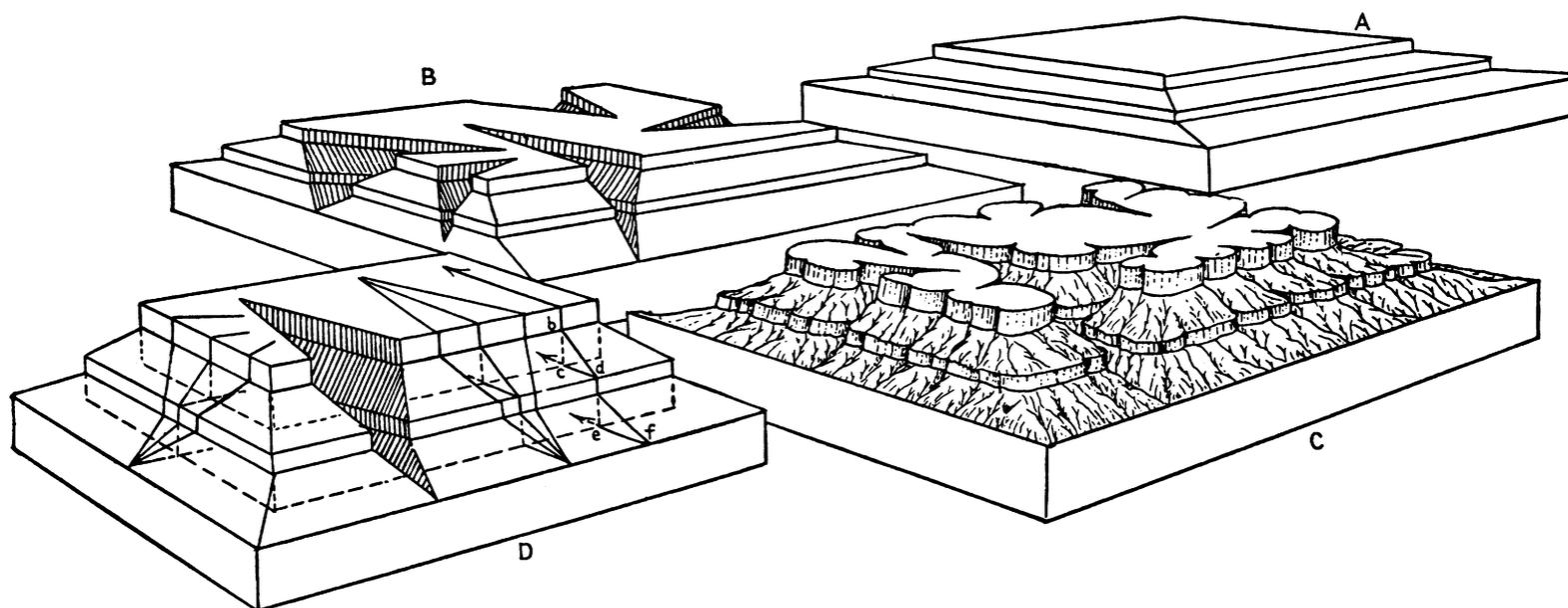


Fig. 59.—Blocks to show several stages in the representation of a dissected tableland made up of several hard and soft layers. The method is completely described in Section 42 of the text.

doubly enhanced in value if it becomes a member of a series. Professor Davis has shown great skill and taste in presenting series of from two to six or more drawings as part of the same figure, in order that the eye, and consequently the understanding, may be carried from one to the other with as little inconvenience as possible. Good examples of this, to

and destruction of a barrier beach. Figure 1 illustrating his paper on the Rocky Mountain Front Range is another good example.

42. Plateaus and canyons of a more complicated character.—The plateaus just indicated suggest uniformity of structure throughout, whereas usually there is an alternation

PLAINS AND PLATEAUS

of resistant and weak beds. The resulting terraces and steps in the erosional forms may readily be represented if the forms are reduced to conform with some simple geometrical pattern.

In Fig. 59, block *A* represents the block out of which the plateau features are to be carved. Two hard formations are represented, each underlain by a softer member. Block *B*,

readily explain themselves. The lines *bc* and *de* are drawn vertical; *cd* and *ef* are directed toward the vanishing point, far away at the left.

The artificial appearance of the plateau may be still further overcome by the use of greater freedom in representing details; but it is nevertheless very desirable at the

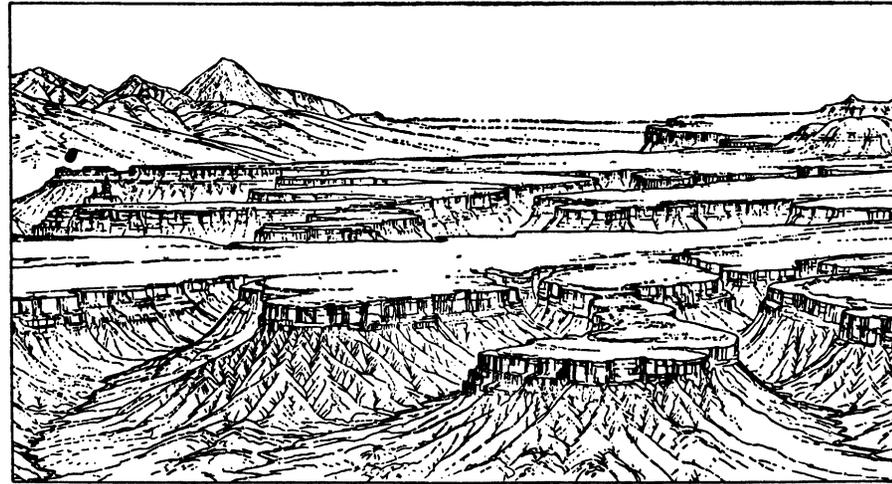


FIG. 60.—Picture of a submaturely dissected plateau, the Mesa Verde, in Colorado. (U. S. G. S.)

similar to block *B* in Fig. 57, shows the plateau cut by a number of notches or canyons, and block *C* shows the same with the angularities rounded off, and with a few details added. Block *D* shows several stages in the representation of the notches. At first a medial line is drawn. This is done accurately by projecting each hard formation down through the underlying soft series to the top of the next hard formation and making use of the construction lines *bc*, *cd*, *de*, and *ef* to determine the points *d* and *f*. These construction lines

outset to block out the drawing along geometrical lines. Modifications may then readily be introduced. This is better than to think in terms of details and overlook the essential form of the larger mass. Fig. 60 is a liberal application of the principles here set forth. It is a sketch, but also may be conceived as a part of a block diagram whose sides are outside of the view. A picture of this kind, whether drawn from a photograph or sketched in the field, may be transformed into a block diagram of any shape desired. The

BLOCK DIAGRAMS OF LAND FORMS

representation of a cross-section on this sketch is shown in Fig. 61. The problem of cutting out a block in either two-

43. Specific example: young plateau. Part of Watrous quadrangle, New Mexico.—Figure 62 represents the south-

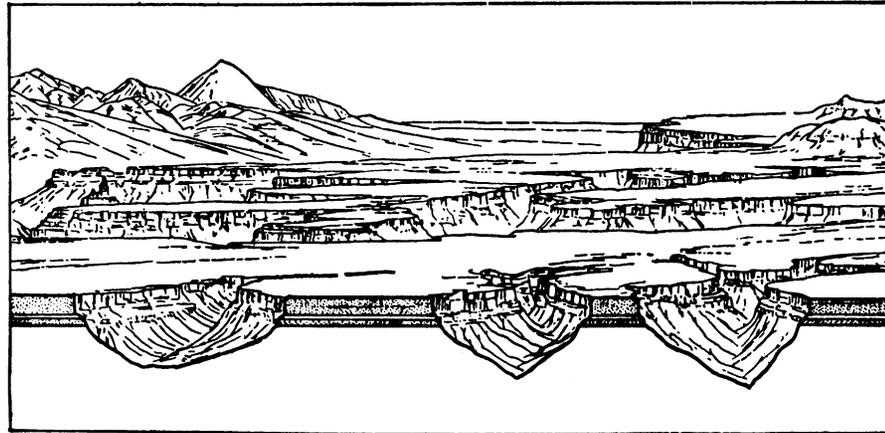


Fig. 61.—The same as Fig. 60 transformed by placing a cross-section through the front part of the picture in order to show geological structure. Any picture can be altered in this manner.

point or one-point perspective is left to the student as a suitable task for the exercise of his acquired skill.

eastern corner of the Watrous quadrangle. The features are portrayed in a purely diagrammatic manner with considerable

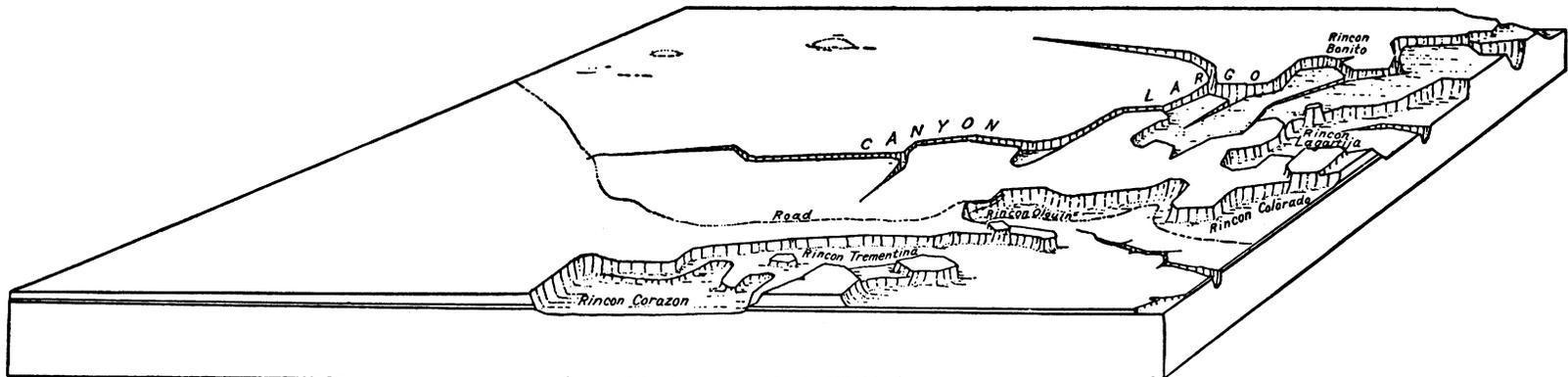


Fig. 62.—Block diagram of southeastern corner of Watrous quadrangle, New Mexico, a young plateau.

PLAINS AND PLATEAUS

angularity. In this case, because of the natural sharpness of the topographic forms, the departure from nature is not unduly great. It will be noted that there has been no slavish regard for details. The essential element of the topography to which especial attention should be directed is the step, terrace, or bench-like arrangement of the canyon walls, revealing definitely the horizontal rock structure. There is no topographic map which displays such diagnostic characteristics better than this one. The canyon of Mora River in the central part of the Watrous sheet would also serve as an admirable subject for a block diagram, similar to Fig. 62, but somewhat simpler. The outer and inner walls of the canyon, due to differential erosion on horizontal structure, are remarkably well shown.

The Marsh Pass sheet, Arizona, reveals horizontal structure almost as satisfactorily, especially the canyons in the northern part. In fact this entire sheet would make an admirable and instructive drawing. In the southern half of the map, Zilh-Le-Jini mesa is a great plateau slightly warped down toward the center so that it is essentially a flat syncline pitching gently southward.

The Mesa de Maya sheet, Colorado, provides another splendid example of a young plateau. Less rugged than this is the Macomb quadrangle, Illinois, which represents a very young plain or plateau, the relief being much slighter than in the previous examples.

44. Specific example: mature plateau. Scottsboro sheet, Alabama.—As an example of a maturely, or better, a submaturely, dissected plateau, this sheet is most useful. The drawing, Fig. 63, represents the entire quadrangle. It is strictly diagrammatic like Fig. 62 and may serve to suggest still further a method of treatment which will be found

advantageous. The omission of details not only conserves time in the preparation of the drawing but frees the drawing of the distractions which would otherwise obscure the essential facts. A drawing of this character can readily and hastily be placed on the blackboard by the teacher without undue sacrifice of time. Although no apologies are here intended, nevertheless it should be emphasized that this type of drawing lacks a certain degree of elegance which can be attained only by the application of care and a critical study

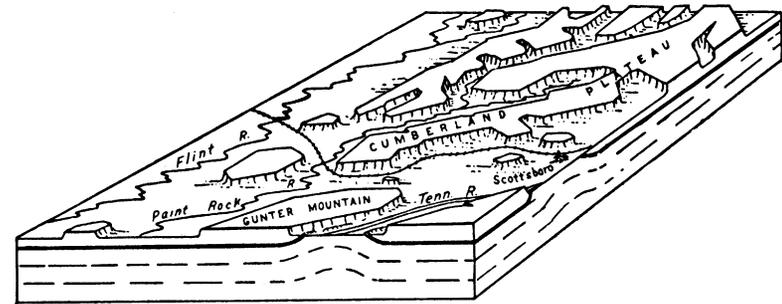


FIG. 63.—Block diagram of Scottsboro quadrangle, Alabama. A maturely dissected plateau. A simple and purely diagrammatic method of presentation, useful for hasty blackboard drawings.

and balance of details. From the map alone one would hardly be expected to know the anticlinal structure of the Tennessee valley although the longitudinal ridges are distinctly represented by the contours.

Another example of a mature plateau is furnished by the Iaeger quadrangle, West Virginia-Virginia, and other sheets in that vicinity. The representation of this area might better follow some device like that used in Fig. 58, *E* or *H*, than the harsh angular method of Fig. 63 or the canyon symbol of Fig. 58, *B*.

BLOCK DIAGRAMS OF LAND FORMS

45. Specific example: old plateau. Goshen Hole, Scotts Bluff and Camp Clarke sheets, Nebraska.—The area comprised in these maps may be considered an old plateau. The mesas in the middle are the remnants of the formerly continuous surface, now represented elsewhere only on the

46. A canyon viewed from below its margin.—In all the plateaus thus far presented, the observer is well above the highest point and looks down upon everything in view. Sometimes, however, it is desirable to draw a canyon as seen from below its rim, as in Fig. 3. A view of this kind loses its

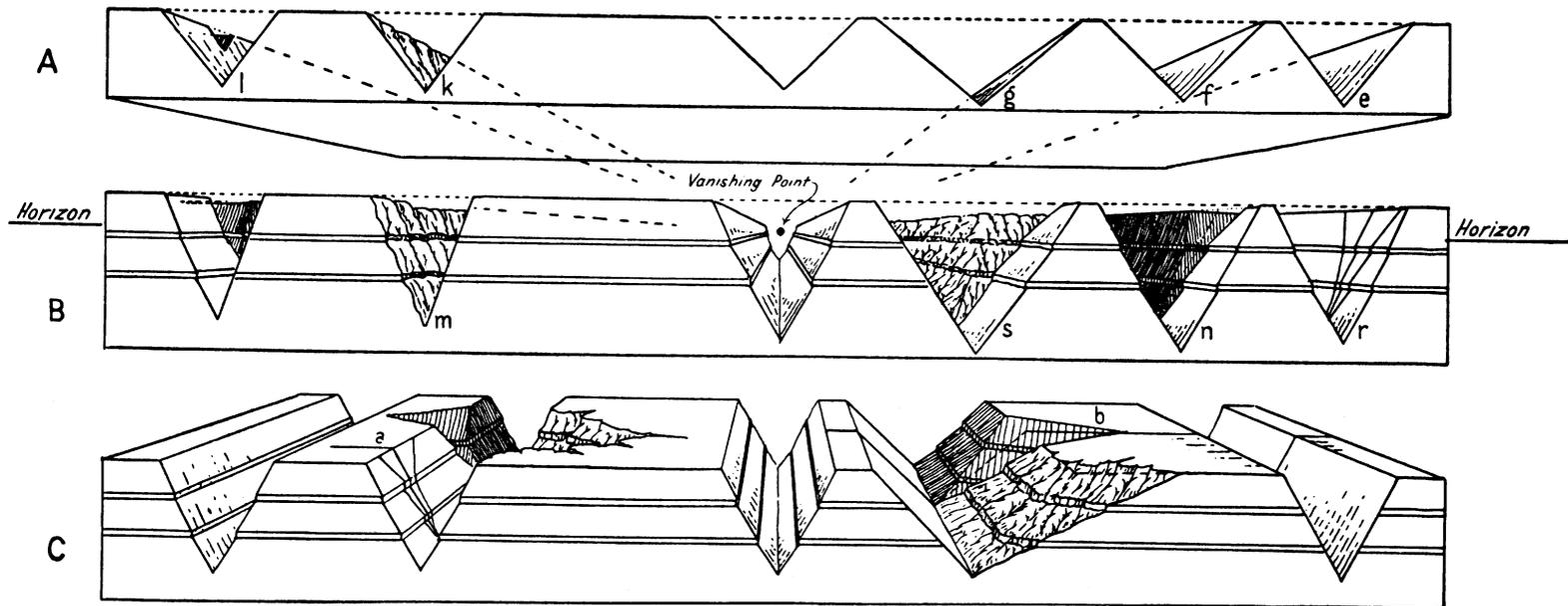


FIG. 64.—Canyons drawn in different positions relative to the observer. In A all of the canyon is above the observer; in B the top of the canyon is above

the observer, the bottom is below; in C all of the canyon is below the observer.

southern and northern margin of the sheets. The illustrations in the Scotts Bluff and Camp Clarke folios will serve as guides to the type of topography here represented. The portrayal of this area, either one sheet, or the three sheets together, is left as an exercise for the student, who will find it a most admirable subject.

resemblance to most block diagrams and becomes essentially a picture or sketch. But, as mentioned before, any sketch can be turned into a diagram shaped like a block and providing faces for structural cross-sections.

