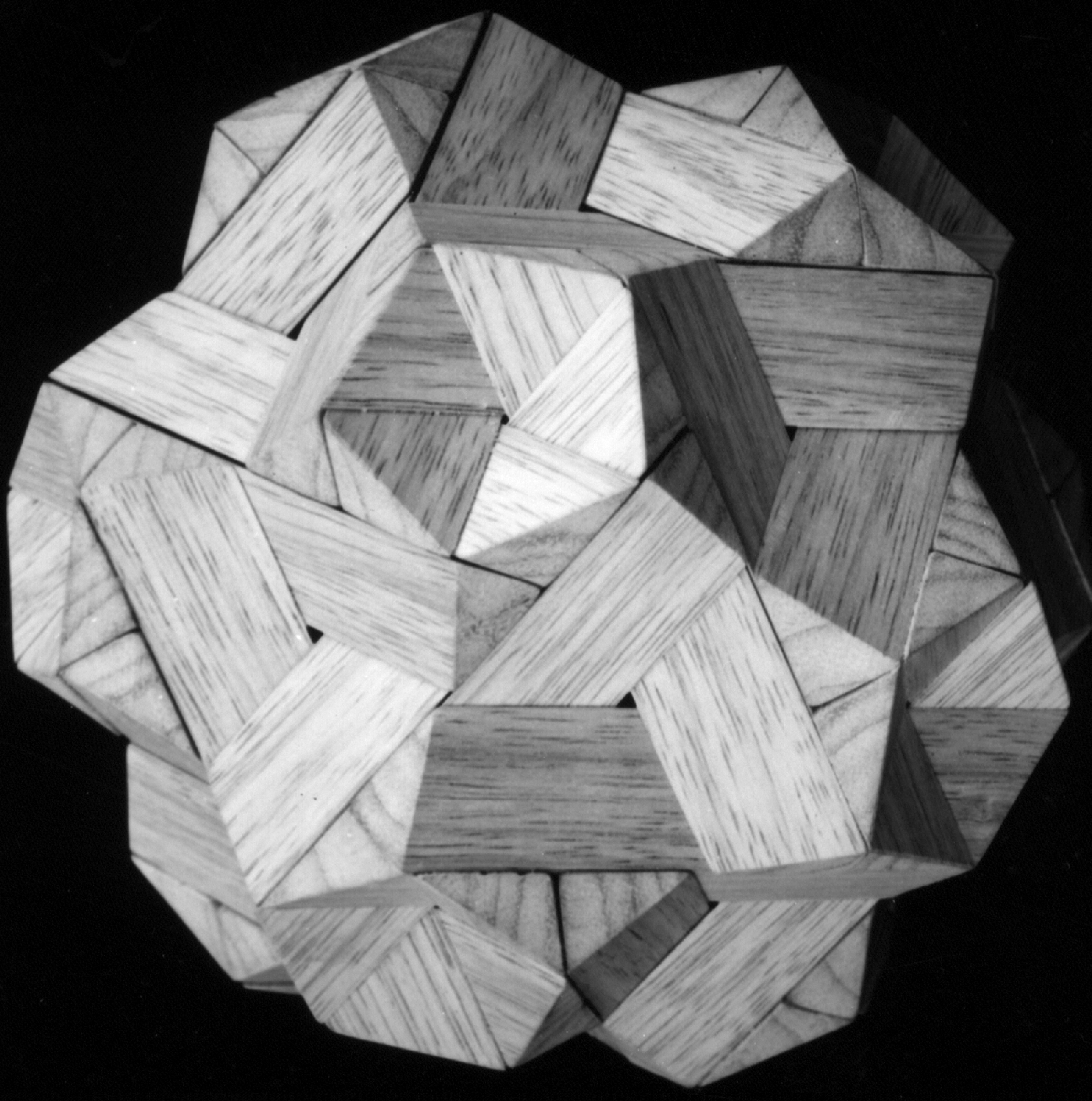
Design Notes
Puzzles 1 to 101-A



by
Stewart T. Coffin

This compilation of Stewart Coffin's design notes are for designs 1 to 100-A. While this represents far more than 100 puzzles, notes to not exist for many puzzles. They are reproduced unaltered as he kept them. It is unlikely that having these notes alone will be of much use. The book, AP-ART, A Compendium of Puzzle Designs or Puzzle Instructions and Ephemera will tie in the numbered design notes with the resulting puzzles.

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#1

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December 7, 1970

DESCRIPTION OF PUZZLE NO. 9, ORTHO-CUBE

Puzzle No. 9, ORTHO-CUBE, consists of twelve orthogonal interlocking pieces which may be fit together to form a cubic assembly having a square hole in the center of each face. There are three types of pieces, four of each type. An unusual feature of this puzzle is that in the first step of disassembly, it comes apart into two identical halves, and in the next step, each half comes apart into two identical quarters. In the third and final step of disassembly, each quarter comes apart into three dissimilar pieces.

The basic building block of all the pieces is a cube. Since the size of this cube is incidental to this description, it will be considered as having sides one unit of length. The pieces may be regarded as being made of a string of such cubes joined together face-to-face, eight cubes for Piece A, nine cubes each for Pieces B and C. The shape of each piece may be described by imagining the path which one would take by starting at the center of the cube at one end of the piece and proceeding to the center of each successive cube in the string, as follows:

Piece A - forward three units, up one unit, left one unit, forward three units, down one unit.

Piece B - down one unit, forward three units, left one unit, down one unit, forward three units, left one unit.

Piece C - up one unit, forward three units, left one unit, down one unit, forward three units, left one unit.

To assemble each quarter of the puzzle, Pieces A and B are first fitted together, then Piece C is added. No other order is possible. The two quarters are joined by a rotating and sliding action, and the two halves are mated by simply sliding them together.

In one version of this puzzle, made of wood, the ends of each piece are darkened to produce an interesting two-toned pattern on each face of the assembly.

An instruction sheet for ORTHO-CUBE is attached herewith as part of this description.

THE ORTHO-CUBE PUZZLE

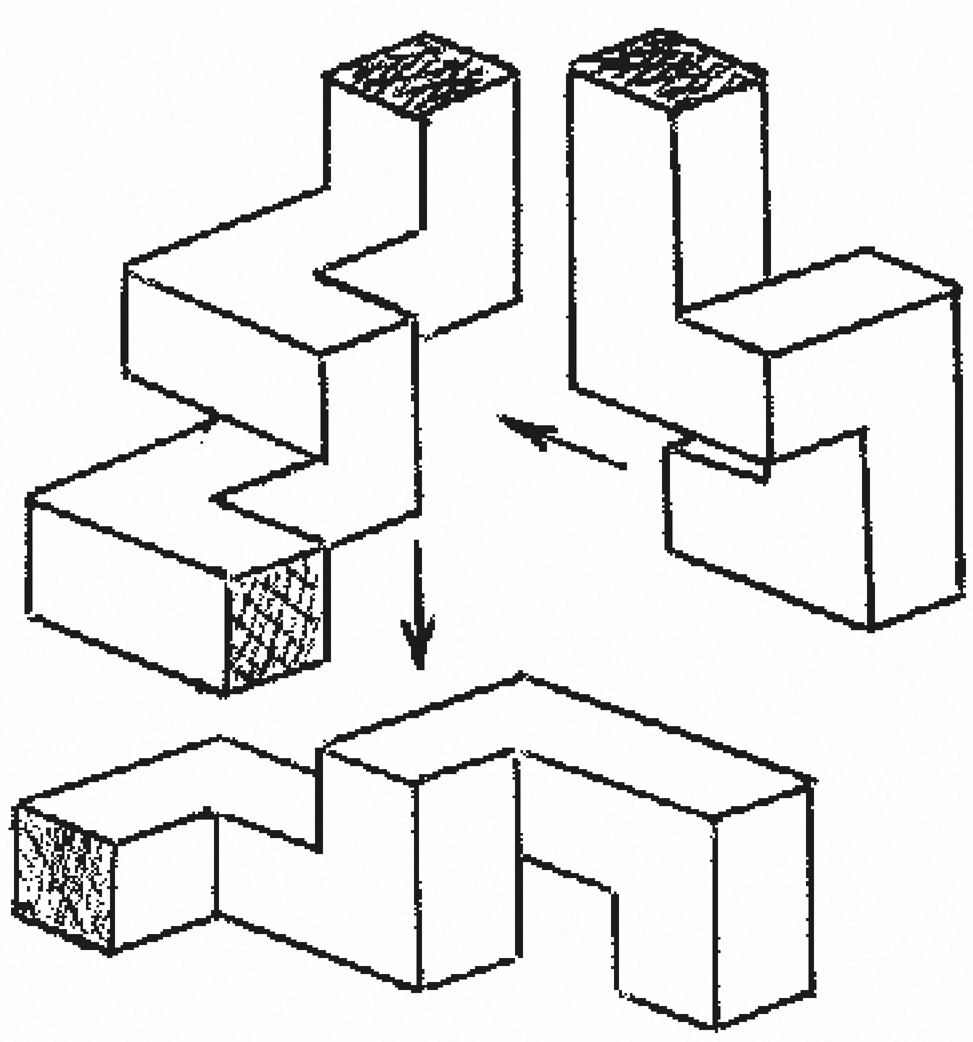
What is it? In geometrical terms, ORTHO-CUBE is a twelve-piece cubic interlocking puzzle. It possesses a dual order of symmetry, making it unique among all known puzzles of this type.

