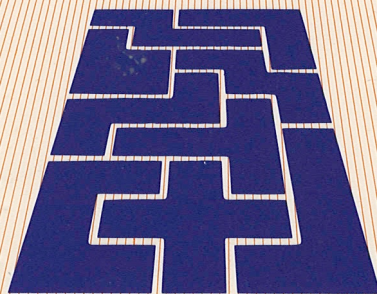
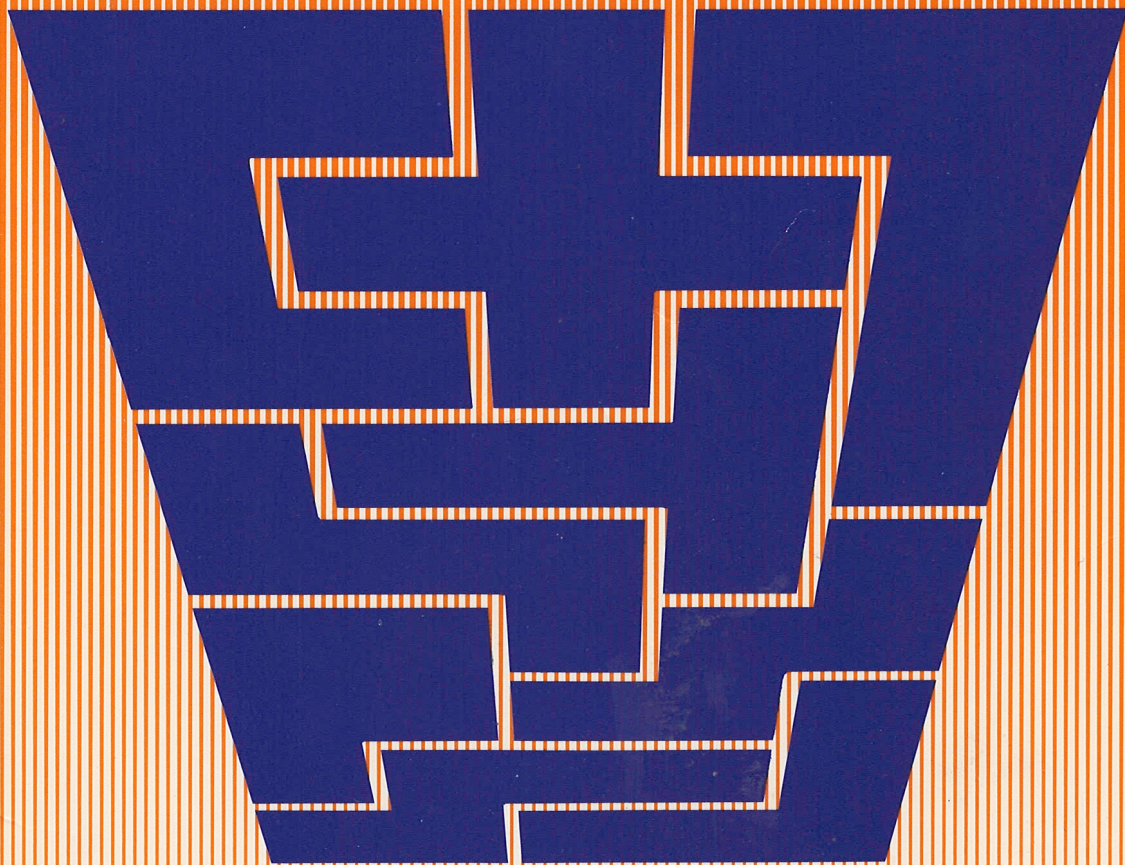


PENTOMINO PUZZLES

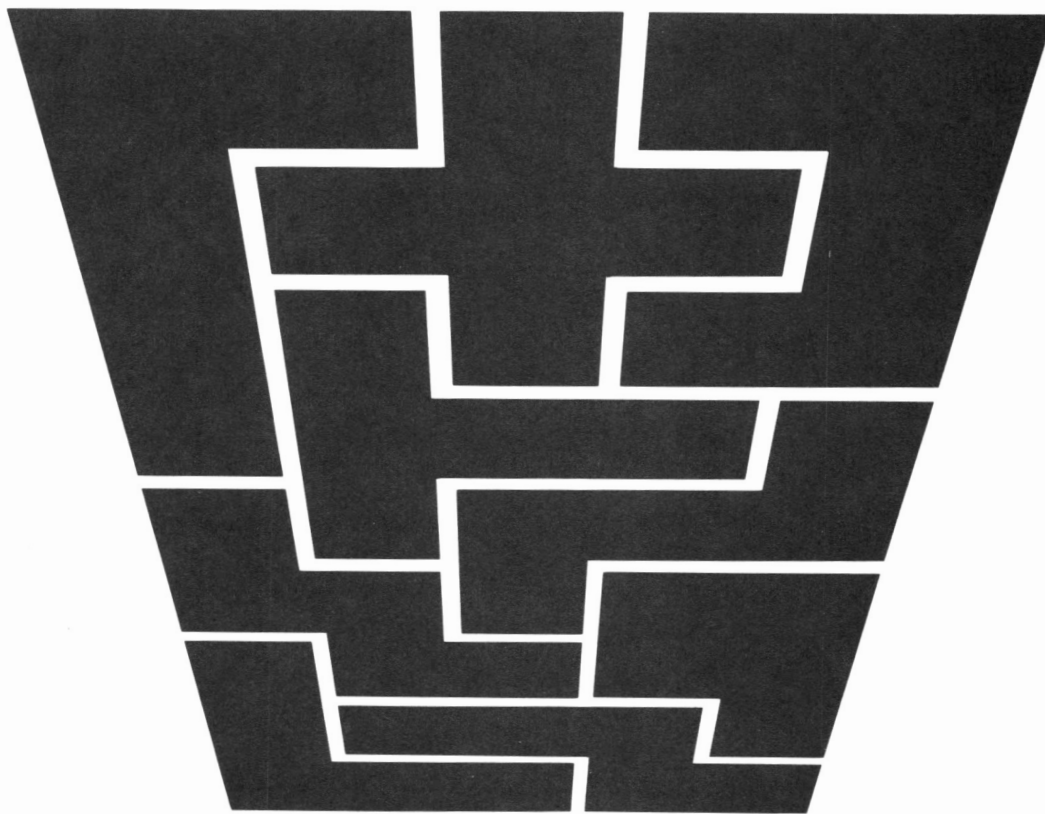


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PENTOMINO PUZZLES



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NOTES TO THE TEACHER

Pentominoes are the geometric shapes that are formed by joining five squares edge-to-edge. The name comes from the word *domino*, the shape made by joining two squares in this way. There are twelve pentominoes, named after letters of the alphabet. (See the drawing at the bottom of this page.) They can be put together to form many interesting shapes.

The first known pentomino puzzle was published in 1906, but the shapes were rediscovered and named by Solomon W. Golomb at Harvard in 1953. They were popularized by Martin Gardner's "Mathematical Games" column in *Scientific American*.

The best-known pentomino puzzle is to cover a 6-by-10 rectangle with all the pentominoes. Most people have trouble finding even one solution, but a computer found 2,339 of them. The last two puzzles of this problem constitute the last two puzzles in this book.

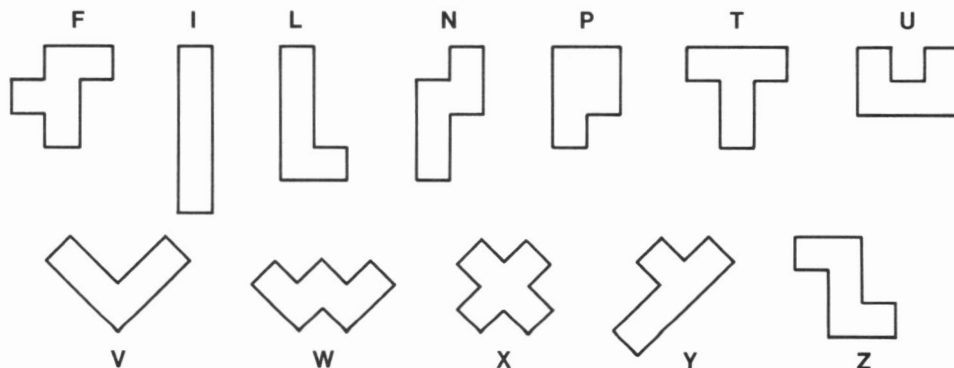
HOW TO USE THIS BOOK

The puzzles in this book are self-explanatory: Cover each figure with pentominoes. The pieces should not overlap or stick out beyond the boundaries of the figures.

The puzzles fall into seven sets somewhat arbitrarily titled Volcanoes, Turnarounds, Buildings, Fish, Broken Rectangles, Farms and Cracked Rectangles. As much as possible, the puzzles are ordered by difficulty within each set, the easier ones coming first. To some extent, the sets are also ordered by difficulty. You may want to keep copies of the puzzles from each set in separate folders. This will help keep the puzzles organized, and will make it easy for a student to take a whole set to his or her desk.

The names for the seven sets of puzzles were chosen, in most cases, for obvious reasons. The Volcanoes and Buildings look relatively like those objects. Turnarounds, when turned upside down (rotated 180 degrees), will still look the same. When the Fish puzzles are held diagonally some people see fish swimming in an aquarium. Broken Rectangles are all incomplete in one corner. A Farm is a rectangle with one or more rectangular holes in it. A rectangle is "cracked" if it includes a two- or three-pentomino staircase in a corner.

Some of the individual puzzles within each set have names of their own. These shapes look very much like what they are called. Perhaps these names will give your students ideas about naming some of the puzzles themselves. Encourage students to think up new titles for puzzles and to give names to some of the others.



Students may solve the puzzles in any order, but it is important they keep track of their progress by checking the puzzles on the checklist (page v) as they solve them. This allows students to see their progress and motivates them to solve more and more puzzles. If they are frustrated at a given level, encourage students to try easier puzzles. (Almost all the sets start with relatively easy puzzles.)

Use pages 1 and 2 as patterns to make pentominoes or as a check to make sure you have a complete set. If you want your students to explore pentominoes further, the following materials are available from Creative Publications.

THE MATH MACHINE-PENTOMINO PUZZLES, Cat. No. 34454
48 basic pentomino puzzles

PENTOMINO ACTIVITIES, Cat. No. 34471

Each of the 84 puzzles consists of two or more figures that must be covered simultaneously with pentominoes.

POLYOMINO LESSONS, Cat. No. 10775

PENTOMINO LESSONS, Cat. No. 34481

These pentomino and grid-paper activities help teach or reinforce many math concepts including area, perimeter, tiling, multiples, triangular numbers, congruence, similarity, maximum-minimum problems, symmetry, strategy games, problem solving, and open-ended research. These books also include dozens of very difficult puzzles.

A NOTE ON SYMMETRY

The figures in this book can be classified into several categories from the point of view of their properties of symmetry.

Group 1

Not symmetric (most Broken Rectangles, all Cracked Rectangles).

Group 2

One line of symmetry in the direction of the pentomino boundaries (all Buildings).

Group 3

One line of symmetry at a 45-degree angle to the pentomino boundaries (all Volcanoes, most Fish, some Broken Rectangles).

Group 4

180-degree rotational symmetry (most Turnarounds).

Group 5

Two perpendicular lines of symmetry in the direction of the pentomino boundaries and 180-degree rotational symmetry (some Turnarounds, most Farms).

Group 6

Two perpendicular lines of symmetry at 45 degrees to the direction of the pentomino boundaries and 180-degree rotational symmetry (Turnaround 18, Fish 41).

Group 7

Four lines of symmetry and 90-degree rotational symmetry (Turnaround 16, Farm 65).

NAME _____

CHECKLIST FOR PENTOMINO PUZZLES

Use this checklist to keep track of the puzzles you have solved.

VOLCANOES

3 4 5 6 7 8 9 10 11

TURNAROUNDS

12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

BUILDINGS

28 29 30 31 32 33 34 35 36 37 38

FISH

39 40 41 42 43 44 45 46 47

BROKEN RECTANGLES

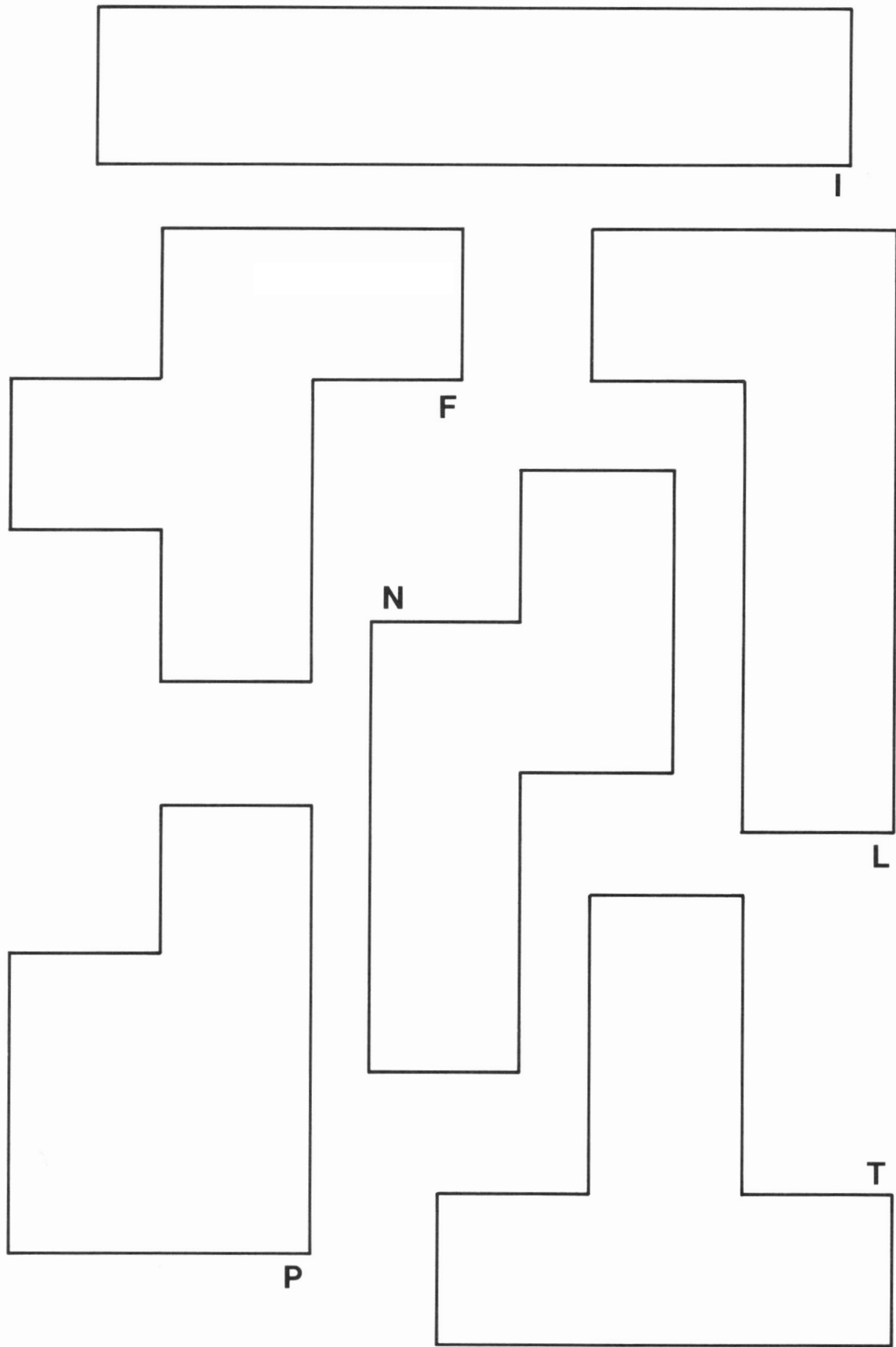
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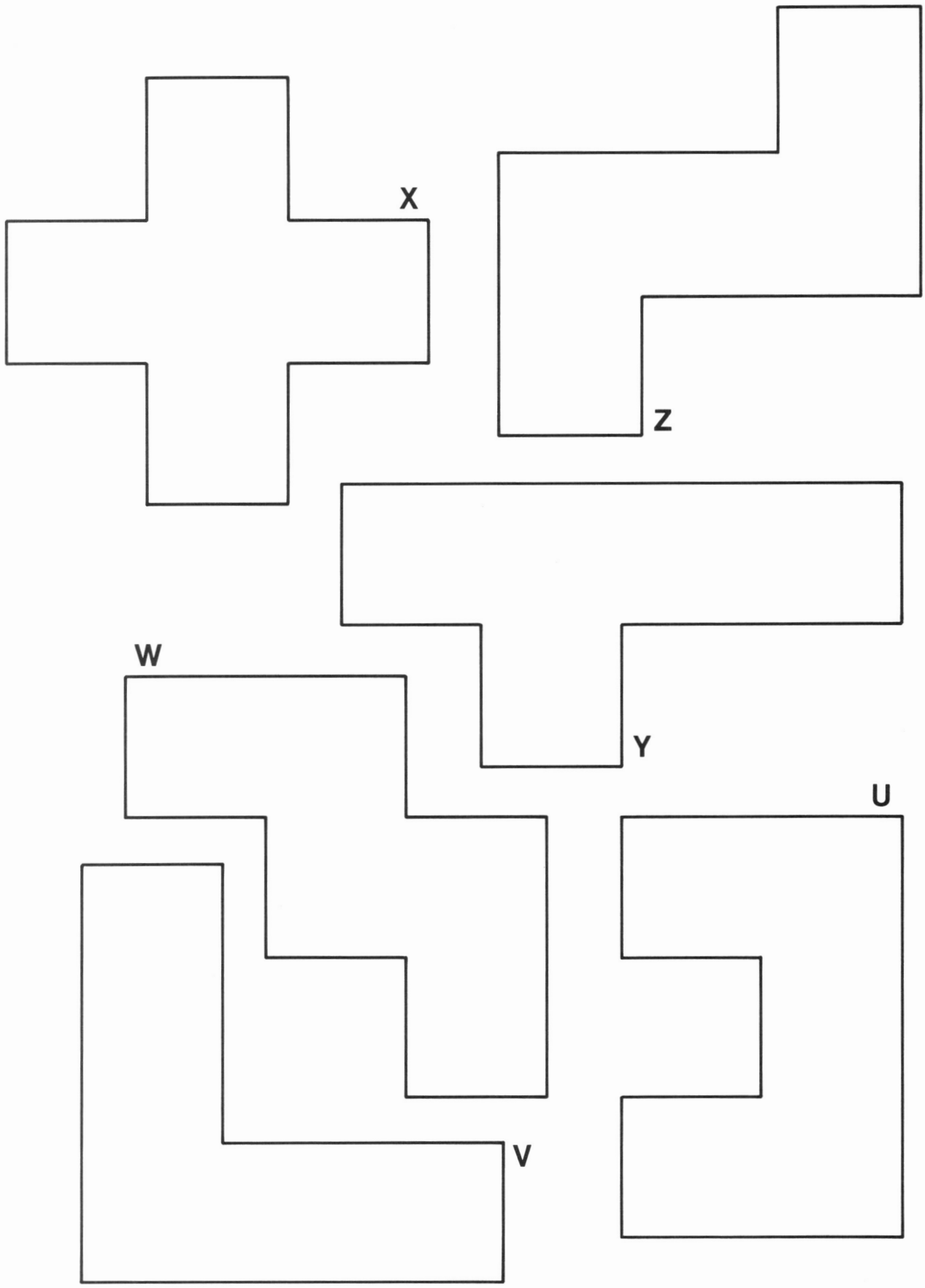
FARMS

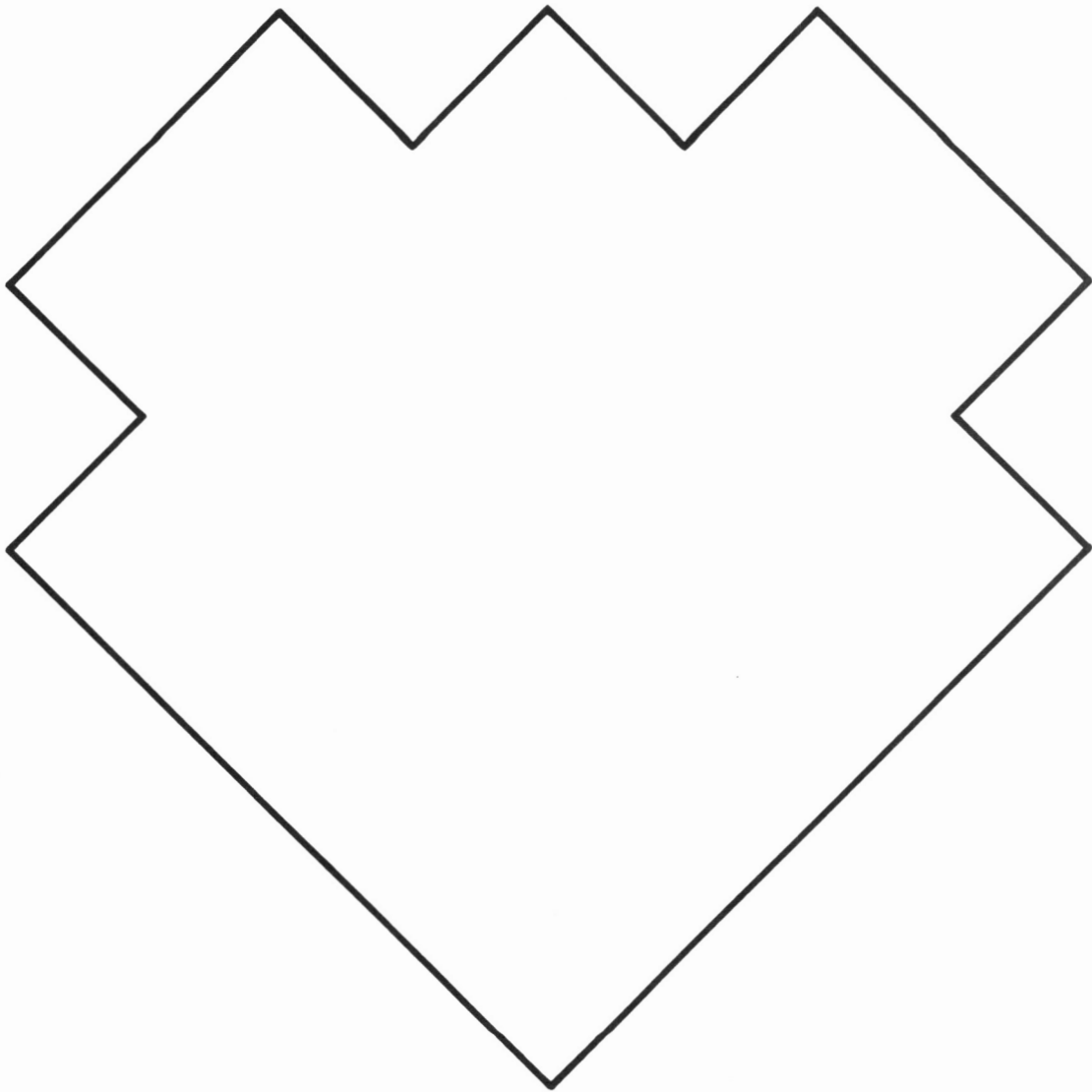
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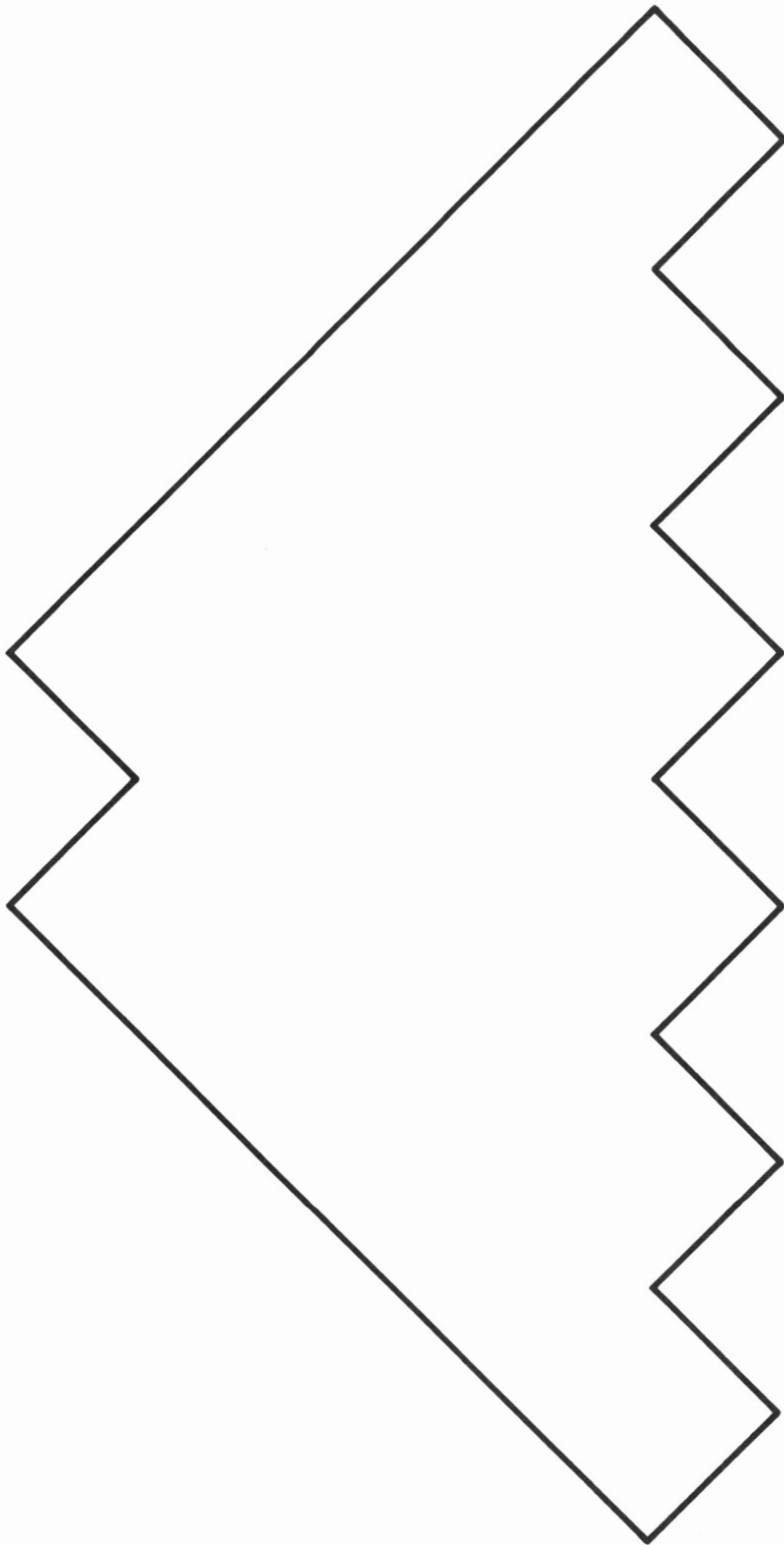
CRACKED RECTANGLES

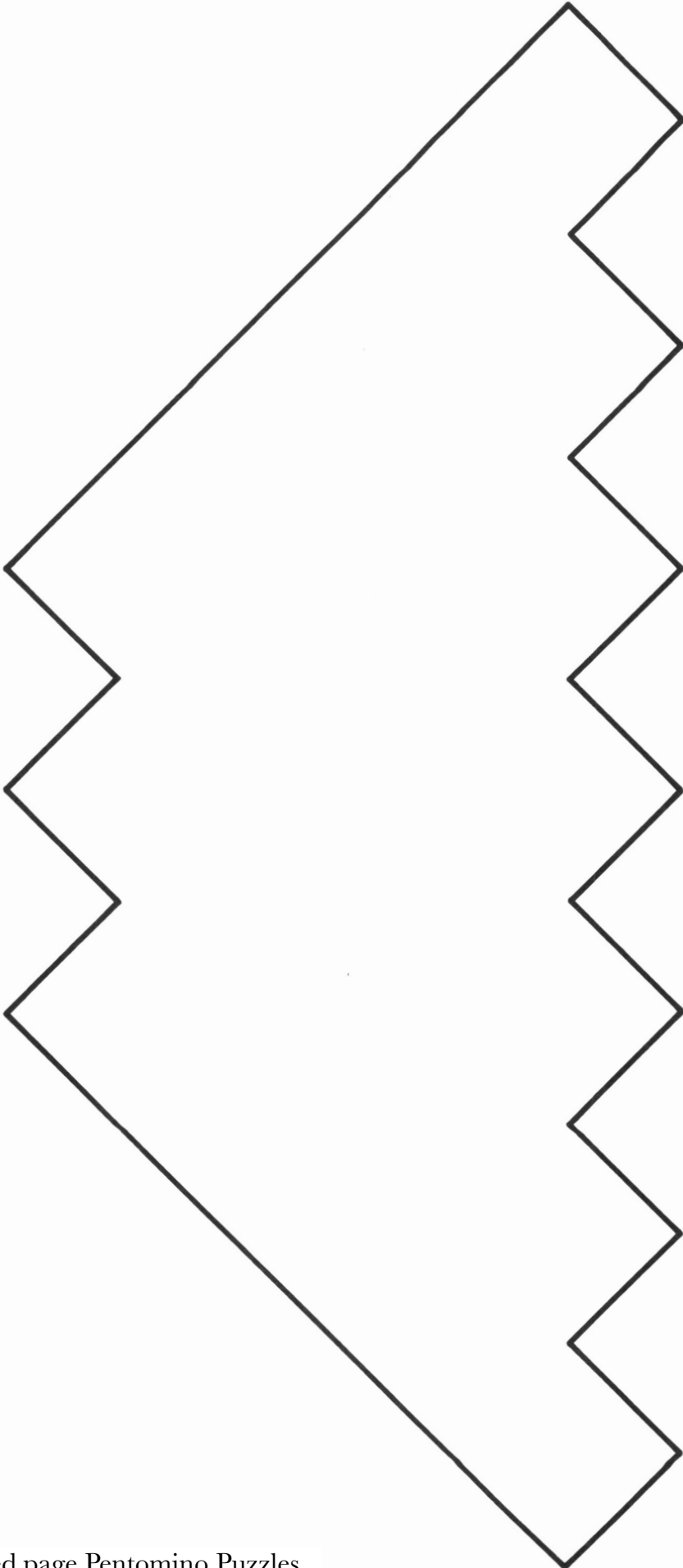
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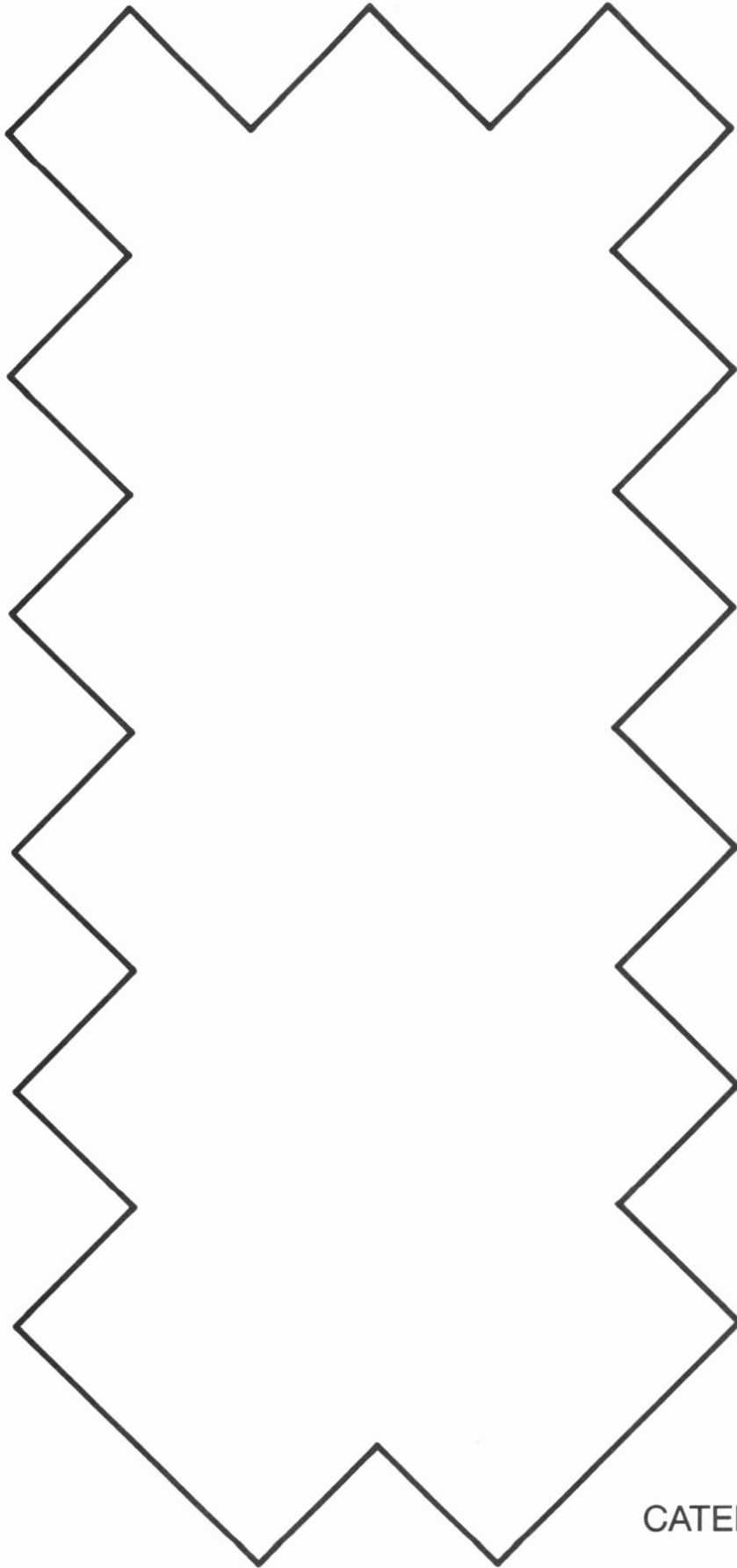




