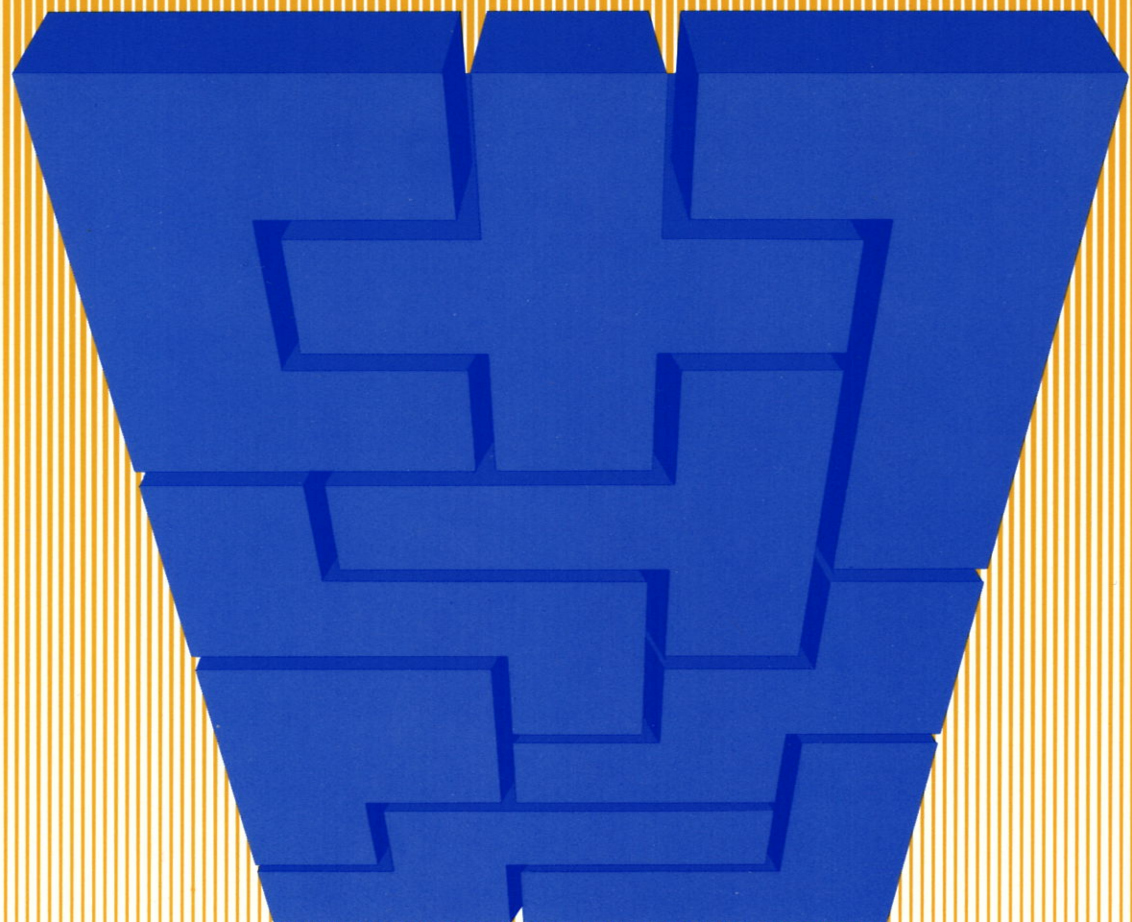
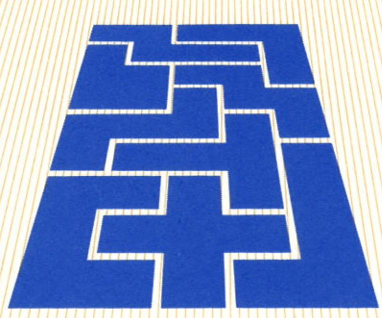
PENTOMINO ACTIVITIES





Henri Picciotto

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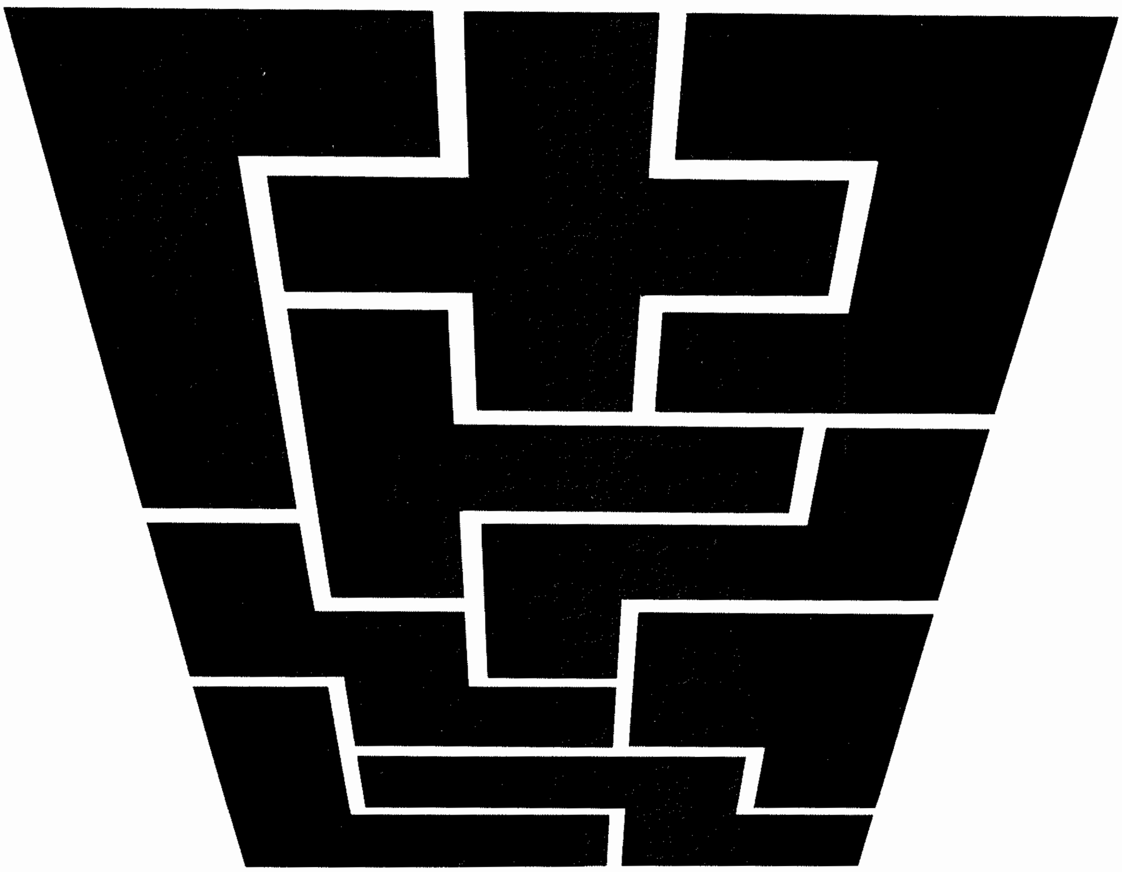

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NOTES ON PENTOMINO ACTIVITIES

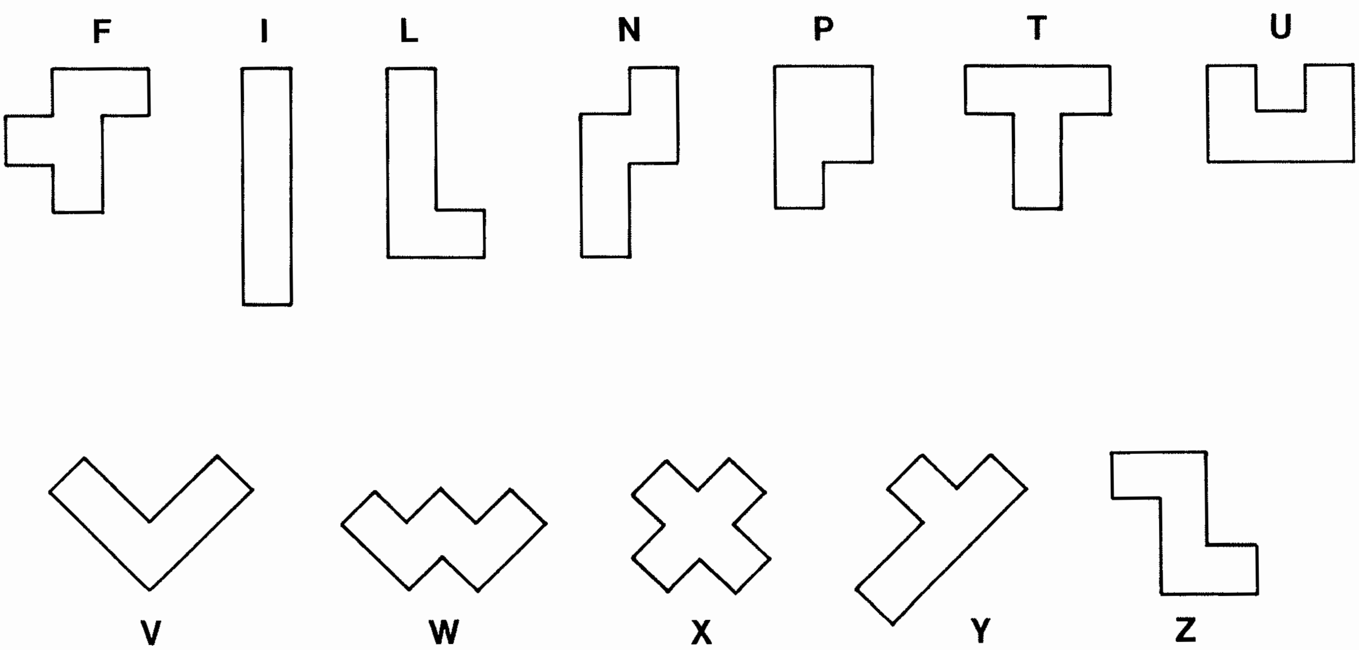
Pentominoes are the geometric shapes that are formed by joining five squares edge-to-edge. The name is derived from "domino," the shape obtained by joining two squares in this fashion. There are 12 distinct pentominoes, named after letters of the alphabet. (See drawing at the bottom of this page.) They can be put together to form many interesting shapes.

The puzzles in this book are self-explanatory. The instructions for all of them are the same: Cover **all** the figures using pentominoes. The pieces should not overlap or stick out beyond the boundaries of the figures.

The puzzles fall into six sets called Warm-Ups, Creatures, Pairs, Stairs, Rectangles, and Blow-Ups. As much as possible, the puzzles are ordered by difficulty within each set, the easier ones coming first.

The challenge of pentomino puzzles is to cover all the shapes on one page simultaneously with one set of pentominoes. To make the puzzles easier to solve, allow the students to borrow pieces from another set of pentominoes. Or, to make them even easier to solve, have the students cover one figure at a time. But, students have not really solved a puzzle until they can cover **all** of the figures on a page at the same time using pentominoes from a single set.

Students may solve the puzzles in any order, but if they are becoming frustrated, encourage them to work with the easier puzzles. Students will probably enjoy the puzzles more if they do not look at the solutions, but try to work out their own. Many of the puzzles are related. It may be helpful for students to keep a record of their solutions using graph paper. Then they can refer to a previous solution when working on a harder, related puzzle.



THE PENTOMINO STORY

Mathematicians and puzzle buffs have enjoyed pentominoes since 1965 when Solomon Golomb, then a mathematician at the University of Southern California, wrote a book about them. Martin Gardner made pentominoes famous by writing several articles about them in SCIENTIFIC AMERICAN.

The best-known problem is to construct a 6 by 10 rectangle using all the pentominoes. Most humans have trouble finding even one solution, but a computer found 2,339 of them. How many can you find?

EXPLANATION OF THE ACTIVITIES AND EXTRA CHALLENGES

Use pages 1 and 2 as patterns to make pentominoes or as a check to make certain you have a complete set.

Warm-Ups: Congruent pairs and triples. In geometry, figures are said to be congruent if they have exactly the same size and shape. Find other pairs or triples of congruent two-pentomino figures. It is possible to use all 12 pentominoes at once in making 3 such pairs. Note that all pairs shown on pages 5 through 11 consist of symmetric designs. Many more congruent pairs are possible if you do not require symmetry.

Creatures and Pairs: The solution to each of these puzzles is unique.

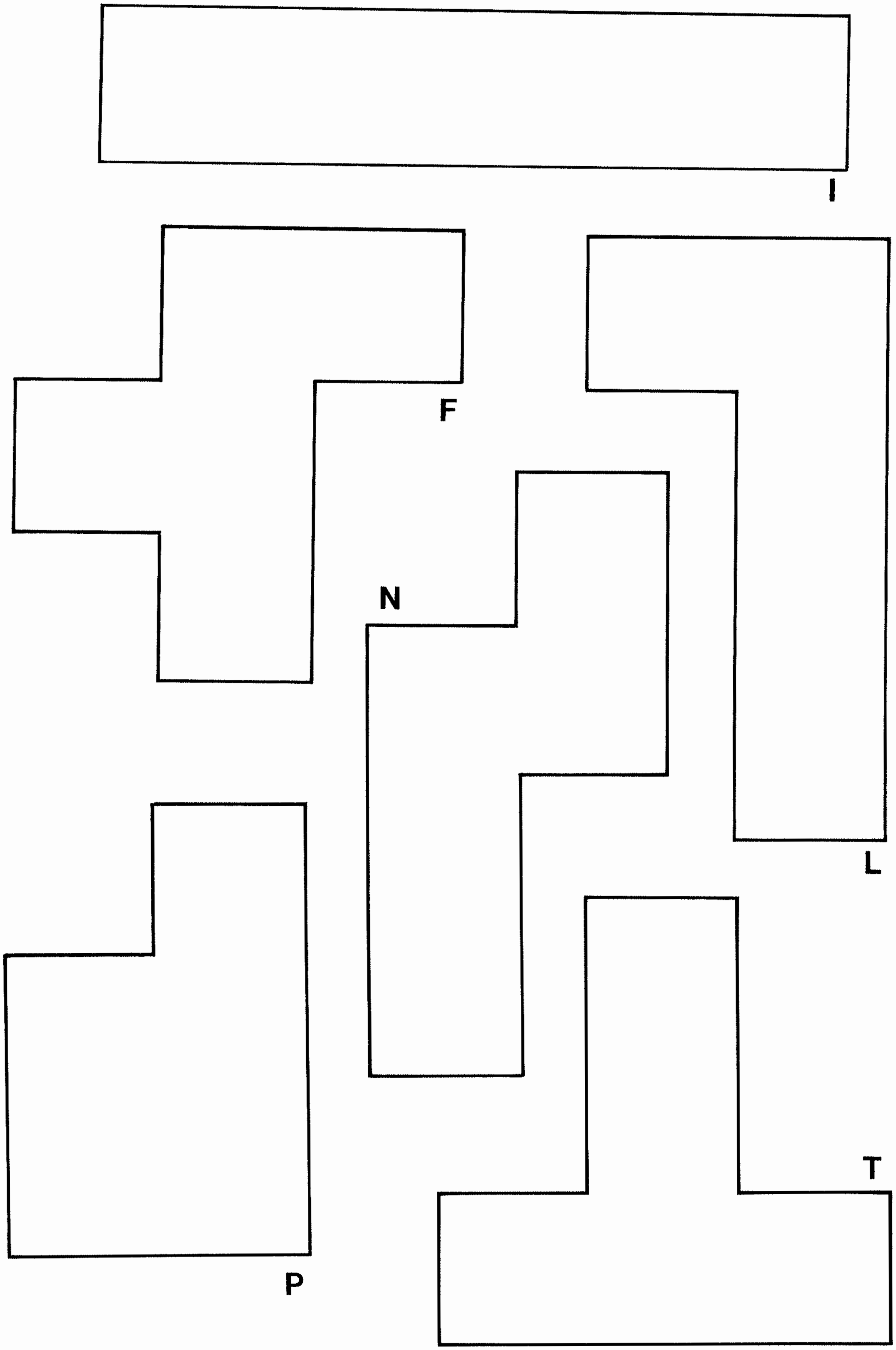
Stairs and Rectangles: Try to make pentomino rectangles or staircases that are larger than those shown in these sets. Make them in combination with smaller ones. Note that each rectangle on page 80 should have a 1 by 1 hole in it when the puzzle is solved.

Blow-Ups: In geometry, figures that have the same shape, but not necessarily the same size, are called similar.

Pages 82 and 83 show pentominoes and replicas with double the dimensions. How many pentominoes are needed to cover the double version?

Pages 84 and 85 are examples of triplication. How many pentominoes can be doubled? All can be tripled.

Pages 86, 87, and 88 show the doubling of two-pentomino figures. Can you solve them and use the remaining pentominoes to make a duplicate of the original two-pentomino figure? (This is called double duplication.)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F
N
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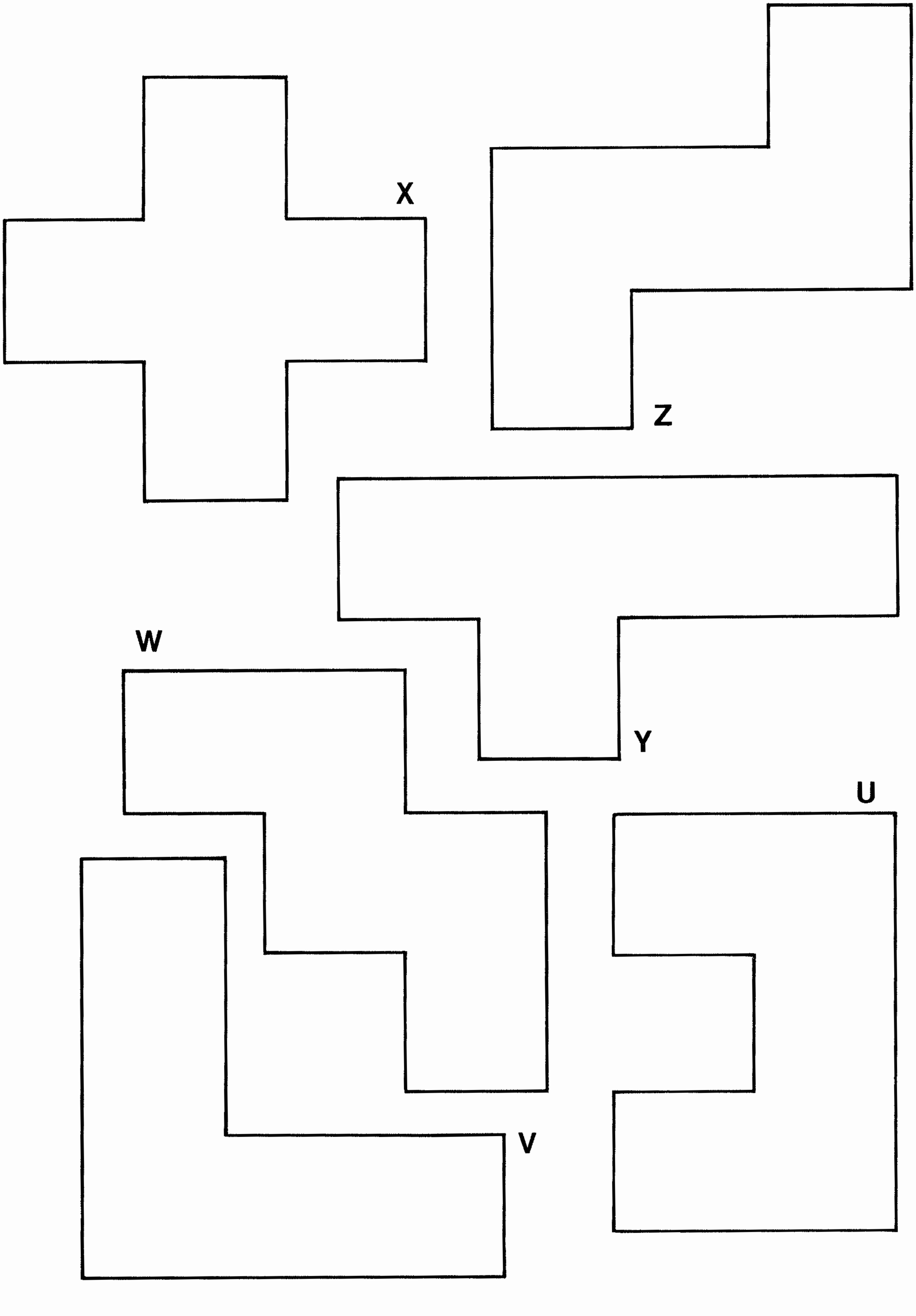

X
Z
Y
W
U
V

NAME ______________________________

CHECKLIST FOR THE PENTOMINO ACTIVITIES

Use this to keep track of which activities you have completed.

WARM-UPS

5 6 7 8 9 10 11 12 13 14 15 16 17

CREATURES

18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

PAIRS

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

STAIRS

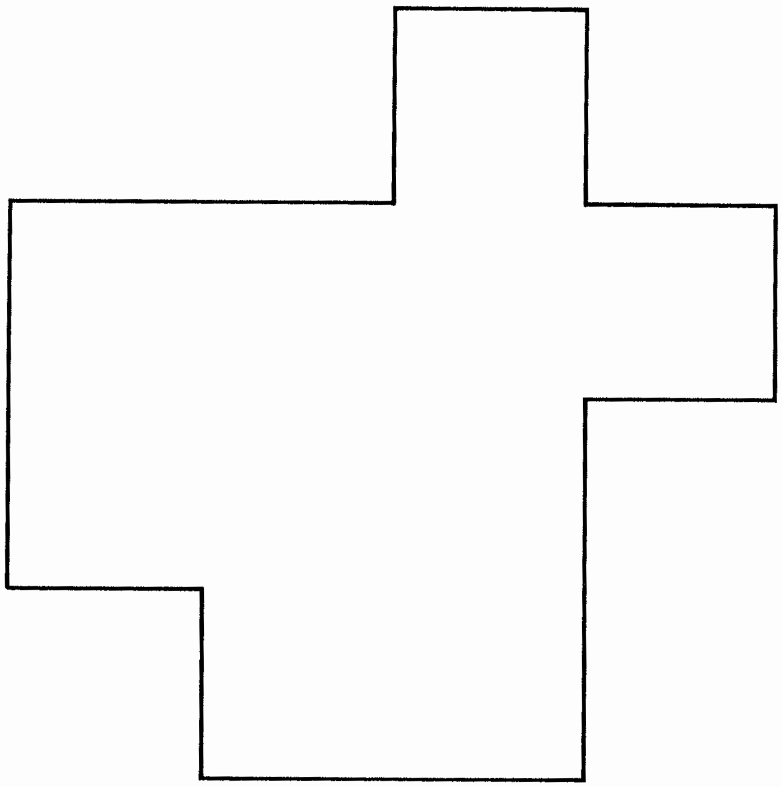
52 53 54 55 56 57 58 59 60 61 62 63 64 65

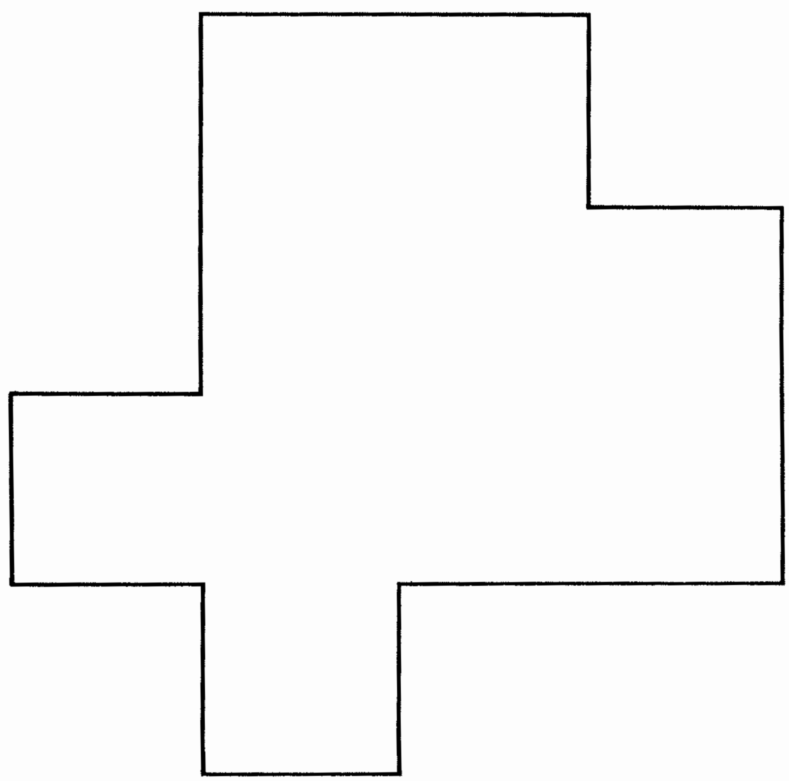
RECTANGLES

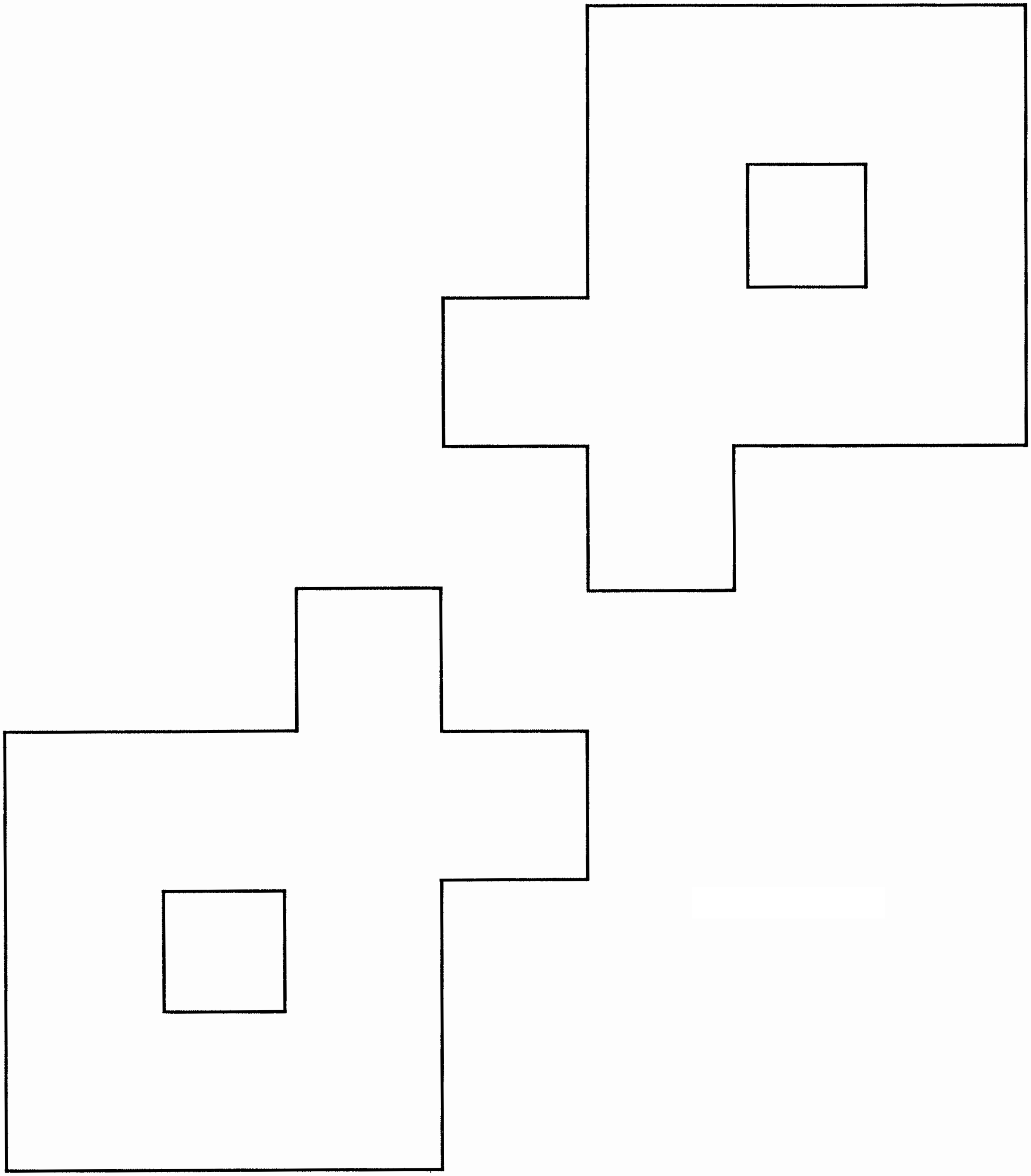
66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81