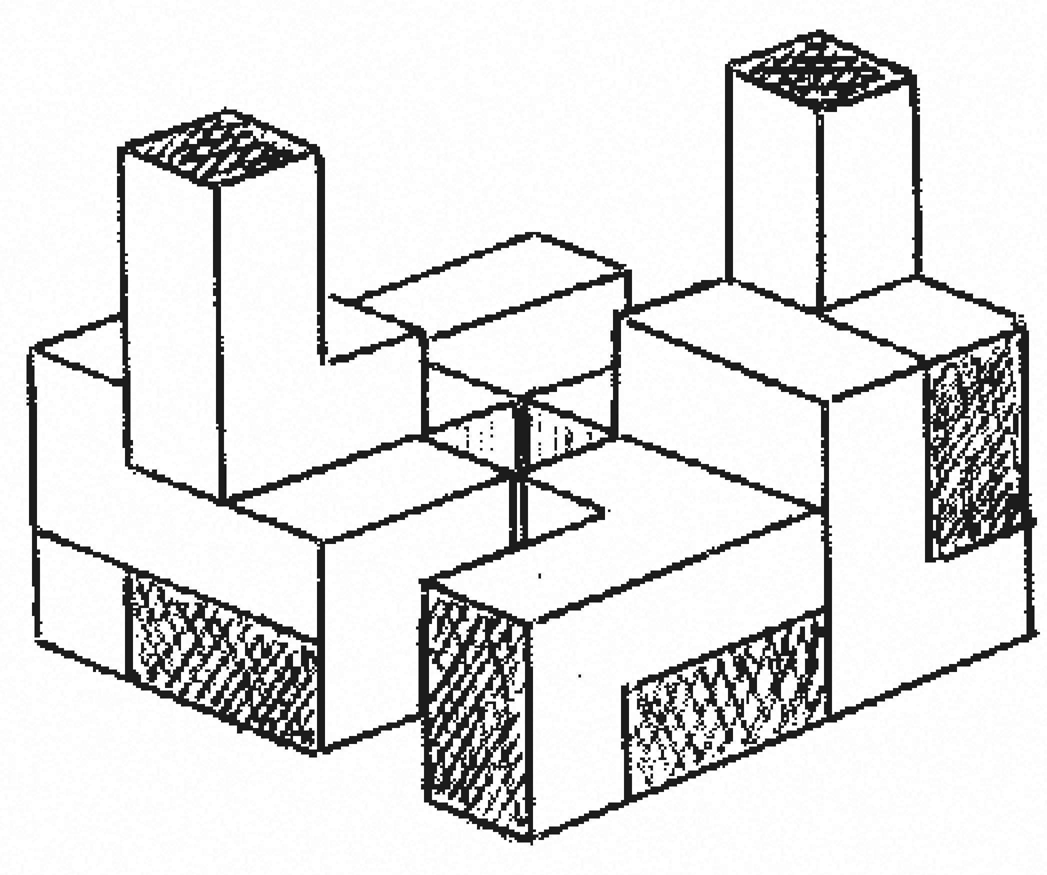
Why the Holes? The involute concavities in the center of each face are a functional aspect of the design, as you will soon discover.

How came the name "ORTHO"? Orthogonal means perpendicular or rectangular, having right angles. Also, in Greek Mythology, Orthrus was a two-headed monster. Or, to stretch the point a whisker, Orphic pertains to Orpheus, hence mysterious, occult, enchanting; also Orphism, an art form characterized by non-representation of form and space, otherwise known as, of all things, Cubism.

Does it Come Apart? Of course. Find a face that has two dark squares (rather than rectangles) and push on both of them. Voila, you now have two halves which are completely identical. Carefully set one half aside for future reference. With the other half, slide the two corner sections toward each other, rotate them slightly, and you now have two quarters which are likewise identical. Set one of these aside also. At this stage, the quarters are inclined to disintegrate spontaneously into three non-identical pieces.

To Reassemble Nothing could be easier. Just repeat the above in reverse order, copying the quarter and half that were (hopefully) set aside. Once the first step of ORTHO-CUBE is thus memorized, its dual symmetry makes it relatively easy to master, despite its apparent complexity, and soon you can amaze your friends by doing it blindfolded.





About the Construction ORTHO-CUBE was designed and is made by Yankee craftsmen, in a unique family operated puzzle shop on a rural New England homestead. The wood is native birch. The finish (smell it) is a special homemade formula containing beeswax produced right on the farm.

copyright:

December 7, 1970

DESCRIPTION OF PUZZLE NO. 5-A, SNOWFLAKE

The SNOWFLAKE Puzzle consists of ten dissimilar shaped pieces, a hexagonal base, and instruction booklet. Each piece has as its basic building block a regular hexagonal prism in which the height is approximately one half the width measured across the flats. The ten pieces of the puzzle represent all the different ways in which such hexagonal units can be joined together edgewise in three's or four's, not counting reflections as separate pieces.

The base also has the shape of a regular hexagon, seven times as large as the hexagonal unit of the pieces. Around its perimeter are located twelve trapezoidal lands, two on each side, such that the flat playing surface of the base contained therein will accommodate ~~an area of~~ 43 hexagonal units.

There are three pieces with an area of three units, and seven pieces with an area of four units, making a total area of 37 units. Thus, when all the pieces are placed on the base, there are always six empty units of space. The relative location of these empty spaces represent some of the different solutions to the puzzle. Some of the objects of the puzzle are:

1. To place all the pieces on the base (very easy)
2. To place the pieces so as to make certain specified patterns, as determined by the location of the empty spaces.
3. Using multi-colored pieces, to place the pieces so that they make both a specified shape and color pattern, such as having the pieces in three different colors and having no two like-colored pieces touching each other.
4. For two or more persons to play games by placing pieces on the base, for example where the last person to be able to fit a piece on the base is the winner.
5. To generate other interesting or symmetrical shapes which do not fit on the base, by using any flat playing surface.

The instruction booklet explains the geometric principles involved, lists numerous challenging problems and games, and includes a skeleton worksheet for recording solutions. A preliminary version of such an instruction booklet is attached herewith as part of this description.

B.71, In these letters I think you can sense some of my frustration in trying to deal with these idiots.

S.C.

November 8, 1977

Sam Sban
93 Belmont Ave.
Paterson, N.J.

Dear Sam:

In December of 1975, I wrote to you and expressed a desire to purchase surplus SNOWFLAKE materials. Upon receiving no response from you, I wrote again a couple months later for the same reason. You say you did not reply because I simply asked for a royalty statement. If you will refer to the letter in question, you will find that it makes no mention of royalties, but reads as follows:

"... I would like to have an inventory of materials on hand, such as pieces, bases, instructions, and packages. Could you also indicate who is the owner of each of these items, if they are for sale, and if so, the price?"

As I have indicated in my recent phone call and third letter, I am still interested in purchasing some of these items, and was hoping that some progress might have been made by now.

You now state that you will have to consult with Atwater before you can quote a price. I should point out to you that he was for several years my business manager, as well as licensor of that particular puzzle. According to my records, I have made at least three written requests of him to persue this matter and expedite it, which he said he would do, but has not done. Furthermore, he now has practically no interest in or recollection of these transactions, and evidently has lost or displaced all records of same. At one time, he told me you stopped making them because your machinery broke. Later, he said it was because you ran out of instruction sheets, but that would have been impossible according tothe figures I have. In another memo, he reported to me that the only parts left over were bases. He has no idea of which parts might be owned by him, by you, or jointly, as I have asked him that specifically and received no answer.

I am interested in purchasing bases and instruction sheets. The sheets were purchased from Minute-man Printing Corp., and you must have some record of what they cost. My guess would be about 10¢ each, and I would expect that might be a fair price for the bases too. Couldn't you just ship me a box of them now to get started? Enclosed is a check for $100, which ought to be sufficient to cover the cost of a few hundred bases, plus an equal number of instructions, packing and shipping, and a phone call to Atwater if you think that is necessary. I will write to him also today.