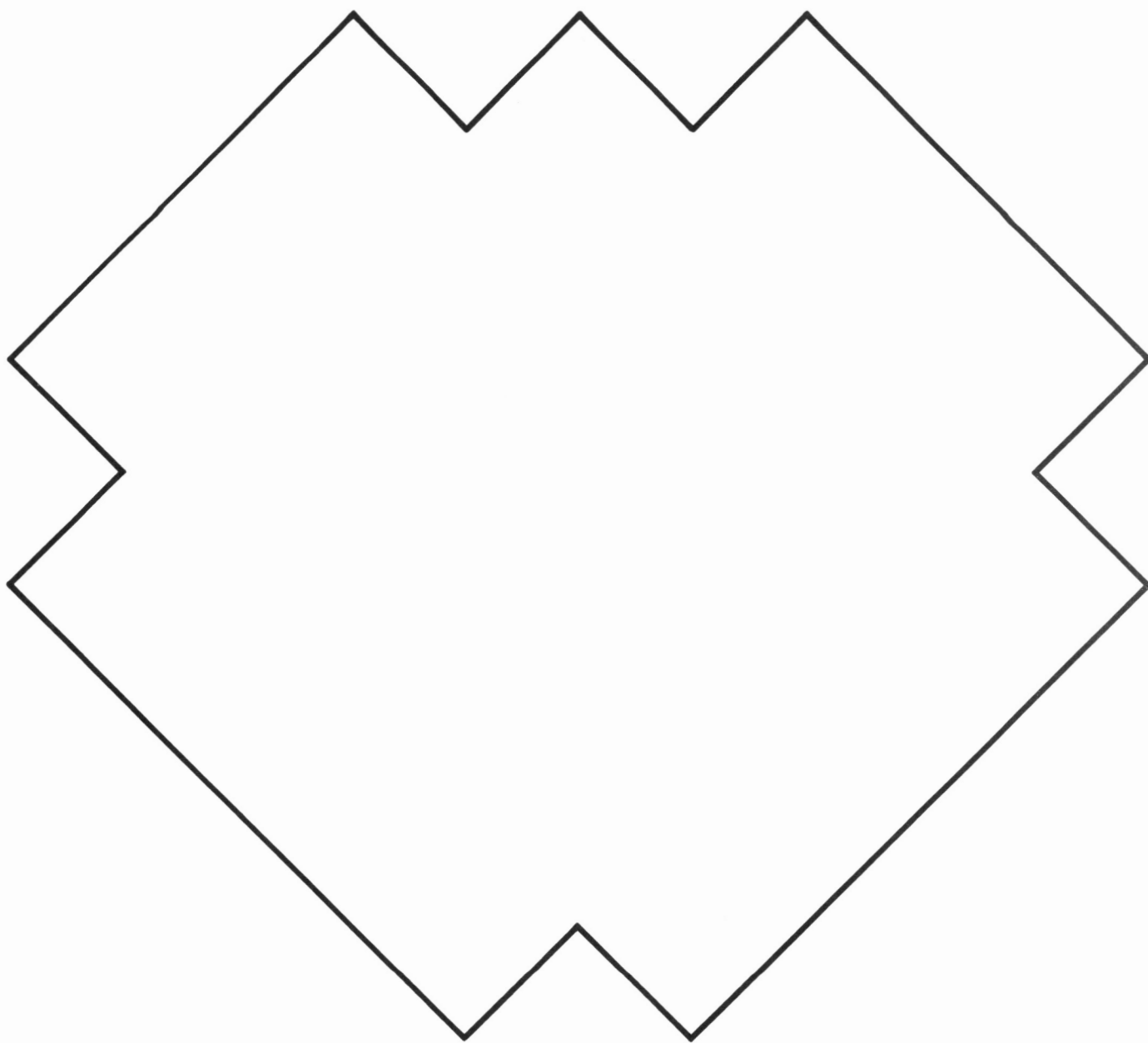




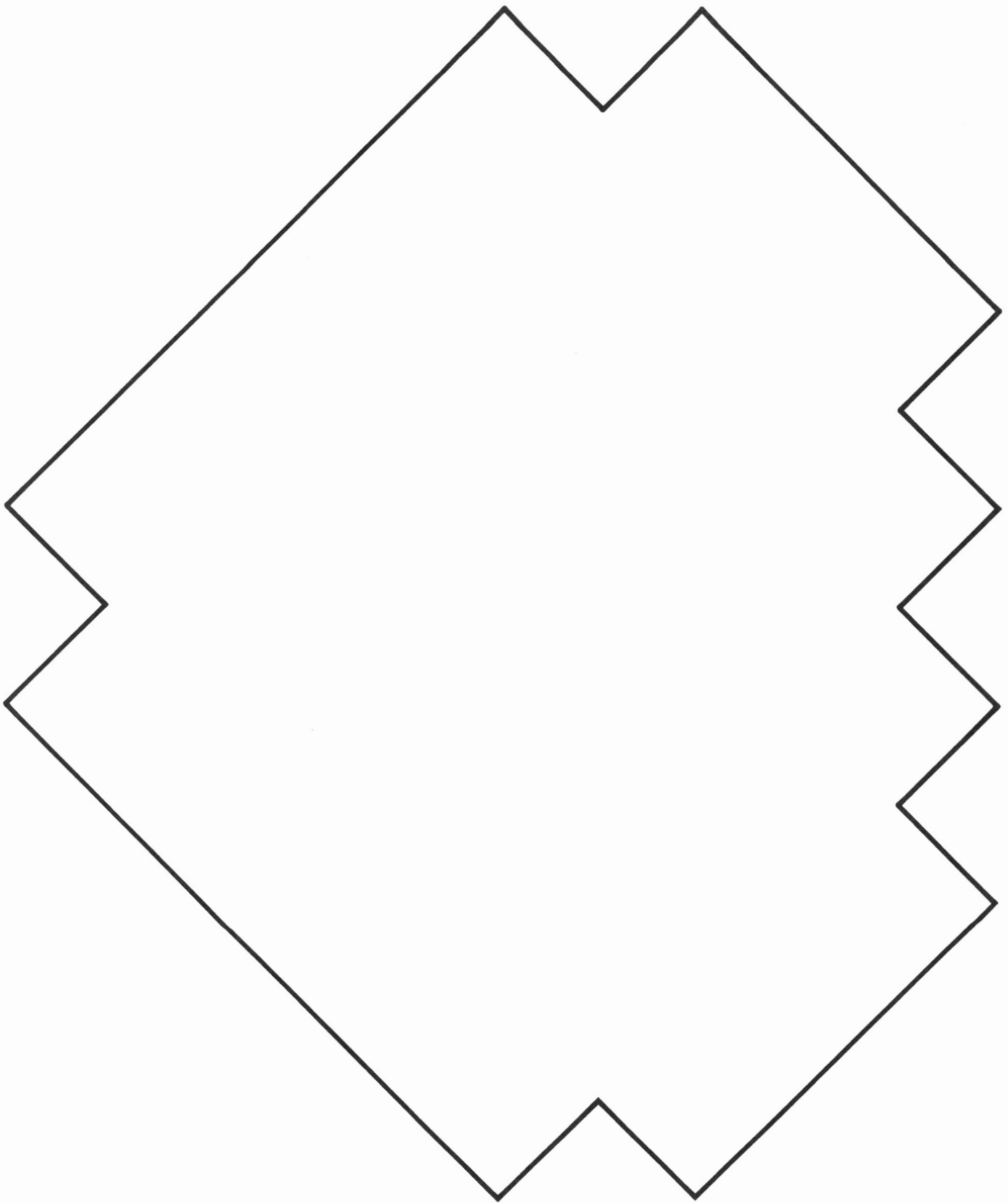


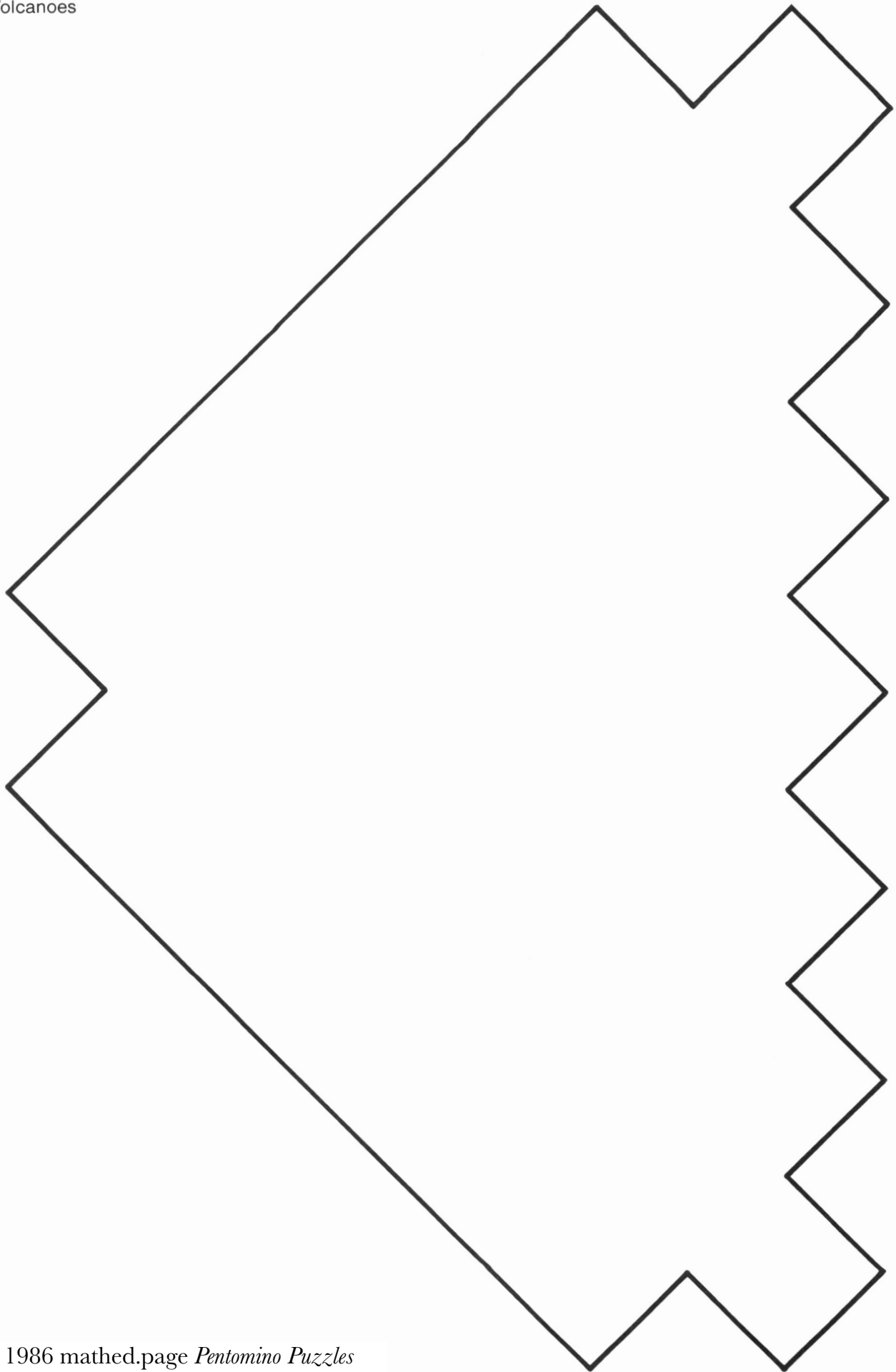


CATERPILLAR

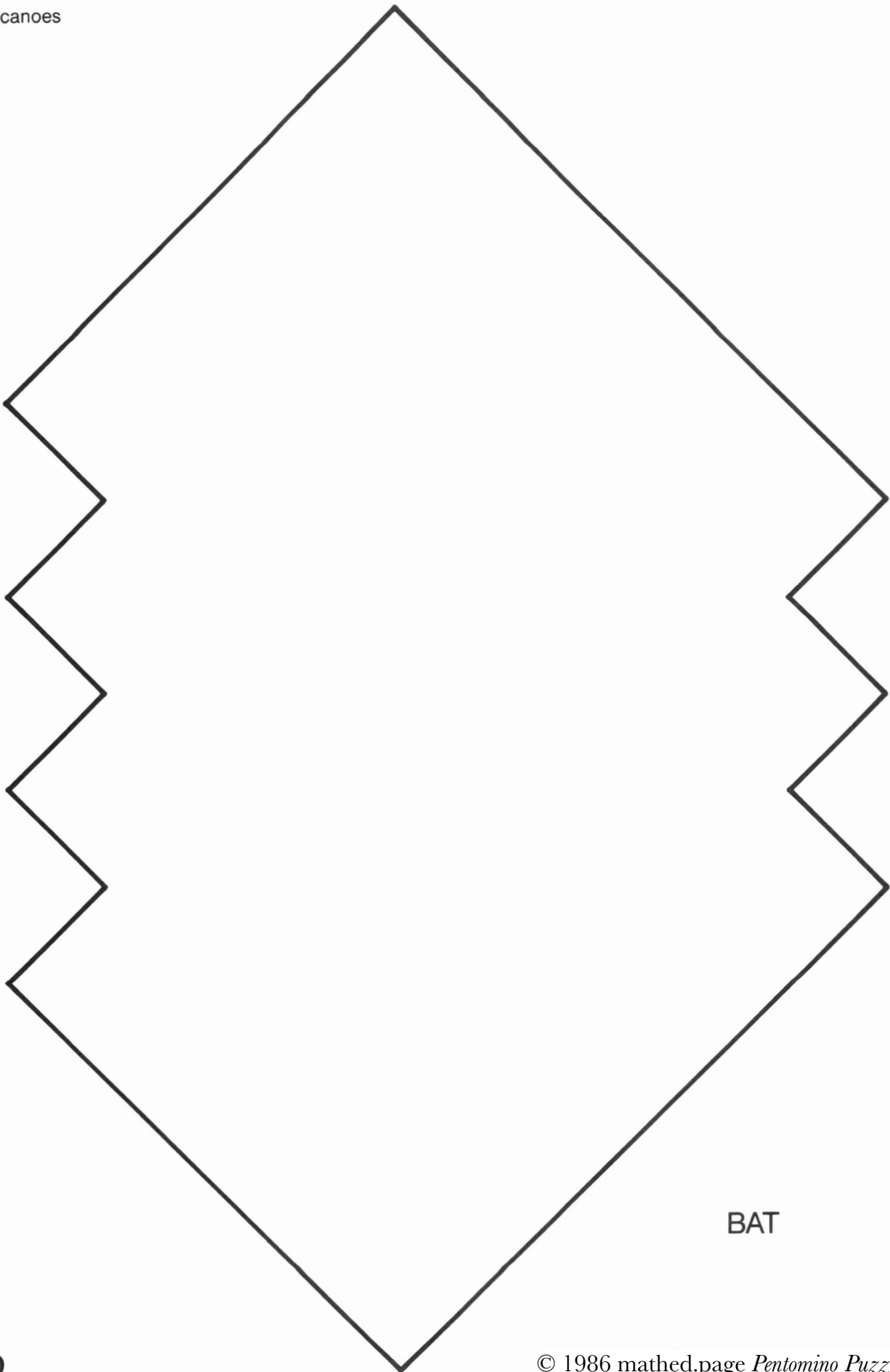


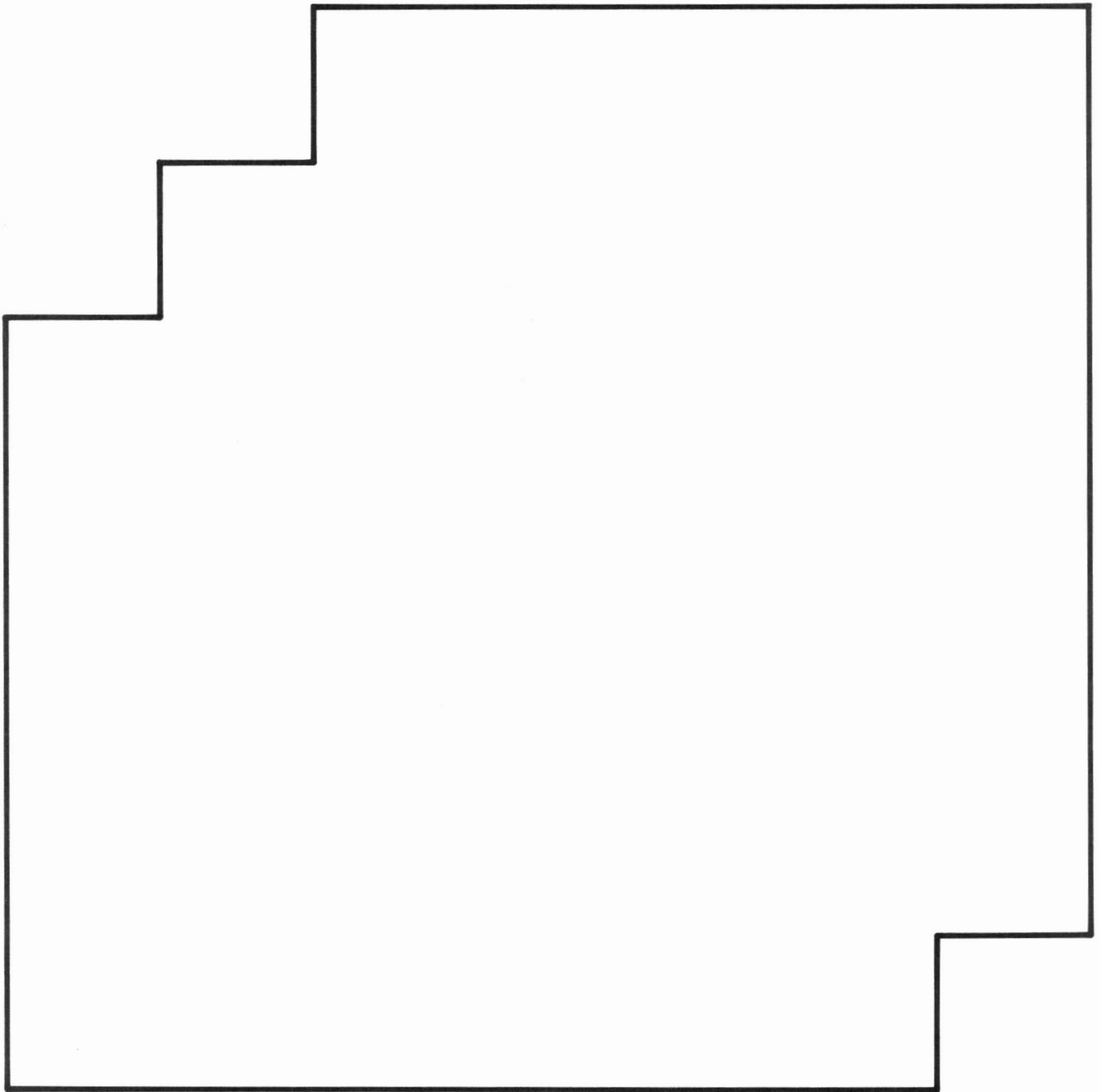
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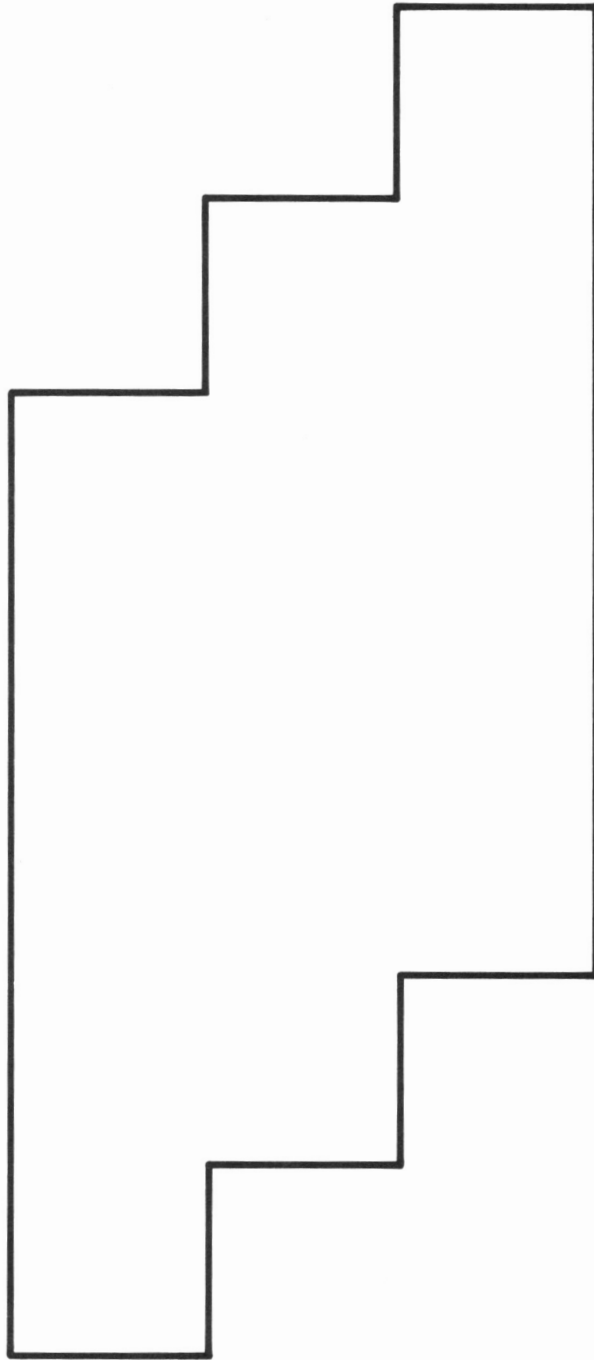


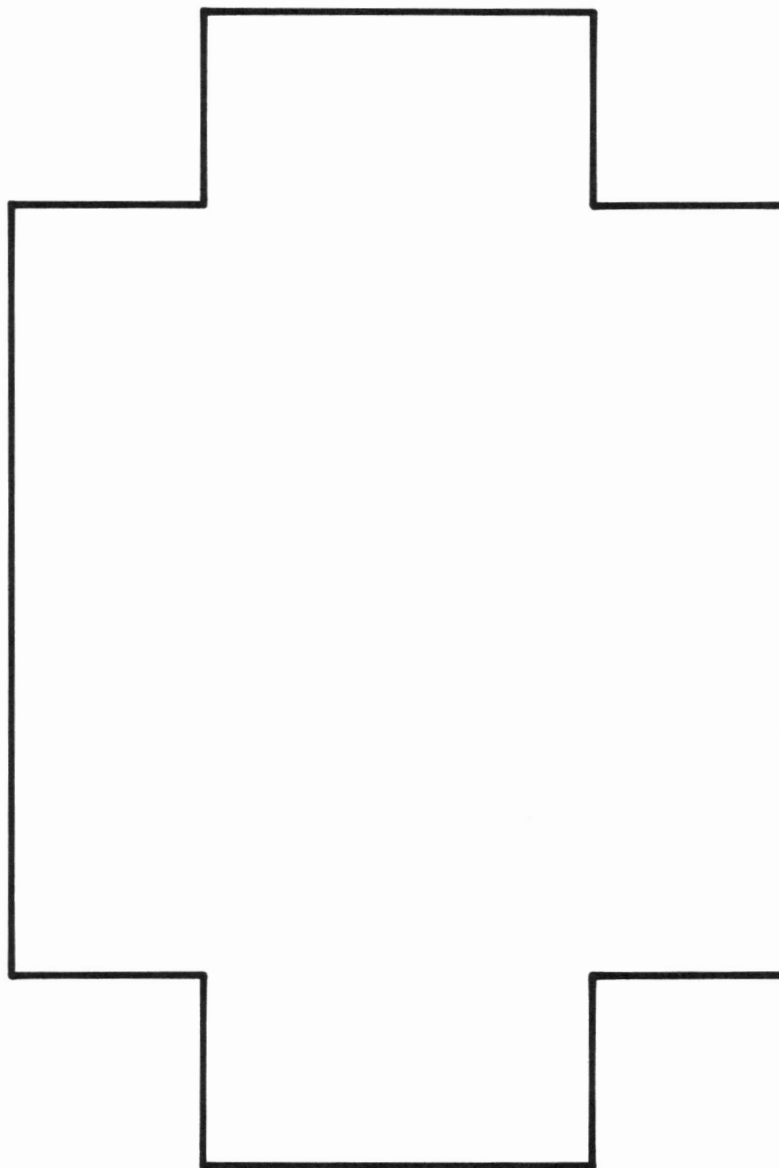


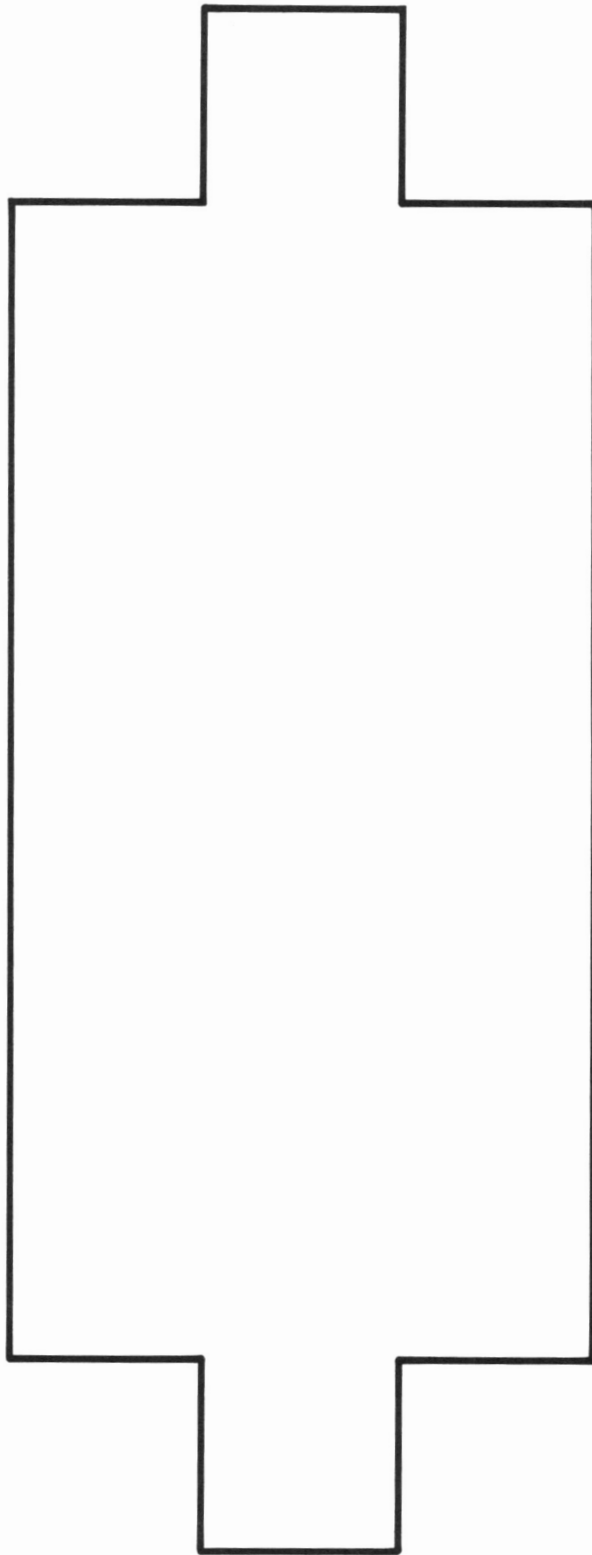
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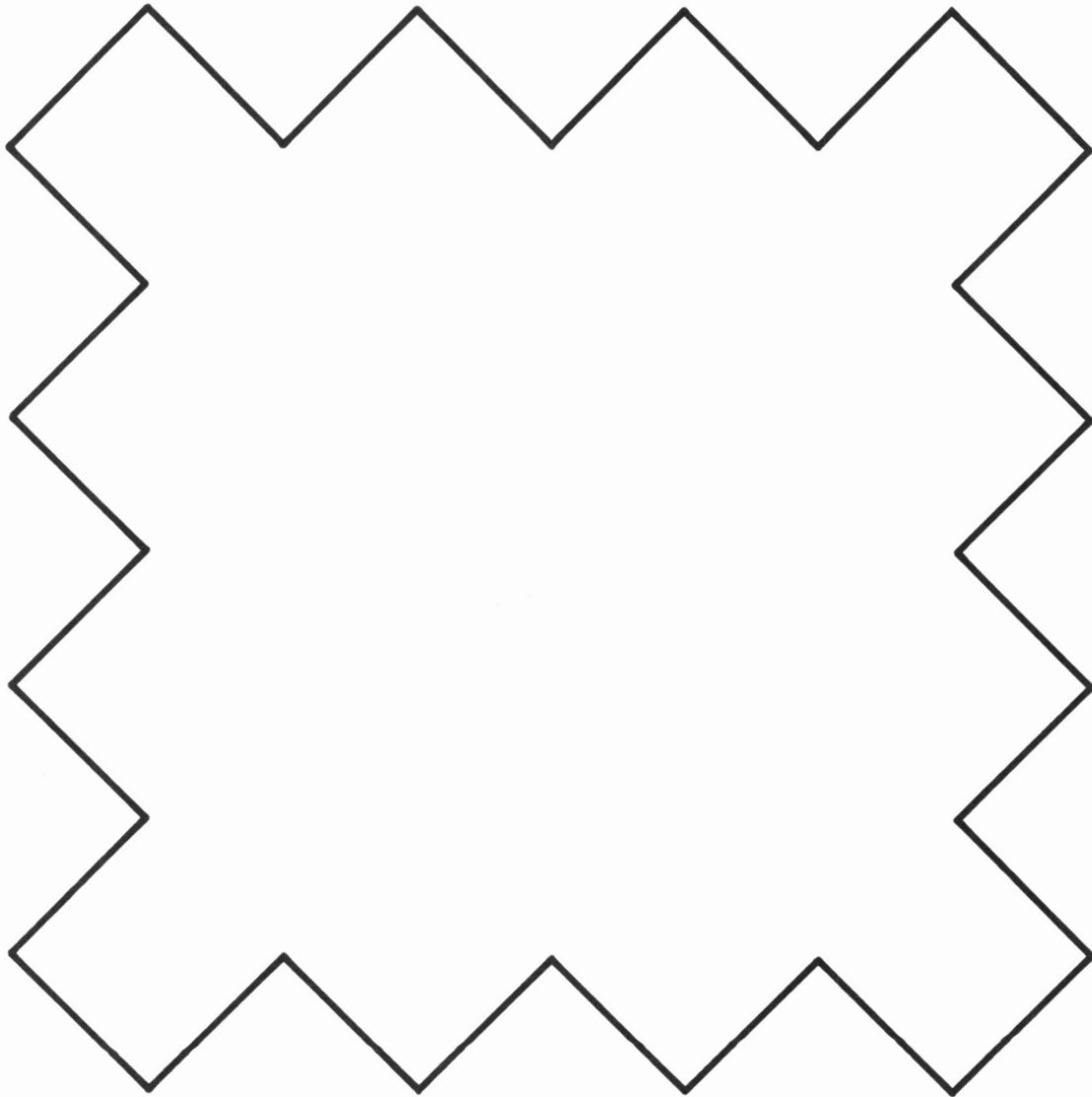