Figure 64 represents three blocks, A, B, and C, drawn in one-point perspective. All of block A is above the

PLAINS AND PLATEAUS

observer's eye. The surface of block *B* is also above the observer's eye. The vanishing point is on the horizon in the center of the picture. To this vanishing point are directed all lines at right angles to the plane of the picture. That is to say, all of the canyons and valleys shown on the three blocks, except the small tributary notches, trend in a direction at right angles to the front of the block. The canyon walls are drawn toward the vanishing point in every case, but it will be noted that the appearance of the canyon depends to a great extent upon the position of the block in which it is cut. Obviously it is not easy to foresee all the difficulties which may arise and to suggest means by which they may be overcome; but it will be helpful to the student, in looking over the three blocks in Fig. 64, to note such points as the following:

1. The canyons farthest to the right and left of the observer present to view a larger area of wall space than those in the middle of the block. This is true whether the canyon is viewed from above or below. Therefore some position like *a* or *b* in block *C*, or *m* or *n* in block *B*, or *e*, *f*, *k*, or *l* in block *A*, renders it possible to express more detail on the canyon walls, such as tributary gorges, than would a position in the center of the drawing.

2. The drawing of tributary gorges is aided by drawing first a medial line, in the manner suggested in Figs. 57 and 59. Thus in Fig. 64, block *B*, the three canyons, *r*, *n*, and *s*, show first in *r* the medial line with the edges of the notch outlined, then in *n* the walls shaded as plane surfaces, and finally in *s* the canyon sides broken up by numerous gullies.

47. A coastal plain. The block.—The usual purpose in drawing a coastal plain in block form is to provide a graphic means for explaining the successive stages in the development

of coastal plain features. That is to say, the diagram serves to illustrate the deductive method of treatment. This is likewise true in the use of block diagrams to illustrate the development of block mountains, dome mountains, folded mountains, and other constructional land forms.

Figure 65 shows in the background a simple undissected block from which the coastal plain features roughly represented in the foreground are to be carved. The drawing

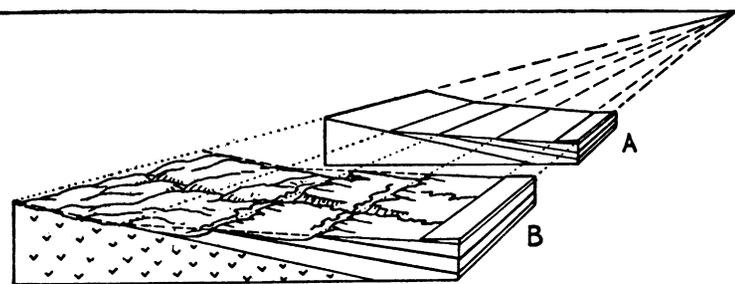


FIG. 65.—Coastal plain in one-point perspective. Block *A* shows the method of laying off the block which later may be modified by stages to indicate the successive forms which lead to the condition represented in block *B*.

makes use of the one-point system of perspective because this gives a full cross-section at the side of the block. As a good understanding of the geological structure is indispensable to a clear comprehension of the features produced by erosion, it is highly desirable that a good full view of the side of the block be presented to the observer, and consequently the one-point system is used.

Figure 66 shows again the undissected block, with certain invisible lines indicated by dots. In the preparation of the block, the front cross-section should be drawn first and the block built on to it. The construction lines are necessary in

BLOCK DIAGRAMS OF LAND FORMS

order to determine the position of points *m*, *a*, and *b*, and the slope of *ma*, and *ab*.

Figure 67, *A*, represents a similar block with some modification in the attitude of the sedimentary beds constituting the coastal plain. Either of these drawings, Fig. 66 or Fig. 67, *A*, will serve as a block from which may be carved the features of a dissected coastal plain. If Fig. 66 is used it will be noted that the lowlands subsequently developed upon the exposed edges of the softer beds are all

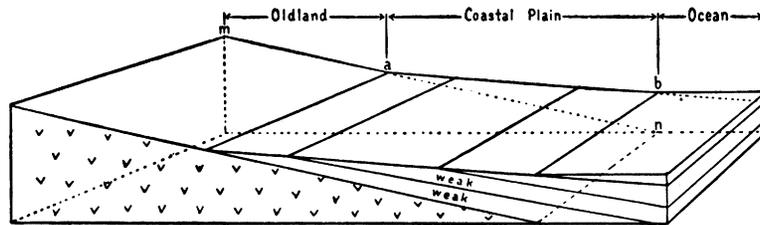


Fig. 66.—Outline of block for coastal plain, in one-point perspective; to show construction lines necessary in drawing the block.

formed simultaneously. But in Fig. 67 the highest or outermost cuesta must be pushed far seaward before opportunity is offered for the development of a cuesta upon the next resistant formation beneath. This development is represented in Fig. 67, *B* and *C*.

A criticism may be offered against the drawings used in Fig. 67 to the effect that they occupy too much space. There is lack of compactness, a matter which is important for textbook illustrations. The drawings in Fig. 67 are suitable for blackboard use, however. Block *A* is readily drawn freehand upon the blackboard. The various stages leading up to *B* and *C* may then be shown by erasing the parts already drawn so that the student observes the actual change from

one phase to another. This; however, can not be done on the illustrated page, but some device like Fig. 68 serves the same purpose. It is compact and shows the change in development from the very youthful condition prevailing in the

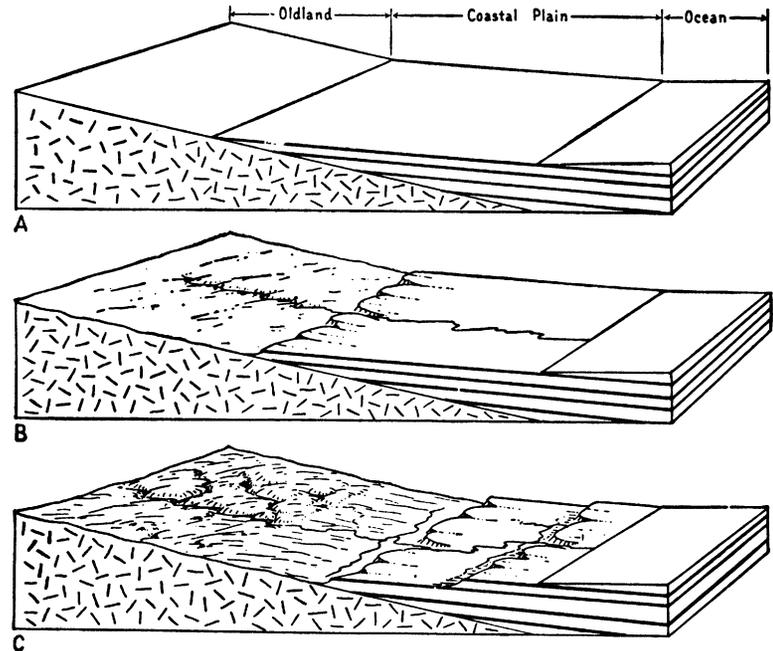


Fig. 67.—Successive stages in the erosion of a coastal plain, shown in one-point perspective. The cross-section of the coastal plain differs from the one in Fig. 66 in that the formations overlap landward, with the result that the subsequent lowlands are not formed simultaneously.

back part of the drawing to mature dissection in the front. The different types of streams are indicated by an initial letter: as consequent, *C*; extended consequent, *EC*; subsequent, *S*; resequent, *R*; and insequent, *I*. The outer low-

PLAINS AND PLATEAUS

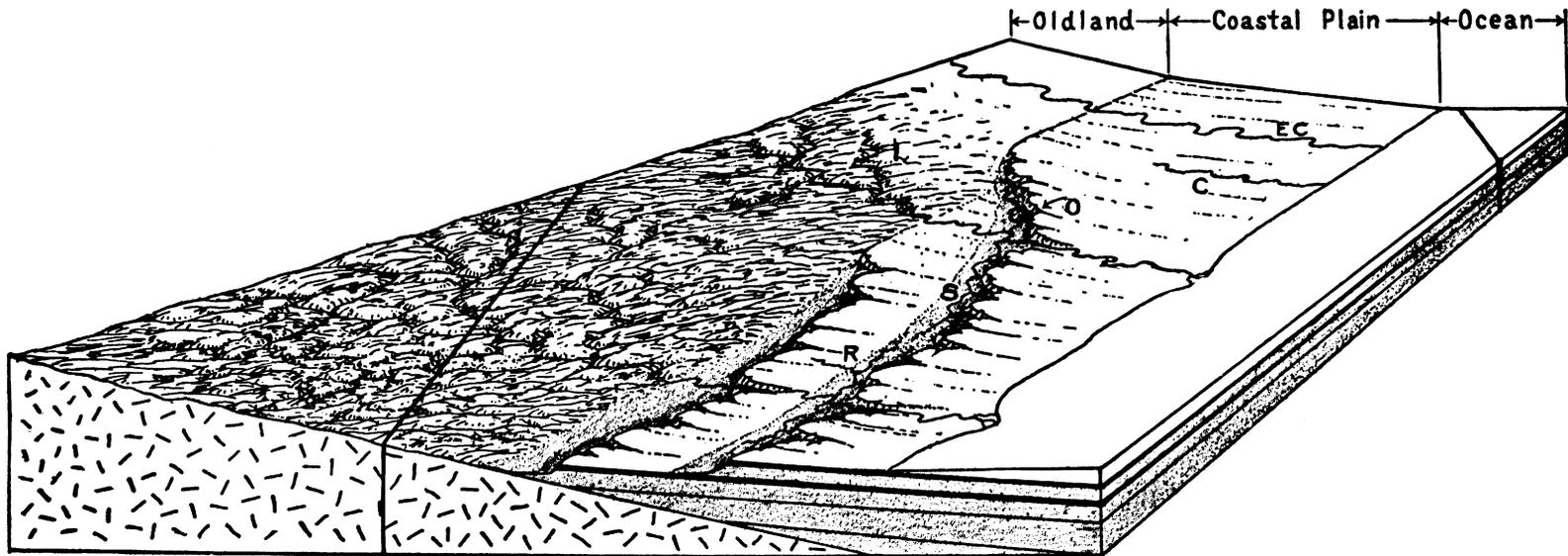


FIG. 68.—Block combining in one illustration the several stages represented separately in Fig. 67. The heavy lines at the right and left show how these useless corners might be eliminated to save room.

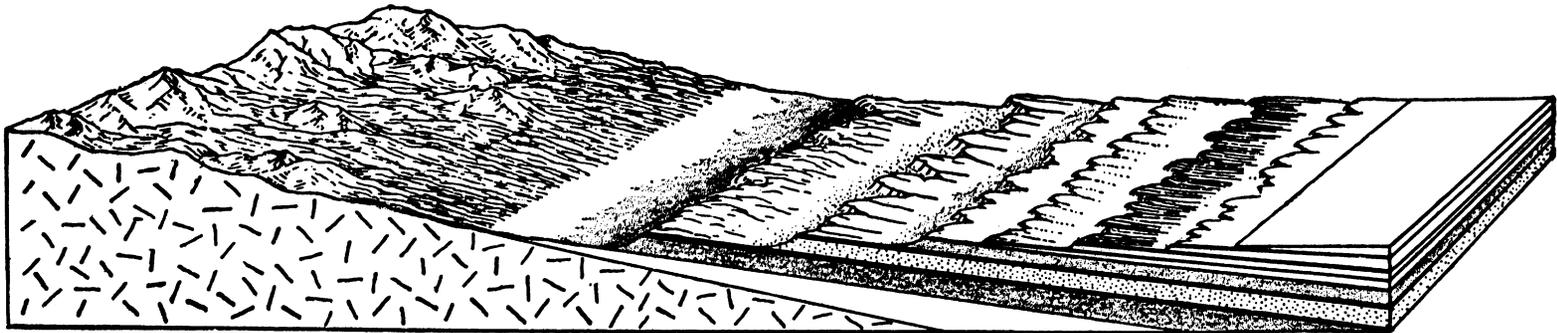


FIG. 69.—Block drawing to illustrate several methods of representing cuestas in order to give each one an individuality of its own.

BLOCK DIAGRAMS OF LAND FORMS

land, the inner lowland, the fall line, the cuestas, wind gaps, beheaded and inverted streams may be similarly labeled. It is suggested that drawings like Fig. 68 can readily and cheaply be reproduced in quantity for laboratory use so that each student may supply on his individual copy the names of different features and types of streams. Fig. 68 may be further improved by eliminating the corners at the right and left as suggested by the heavy lines. This makes it possible to reproduce the important portion on a larger scale or to utilize it so that less room on the printed page is required.

48. The coastal plain. Differentiation of cuestas produced by differing rock layers.—Cuestas vary in character owing to the differences in the rocks which produce them. Some cuestas are distinct escarpments; others are more rounded and flowing in outline. It is usually worth while to suggest these differences, and by judicious shading it will be possible to give a distinct character to each cuesta, as suggested in Fig. 69. Davis does this with great skill, as in his *Beschreibung der Landformen*, Fig. 99.

49. Specific examples: cuestas of mature coastal plains.—*a.* New Jersey. *b.* England. *c.* France. *d.* Wisconsin and New York. *e.* Germany and Sweden.

a. Figure 70 presents in skeleton form a block diagram representing four topographic maps of New Jersey. These maps may be studied in connection with the geological map of the state and thus a very detailed diagram, indicating each geological formation in cross-section and in outcrop, may be prepared. The diagram here shown is simple and generalized but suggests the way the drawing should be laid out. The labeling of other features, such as the streams, the individual hills, and Sandy Hook, and the introduction of

smaller towns, might serve to give more realism to the drawing. The purpose for which the sketch is made should determine the data to be indicated. If it is to illustrate the geology, then all formations should be represented and labeled and the outcrops dotted in, even though no control

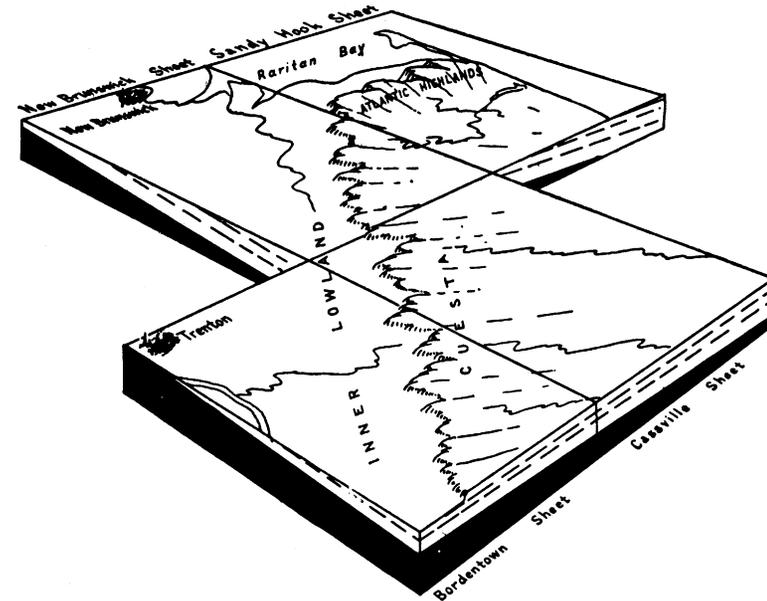


FIG. 70.—Block diagram in two-point perspective showing topography of four quadrangles in the coastal plain region of central New Jersey.

is exerted upon the topography. On the blackboard these formations can readily be colored. For laboratory and individual use students could be provided with simple outline drawings similar to Fig. 70, and be required to represent the outcrop of various formations, using different degrees of shading, colored pencils, or water color. A most instruc-

PLAINS AND PLATEAUS

tive diagram would comprise a larger area, such as all of New Jersey, unless a very detailed problem were under consideration.