In case you were wondering, I was planning to make a paste-over label to replace your name and address with mine on the instruction sheet.

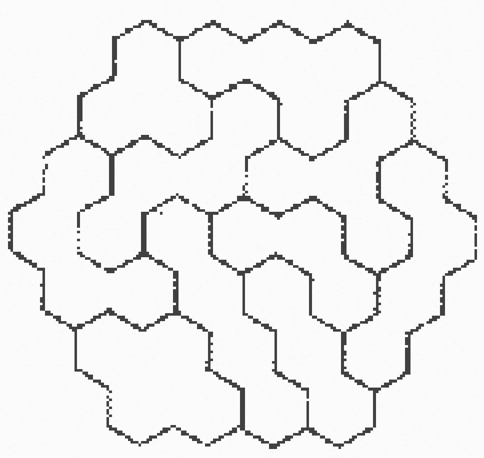
Sincerely yours,

Stewart T. Coffin

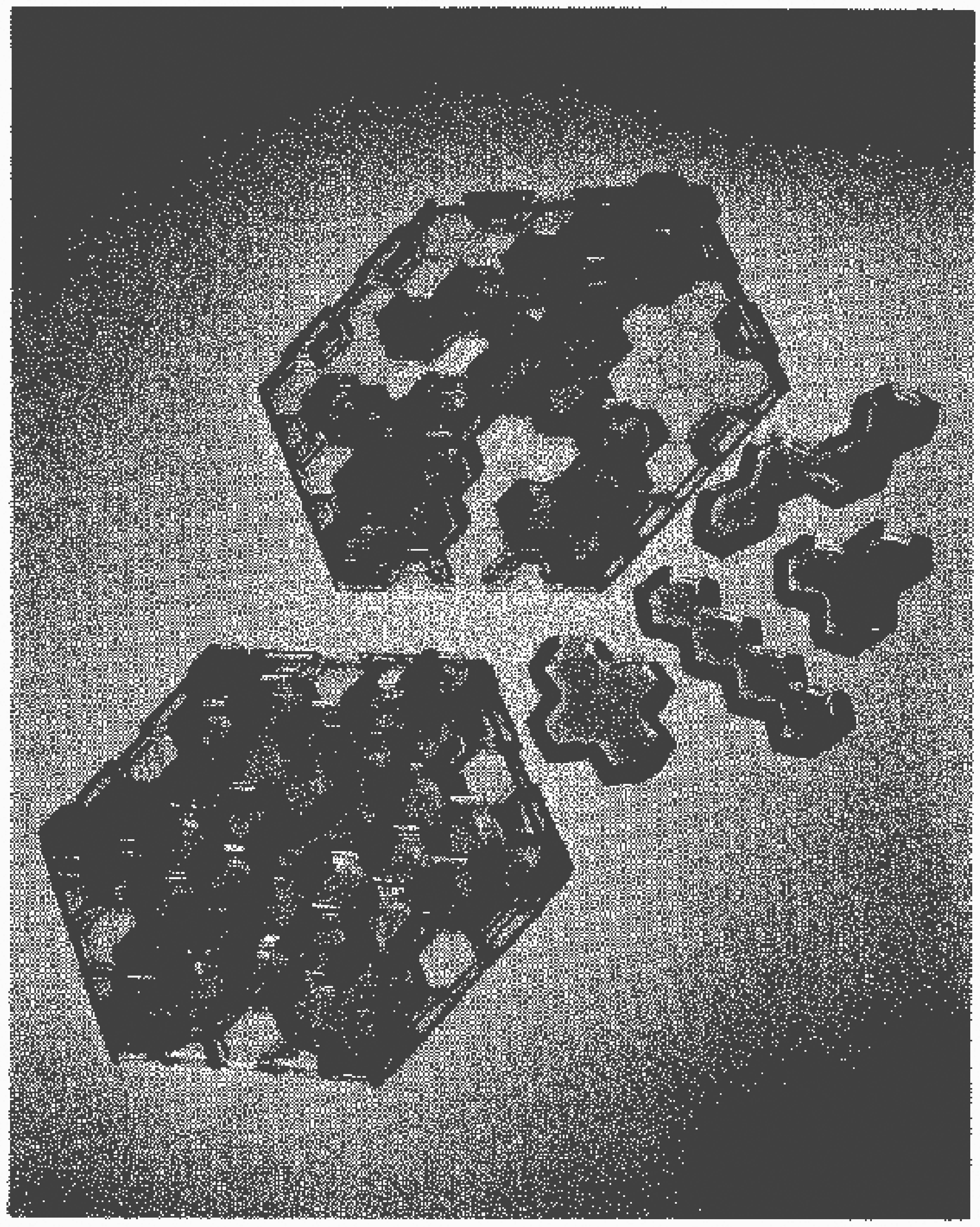
Stewart T. Coffin

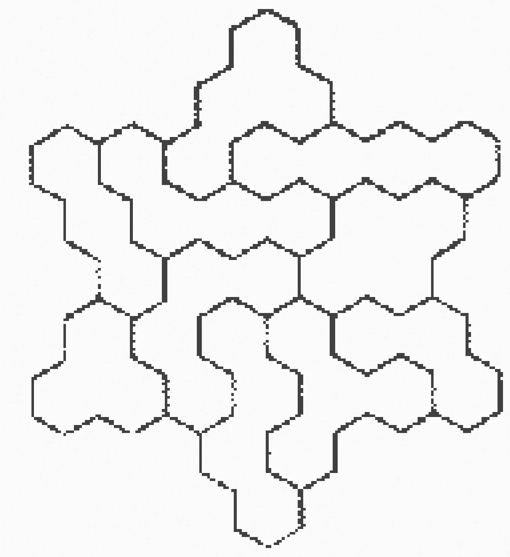
Snowflake™

A SET OF INTRIGUING PUZZLES AND GAMES FOR ALL AGES

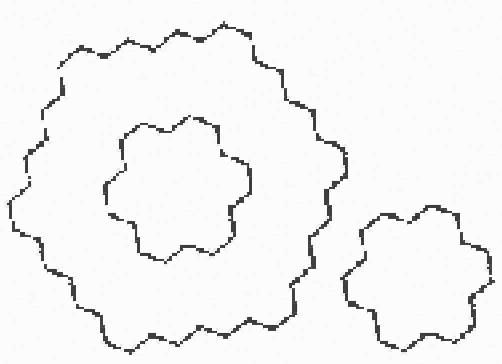


HEX

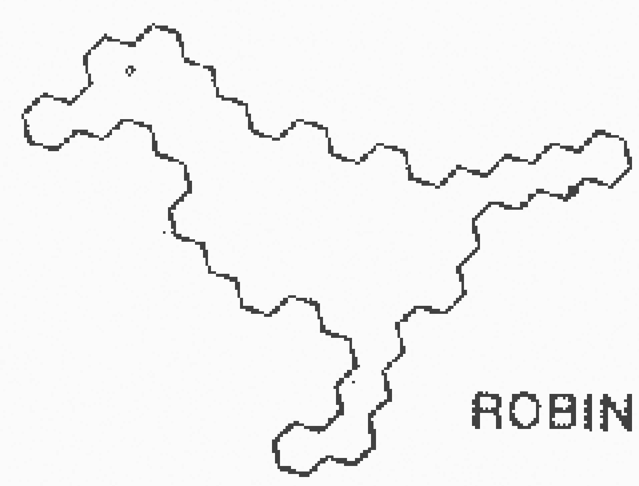




SNOWFLAKE



WREATH and SNOWBALL



ROBIN

A 6-inch hexagonal base on which the ten, ¼'' inch thick hand-cast polyester pieces fit to make over 30 hard-to-discover symmetrical figures, and an infinitely large number of please-yourself original designs. A 10-page leaflet includes game rules, over 50 puzzle challenges, and more.

SNOWFLAKE, ™in an exclusive edition, was selected for the 1971 Christmas catalog of The Museum of Modern Art, New York. It is finding enthusiastic response in homes, schools and hospitals because it is fun and aesthetically pleasing, and it gives excellent practice to perceptual, manual-manipulative, and design skills.