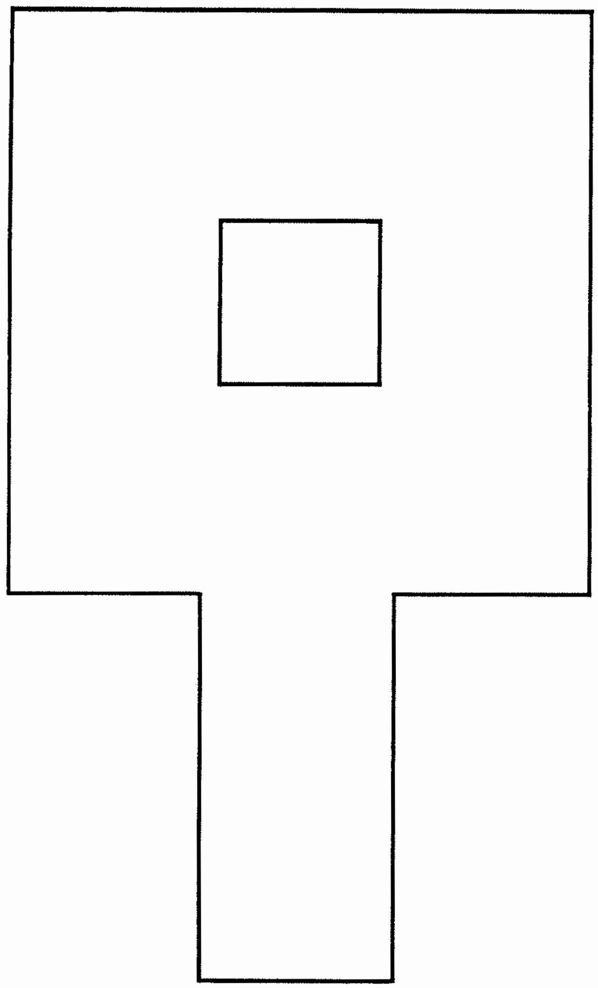
BLOW-UPS

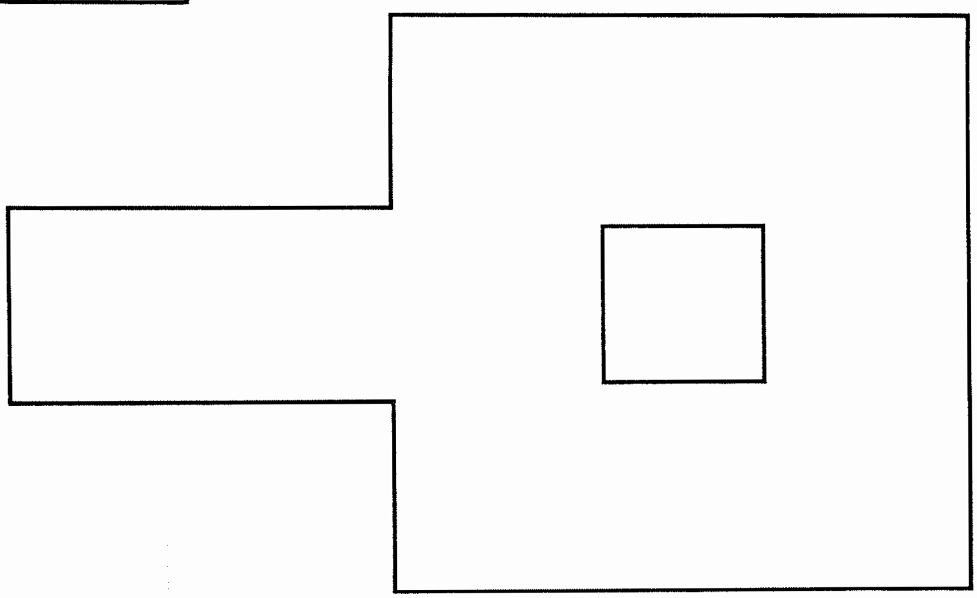
82 83 84 85 86 87 88

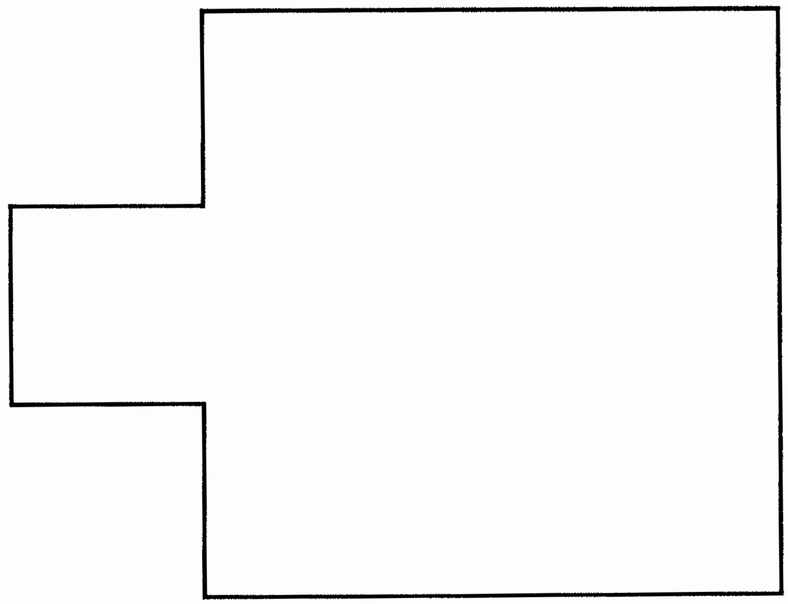


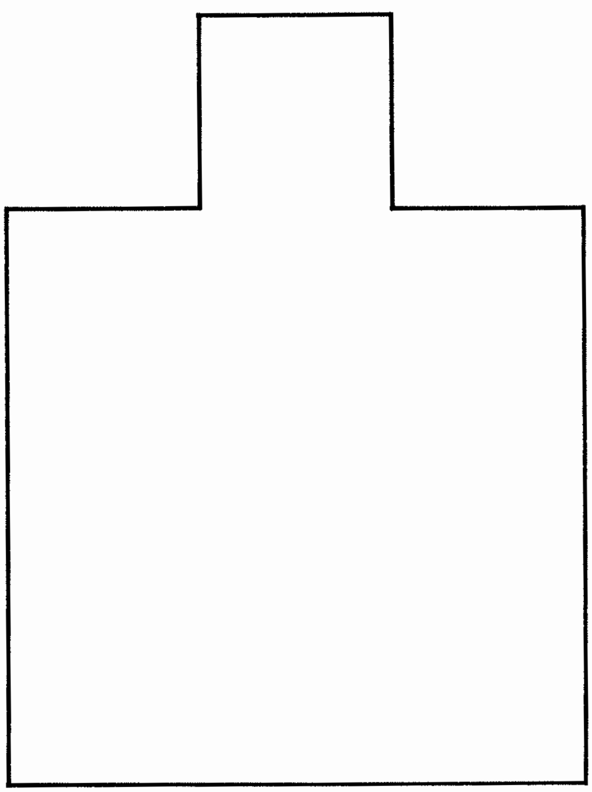


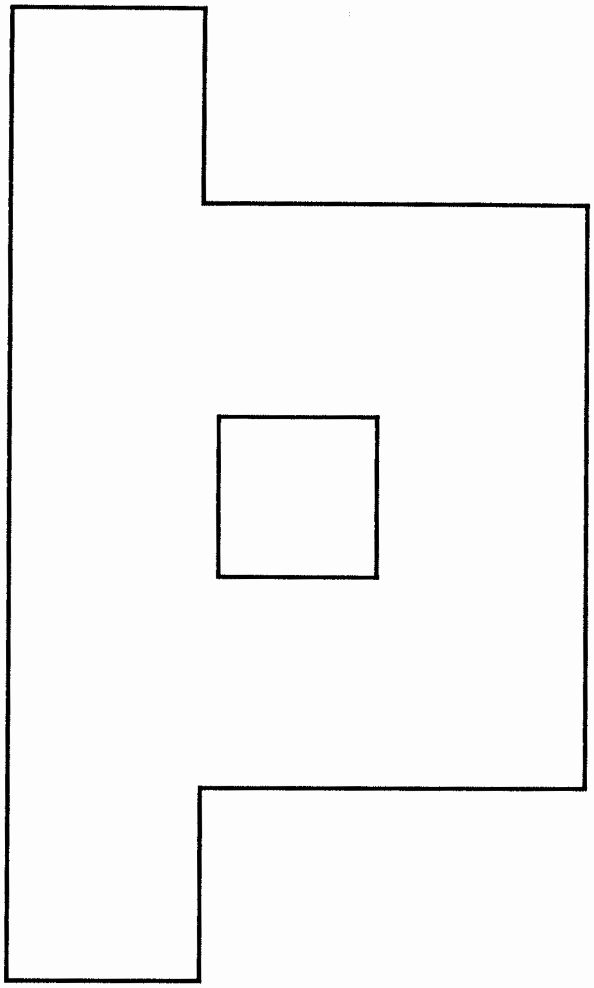


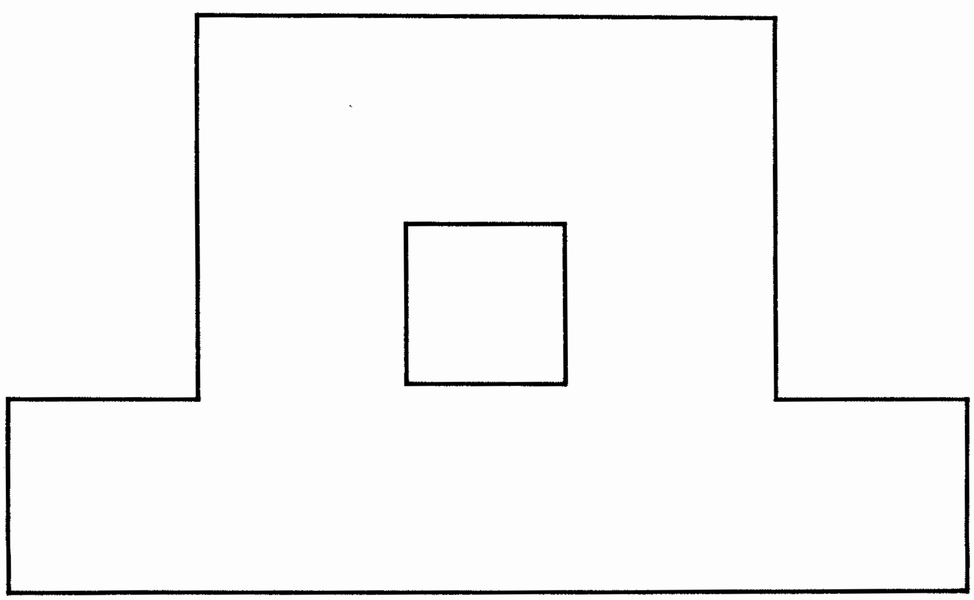


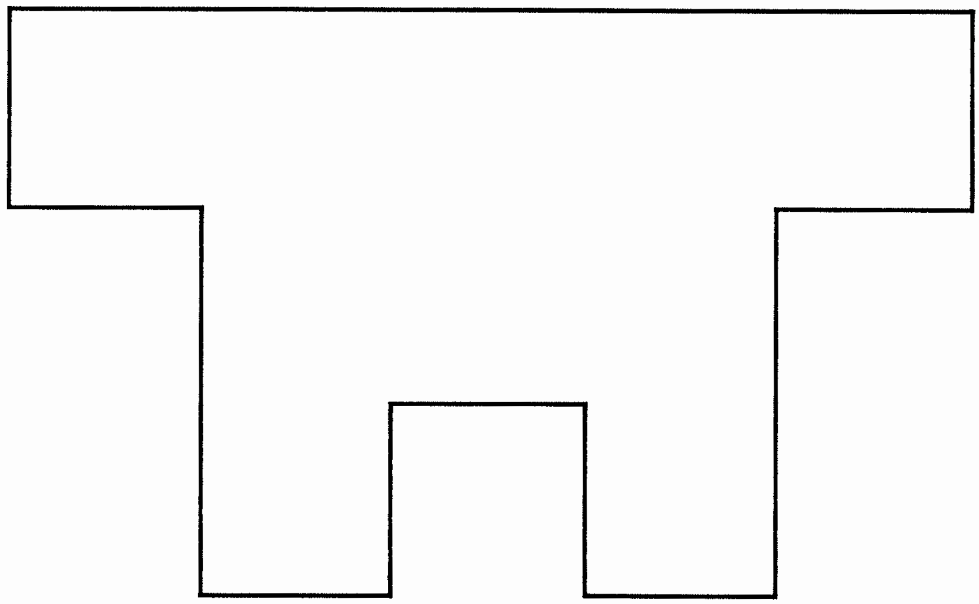


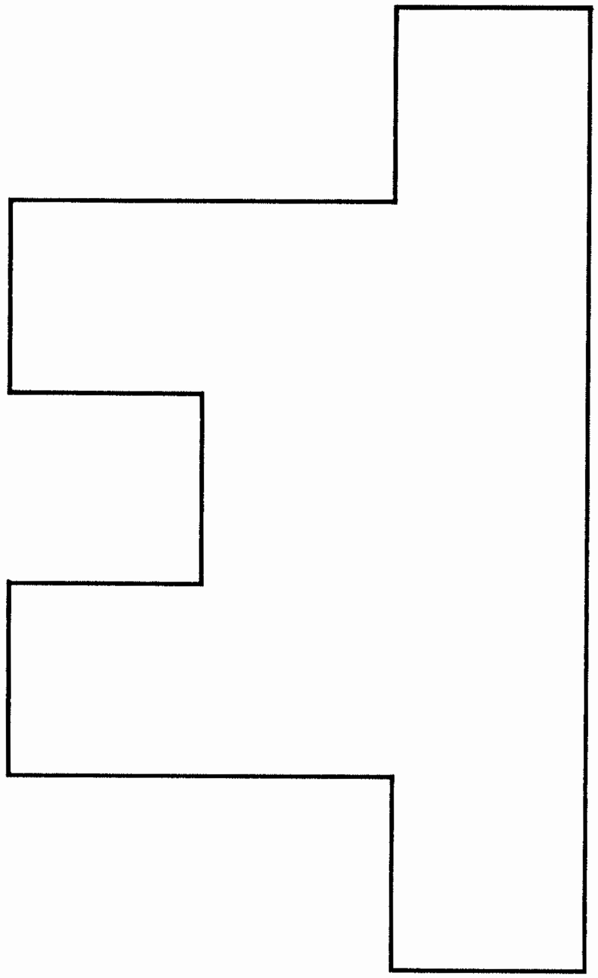


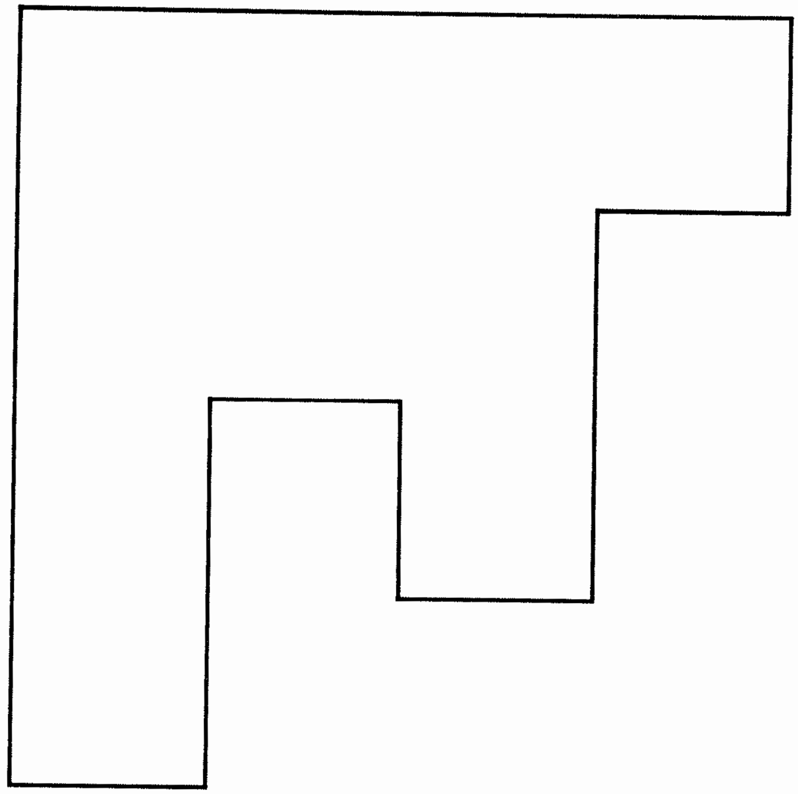


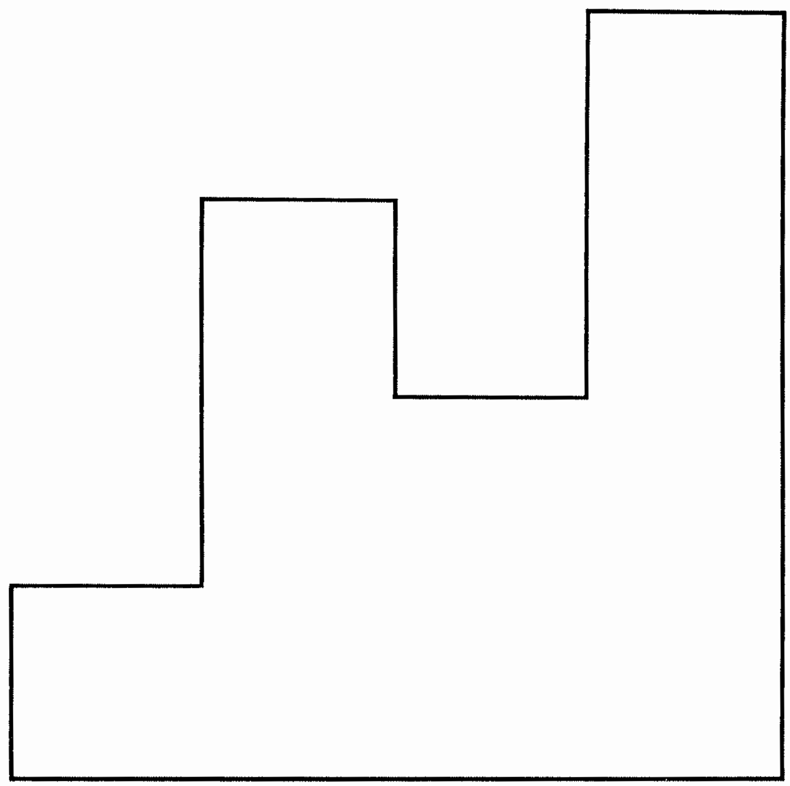


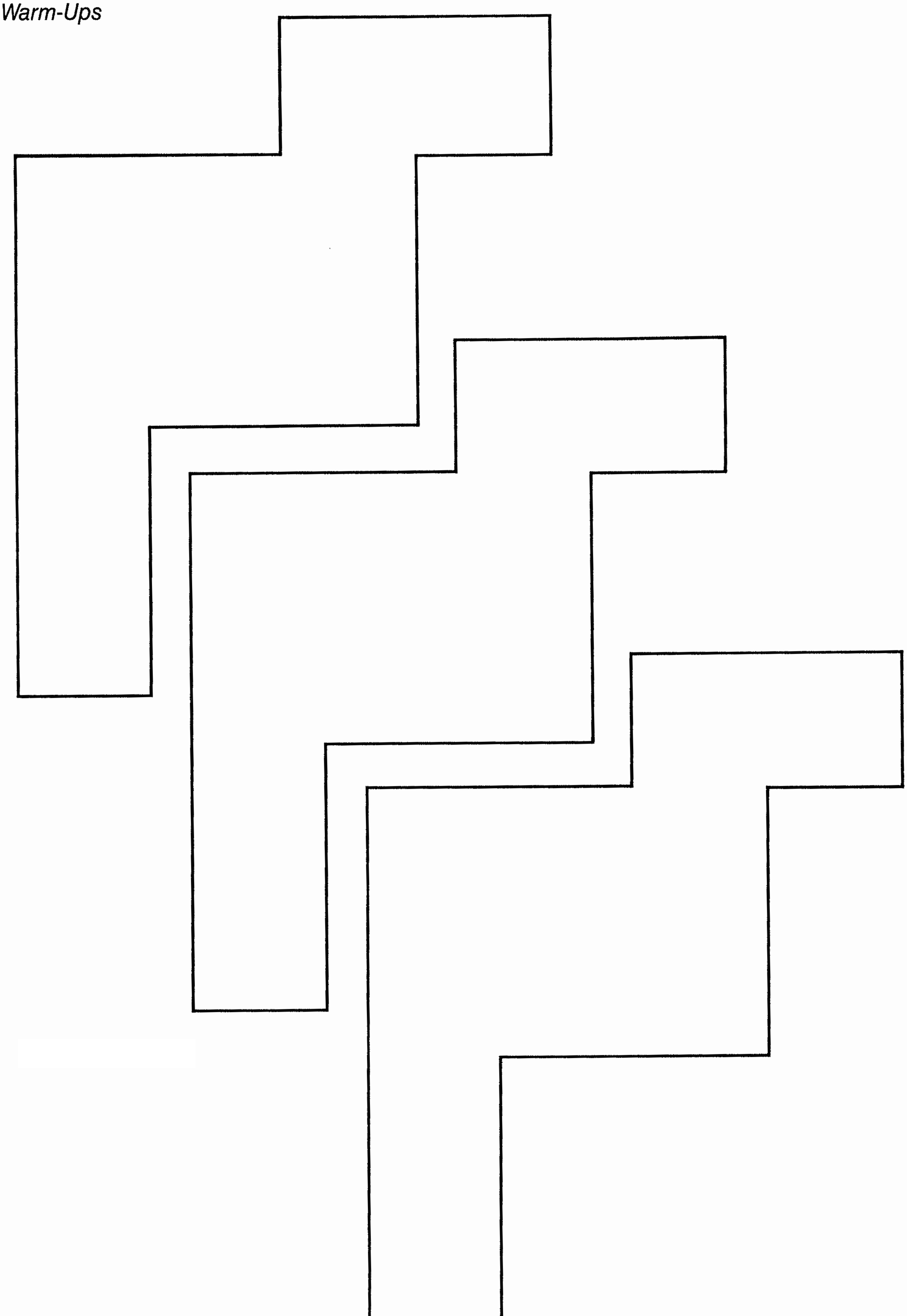


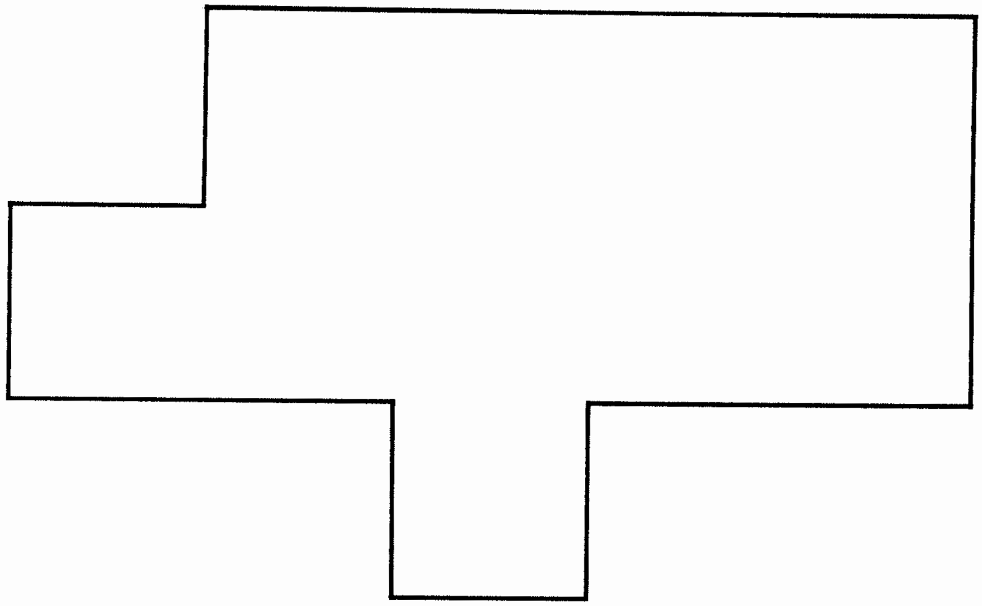


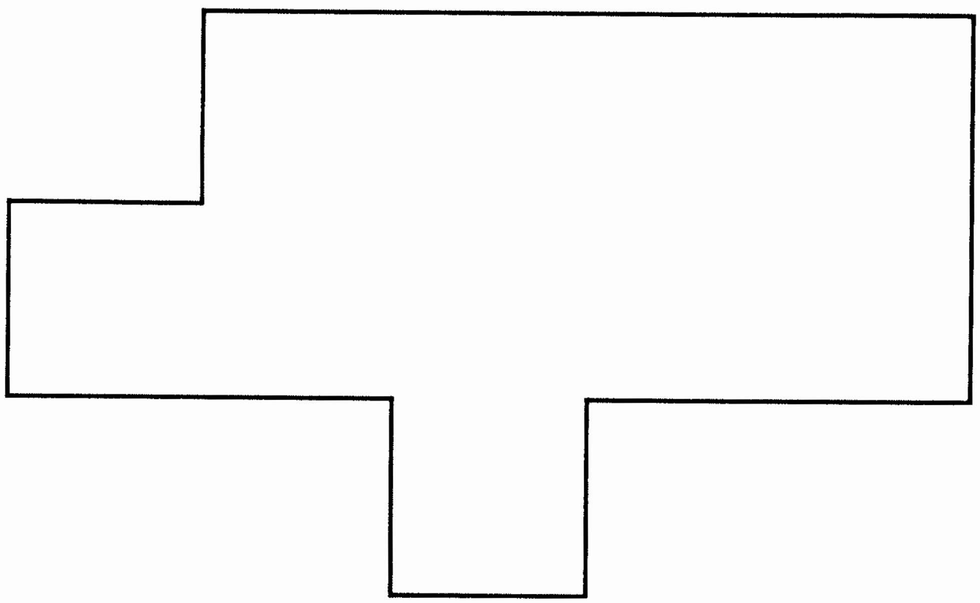


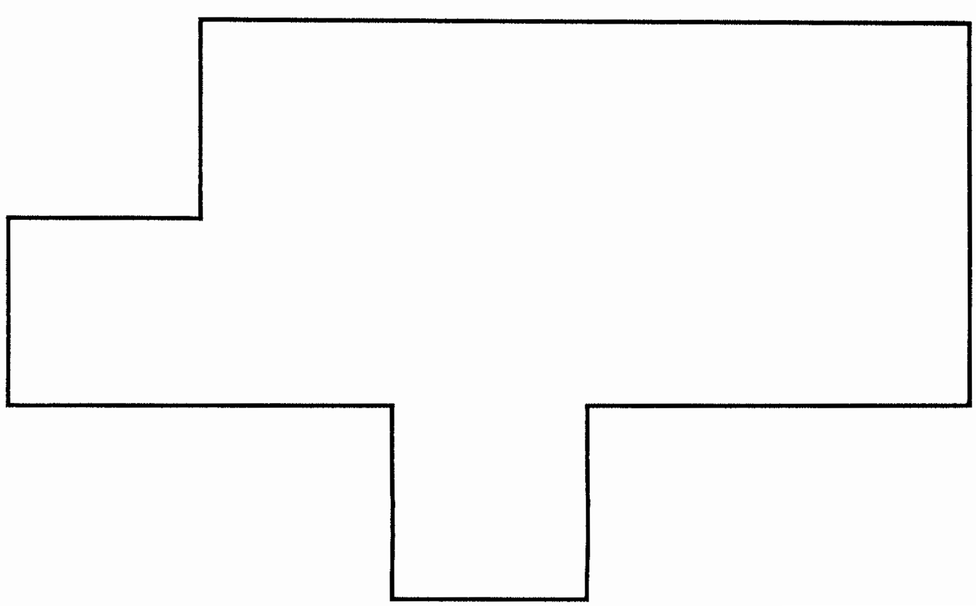


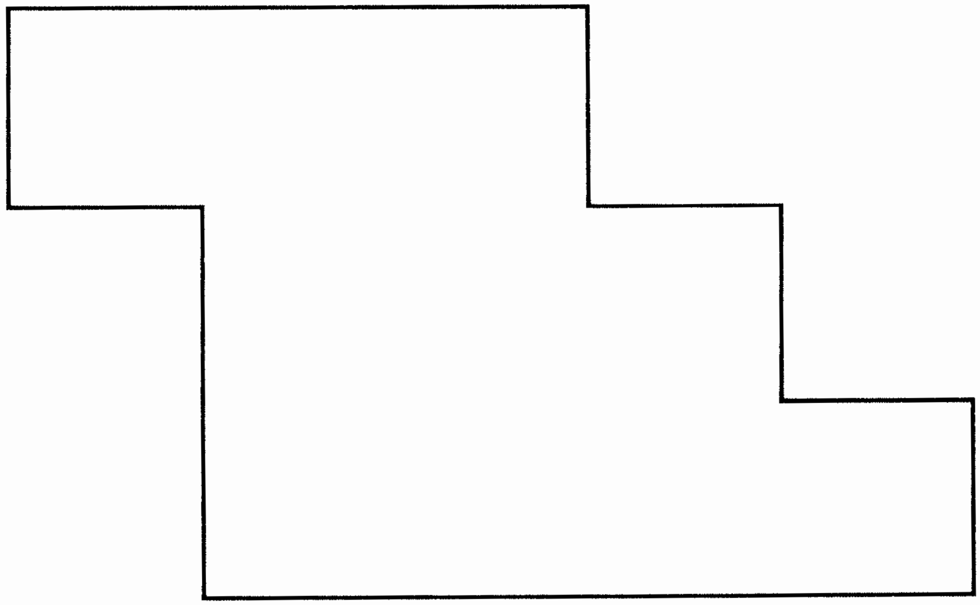