If the purpose of the drawing is to bring out certain human relationships, then more towns should be shown, as

maps represent only a narrow strip across the English coastal plain. With the geological map the larger relationships are made clear. Blocks *A* and *B* in Fig. 71 represent two different points of view of the same area. Block *A* is the better selected one because the edges of the escarpments

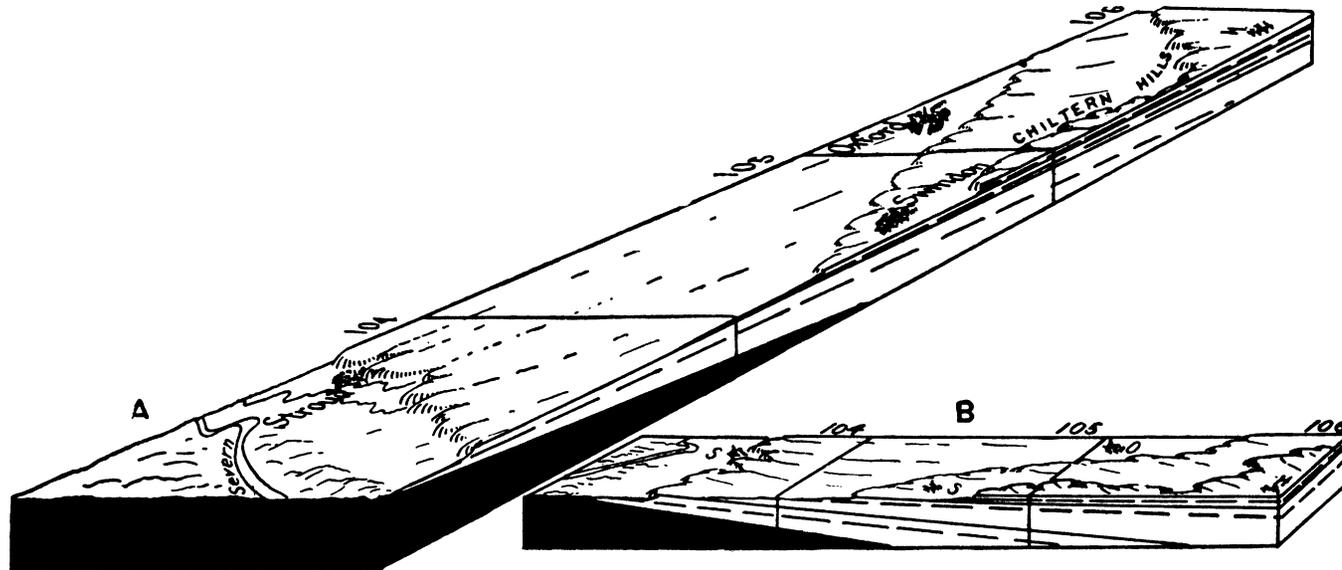


FIG. 71.—Block diagrams of part of southern England, vicinity of Oxford, showing coastal plain topography; representing sheets 104, 105, 106 of

the British Ordnance Survey (large sheet series, one inch to a mile). Block *B* represents the same area as block *A*, viewed from a different angle.

well as the chief railroads and roads. Types of soil, the occurrence of mineral deposits, and forests are only a few of the numerous subjects which might be emphasized.

b. In Fig. 71 a part of the coastal plain of England is shown. Three of the British Ordnance Survey sheets are represented, Nos. 104, 105, and 106 of the large sheet series published in colors on a scale of one inch to a mile. These

are seen from the front. Thus they are not only more readily drawn, but also appear more real. In the cross-sections the oldland is filled in solid black. Many of the other British maps are equally suitable. A very simple one is the Lincoln sheet, No. 147 of the same series, showing a north-south escarpment formed on a slightly eastward-dipping bed.

c. The maps of France on scales of 1:80,000 and

BLOCK DIAGRAMS OF LAND FORMS

1:200,000 offer equally good examples. These, studied in connection with the geological map of France, provide numerous opportunities for the preparation of block diagrams illustrating the characteristic cuestas of a coastal plain. The Rheims sheet, No. 34, and the Dijon sheet, No. 112, of the 1:80,000 map are two of the best examples. Fig. 72 represents sheet No. 17 Chalons and No. 18 Metz of the 1:200,000 map. These display a belt from the oldland

in this particular example will help illustrate the movement of armies and battle lines during the Great War. The occurrence of coal in the Saarbruck region, in the formations of the oldland, opens up the field of economic geology to which a sketch of this kind aptly lends itself.

d. Wisconsin and New York. In Wisconsin several maps lend themselves nicely to the portrayal of specific areas showing coastal plain cuestas. The Sparta, Tomah, Kendall,

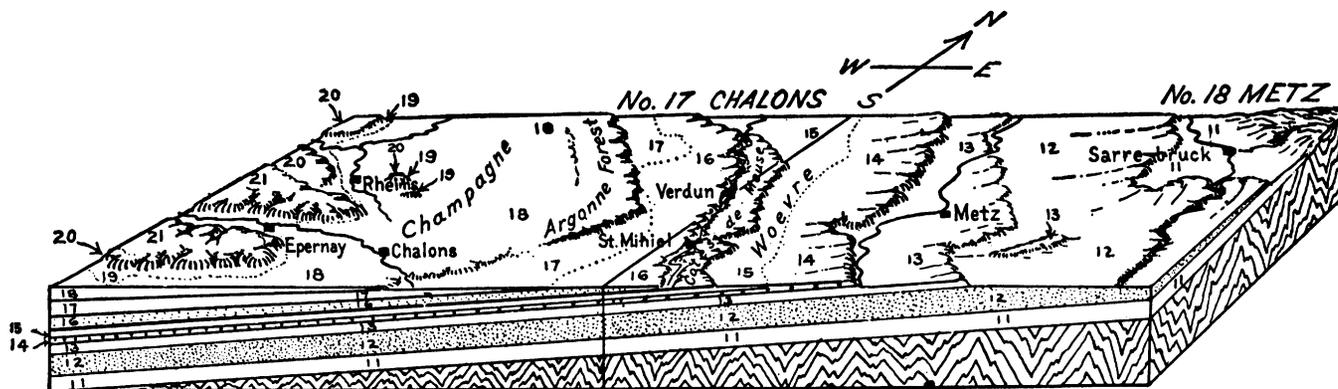


FIG. 72.—Block diagram of part of eastern France, showing the cuestas of the Paris Basin. Representation of Chalons Sheet No. 17, and Metz

Sheet No. 18 of the French map 1:200,000. The figures refer to the formations numbered on the geologic map of France, scale 1:1,000,000.

at the base of the Ardennes on the east almost to the center of the Paris Basin on the west. Use of the geological map of France, scale 1:1,000,000, has made it possible to number the formations on the diagram to correspond with the numbering on the geological map. A diagram of this type, while primarily useful to show the relation between surface features and underground structure, can have a much wider application. It can serve as a base for the location of railroads, roads, towns or distribution of agricultural industries, and

and Mauston sheets together show a belt having marked characteristics. Specific information on this region may be gained by reference to the geological map of Wisconsin, and Martin's report on the physical features of the state. Those having access to G.H. Smith's bachelor's thesis in the University of Wisconsin Library on the relation between topography and structure in the Driftless Area will be able to go far toward preparing a useful and interesting drawing, similar to one which is there outlined. The Winnebago

EXERCISES

Special sheet of Wisconsin shows distinctly a part of the Niagara cuesta.

The Tug Hill plateau region in the western Adirondacks is equally satisfactory. The Carthage, Lowville, Highmarket and Fort Leyden sheets together represent a well-defined cuesta facing toward the northeast. The geological map of New York State renders assistance in regard to structure.

e. Germany and Sweden. In southeast Germany the cuesta formed by the Swabian Alps comes out beautifully on several of the German maps, scale 1 : 100,000, notably sheets No. 606, 607, 619, 620, 633 and 634.

The cuestas forming the plains of Skane in southern Sweden are very well shown on the Engelholm sheet, No. 8, of the map of Sweden, 1 : 100,000. Two cuestas are present, trending in a northwest-southeast direction. The intermediate lowland in which Engelholm lies is partly submerged under the bay of "Skelder Viken." Both cuestas have a

sharp northward-facing scarp and a gentle back slope to the south. The adjacent Finja sheet, No. 9, to the east, shows for a few miles the continuation of the two cuestas, but later they are lost under the heavy cover of glacial drift. The cuestas forming the islands of Öland and Gotland in the Baltic are strikingly represented on the Swedish maps. Most of Öland appears on the Mönsterås, Kalmar, and Ottenby sheets, Nos. 22, 17, and 12 of the Swedish map, 1 : 100,000. Most of Gotland appears on the Visby, Roma, and Hamra sheets, Nos. 39, 31, and 23 of the Swedish map. The island of Öland displays distinctly the steep westward face and the gentle eastward slope of the innermost cuesta. The inner lowland is submerged to form Kalmar Sund. Gotland is apparently made up of several cuestas, none of them of very great length. The drowning of the intermediate lowlands accounts for the small bays at the north and south ends of the island.

EXERCISES

BASED UPON THE ILLUSTRATIONS IN CHAPTER IV

Exercise 1. In Fig. 40, draw ellipses in all of the lozenge-shaped spaces on block *A*; then darken some of the lines similar to the ones already drawn. Transfer the stream forms to block *B* by means of tracing and carbon paper. On block *C* represent freehand a stream similar to the one that has just been drawn. On block *D* draw incorrectly another stream.

Exercise 2. On Fig. 42 add slope lines to produce an effect like that shown in Fig. 44. (Be sure to represent in profile the front and back edges of the block where the stream flows below the surface of the plain.)

Exercise 3. On Fig. 42, draw meander spurs similar to Fig. 46, first as they would appear if the river were flowing toward the observer, and second as they would appear if the river were flowing away from the observer.

Exercise 4. On Fig. 47, complete streams *A*, *B*, and *C* in accordance with method shown in stream *D*. Extend stream *D* two or three meanders toward the observer.

Exercise 5. On Fig. 48, complete stream *A* to resemble stream *B*; complete stream *C* to resemble stream *D*. Add a tributary to stream *B* cut only slightly below the plain, and a tributary to stream *D* cut deeply below the plain.

Exercise 6. On Fig. 50, complete streams *A* and *B* to resemble stream *C*.

Exercise 7. On Fig. 57, determine position of the two vanishing points; then on block *A* represent a series of straight-walled gorges like

STREAMS

90. Young, mature, and old streams: a definition.—

A young stream is a stream whose capacity to transport a load is greater than the load it is called upon to carry. A mature stream is one that is loaded to capacity. When a stream has a steep gradient, and therefore a swift current, it usually carries its load of sediment with great ease and has enough energy left over to erode its bed and thus deepen its valley. Such a stream is young and its valley is usually V-shaped and narrow, and its course is characterized by cascades and waterfalls, potholes, and other evidences of vigorous erosion. When a stream has a gentle gradient or is overabundantly supplied with mud and silt by its tributaries, it uses up all its energy in carrying along this load, and instead of cutting down its channel it occasionally must deposit some of its load when temporarily there is brought to it more than it can remove. Such a stream is said to be mature, and its valley is usually wide and flat, owing to the floor of alluvium which the stream, in its meandering, has deposited on its flood plain. When such a mature stream is deprived of its usual load of mud through any change in the behavior of its tributaries, it ceases to deposit and, owing to its excess energy, it cuts down into its flood plain which it proceeds to remove, leaving only remnants here and there along the valley wall as terraces. Such a stream is said to be revived or rejuvenated.

If a river system so wears away the land that there are no hills left in its drainage area and all its tributaries are like it in flowing over a low plain, the river is said to be old. That means that it is carrying almost no load. Its gradient is so gentle it can just barely flow along without having to transport any material. Its tributaries are like it, even to their headwaters, and because of their slight energy they bring little or no debris into the main stream. Needless to say, this condition is perhaps never reached by large river systems whose headwaters must usually be found actively at work among the mountains surrounding the drainage basin. None of our large rivers, then, have passed beyond the mature stage.

91. Young streams: the V-shaped gorge, steep gradient and irregular bed with rapids and waterfalls.—When this subject is first presented to young students the teacher will add much life to his demonstration if he build up the situation on the blackboard in the manner shown in Figs. 134, 135, 136, and 137. First, draw the V-shaped cross-section of the stream. Then, after that has been duly discussed, build out the topography back of it. The figures indicate some of the intermediate steps which will be found helpful in a hurried blackboard illustration. The time consumed in preparing such sketches is an important item and usually should not exceed a minute. Sketches like Figs. 134, 135, 136 and

BLOCK DIAGRAMS OF LAND FORMS

137 can easily be prepared in half that time, unless the teacher stops for a discussion, a thoroughly commendable practice.

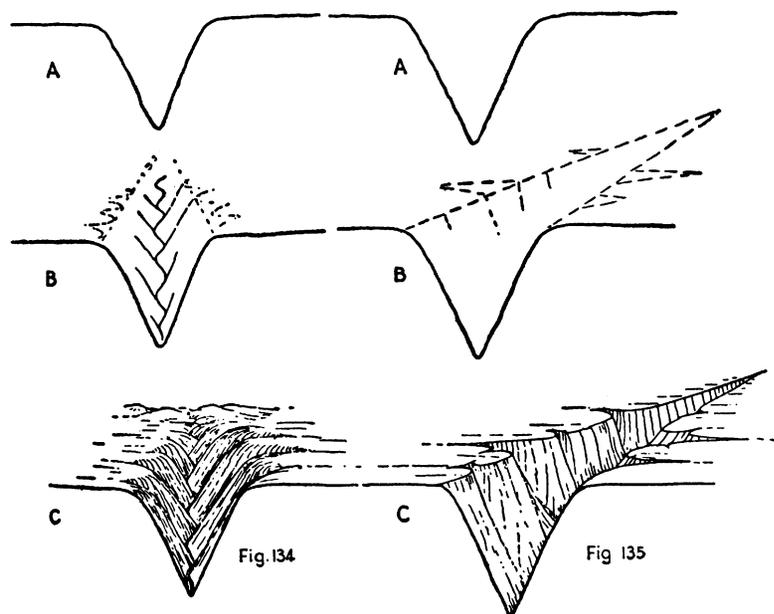


FIG. 134.—Steps of procedure in drawing a young stream valley. First, the V-shaped cross-section shown in *A*. Second, the wavy course of the stream with spur profiles tangent to the curves of the stream. Also faint guide lines for general form of valley, shown in *B*. Finally, in *C*, the completed sketch. Discussion of this region would include the erosive work of young streams, their winding course, the interlocking spurs, and valley widening due to weathering. This might be followed with a remodeling of this drawing on the blackboard to show later conditions as the valley becomes wider.

FIG. 135.—Steps of procedure in preparing sketch of young valley with V-shaped cross-section. A sketch like this may then be remodeled to show structural control due to horizontal beds of hard rock.

92. The profile of a young stream.—The gradient of a young stream, as indicated by its profile, may be explained by some means such as those used in Figs. 140, 141, 142. In Fig. 140 the teacher first puts on the blackboard the sloping curve representing the rather steep course of the young stream.

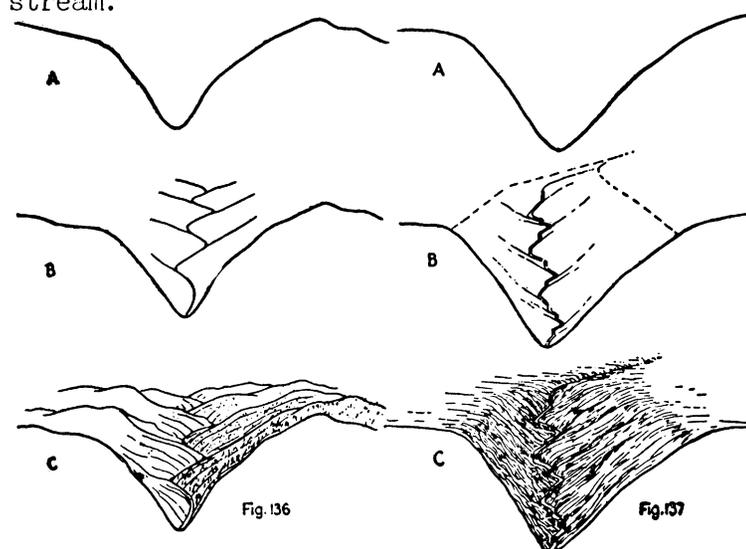


FIG. 136.—Steps of procedure in preparing sketch of young valley in rugged region, with a little suggestion of forest cover on the mountain sides to gain effect of distance.

FIG. 137.—Steps of procedure in preparing sketch of young valley with stream having falls and rapids. Draw first the V-shaped cross-section *A*. Then the winding course of the stream, exactly like *B* of Fig. 134 or 136, but interrupt the straight stretches of the stream with steps to represent vertical descents or falls, as in Fig. 138. Discussion of the completed sketch may include questions of rock structure, reaches and rapids, potholes, retreat of falls, valley widening, and development of the graded profile.

STREAMS

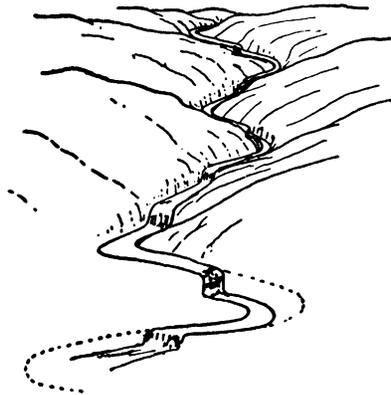


FIG. 138.—A sketch similar to Fig. 137 but showing a little more distinctly the way the swinging curves of the stream are modified to allow for falls.

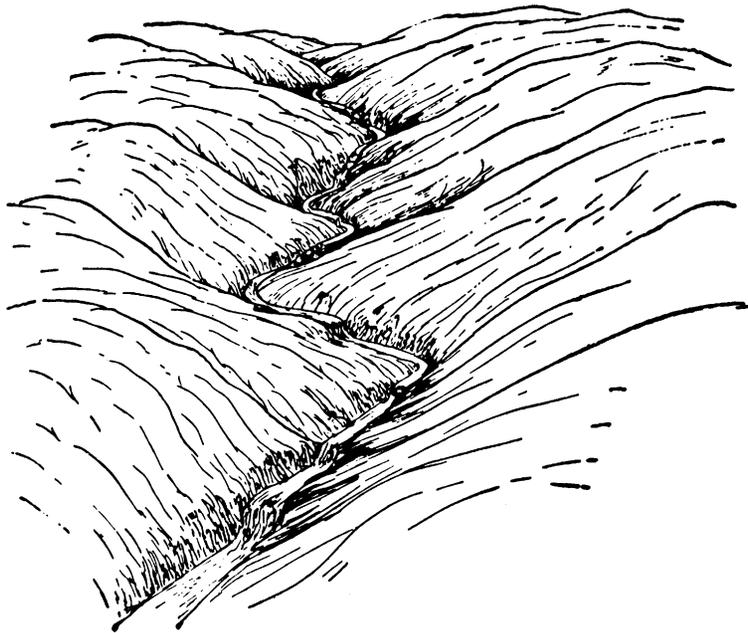


FIG. 139.—A valley similar to Fig. 137 but without the cross-section in the foreground. A little freer and perhaps a more natural handling of the problem.

