TECHNICAL NOTES

A DUAL-GRID SYSTEM FOR DIORAMA LAYOUT

RUTH MORRILL

Dioramas featuring three-dimensional figures arranged before landscapes painted on a concave background shell became prominent as museum displays late in the nineteenth century. The composition for these background paintings was generally created from field studies executed at the diorama site. The field references were then worked into a scale drawing where the problems in composition were resolved before the finished drawing was enlarged to fit the diorama shell.

Normally, the enlargement of a drawing is a simple matter of transferring material from grid squares of one size to grid squares of another. The transfer of a panoramic sequence to the curve of a diorama presents an unusual problem in this type of transfer and one that had not been explored by muralists prior to the advent of diorama display.

By the time Perry Wilson came to diorama painting in 1934, many dioramists had devised their own methods for transfer. Some set up an eye-level line along the diorama curve and drew freehand, stepping back to study the drawing and moving to the wall to make adjustments. Some used a set of corrective rectangles on the extreme bend of the curve or, using strings at the diorama opening, established horizontal lines that could be used as a guide. Others used a projector, threw a photographic image to the diorama wall, and made corrections by eye to offset any distortion where the projected image met the curve.

Mr. Wilson's first assignment at the American Museum of Natural History was as assistant to William R. Leigh, head of the museum's artistic staff. In this position, he worked with some of the finest dioramists in the world and, although admiring of their painting skills, found himself dissatisfied with their methods for producing realistic landscapes on concave diorama background surfaces. He felt the need of a more precise method, one based less on artistic judgment and more upon the constancy of mathematics.

Drawing upon his architectural training, he began searching for a way to make a concave arc appear to stretch out to infinity in all directions—a way to bend the diorama arc to a straight line by means of geometric illusion. Once he had accomplished this, he found that, due to photographic distortion, the photographs he relied upon for form and accuracy did not meld when used in panoramic sequence; and he found it necessary to develop a second type of grid to adjust to this. His final stroke

Ruth Morrill *(950 Benham Street, Hamden, CT 06514) worked with Perry Wilson during his assignment in Litchfield, Connecticut, at the White Memorial Foundation, and came to know his dual-grid system for creating diorama background paintings.*

FIGURE 1. Perry Wilson sketching the background for the mule deer group at the American Museum of Natural History. *(Courtesy of the Department of Library Services of the American Museum of Natural History. Transparency 296651.)*

was to link the two grids through the viewing distance to the diorama wall on the one hand and the focal length of the camera on the other. This enabled a transfer from a flat photograph to a curved diorama wall in perfect scale.

CONSTRUCTION OF THE DIORAMA GRID

Figure 2 shows a diagram of Mr. Wilson's procedure for preparing a grid for the diorama wall. His system, although slightly demanding in its precision, is based upon fairly simple geometry. Outlined here are a number of steps that are illustrated in the diagrams included in the text that follows. All steps apply to Figure 2.

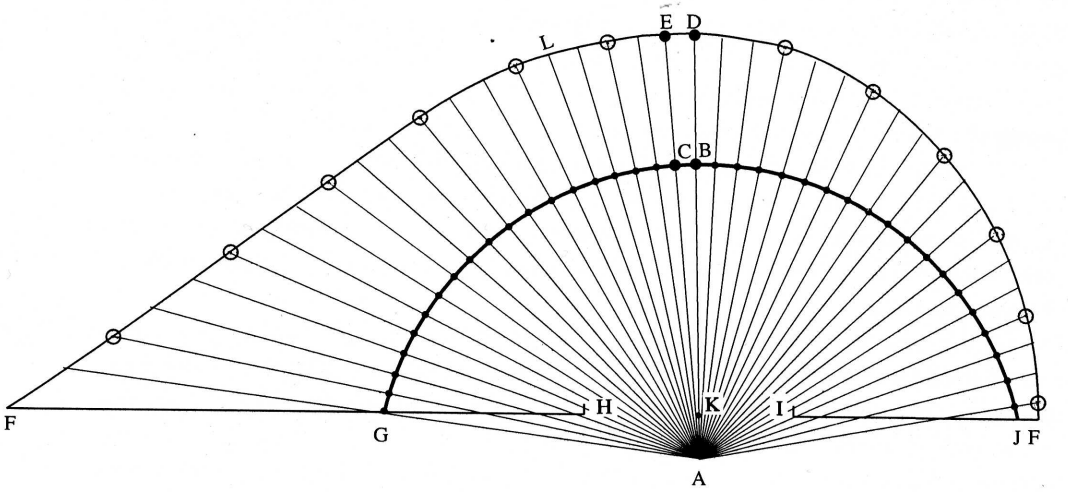
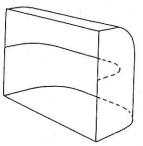
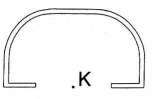