Published by Atwater-Span: made by Span Products, Inc. for

SMALL WONDERS, Inc., Acton, Massachusetts 01720

Copyright:

See Sci. Amer. (Martin Gardner) June 1967

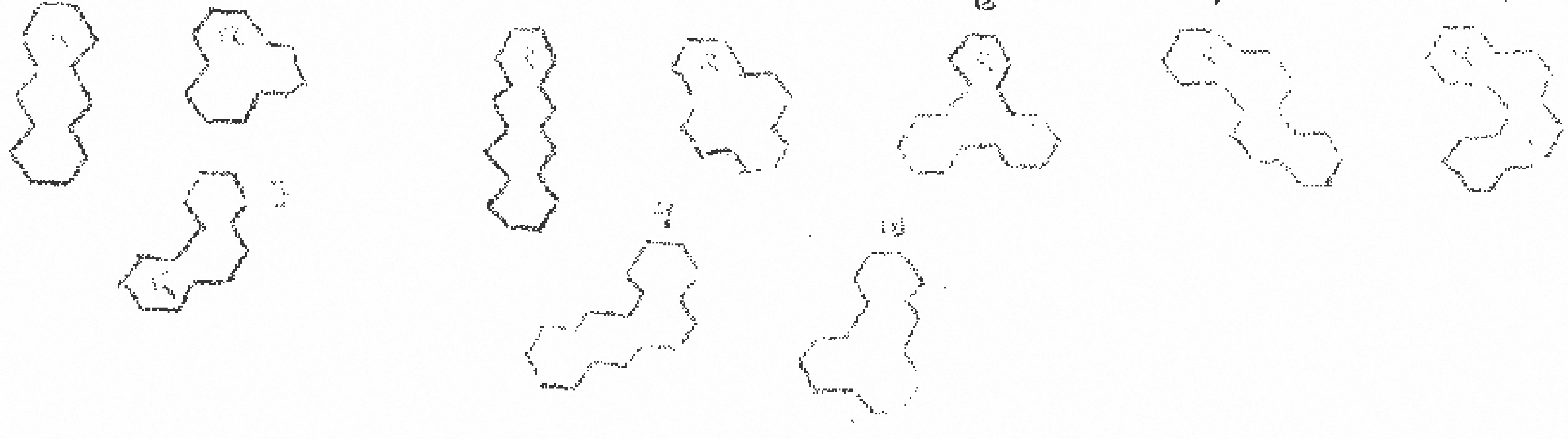
November 10, 1969

DESCRIPTION OF PUZZLE NO. 5, "HEX-MAS"

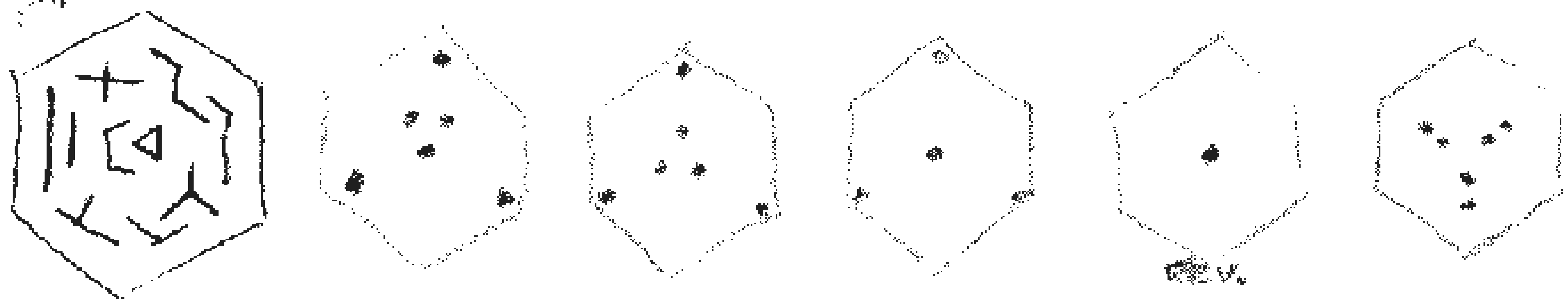
The HEX-MAS puzzle consists of ten flat pieces, no two of which are alike, all having outlines which fit on a regular hexagonal grid. They are generated by taking all the possible ways in which three or four hexagons may be joined together in such a grid. There are three pieces of three hexagons each, and seven pieces of four hexagons each, giving a total area of 37 hexagon units. This happens to be a number of hexagons which form a perfect solid hexagonal shape with four hexagons along each edge.

Pieces one through seven are solid green on one side, and on the other side are all green except for one hexagon which is red. Piece No. eight is similar, except that it has two red hexagons on one side. Pieces nine and ten are solid gseen on both sides.

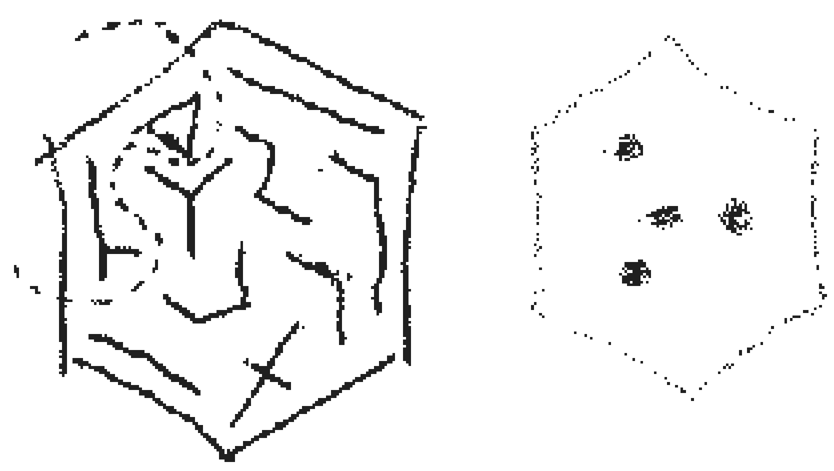
A booklet provided with the puzzle illustrates in color several challenging shapes and color patterns which can be achieved using all the pieces. The simplest and most basic is to form the perfect solid hexagon, without regard to color. There are well over 100 solutions to this. Second, to form the same hexagon, but solid green. Third, to form the hexagon with the particular color patterns illustrated. Some of these have names with Christmas themes, such as "Wreath", "Ball", etc. Fourth, to form others shapes and color patterns illustrated, such as: Xmas Tree, Top, Lantern, Church, Candle, etc. Fifth, a grid is provided for recording original creations.

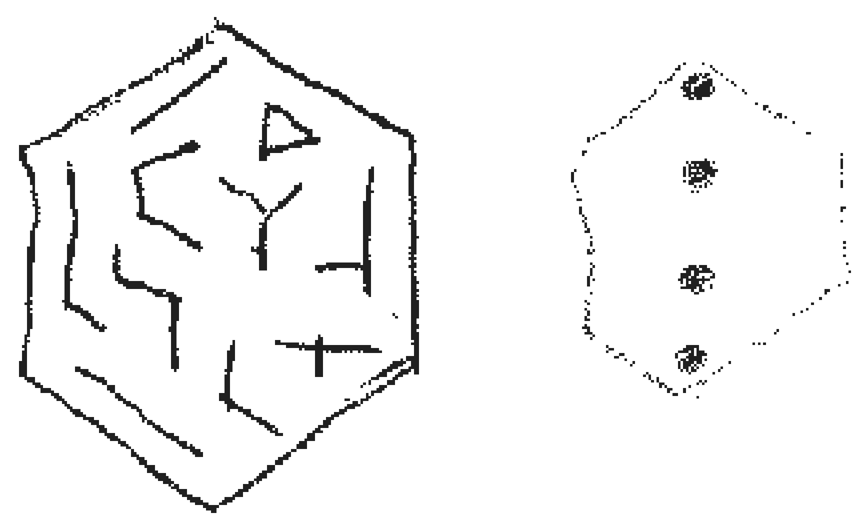


wreath/ball

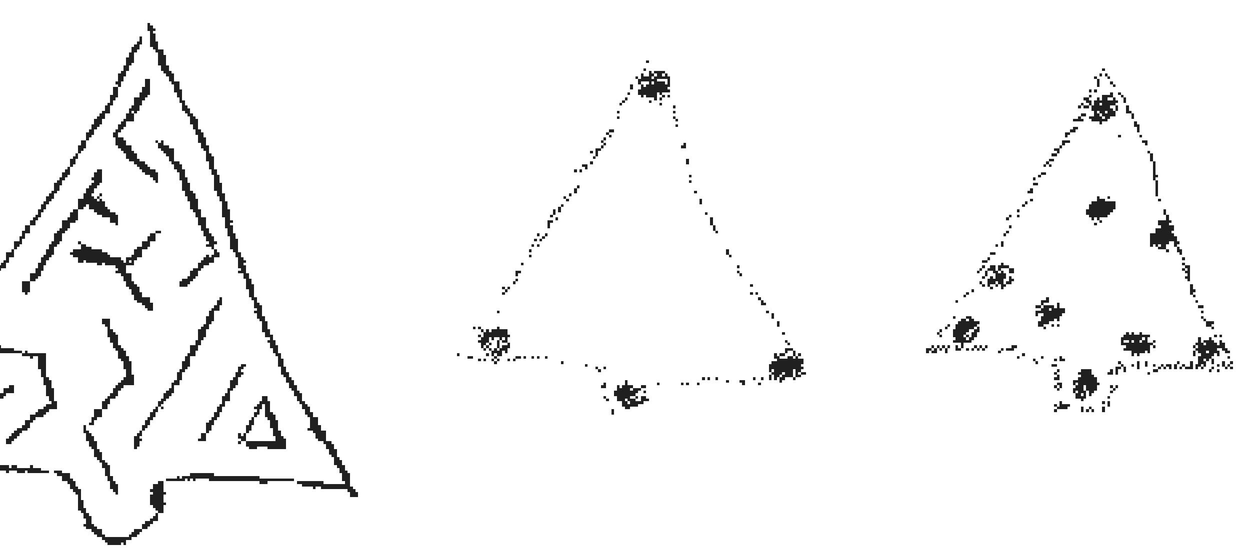


etc.