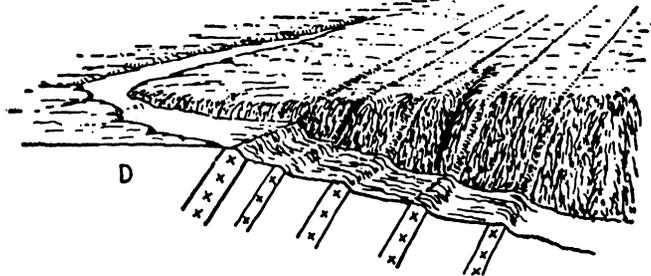
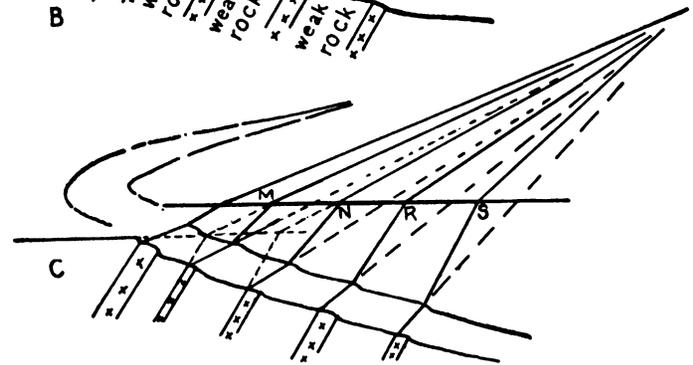
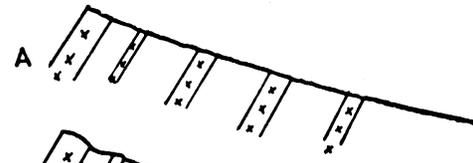


FIG. 140.—Steps of procedure in preparing sketch of young valley seen from the side in order to show stream profile with rapids due to hard ledges. Sketch C shows use of vanishing point and indicates how the positions of the points M, N, R, and S are obtained.

DELINEATIONS

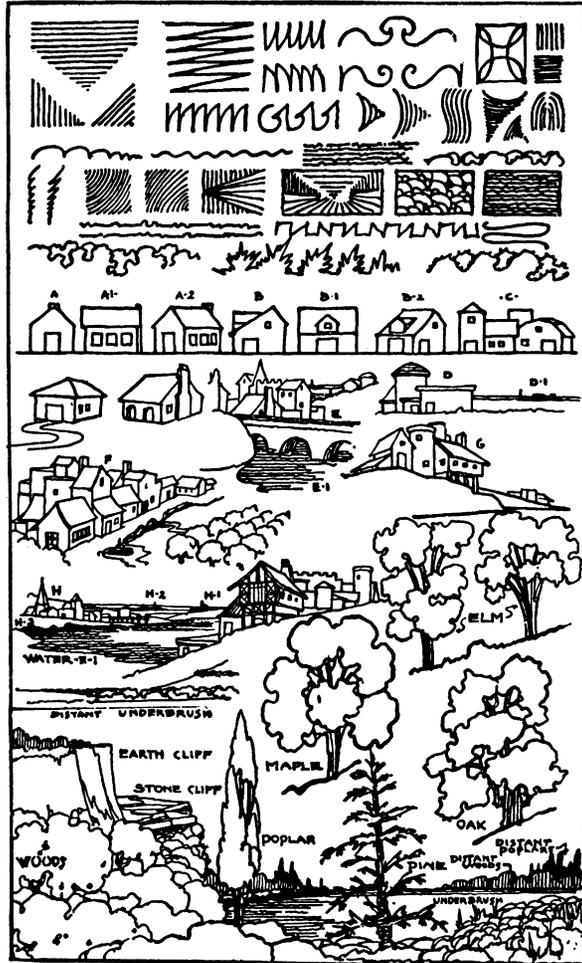


FIG. 241.—Delineations. Simple strokes and symbols used in landscape sketching. (From Grievs, by permission.)

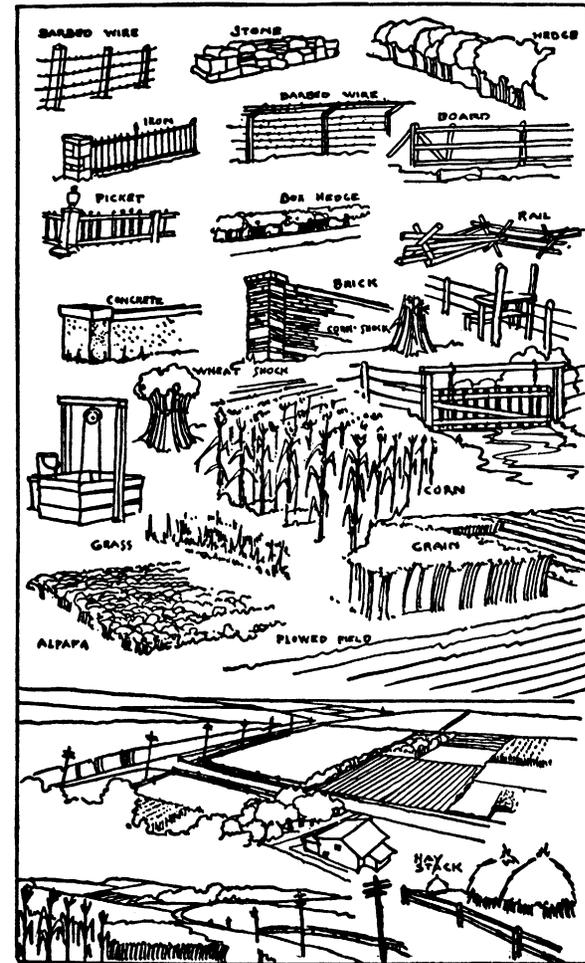


FIG. 242.—Delineations and landscape sketches. (From Grievs, by permission.)

LANDSCAPE SKETCHING

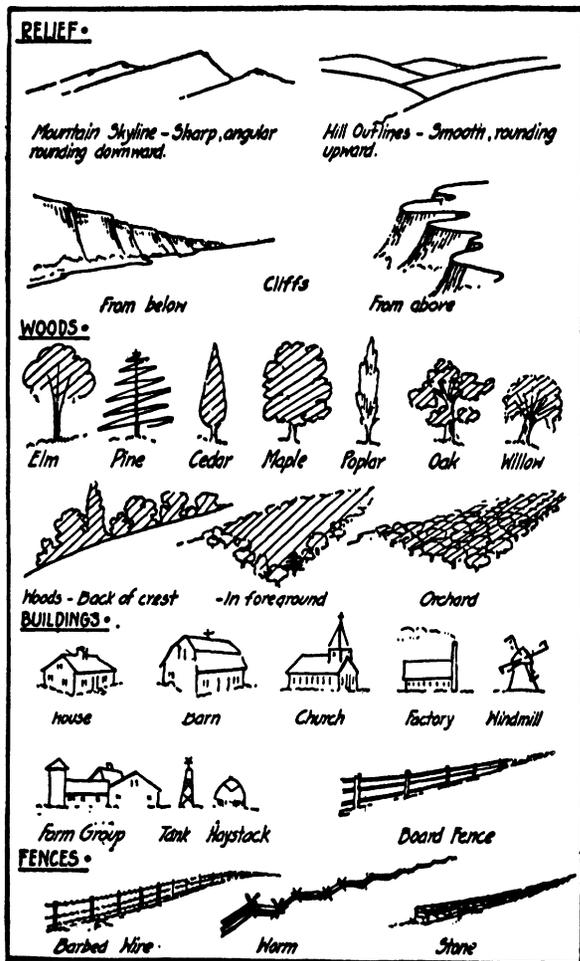


FIG. 243.—Delineations. (From Finch, by permission.)

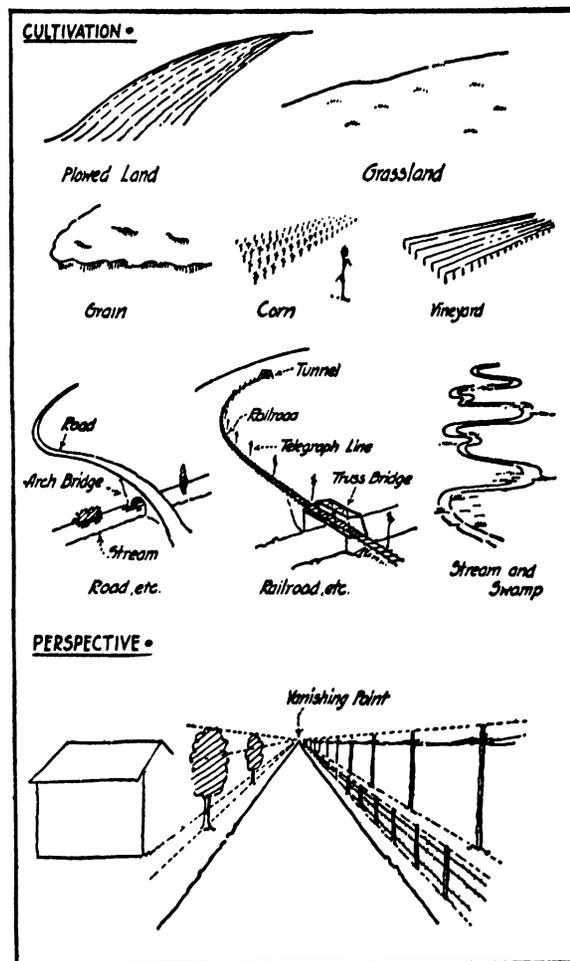
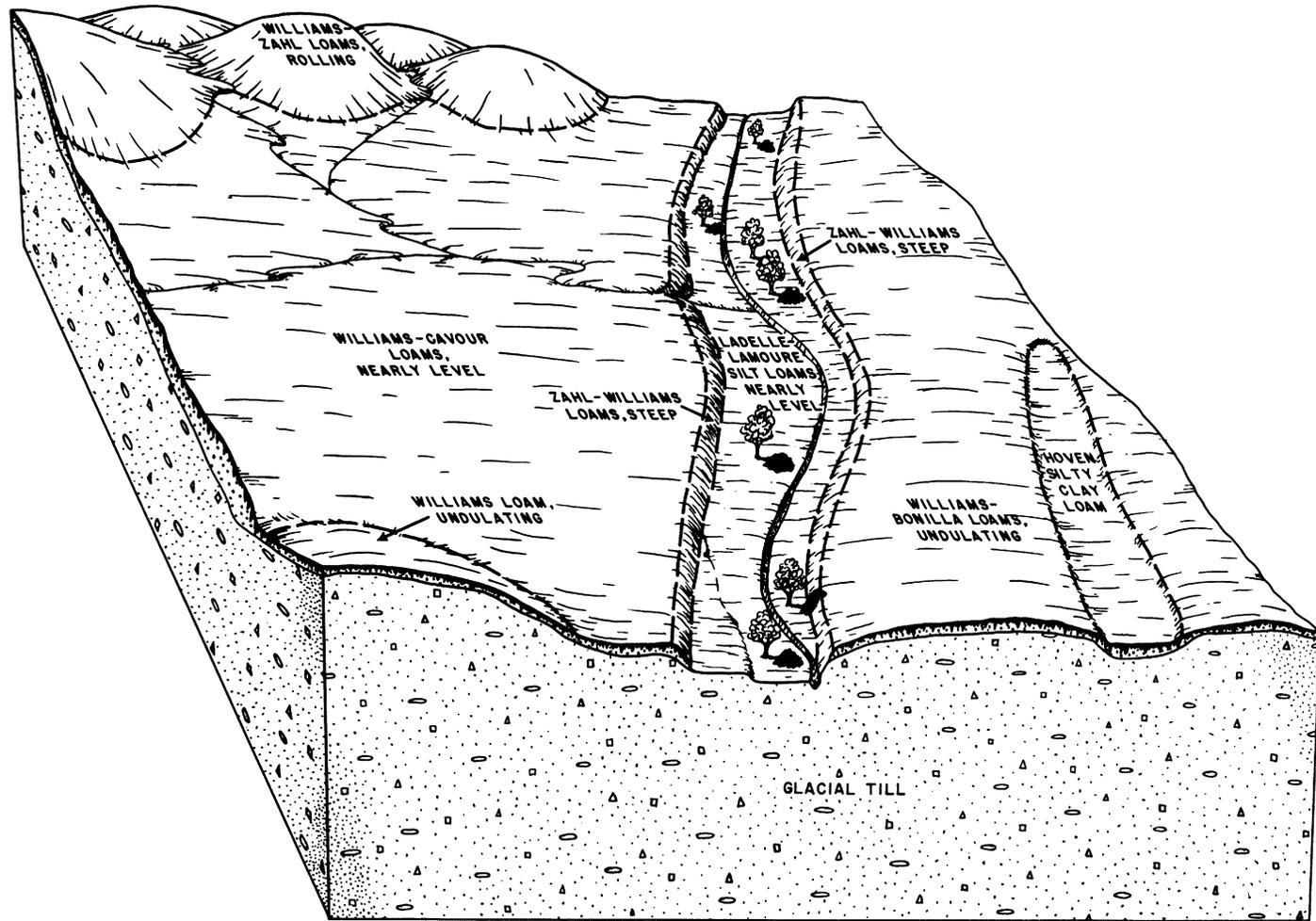


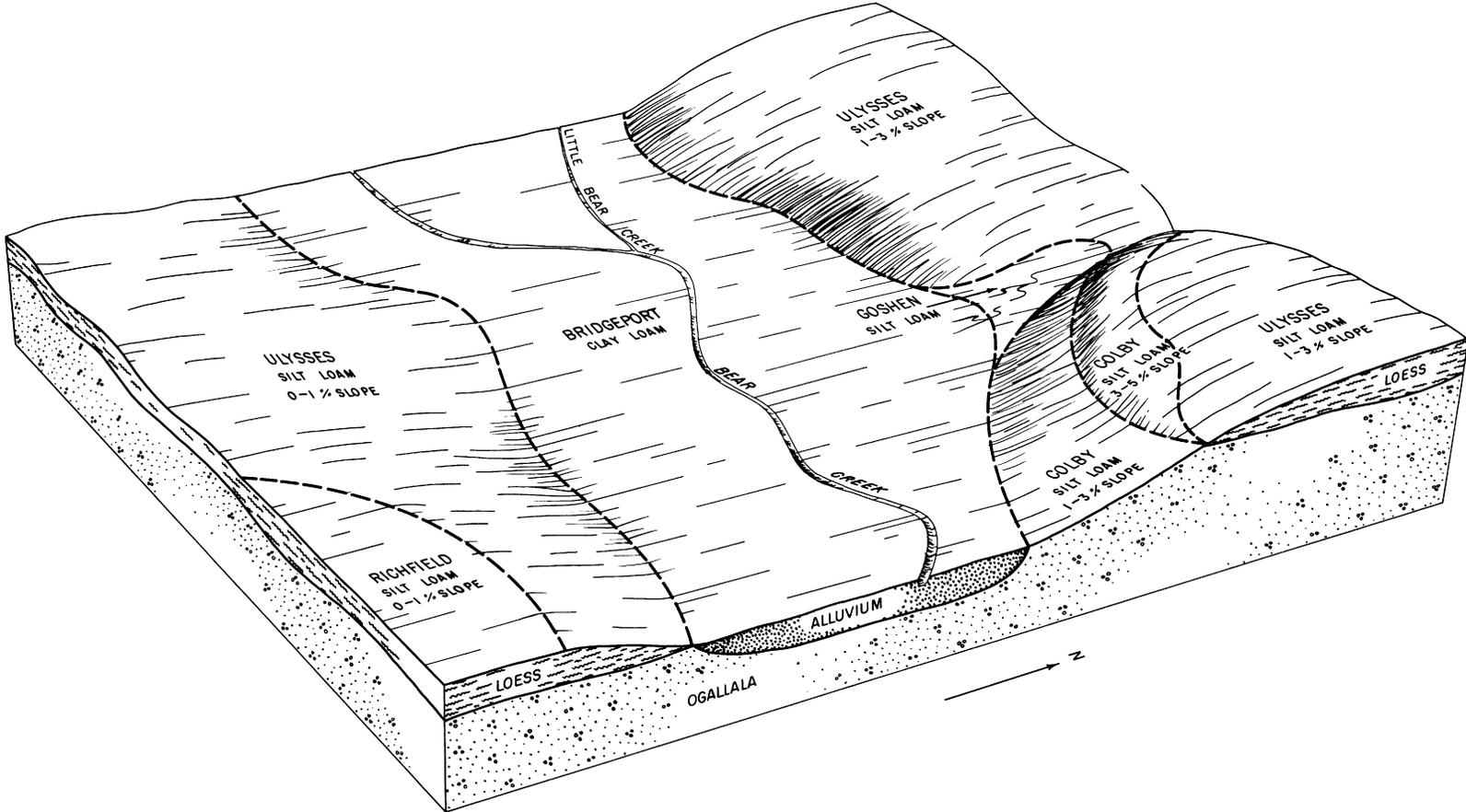
FIG. 244.—Delineations and perspective. (From Finch, by permission.)