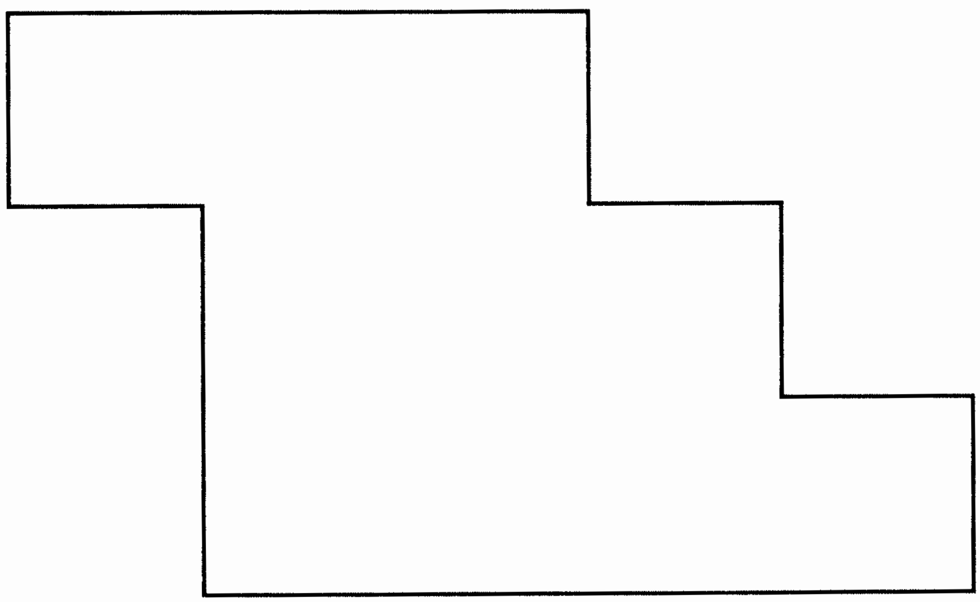


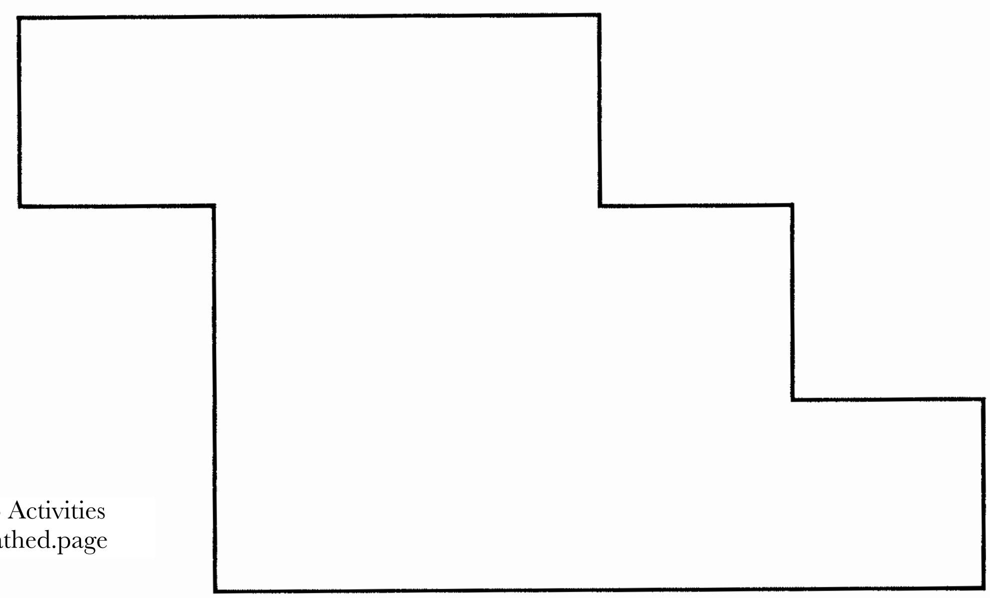


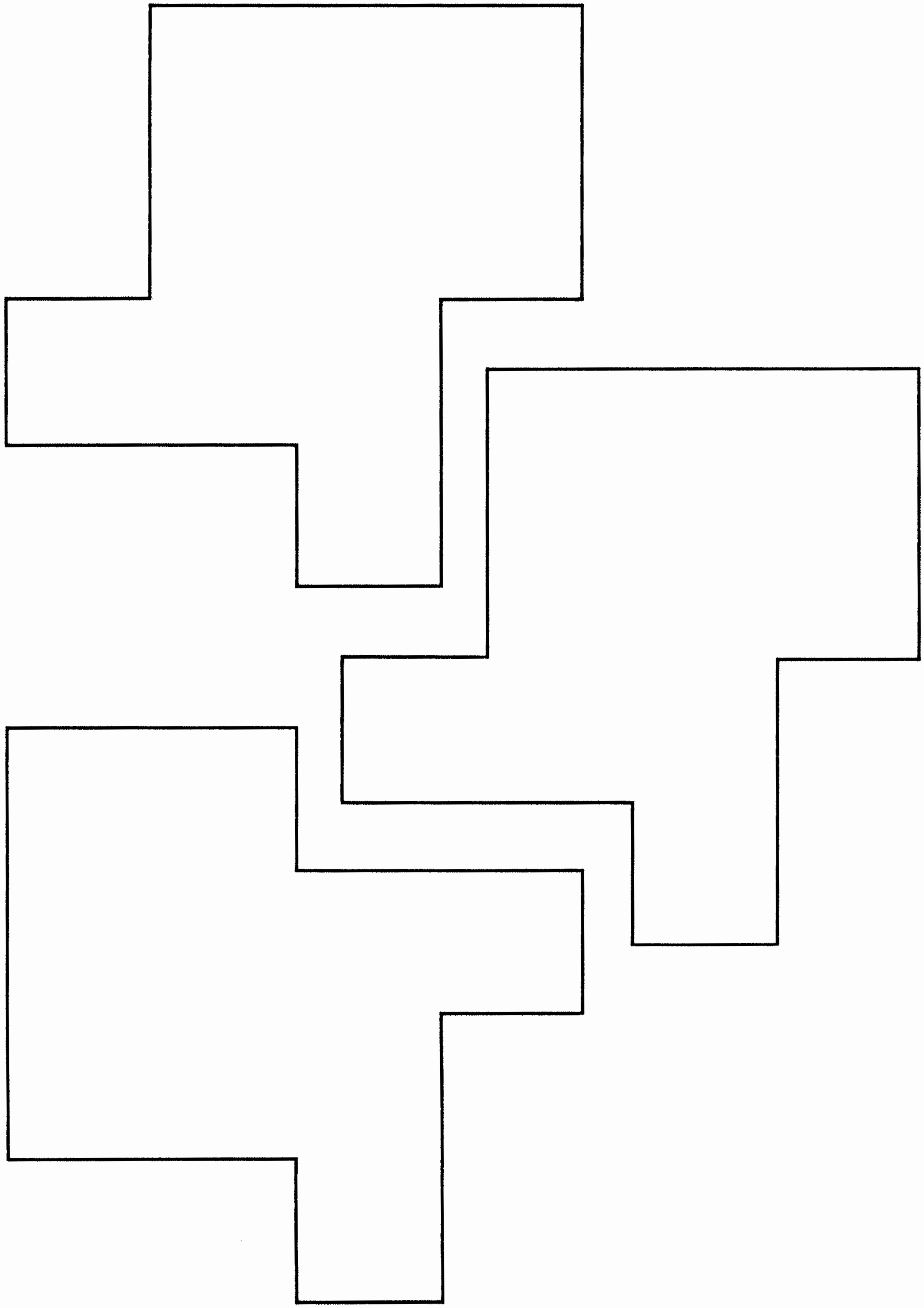


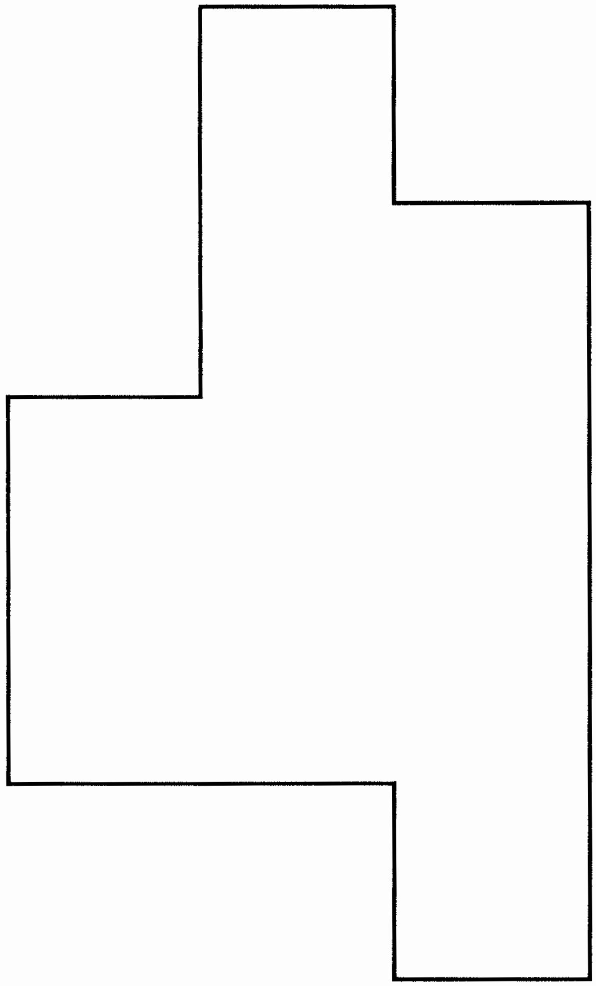


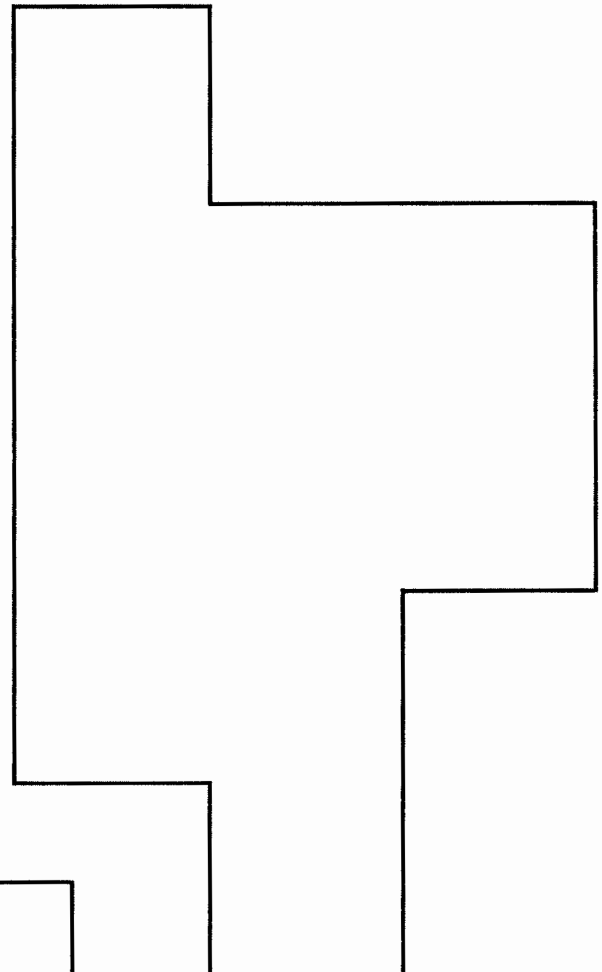


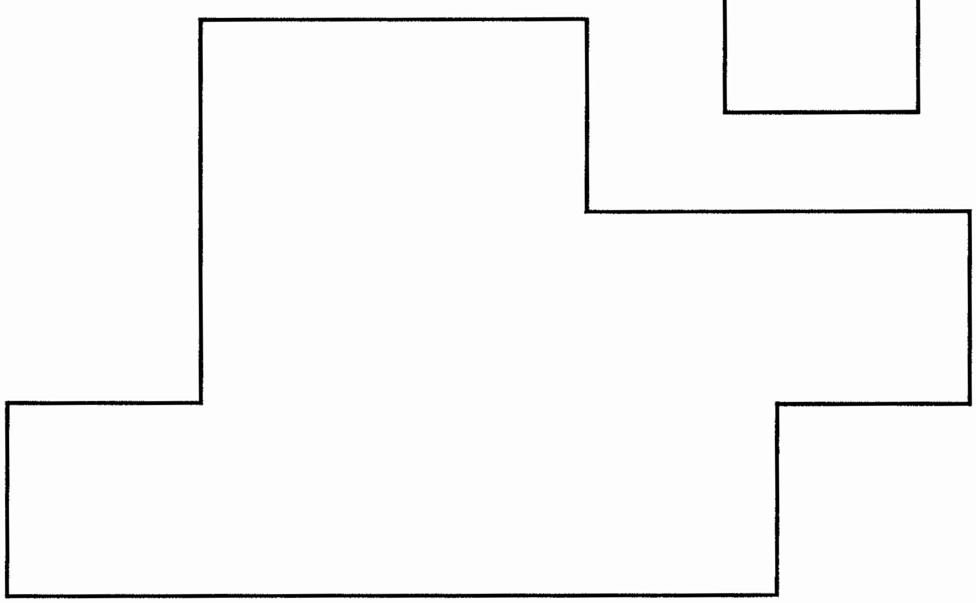


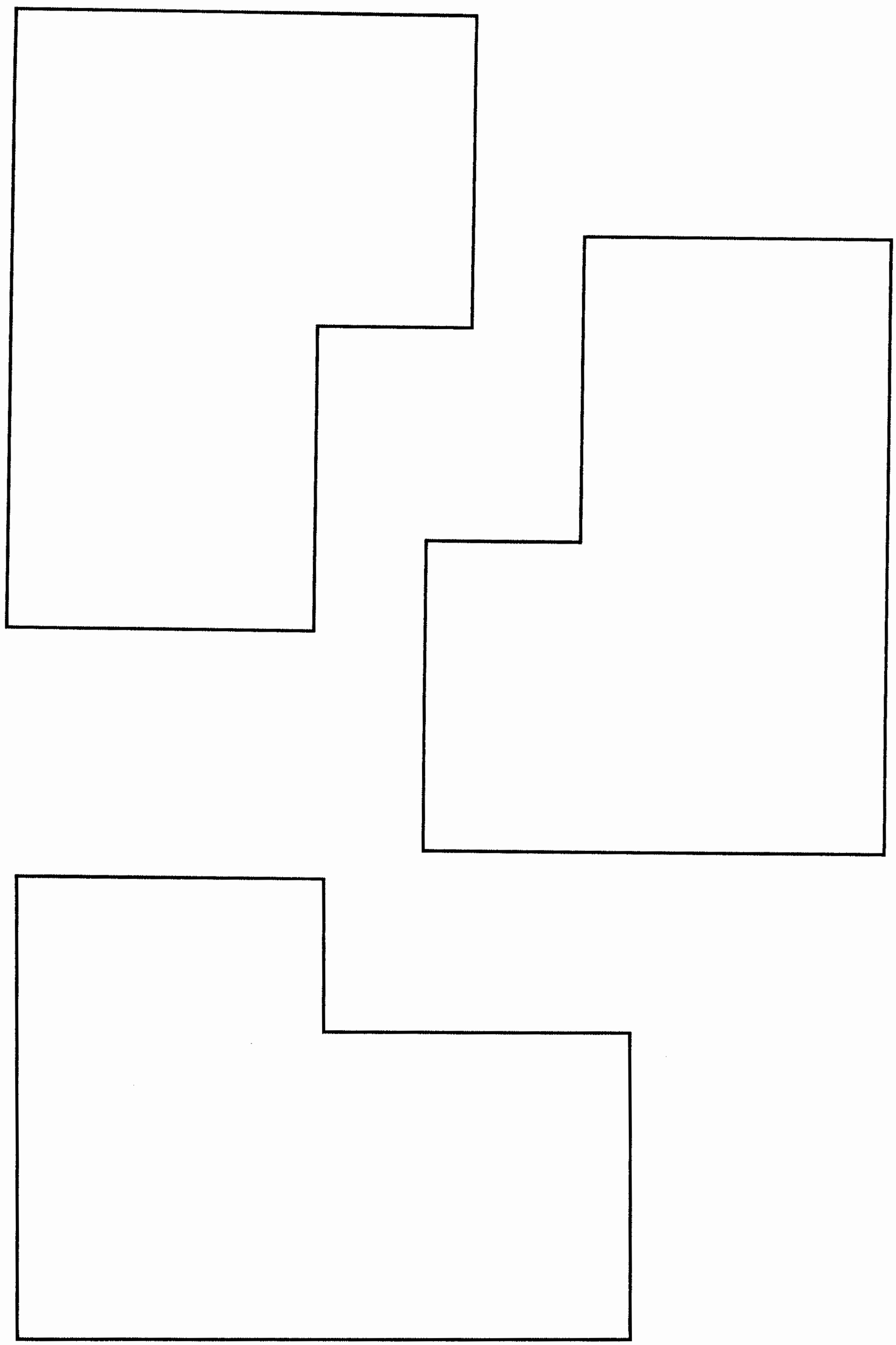


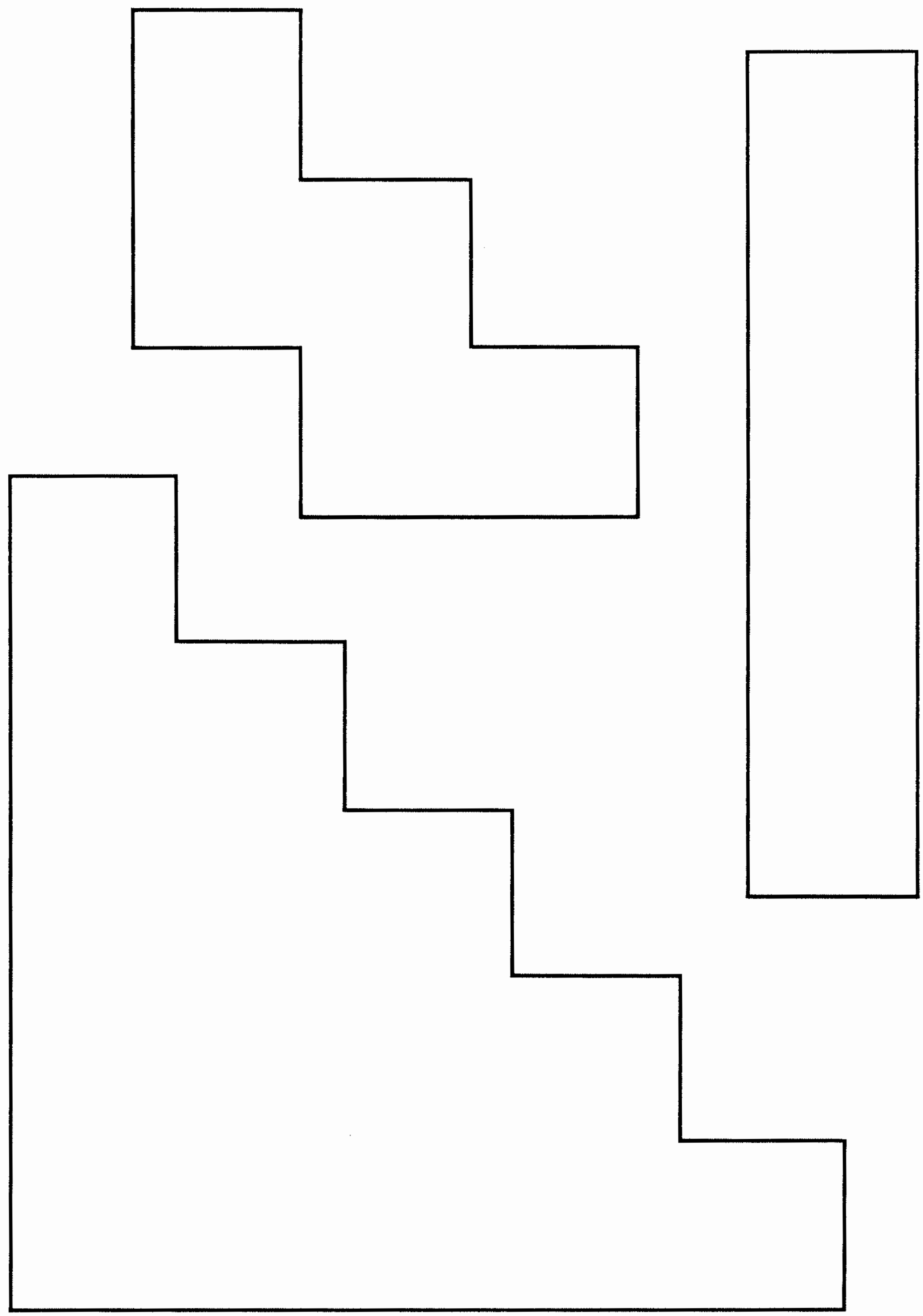


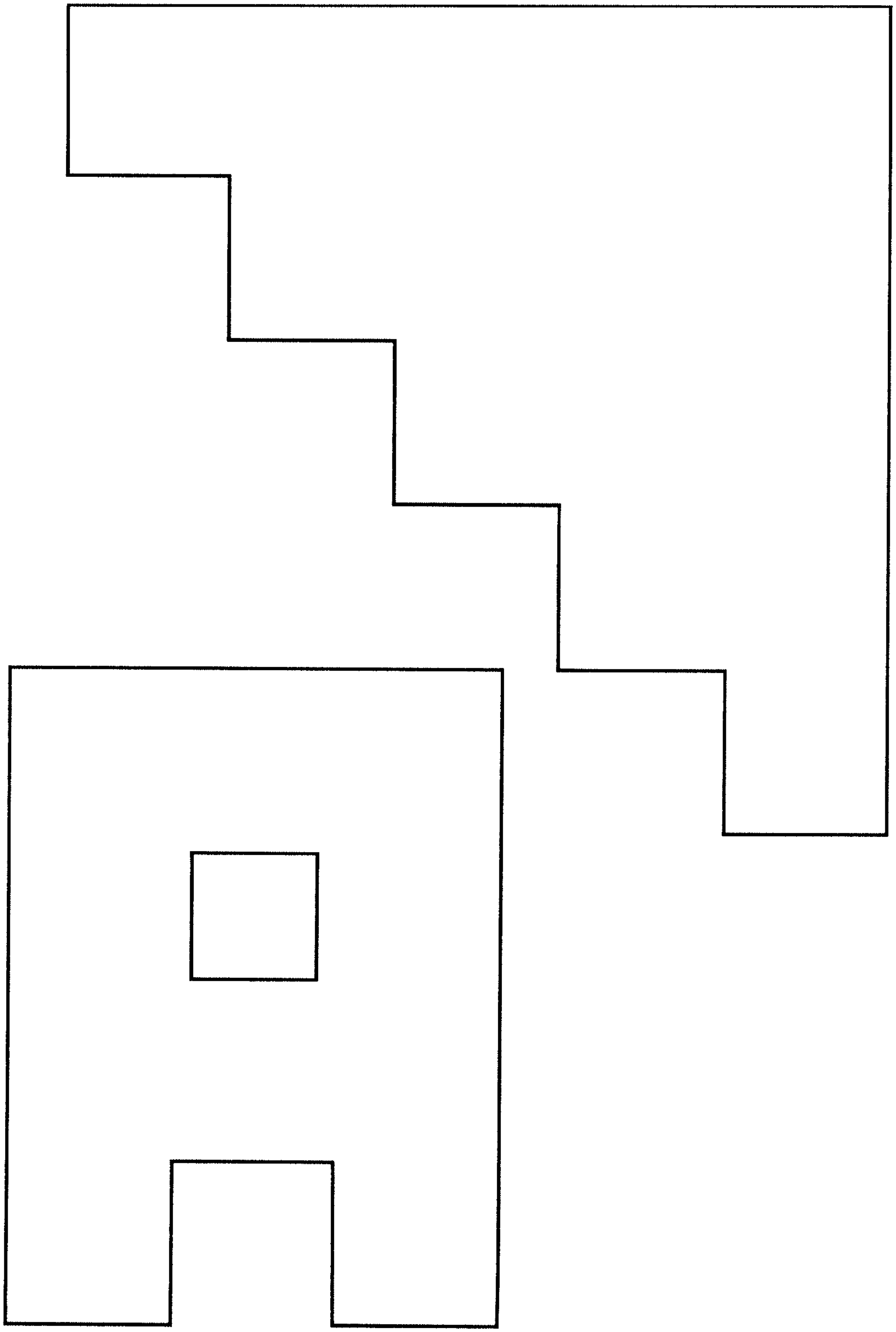


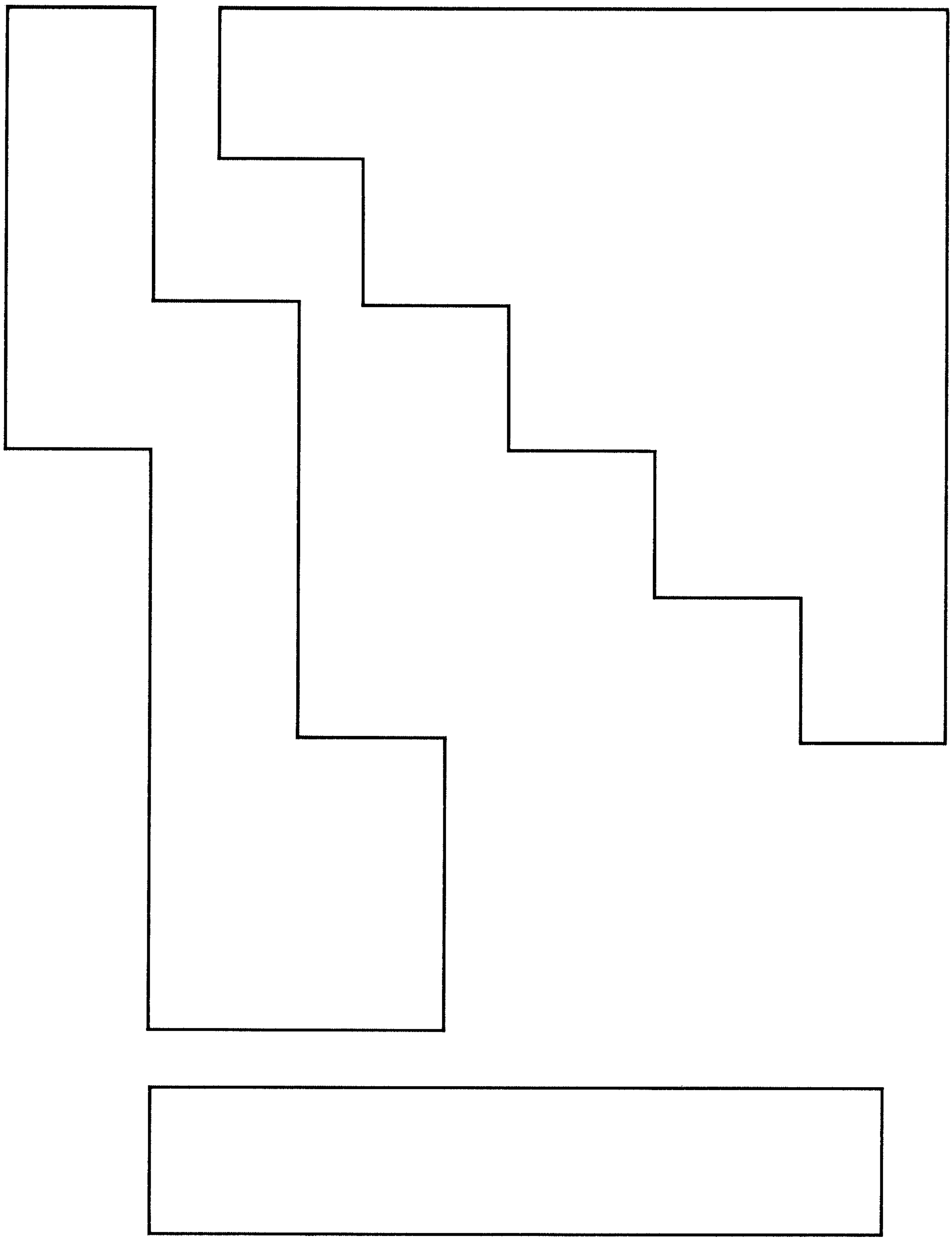


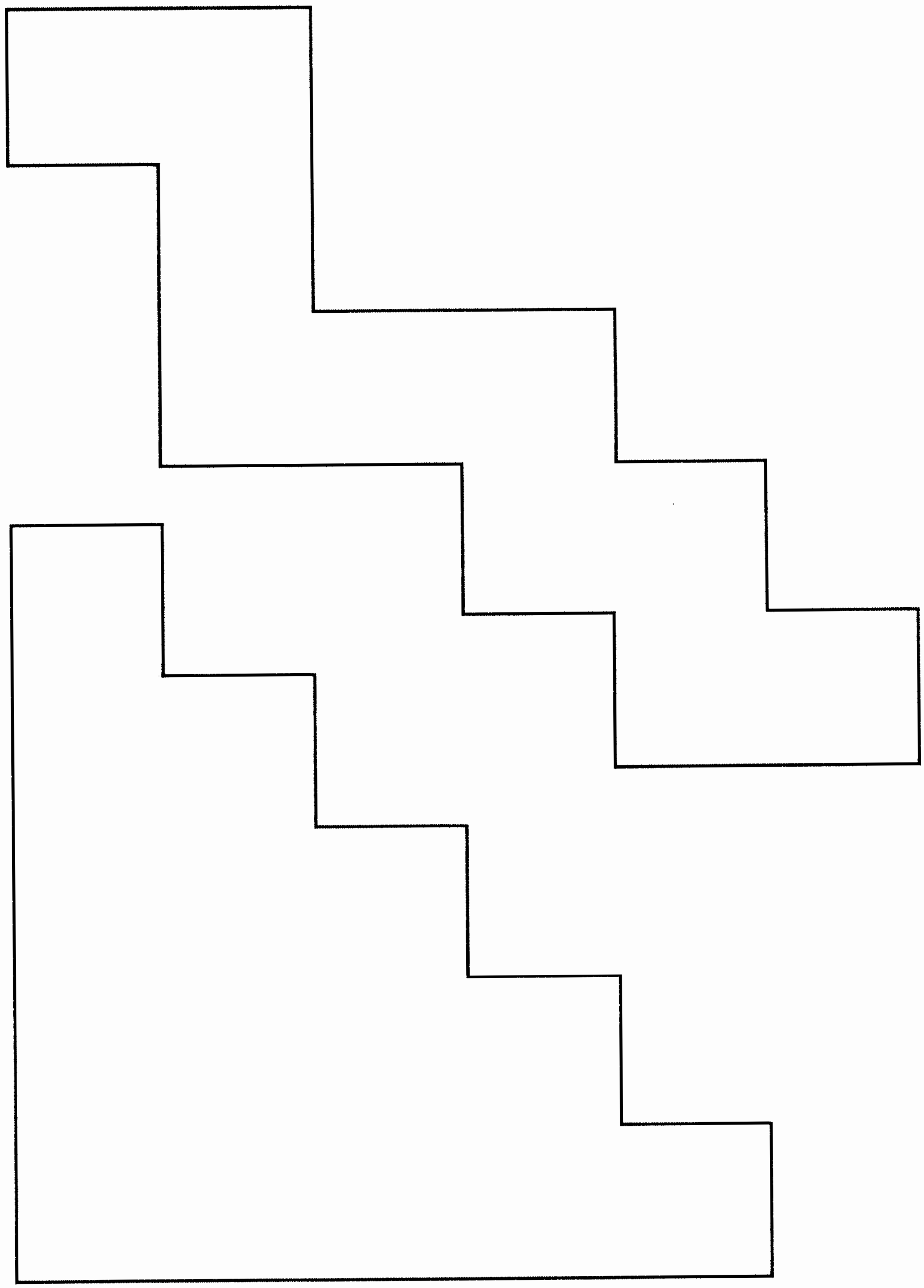


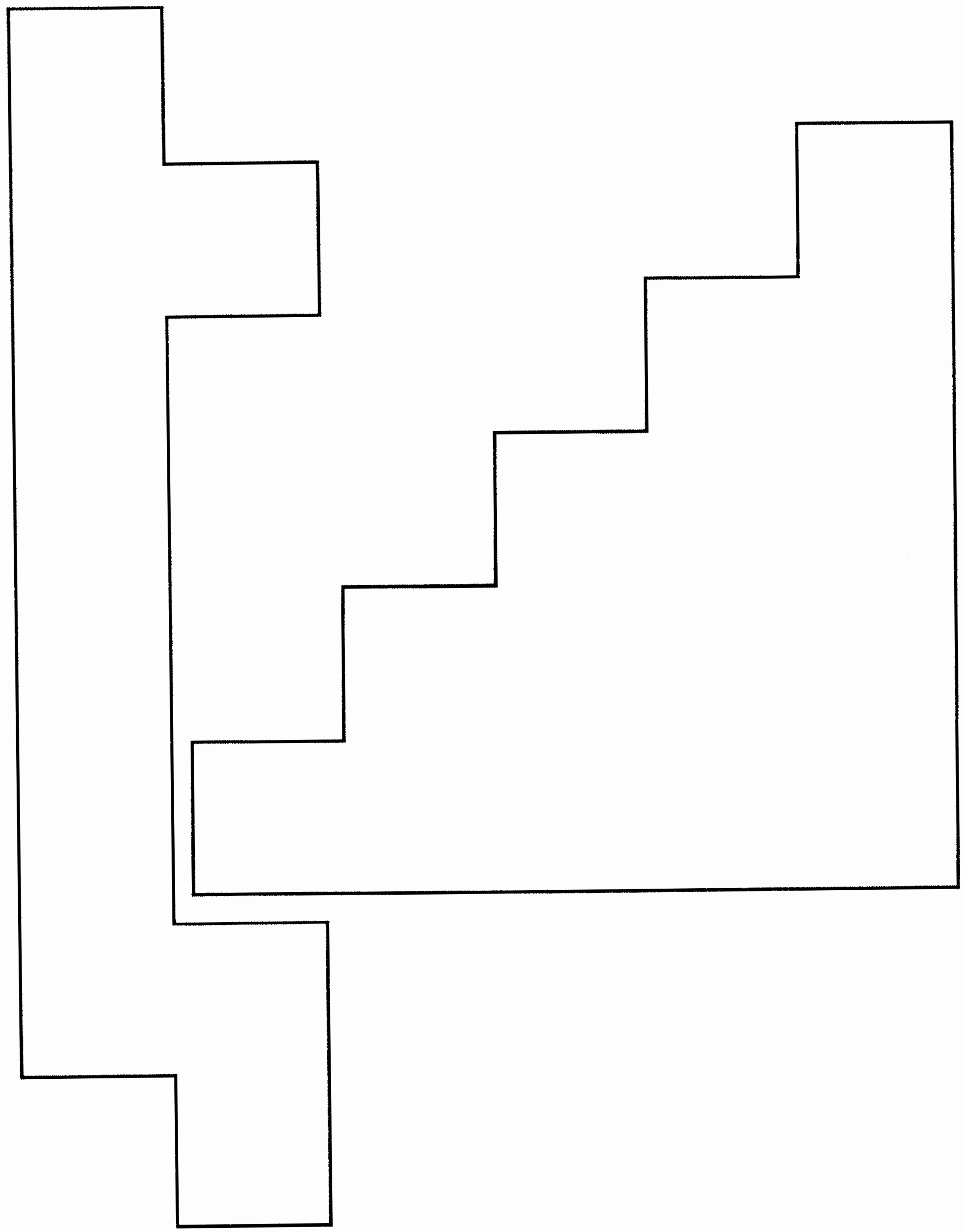


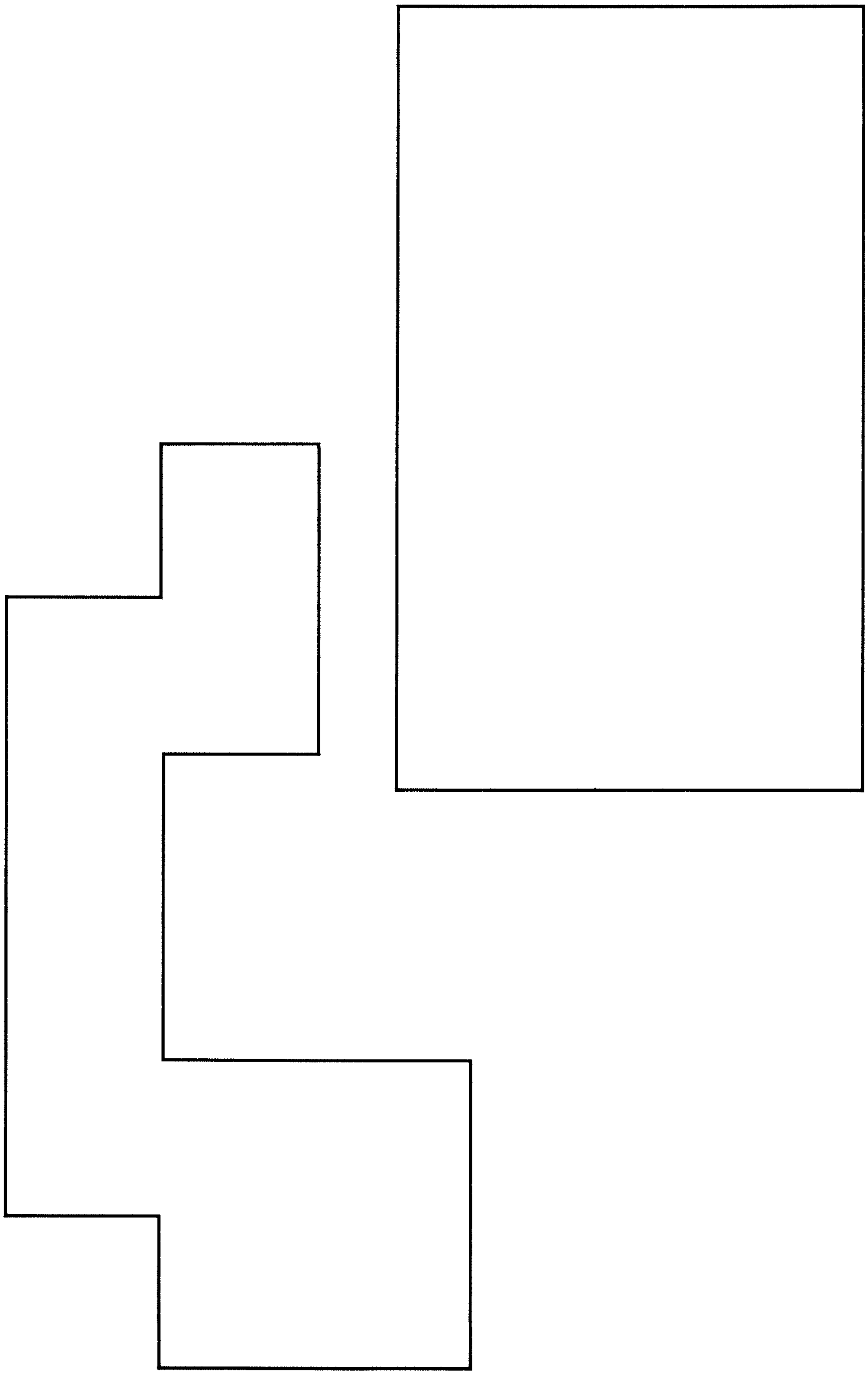


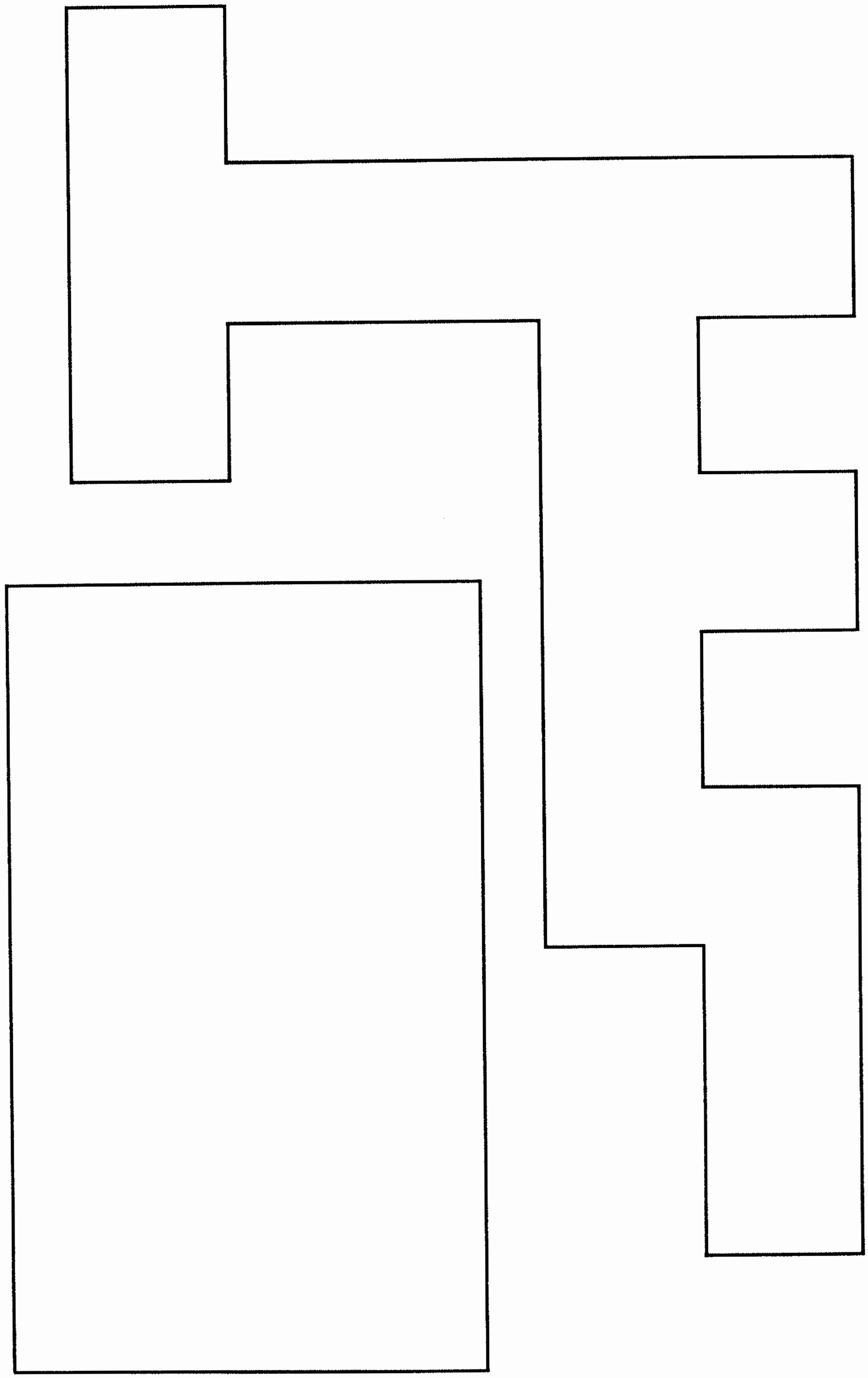


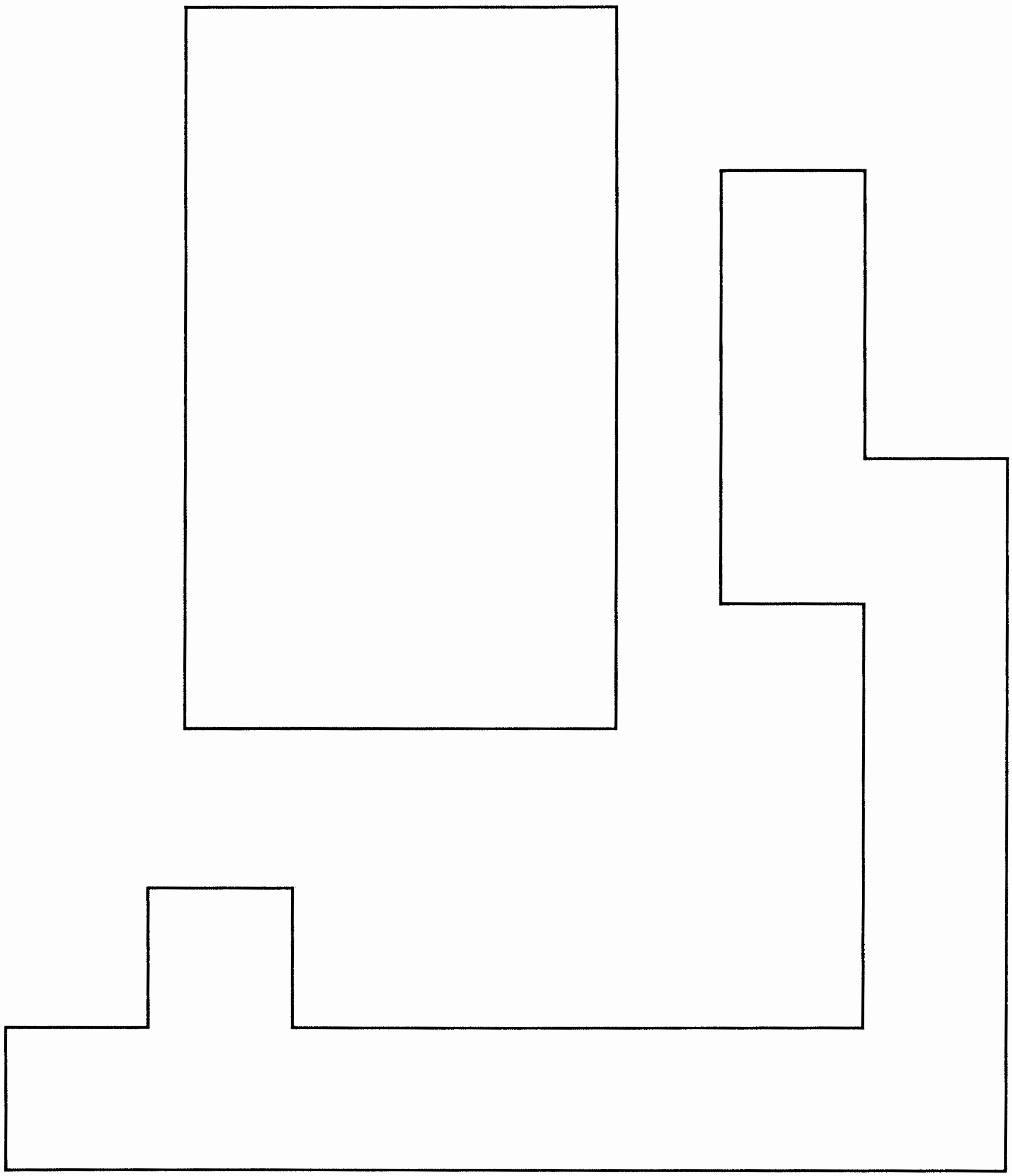


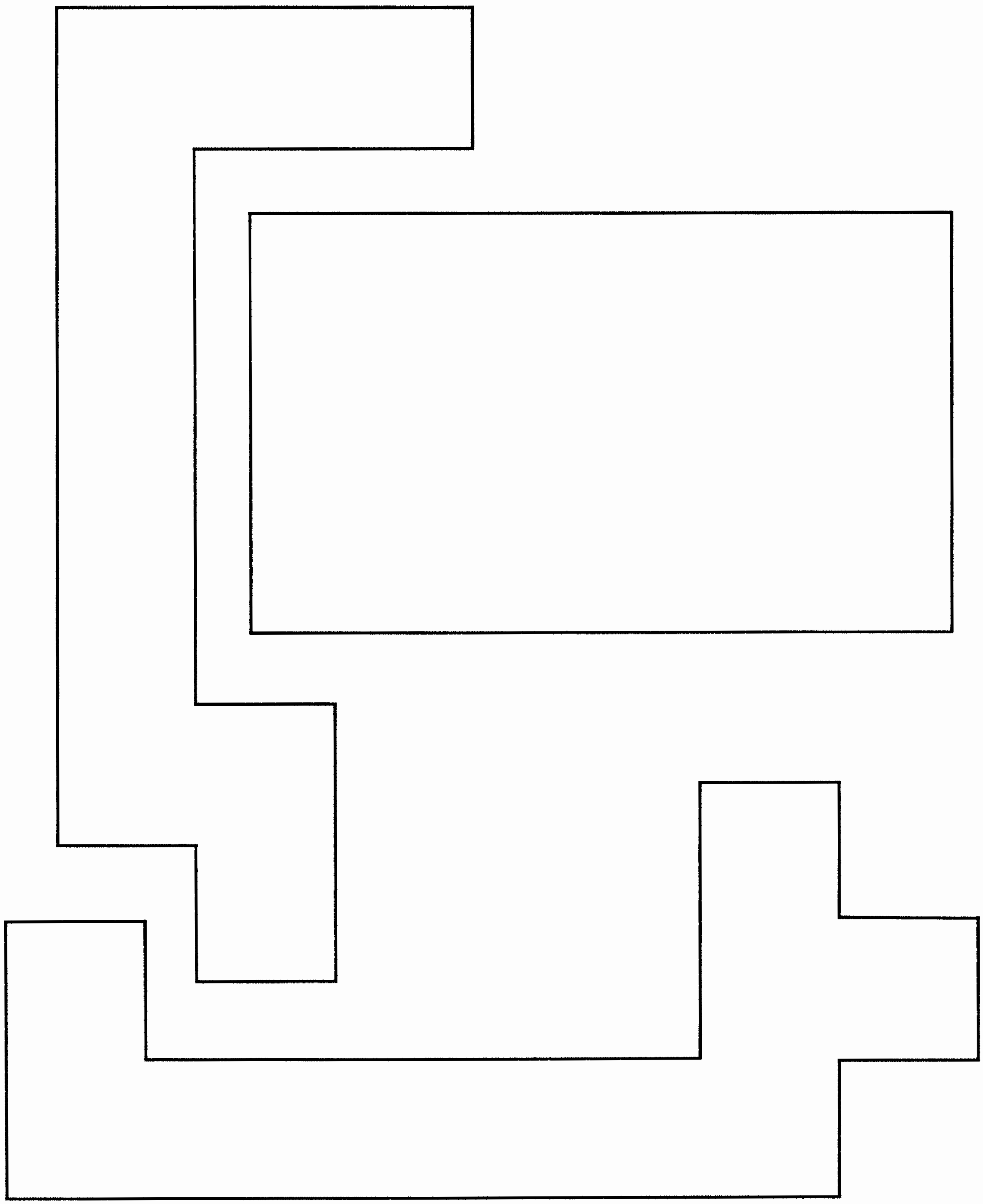