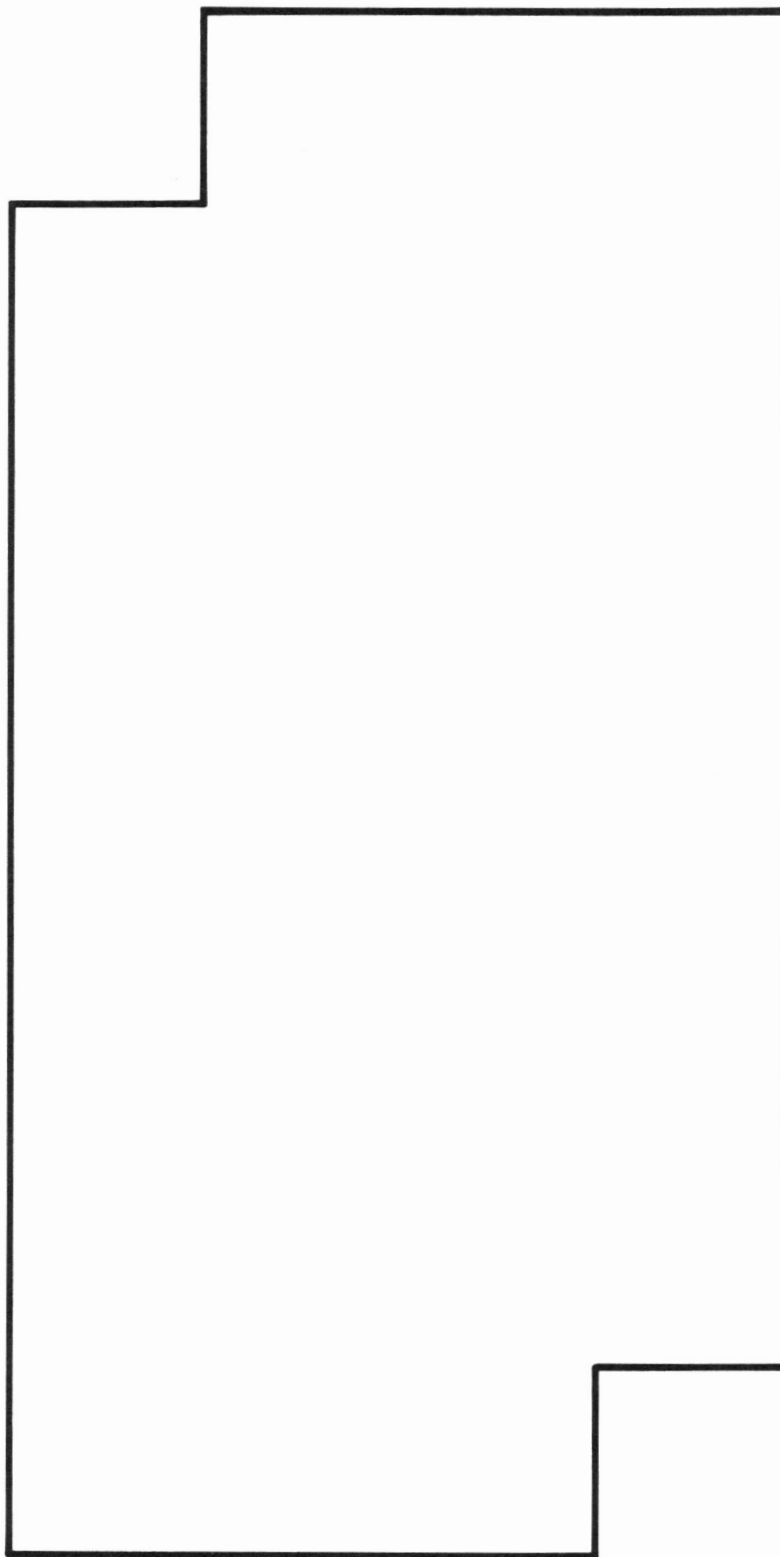


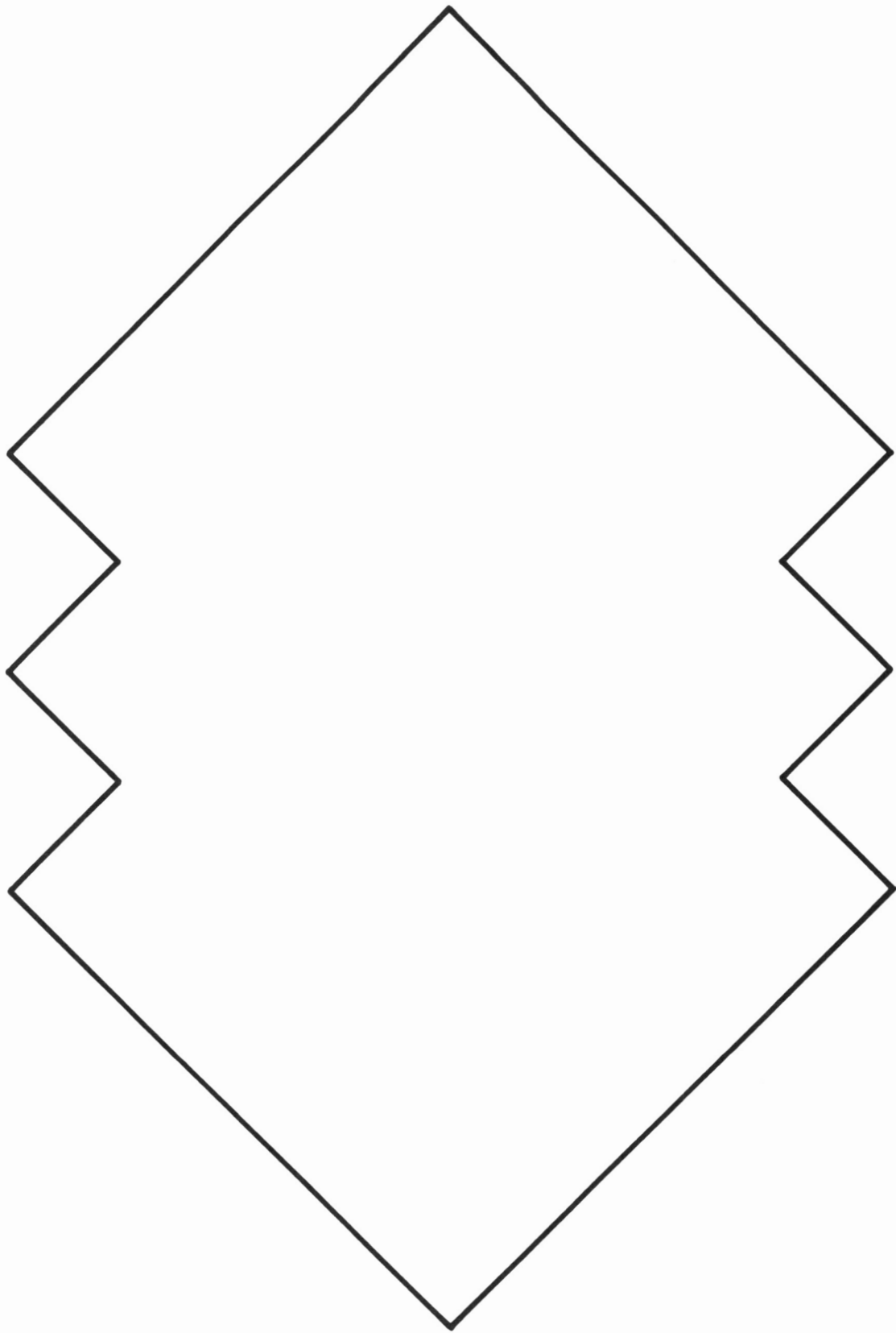


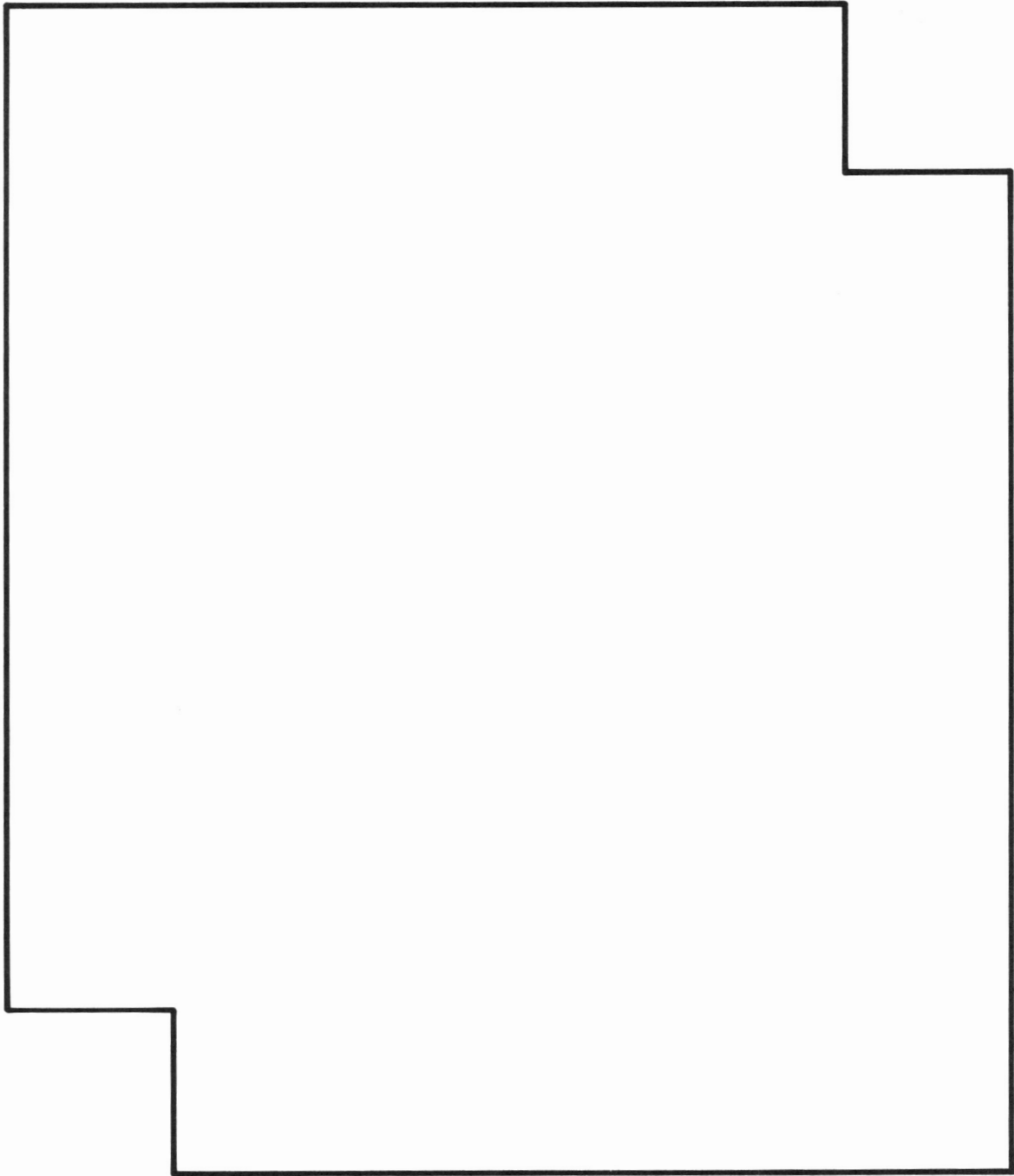


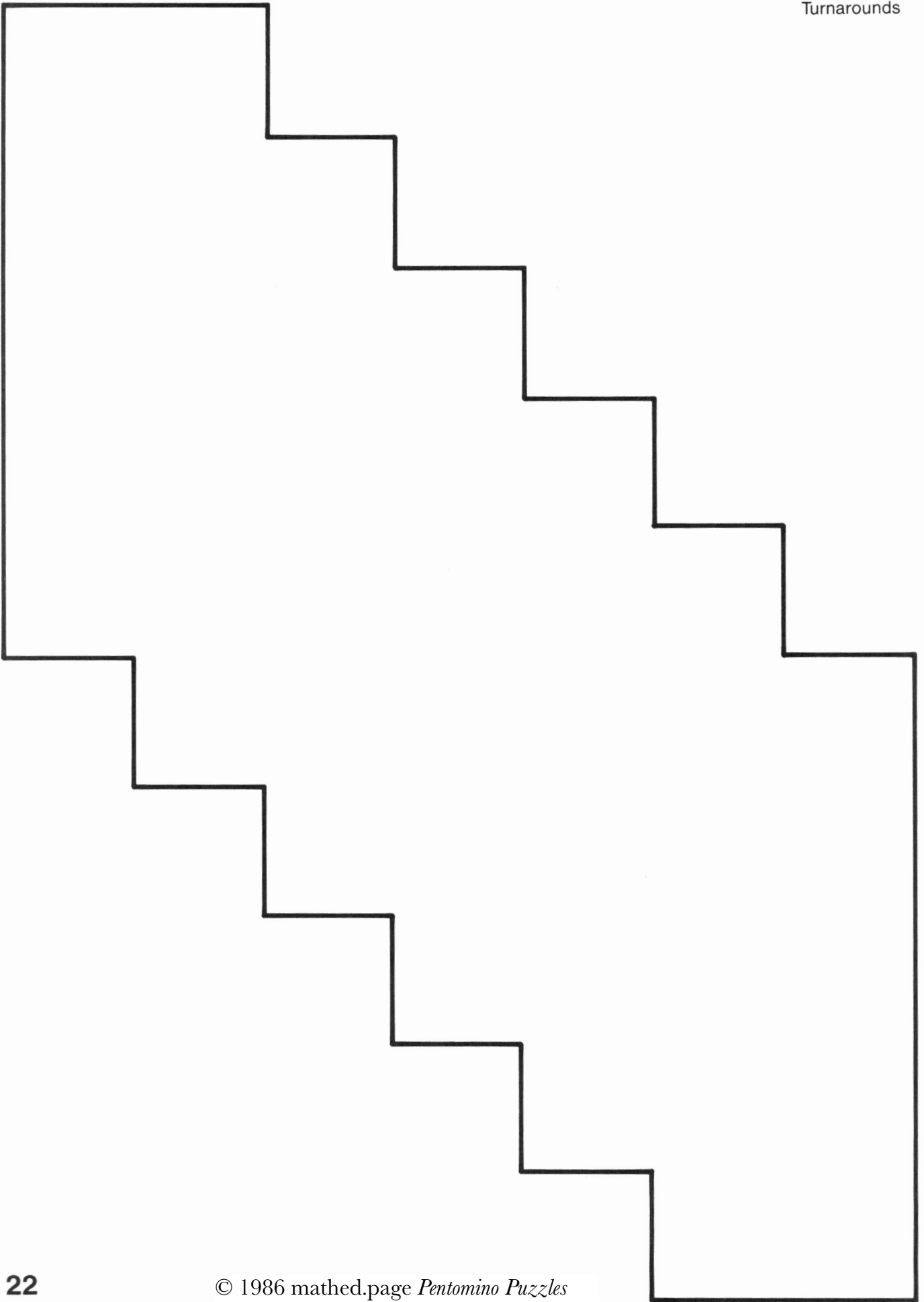


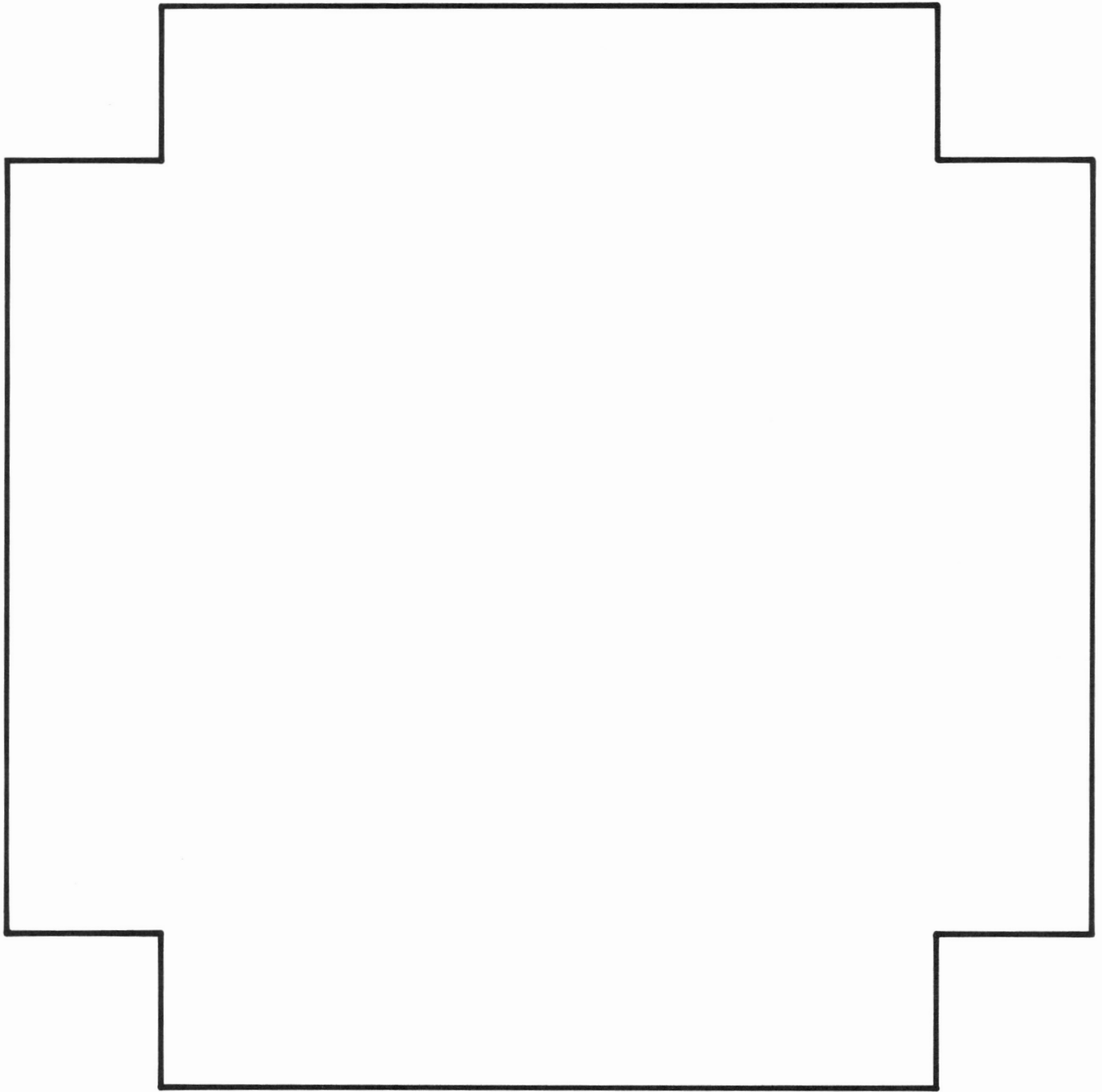
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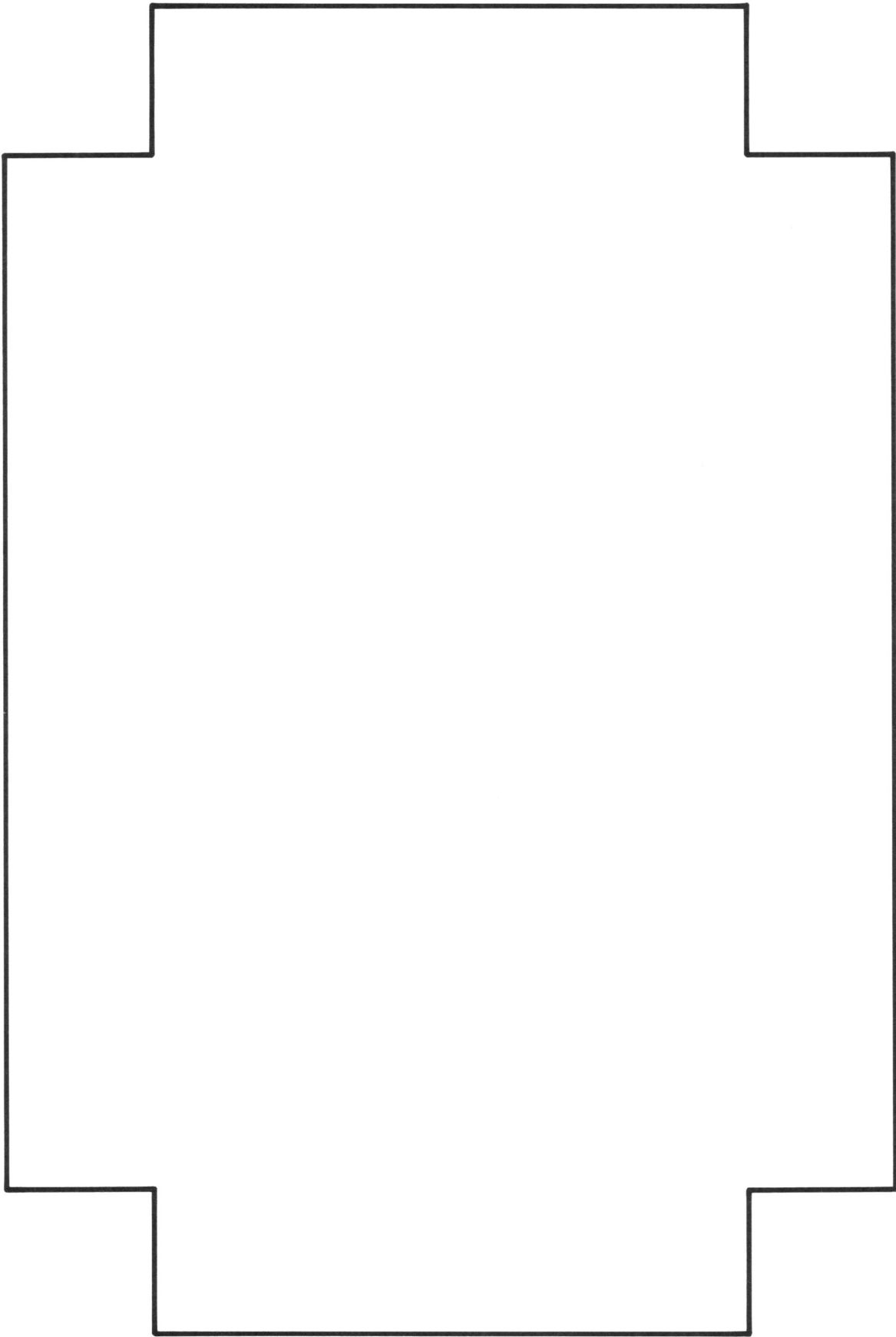


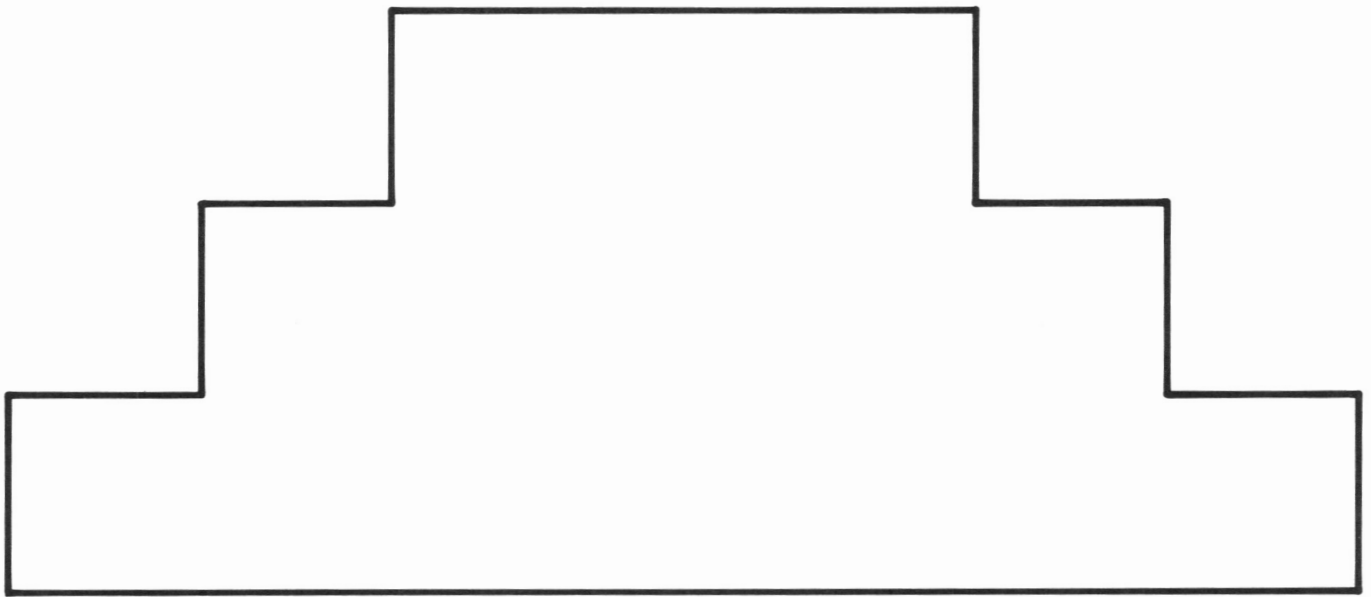




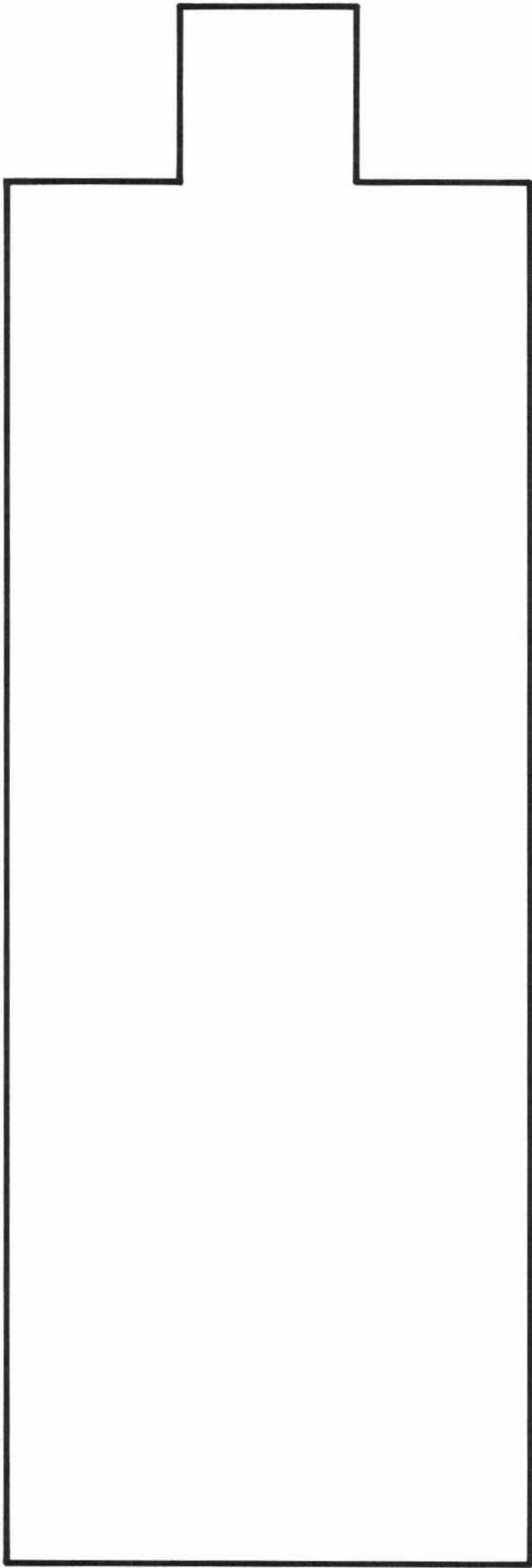




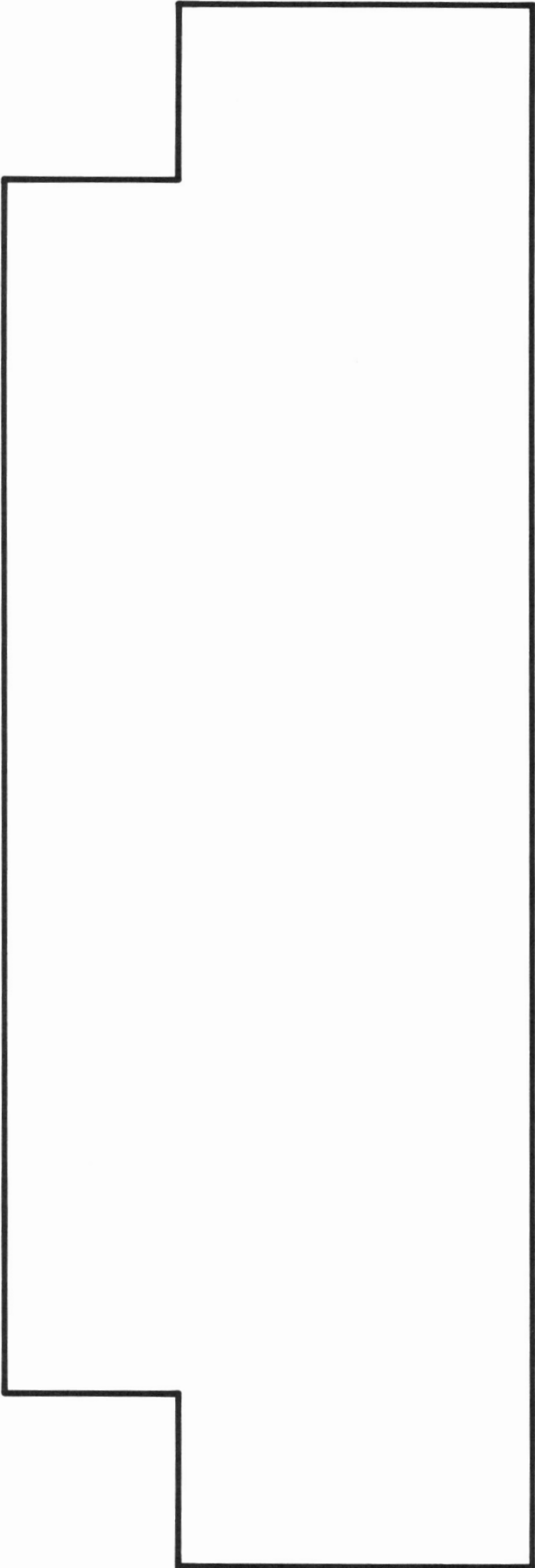


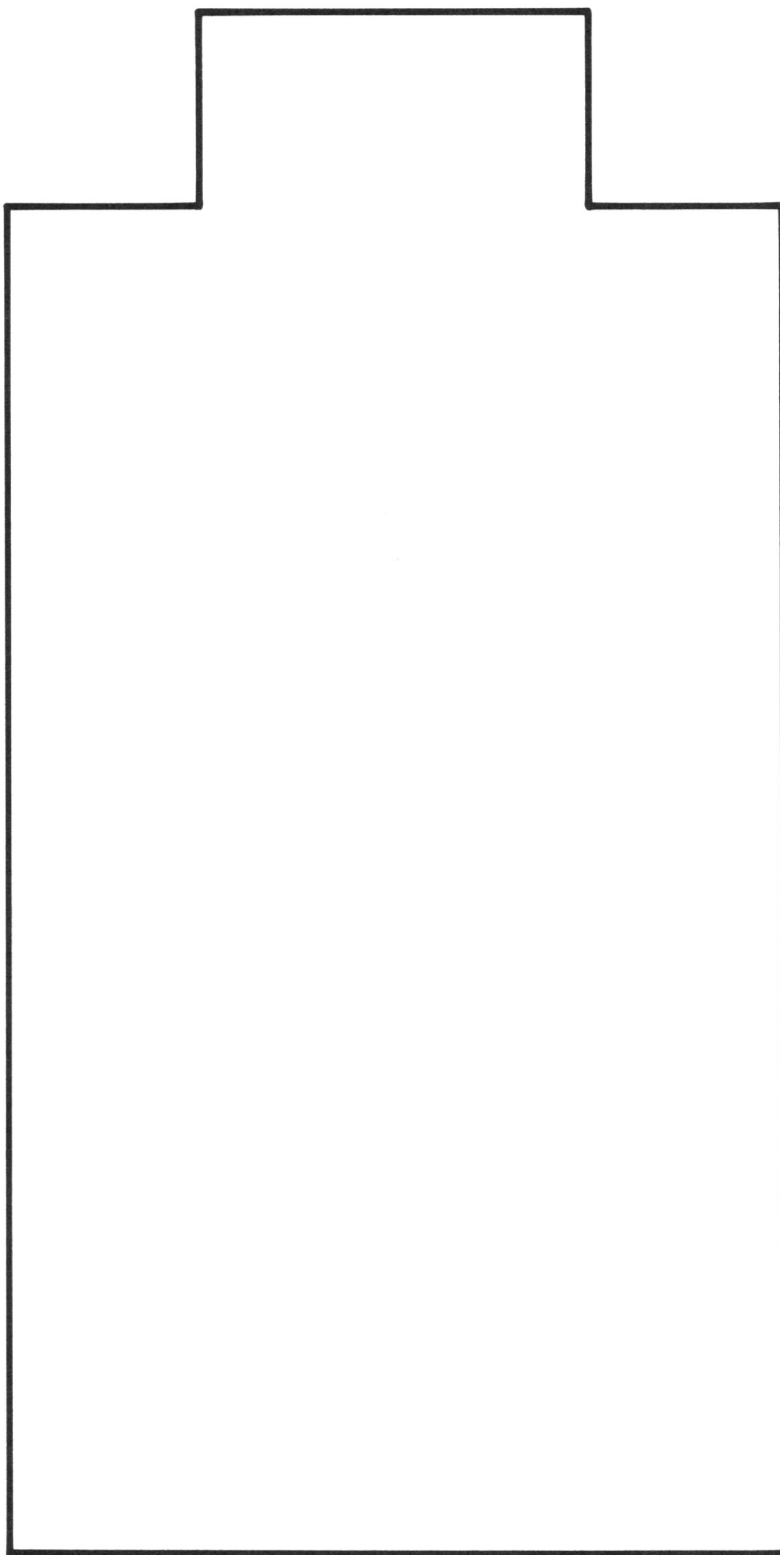


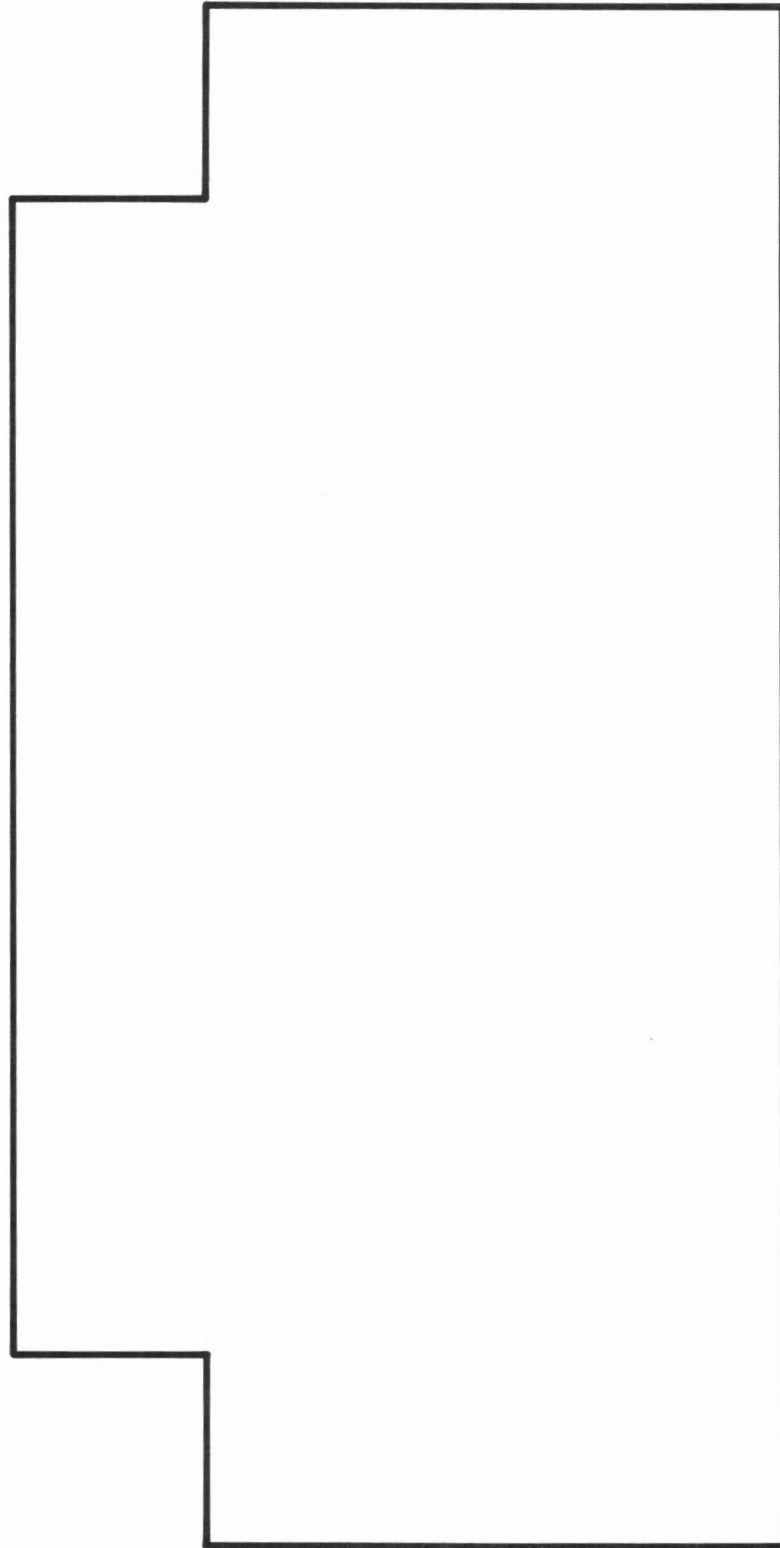
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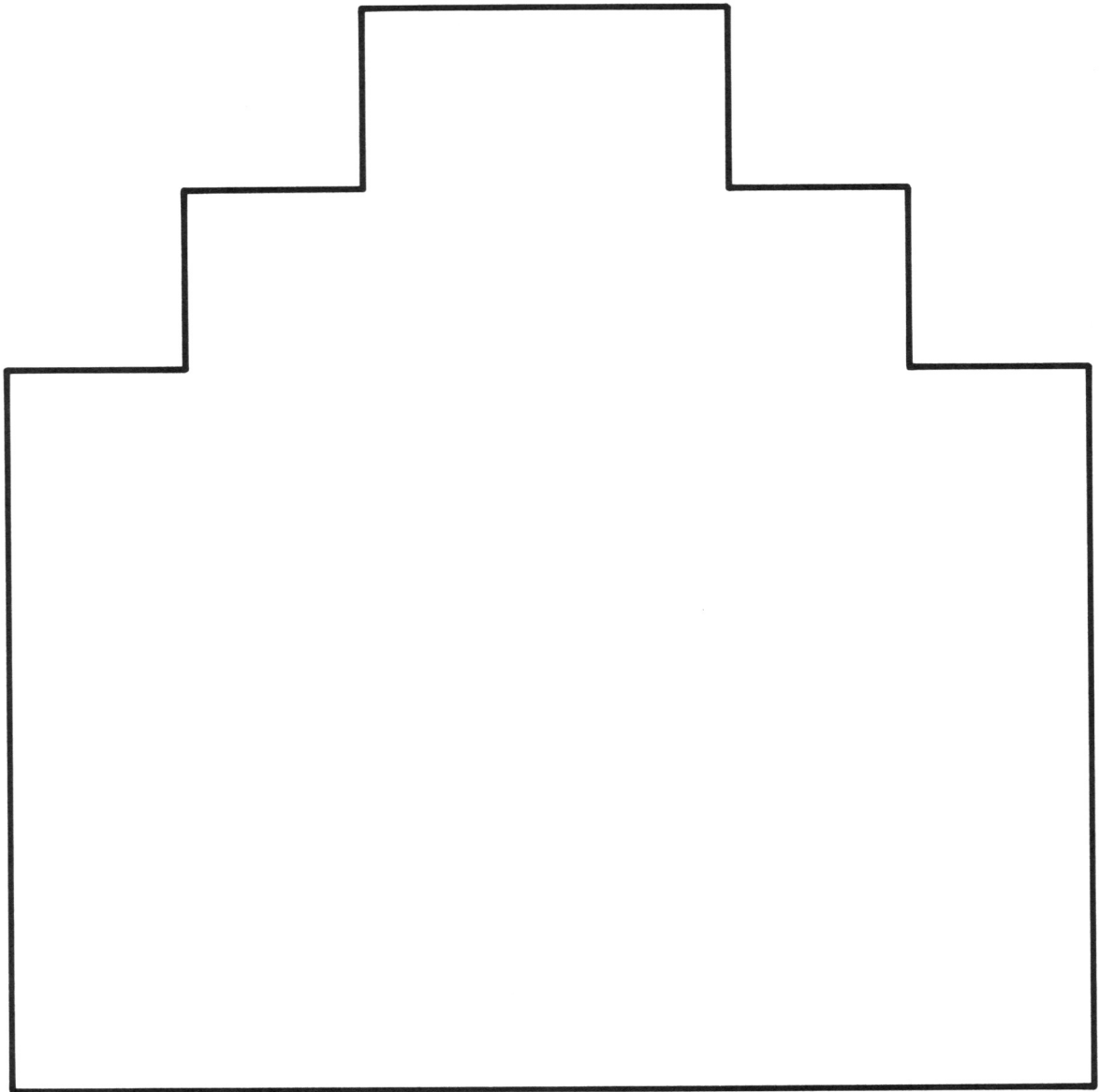