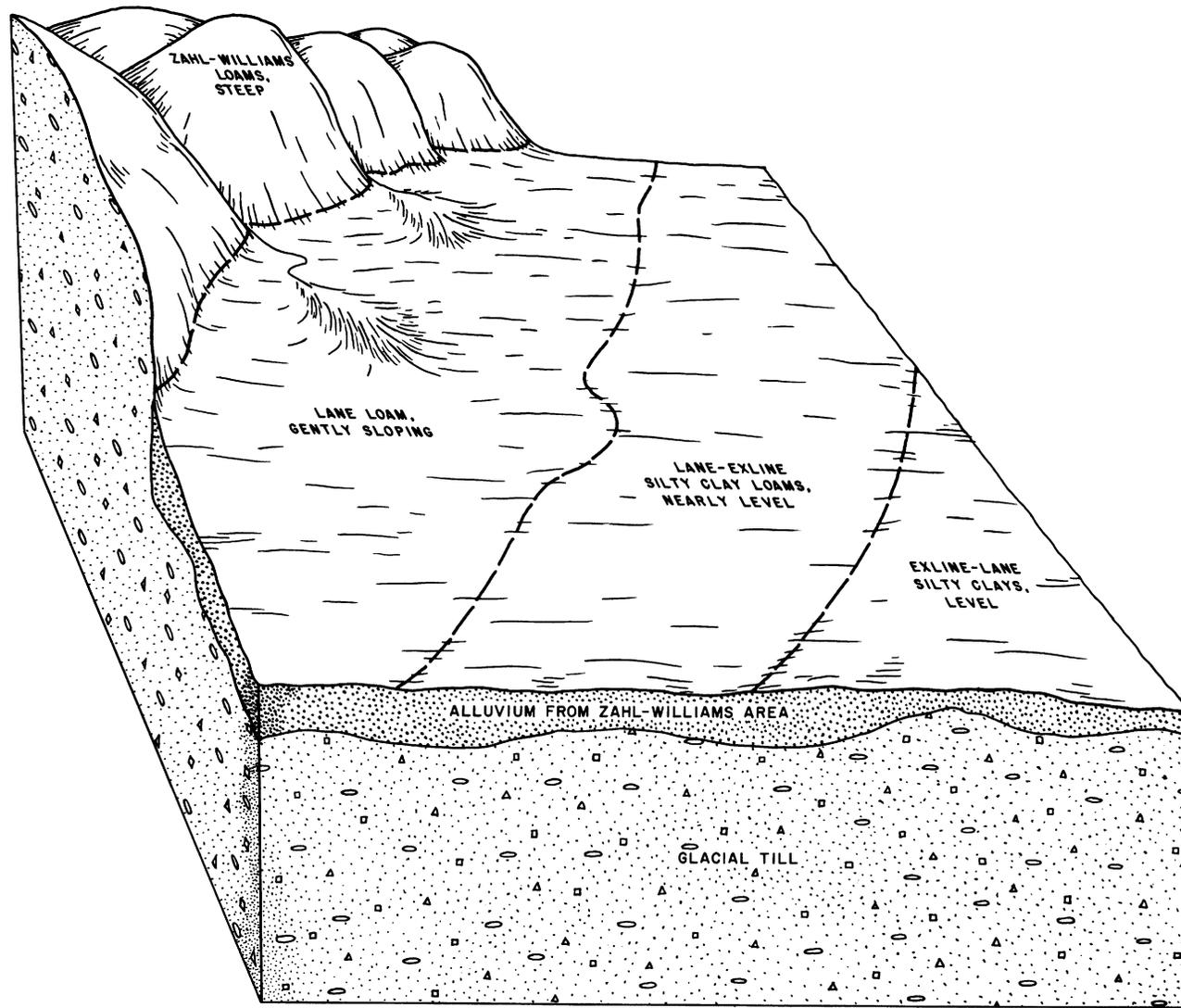


A TYPICAL CROSS SECTION OF NORTHWEST OR SOUTH CENTRAL HAND COUNTY.