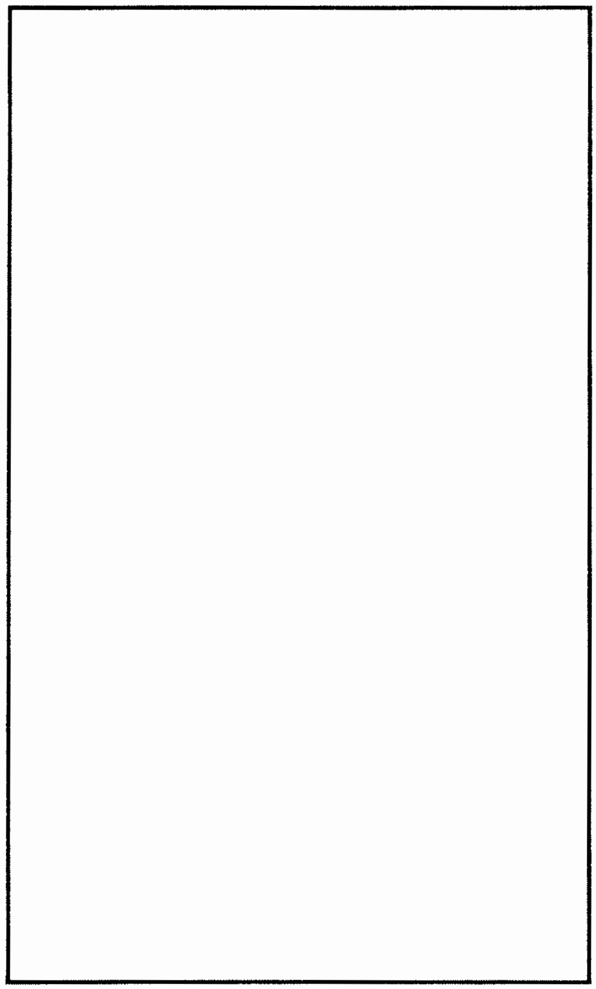


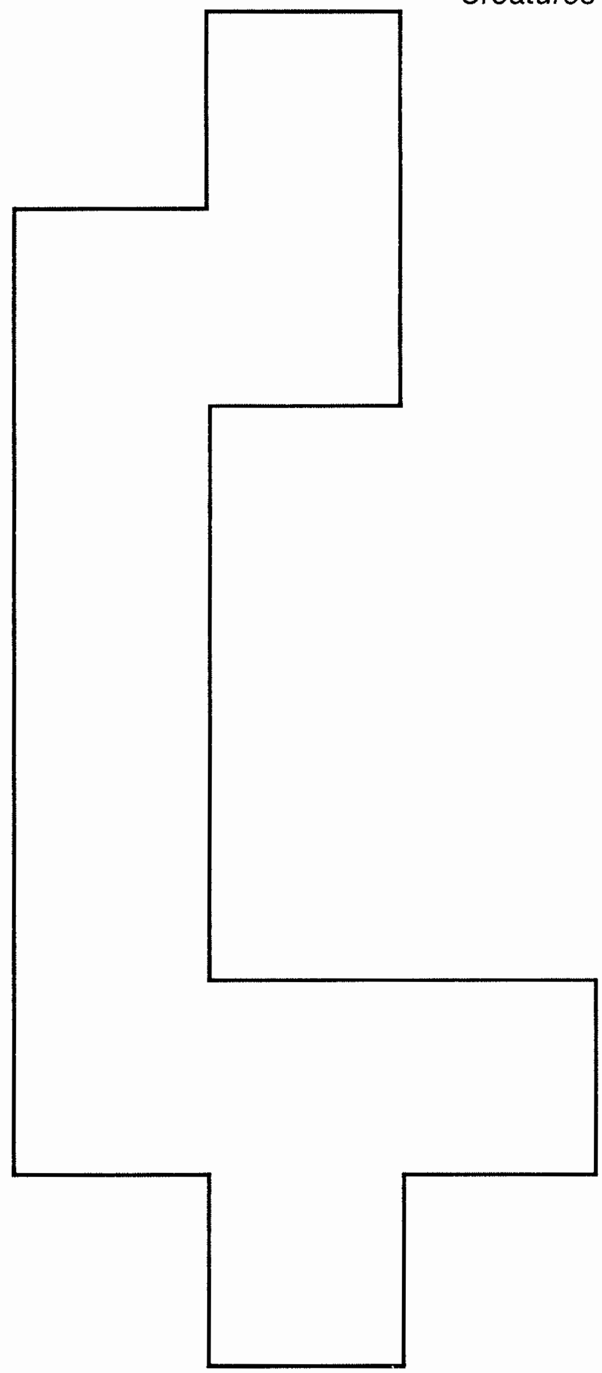


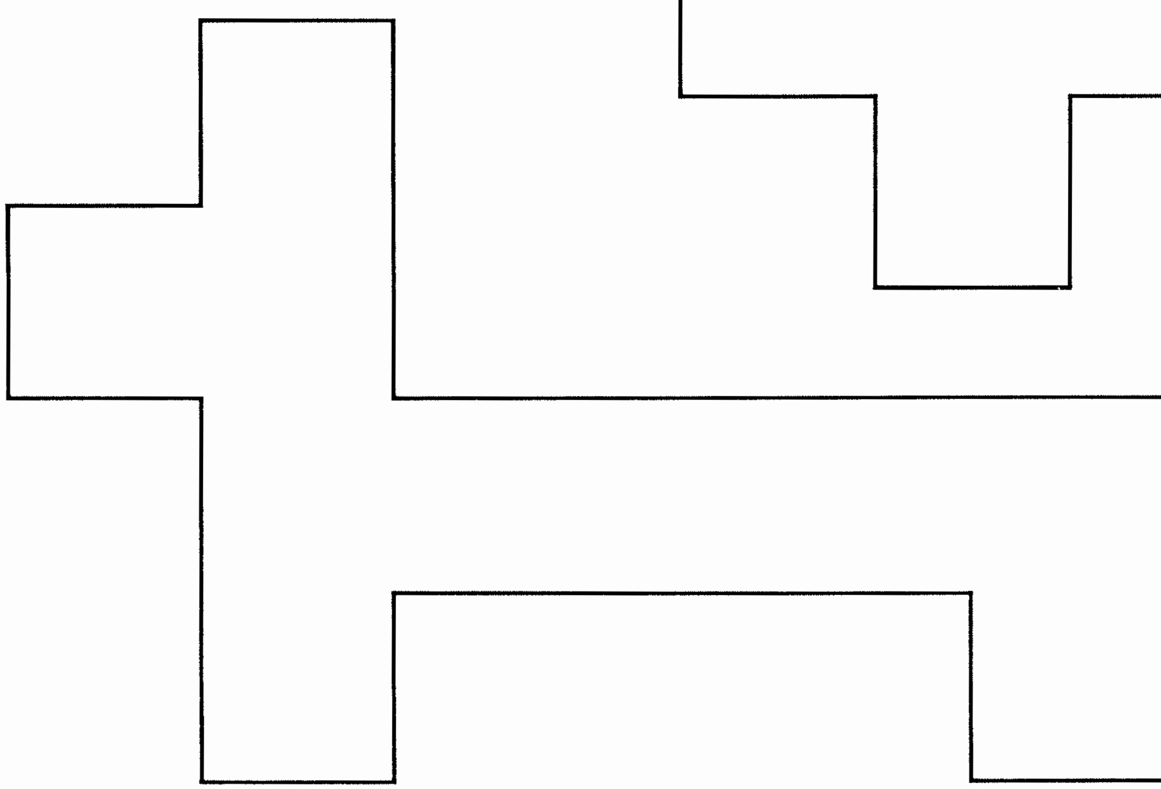


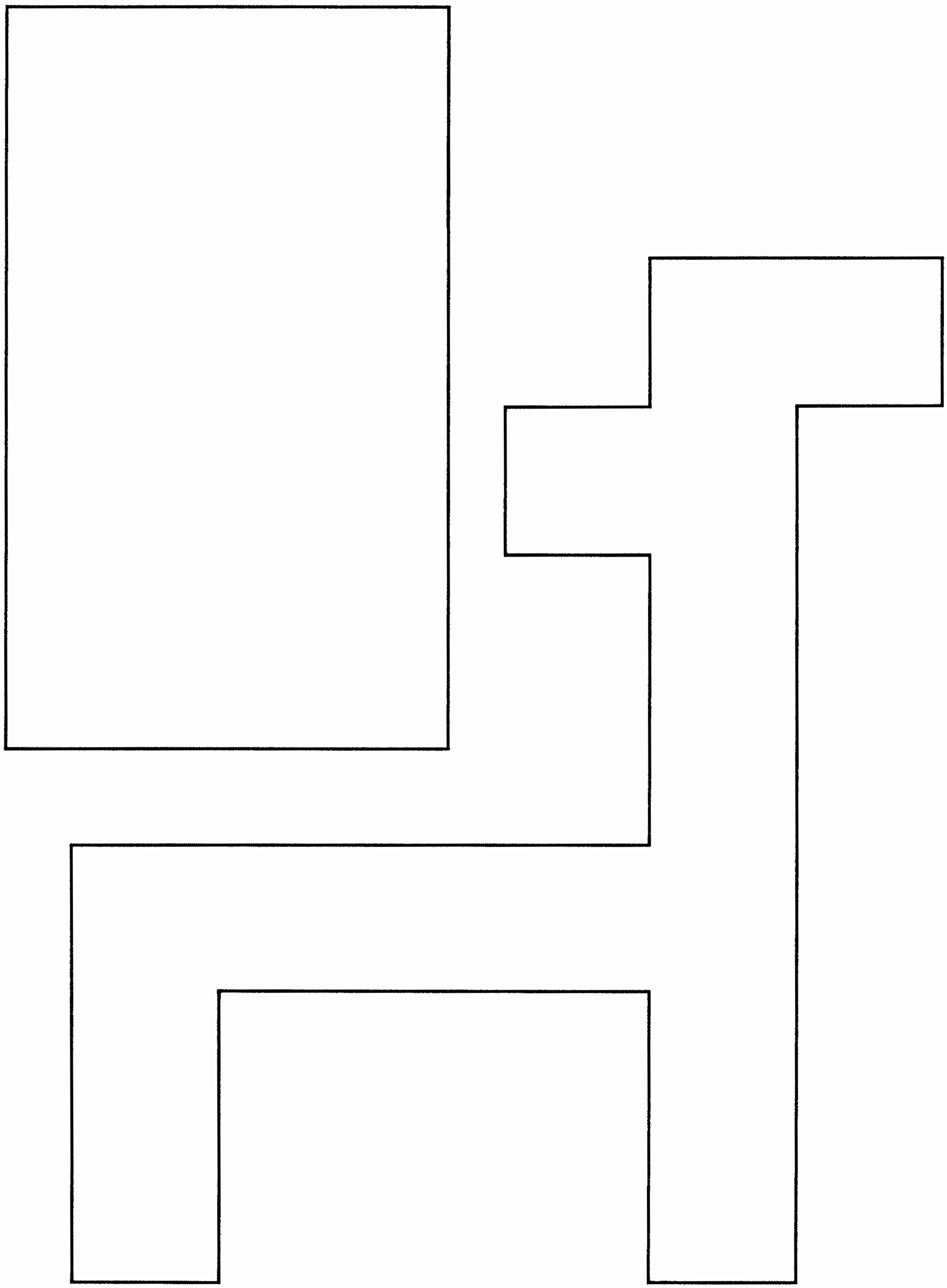


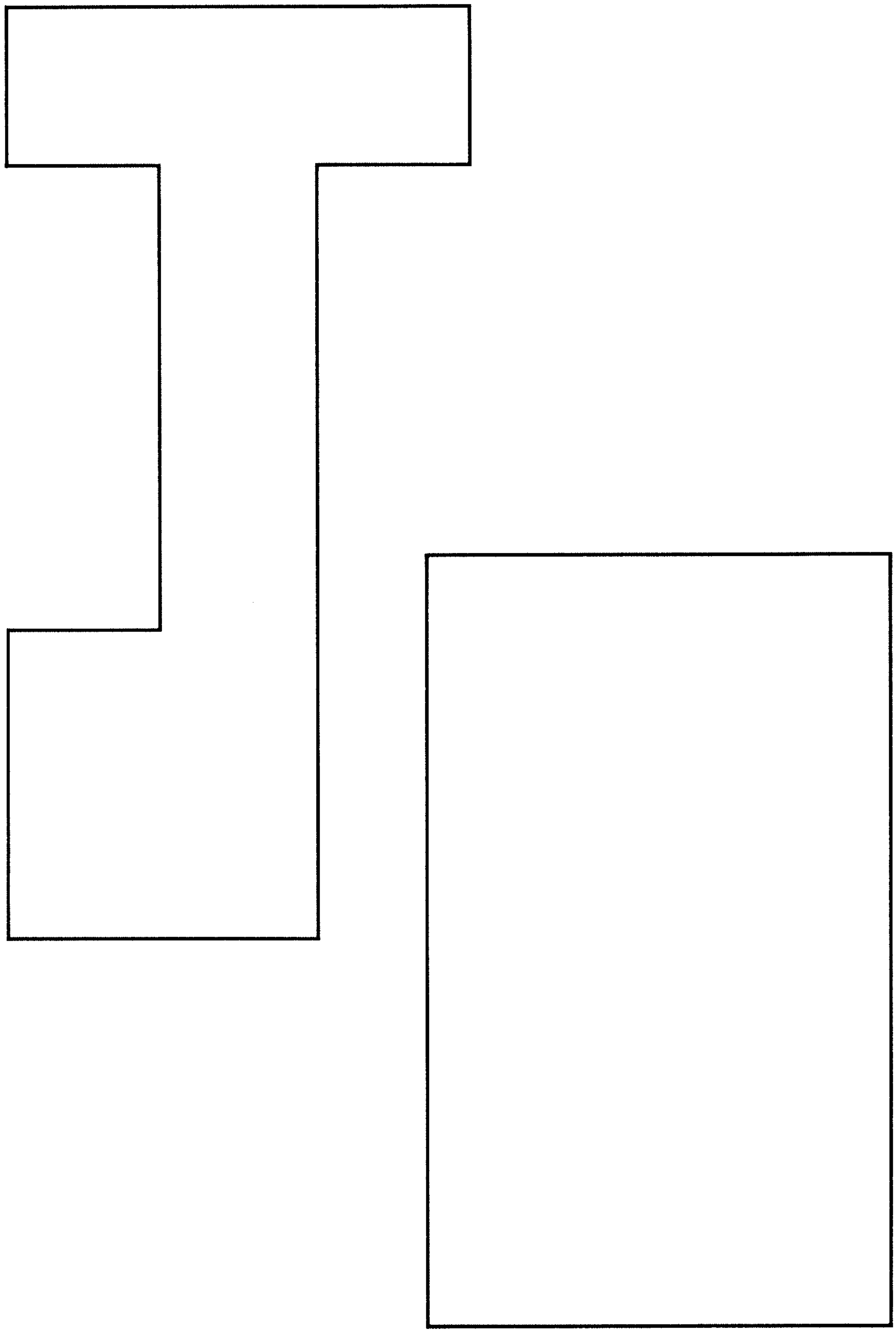


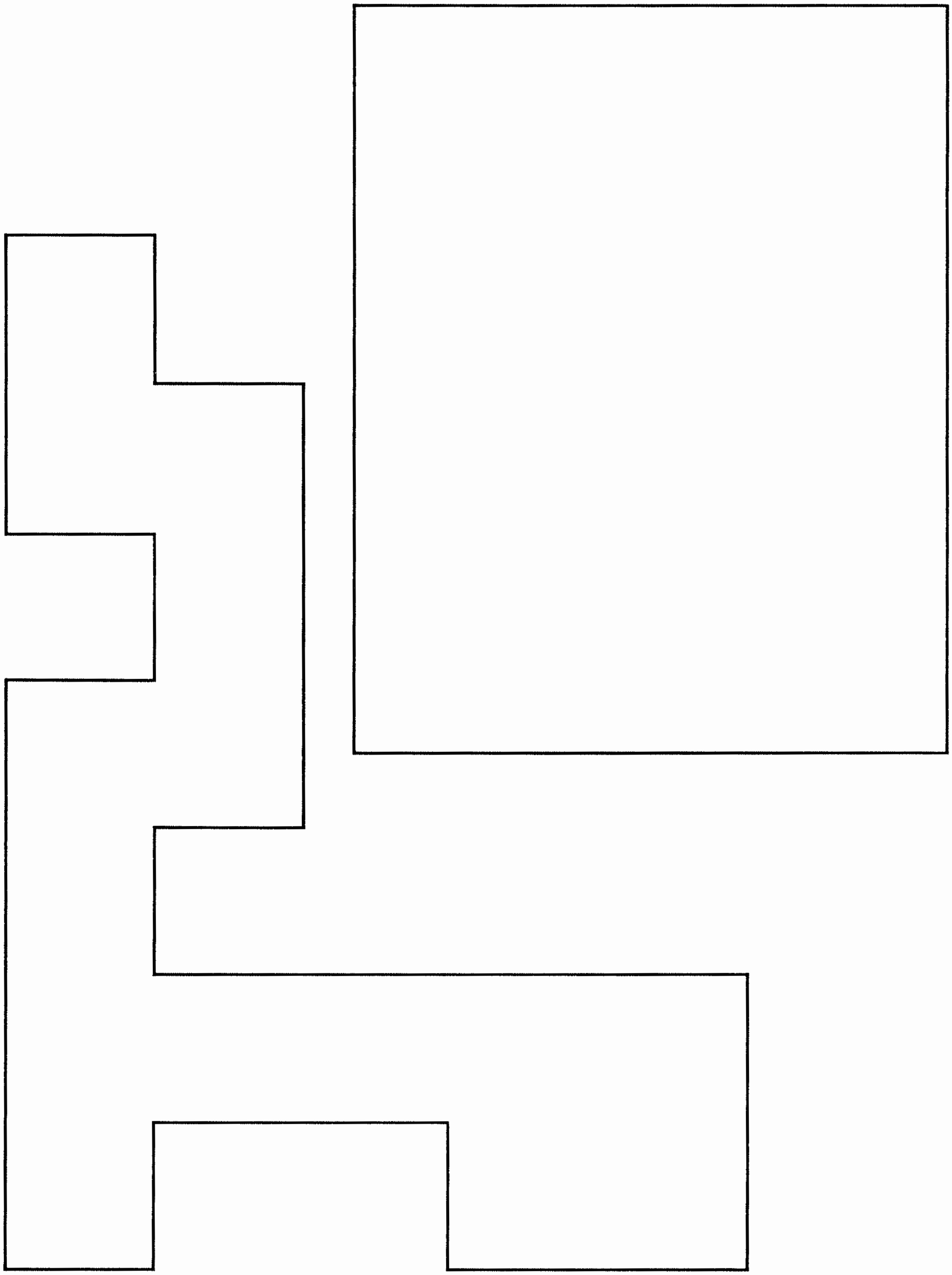


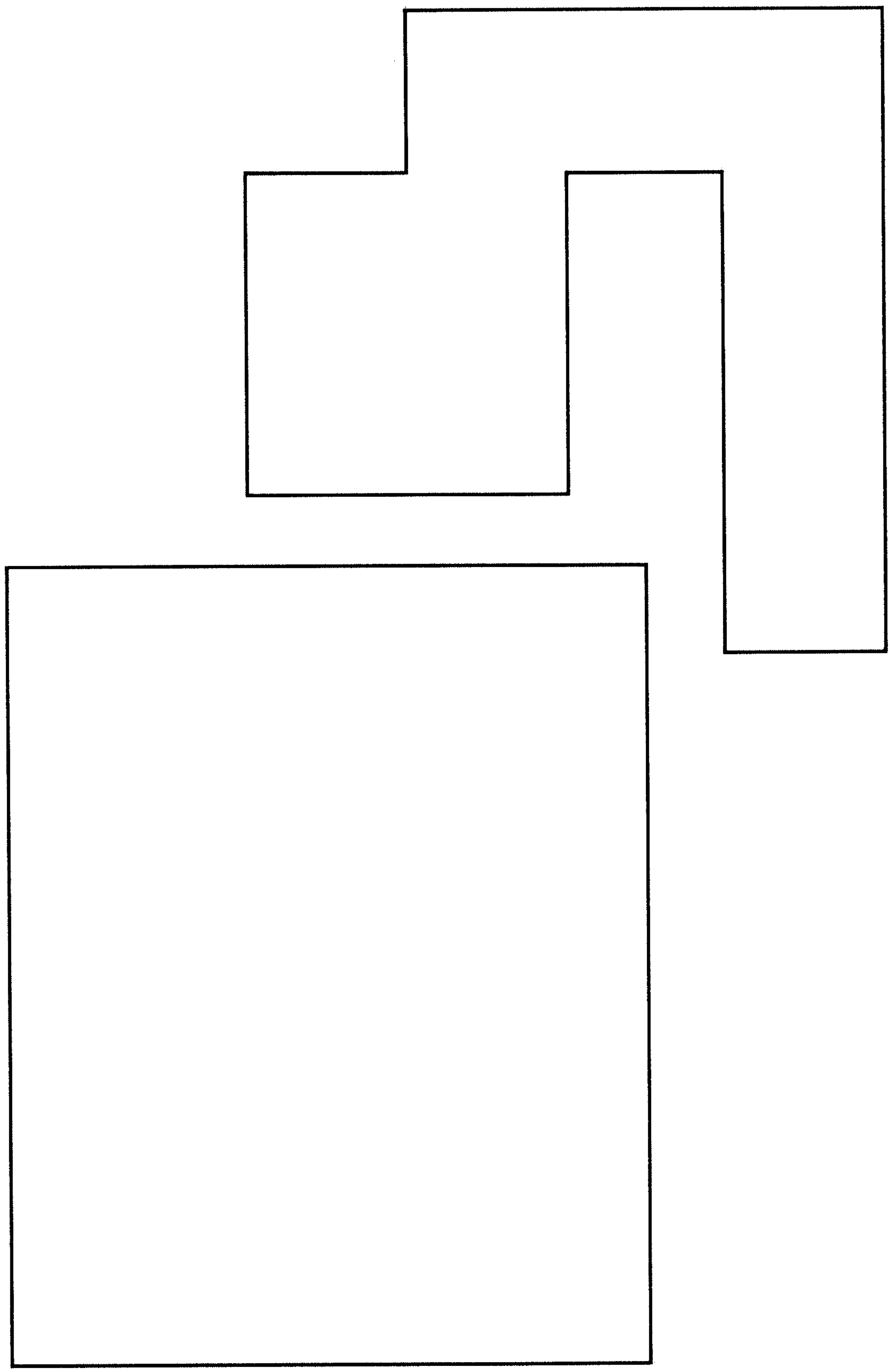


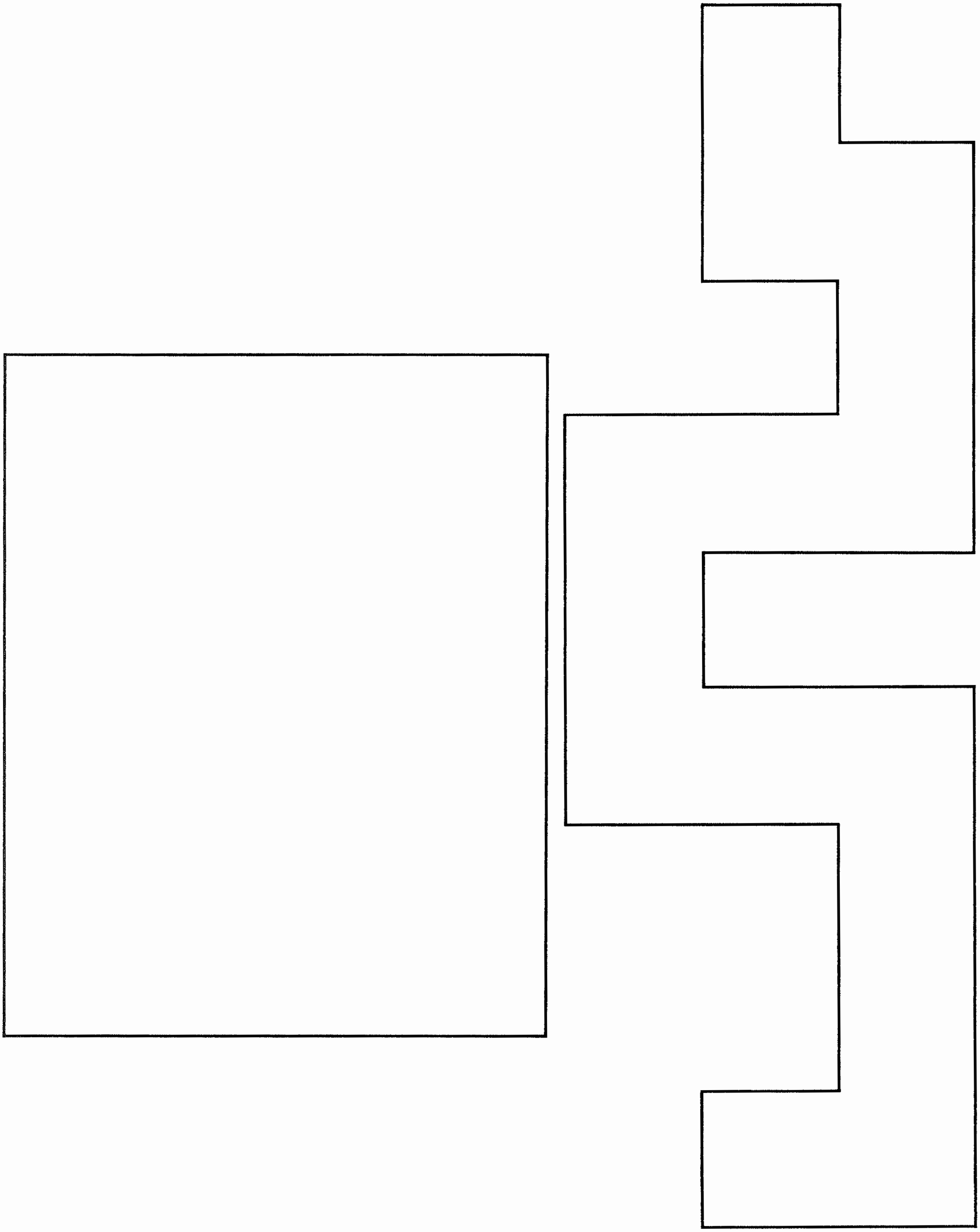


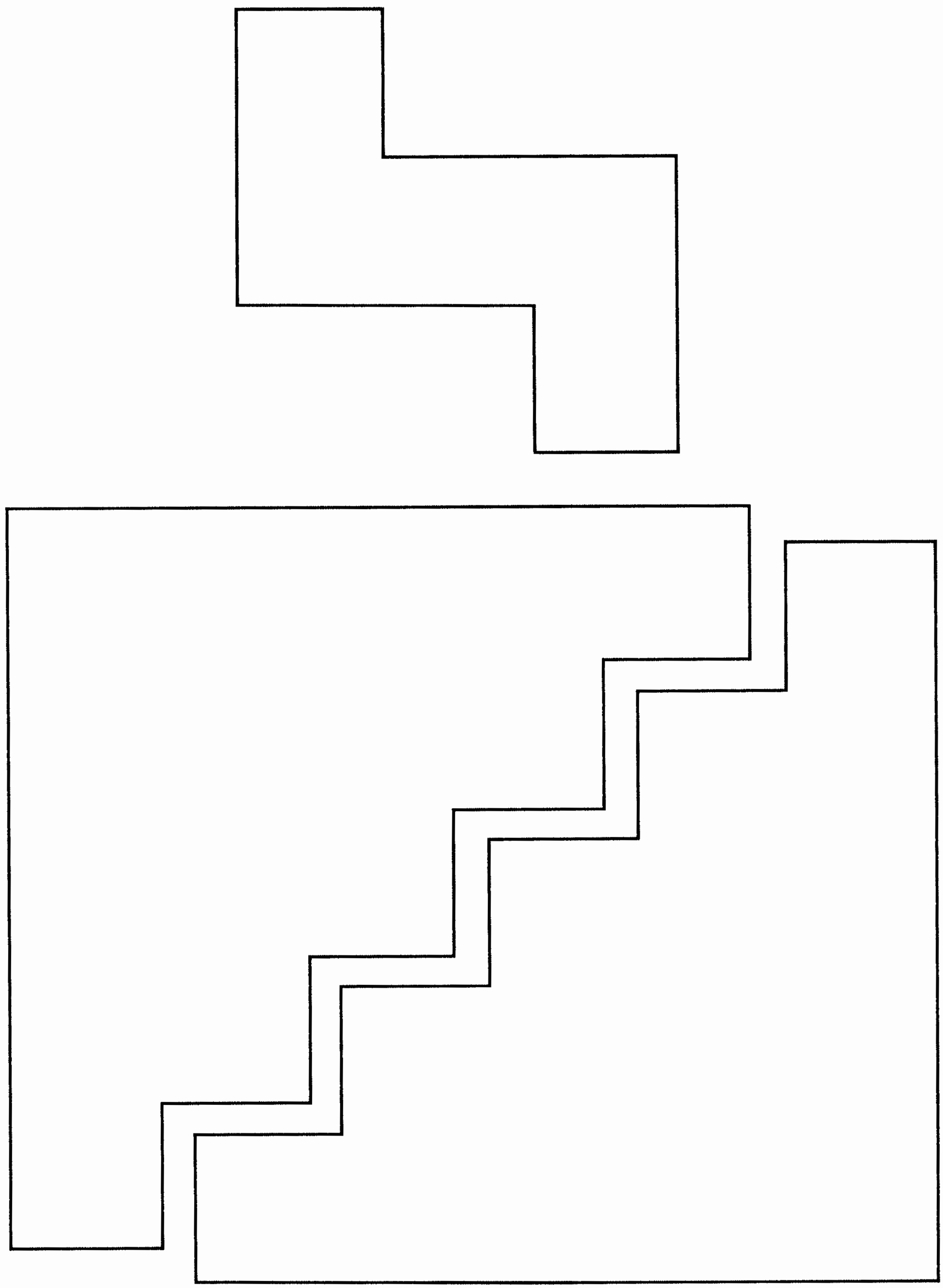


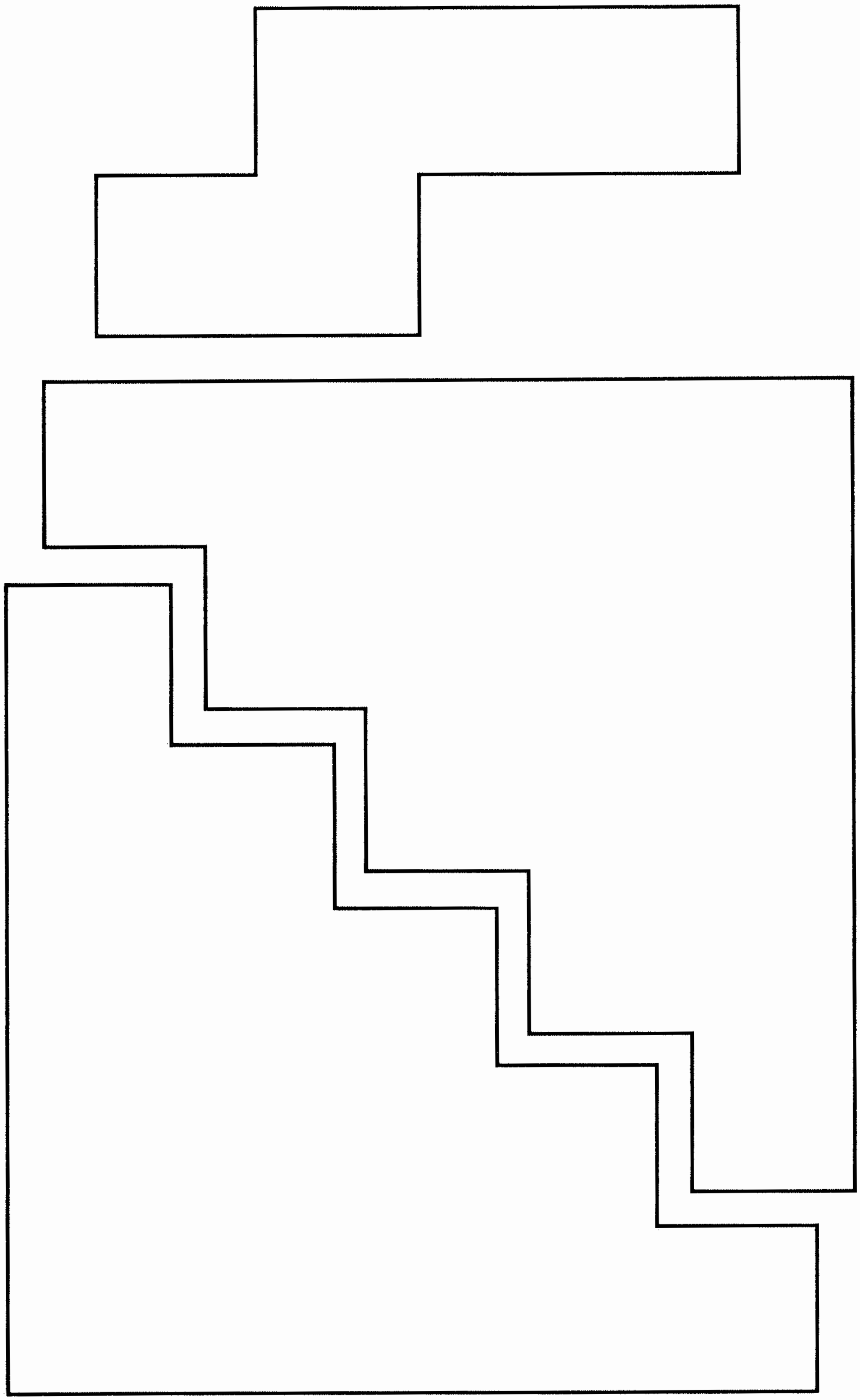


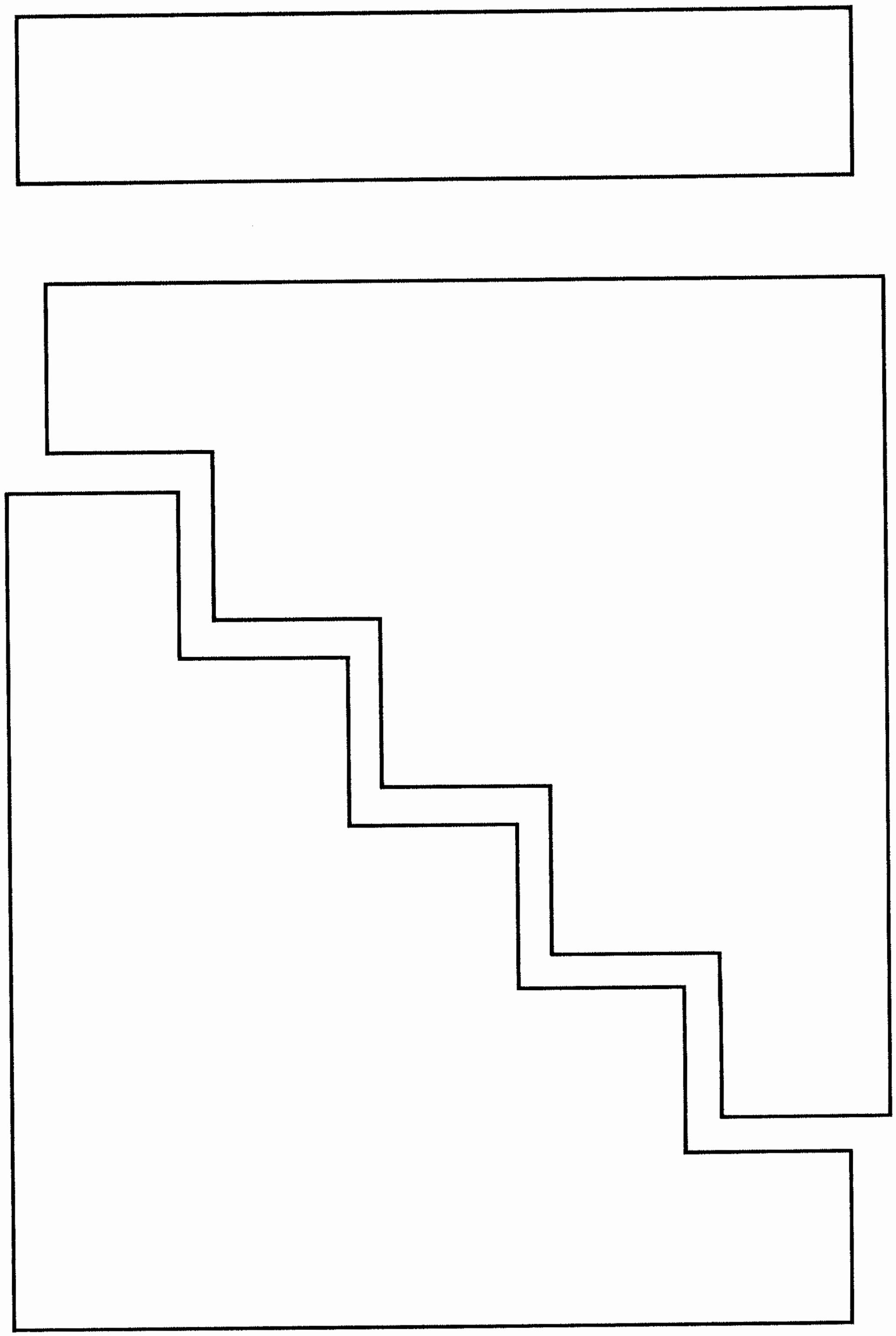


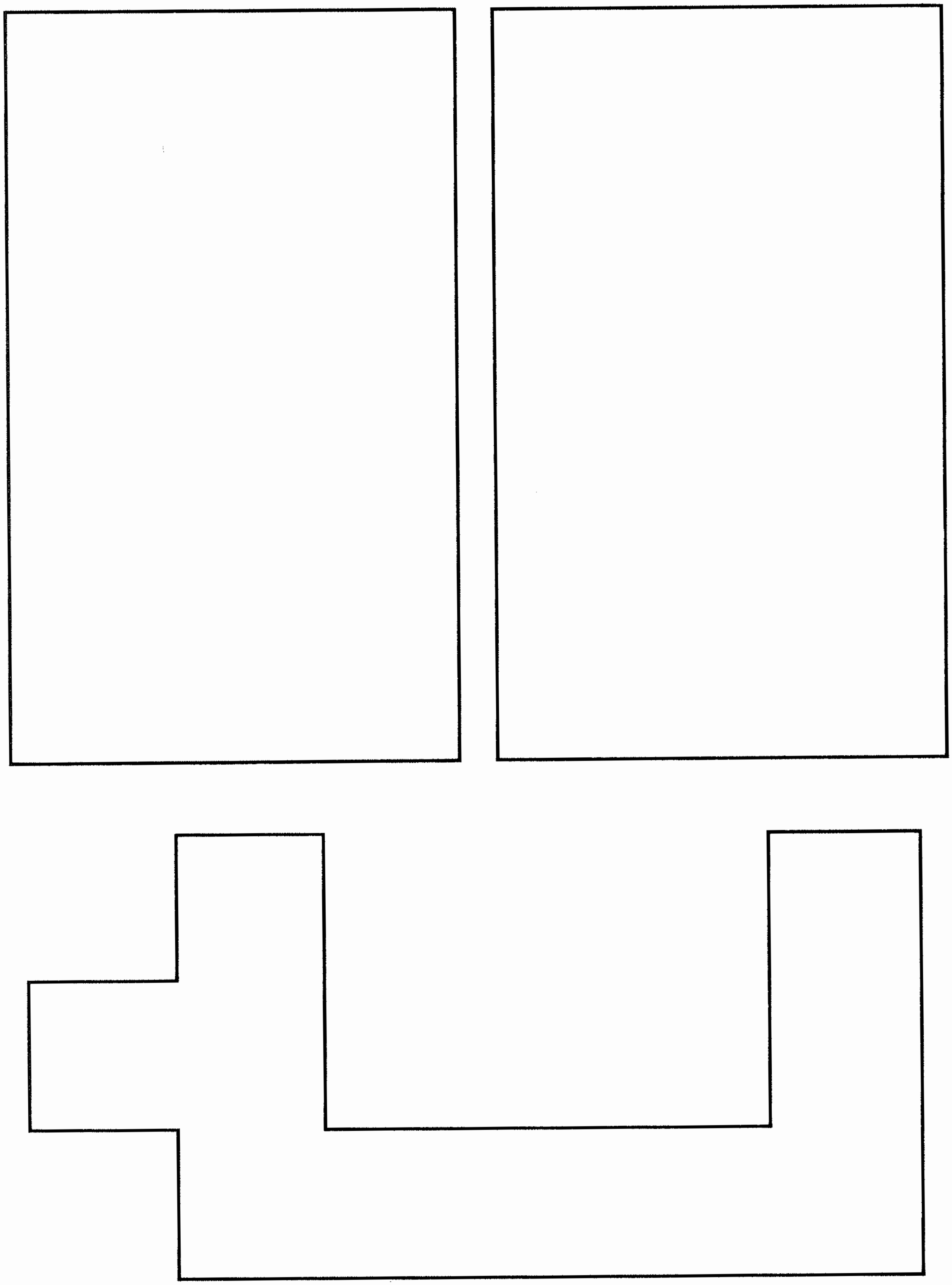


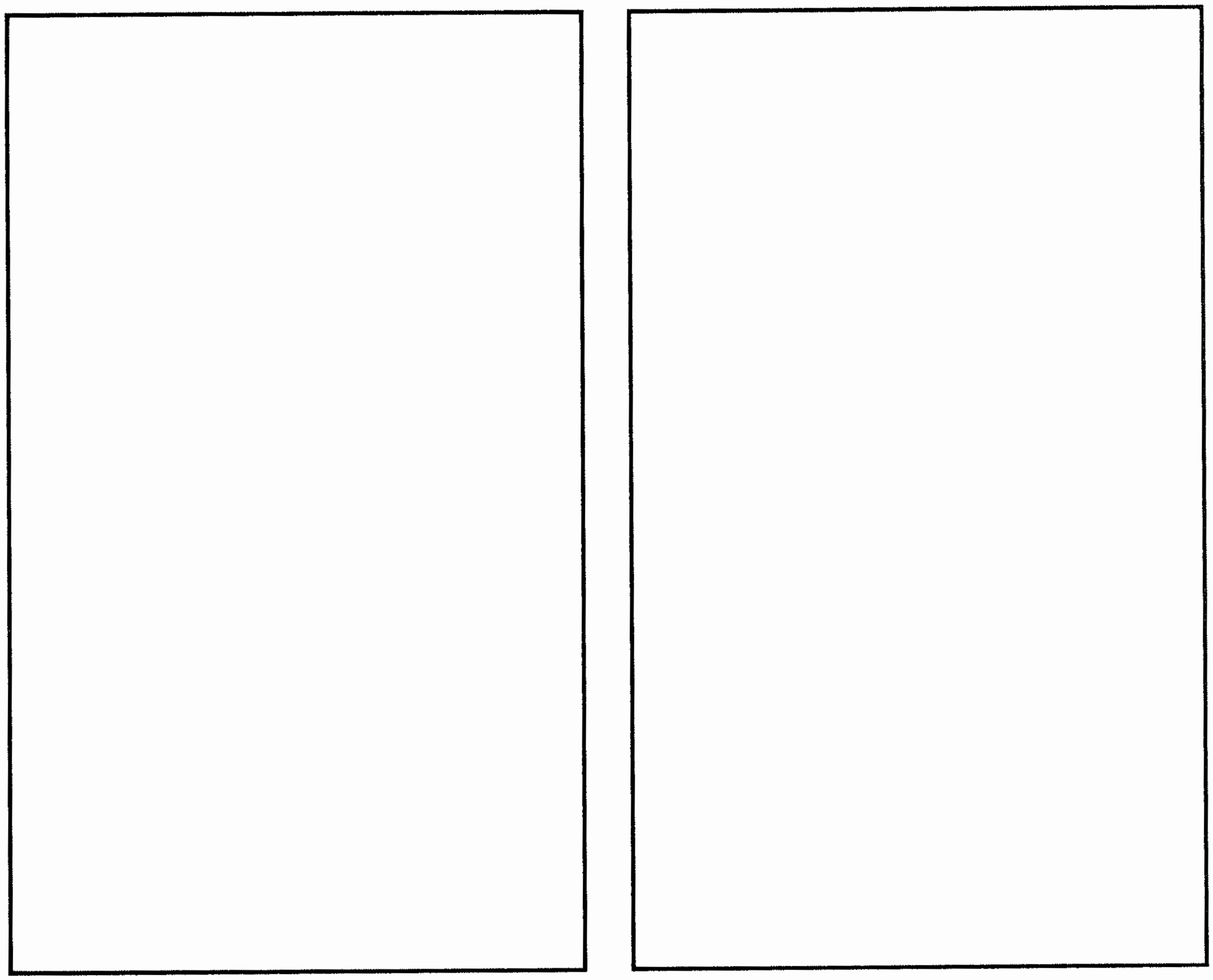


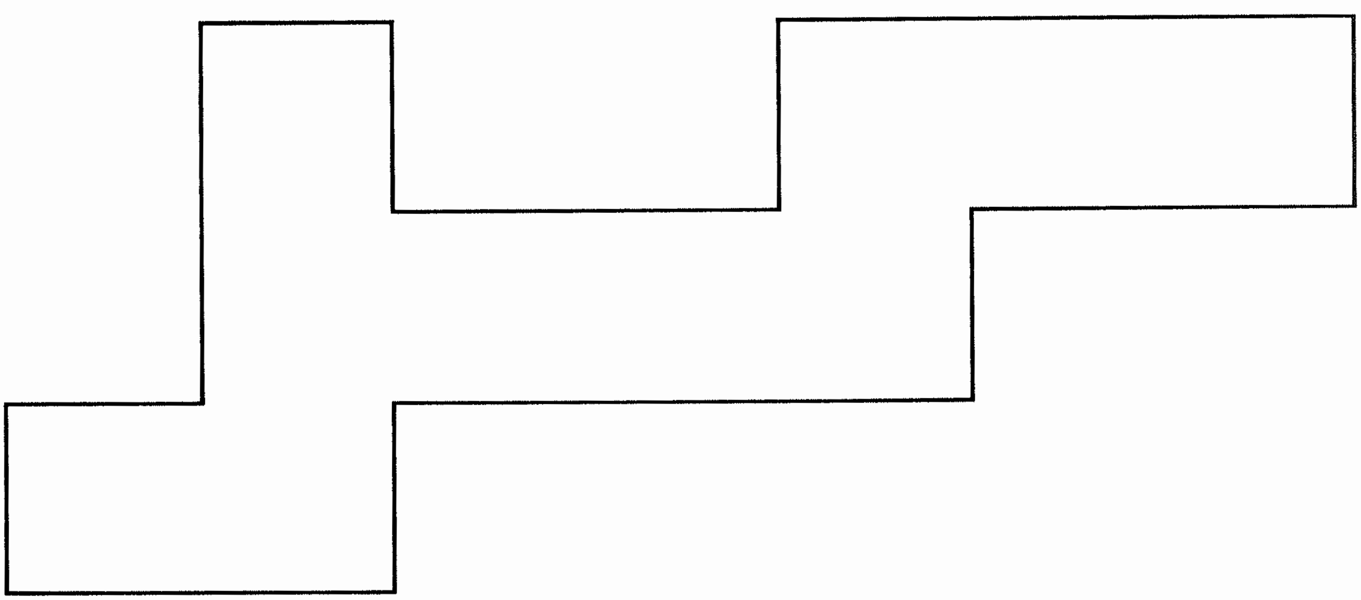


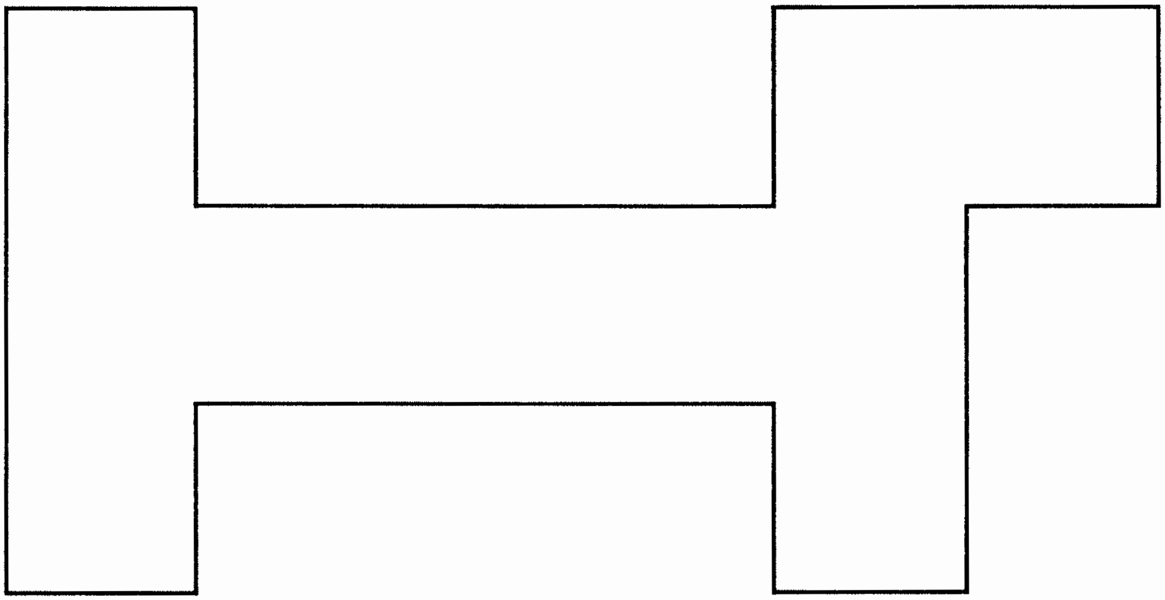


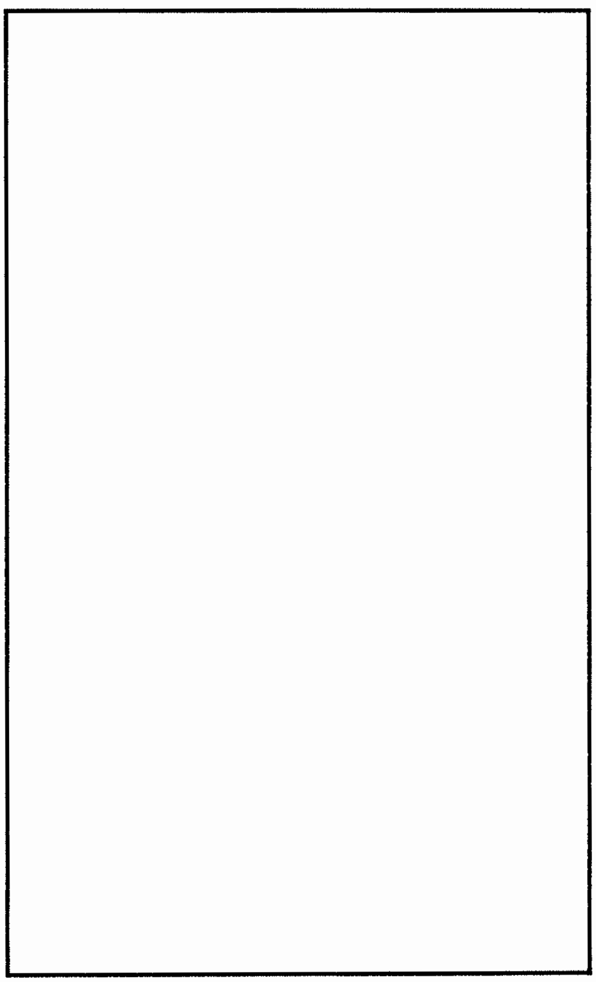