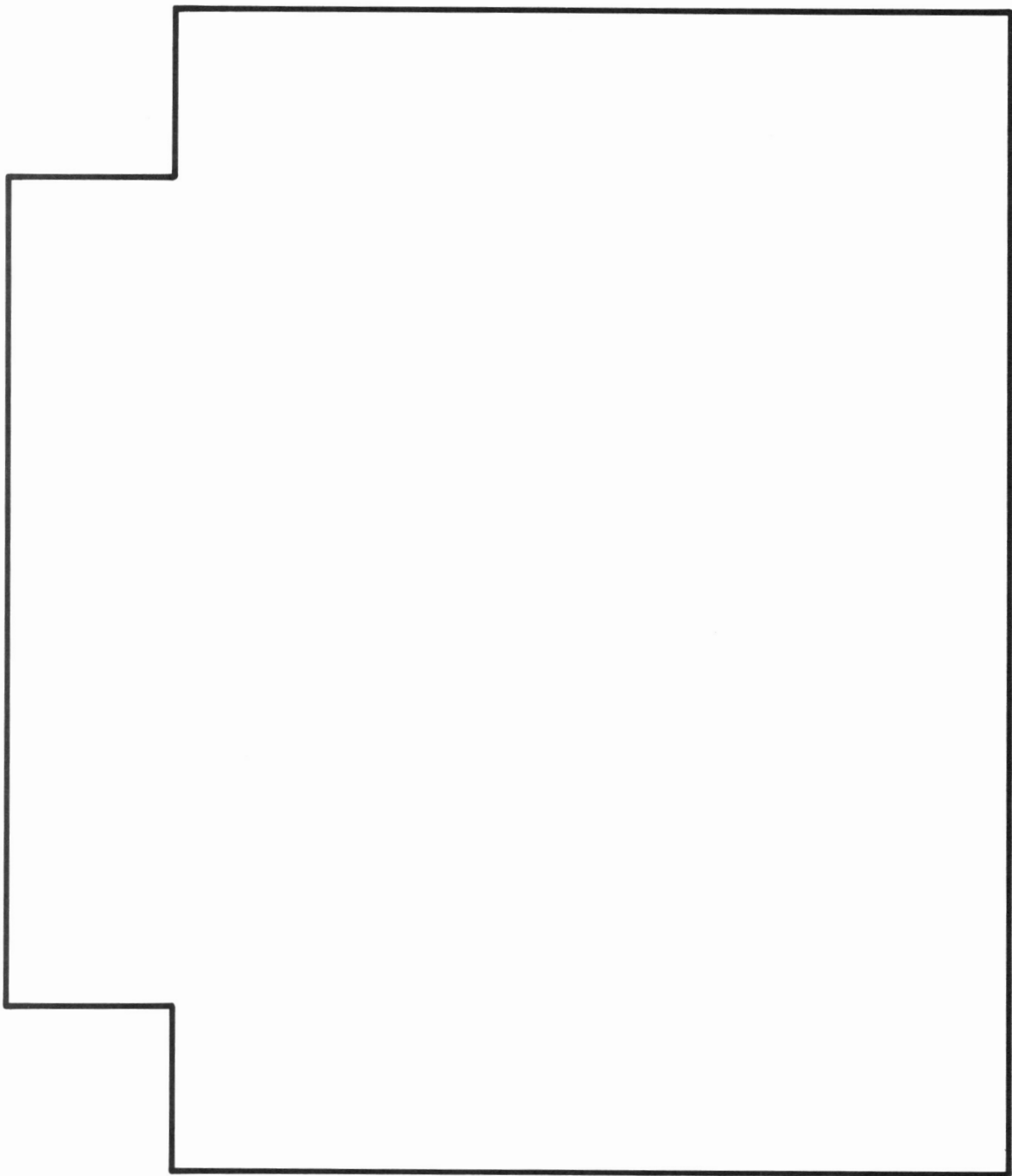
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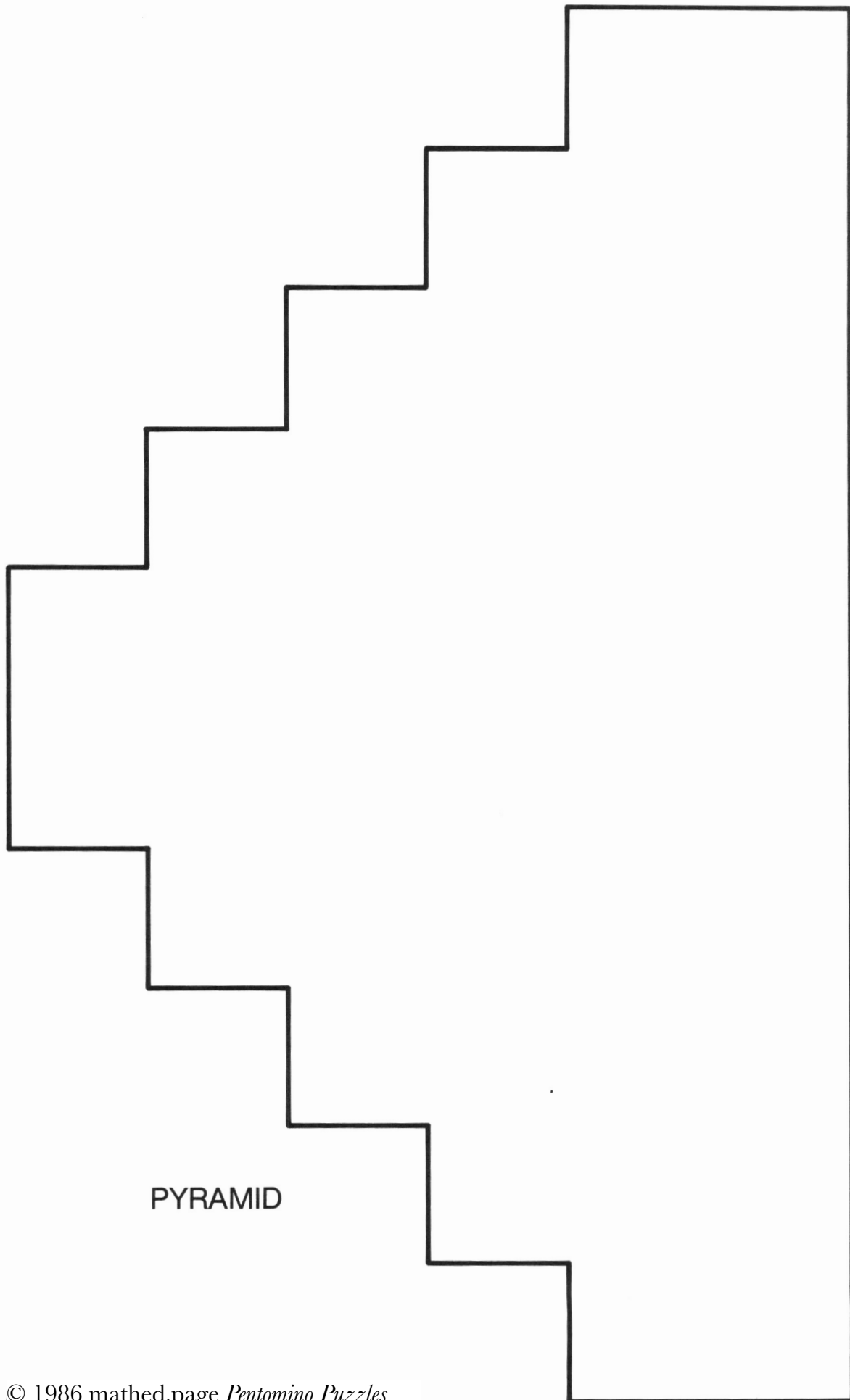






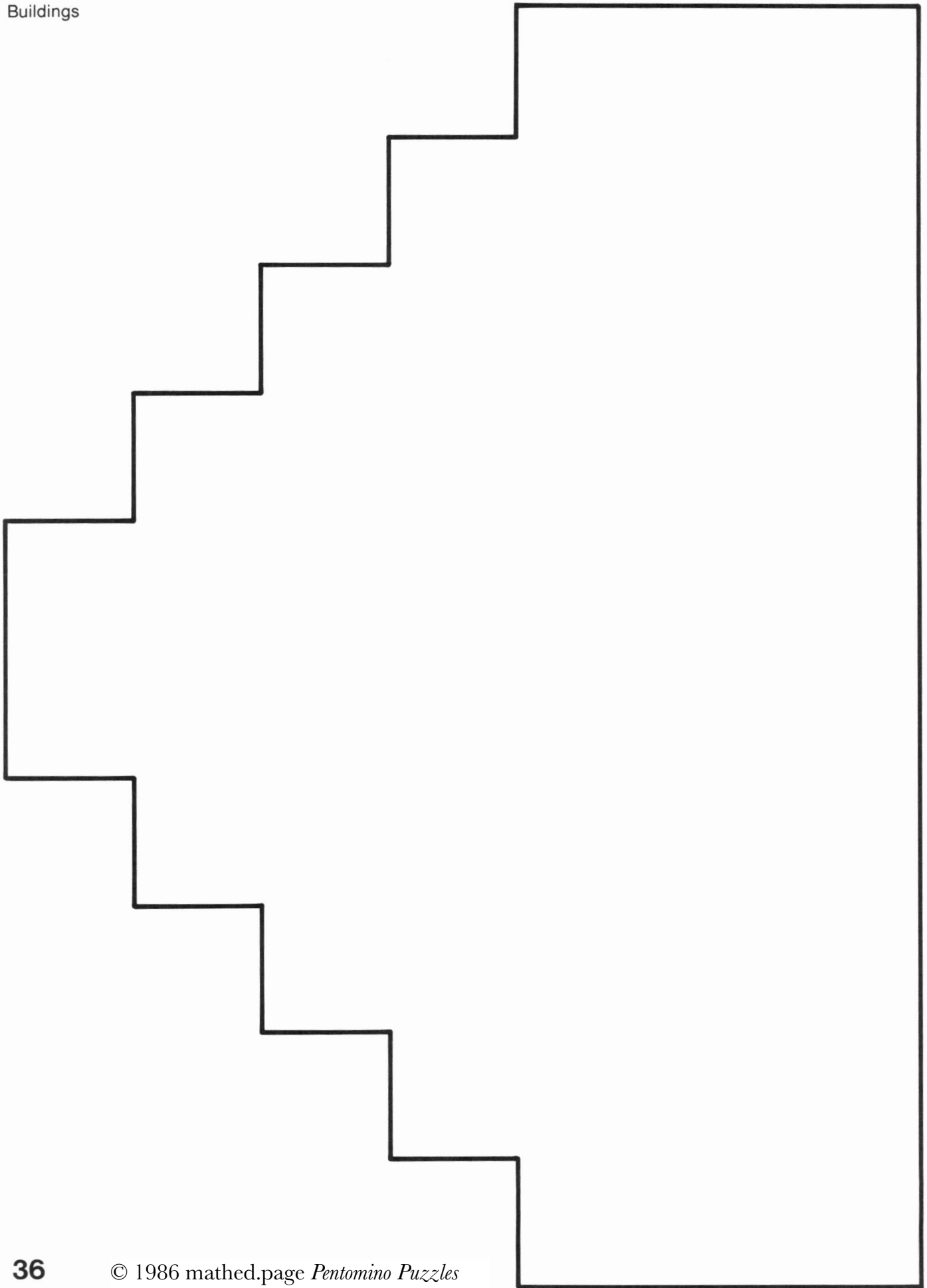


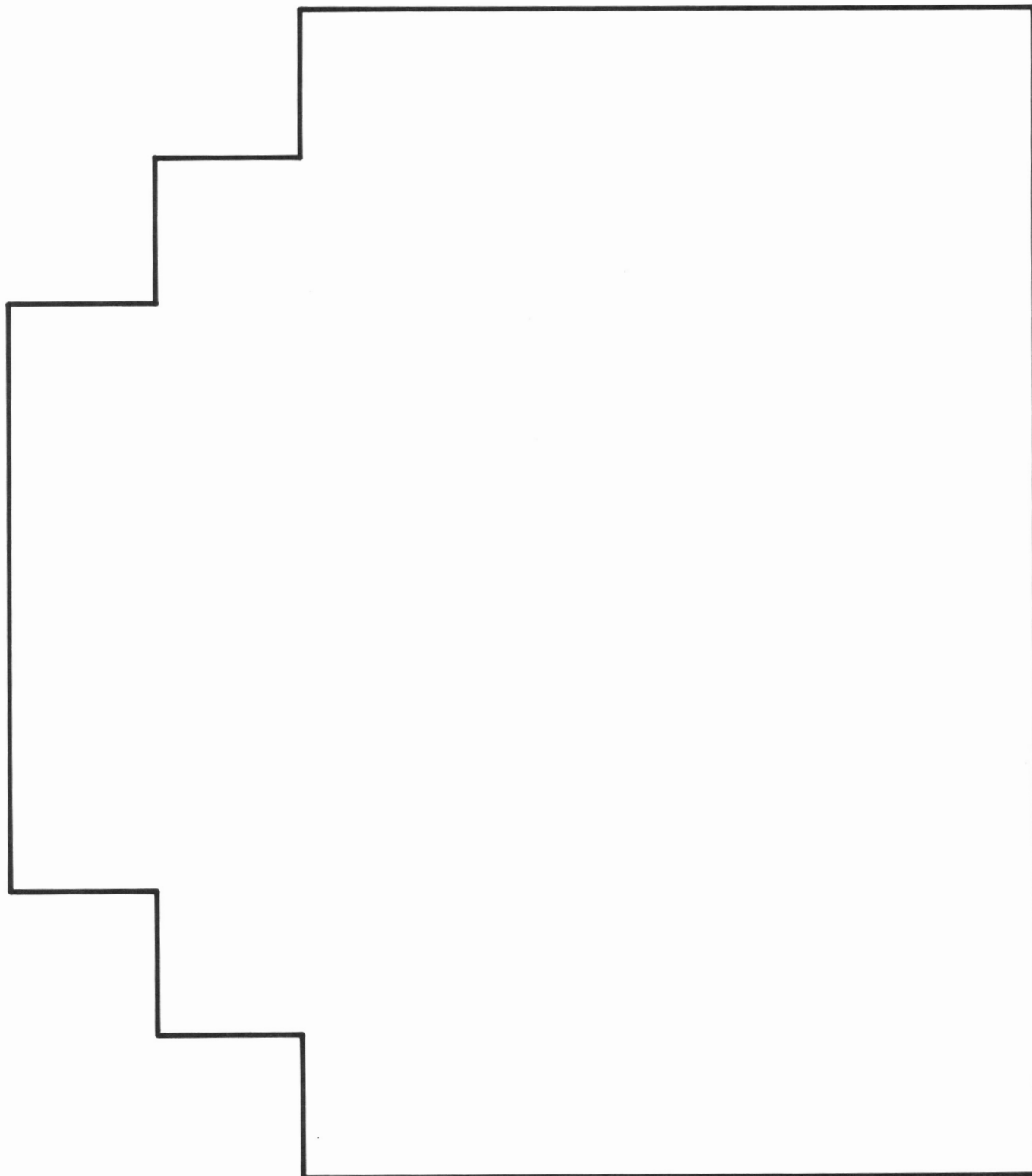


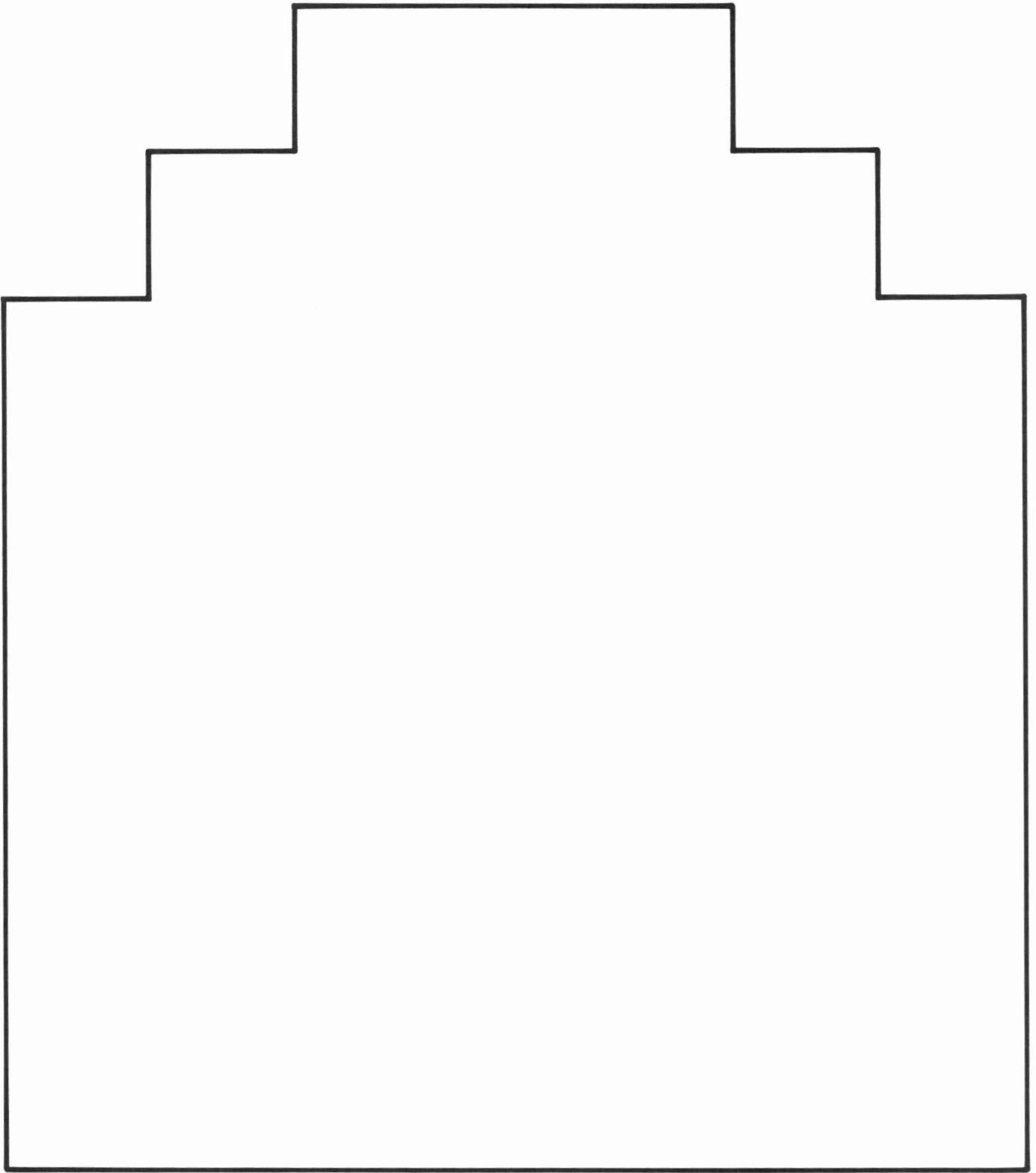


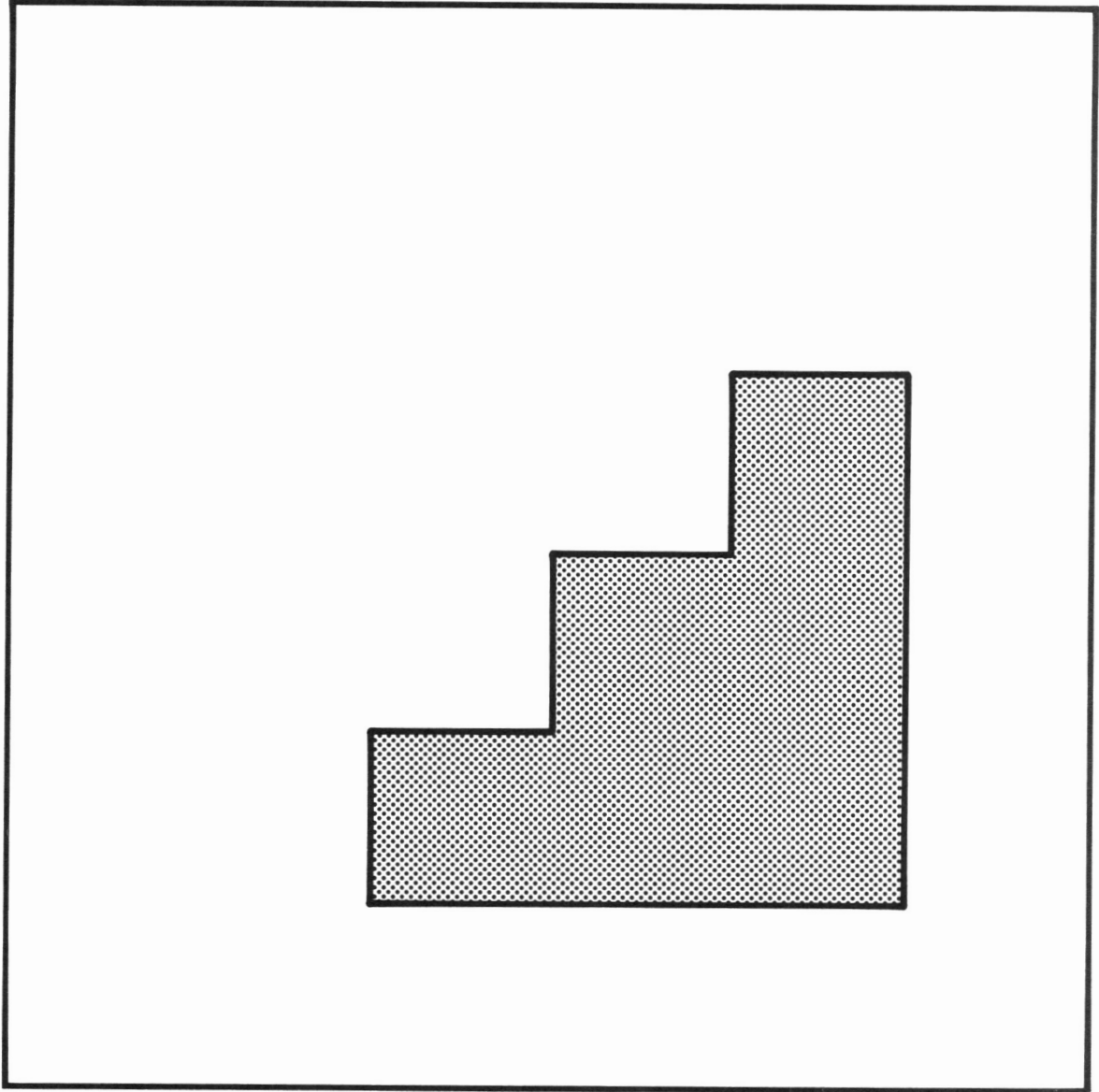
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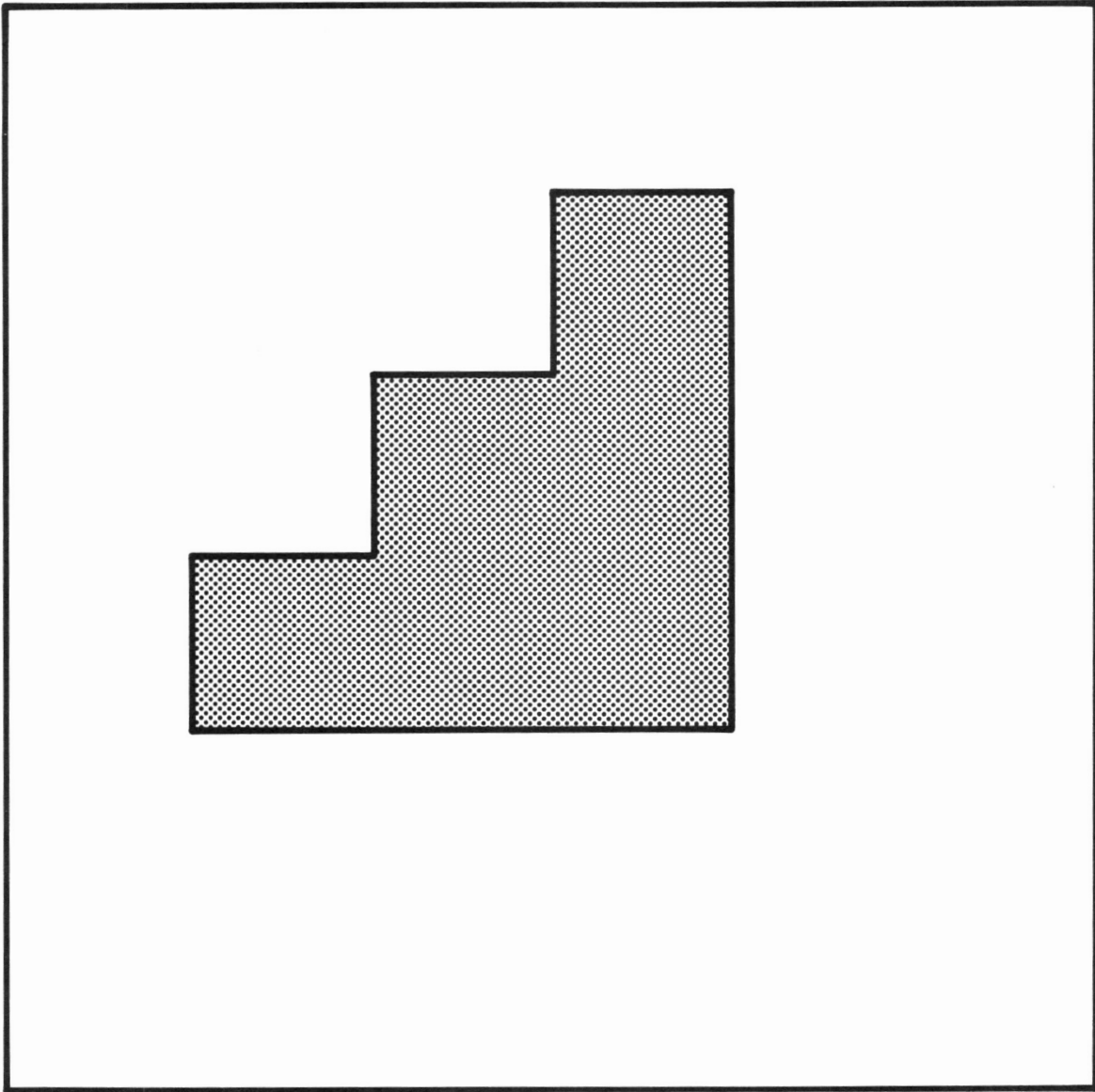
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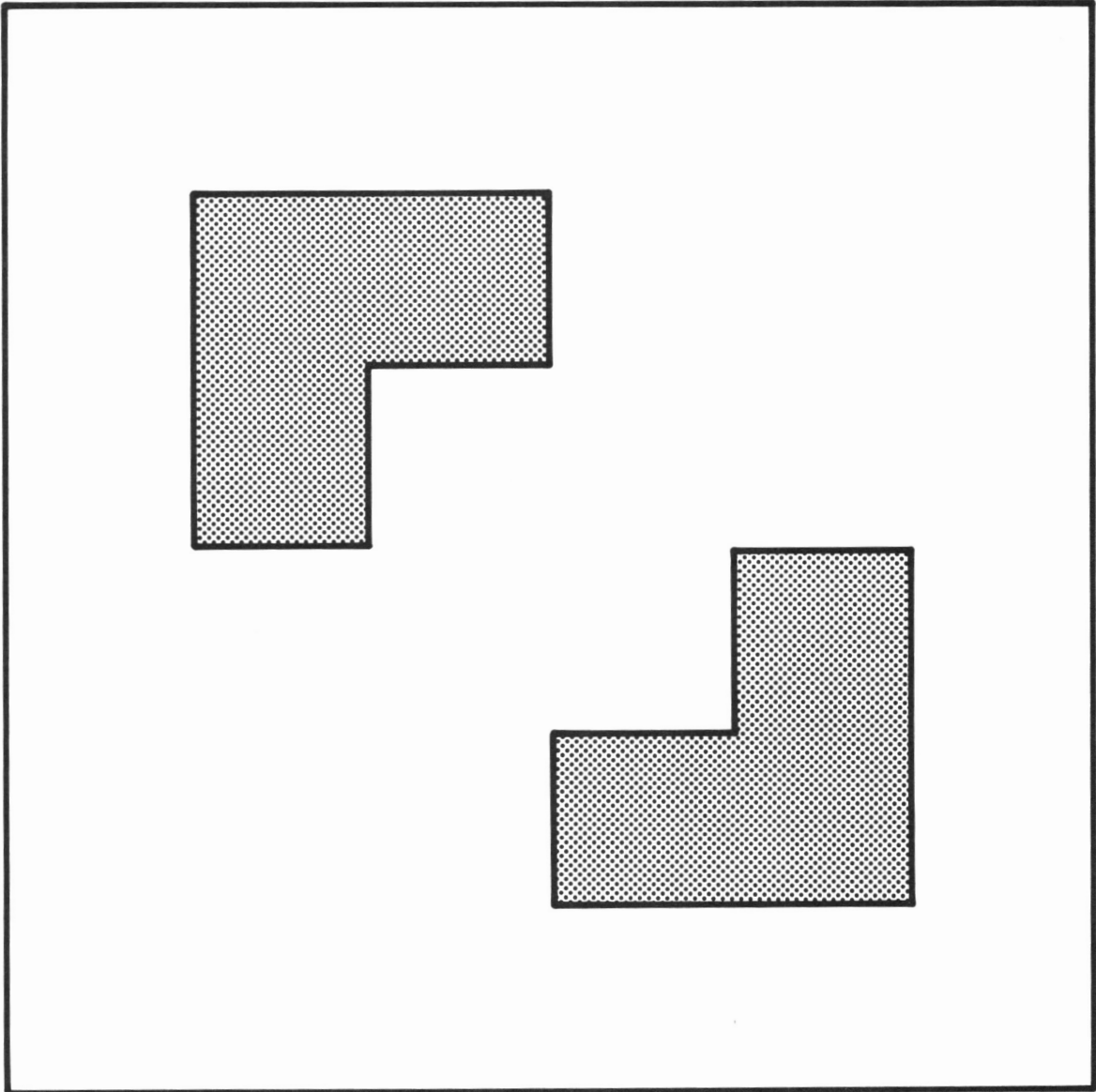