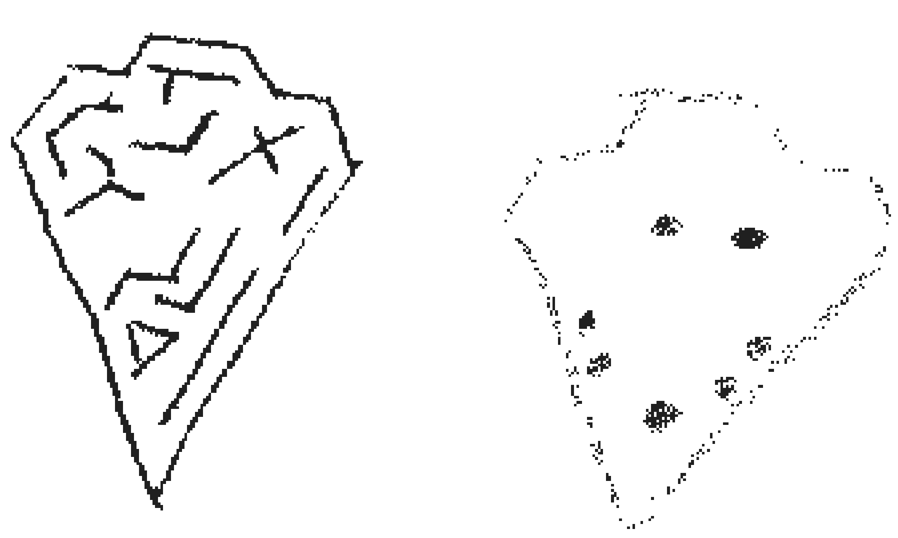




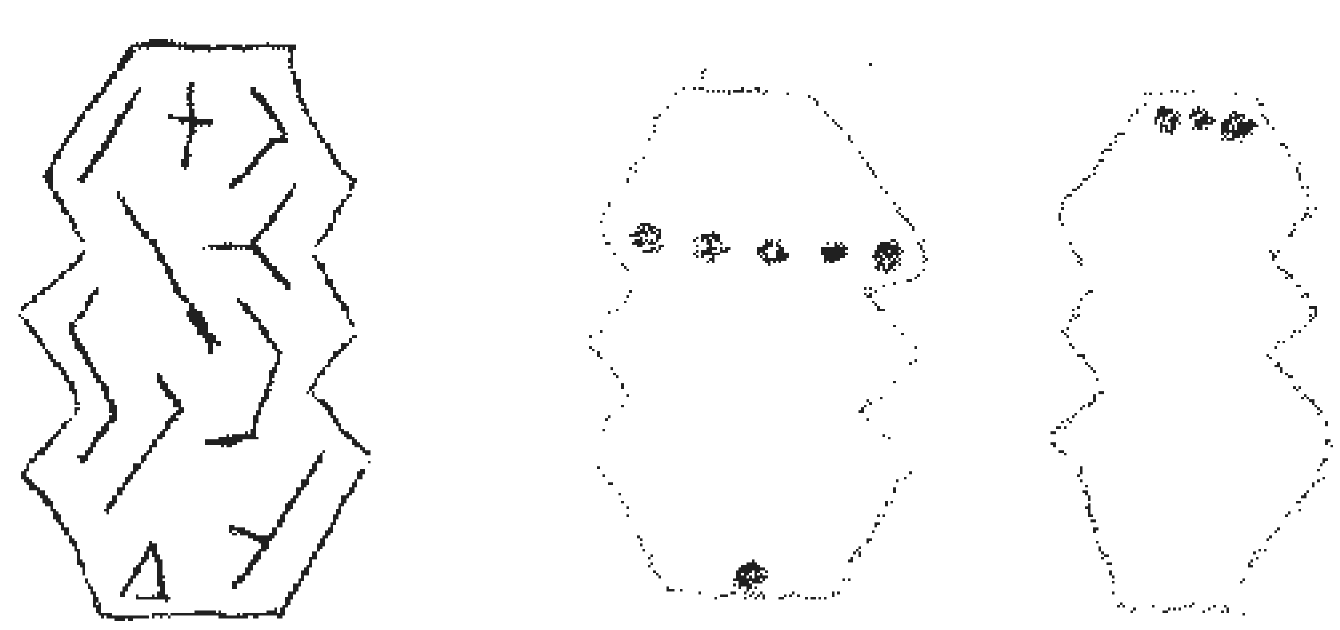
Xmas tree



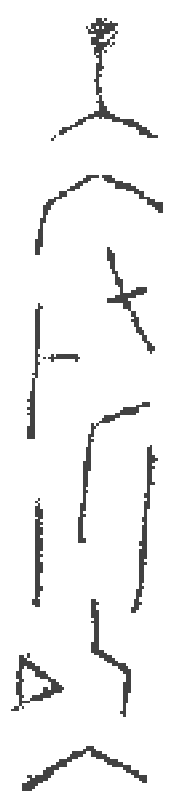
top

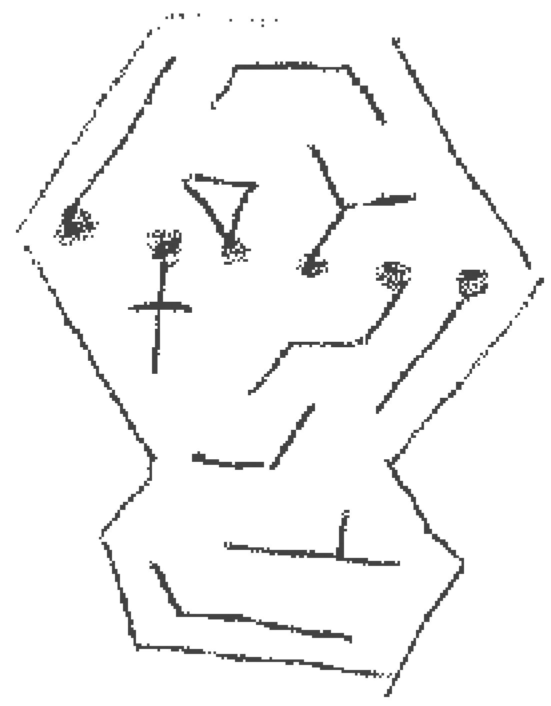


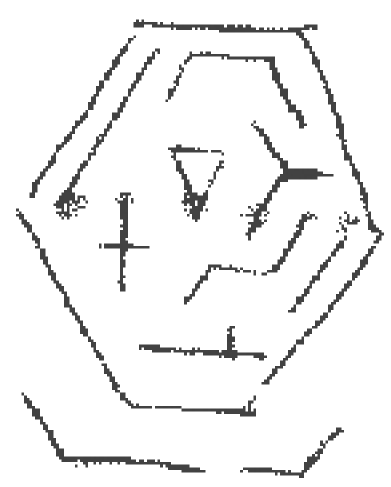
lantern



Candle

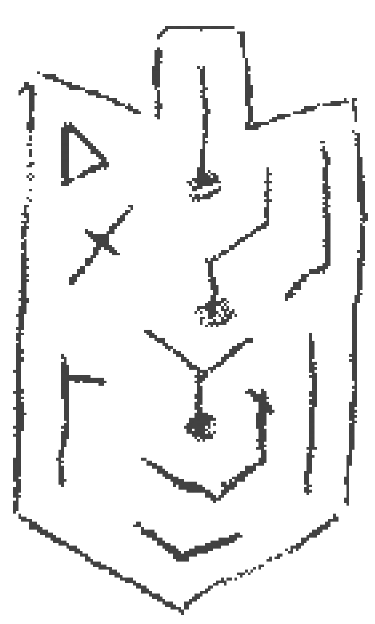






Wreath

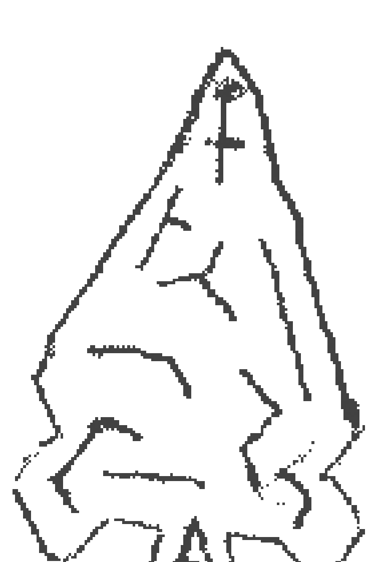
omit ^ ⅄



~~Traffic light~~

lantern

Church



Tree

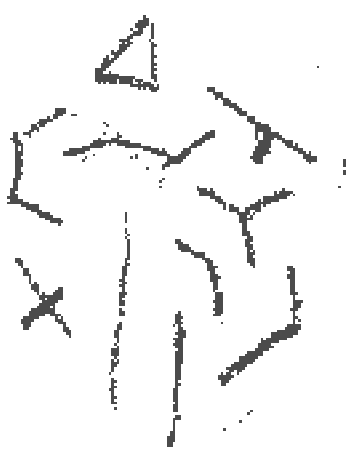
Rev.