DIAGRAM SHOWING PATTERN OF UPLAND SOILS
IN NORTHEASTERN STANTON COUNTY, AND
CROSS SECTION OF LOWER BEAR CREEK VALLEY

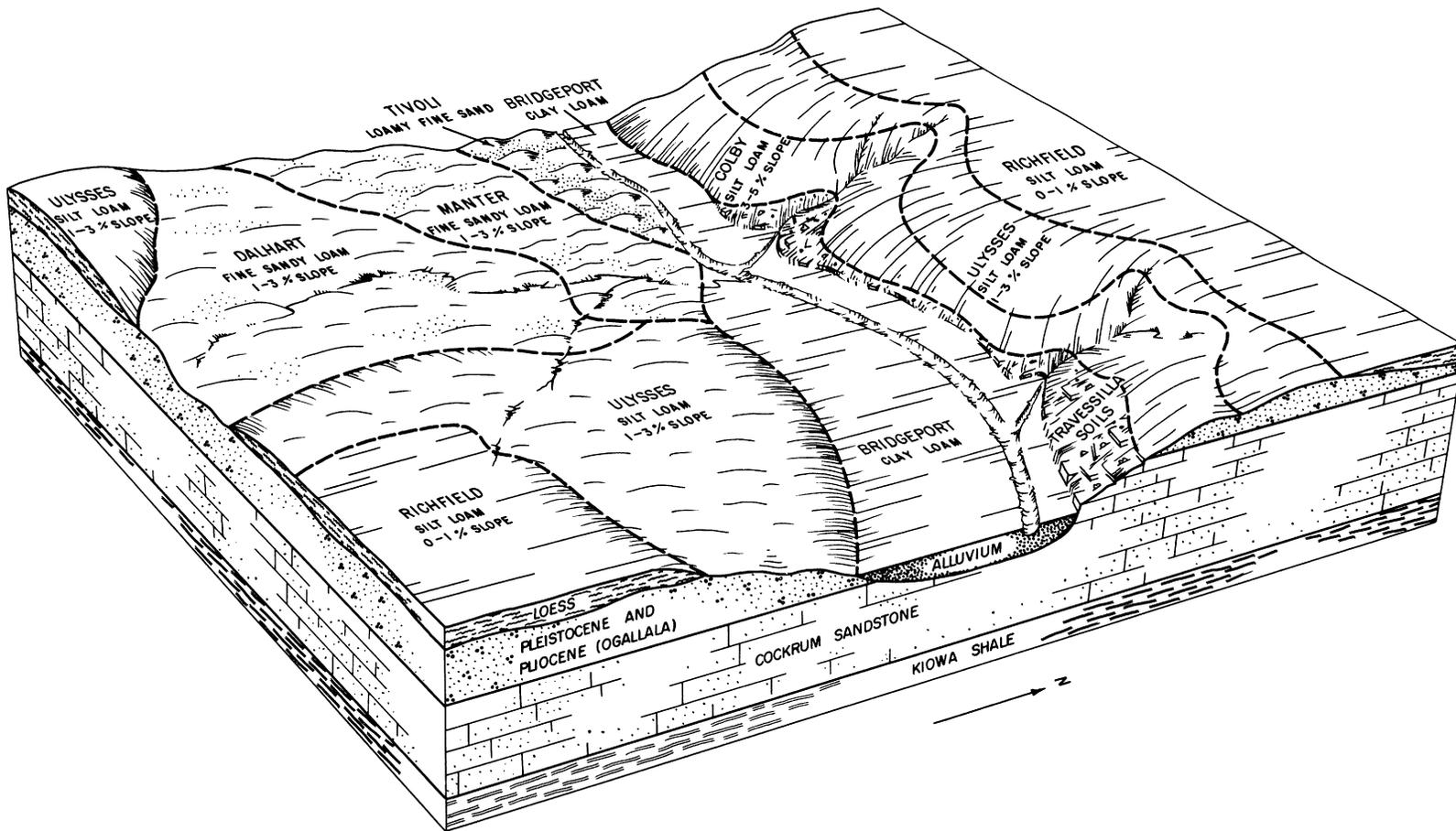
89



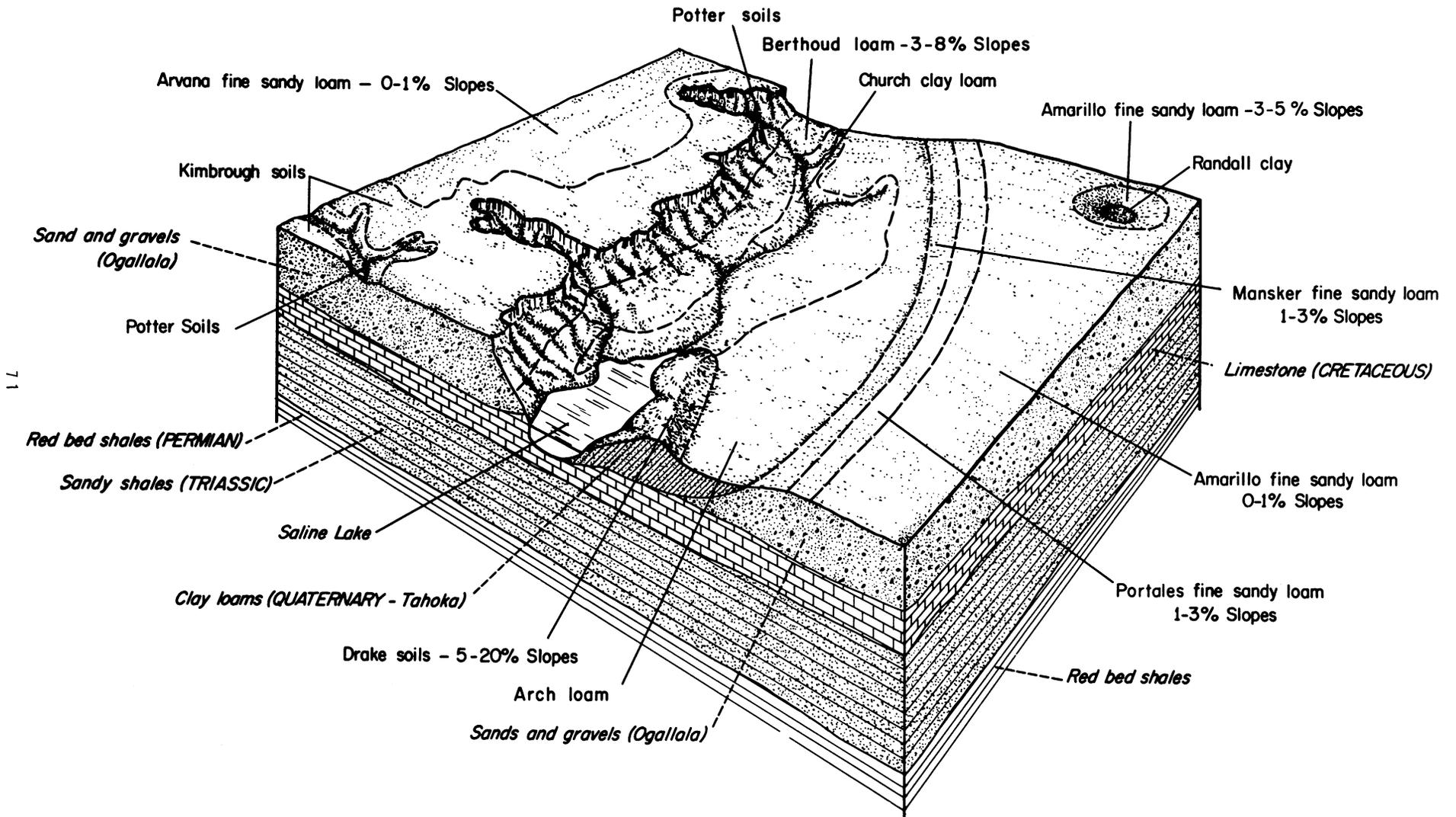


A TYPICAL CROSS SECTION ADJACENT TO THE REE AND WESSINGTON HILLS, HAND COUNTY

CROSS SECTION OF UPPER BEAR CREEK VALLEY
STANTON COUNTY, KANSAS

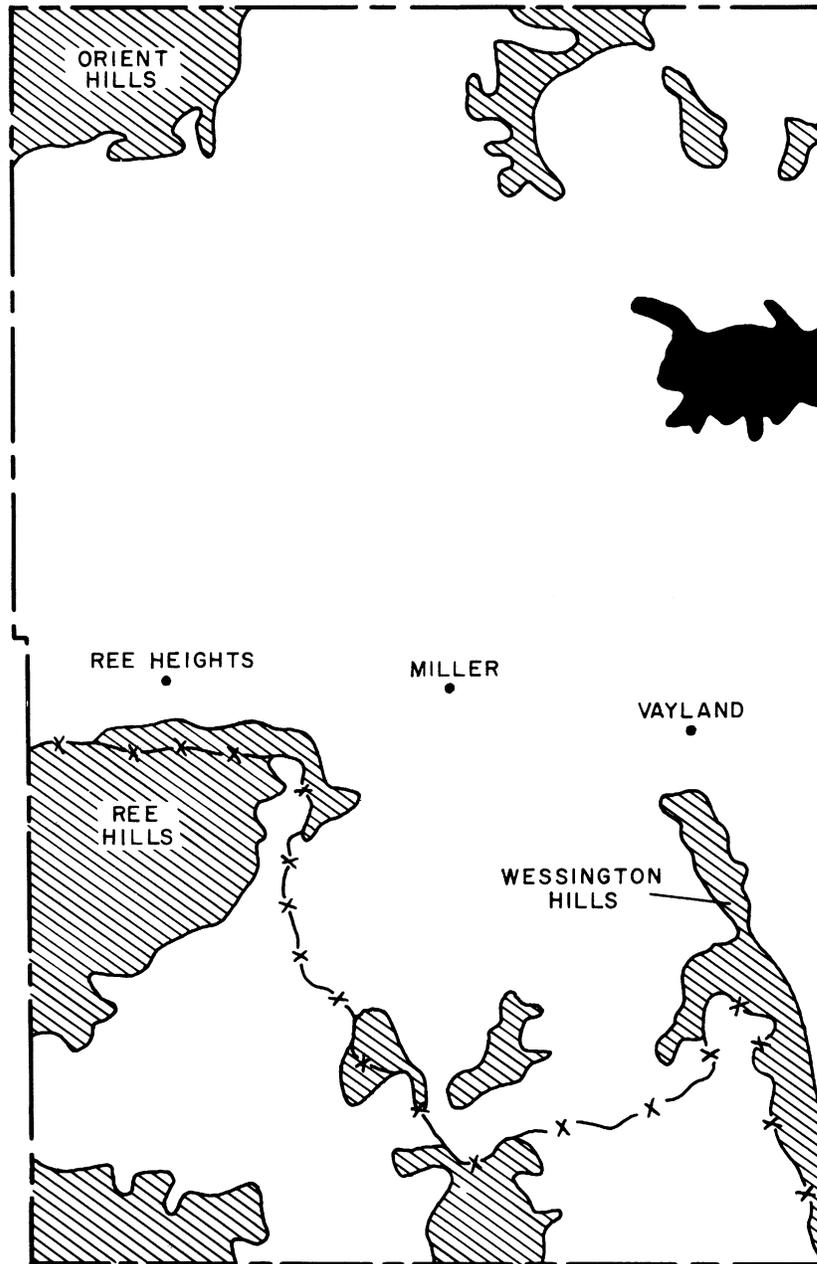


SALINE LAKE MAIN SOIL AREA IN BAILEY COUNTY, TEXAS

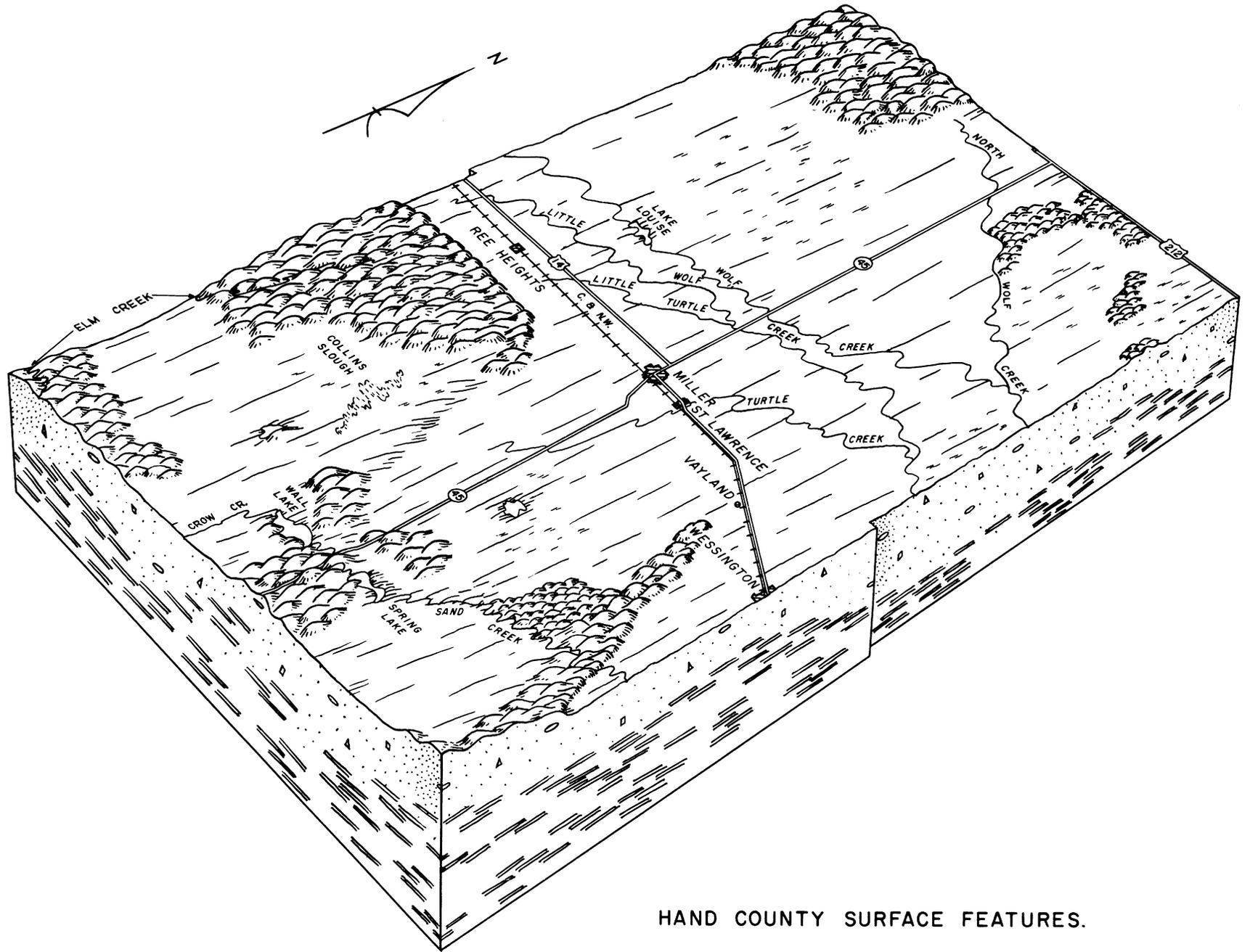


71

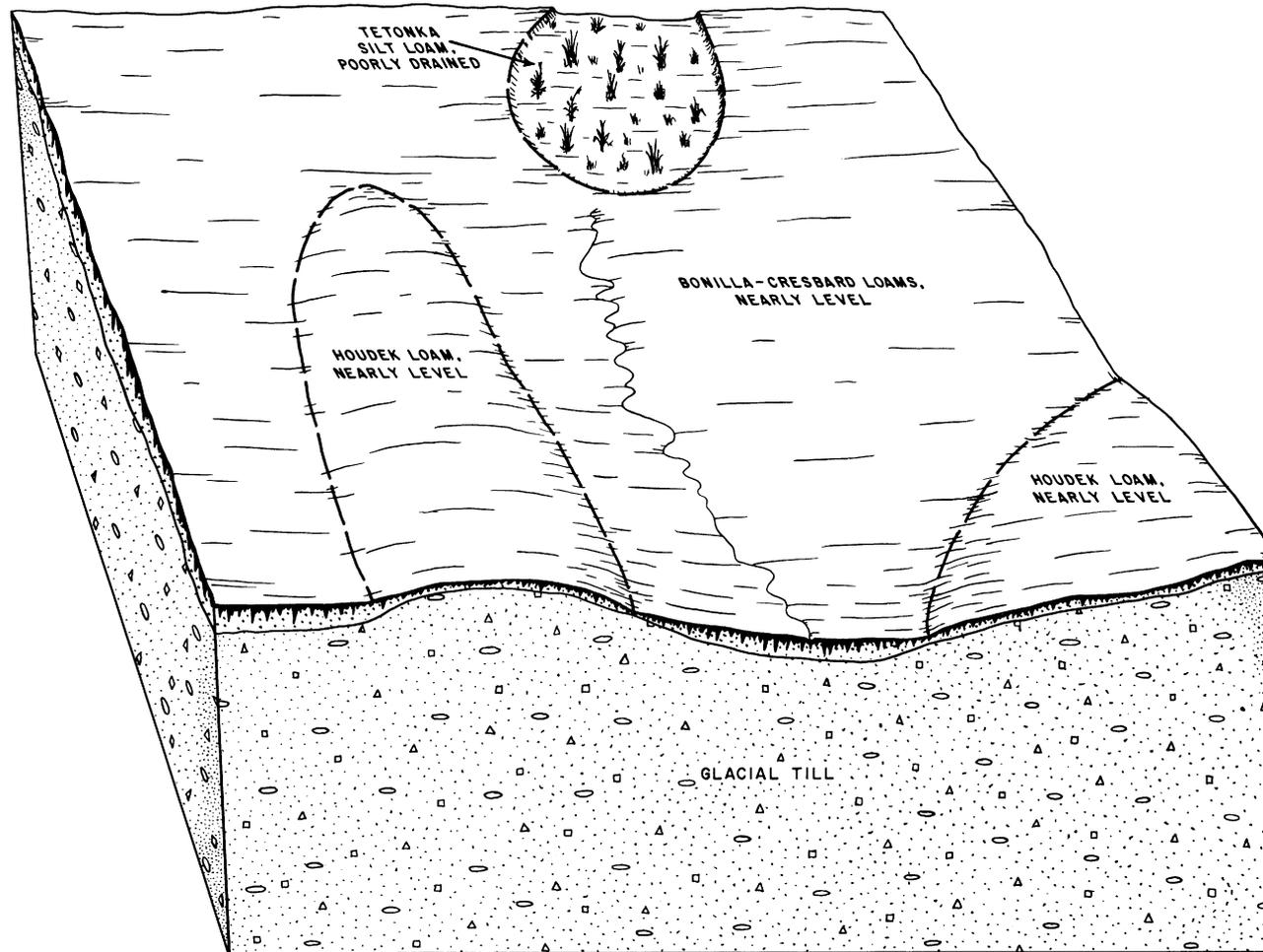
LOCATION OF THE MAIN GLACIAL DEPOSITS IN HAND COUNTY



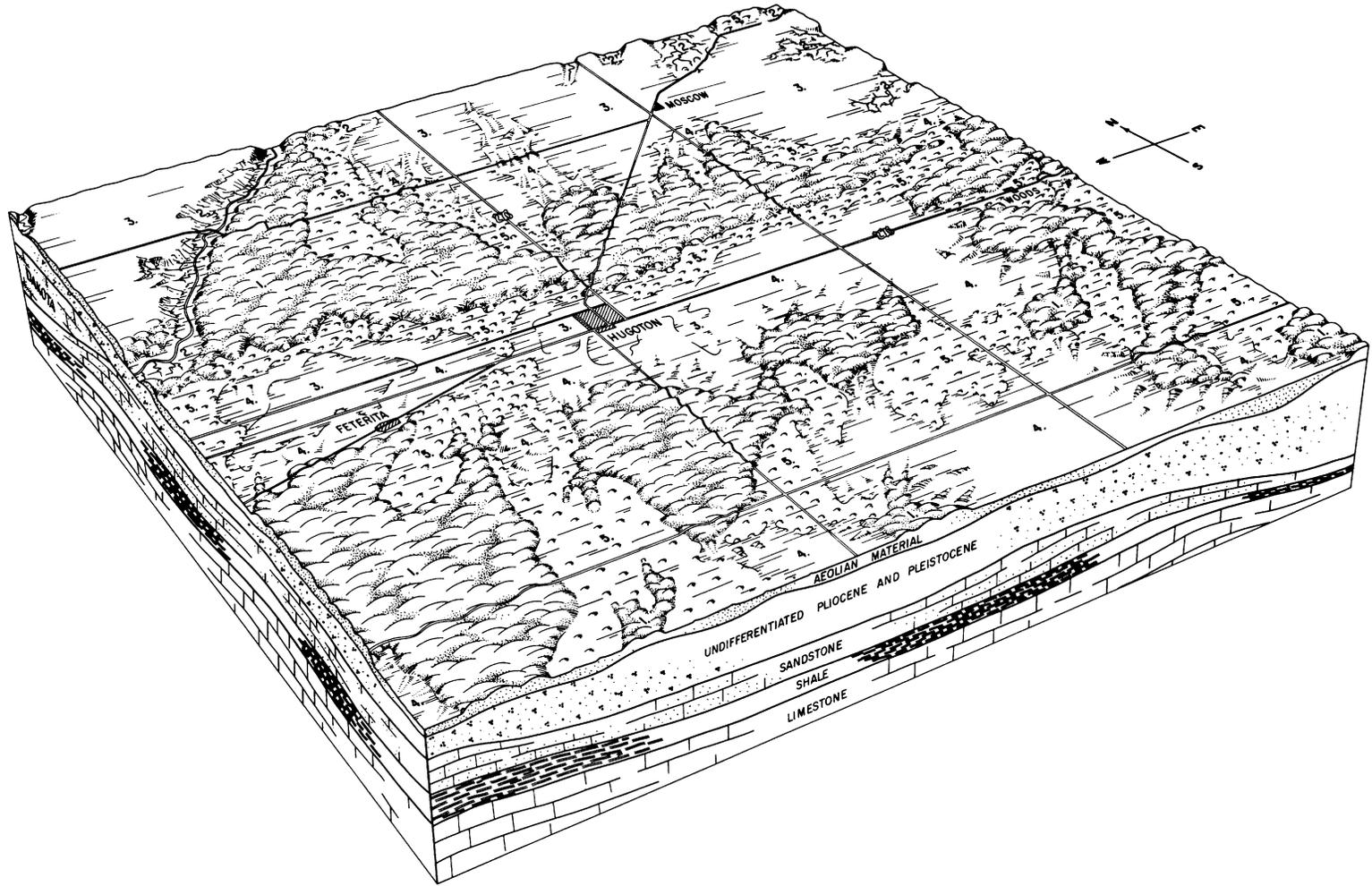
- NEARLY LEVEL AND UNDULATING GROUND MORAINE.
- ROLLING AND HILLY MORAINAL TOPOGRAPHY.
- NEARLY LEVEL LOAM GLACIAL OUTWASH.
- BOUNDARY SEPARATES THE MANKATO GLACIAL DEPOSITS TO THE NORTH FROM THE CARY GLACIAL DEPOSITS TO THE SOUTH.



HAND COUNTY SURFACE FEATURES.



A TYPICAL CROSS SECTION OF NORTHEAST HAND COUNTY.



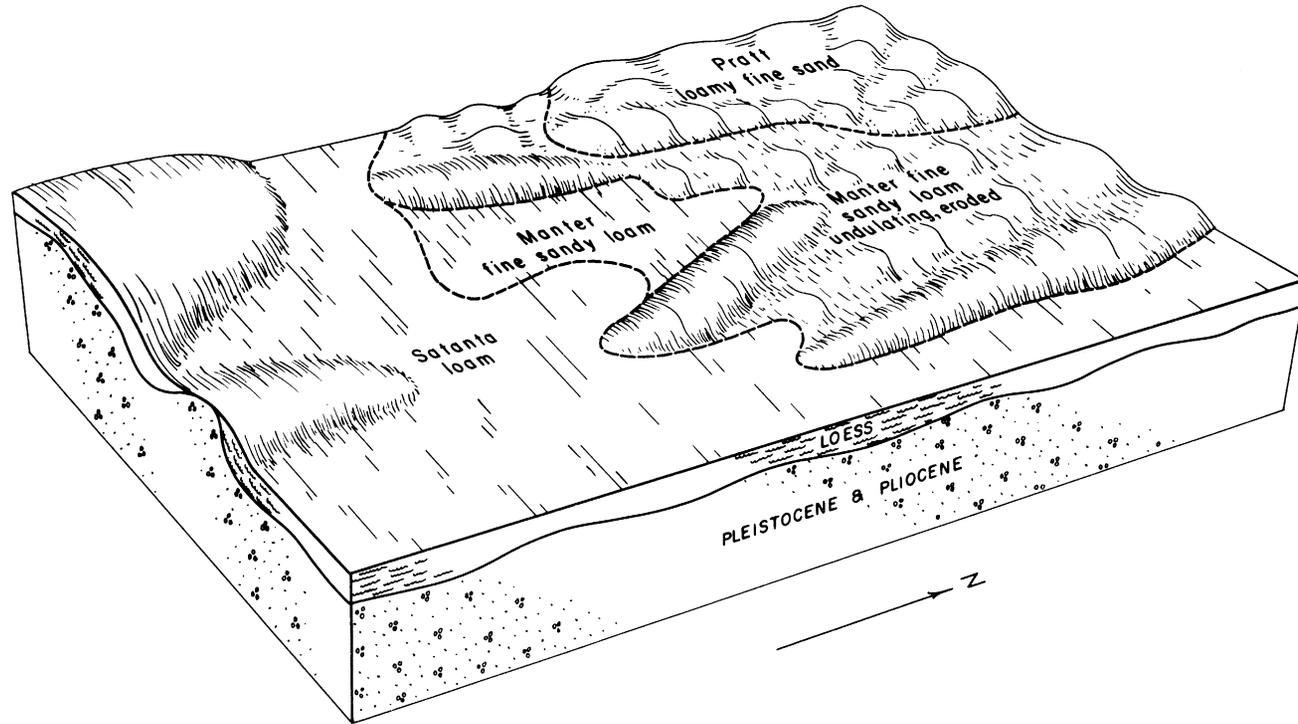
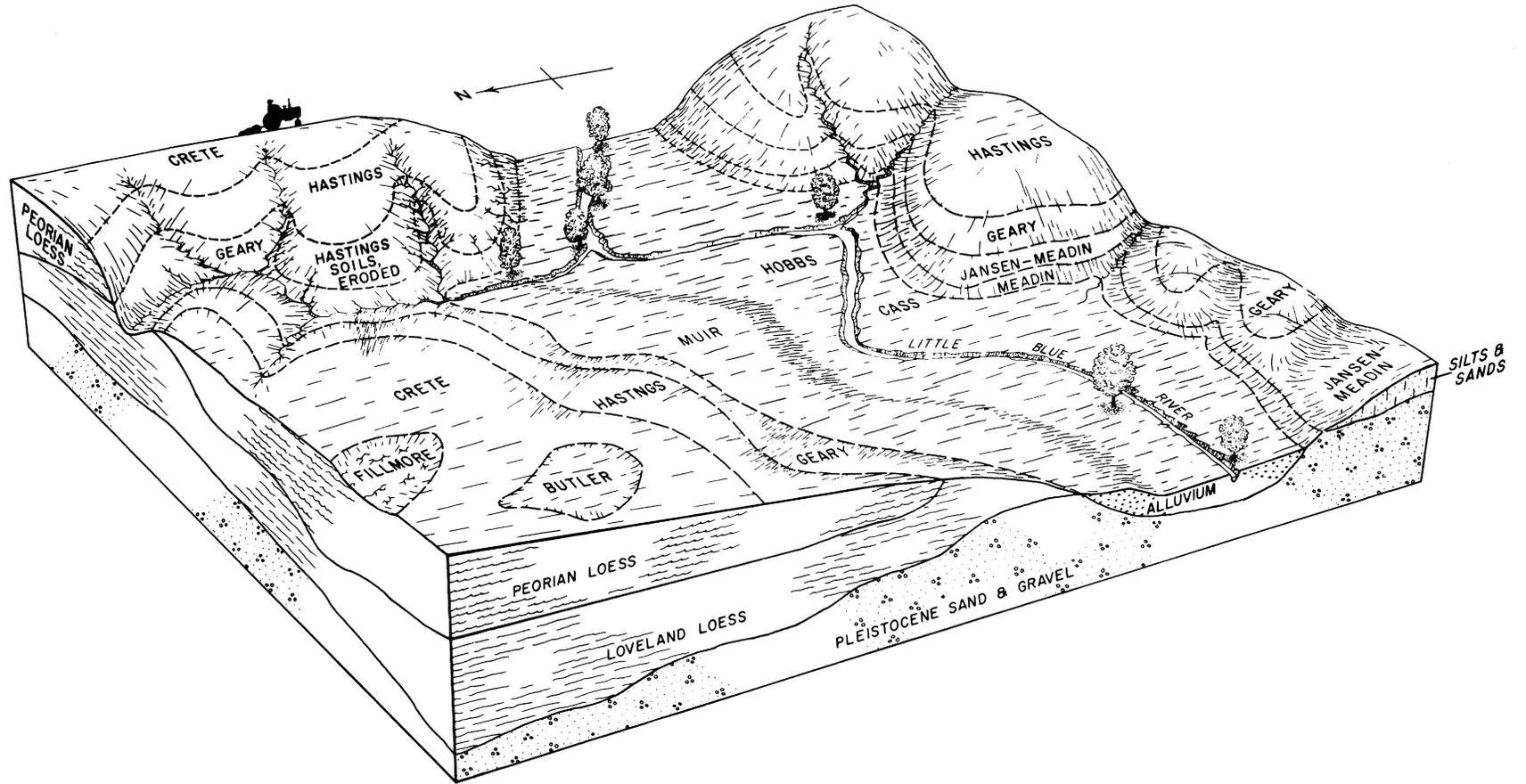