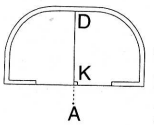
FIGURE 2. Floor plan showing points used in construction of a diorama grid. **A,** central viewing point; **AB,** inner arc radius; **AD,** central vertical line indicator (distance from central viewing point to the diorama wall; **AL,** one of the vertical line indicators used to determine the length of the horizontal spacing intervals; **CB,** spacing on inner arc; **ED,** spacing for horizontal lines as they cross the central vertical line; **FF,** curve of the diorama shell. (The normal curve is a U shape, as in the step figures.) **GJ,** inner arc. Lines projected through uniform spacings on this arc are called vertical line indicators and point to location of vertical lines of the grid. **HI,** viewing opening; **K,** center of viewing opening; **D,** center of the diorama wall as related to viewing opening; **O,** third verticals, used to determine horizontal spacing intervals.



1. **Establish an eye-level line.** Draw a line 5' 2" from the floor across the face of the diorama wall.

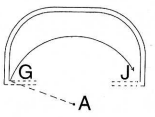


2. **Locate the center of the diorama opening (the viewing space enclosed by glass).** Indicate the center point on the diorama floor (K).

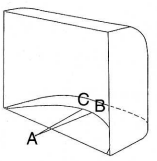


3. **Locate the central viewing point (A).** This point is located 12" back from the center of the diorama opening for small habitat groups, 18" or 24" for larger ones.

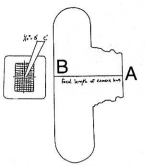
4. Project a line from the central viewing point (step 3) through the center of the diorama opening (step 2) and on to the base of the diorama shell (Line AD).



5. On the floor, inscribe the largest arc that can be fitted within the confines of the diorama shell before the walls have been installed (Arc GJ). Initiate the arc from the central viewing point.



6. Determine the width of the spacing intervals that will be used along the arc to determine the location of the vertical lines of the grid. The spacing interval will vary with the size of the arc and is determined from a simple equation involving: (a) the radius of the arc, (b) the focal length of the camera used to take the photographs, and (c) an arbitrary measurement based upon the number of units that will fit comfortably across a Kodachrome slide, allowing five or six units on each side of the center.

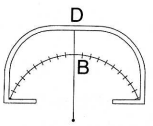


The inclusion of the focal length of the camera as one of the "knowns" assures continuity in the scale of the landscape when the panoramic series of photographs is transferred to the diorama shell. For example:

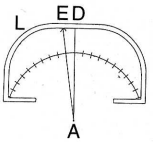
AB the radius of the diorama arc = 66"
A'B' the focal length of the camera lens = 50mm or 2"
B'C' the spacing unit used with the photographic grids = .1"
BC the unknown spacing to be used along the arc

$$\frac{AB}{A'B'} = \frac{BC}{B'C'}$$

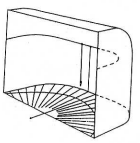
Substituting in the formula: $\frac{66"}{2"} = \frac{BC}{.1"}$ determines that BC = 3.3"



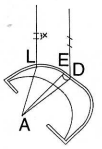
7. Mark the spacing determined in step 6 along the arc. Start the spacings at point B, where Line AD intersects the arc, and work to the right and to the left along the arc.



8. Project lines from the central viewing point through the spacing points marked along the arc in step 7 to the diorama wall. These lines mark the locations for the vertical lines of the grid and are called vertical line indicators (AD, AE, AL, etc.).