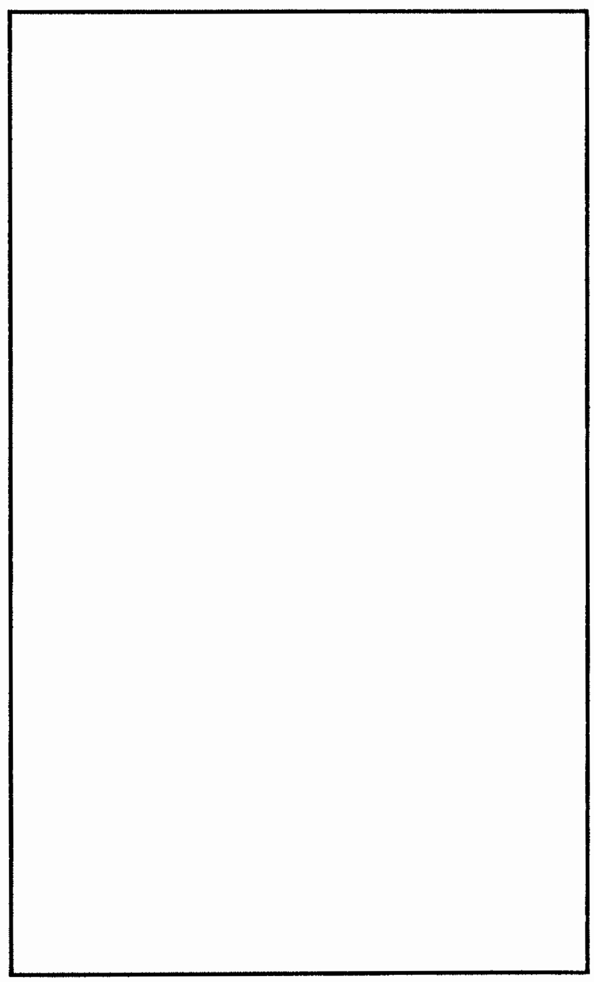


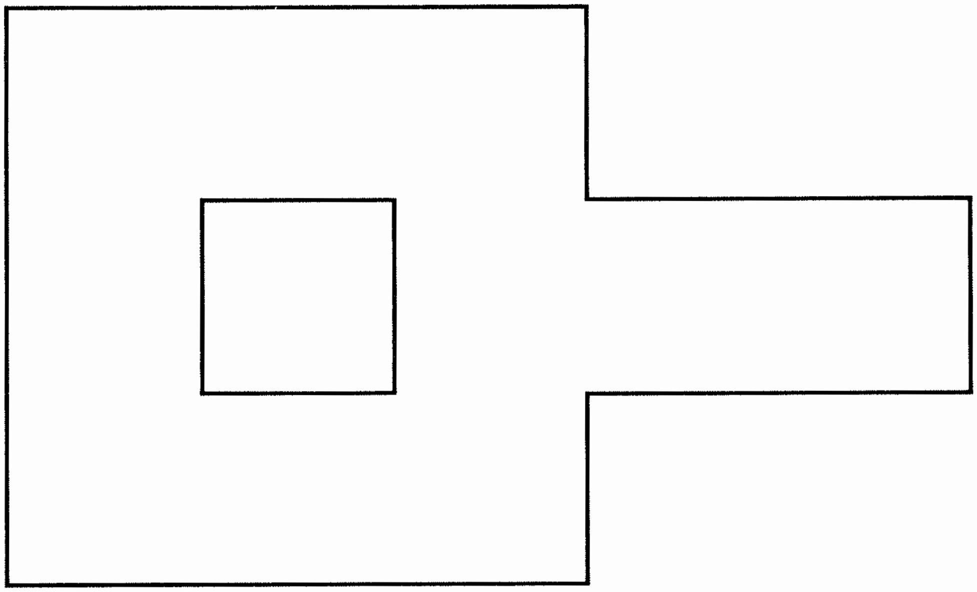


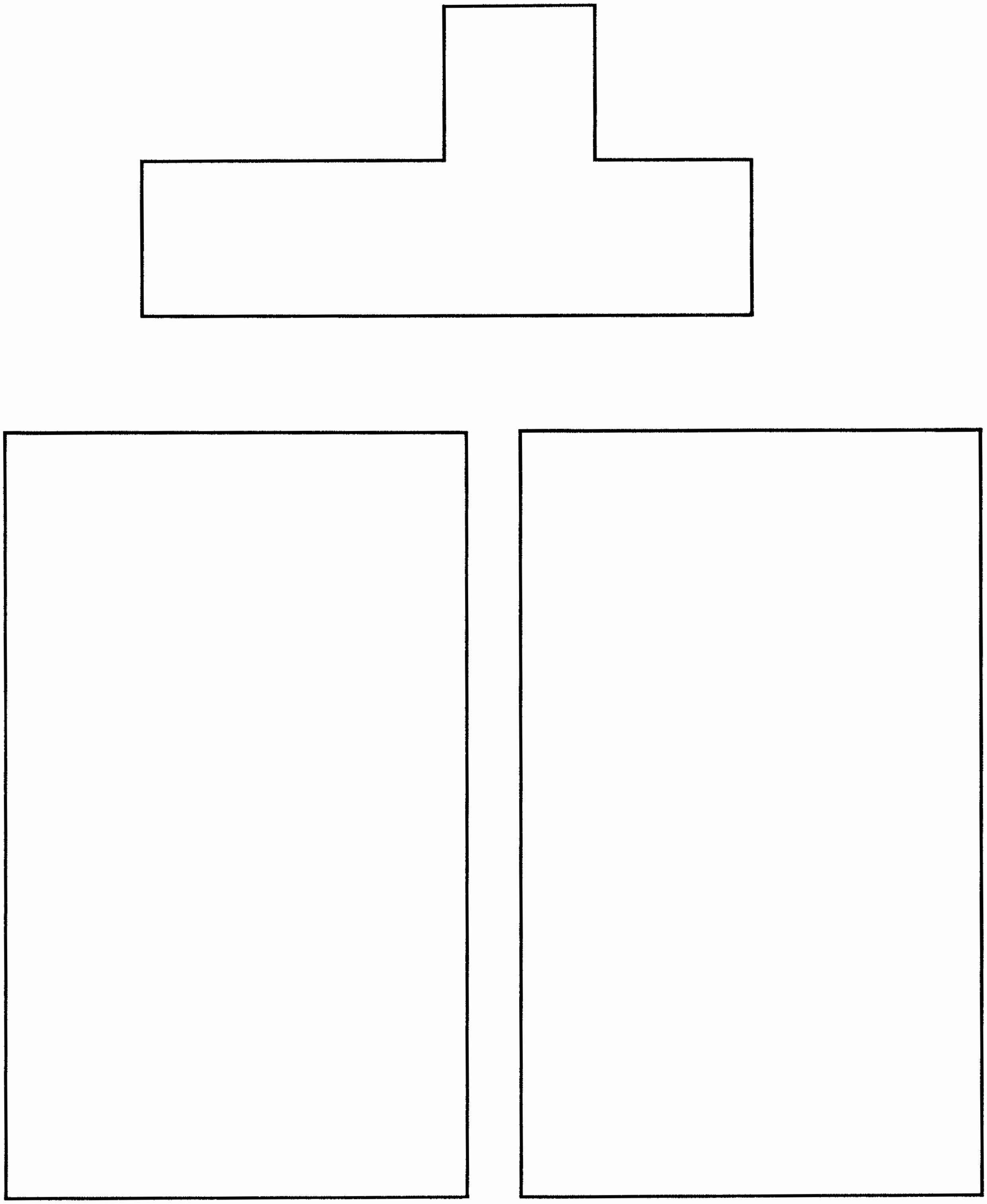


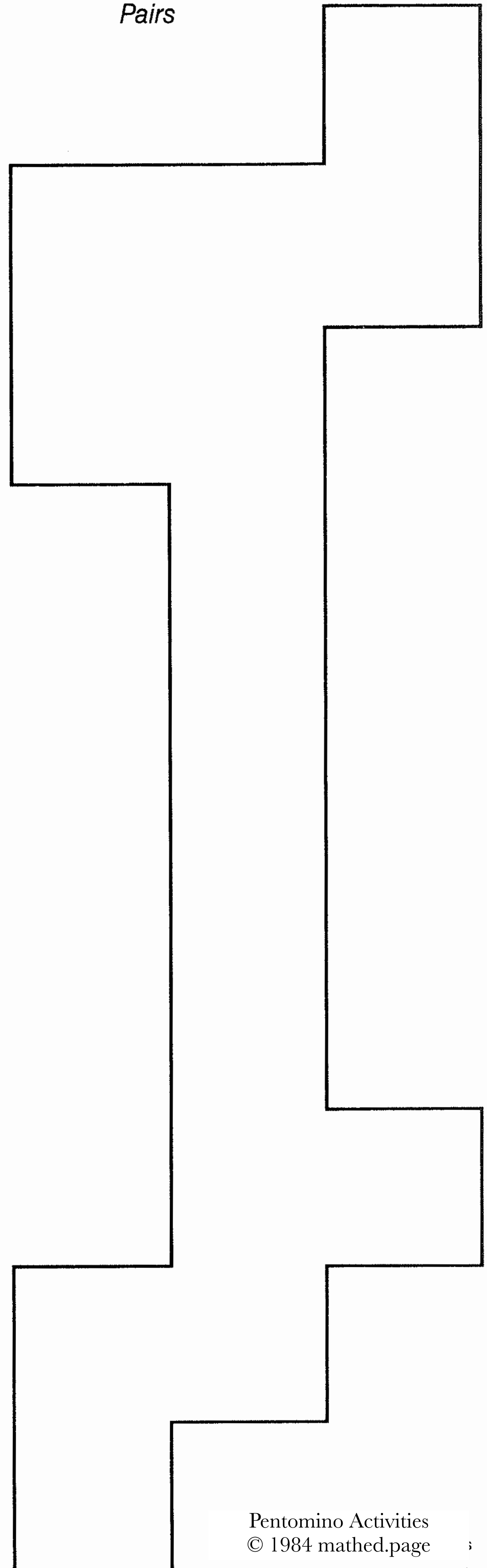


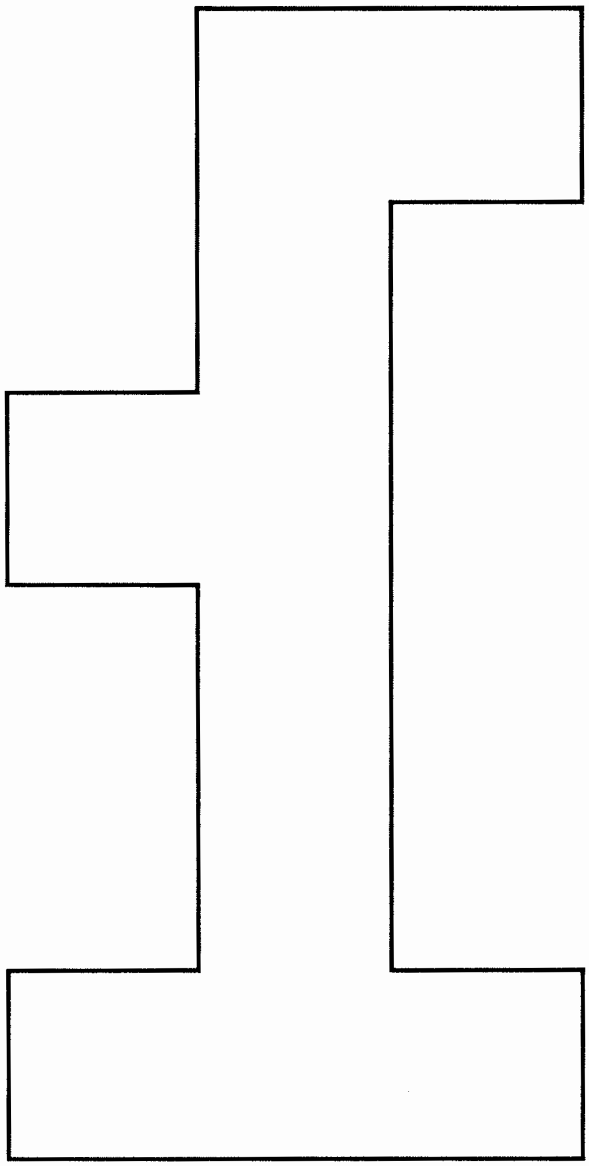


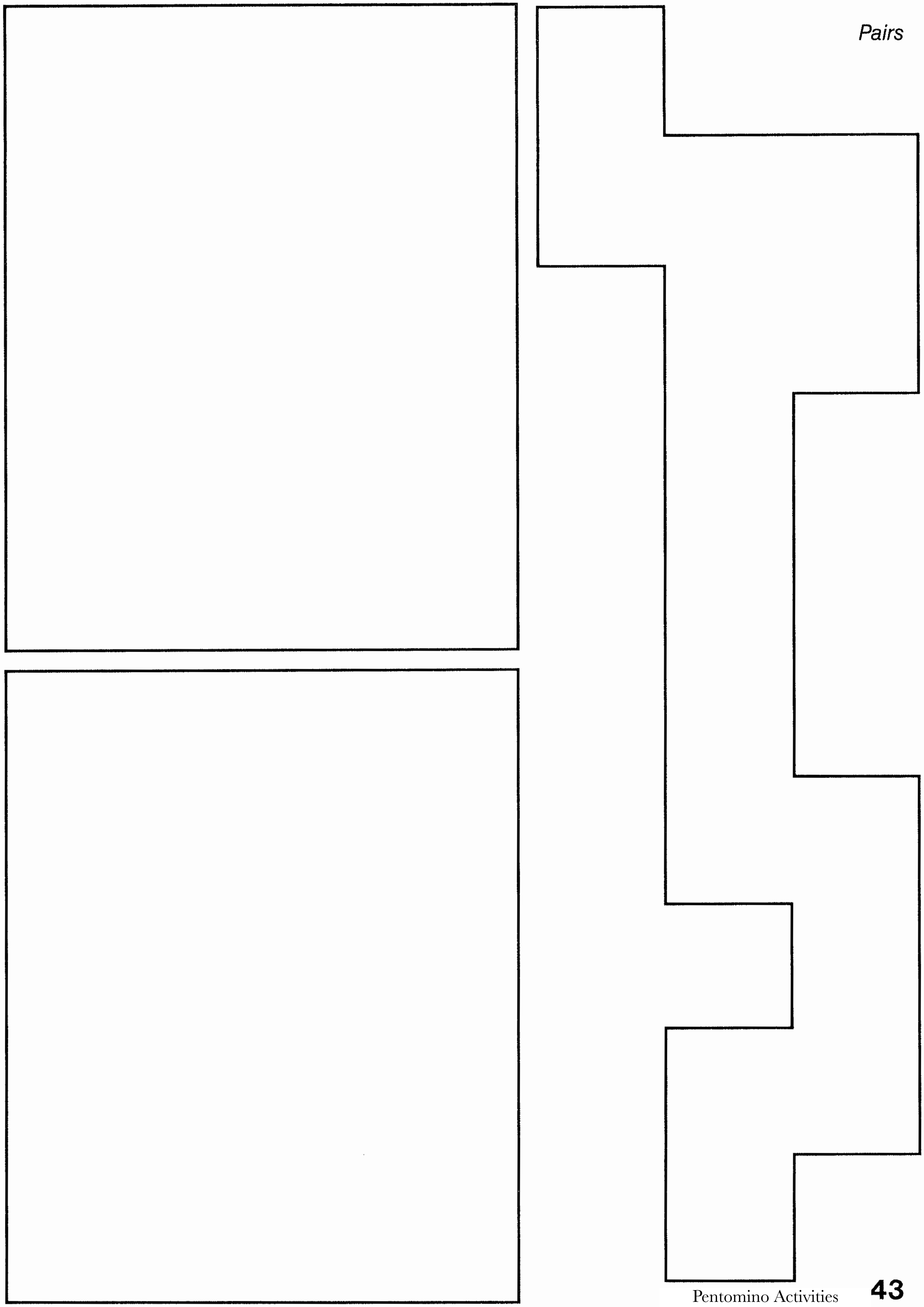


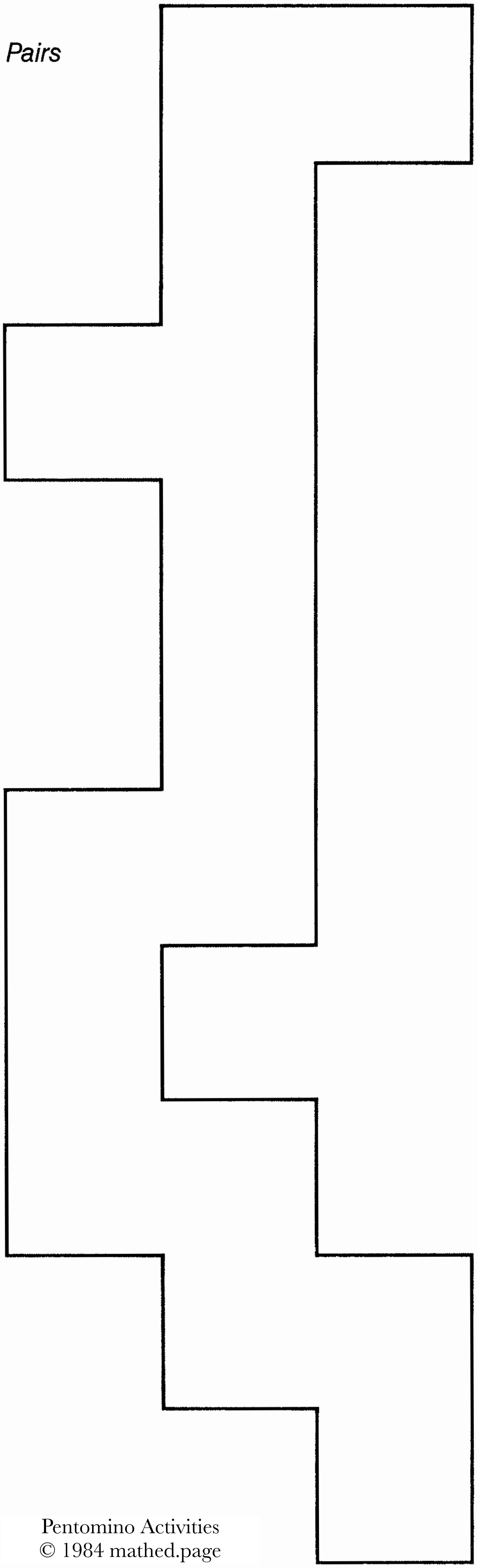


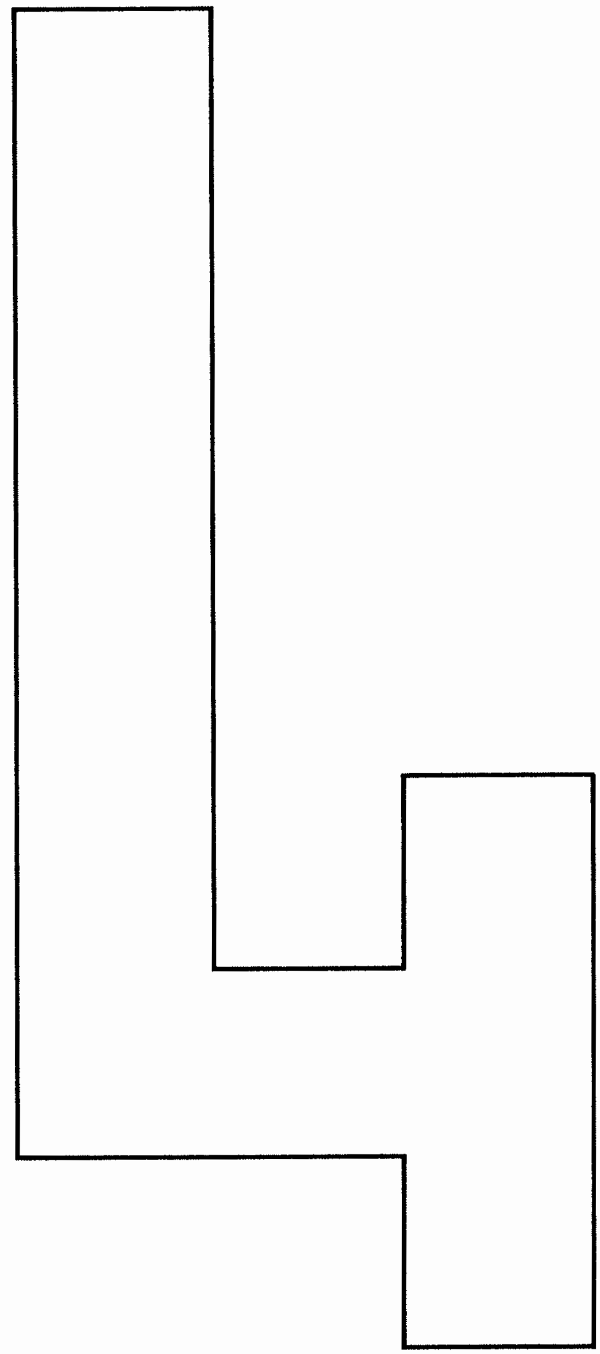


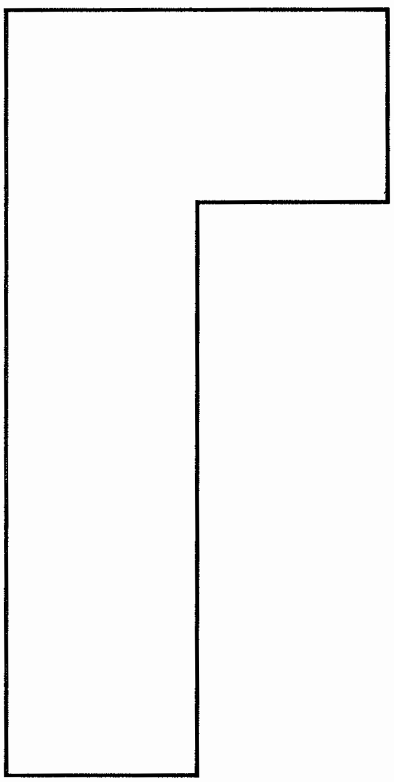


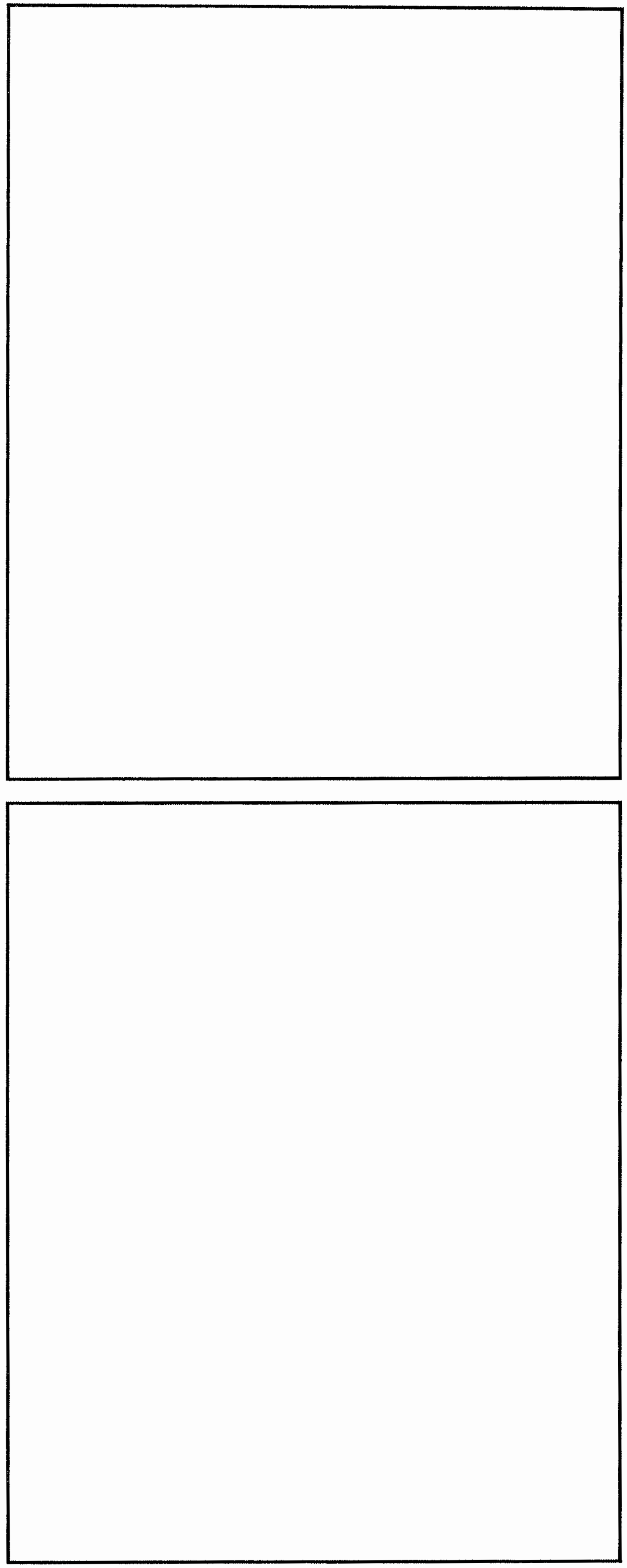


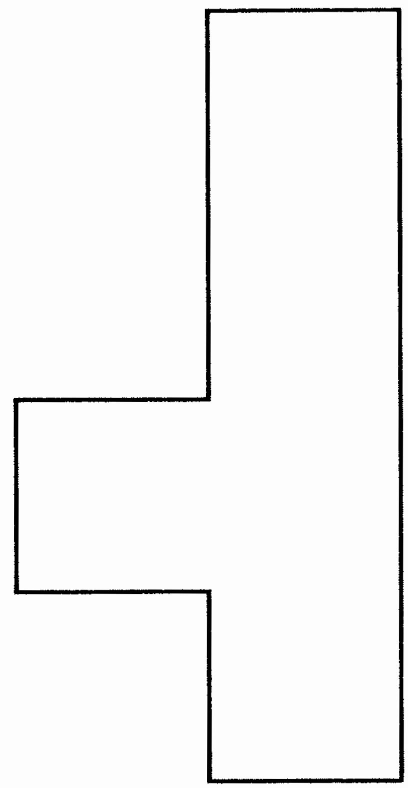


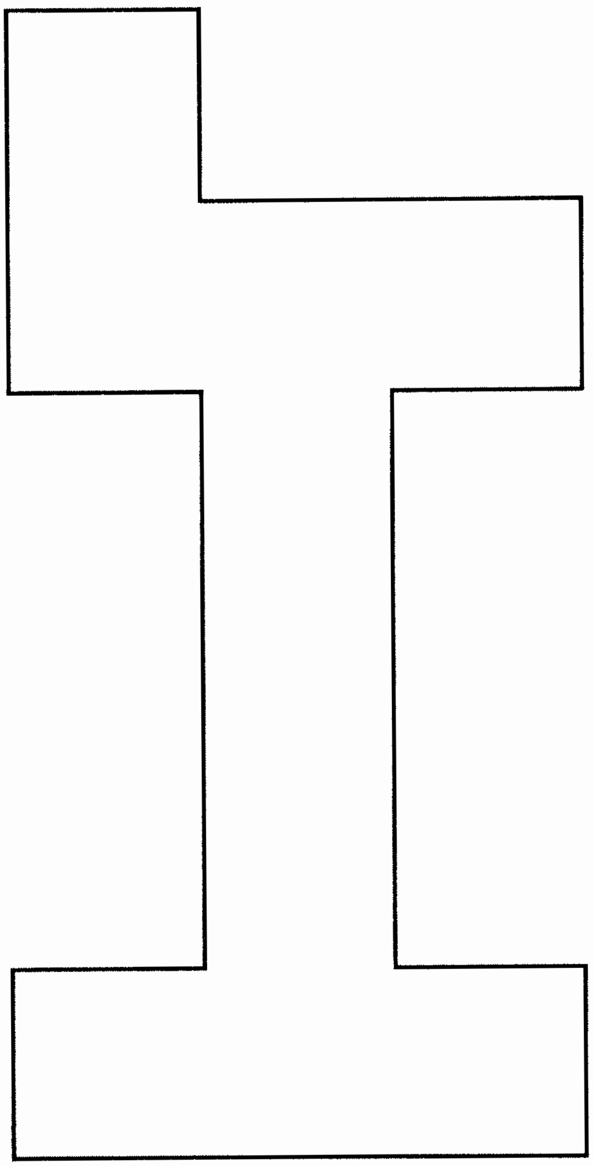


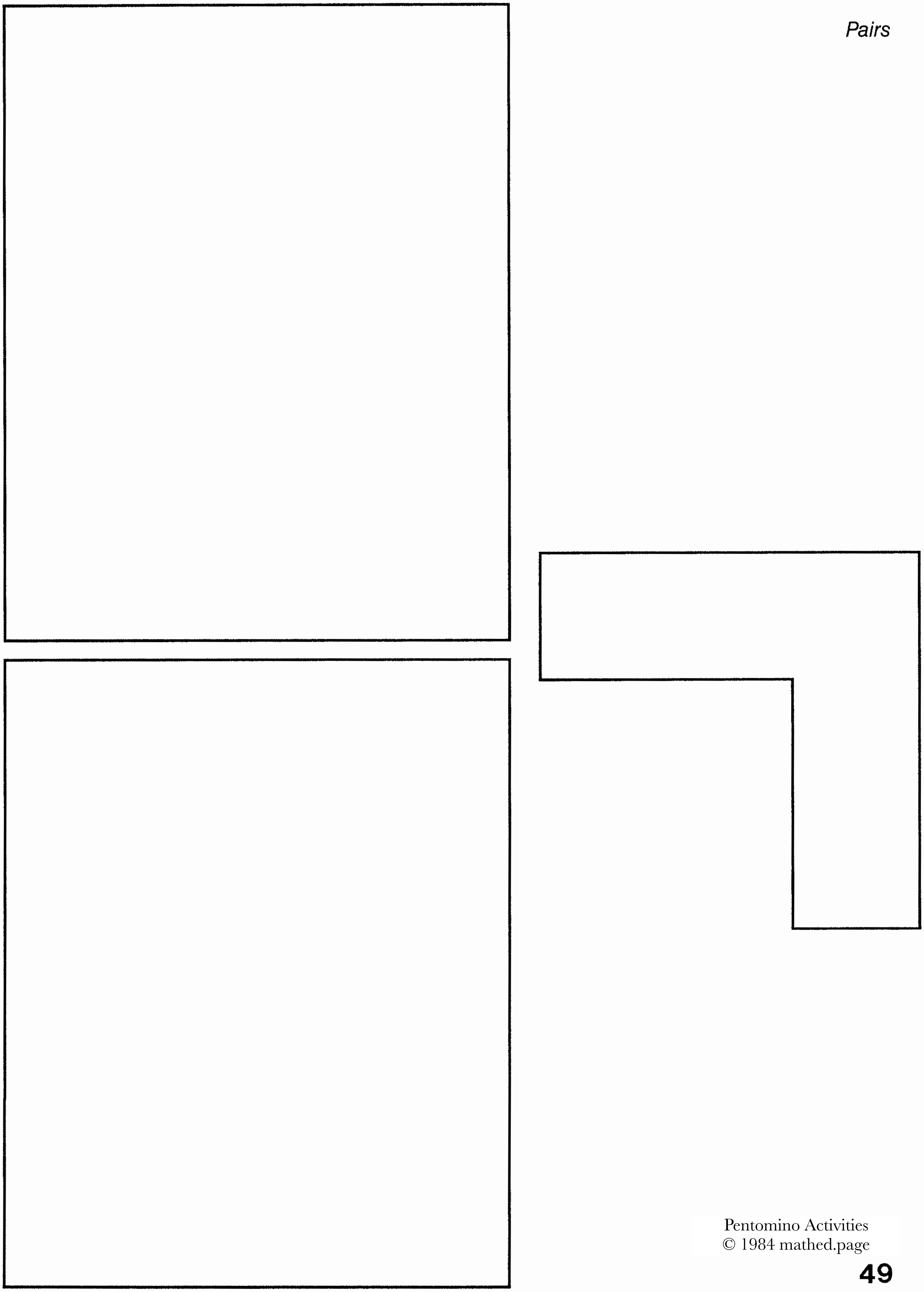


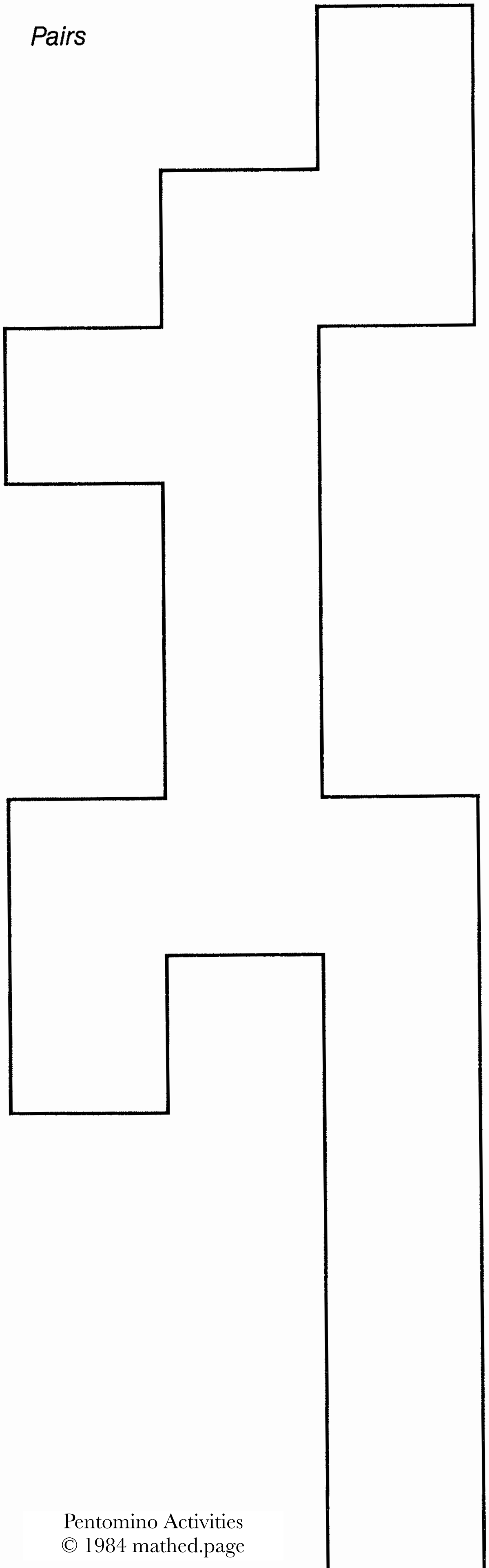


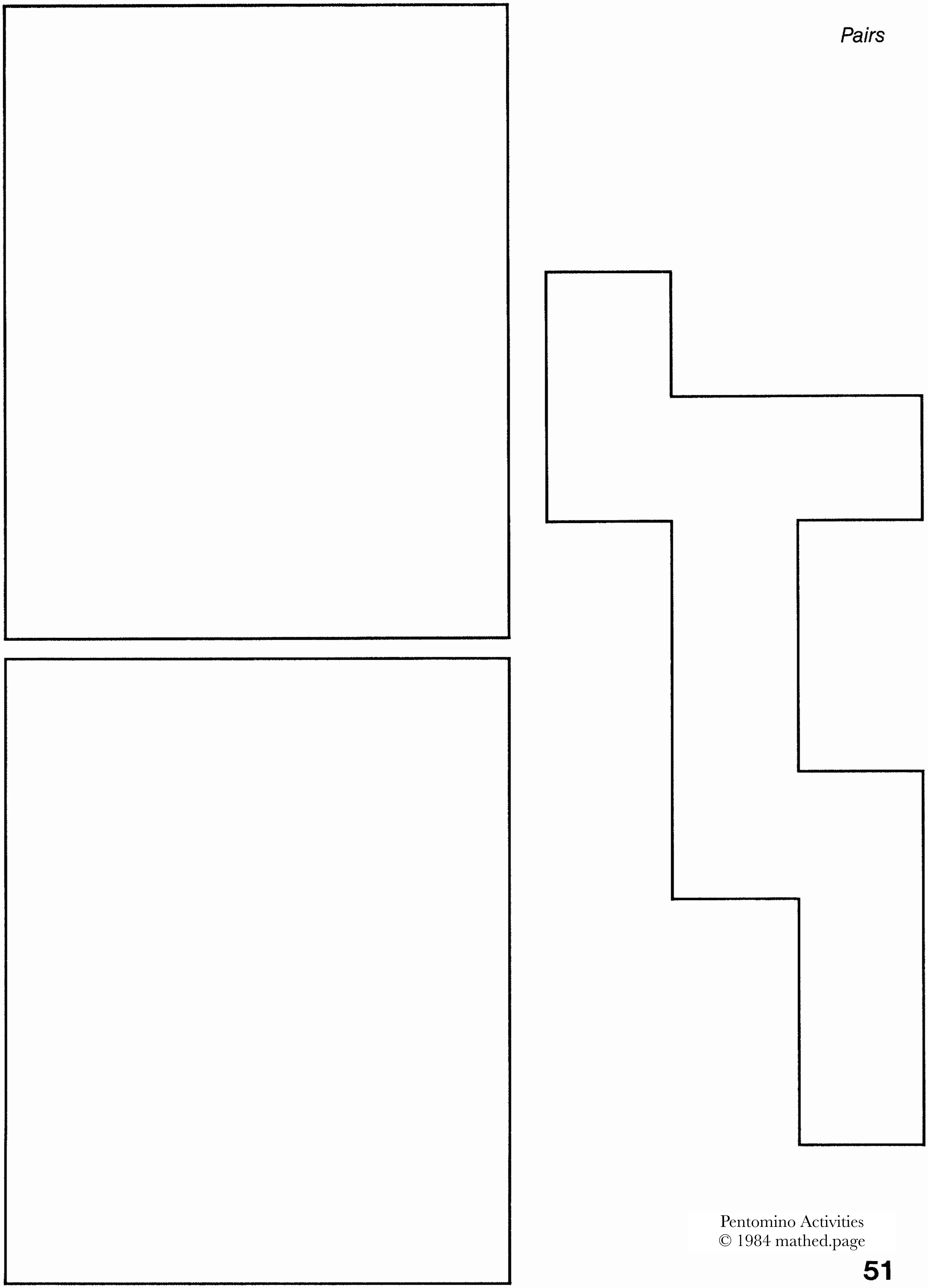


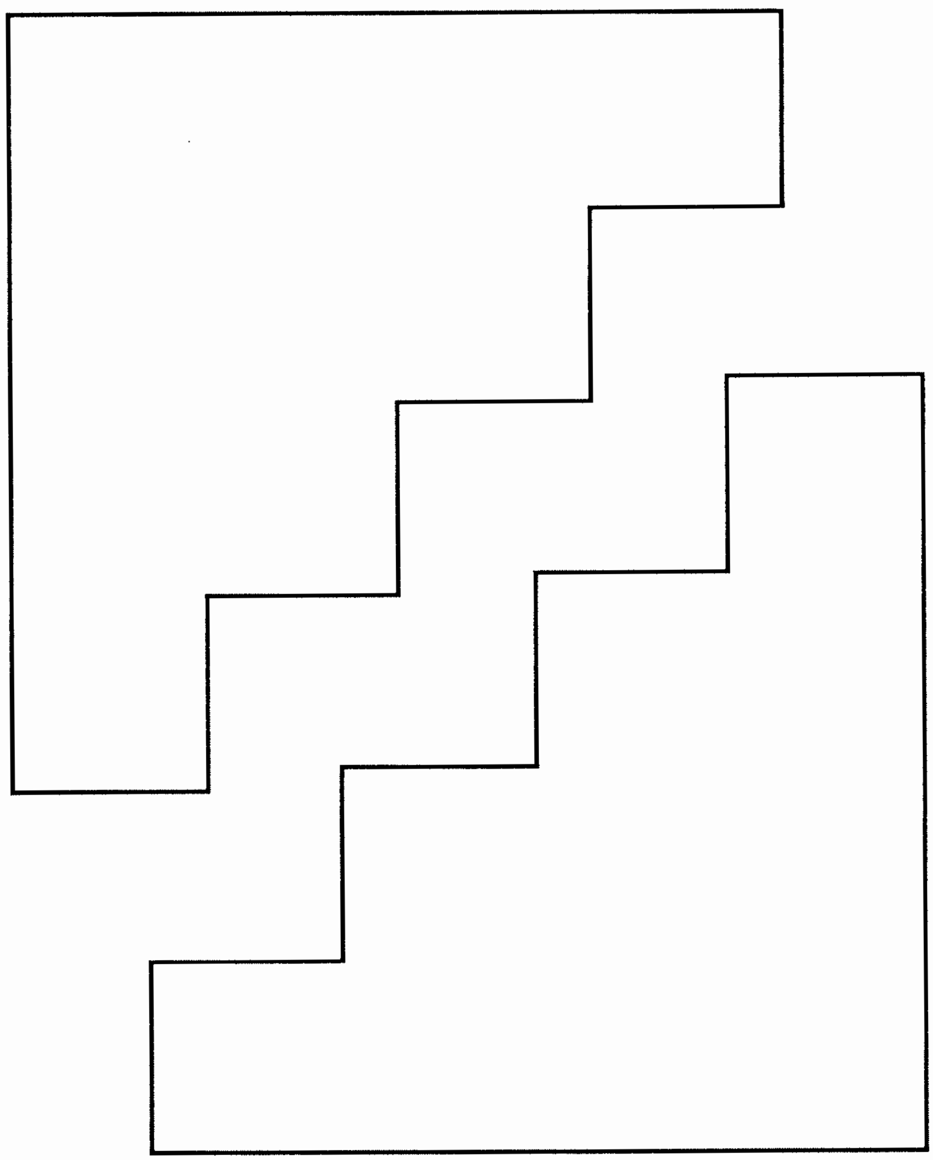