DIAGRAM OF THE MANTER—SATANTA SOIL ASSOCIATION IN THE TRANSITION AREA BETWEEN THE SANDHILLS AND THE UPLAND PLAINS



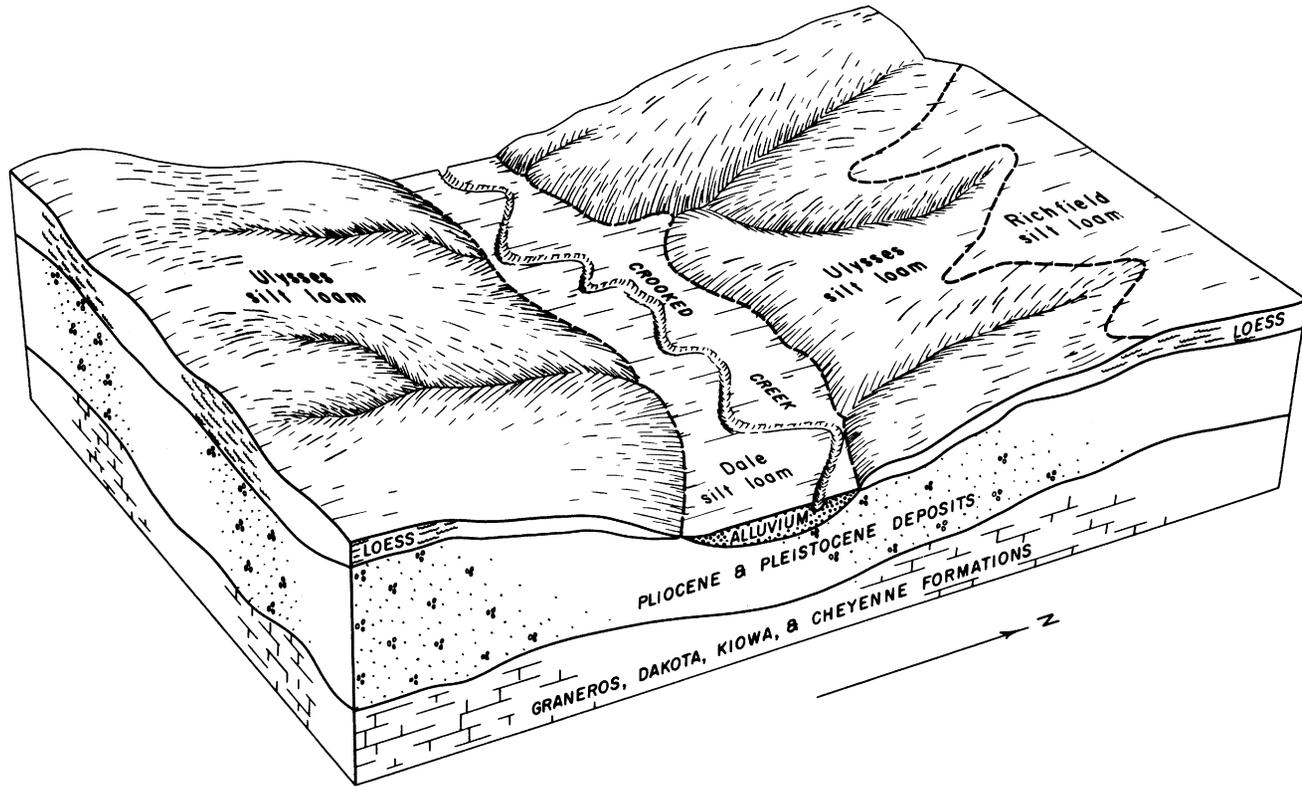
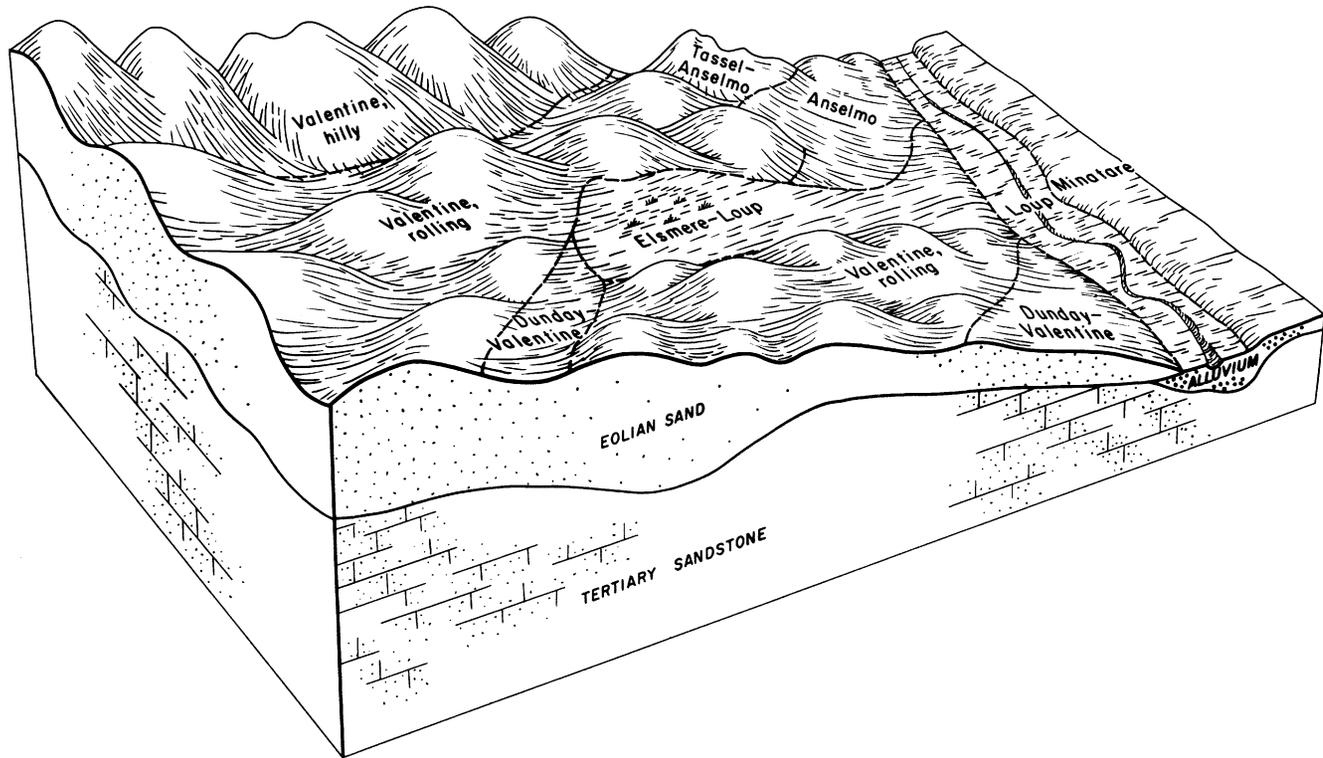
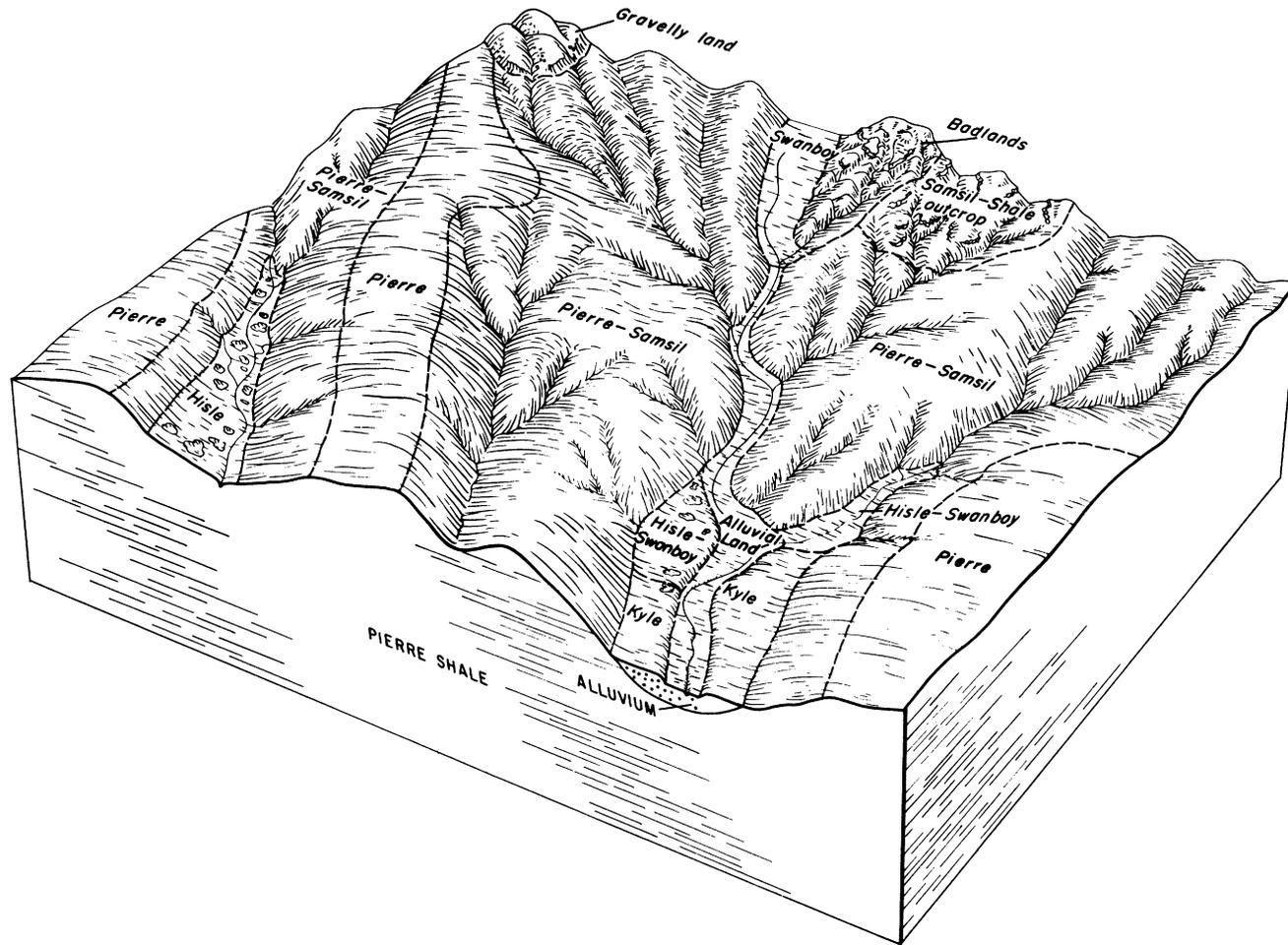


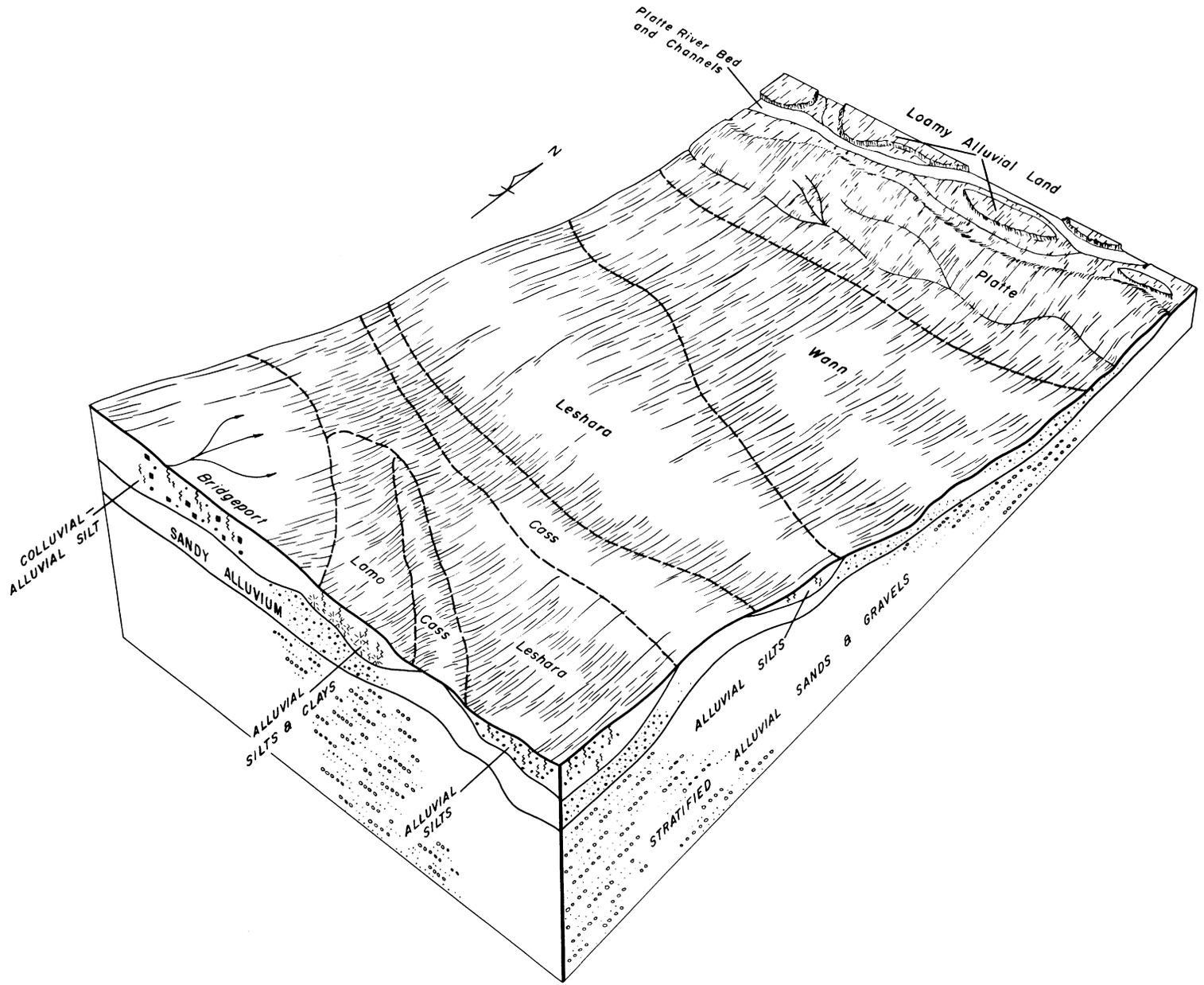
DIAGRAM OF RICHFIELD-ULYSSES-MANSIC SOIL ASSOCIATION
IN THE CROOKED CREEK DRAINAGE AREA