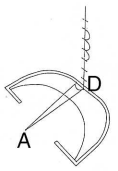


9. Determine reference points along the eye-level line for the vertical grid lines. Drop a plumb bob from the eye-level line to each point located in step 8. Mark the origin of the drop on the eye-level line.



10. Draw vertical lines to connect the floor and eye-level reference points. The lines should extend to a height sufficient to provide grid units for all the material on the reference photographs but should not protrude too far into the light colors of the sky.

11. Measure the space between the central vertical line indicator AD and its adjacent vertical line indicator AE (interval ED). See Figure 2. This measurement is taken at the base of the wall. This spacing will be placed along the center vertical line, starting at the eye-level line and working up and then down and locates the space between the horizontal lines as they cross the center vertical line.



12. Calculate horizontal spacings for the other vertical lines. The spacing intervals for the horizontal lines that will cross the rest of the vertical lines are based on an equation that uses (a) the spacing found between lines AD and AE at the diorama wall, (b) the length of the central vertical indicator, and (c) the length of another of the vertical indicators. An example:

AD, length of the central vertical indicator = 74"
DE, spacing between lines AD and AE (step 11) = 4.6"
AL, length of another vertical indicator = 76"
X, the horizontal-spacing interval for line AL

$$\frac{AD}{DE} = \frac{AL}{X} \qquad \frac{74"}{4.6"} = \frac{76"}{X} \qquad X = 4.7"$$

Calculate the horizontal spacing interval for every third vertical. Space the X values along the appropriate vertical, starting at the eye-level line and working up and then down.

13. **Connect the horizontal spacings dots across the vertical lines.** To make a smooth line, use a flexible straightedge and try to span at least nine dots. Start work from the eye-level line.

14. **When observed from the viewing point, the horizontal lines of the grid will appear straight, and the grid units will appear square.**

REFERENCE PHOTOGRAPHS USED WITH THE DIORAMA GRID

Mr. Wilson relied heavily upon a series of panoramic photographs taken at the diorama site. The pictures were taken from a tripod leveled to a height of 5' 2", the same height he used as a standard eye-level line in the diorama shell (step 1). The photographs were carefully planned. First, he selected a center for his composition and then, swinging the camera to the right and left, he selected key features of the landscape to serve as markers when matching adjoining photographs. A series of five photographs, two to the right and two to the left of the center were usually sufficient, although he often took an extra shot at each end of the panorama just to make sure he had enough material.

A second panoramic swing with the camera tipped down to increase coverage of the foreground was made (Figure 3). A third swing, with the camera tipped up to record subtle changes in sky color completed the photographic references.

When he attempted to combine the photos of the panorama, he found a slight distortion at their outer margins that caused a rippling effect where adjacent photographs met as they were enlarged to the diorama wall. To compensate, he designed a grid that would correct this discrepancy (Figure 4). The corrective grid was adapt-

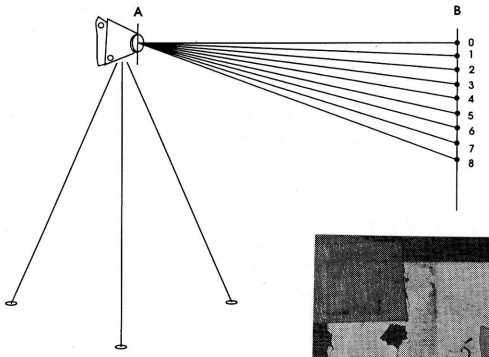


FIGURE 3. Degrees of camera tilts represented by the grids in Figure 7: 0, 90°; 1, 86°; 2, 82°; 3, 78°; 4, 74°; 5, 70°; 6, 66°; 7, 63°; 8, 60°.