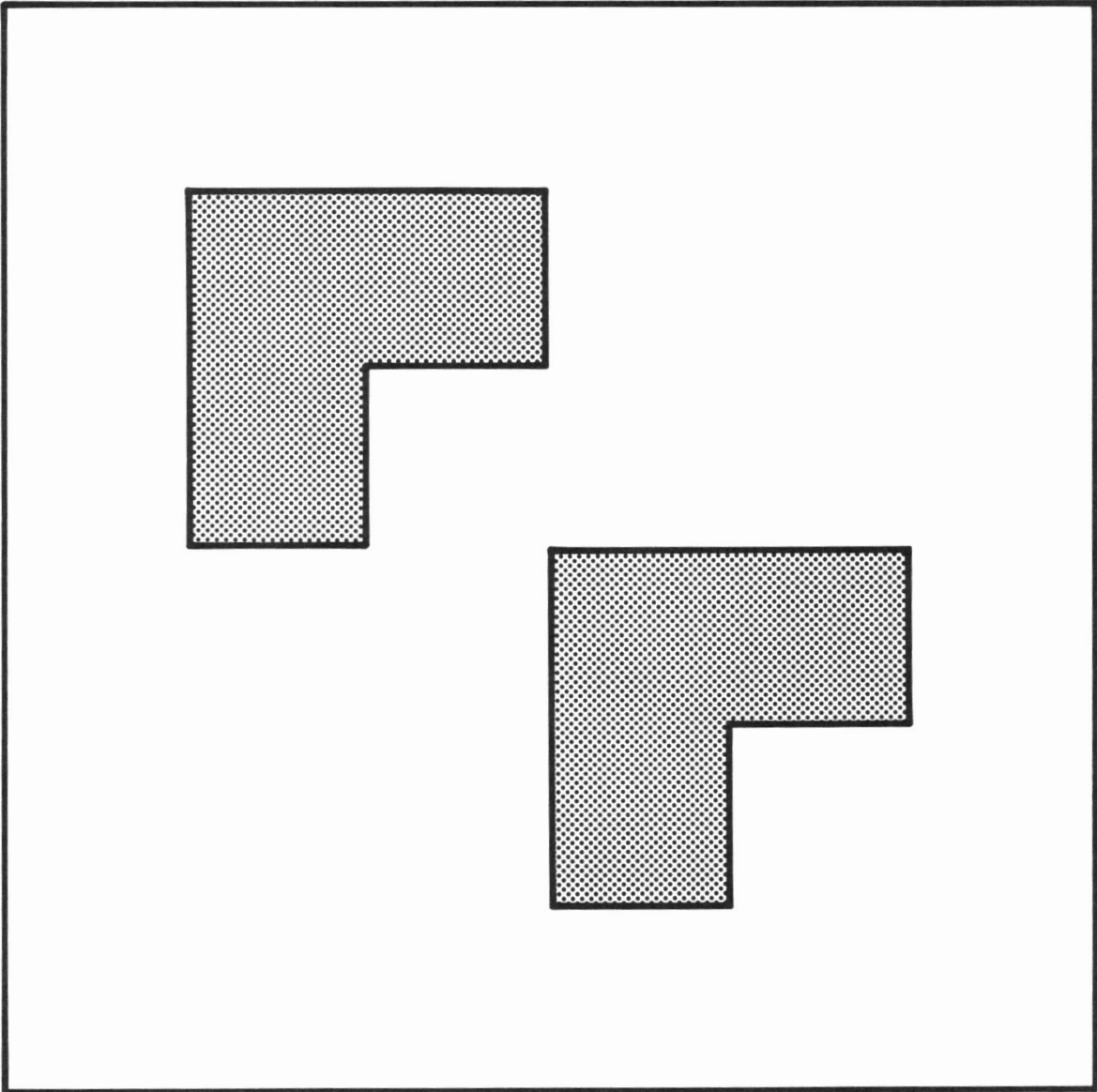


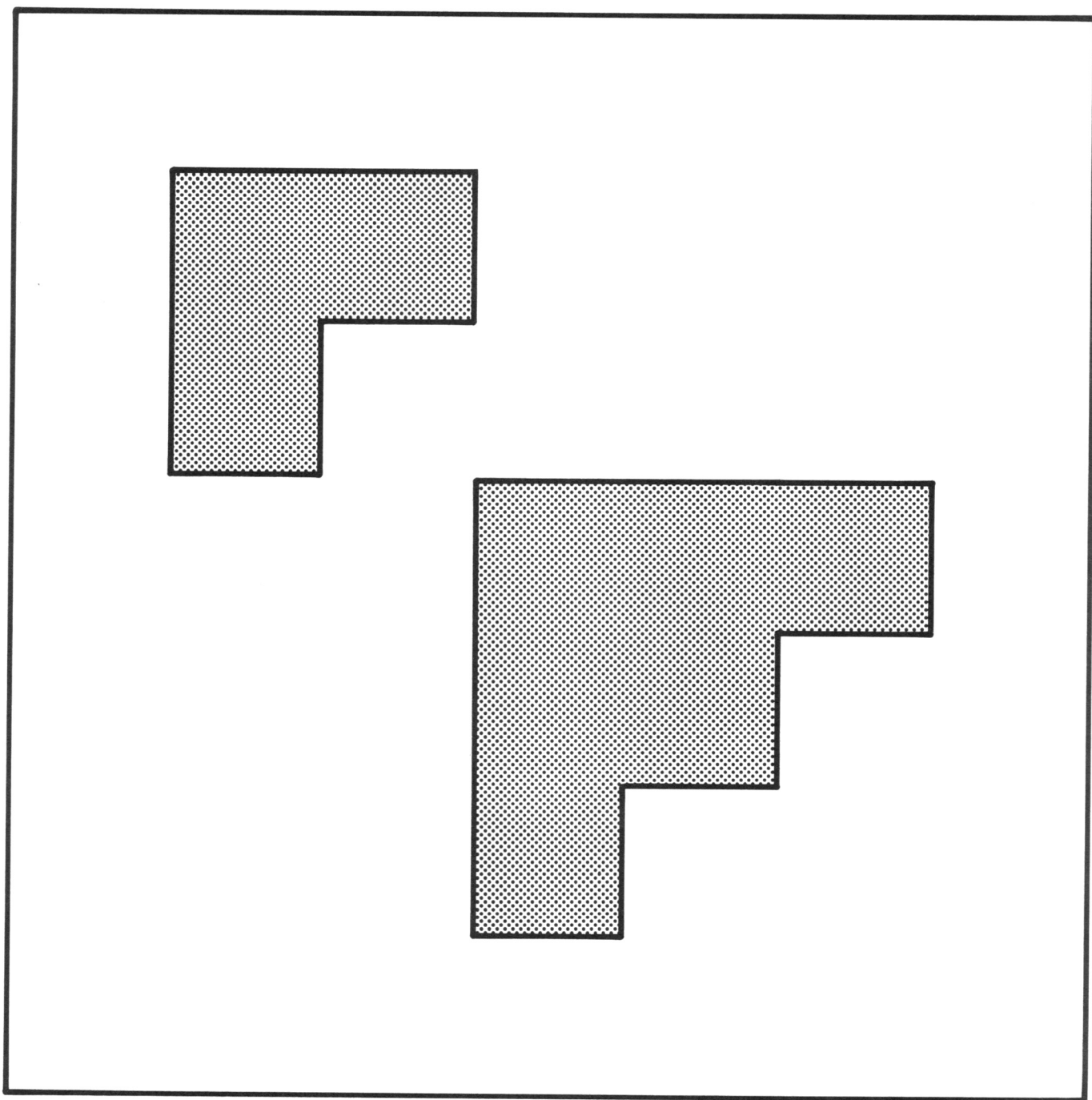


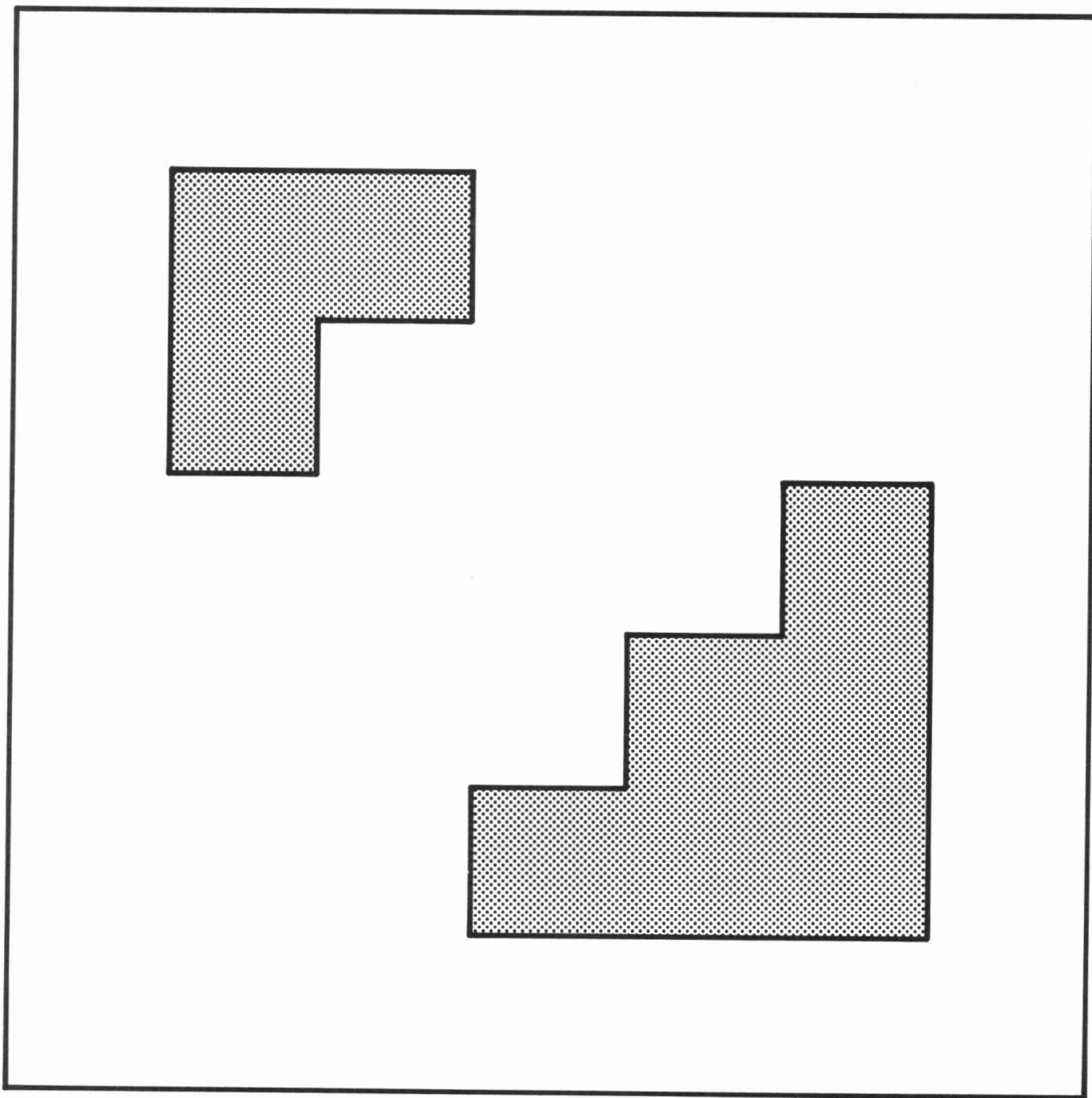


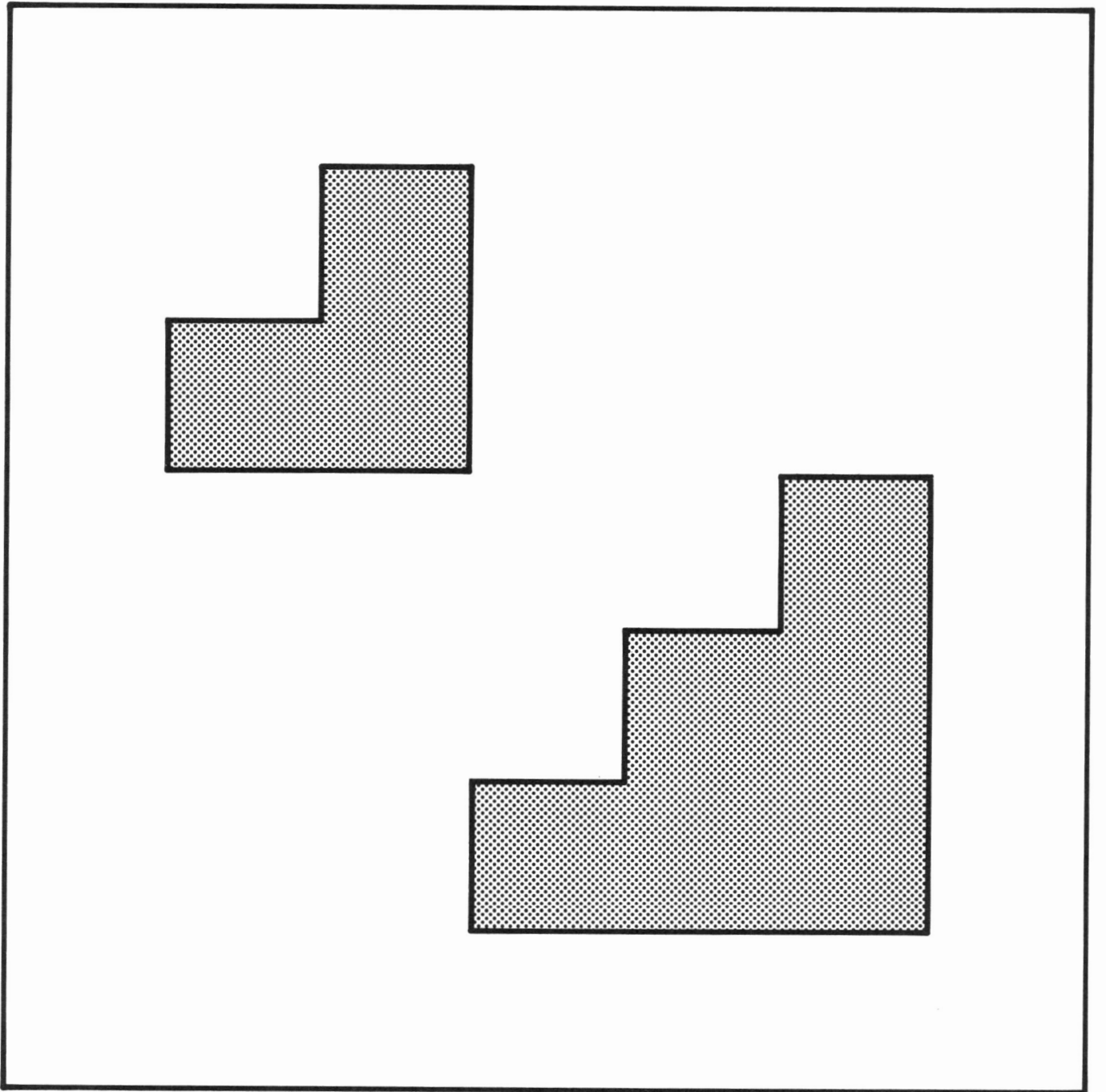


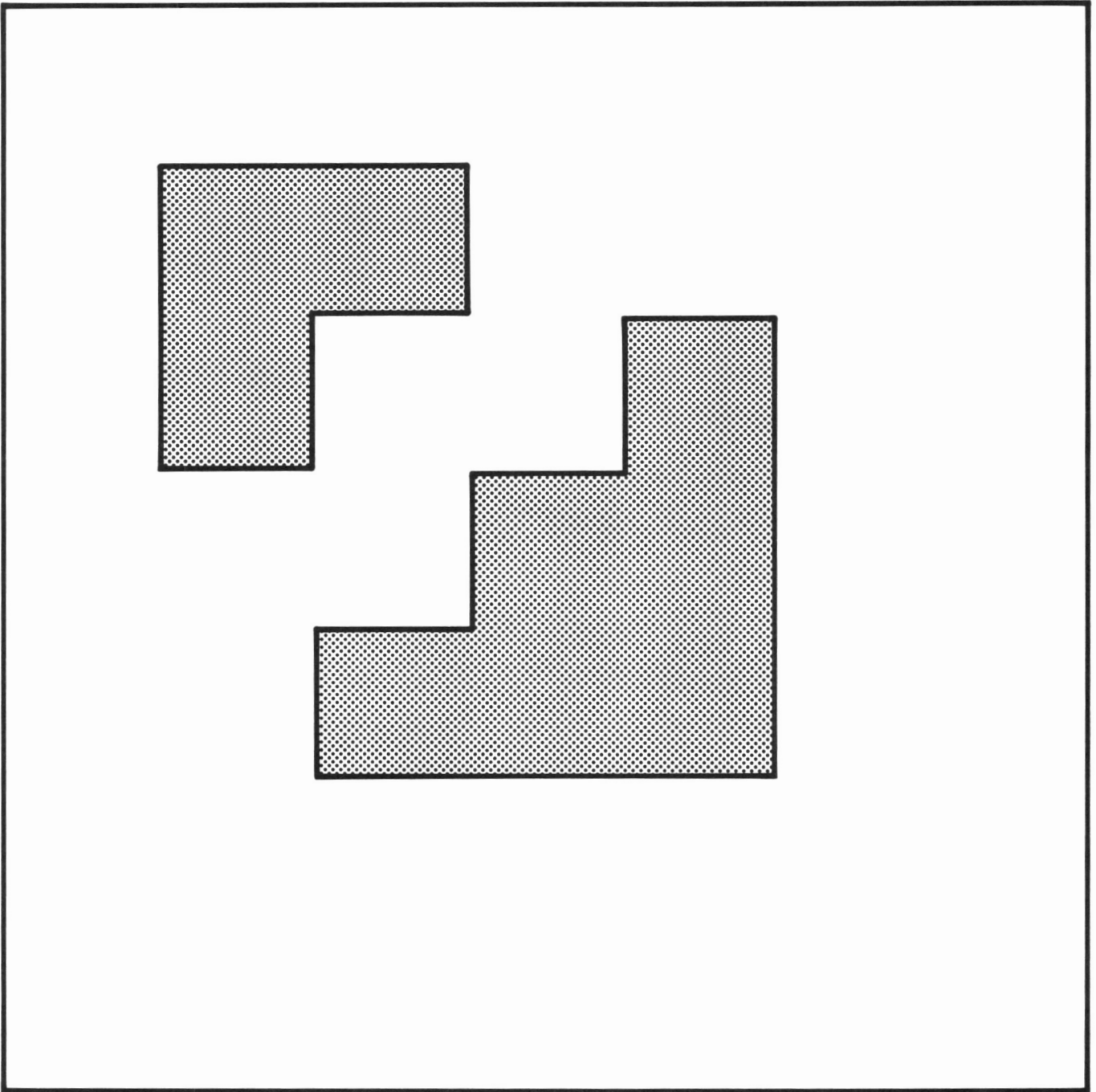


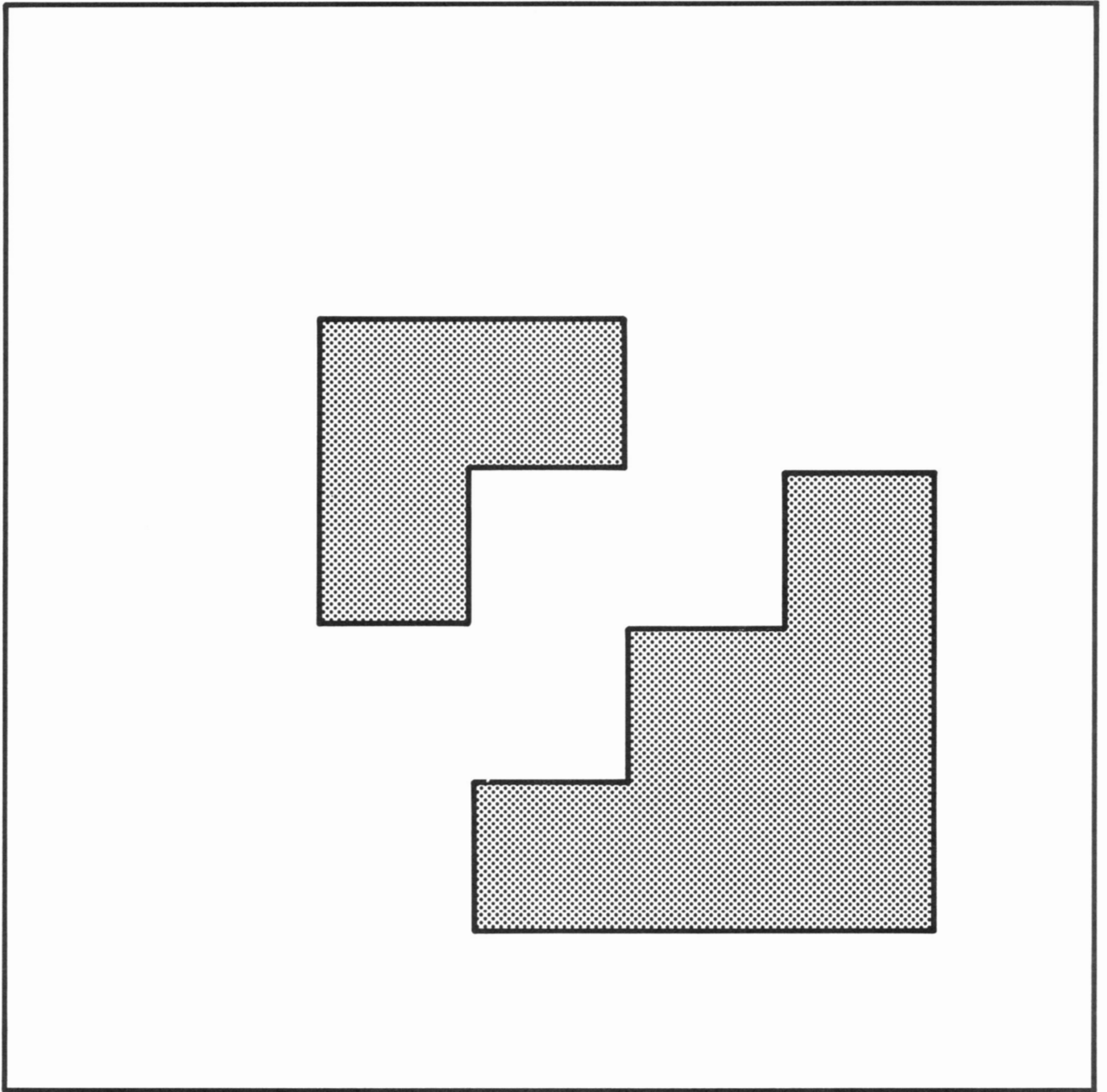


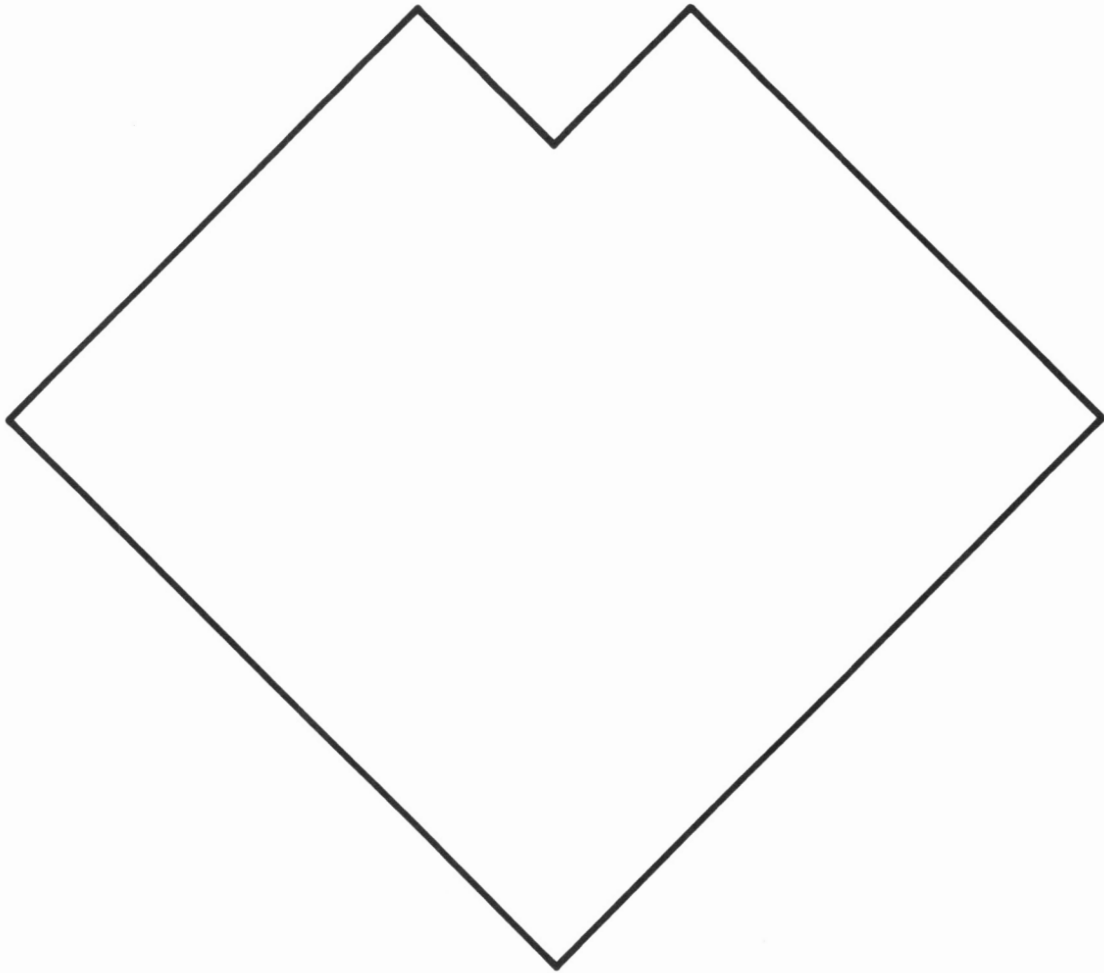




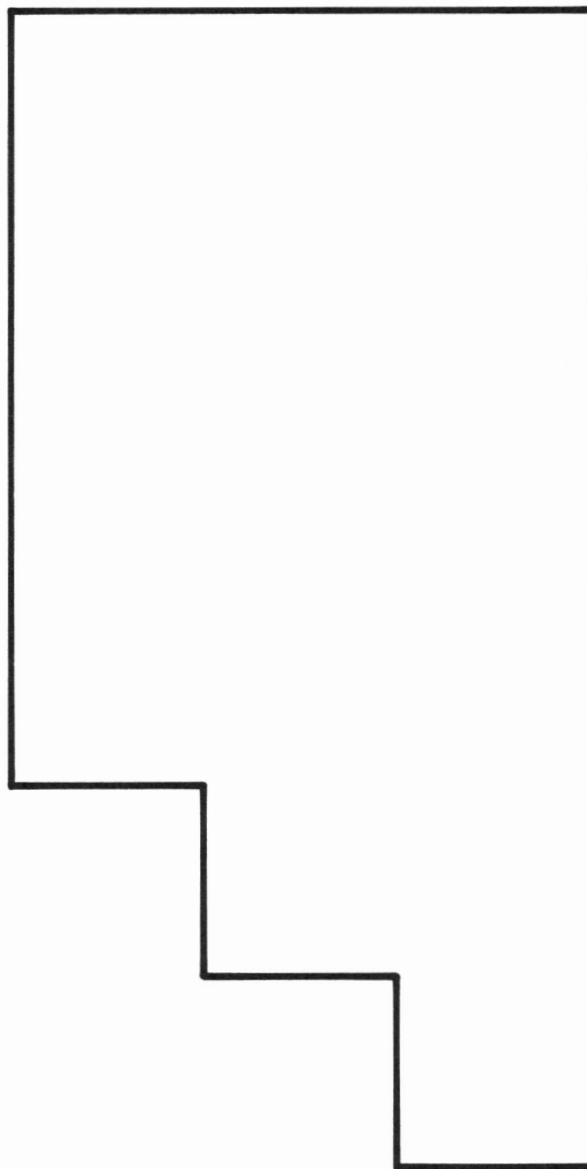


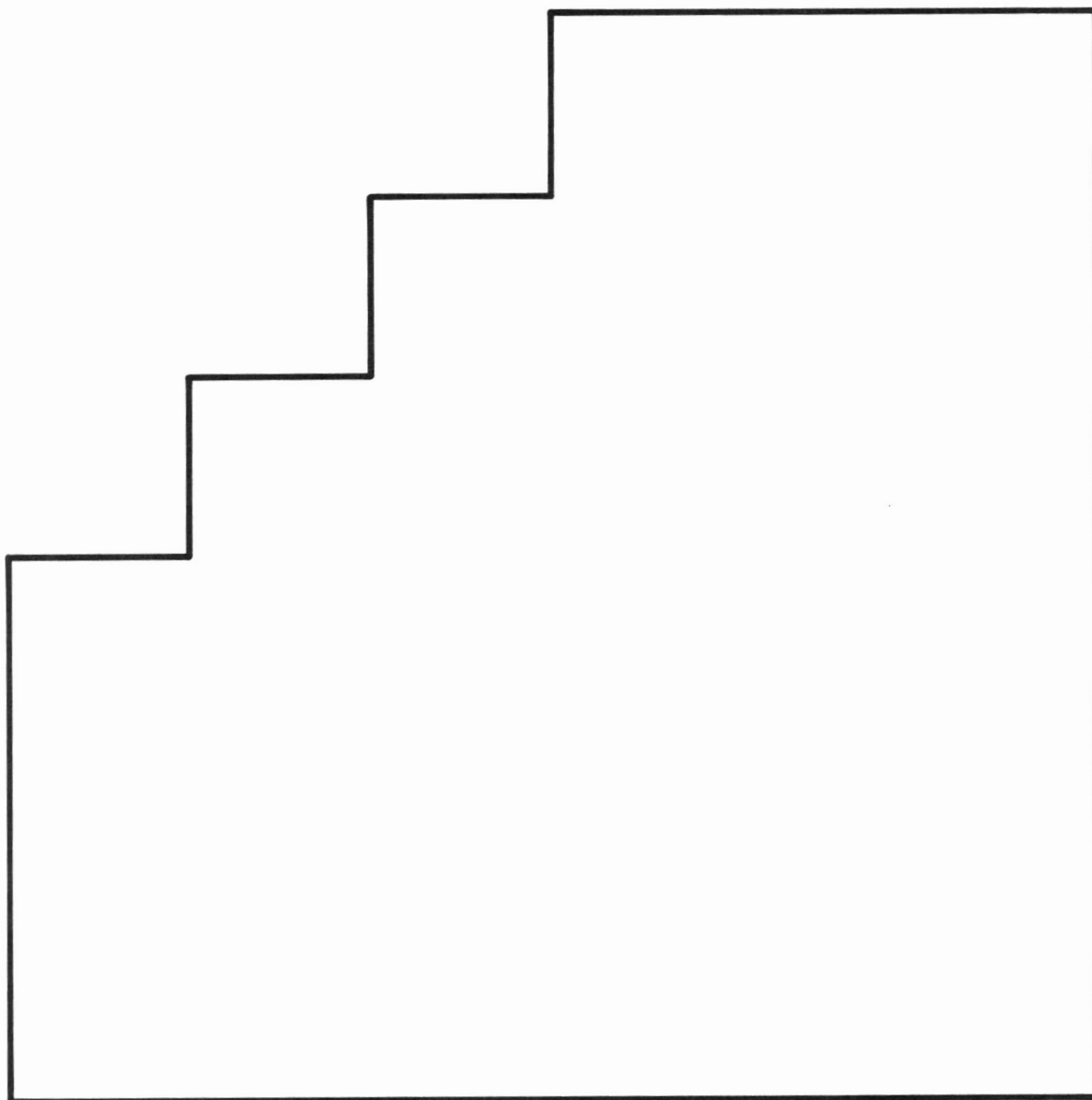


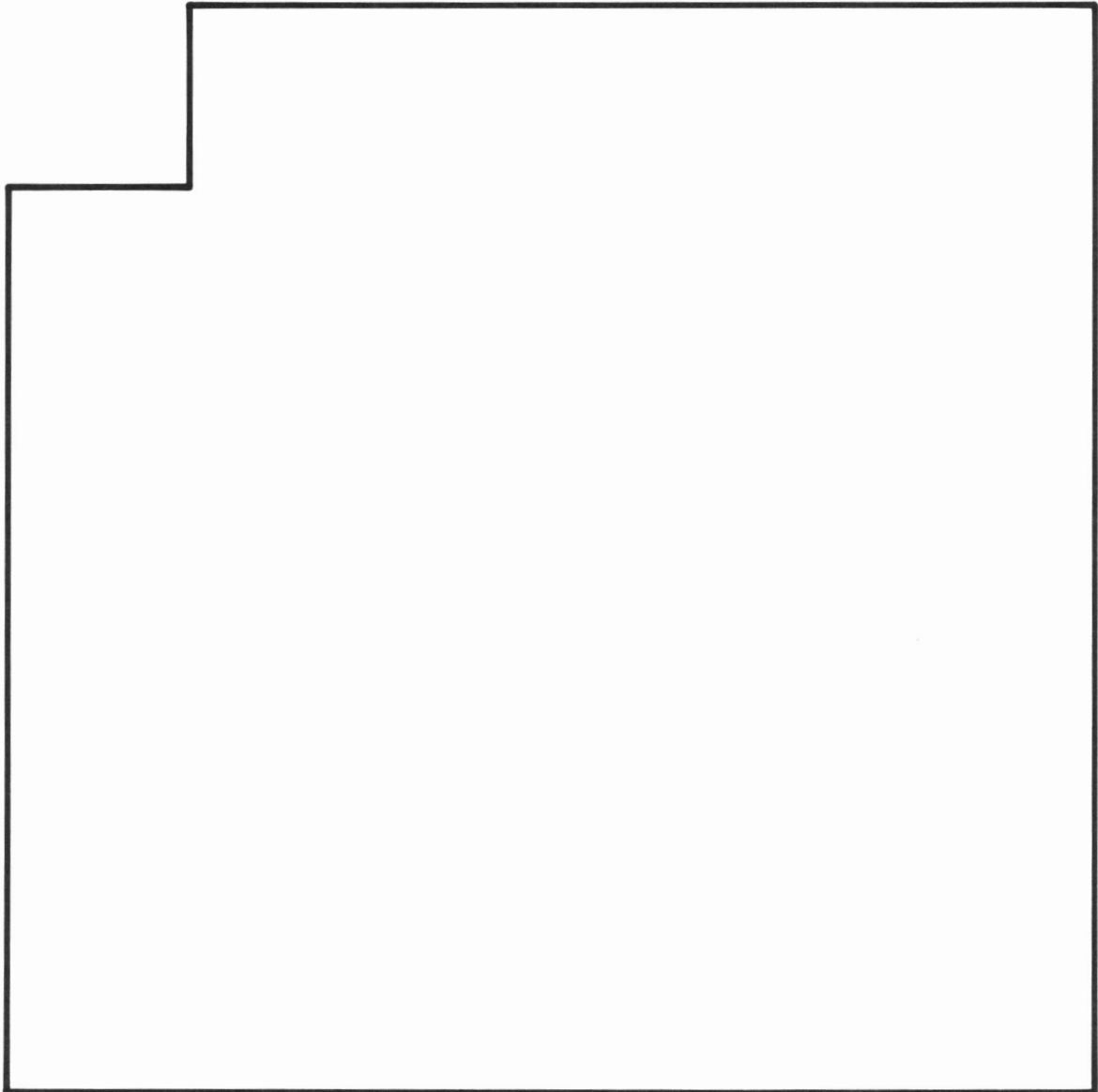


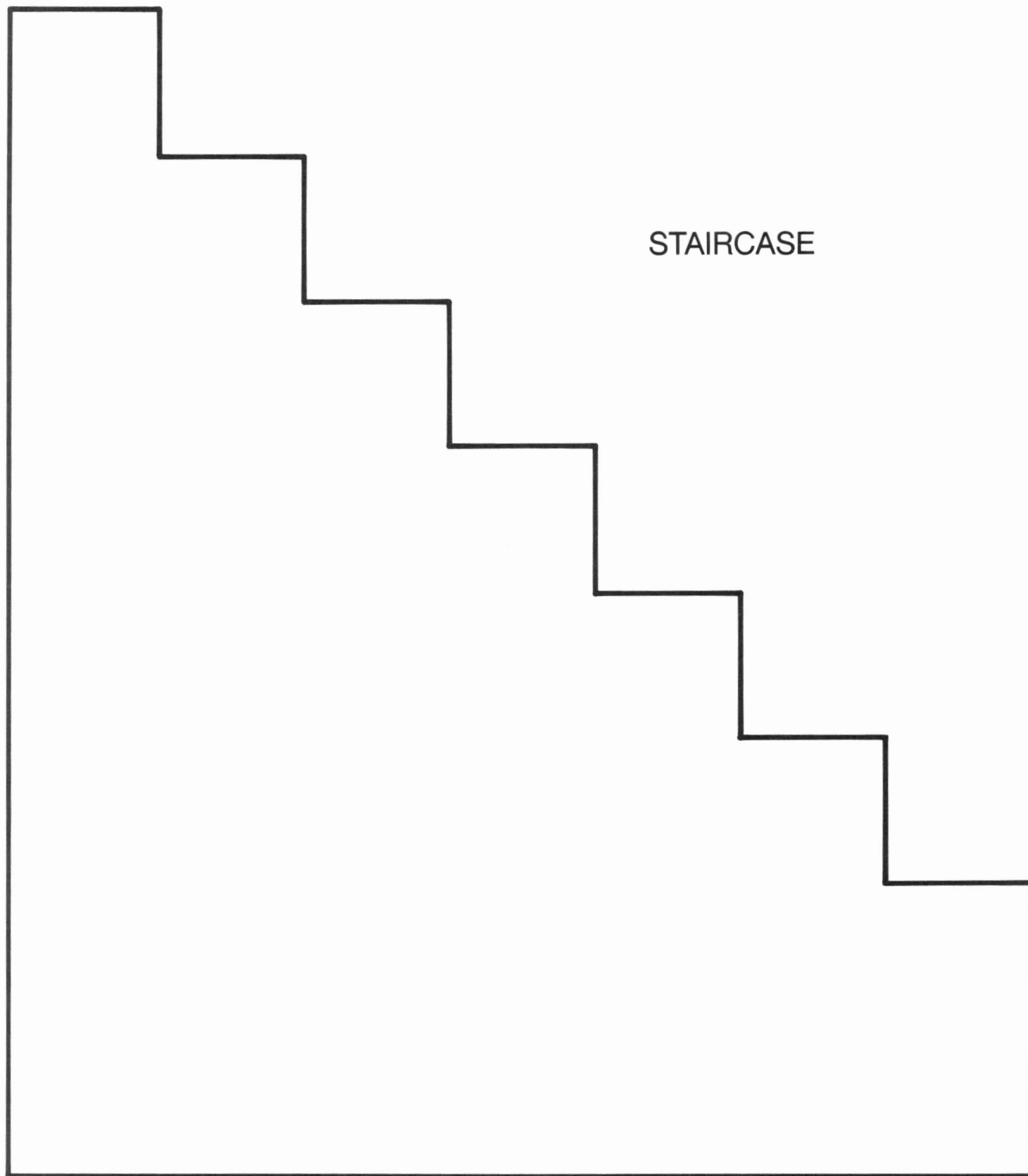


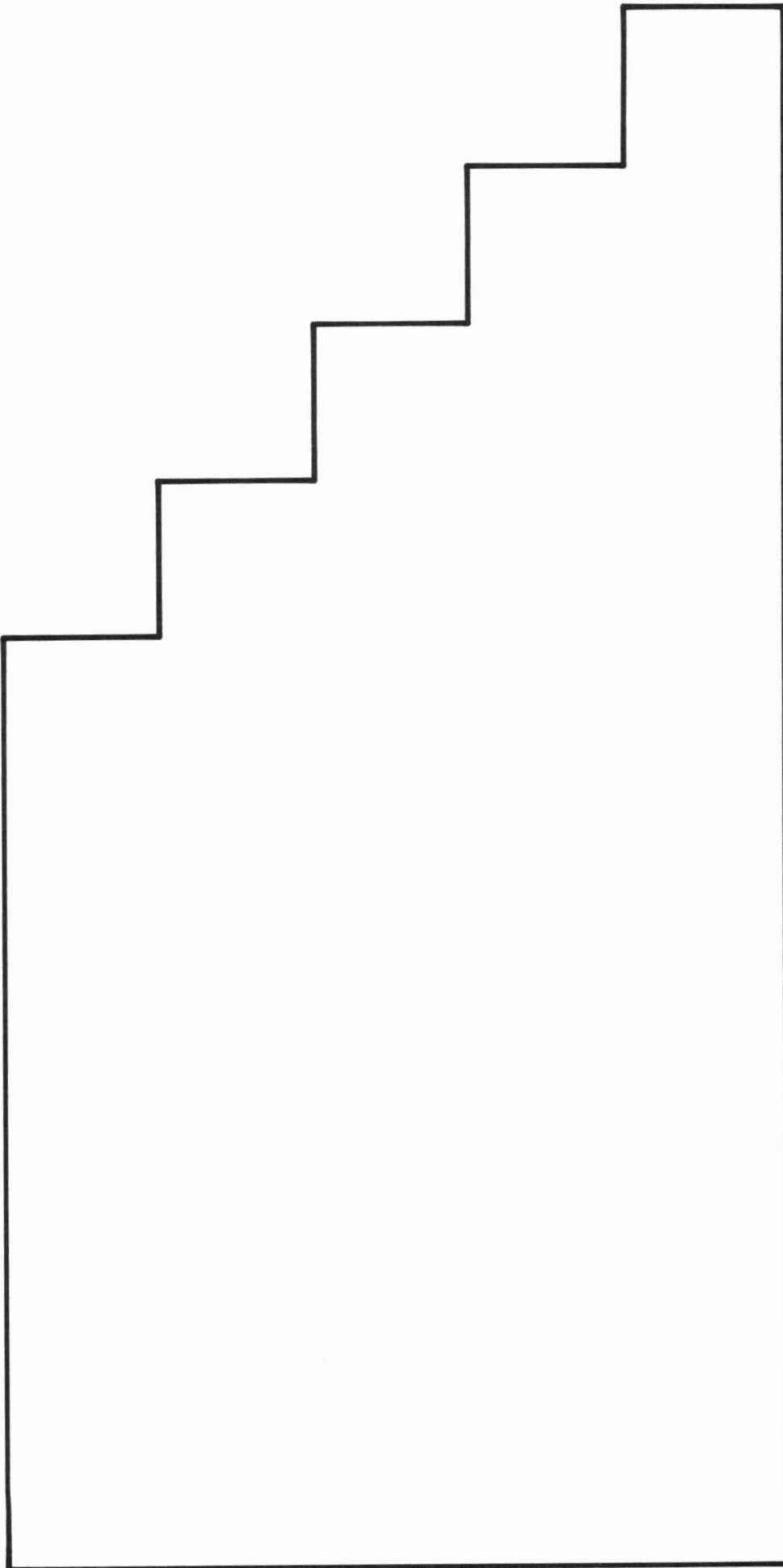
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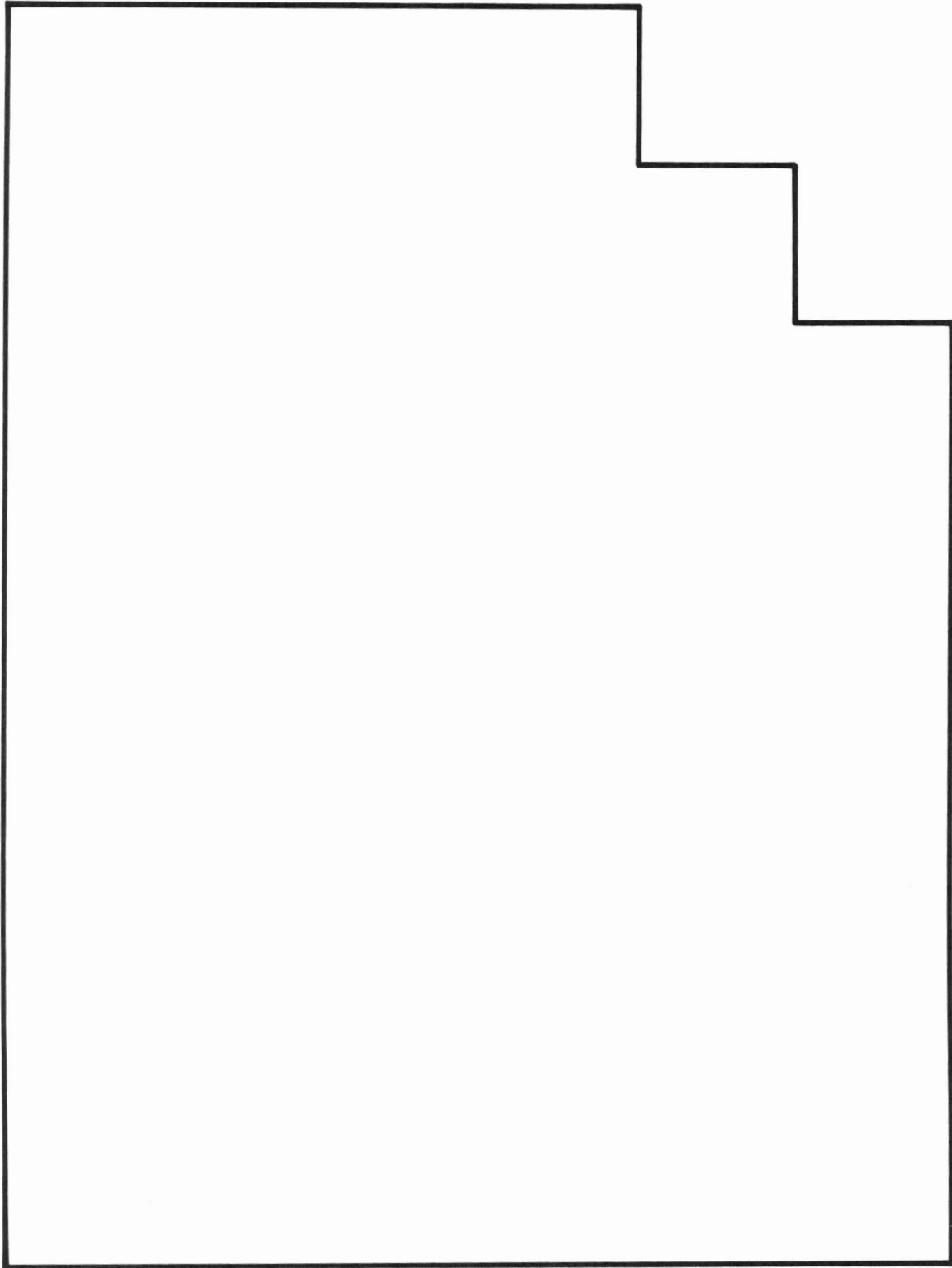