TYPICAL AREA IN THE VALENTINE AND MINATARE-LOUP ASSOCIATION



TYPICAL AREA IN THE PIERRE-SAMSIL SOIL ASSOCIATION



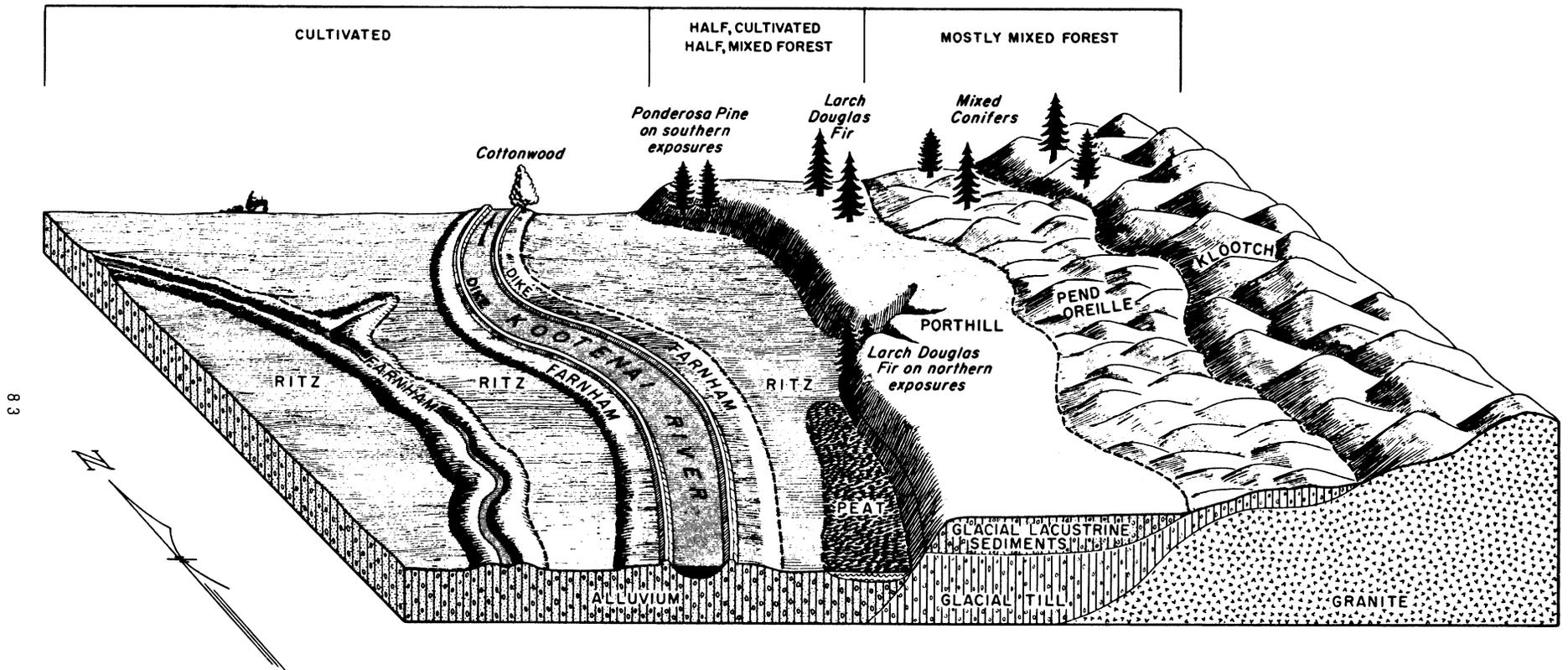
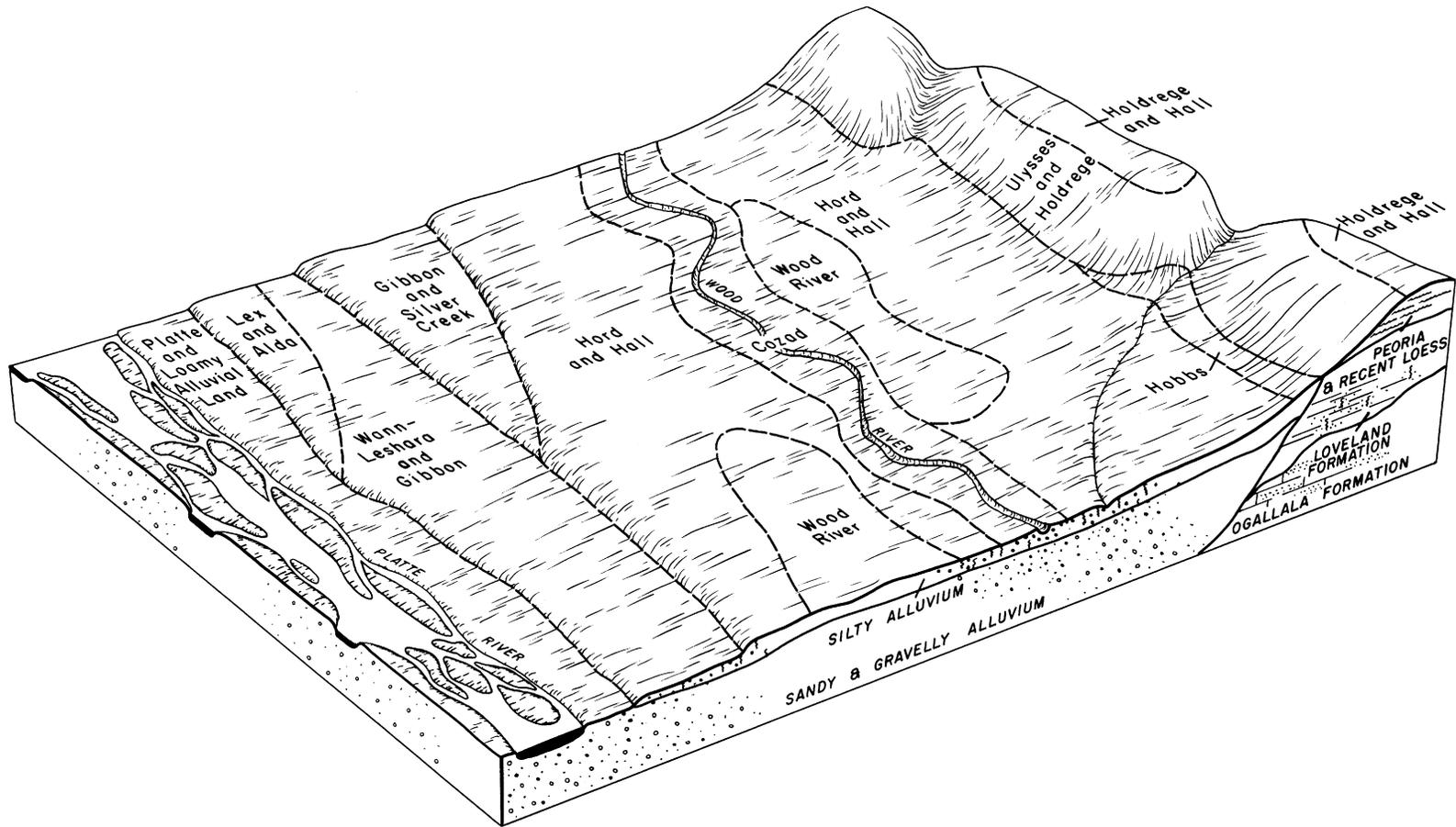
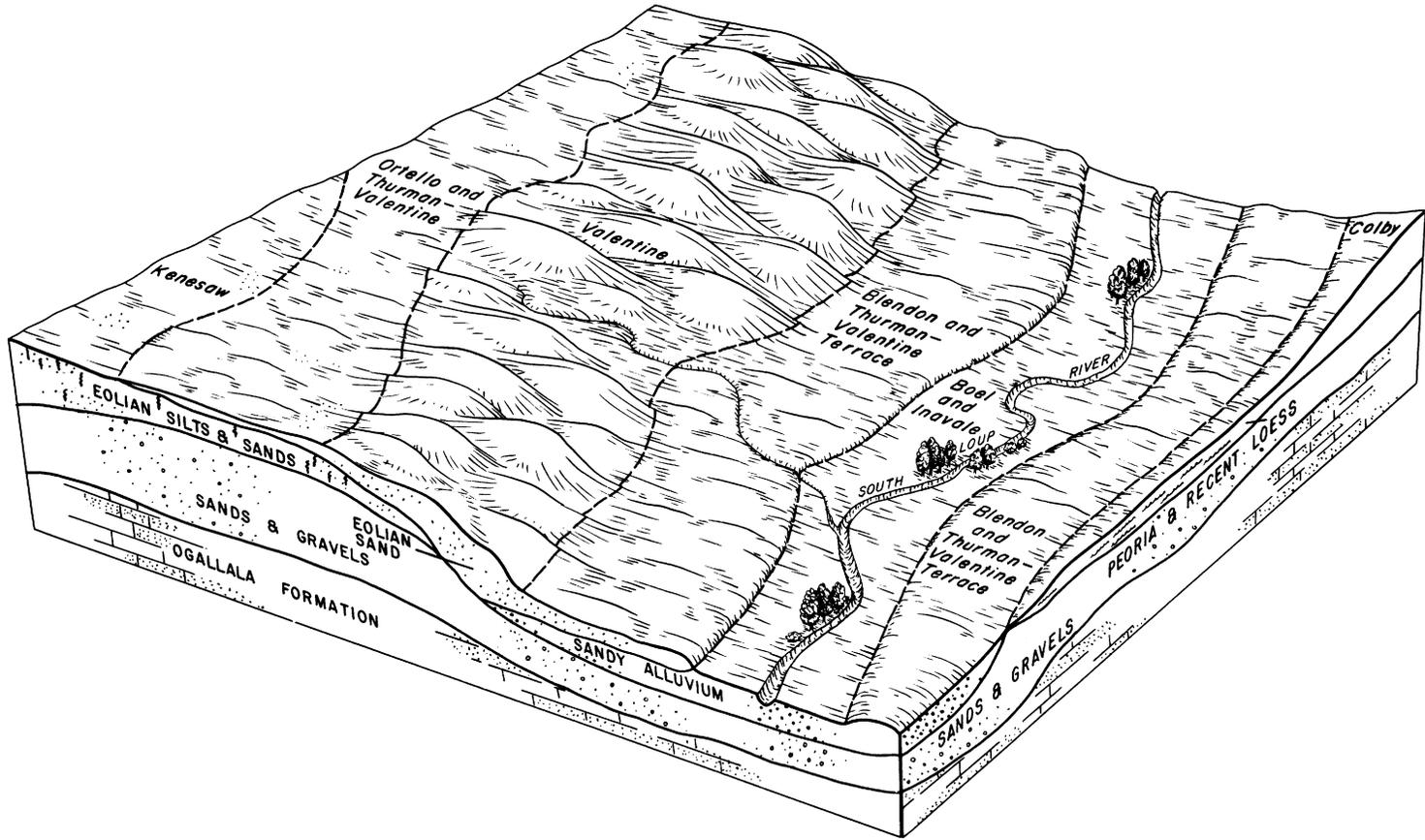
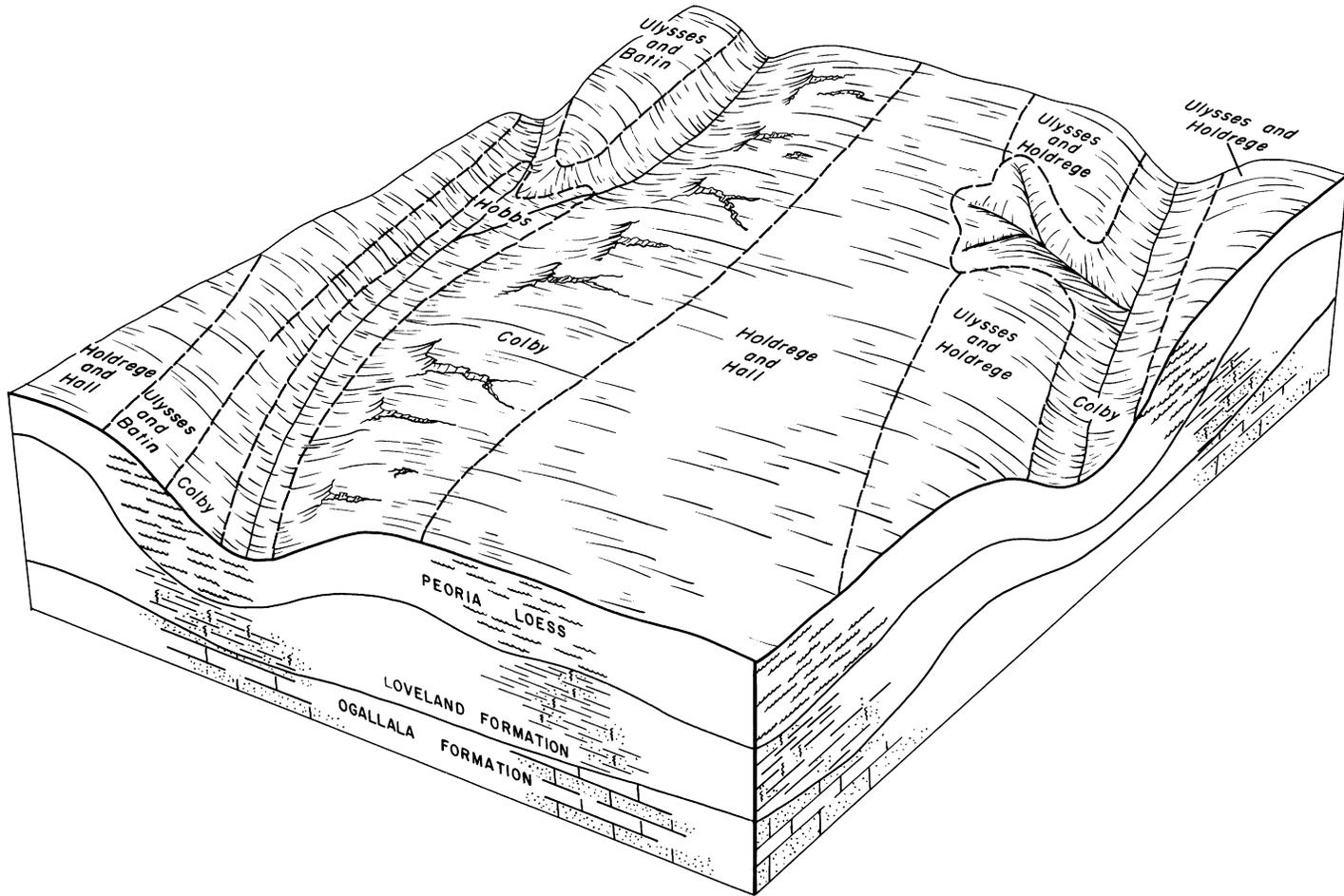
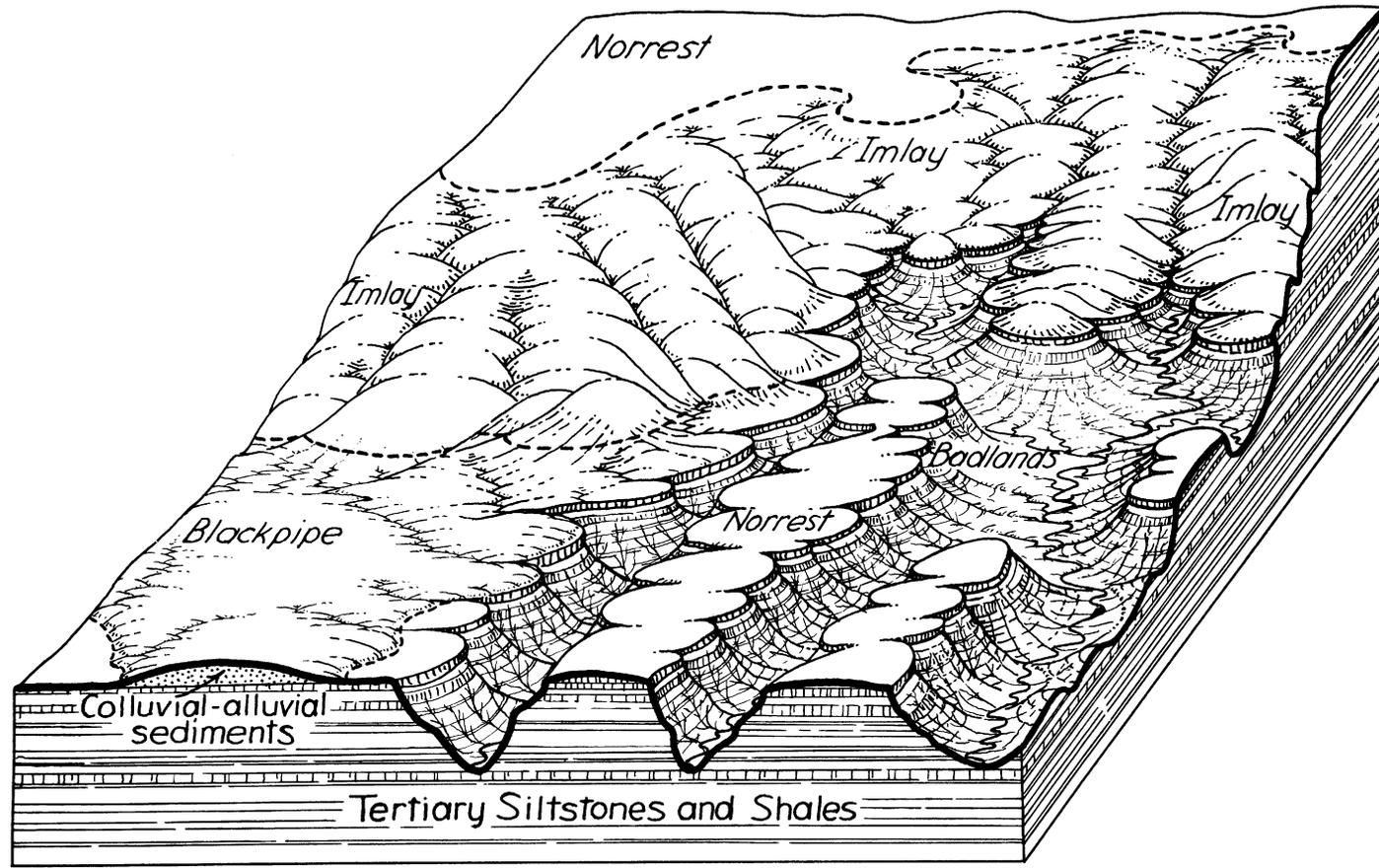


Diagram of a landscape in the Boundary Soil Conservation District . The soils named on the land surface are shown in their natural relationship to each other .



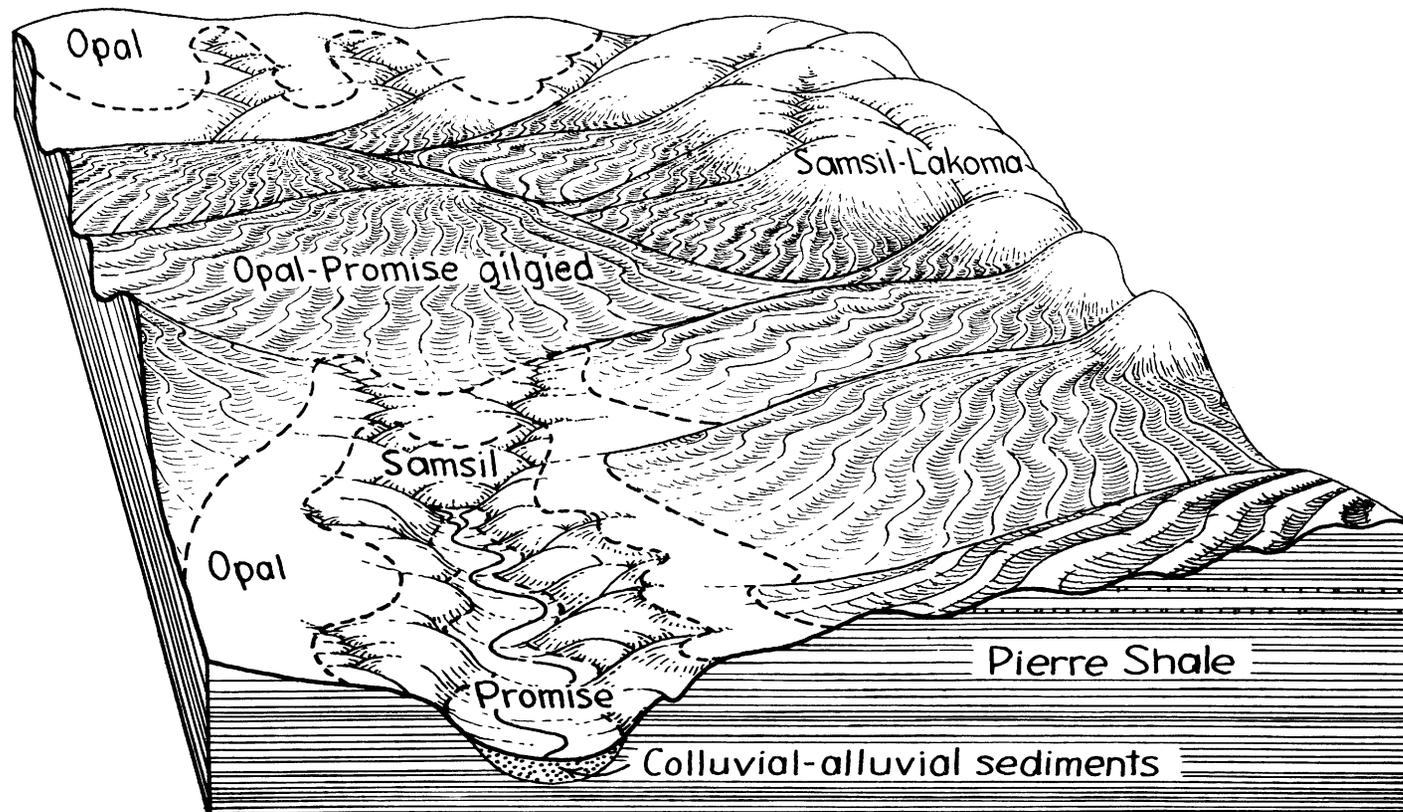






So. Dak Agric. Expt. Station

G. J. Buntley



So. Dak. Agric. Expt. Station

G. J. Buntley

HARLAN COUNTY RANGE SITES AND REPRESENTATIVE SOILS