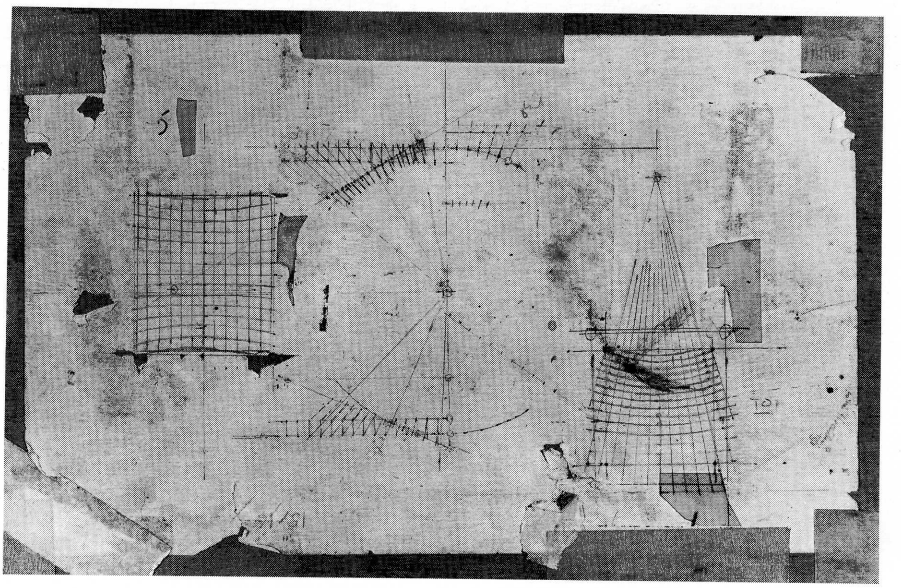


FIGURE 4. Perry Wilson's diagram showing his method for constructing enlarging grids for photographs taken at a 90° angle to the eye level and for various degrees of camera tilt. This construction is available in the file for James Perry Wilson at the National Museum of American Art.

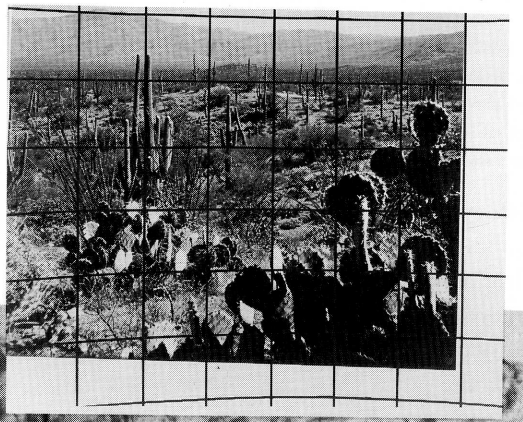
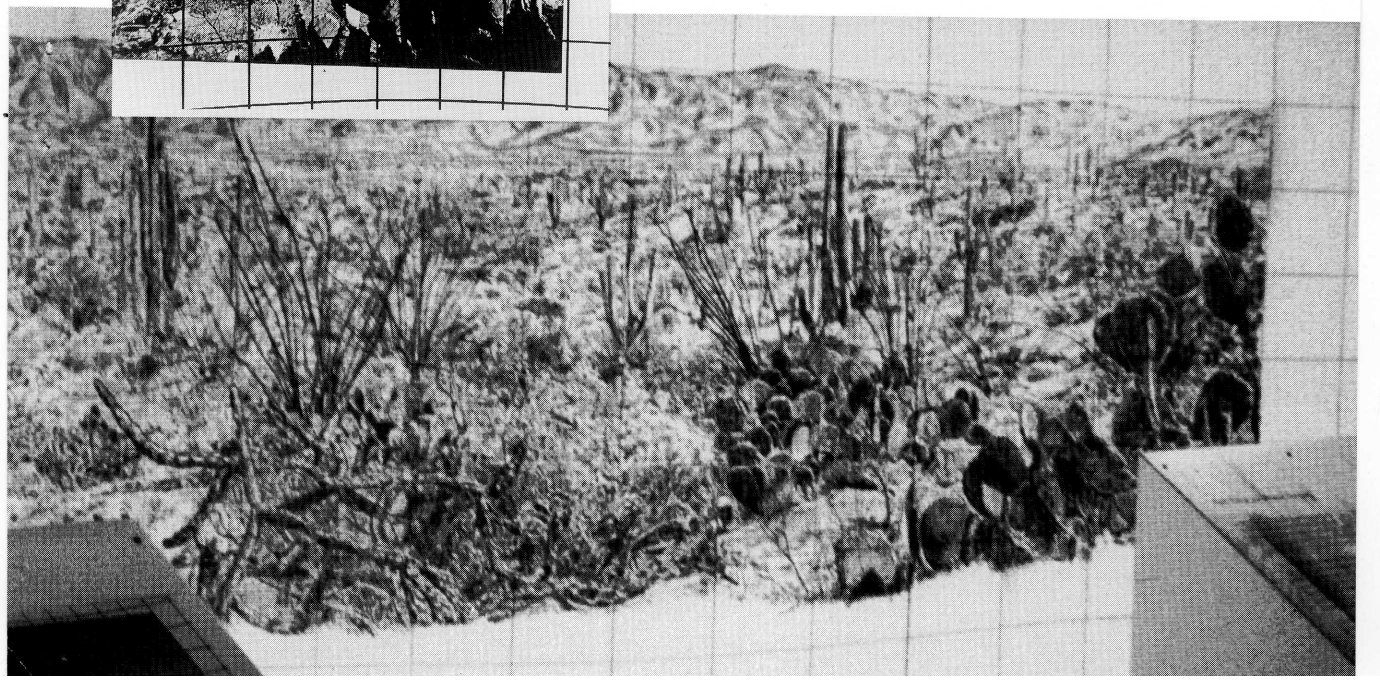