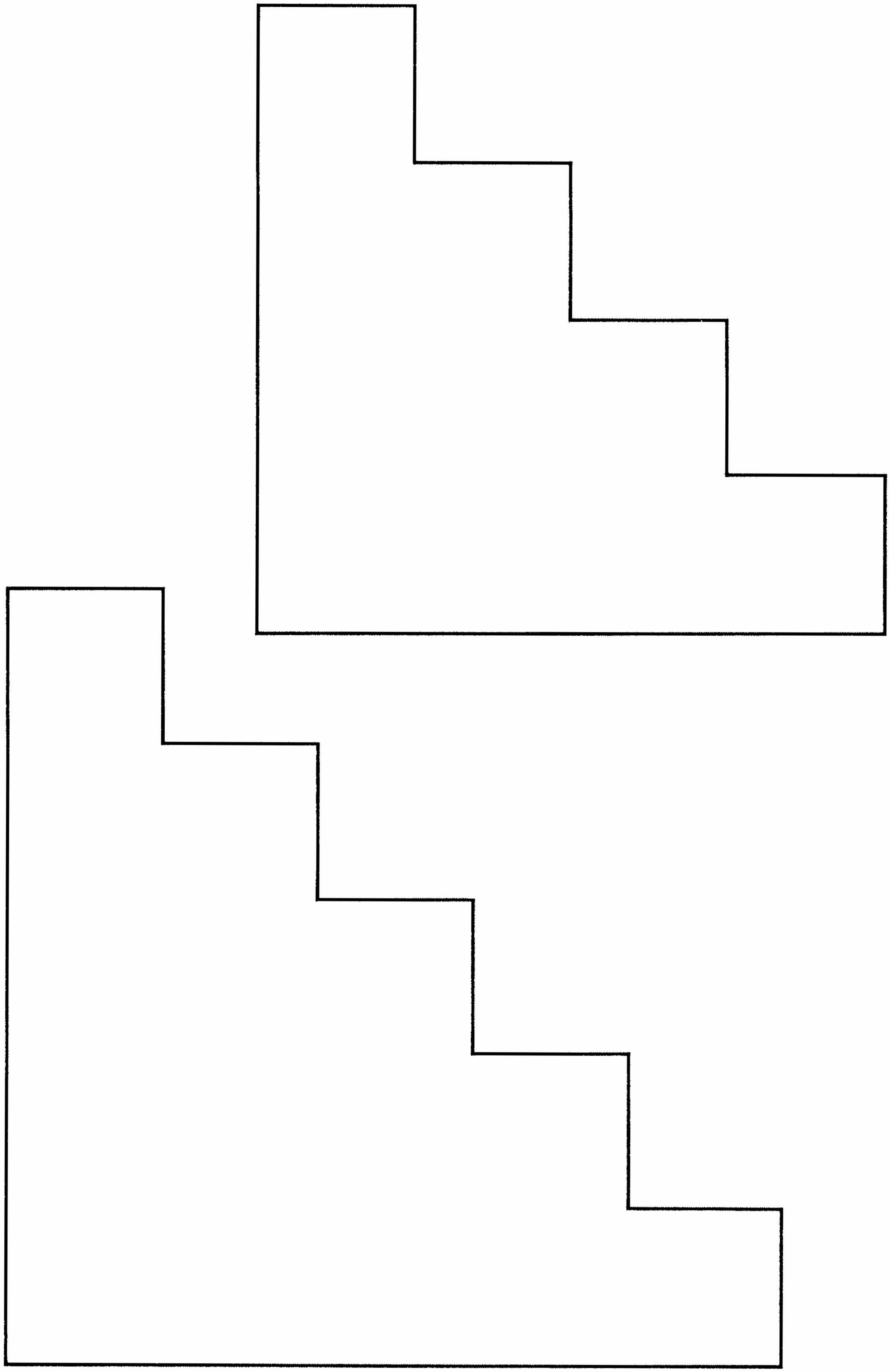


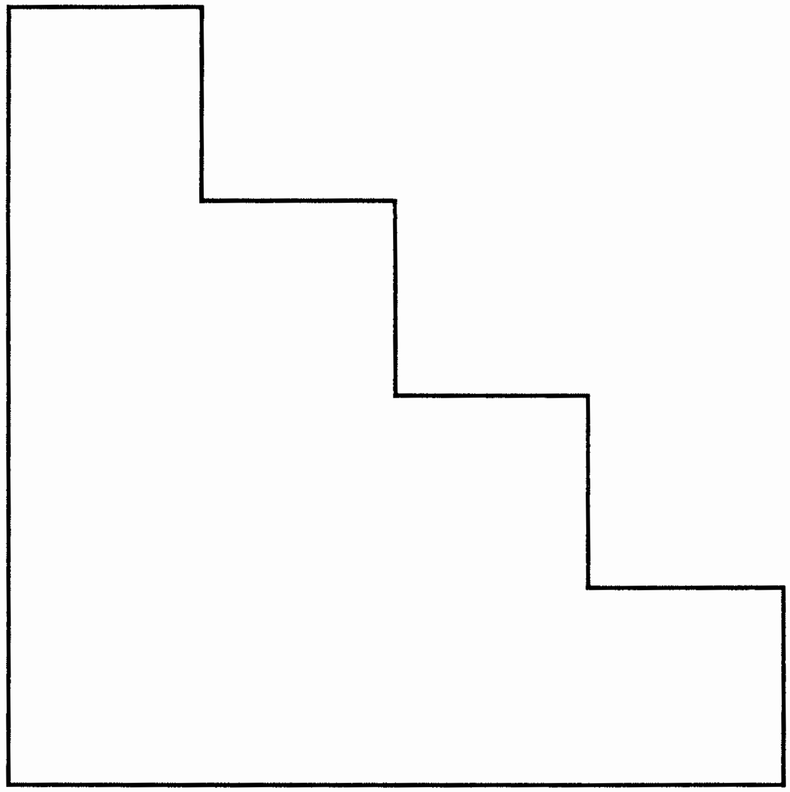


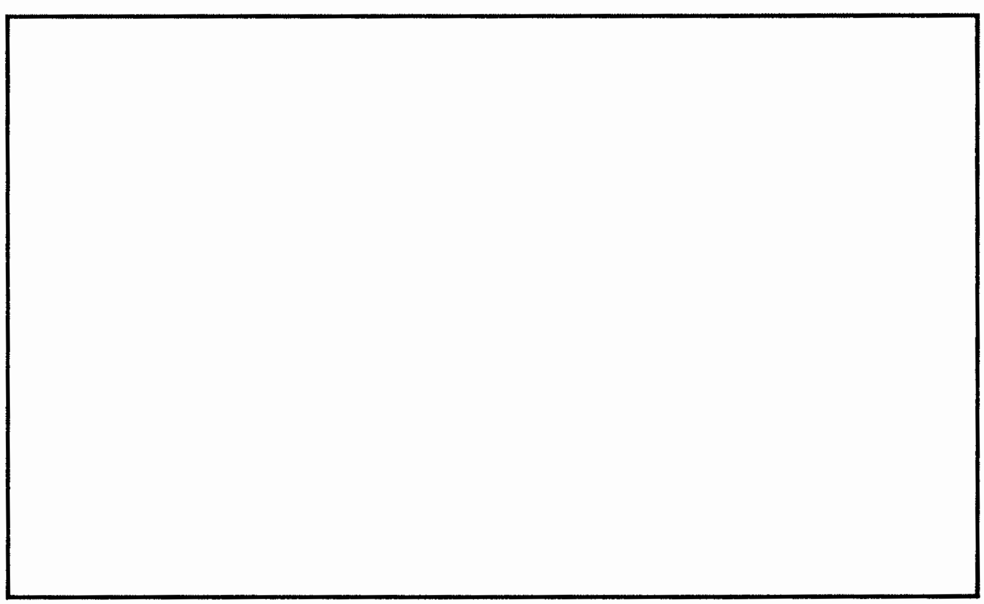


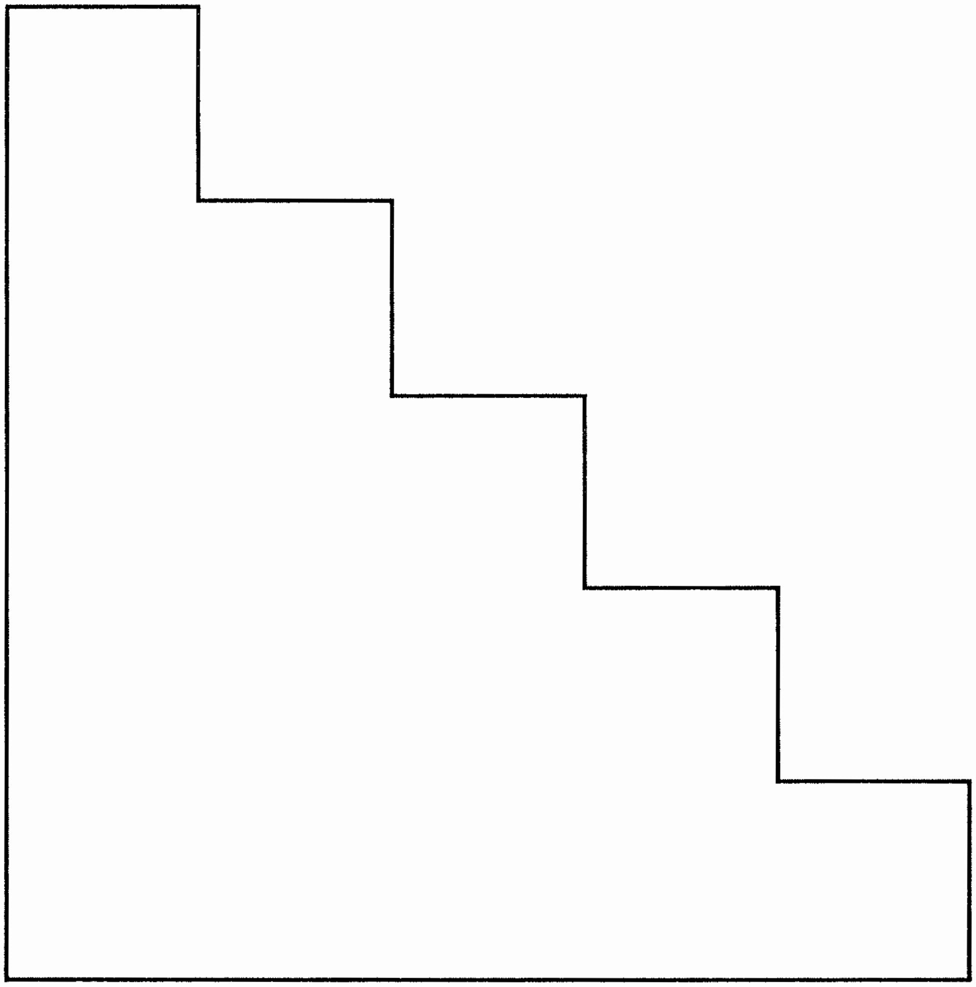


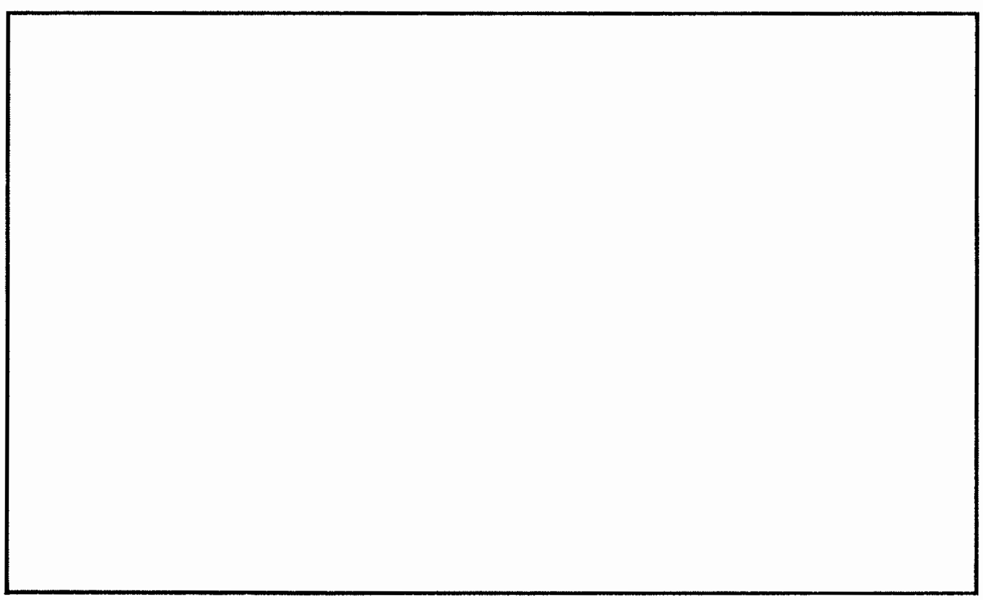


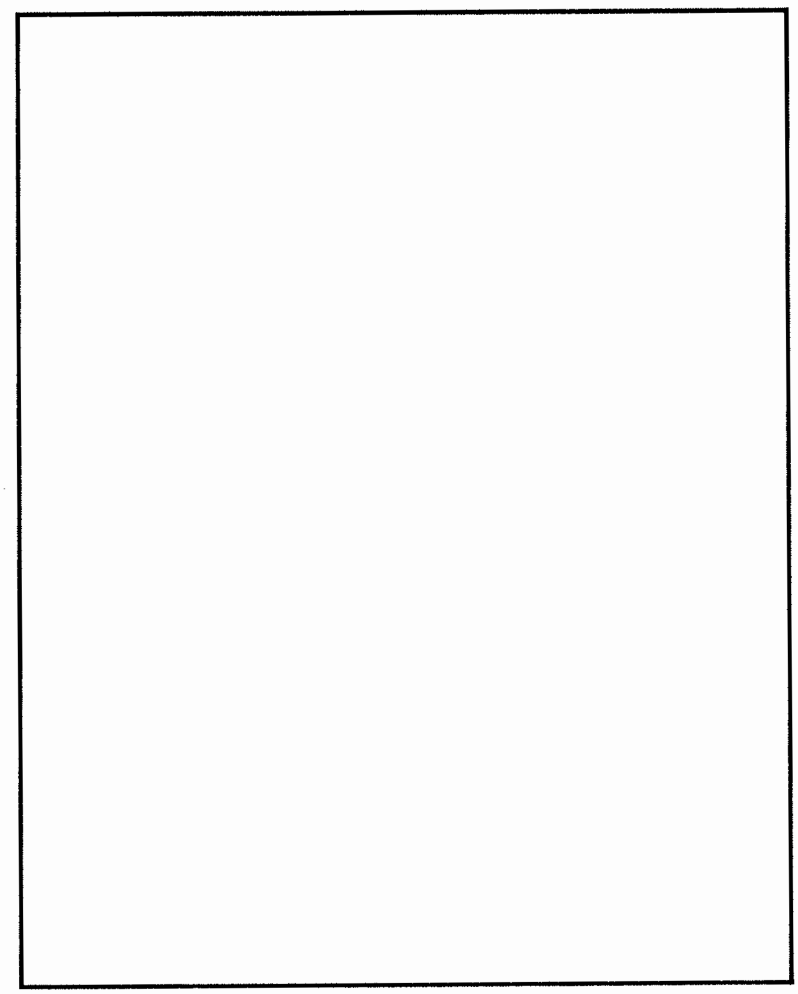


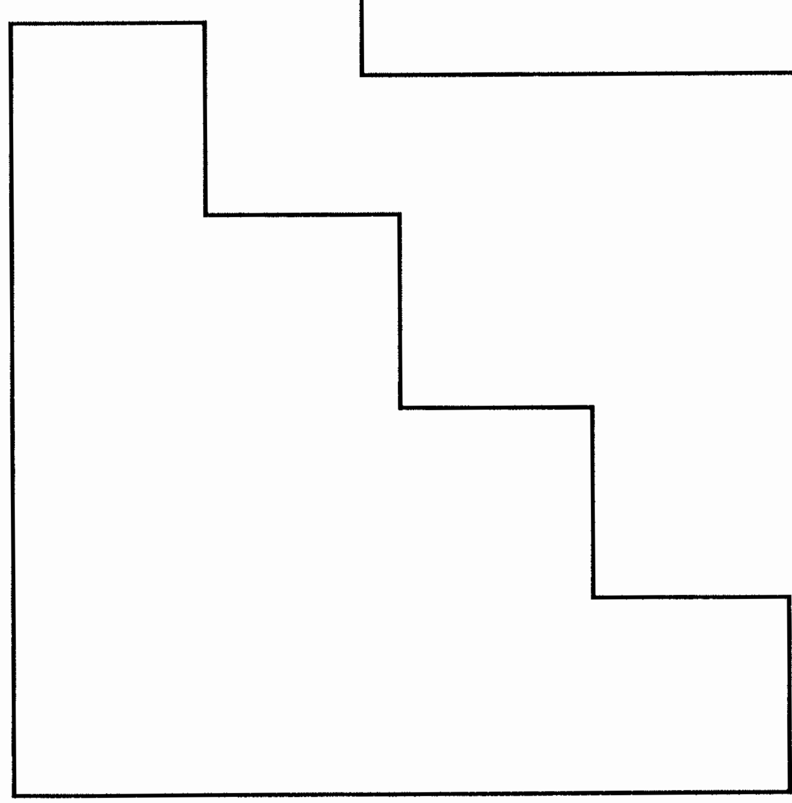


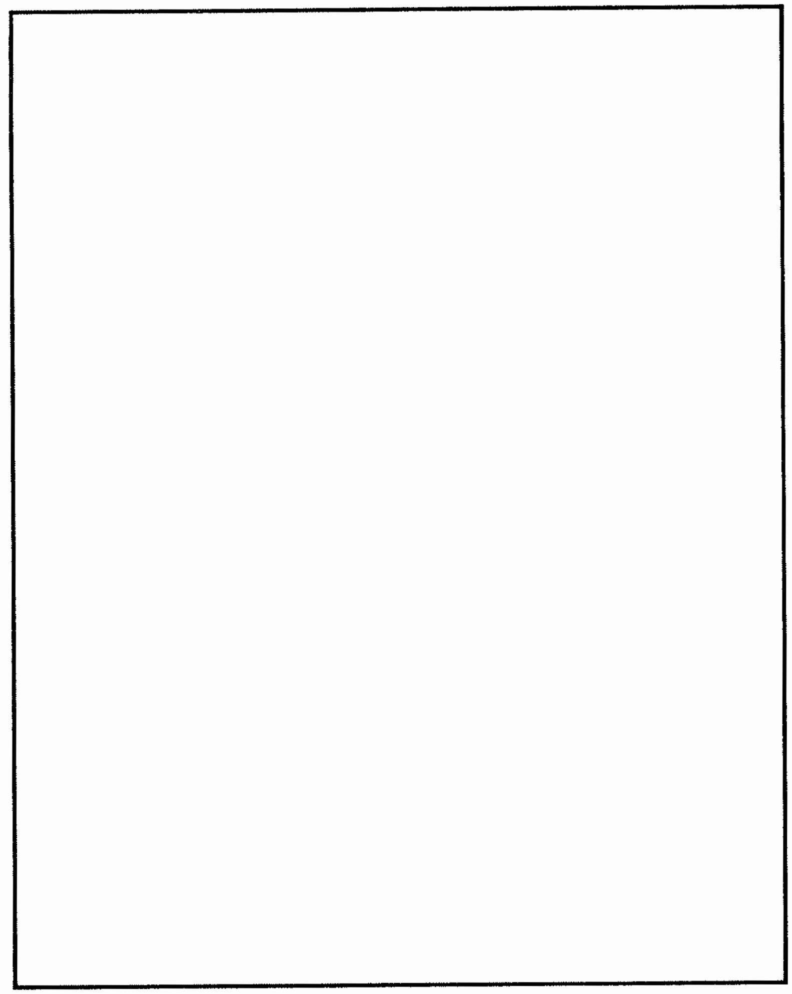


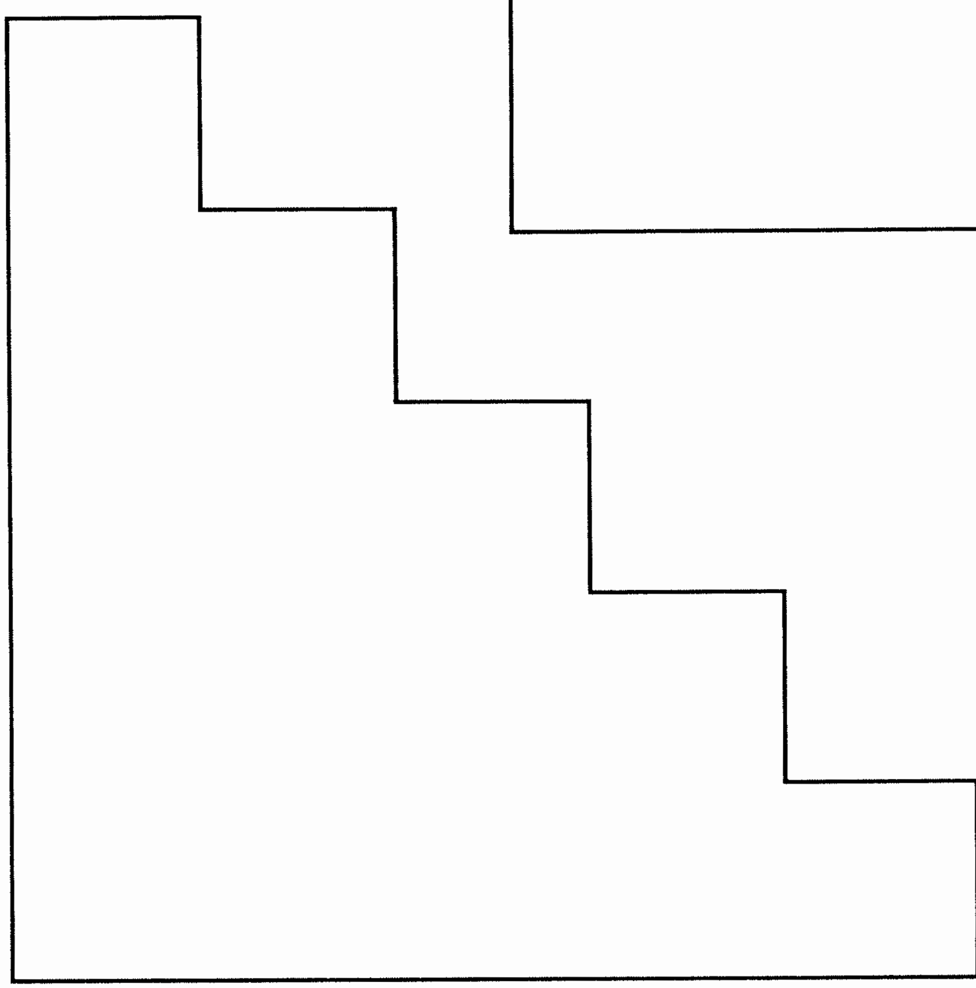












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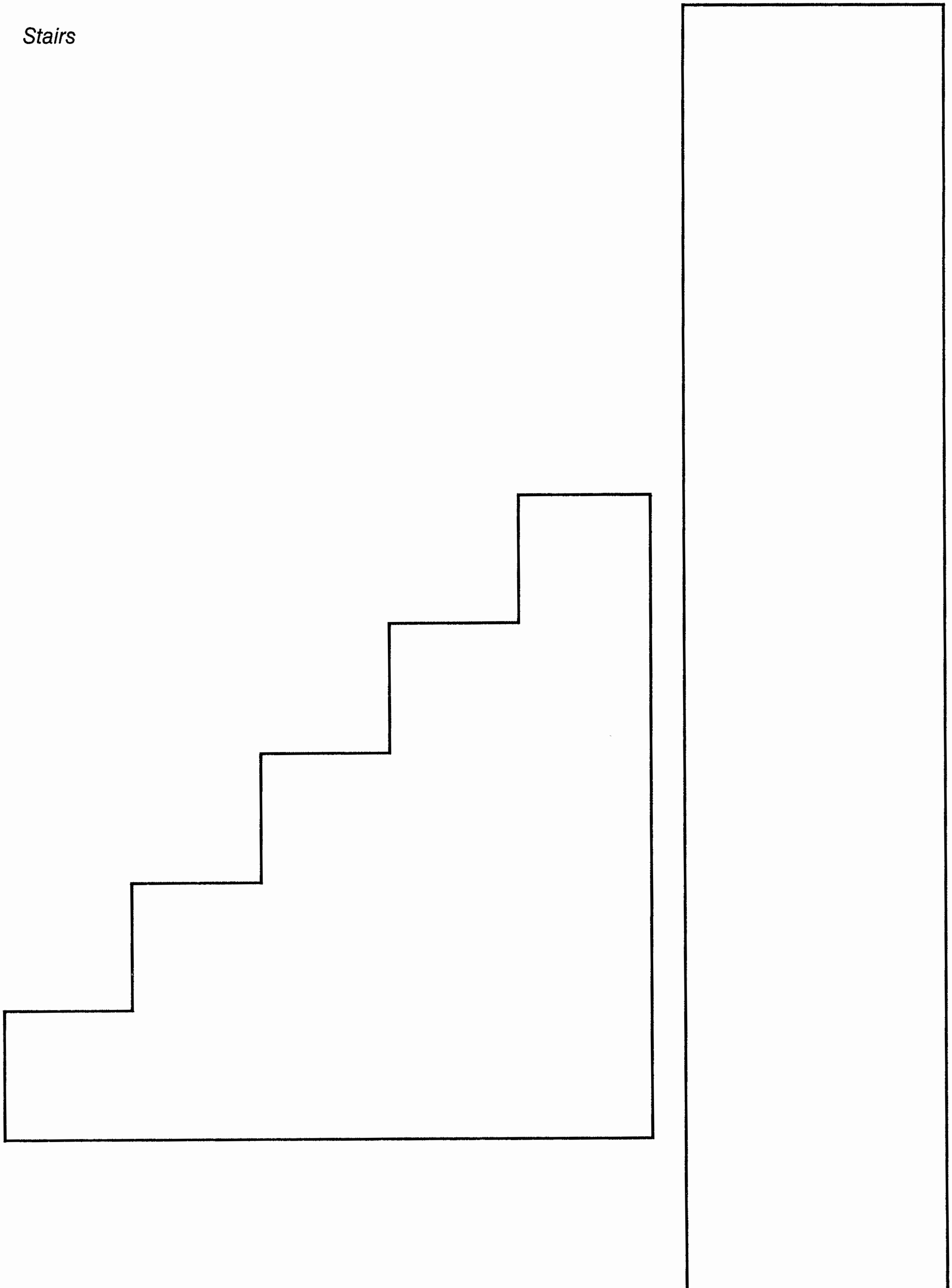

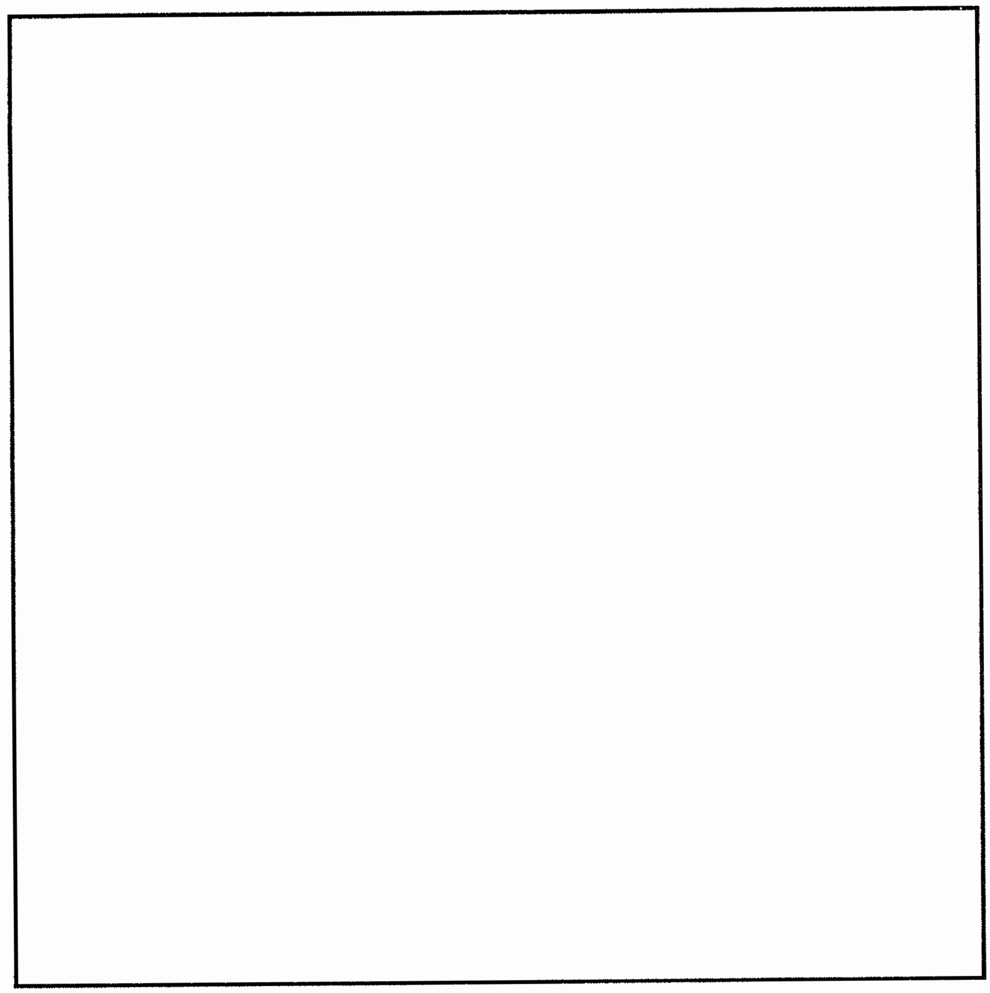

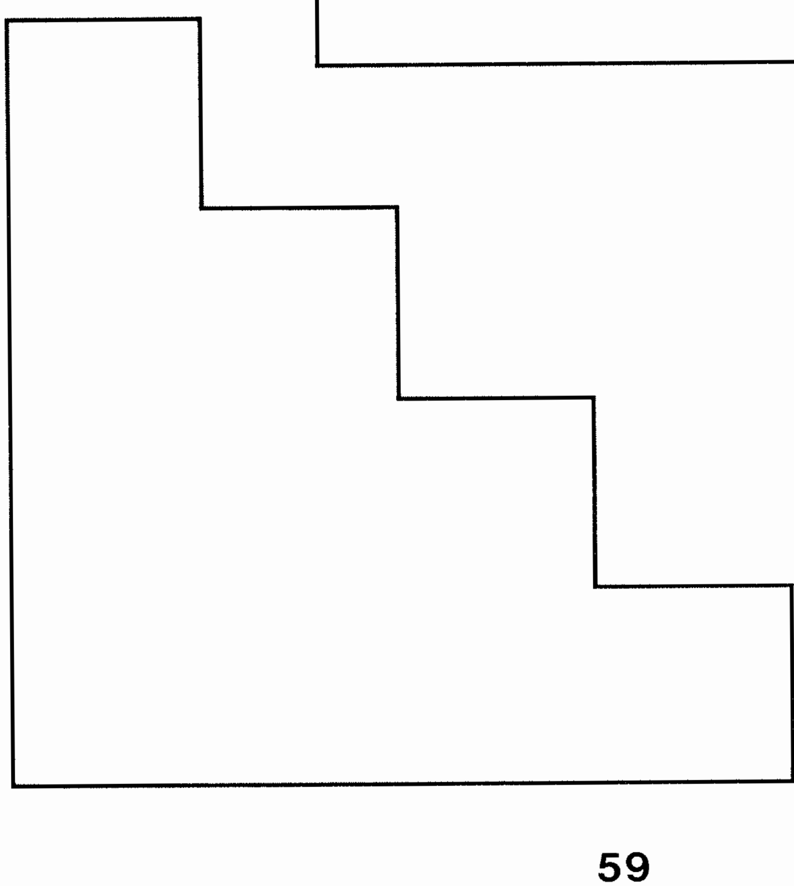

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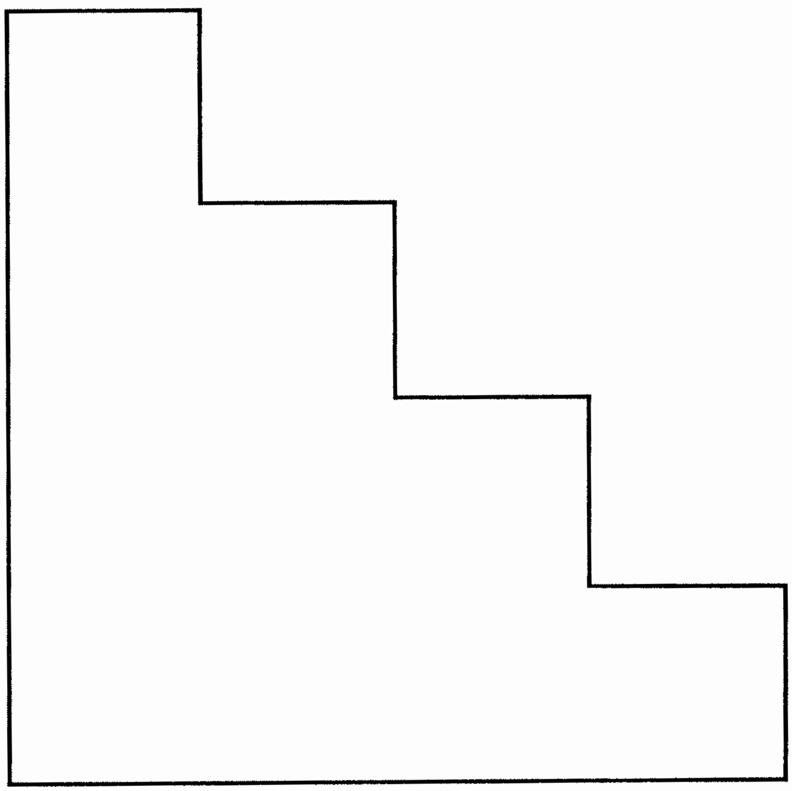