1.

2.

3 & 4.

5-10



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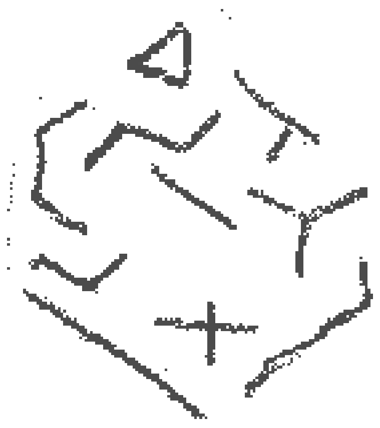

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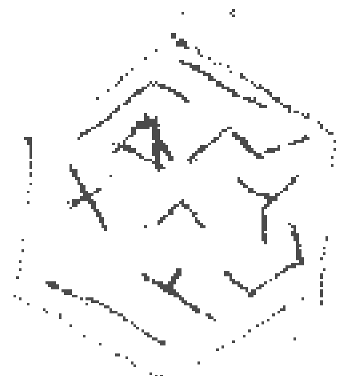

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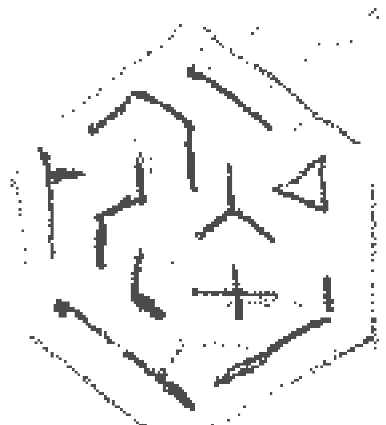
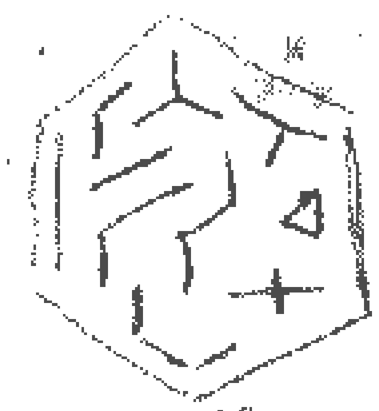


18
weedon



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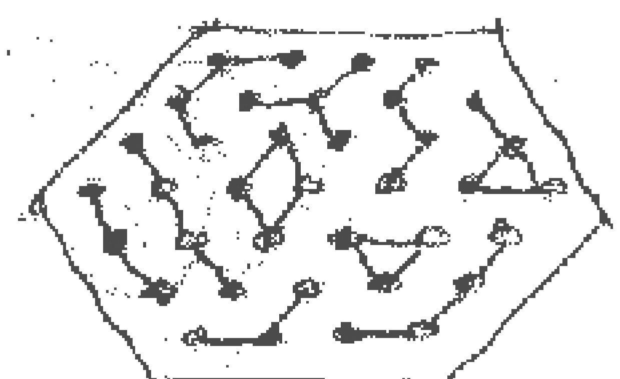
WEEDON



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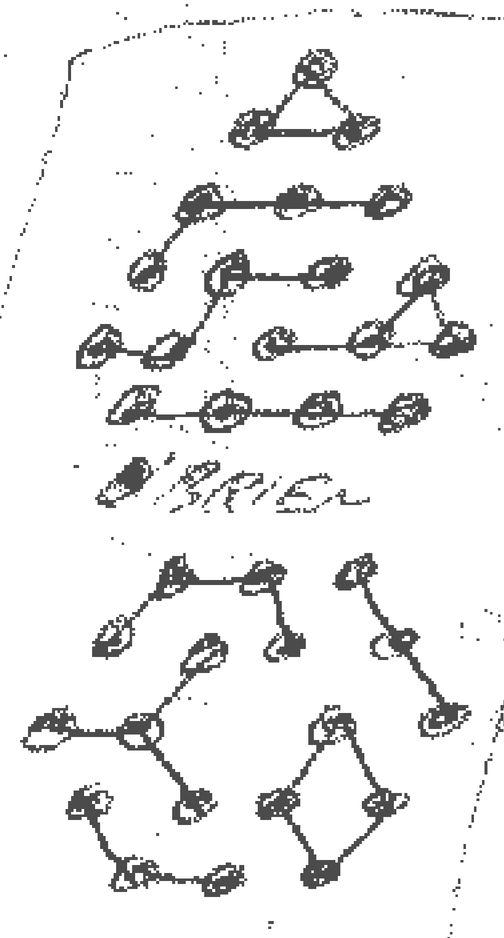
O'BRIEN



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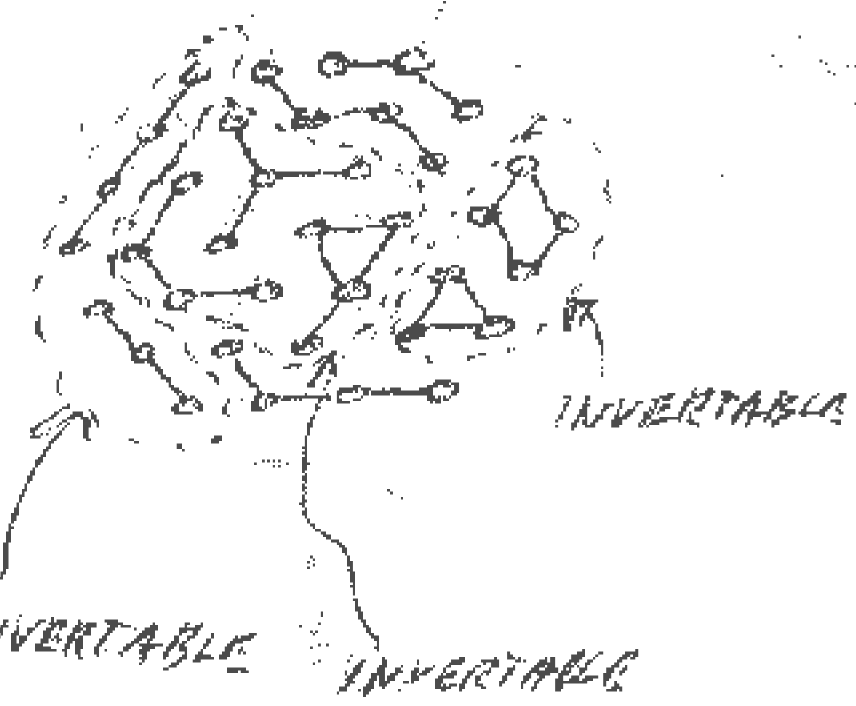

8 solutions
(20-27)
O'BRIEN

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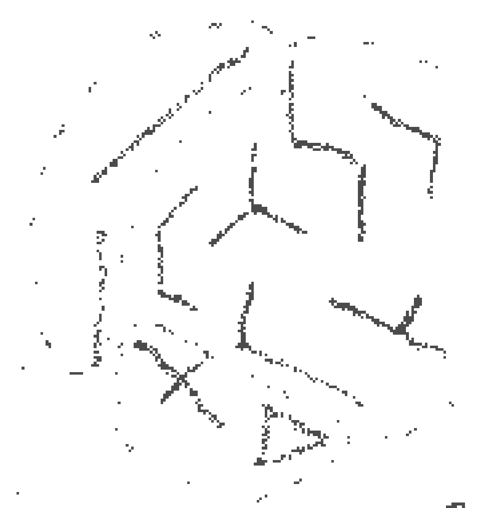

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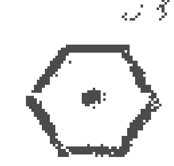