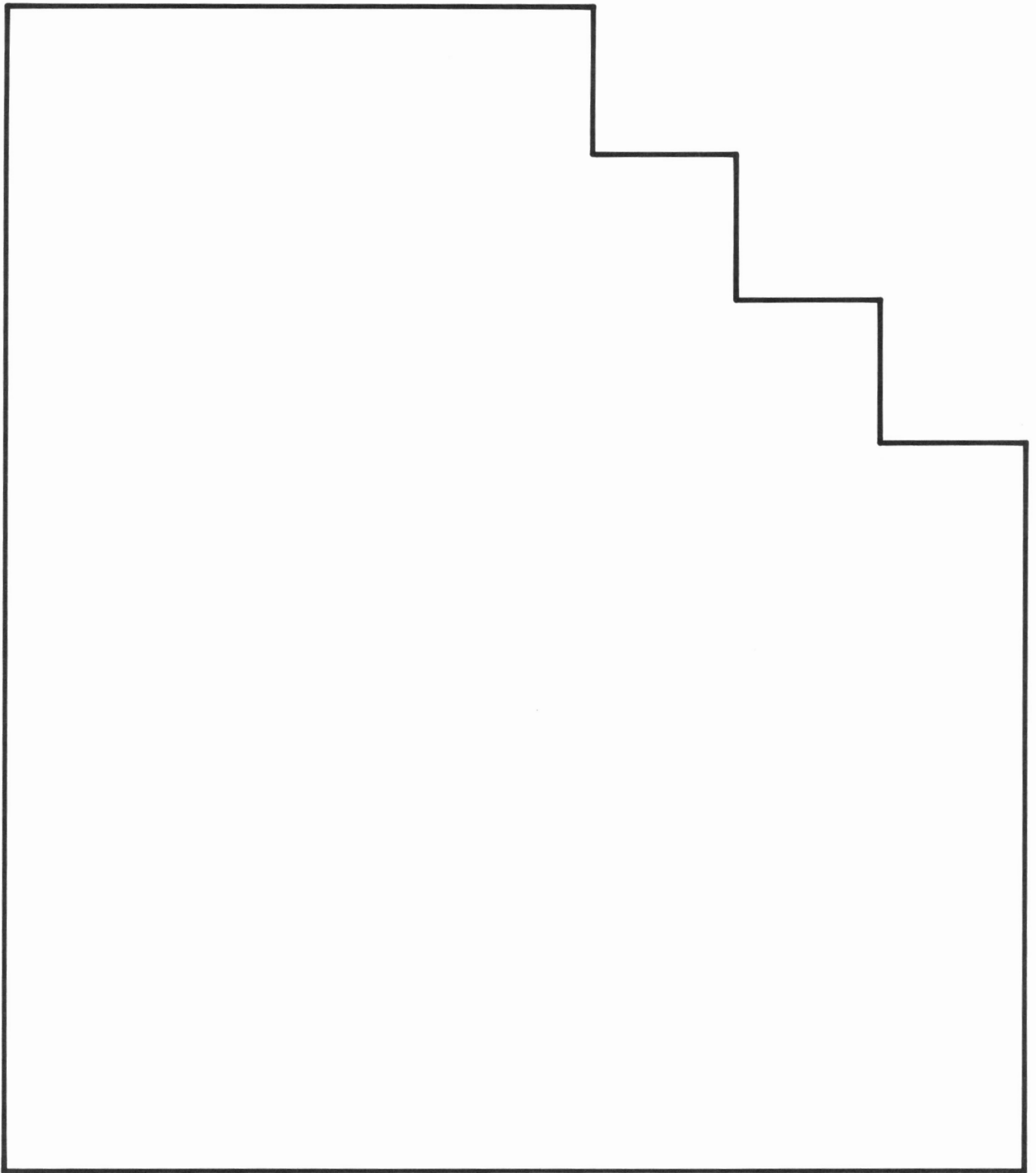


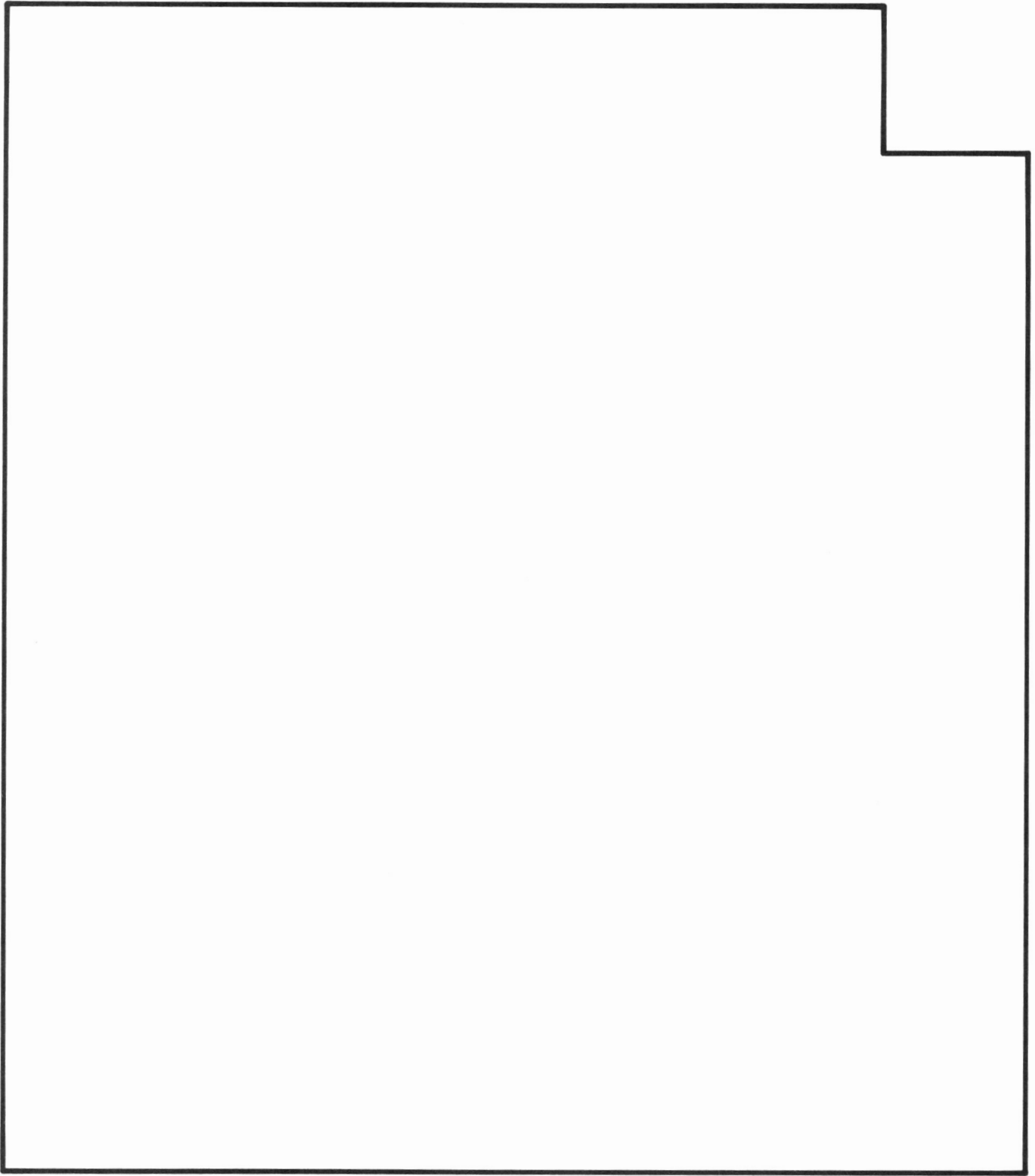


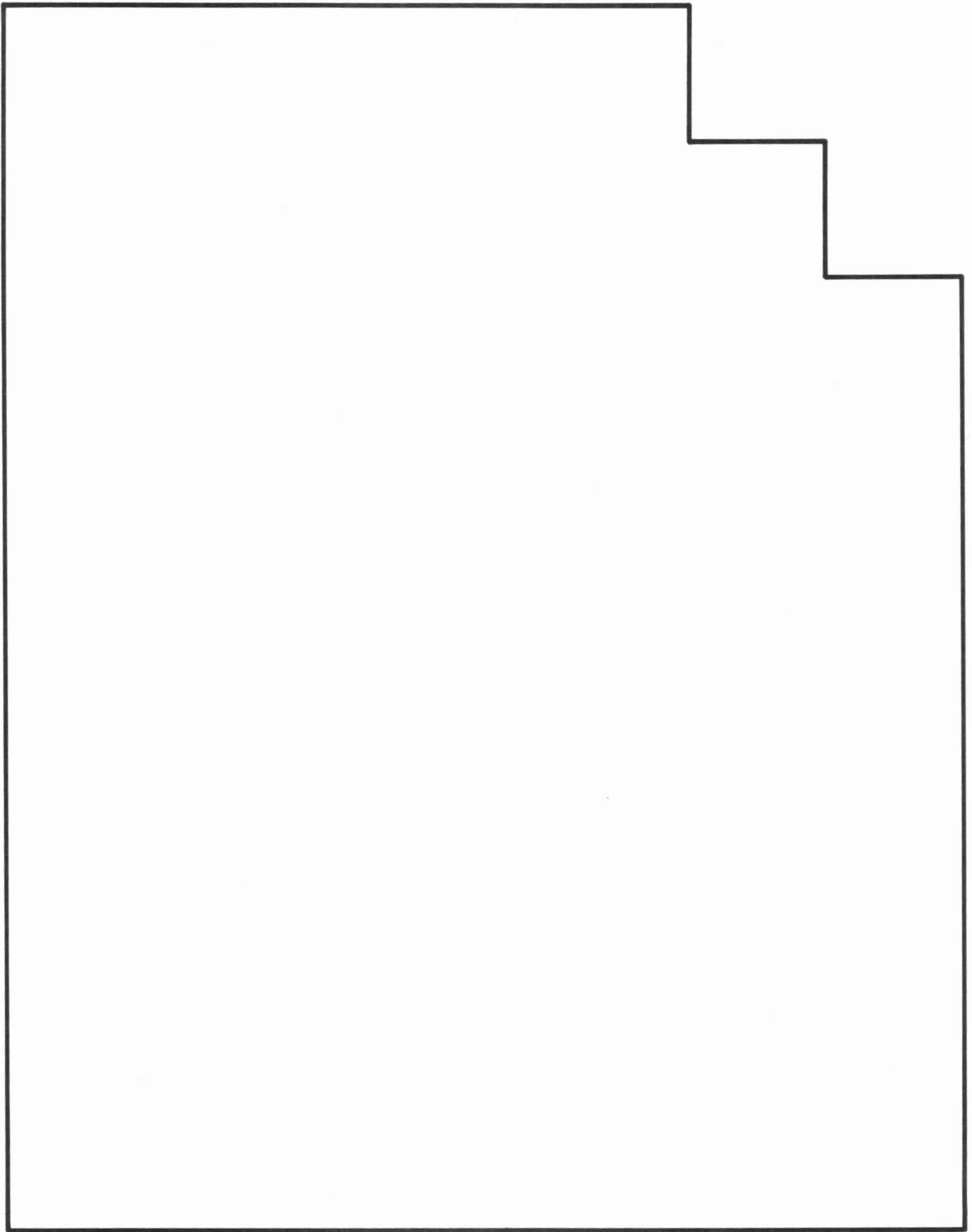


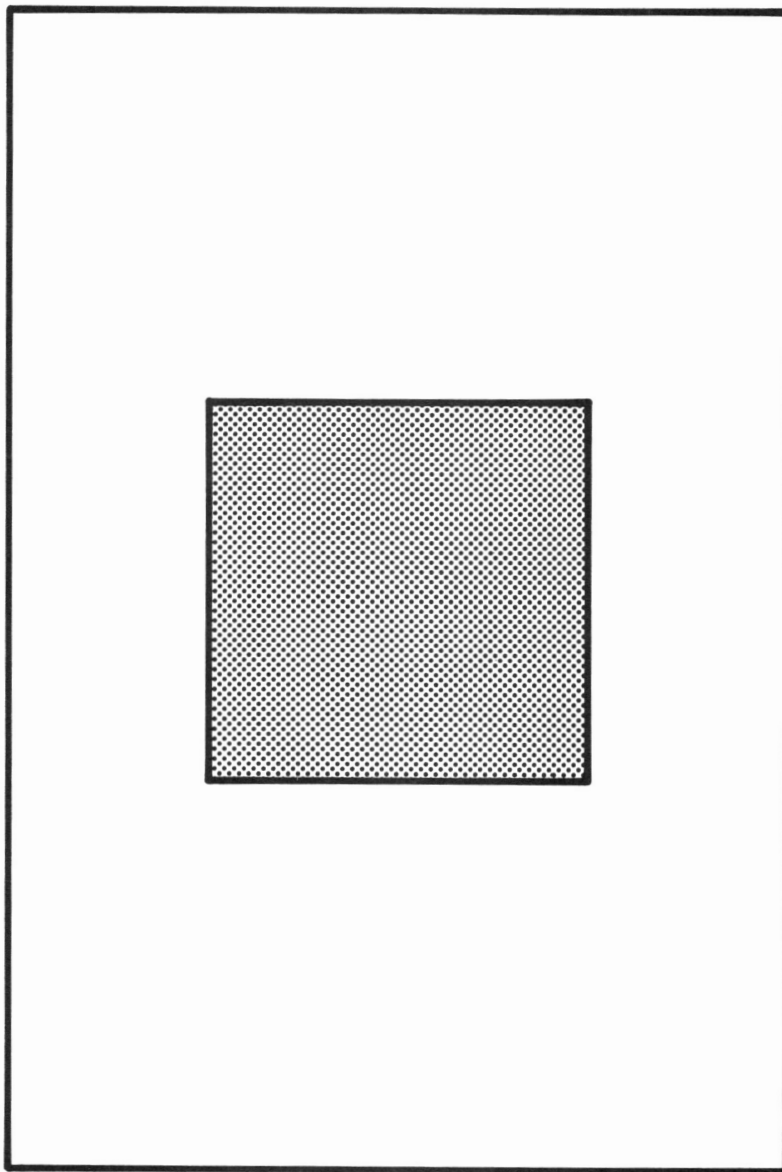


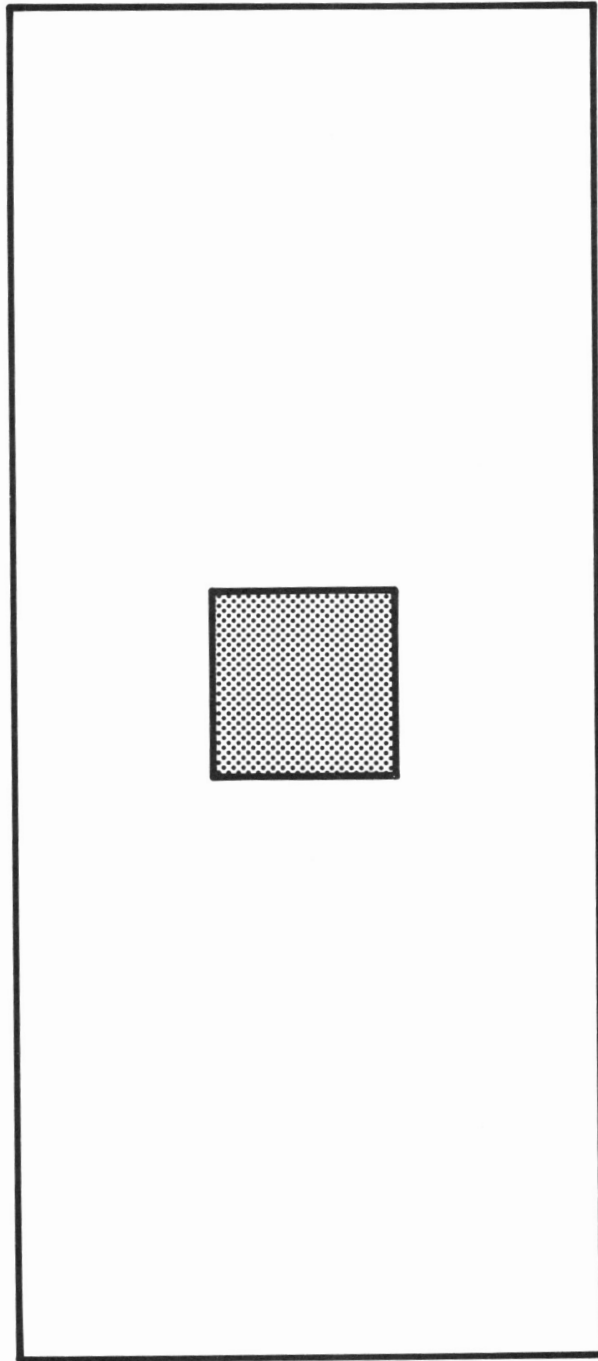


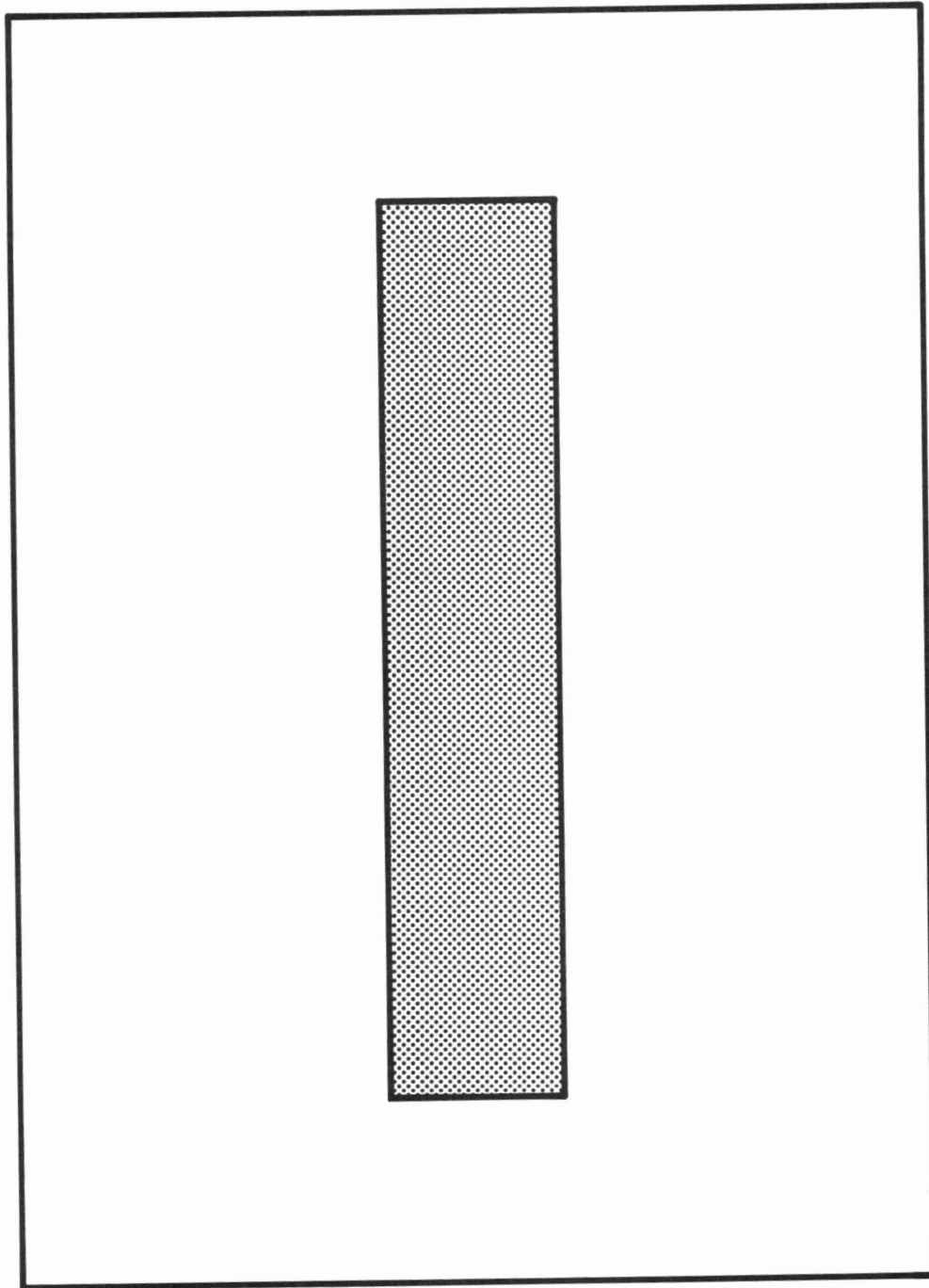


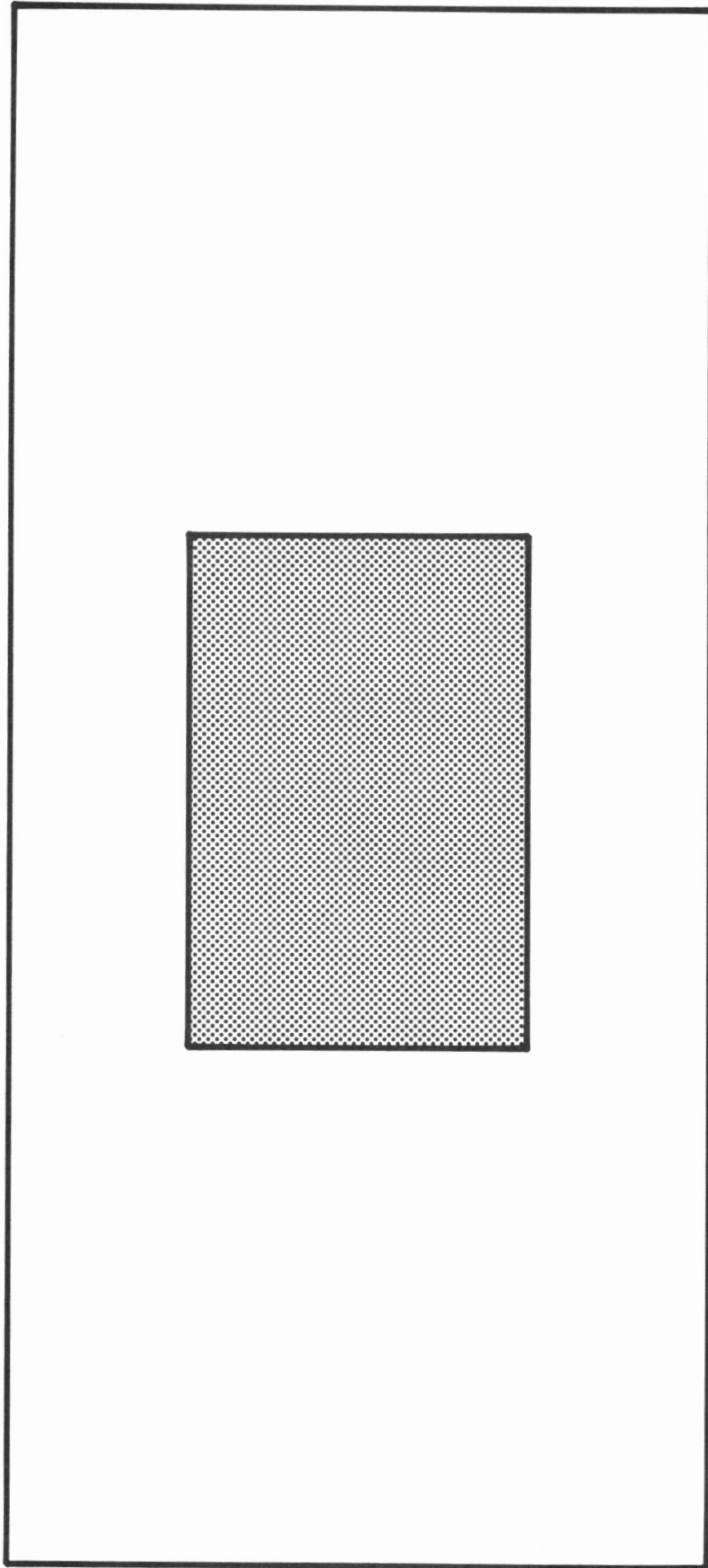


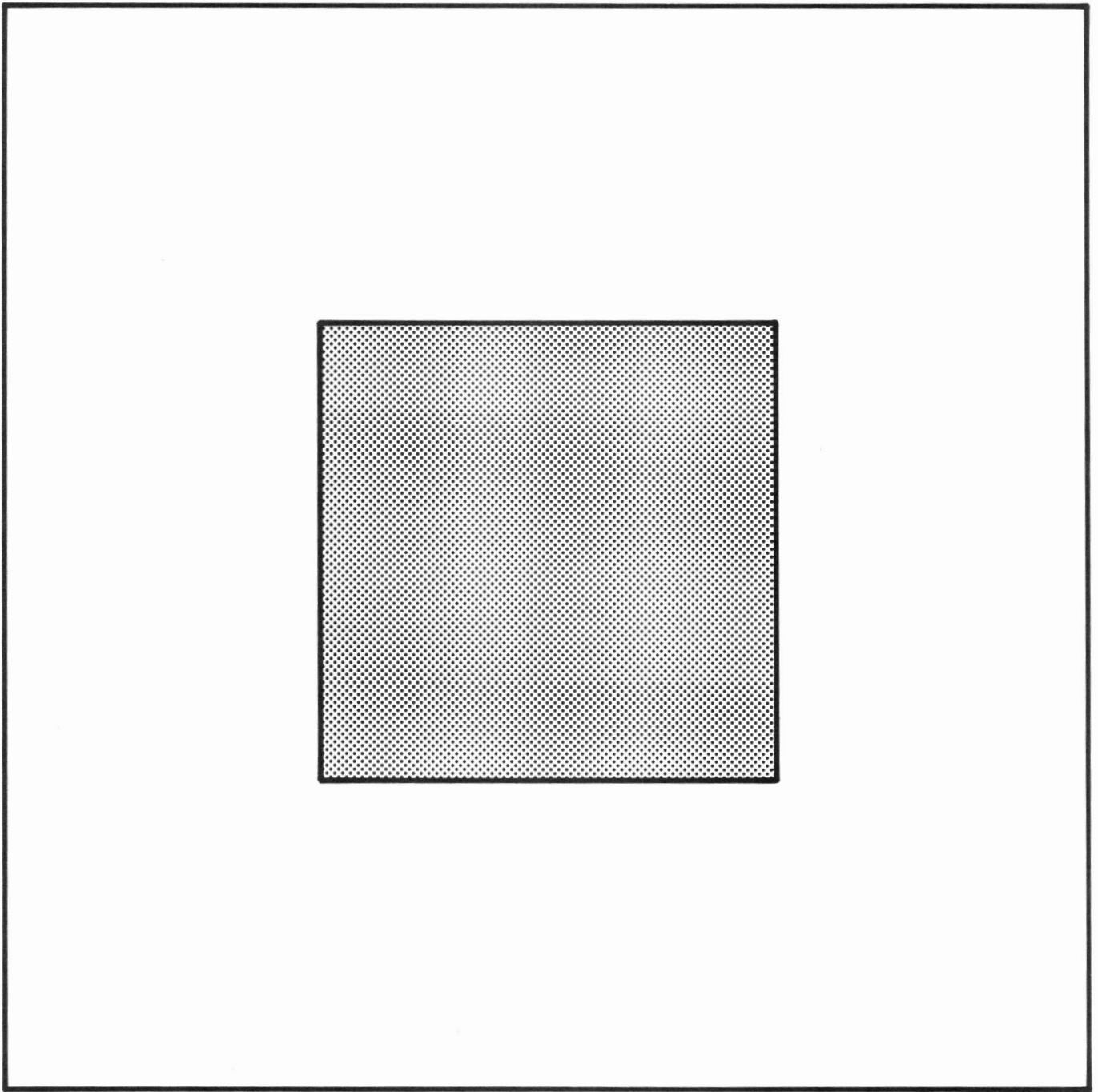


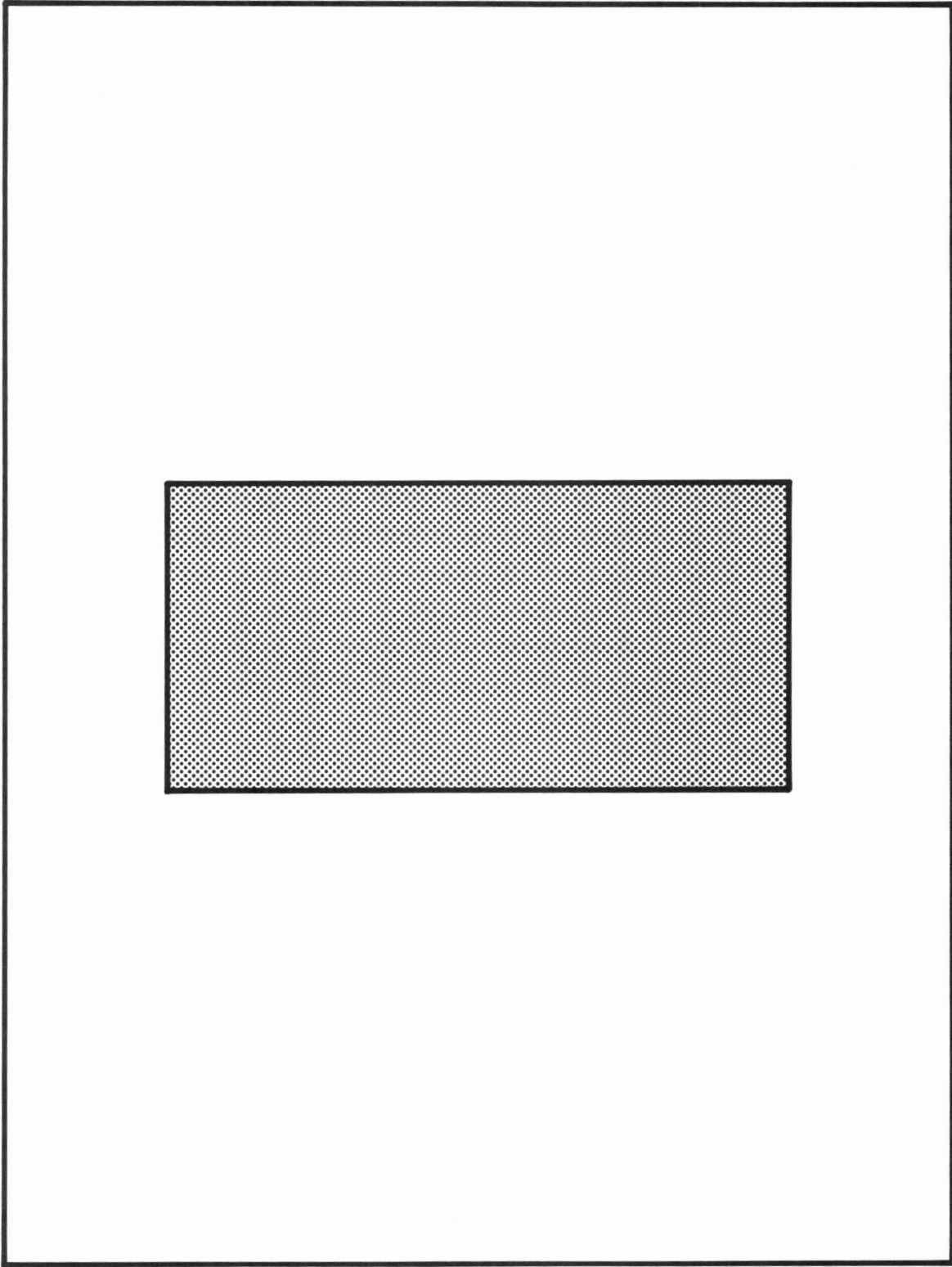


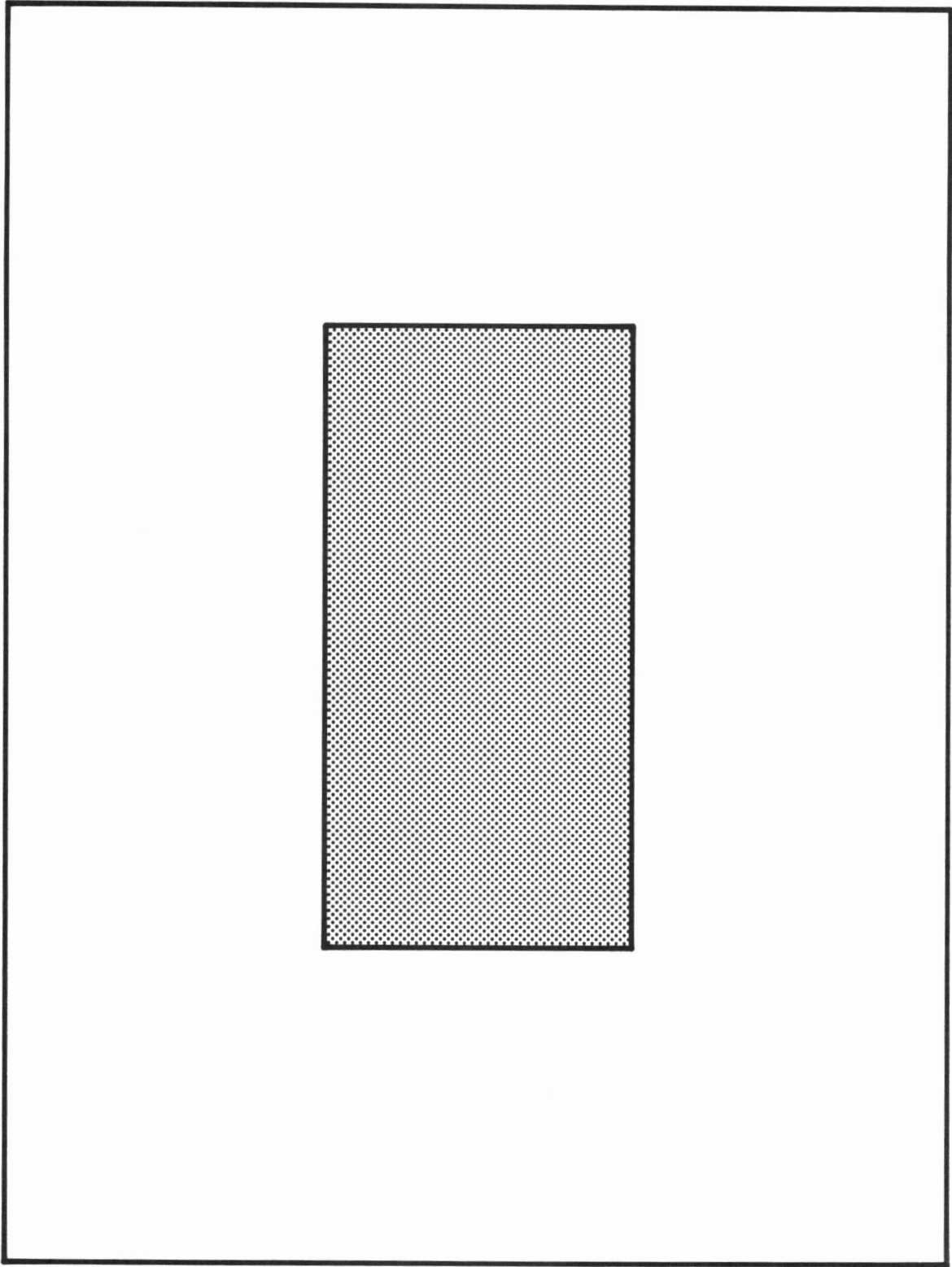


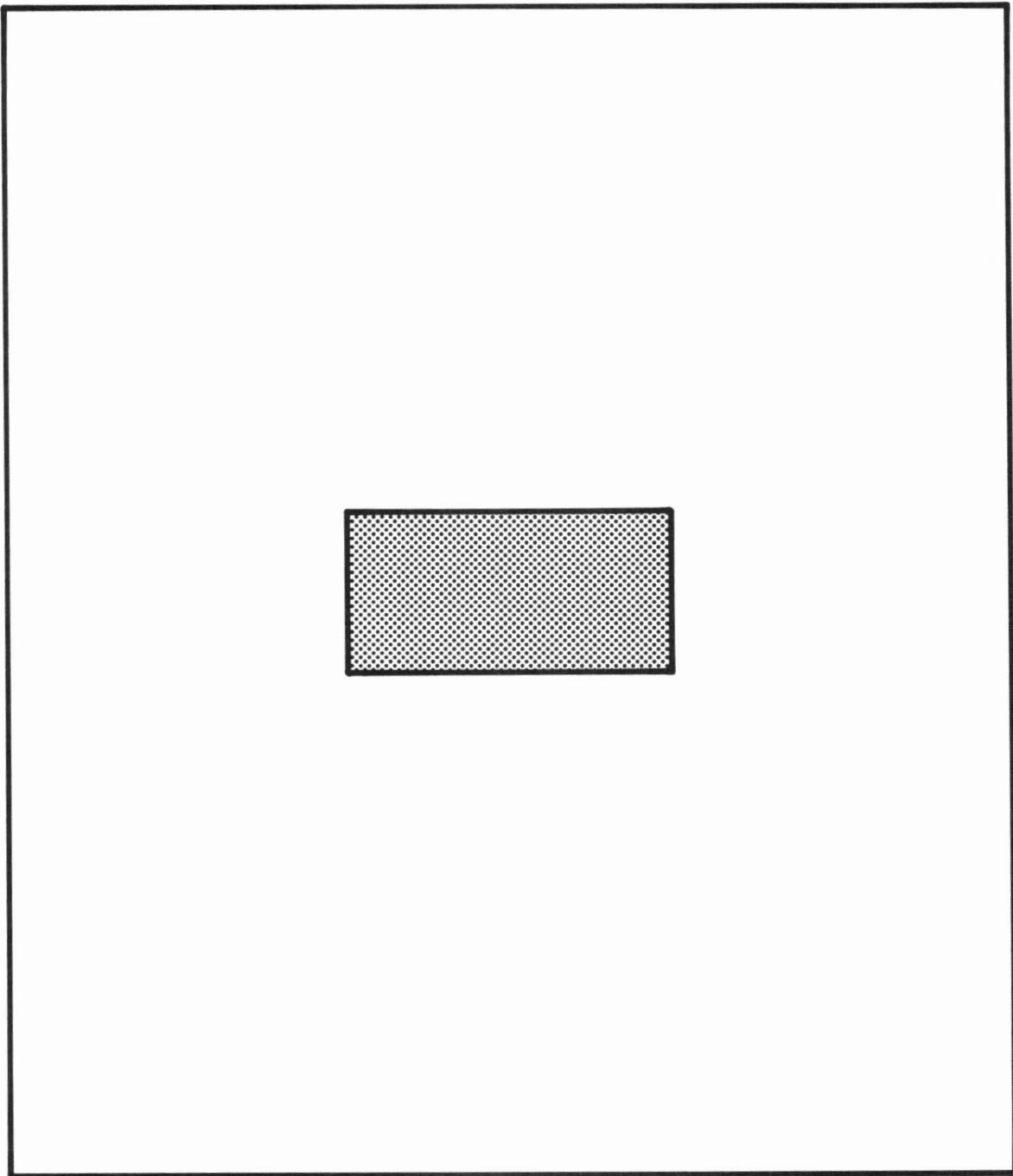


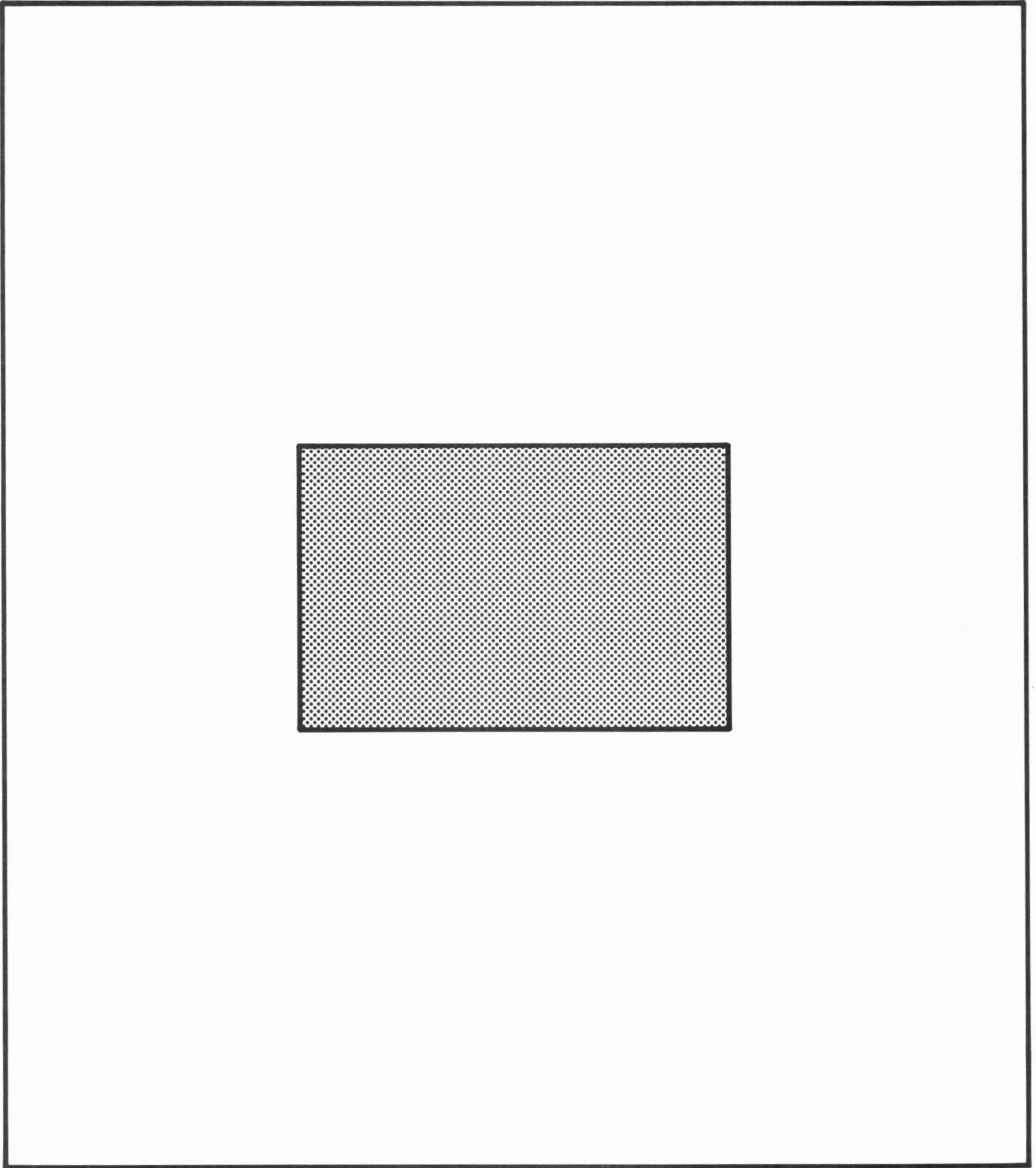


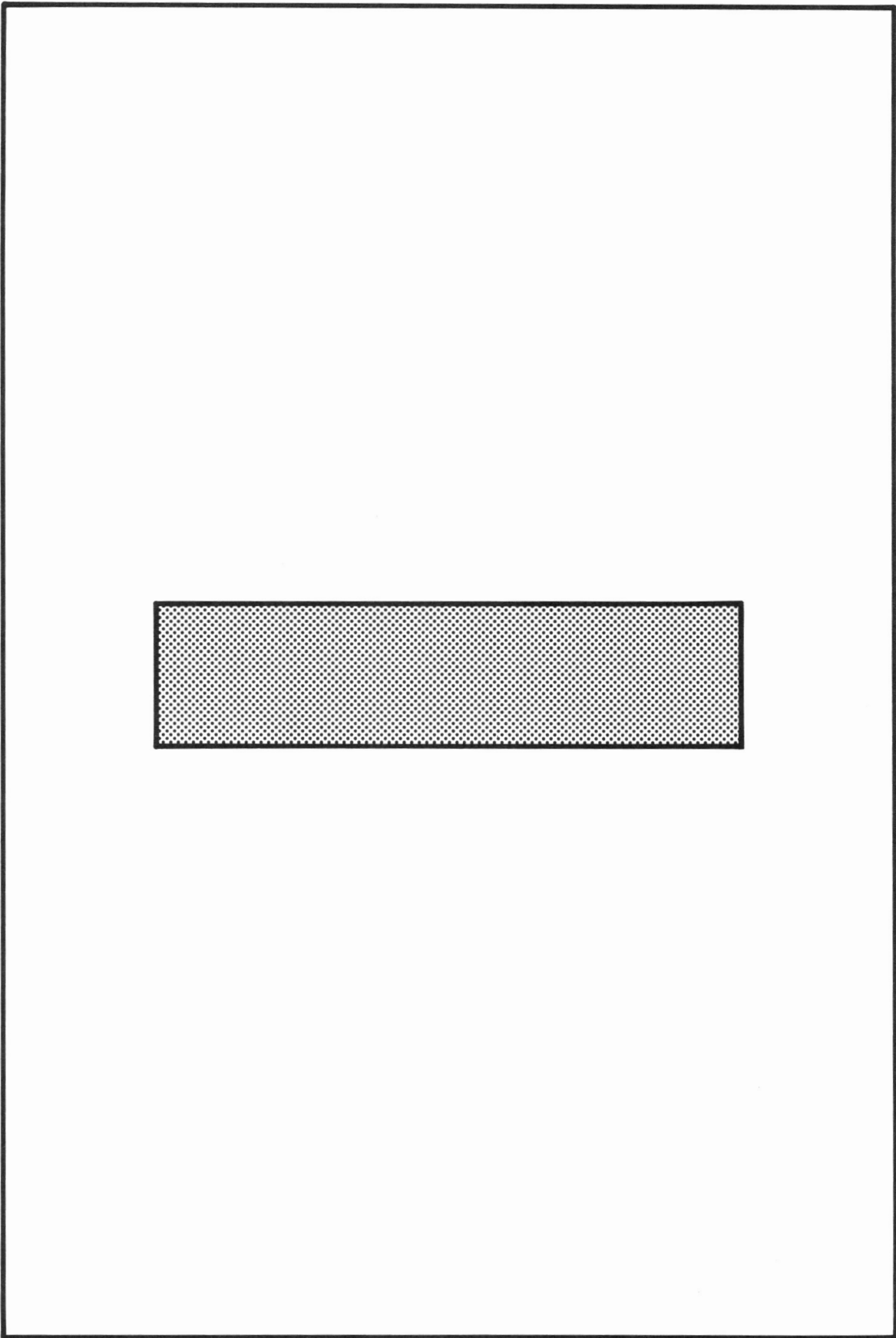


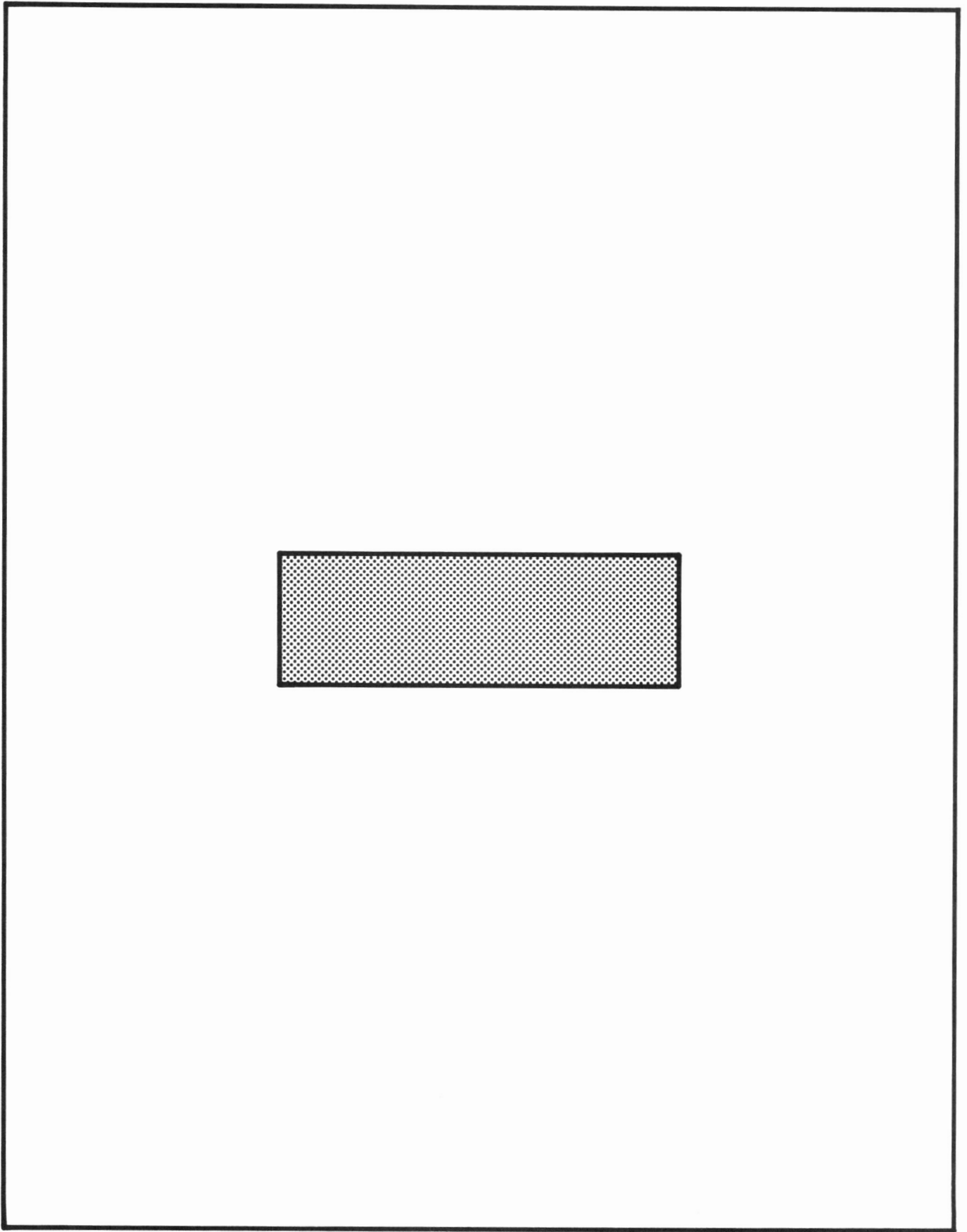


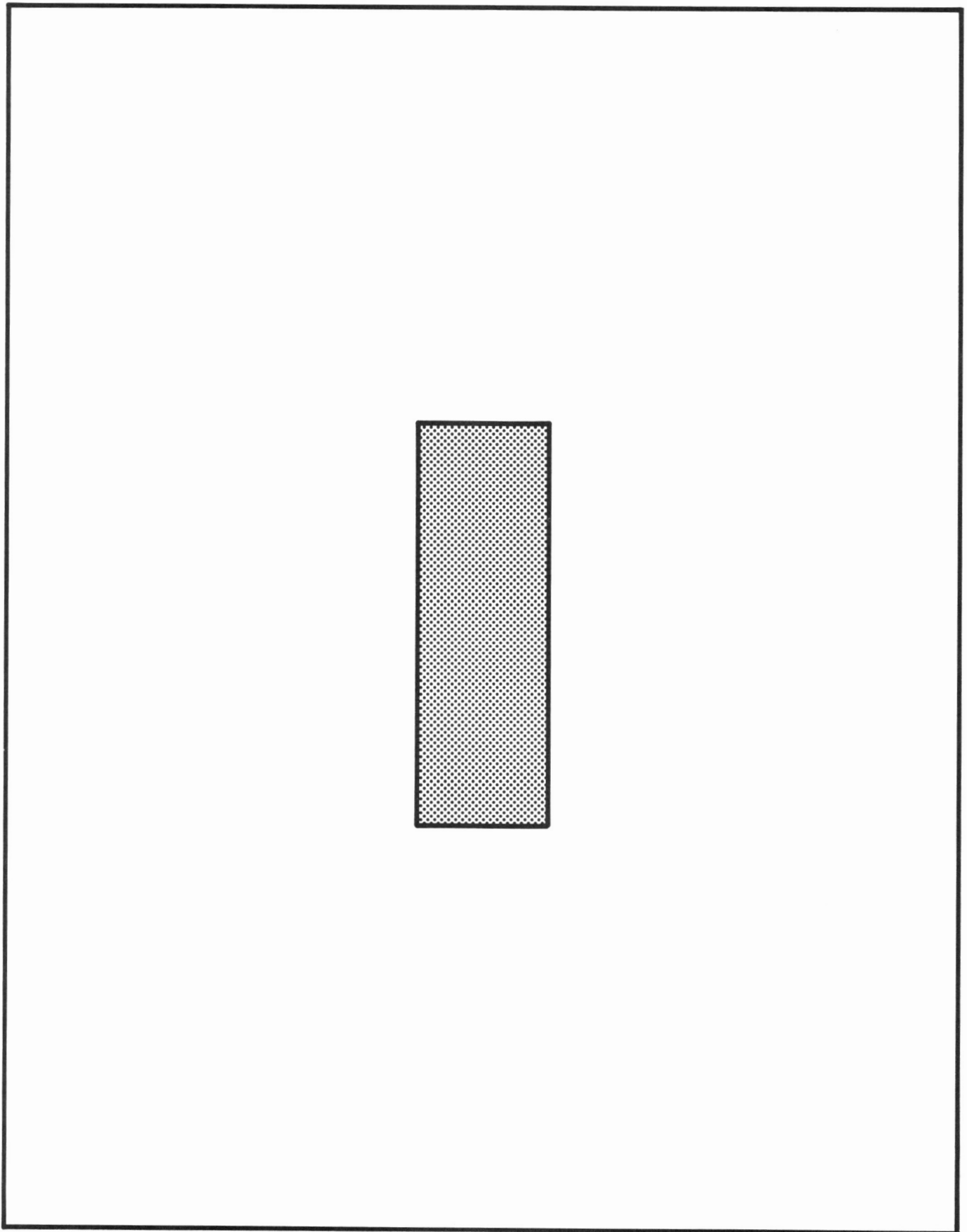


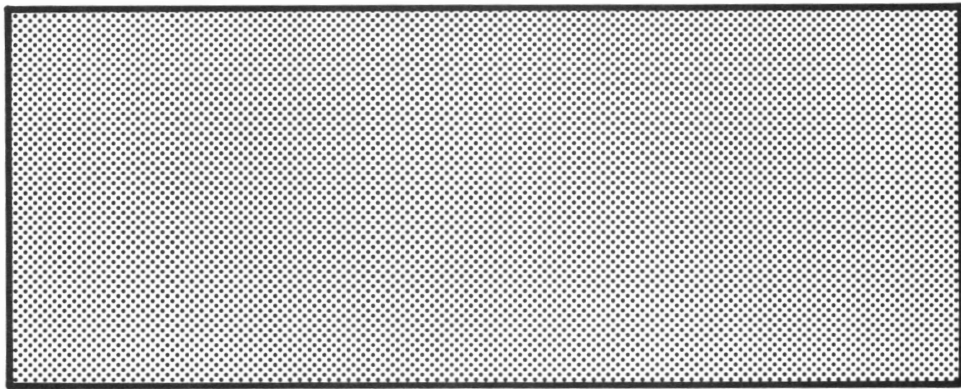


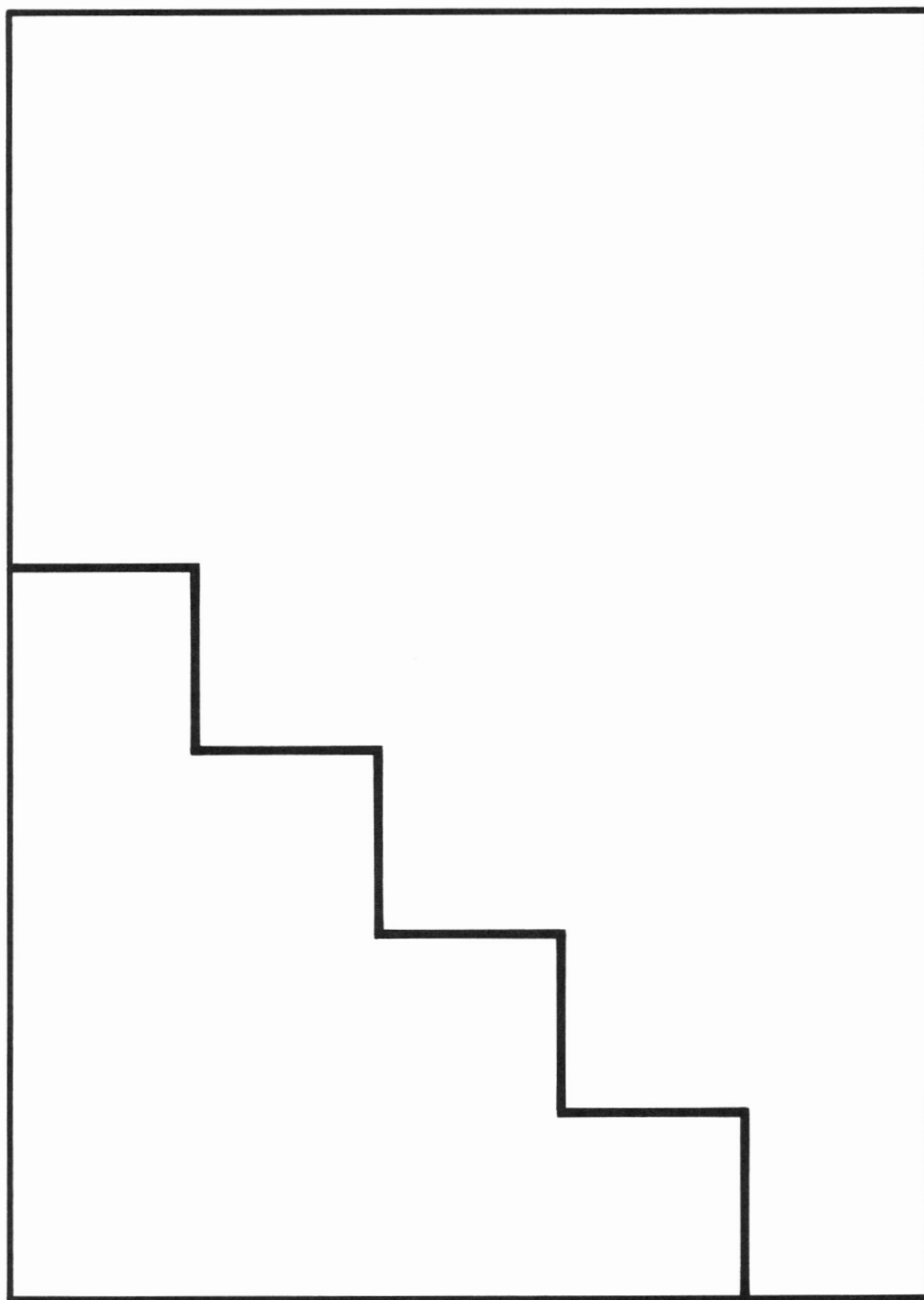


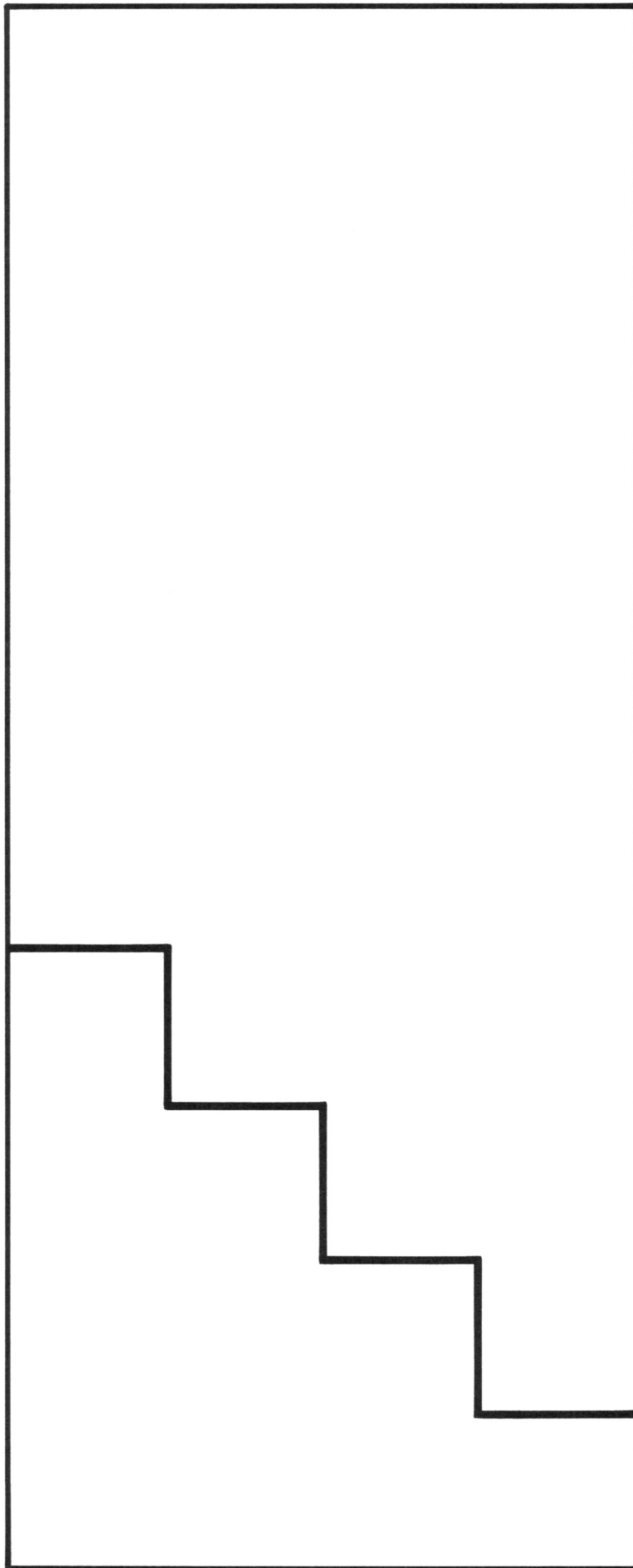


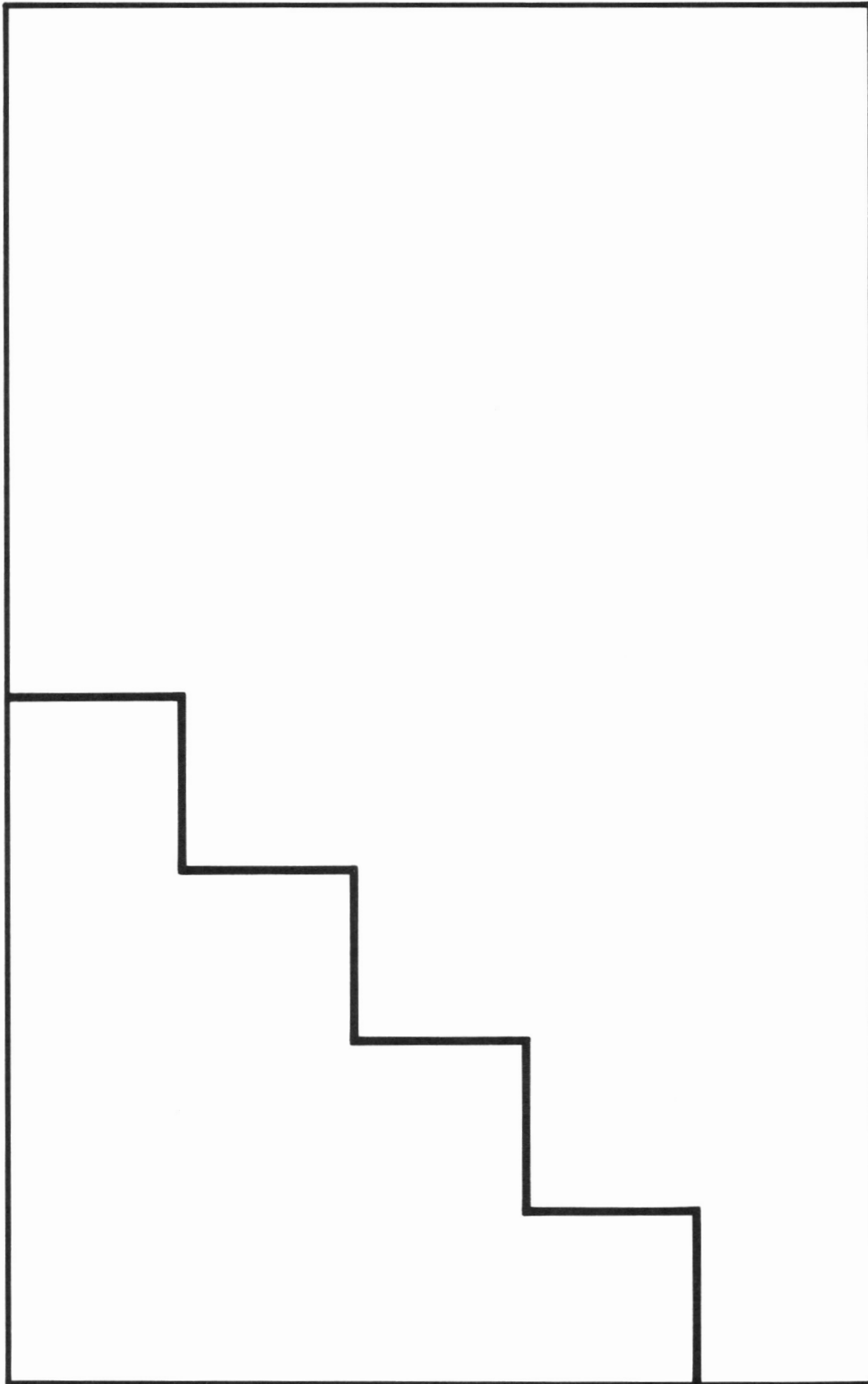


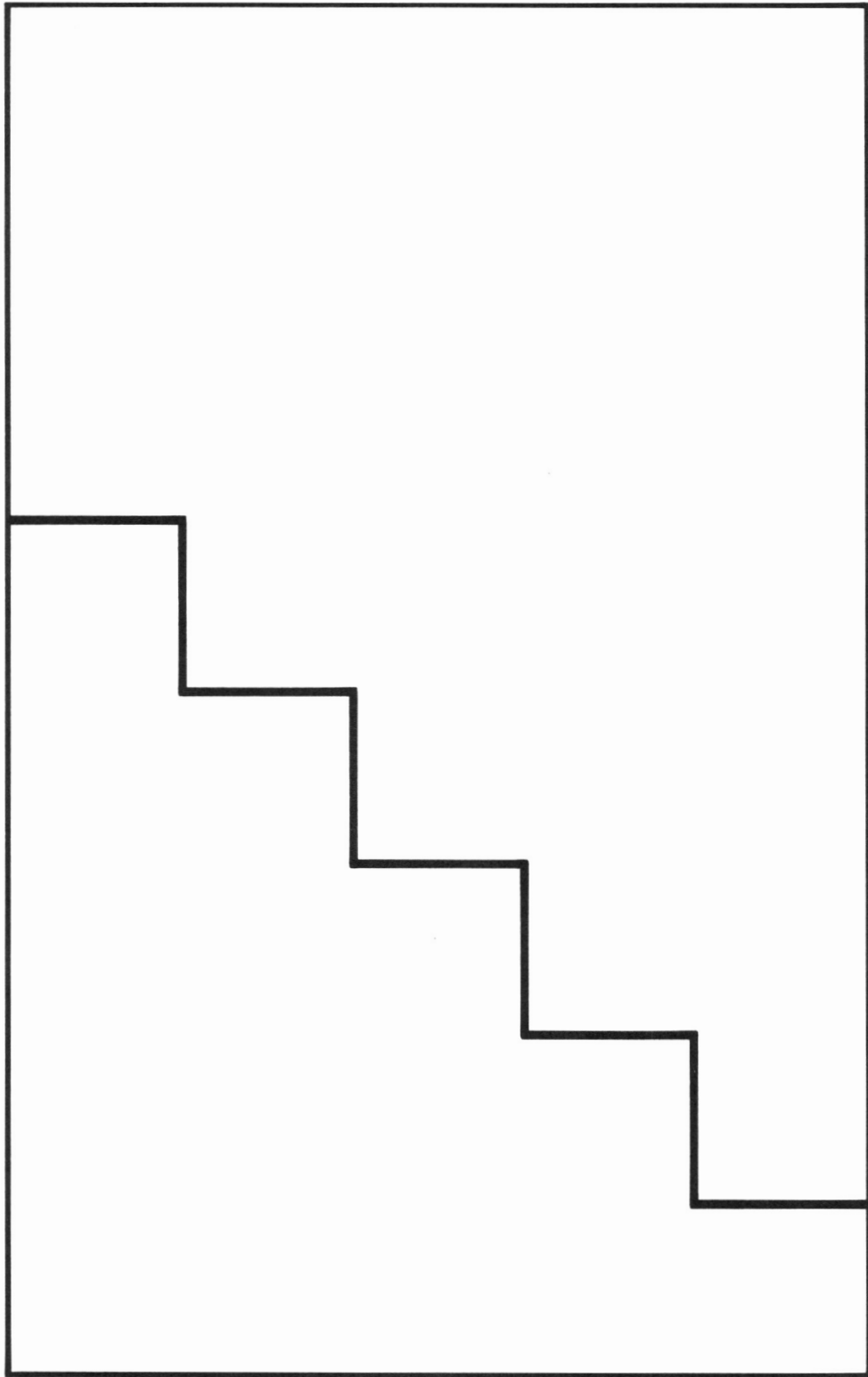


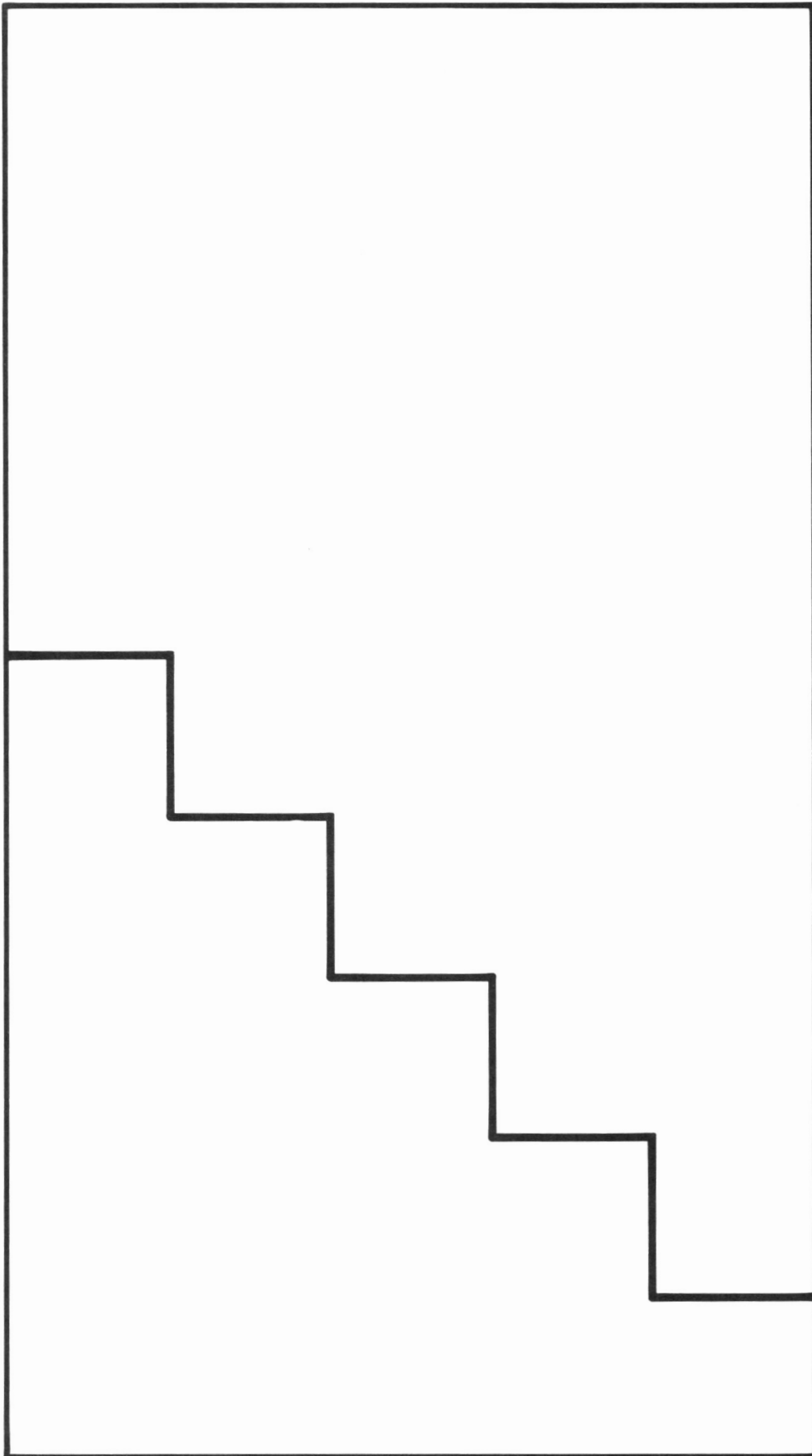


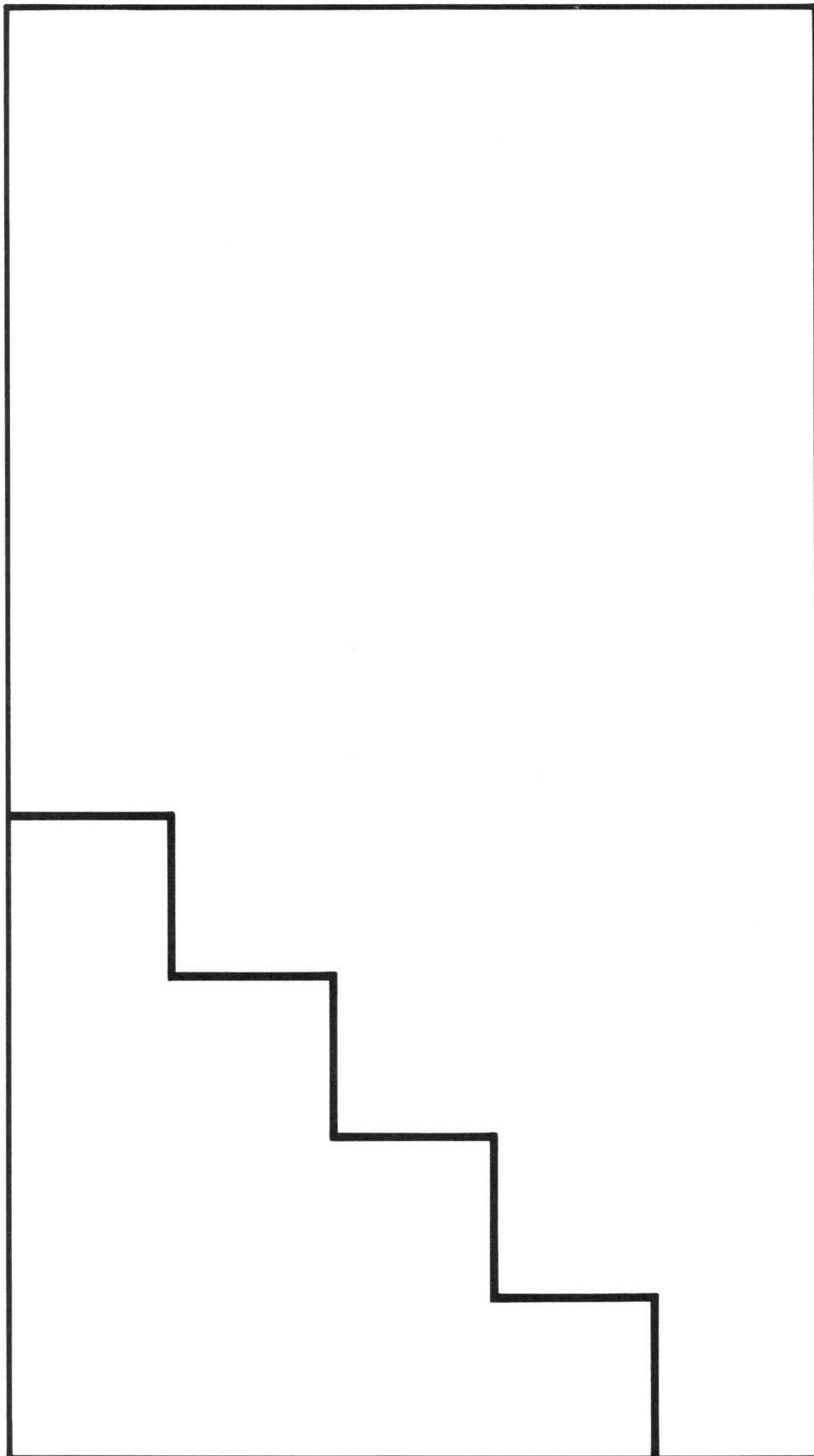


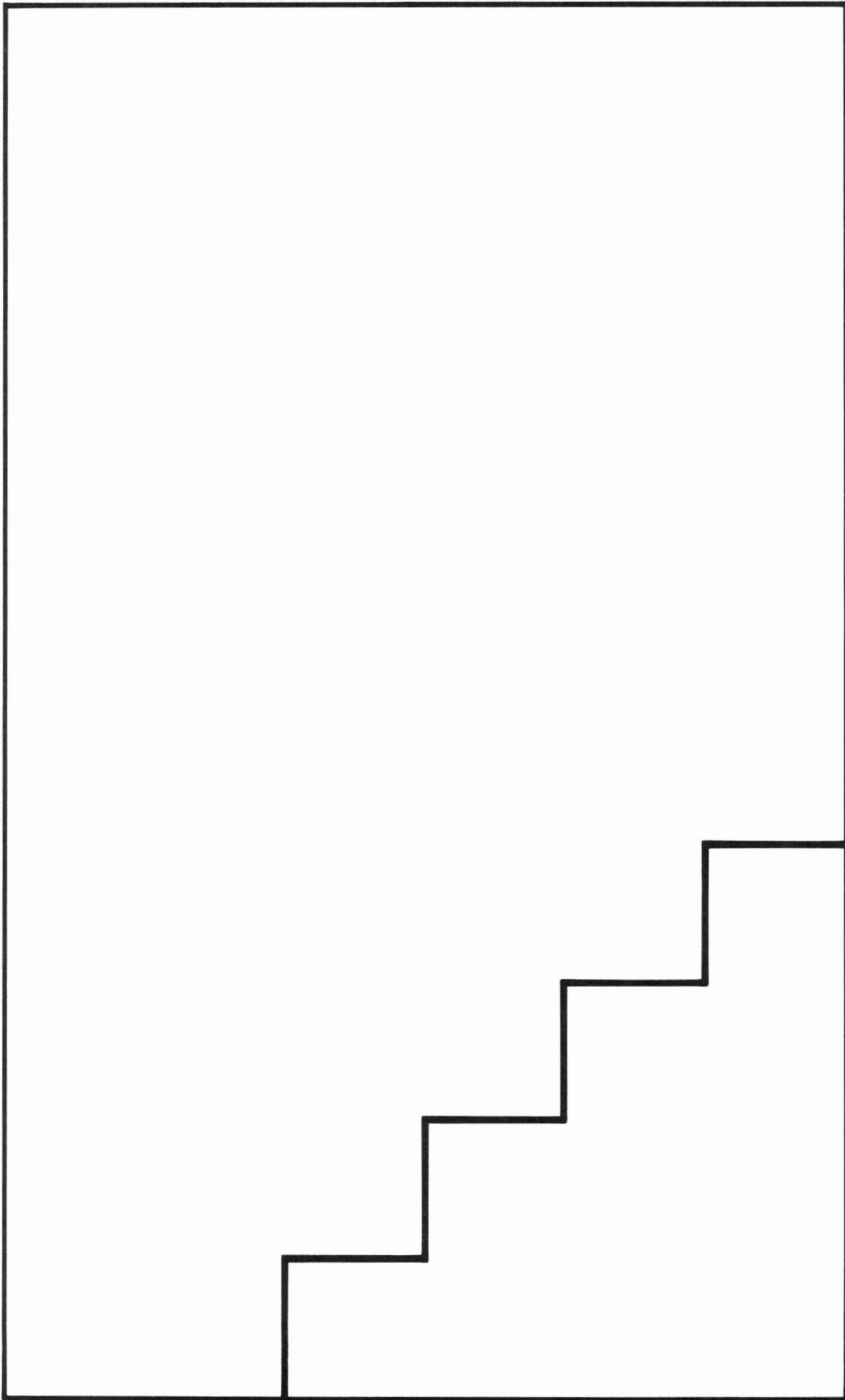