FIGURE 5. Reference photograph with grid.

FIGURE 6. Diorama shell with charcoal drawing following the reference photograph. The extreme bend of the curve can be observed at floor level, while the illusion of expanding space in the drawing defies the curve in its stretch to infinity.



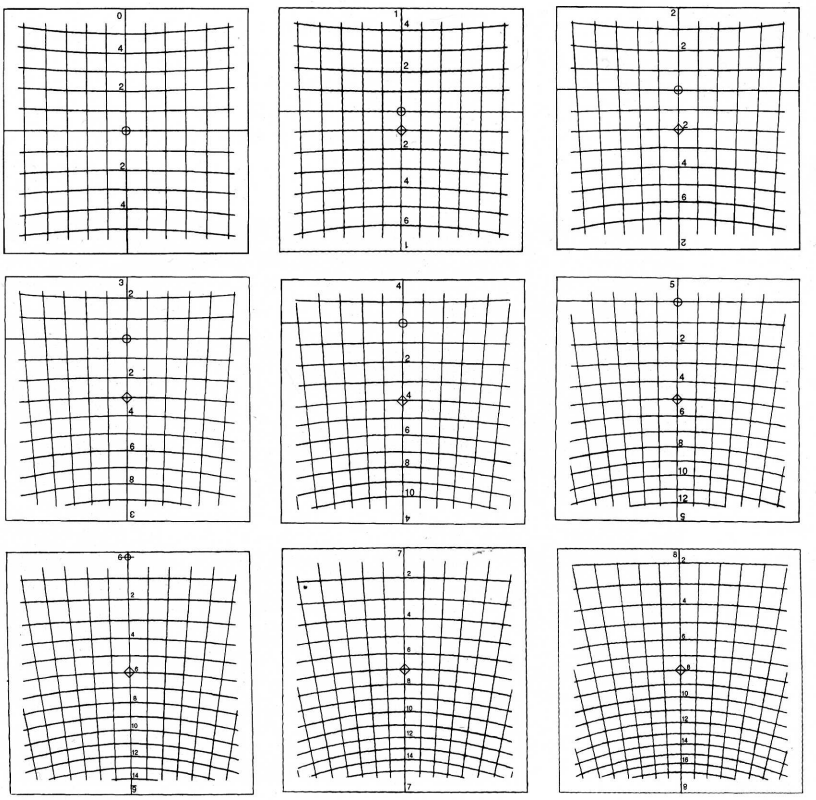


FIGURE 7. Wilson grids 0–8 (90°–60°) for enlarging a panoramic series of photographs to a curved surface. The 0 grid is used with the panoramic swing taken with the camera directed at a right angle to the eye-level line. Each additional number from 1–8 adds one row of horizontal units that can be transferred from the photographs to the diorama wall. These grids were made for a 35mm camera lens but will work, with some loss of scale, with a 50mm lens.