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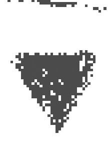
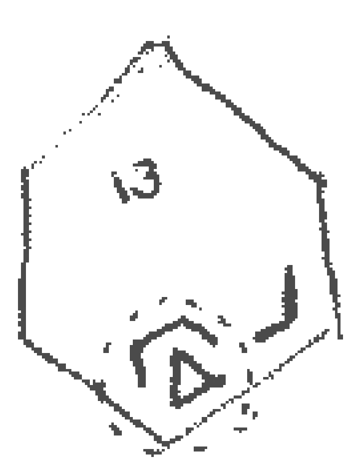
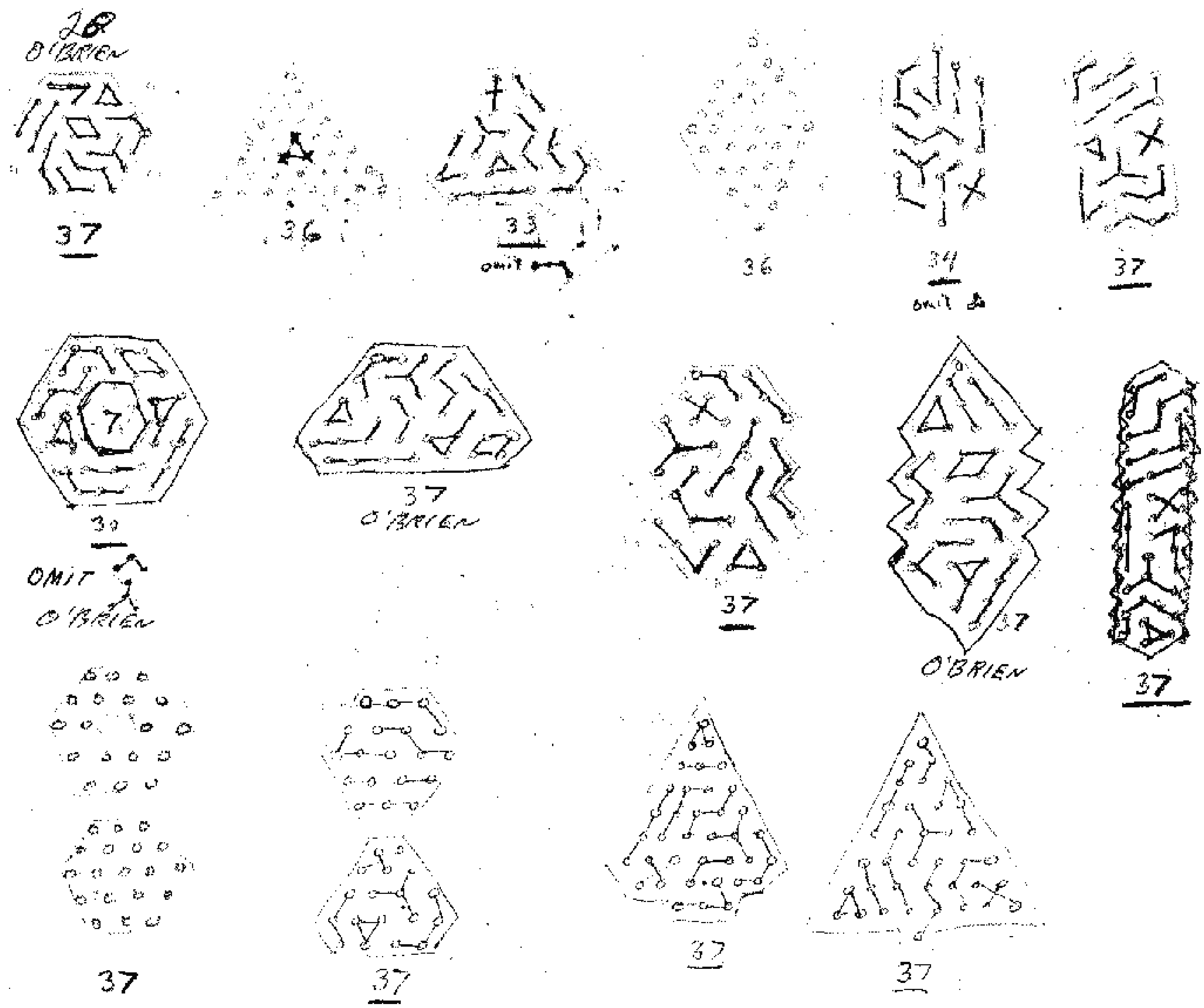




40-45

OMIT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O'BRIEN
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#5

Copyright:

September 29, 1970

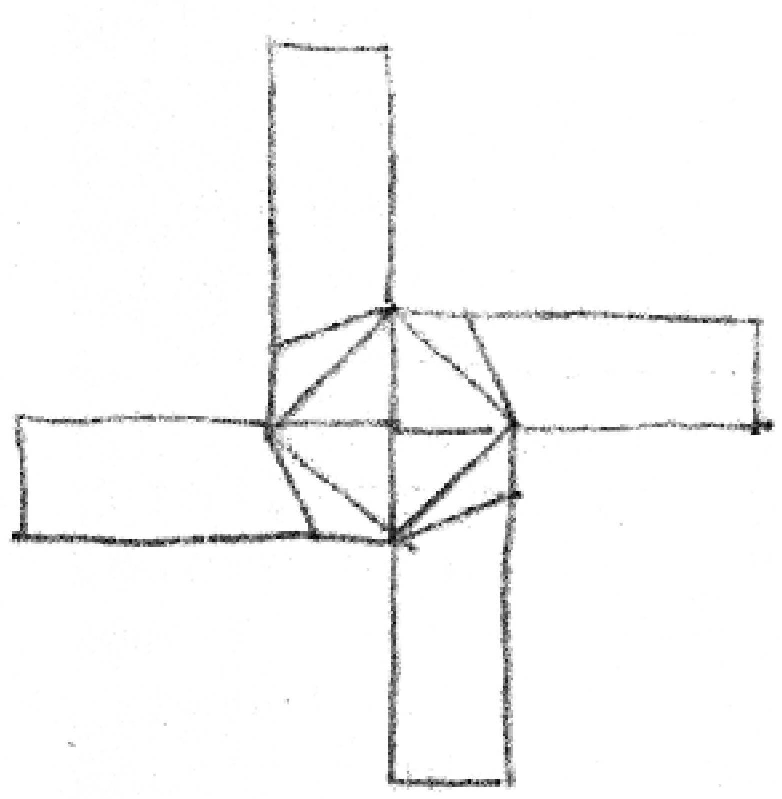
DESCRIPTION OF PUZZLE NO:.2-B, SPIDER-SPINNER

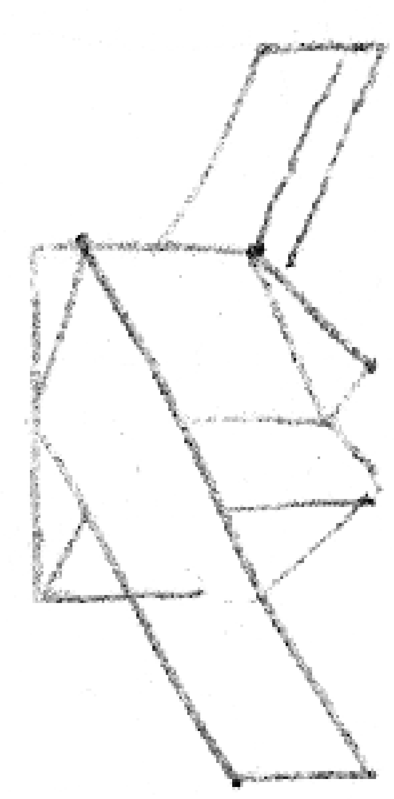
Puzzle No. 2-B, SPIDER-SPINNER, consists of six pieces, all identical in shape. Each pieces consists in turn of four identically shaped sub-pieces, which are bonded together. Each sub-piece has the shape of a prism of 30-60-90 degree triangle cross-section and oblique end faces. The sub-pieces are in four colors, six of each color. The four sub-pieces in each piece are joined together at one end to form a spider configuration, with the 30-degree face (i.e. the face opposite the 30-degree edge) of the first sub piece resting flat against the 90-degree face of the second sub piece, the 30-degree face of the second sub piece against the 90-degree face of the third ~~six~~ sub-piece, the 30-degree face of the third sub-piece against the 90-degree face of the fourth sub-piece, and the 30-degree face of the fourth sub-piece against the 90-degree face of the first sub-piece, in an axially symmetrical arrangement. The four sub-pieces in each piece are mutually dissimilar in color, and the six possible permutations of color sequence constitute the six pieces, for example: R-Y-G-B, R-Y-B-G, R-G-Y-B, R-G-B-Y, R-B-Y-G, R-B-G-Y. #5

One object of the puzzle is simply to assemble the pieces to form a symmetrical solid having no apparent voids. In order to accomplish this, it is necessary to first sub-assemble the pieces in two sets of three, and then mate the two halves together to complete the assembly. It can be disassembled in the opposite manner, or simply by spinning it.