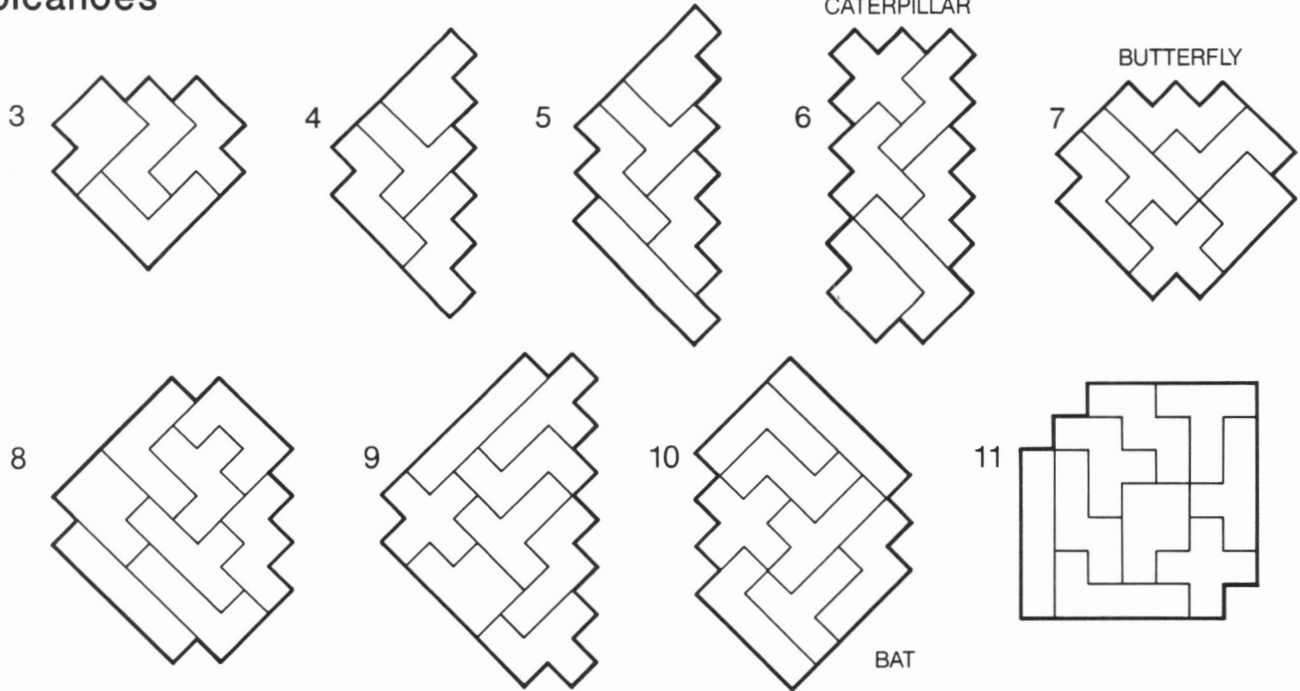




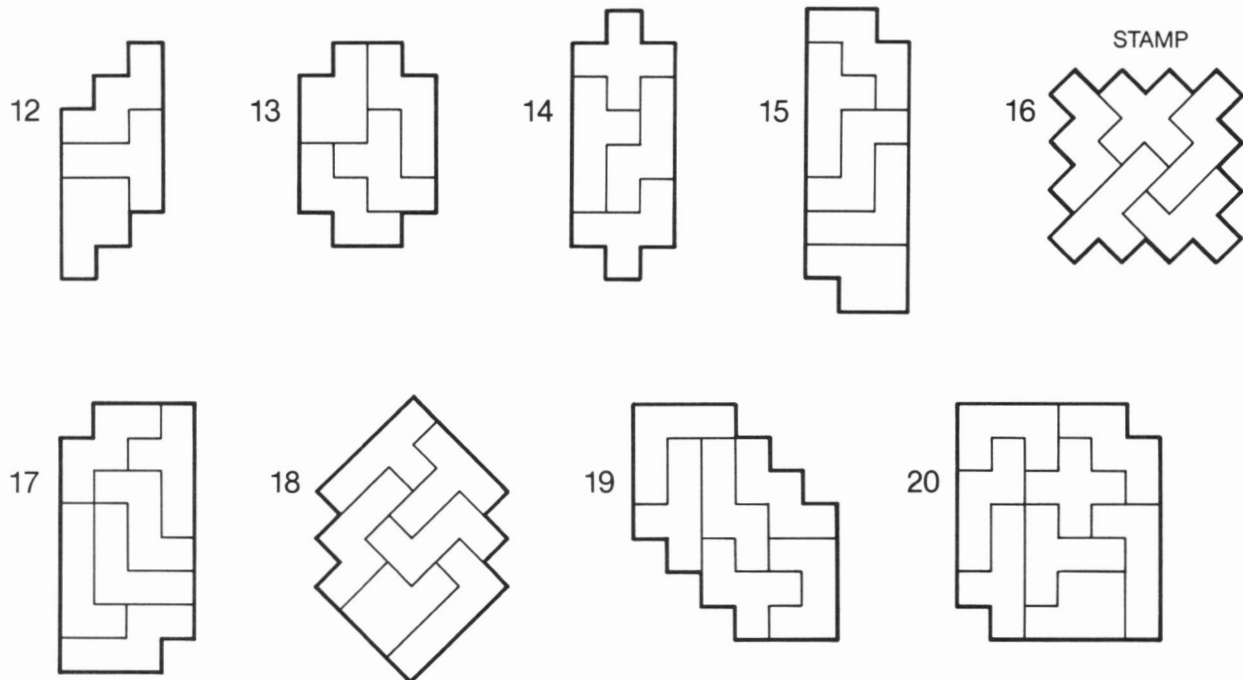


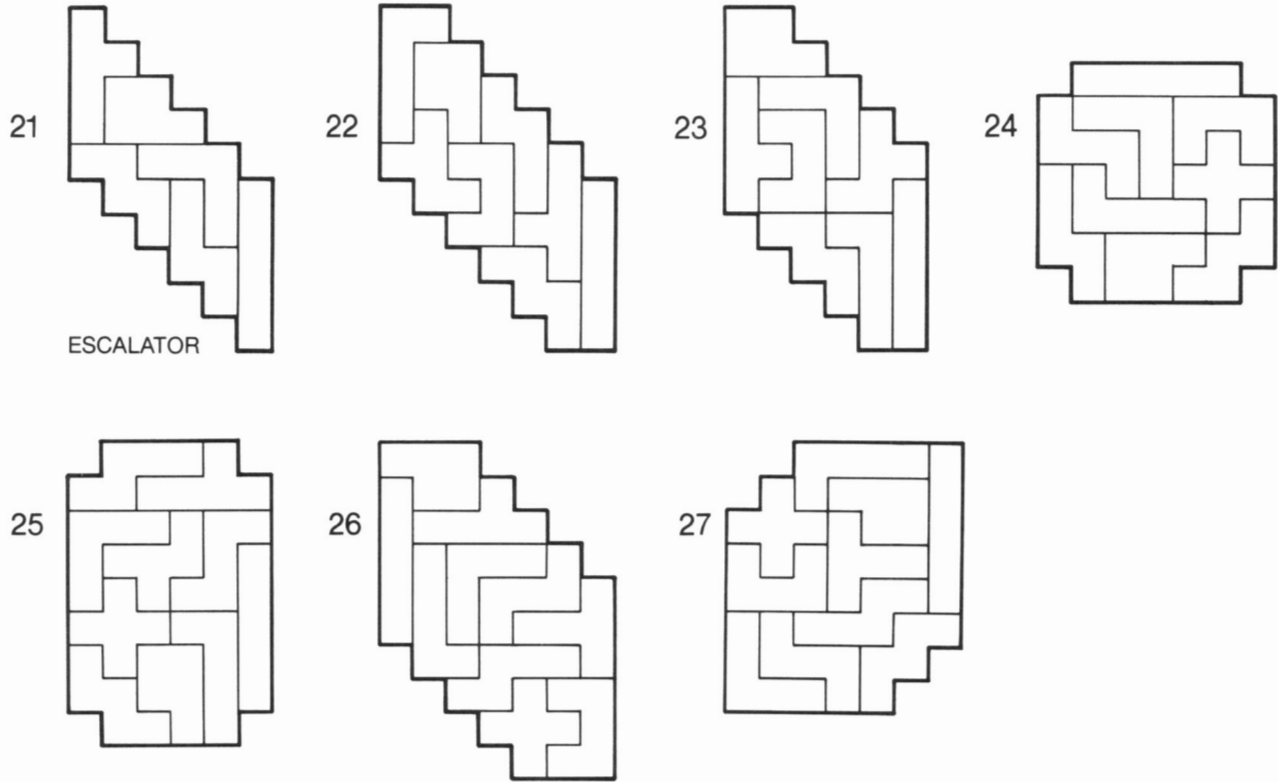
Solutions

Volcanoes

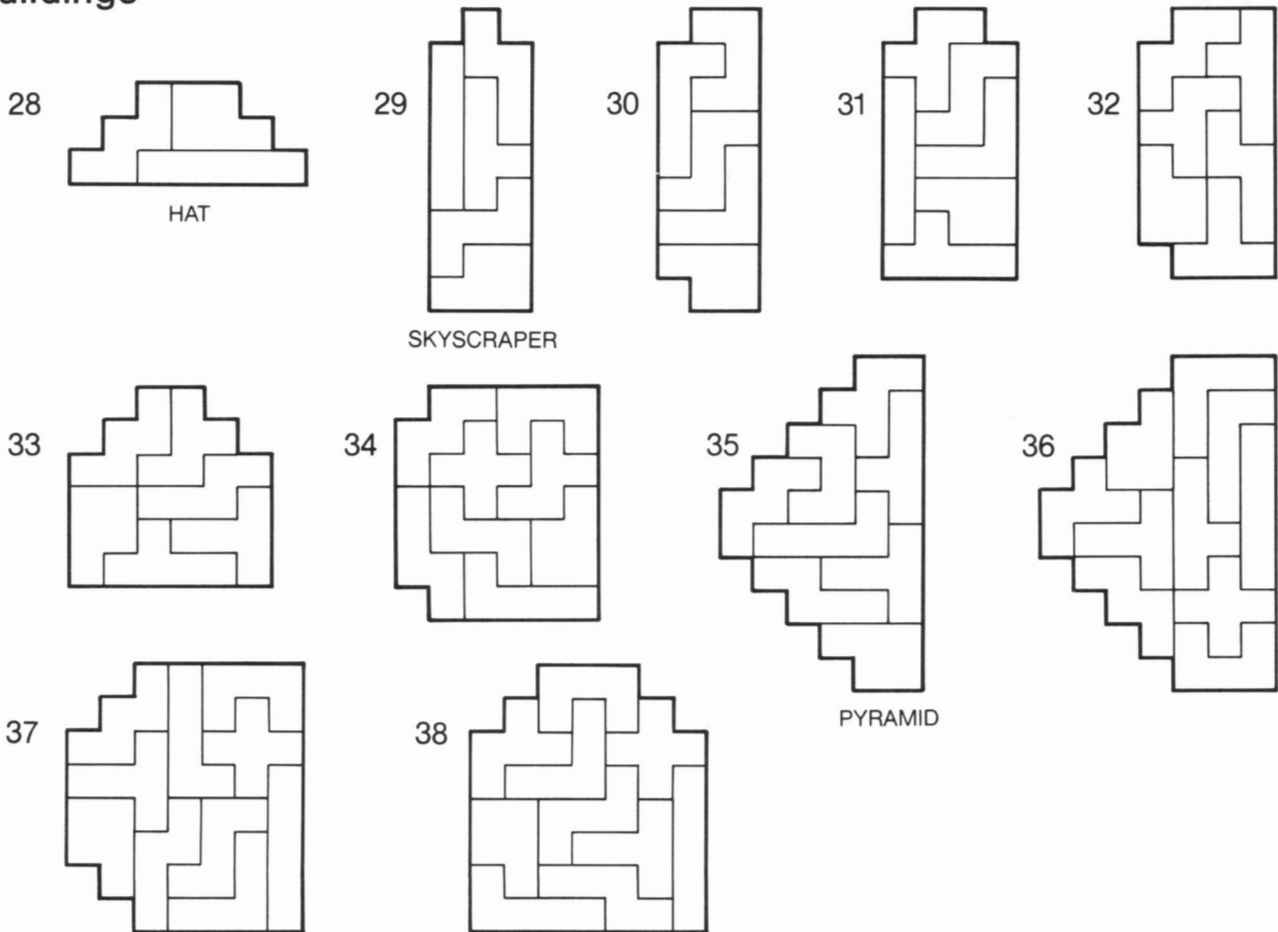


Turnarounds

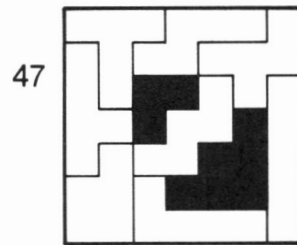
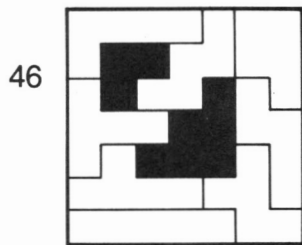
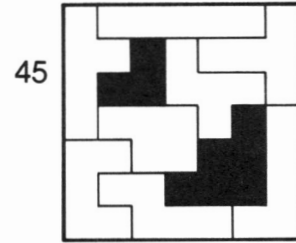
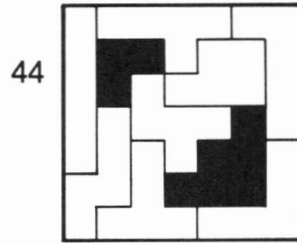
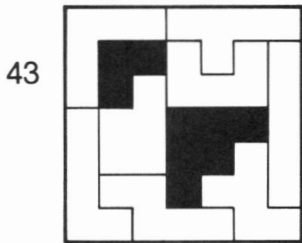
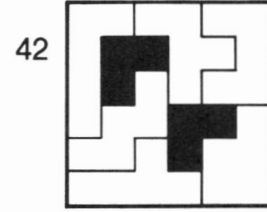
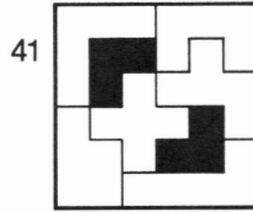
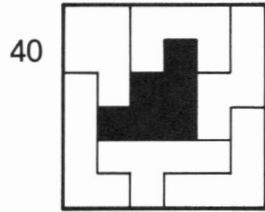
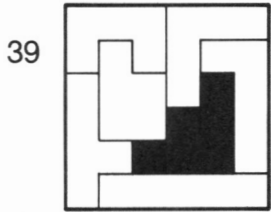




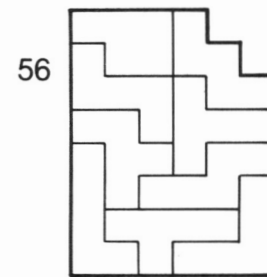
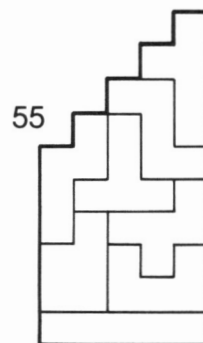
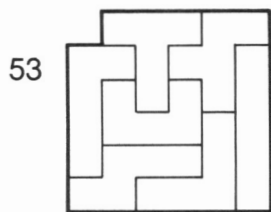
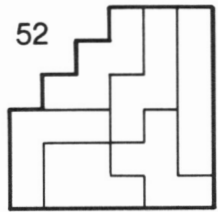
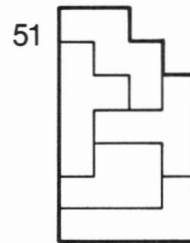
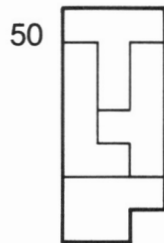
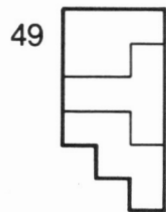
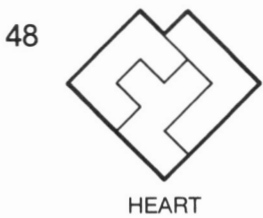
Buildings

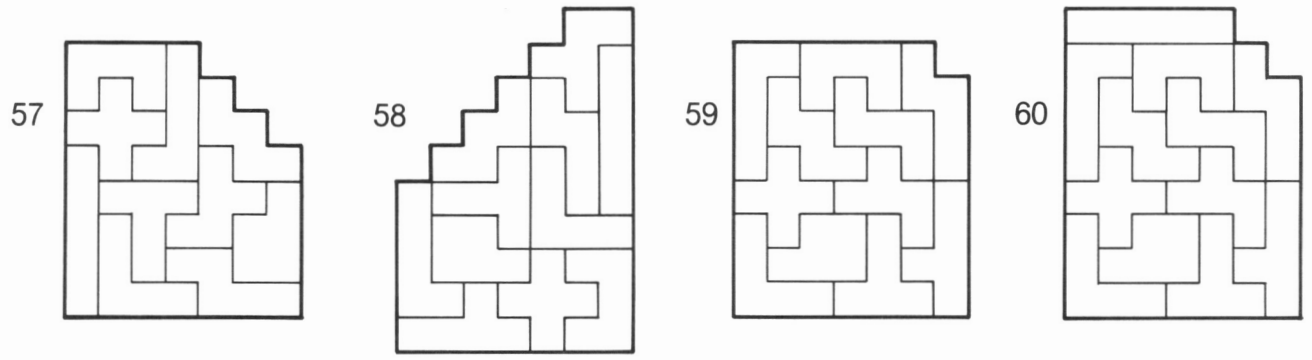


Fish