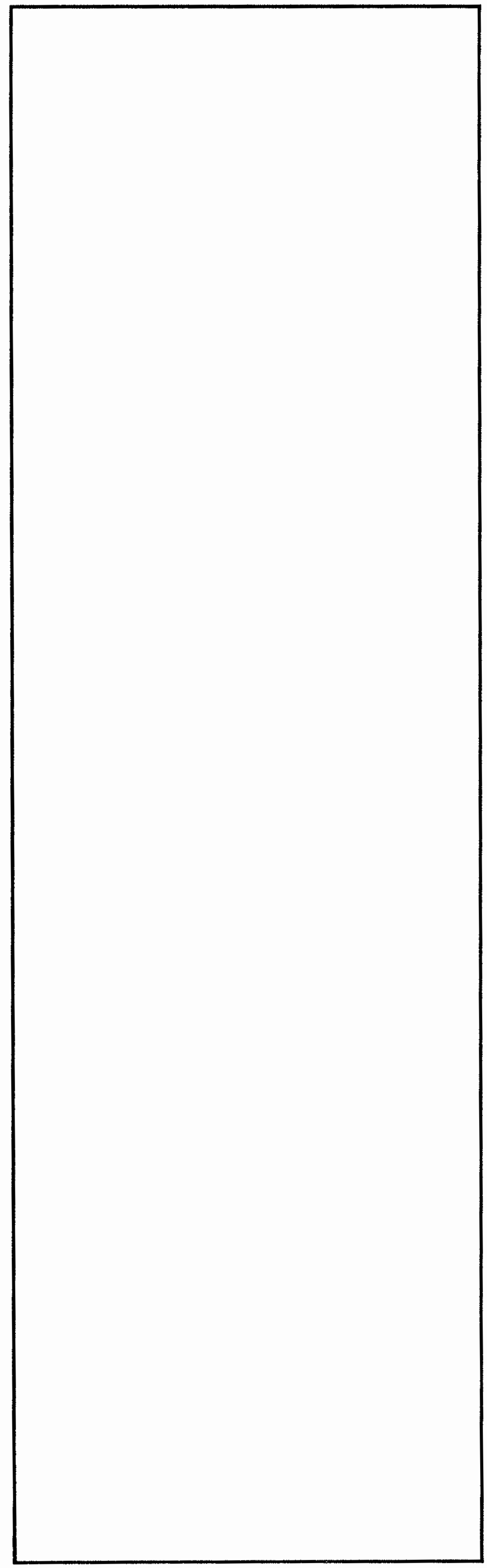

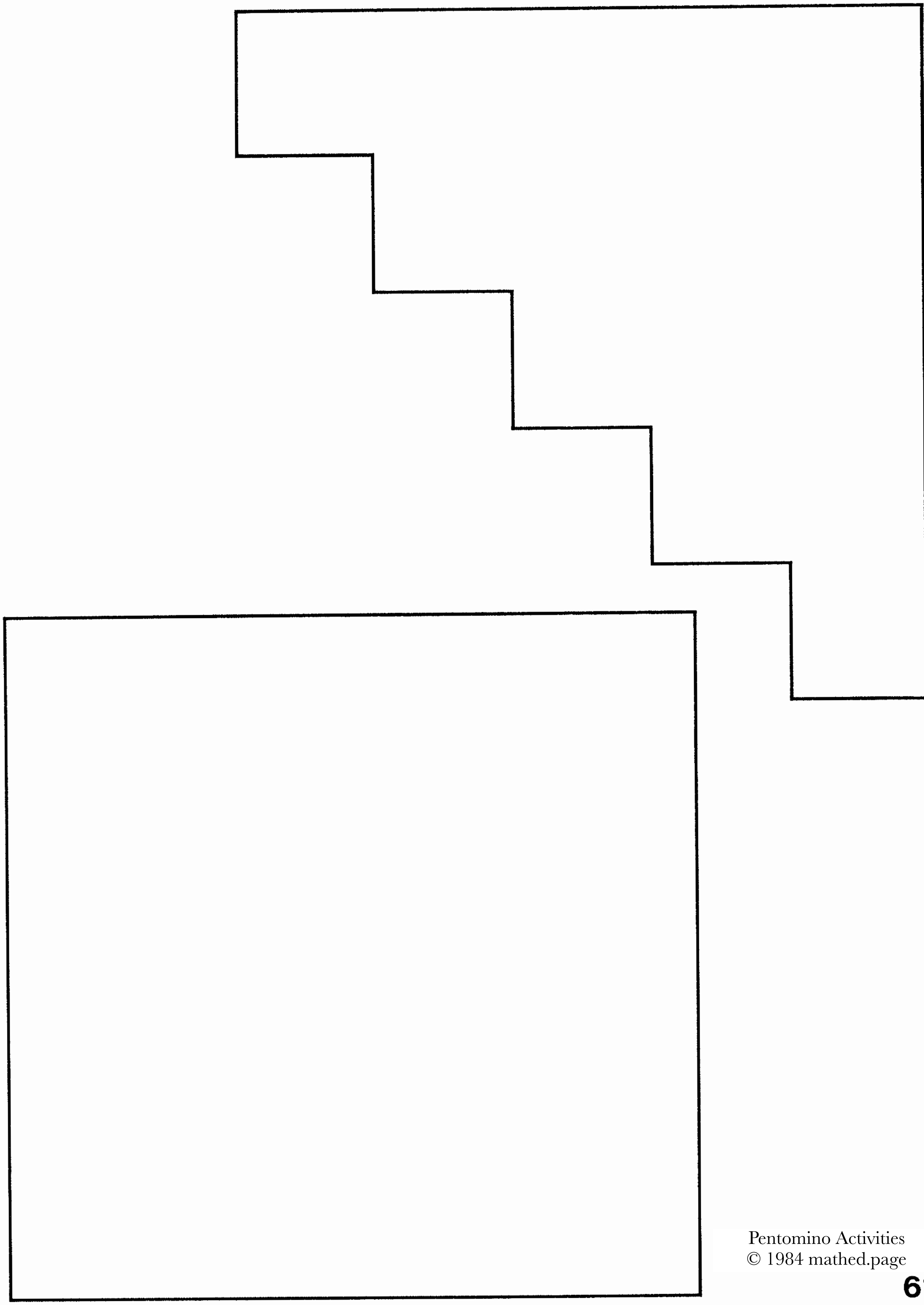

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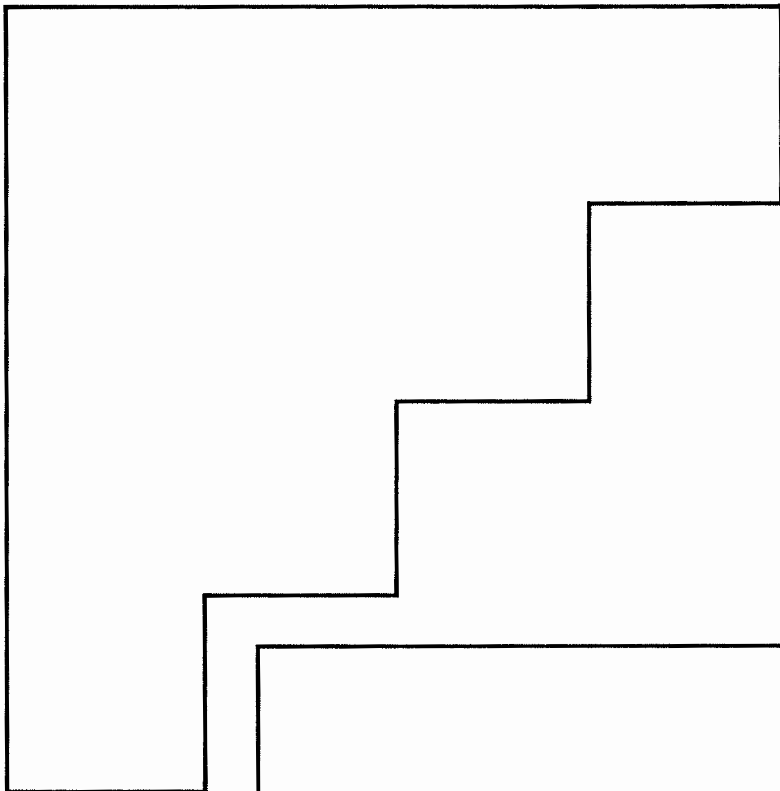

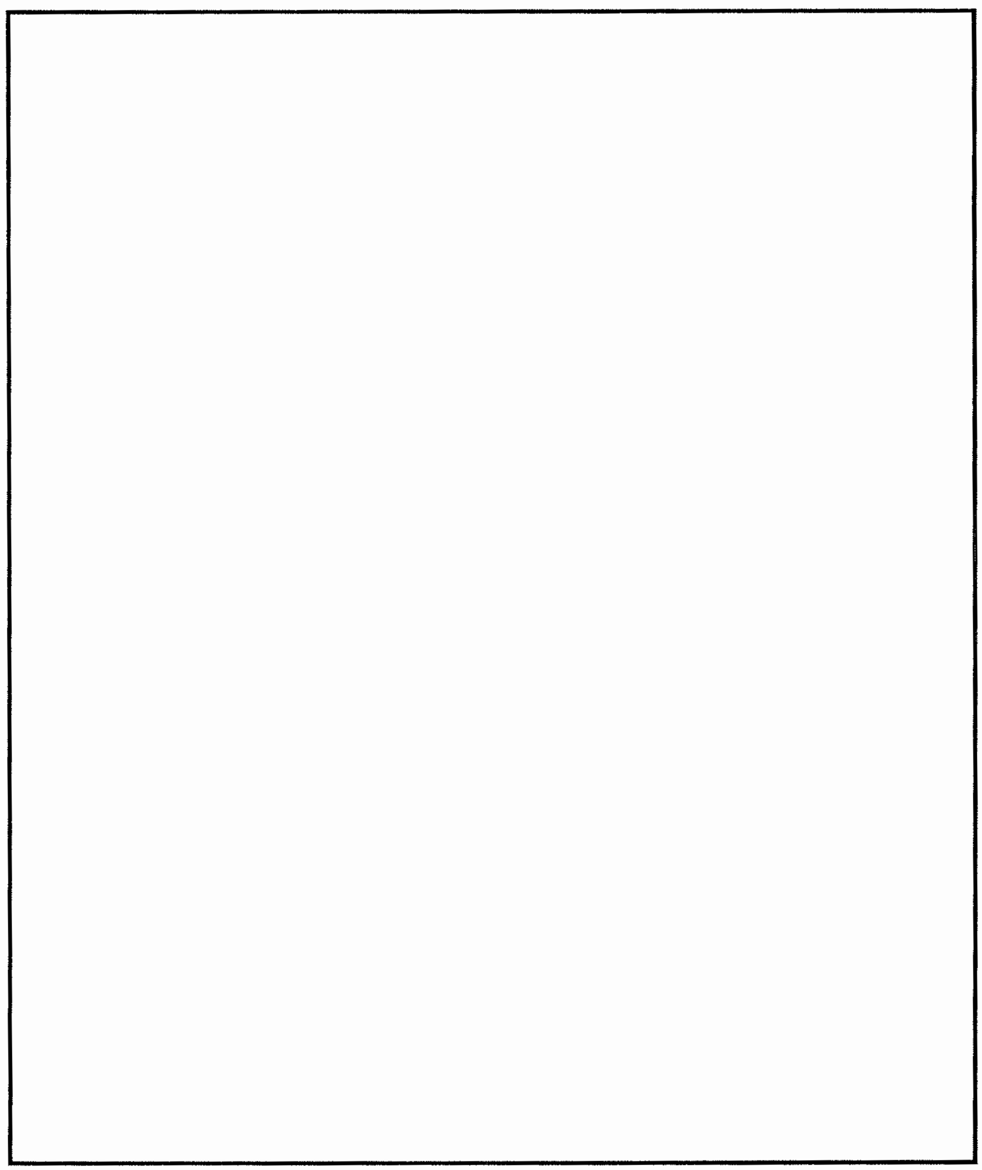

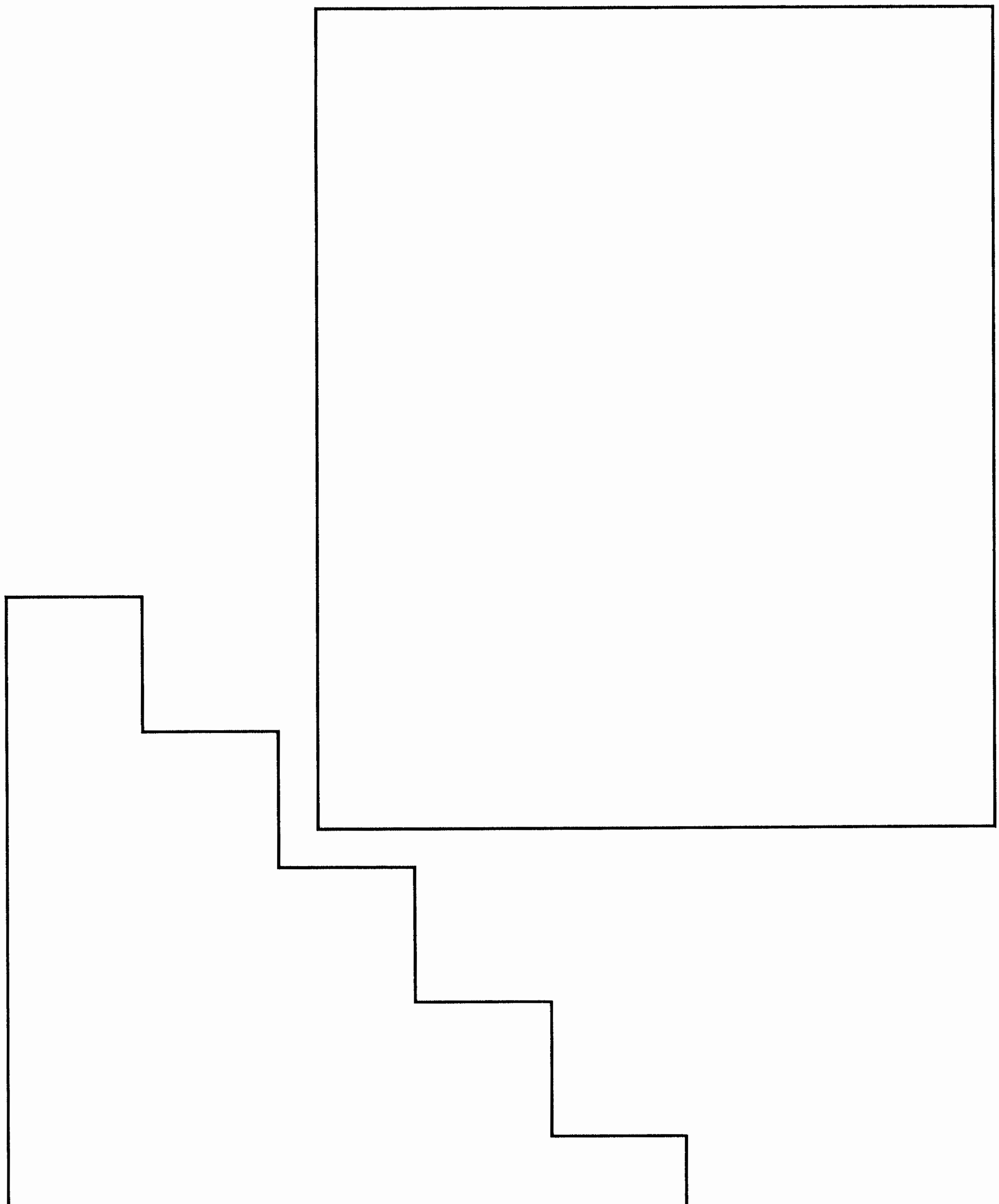

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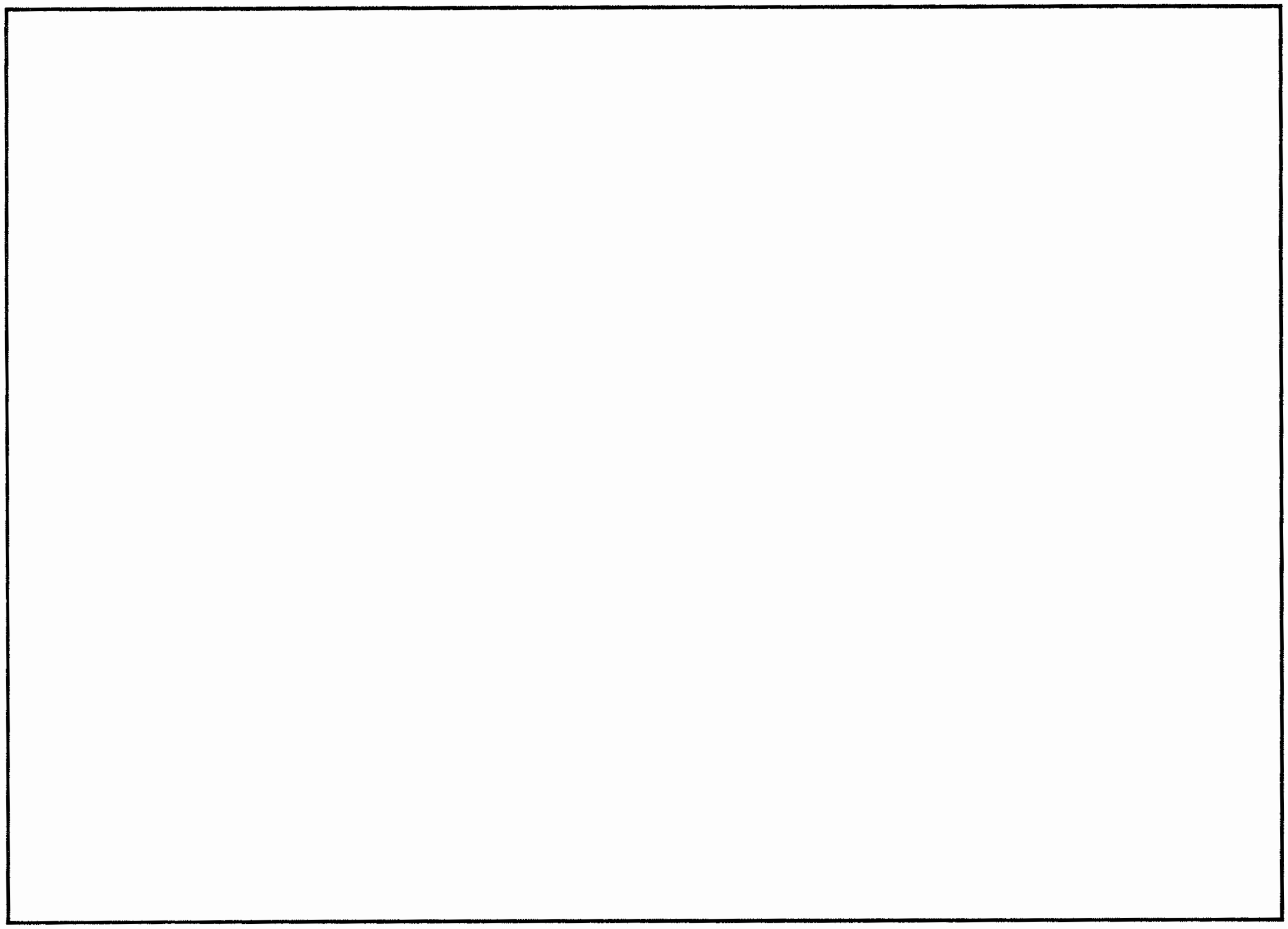
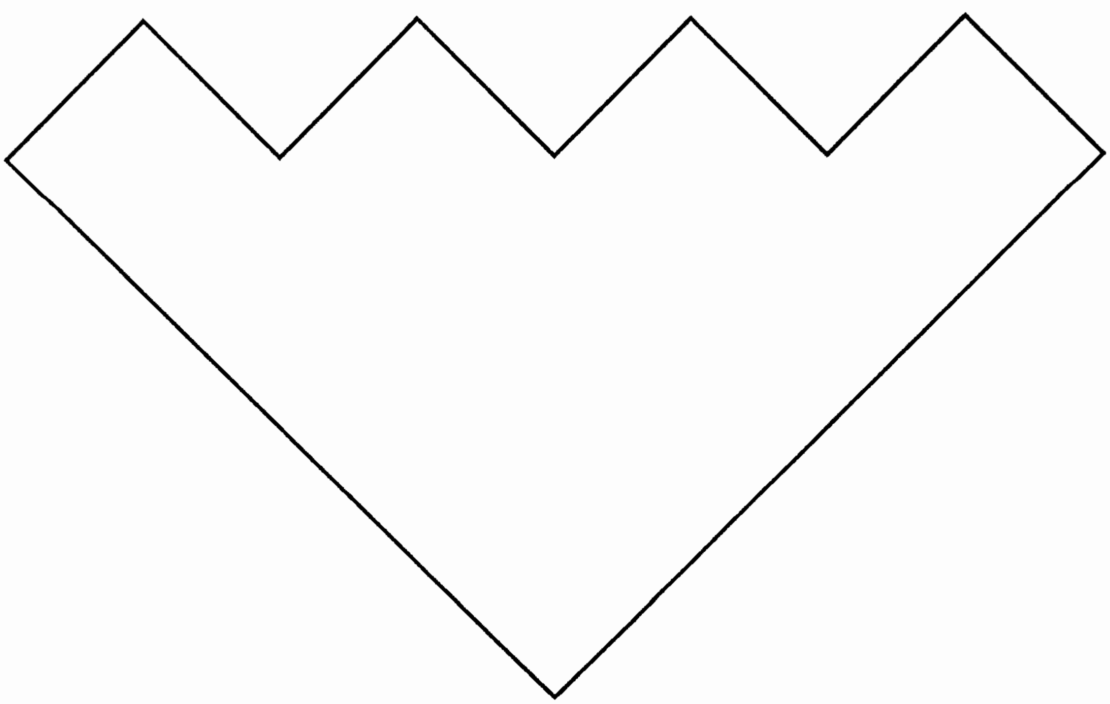
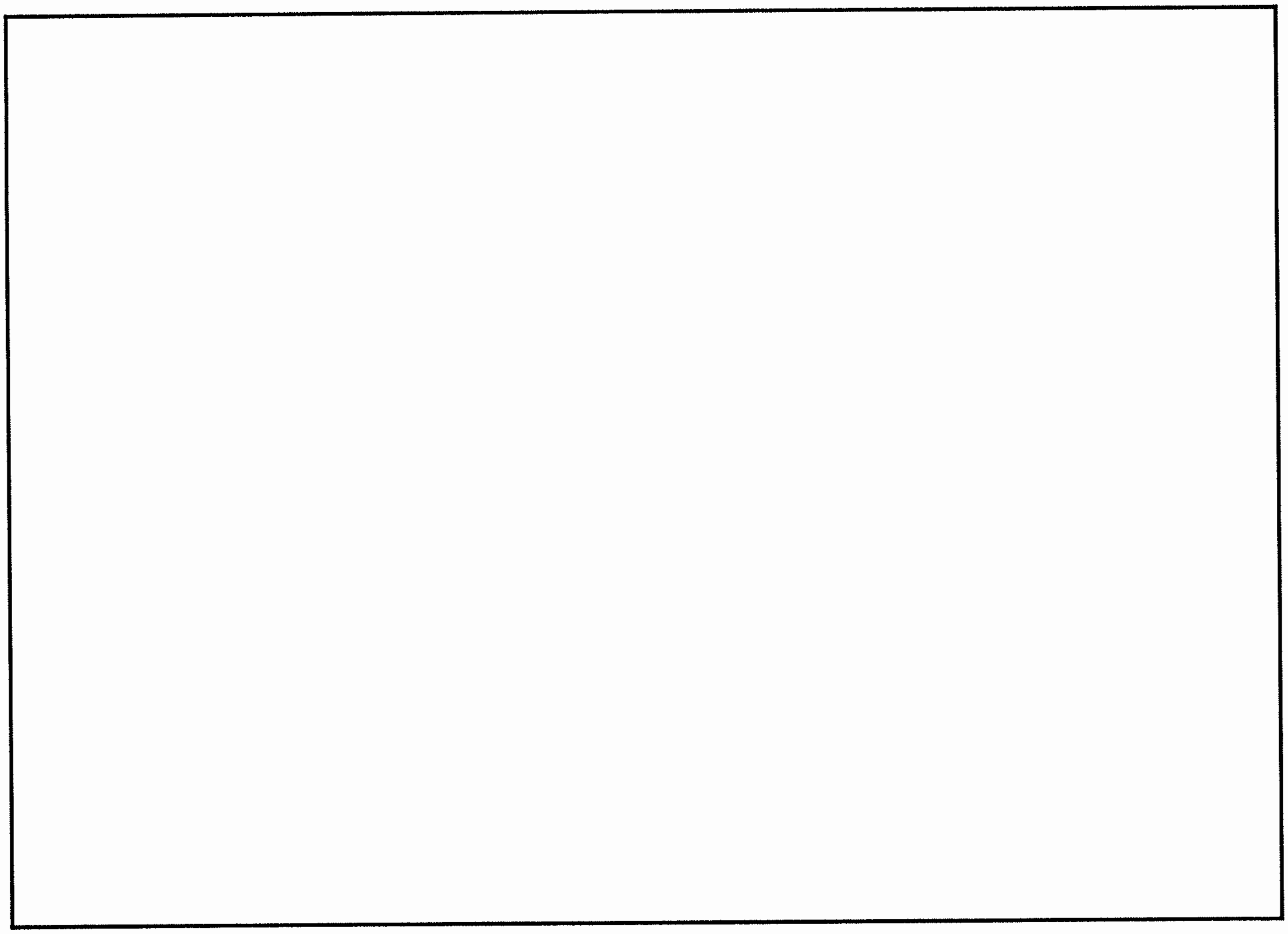
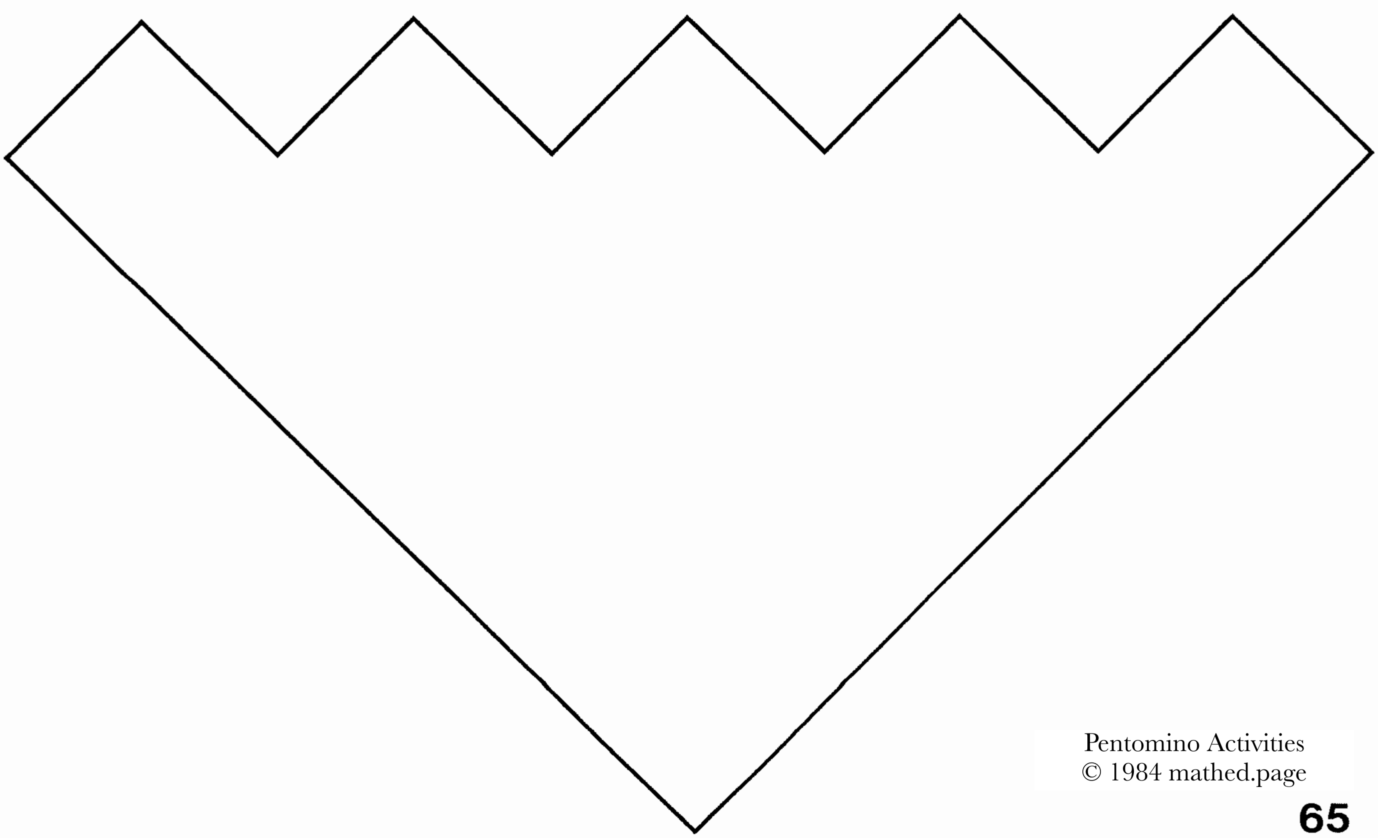
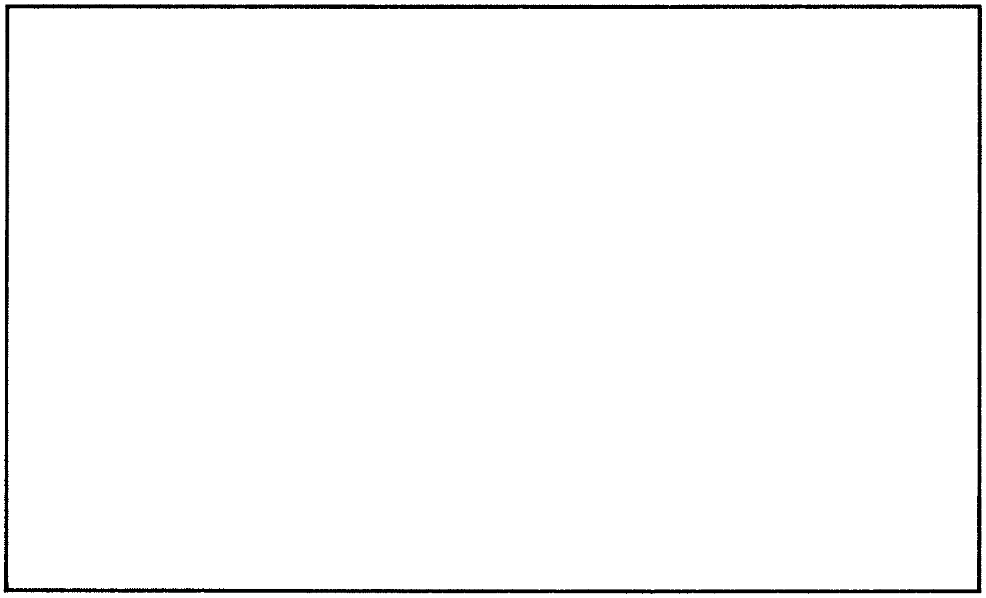
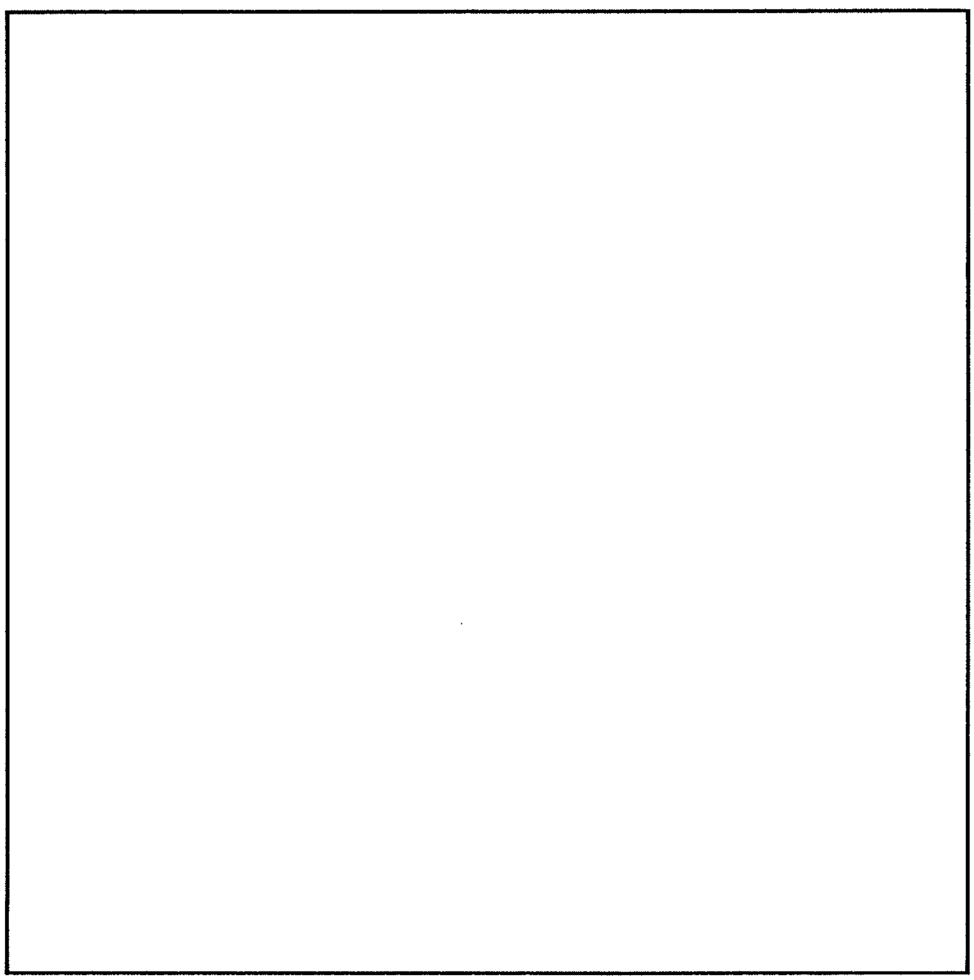