Copies can be taped to slides for viewing through a slide viewer. The grids can be used as presented with photographs taken when the camera is tipped down, upside down when the camera is tipped up. The circled horizontal line indicates the position of the 90° eye-level line at that particular angle of camera tilt. The offset square indicates the center line of that grid.

ed (Figure 5) to cover camera angles from the 90° eye-level line to 60° away from the eye-level line. Each photograph of a panoramic swing should be fitted with a grid that remains on the slide throughout the painting of the diorama.

Fit the grid for the center photo of the panoramic swing first, with the center horizontal line of one of the 0 (90°) grids carefully placed along the eye-level line of the photo. Indicate on the center line of the grid, the point chosen as the center of the diorama when photos were taken (the offset square in Figure 7 grids). The center horizontal line will follow the eye-level line across the slide. Tape grid to photo.

Line up the next photo in the series. Using another 0 grid, match the eye-level line of that photo to the eye-level line of the photo just fitted, matching the landmarks at the outer margin into corresponding grid units. The eye-level line of this second photo should go straight across the slide from its match with the eye level of the photo it adjoins rather than following the eye-level line established in the center photo. In this way, the eye-level line will slowly lift away from the center of the outer slides of the panoramic series, correcting the slight arc caused by taking photos from a central point.

Grids for camera angles tilted away from the 90° angle must be keyed to those above or below as well as to those adjacent. With the grids fastened in place, transfer of the details from the flat surface of a gridded photograph to the curved surface of a gridded diorama shell has become manageable.

VALUES, REALISM, ACCURACY

Technical assists such as this grid system, combined with good field notes, color studies, and photographs, will help overcome many of the difficulties encountered during the painting of a realistic landscape on the curve of a diorama alcove. However, unless the artist understands values and is willing to accept the restraints of strict realism and accuracy in painting, the diorama will not exude the breath of life Mr. Wilson's dioramas express.

It would be impossible to explain how to paint a "Wilson" diorama, for it is not just their layout that sets them in a class by themselves. It is his handling of medium and his ability to portray a sense of place and moment. His landscape paintings are superb and confidently stated. Dripping with atmosphere that characterizes the mood of a day, exuding an ethereal touch of light that captures the essence of a moment, they demonstrate a perfect understanding of value and an exquisite expression of tone that provides restful continuity. These qualities blend to create a painting that opens a window to natural beauty. Their delicate truth can only be a reflection of the sensitivity of the artist, a sensitivity that awakens the viewer to beauty too often passed unseen.

Dismissed as being too realistic and lacking in imagination, Mr. Wilson's work has been ignored by critics and collectors. But a study of his paintings reveals a master whose gentle landscapes, rendered without flair and pretension, demonstrate careful thought and meticulous handling. The apparent ease of rendering masks the intelligence and talent brought to bear in their execution.

An examination of his dioramas and field studies shows his close attention to values and his wonderful ability to interpret light and atmosphere which, when combined with his personal "handwriting," or painting style, produced a spiritual window to the out-of-doors he knew and loved.

He was aware of the permanence required under the punishing light and heat of museum lighting and made color swatches of the different paints he used, watching them for several years to see how they interacted chemically and how they stood up over time. His palette was limited, consisting of nine Winsor Newton colors: Ultramarine Blue, Cobalt Blue, Winsor Blue, Cadmium Yellow Pale, Cadmium Yellow Deep, Yellow Ochre, Indian Red, Cadmium Scarlet, Alizarin Crimson, with Permalba as his White. Occasionally, he mixed in a little Burnt Umber when extreme darks were needed. His dark tones contained no black.

He was a team worker. He felt no need to call attention to his art. In fact, he seemed to delight in making his paintings so realistic they all but vanished as the viewer became absorbed in the diorama scene. Painting at a time in art history when most of his contemporaries were exploring the new, the abstract, the nonobjective, his work remains to set the standard for dioramists around the world.