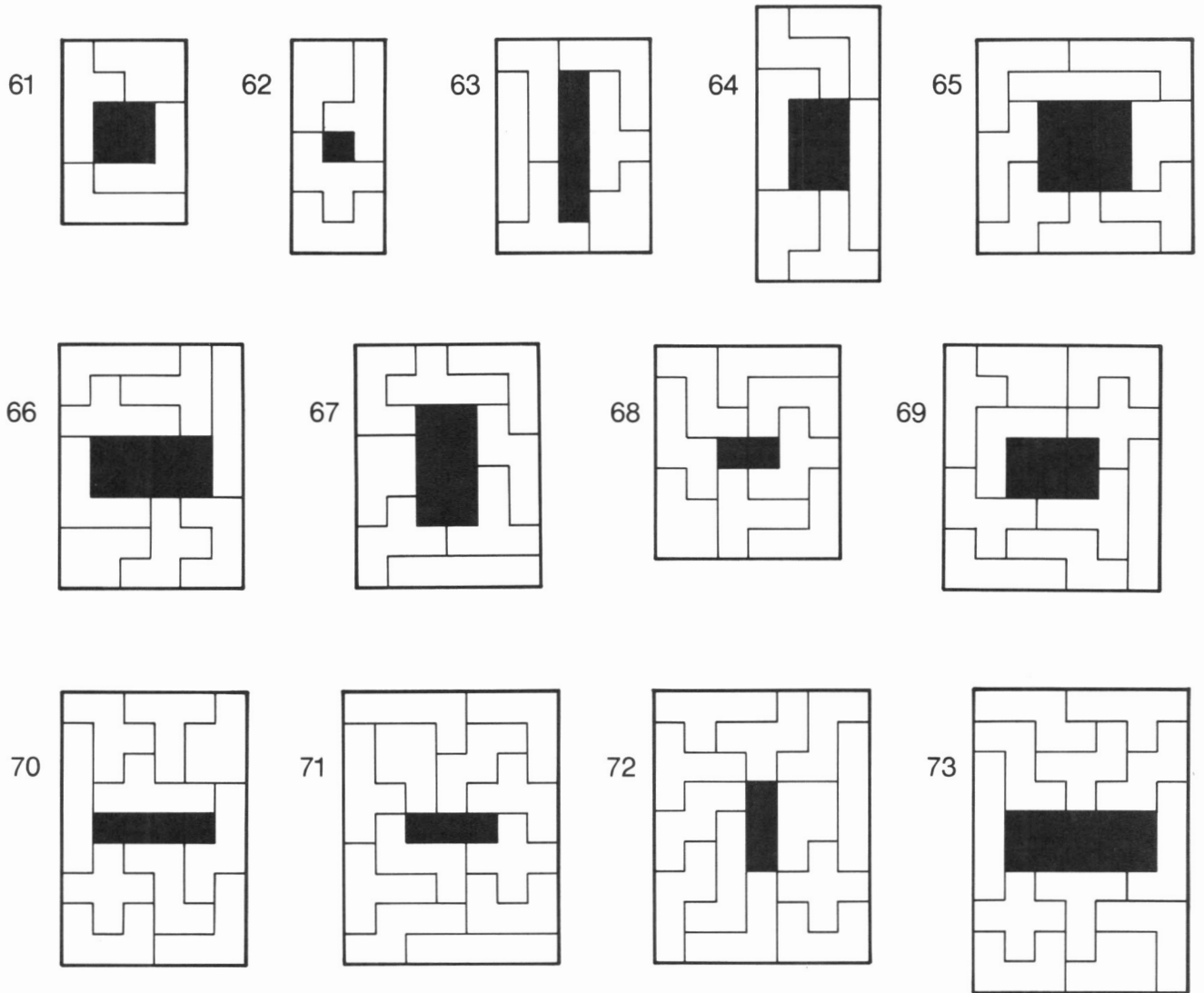


Broken Rectangles



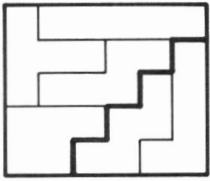


Farms

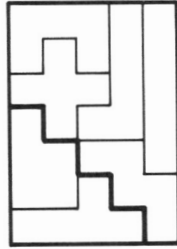


Cracked Rectangles

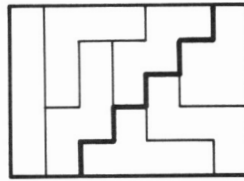
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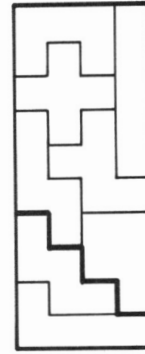
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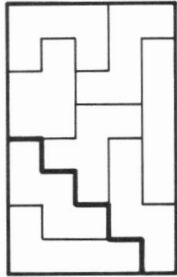
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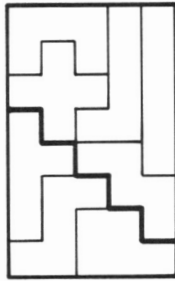
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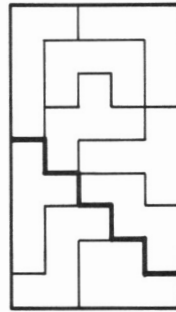
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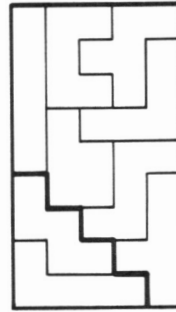
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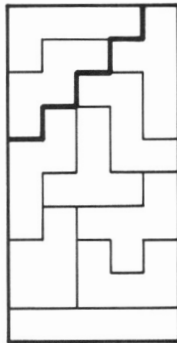
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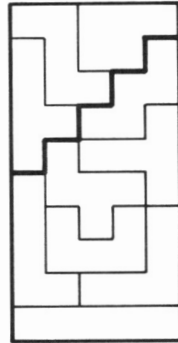
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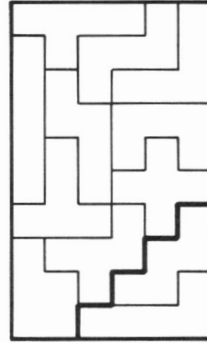
82



83



84



85