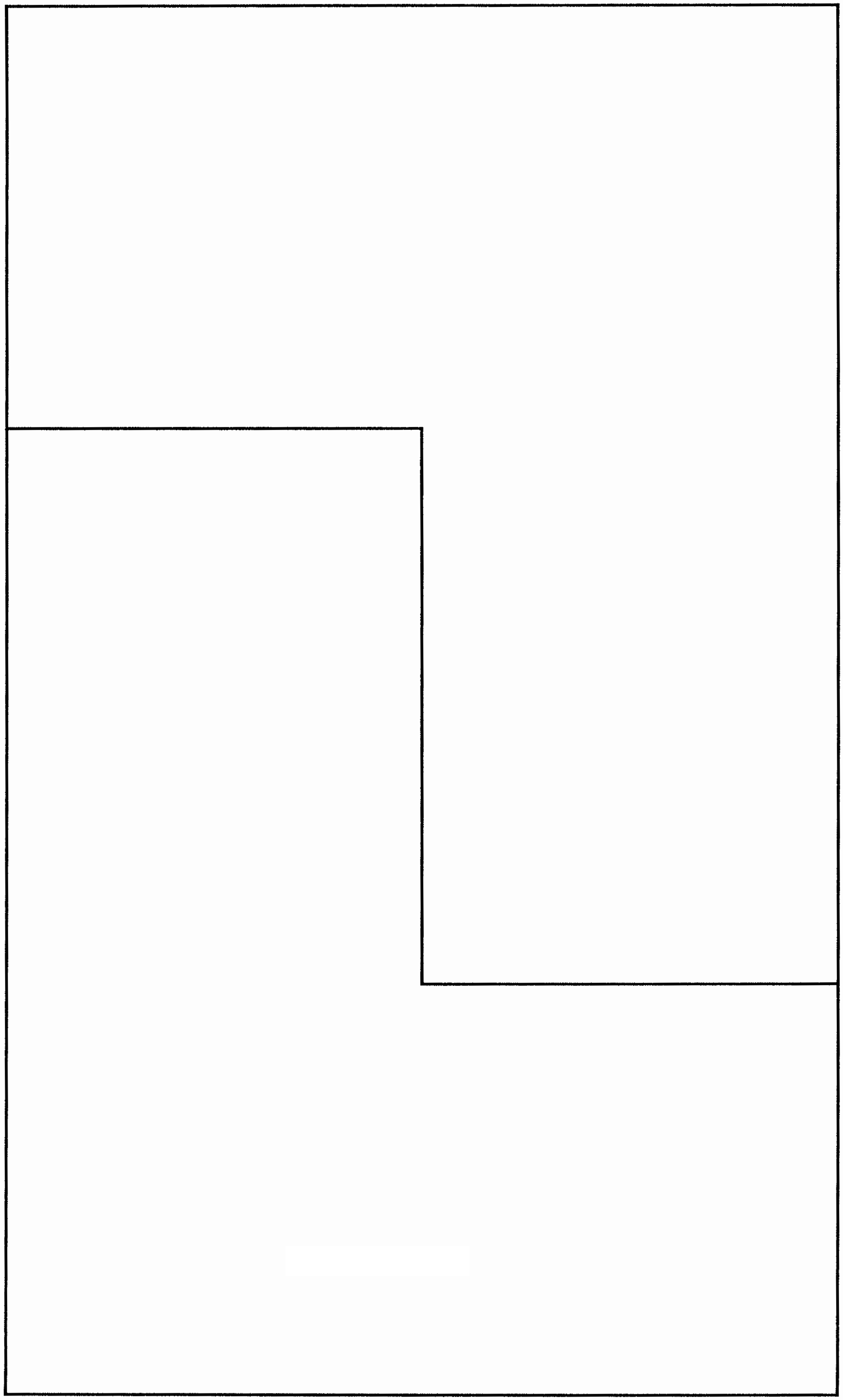


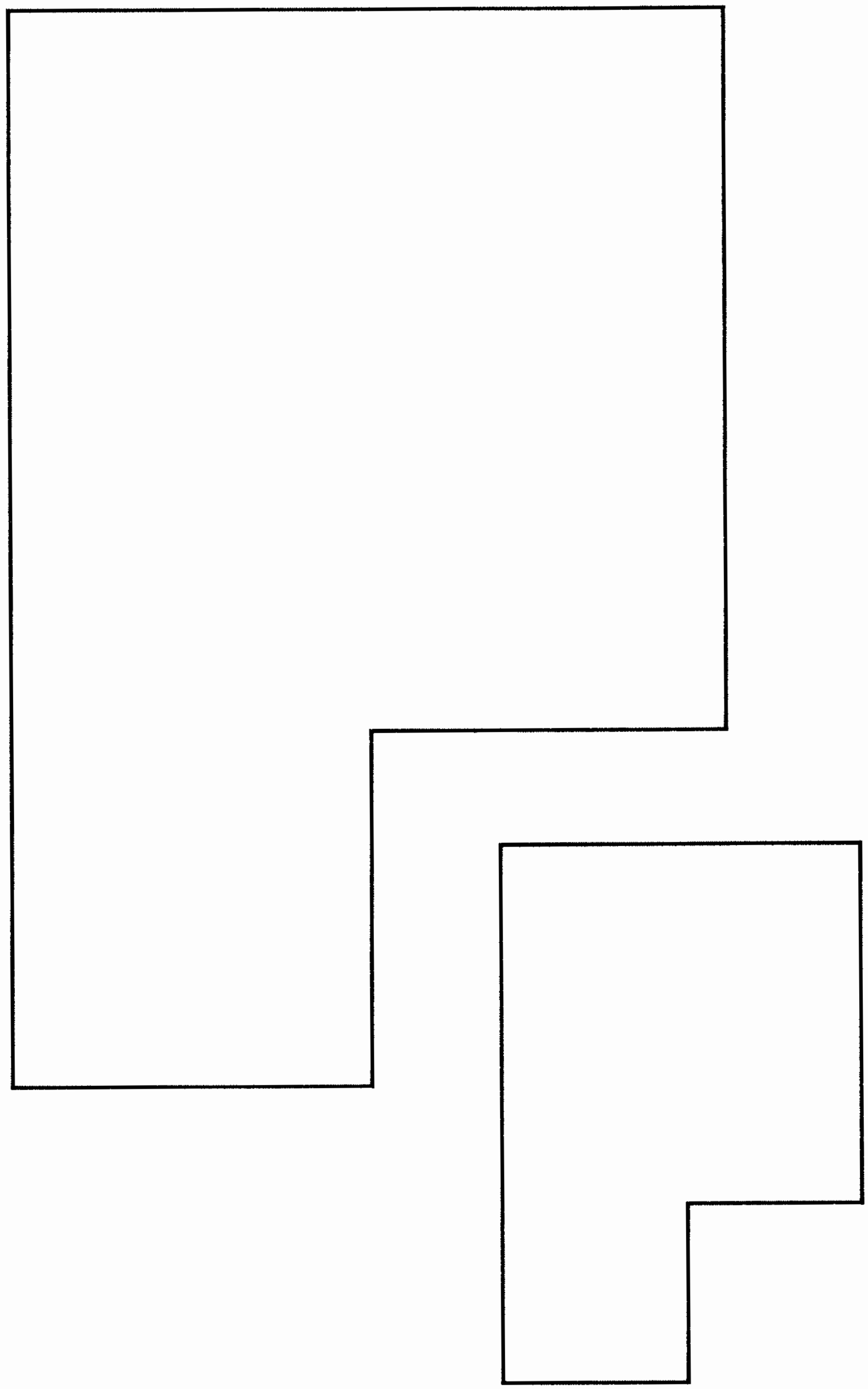


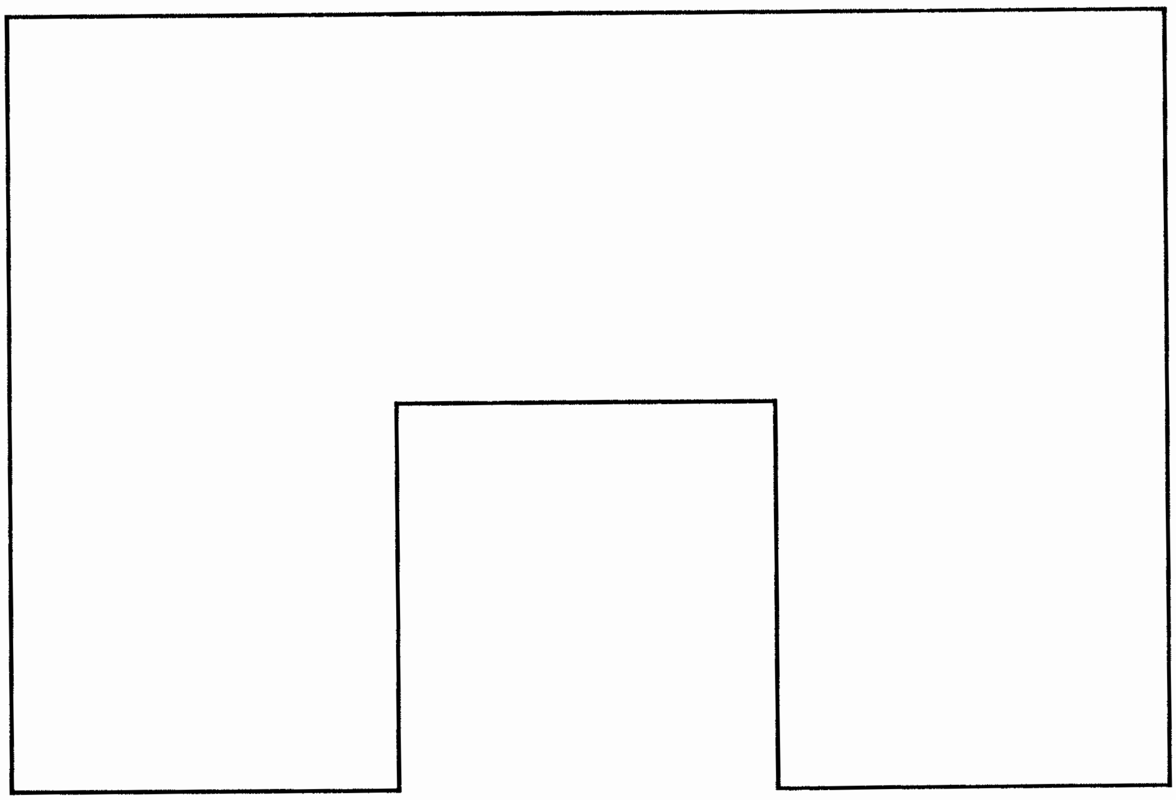


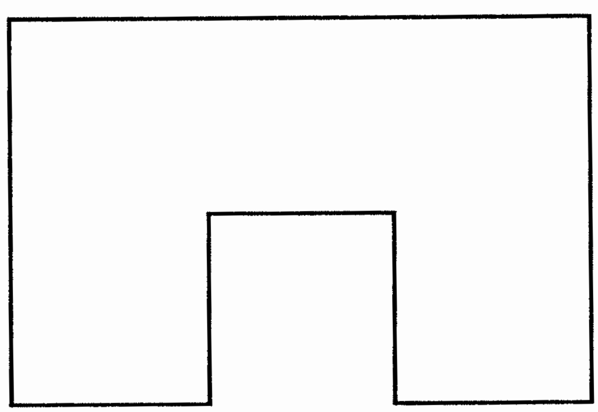


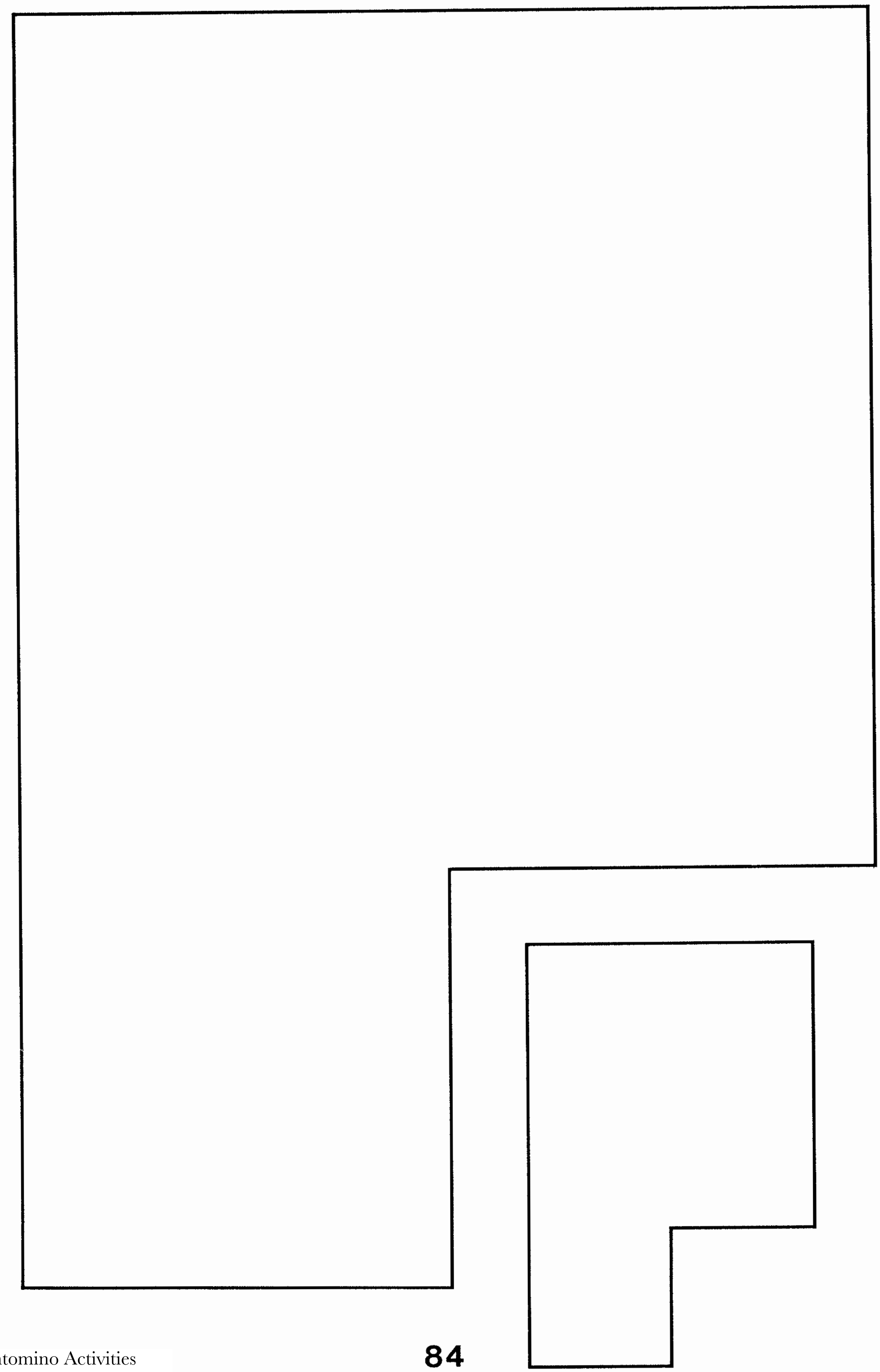
Rectangles

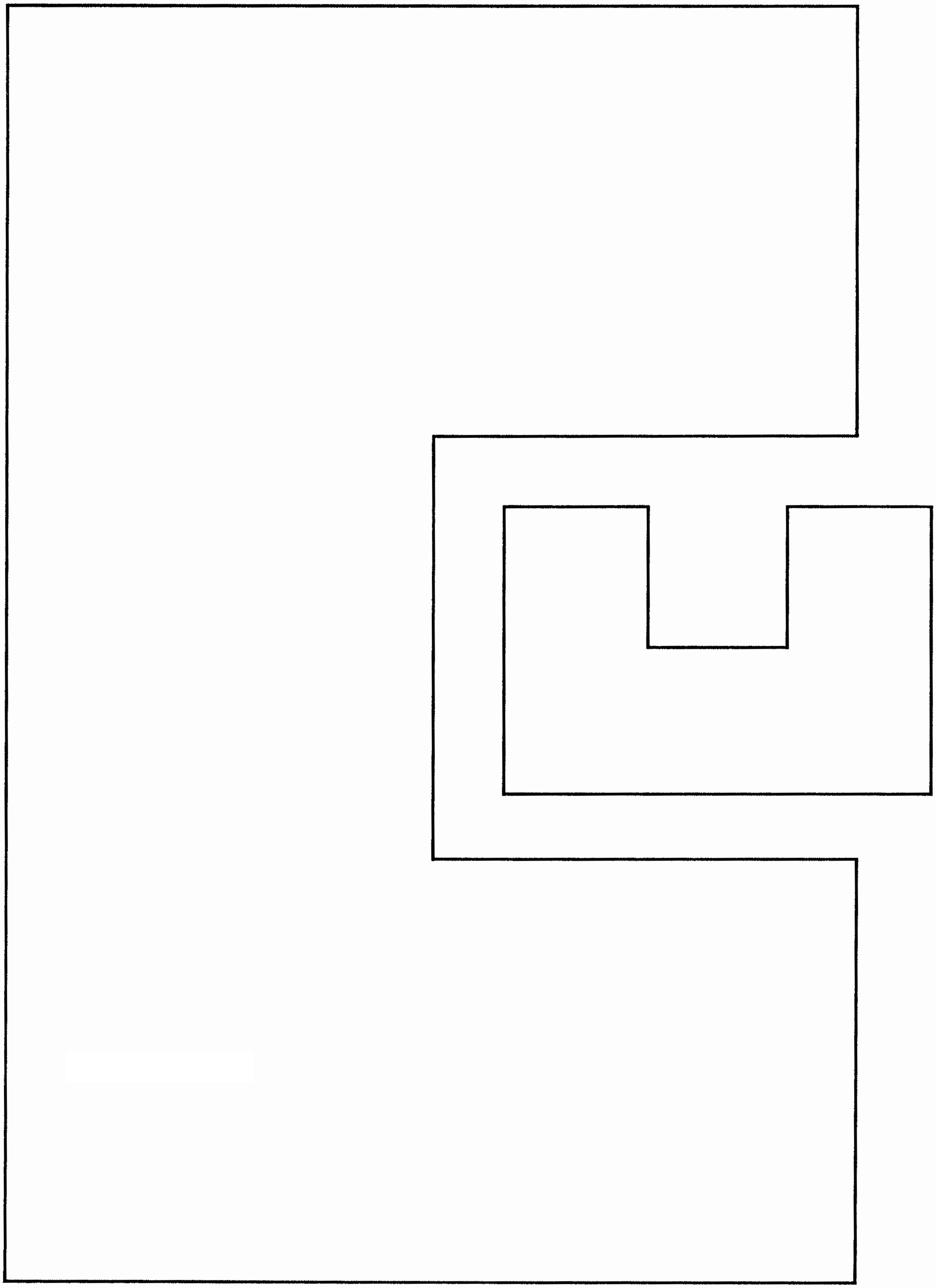


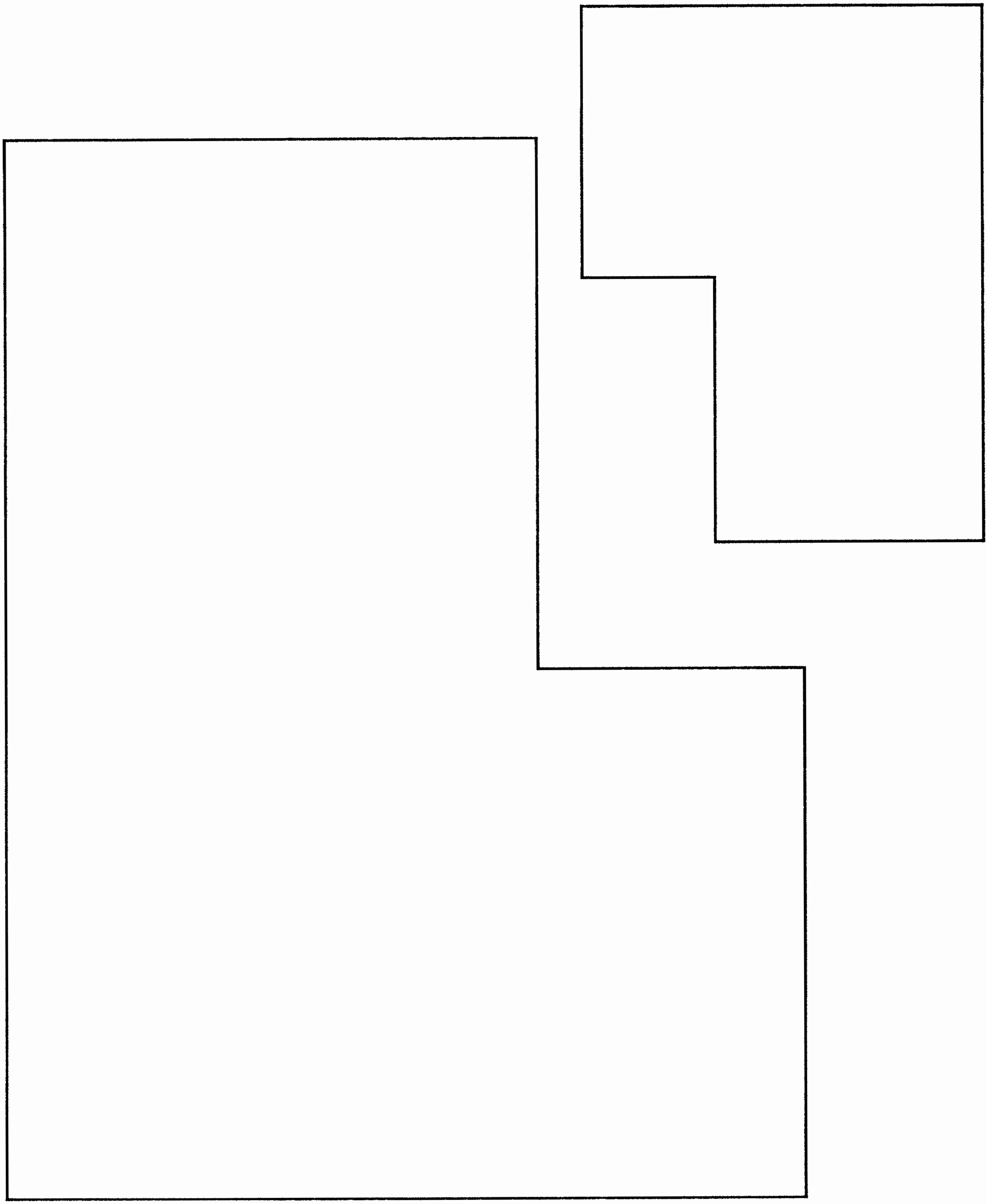


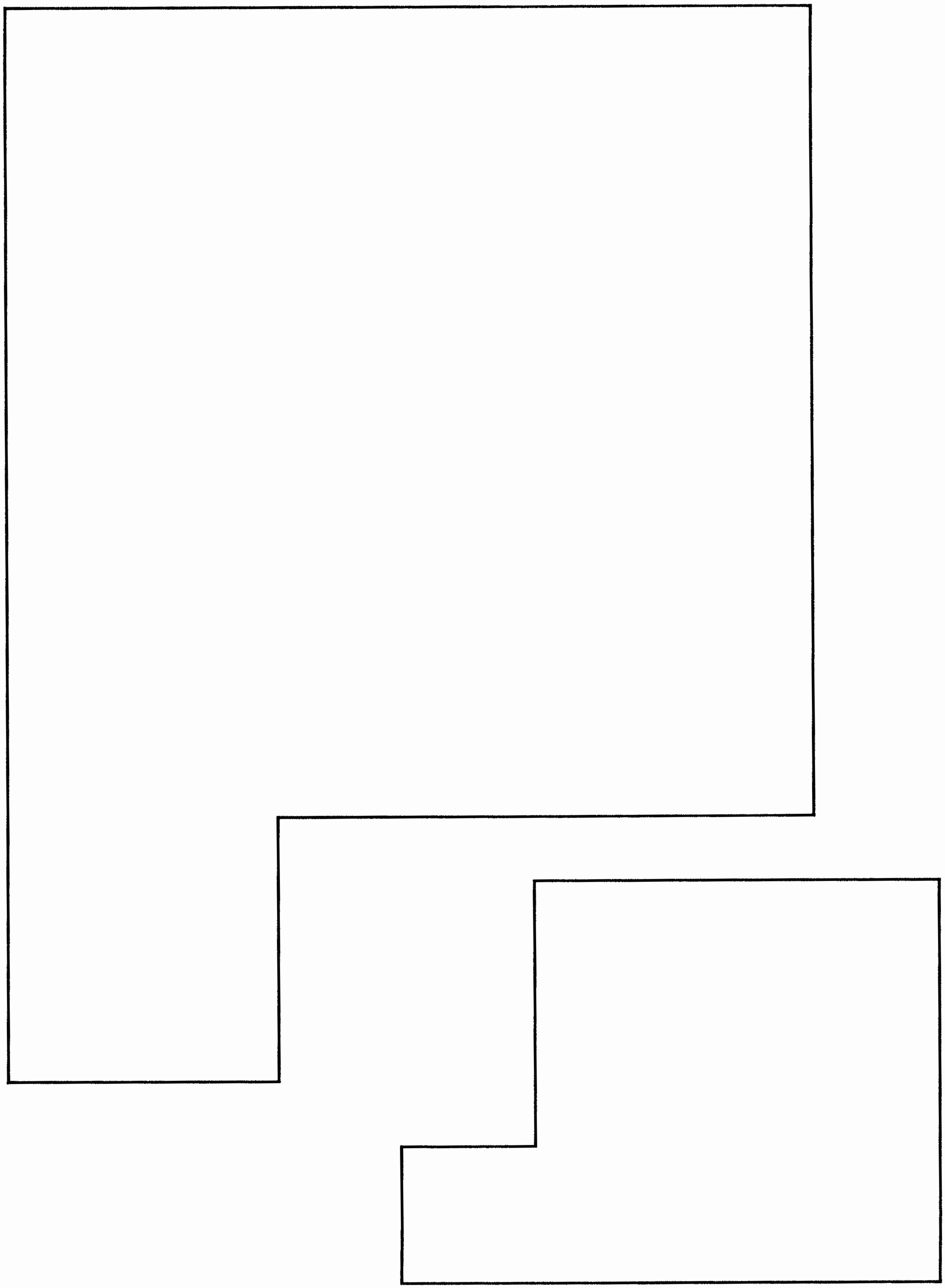


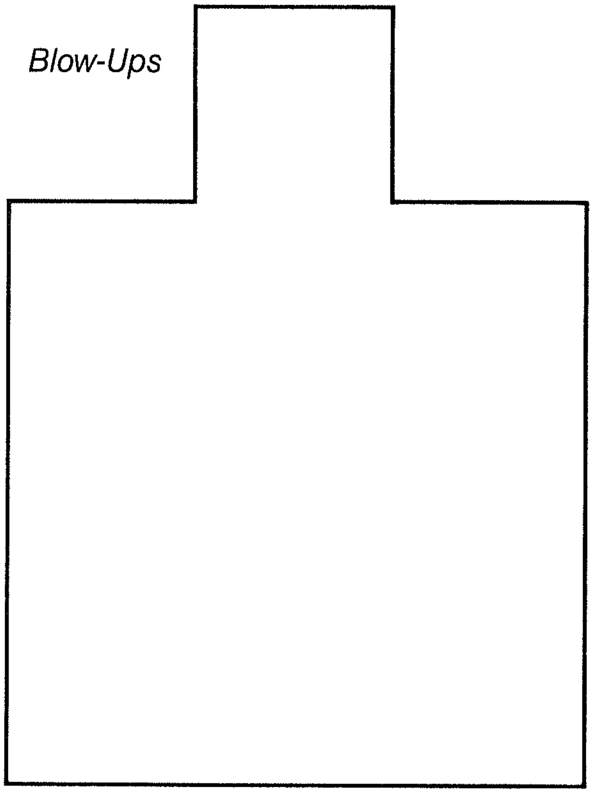


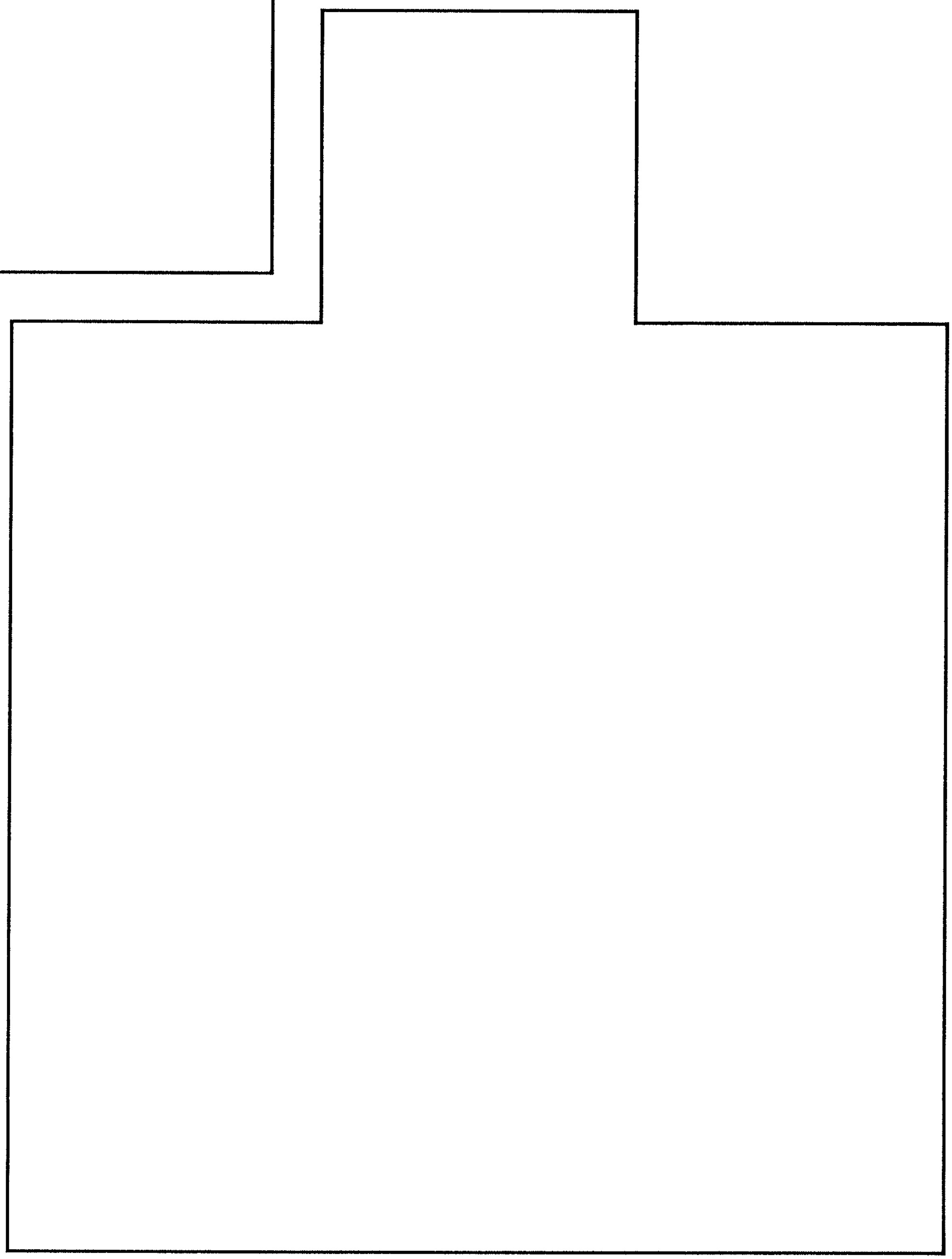












Solutions

You will learn the most from these solutions by not looking at them until you have solved the puzzles by yourself and recorded your solutions. Then compare your solutions to those given. (If they differ, please send the author a copy of your solutions.)

The solutions to figures that consist of only a few pentominoes are given by the letter names of the pieces involved. If you have forgotten the letter names of the pieces, refer to Notes.

Many puzzles involve two- and three-pentomino stairs, and 3x5 and 4x5 rectangles. The solutions to these four basic shapes are illustrated in Figures 1 through 4, and are referred to below by the names of the pieces used in each instance.

(Note that the following 4x5 rectangles are not used in the solutions mentioned above, and are therefore not illustrated: ILPV, ILTY, LPTV, LPUY, LPVY, LPVZ, LPWY, LPYZ, LUVY, NPUY.)

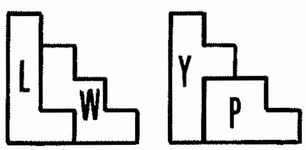


Fig. 1 Two-pentomino stairs

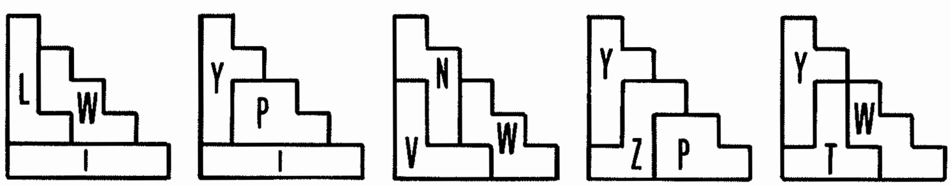


Fig. 2 Three-pentomino stairs

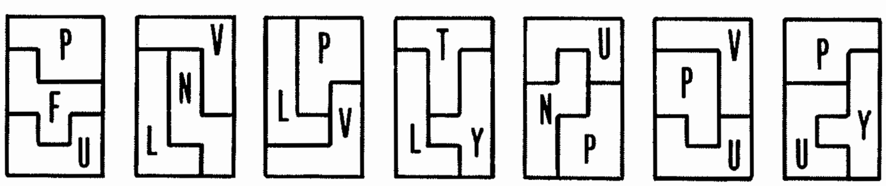


Fig. 3 3x5 rectangles

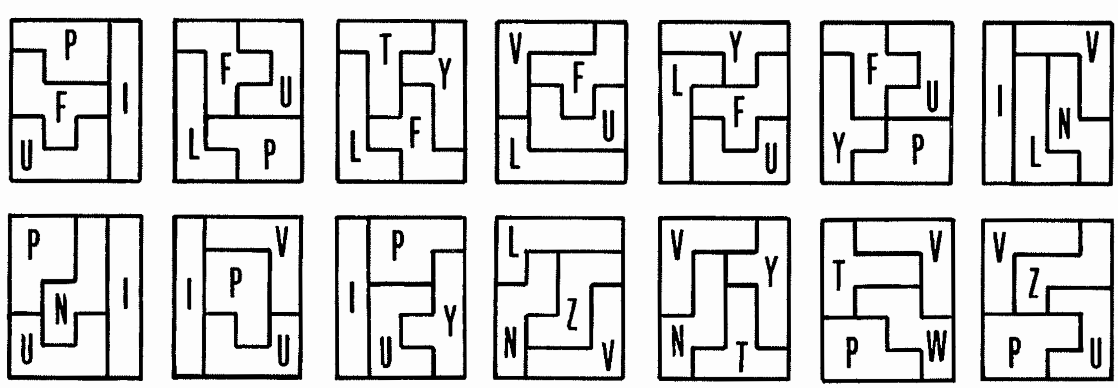


Fig. 4 4x5 rectangles

Congruent pairs:

5: PY, WX
6: UY, VX
7: NV, TU
8: NP, UX
9: IU, TZ
10: FT, IU
11: FL, TY

Congruent triples:

12: FY, LZ, NV
13: FP, LY, NZ
14: LN, PT, WZ
15: FP, NZ, TU
16: FT, NY, PZ
17: LN, PU, VZ

Three-pentomino stairs:

18: PYZ
19: NVW
20: TWY
21: IPY
22: ILW

3x5 rectangles:

23: LTY
24: LPV
25: FPU
26: PUY
27: PUV
28: NPU
29: LNV

4x5 rectangles:

30: FLUV
31: NTVY
32: PTVW

Pairs of three-pentomino stairs:

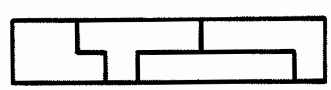
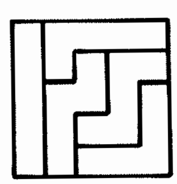
33: IPY, NVW
34: ILW, PYZ
35: NVW, PYZ

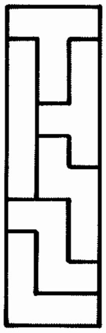
Pairs of 3x5 rectangles:

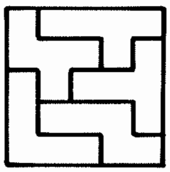
36: LTY, NPU
37: LTY, PUV
38: LNV, PUY
39: LTY, FPU
40: LNV, FPU

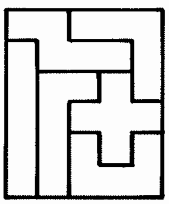
Pairs of 4x5 rectangles:

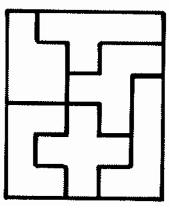
41: FLPU, NTVY
42: FPUY, ILNV
43: FLUY, PTVW
44: FLTY, IPUV
45: FPUY, LNVZ
46: FIPU, NTVY
47: FIPU, LNVZ
48: IPUY, LNVZ
49: FLTY, INPU
50: FLTY, PUVZ
51: ILTY, PUVZ

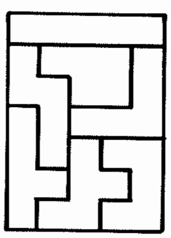
52: LW, PY
53: ILW, PY
54: LNV, PY
55: IPY, LNV
56: FW, IPUY
57: FLPU, WTY
58:  and NVW
59:  and PY

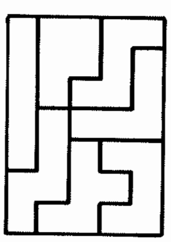
60:  and LW

61:  and ILW

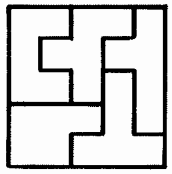
62:  and PY

63:  and NVW

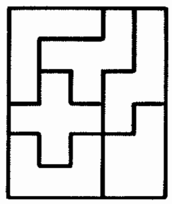
64:  and LW

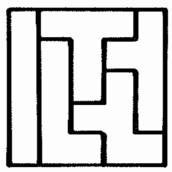
65:  and TWY

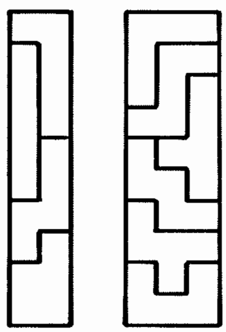
66: FLPU, NTVY

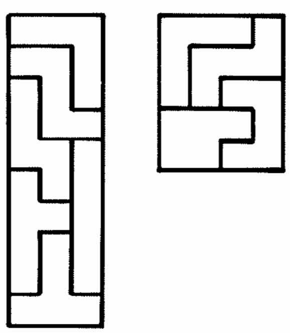
67:  and LNV

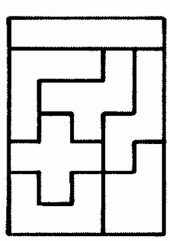
68: FLTY, NPU

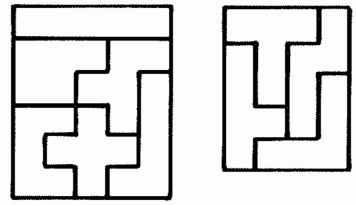
69:  and LTY

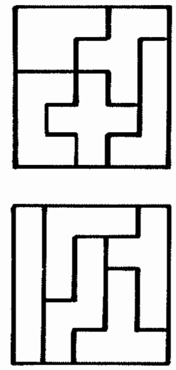
70:  and PUVZ

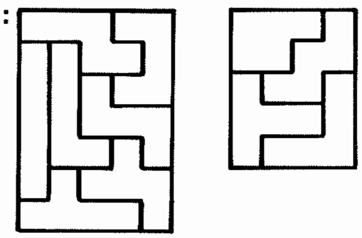
71: 

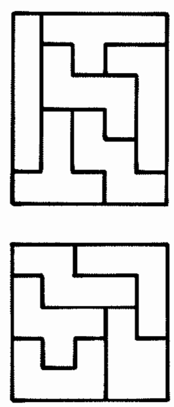
72: 

73:  and LTY

74: 

75: 

76: 

77: 

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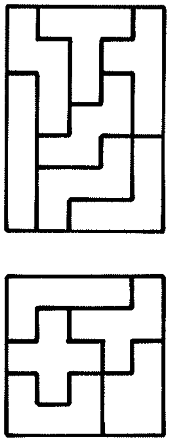

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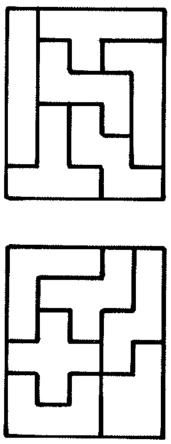

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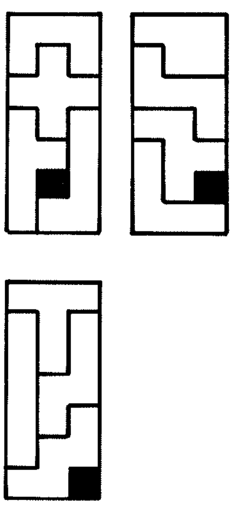

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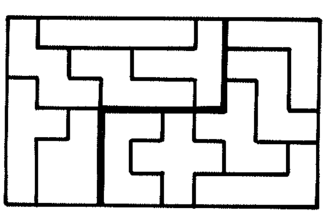

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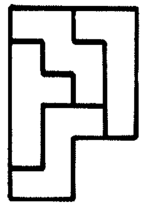

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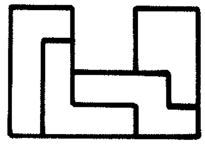
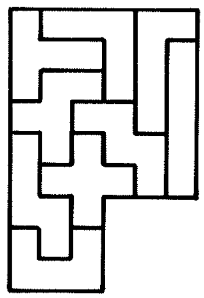


84:



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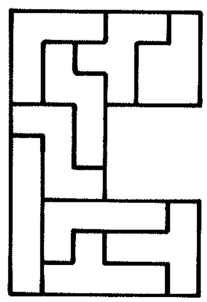

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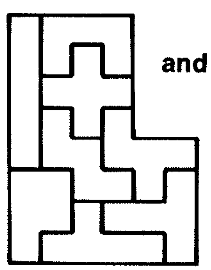
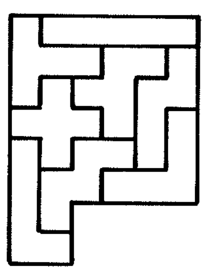


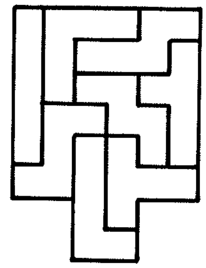
and LN or VZ

87:



and PZ or UY

88:



and FP or UX