A further object of the puzzle is to assemble it to obtain certain color combinations, such as:

1. All parallel adjacent sub-pieces form like-colored pairs. There are two distinctly different solutions to this.
2. Each of the eight triangular patterns are a solid color, i.e., the three sub pieces forming each triangle are like-colored.
3. No like-colored sub-pieces touch each other. There is one symmetrical solution, and a number of other solutions to this.





#6

Copyright:

March 20, 1971

DESCRIPTION OF PUZZLE NO. 17, FOUR CORNERS

Puzzle No. 17, FOUR CORNERS, consists of six pieces which are identical in shape. Each piece consists in turn of three sub-pieces which are joined together end-toeend. The center sub-piece has square cross section and beveled end faces. The end faces are mutually perpendicular, and have a common point. The two end sub-pieces are identical in shape, having equilateral triangular cross section and parallel beveled end faces, one of which is joined to an end face of the center sub-piece.

The six pieces may be assembled to form an interlocking assembly having a symmetrical tetrahedral form. To assemble, the pieces are first sub-assembled into two dissimilar groups of three pieces each, and the two groups are then mated together. It is disassembled in the opposite manner. This can be done along any one of four independent axes of the assembly.

By making the end pieces distinguishable from one another, such as different colors or different types of wood, accoding to the following:

Piece	one end	other end
1	A	B
2	A	C
3	A	D
4	B	C
5	B	D
6	C	D

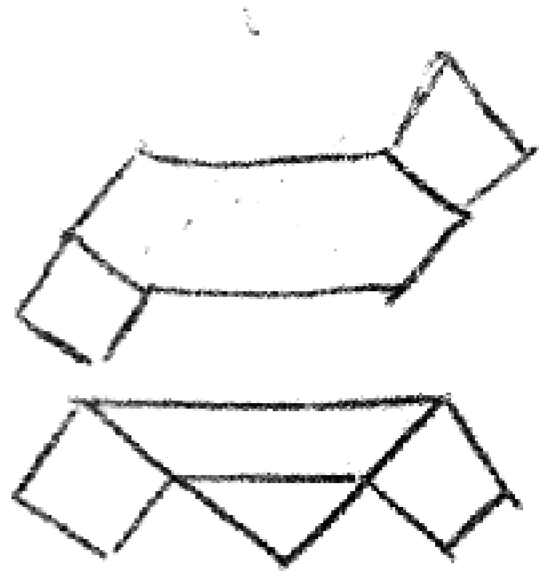
#7

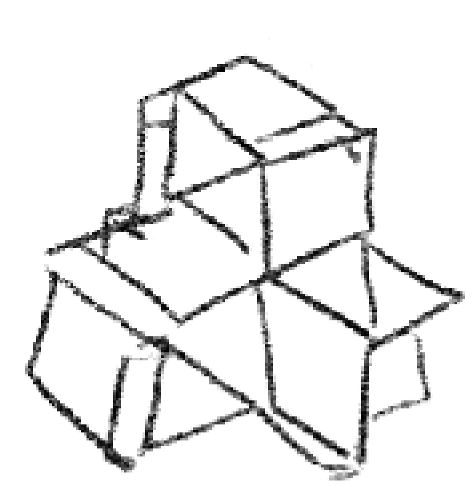
representing all possible dissimilar combinations, several challenging pattern problems are made possible:

1. Arrange the pieces such that the three ends at each of the four apexes are matched.
2. Arrange the pieces such that the star-shaped pattern on each of the four faces is matched.
3. Arrange the pieces such that the triangular pattern on each of the four faces is matched.
4. Arrange the pieces such that the spiral pattern surrounding each apex is matched.

There is one enantiomorphous pair of solutions to each of these problems. No other symmetrical arrangements are possible.

In the preferred version of this puzzle, the pieces are made of dissimilar cabinet woods, and the name FOUR CORNERS refers not only to the shape of the puzzle, but also to the fact that the woods come from, as it were, the "four corners of the world".





Copyright:

FIRST DRAFT ONLY (minus illustrations)

March 20, 1971

World Wide Games:

FOUR CORNERS PUZZLE

This tetrahedral-shaped puzzle is made up of six pieces, all identical in shape. Each piece consists in turn of three dissimilar woods joined together. The center sections are birch. The four beautiful cabinet woods which make up the four corners of the assembly come literally from the four corners of the world. How many of them can you identify?

Disassembly: Manipulate the puzzle gently until you discover the sliding motion which separates the puzzle into two halves. Notice that this motion can take place along any one of four different directions. Note also the most extraordinary fact that, although the individual pieces are ~~xxxx~~ symmetrical and identical in shape, and the completed assembly is also symmetrical, the two halves are always distinctly <u>dissimilar</u>. How can this be?

Assembly: Opposite of disassembly procudure. Confused? Remember that the first step is to make up two dissimilar halves, as illustrated. These should then slide easily together. If they do not, it is because the pieces are not aligned properly, in which case all the force in the world will not do any good.

Symmetrical Solutions: When the mechanical assembly technique has been mastered, you are ready to investigate some more challenging and fascinating aspects of this puzzle. In the preferred solution, as illustrated, only one type of wood appears in each of the four corners. There are two ways to do this.
Problem 2. Assemble such that each of the star shaped patterns on each of the four faces is one kind of wood.
Problem 3. Assemble such that each of the triangular patterns on each face has like kinds of wood.
Problem 4. Assemble such that each of the four spiral patterns, as shown, is one kind of wood.
There are two solutions to each of these problems.

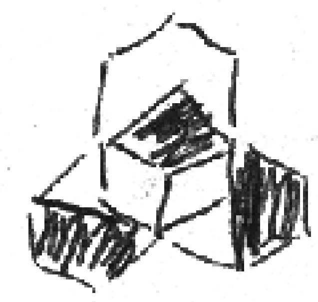
Other Observations: Have you identified the woods yet? Can you guess the countries from which they come? Notice that, unlike most interlocking puzzles, this one has no "key" piece. All of the pieces are equivalent, and they all help to hold each other. Is there a moral in this?

Still more — 4 cor, color sym but not axis of sym

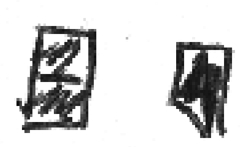
start with 1a, turn pieces 1 + 4 end-for-end  R + Y, B + G
" " 2 + 5 B + Y, R + G
" " 3 + 6 Y + G, R + B

1b. turn 1 + 4 R + Y, B + G  (same)
2 + 5
3 + 6

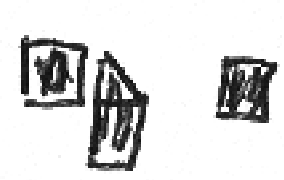
all corners 2 + 1 color

2a. 1 + 4  all corners triple color
2 + 5
3 + 6

2b. 1 + 4 "
2 + 5
3 + 6

3a. 1 + 4 
2 + 5
3 + 6

3b 1 + 4 "
2 + 5
3 + 6

4a. etc 

So: 8 ways with color sym + axis

32 ways if no axis req'd.
(including 24 with no axis)

480 × 8 = 3840

10 × 8 × 6 × 4 × 2

bottom	1 1'	
back	2 up 2' up 3 3' 5 5' 6 6'	× 8
left	3 front 3' front 6 6'	× 4
~~Front~~ Top	4 left or 4' left	× 2
front	5 or 5'	× 2
Right	6 or 6'	× 2

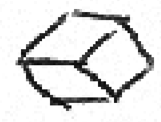
= 256 ways with opp

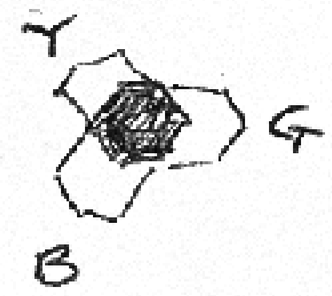
3840 total ways

#6

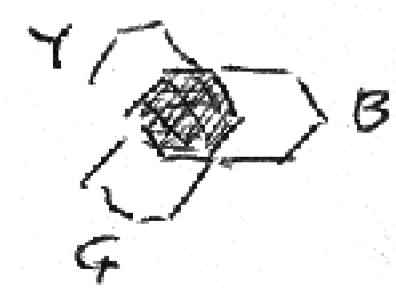
Complete Analysis of 4-color 4COR

Symmetrical color - four patterns possible: 1 always opposite 4, etc.

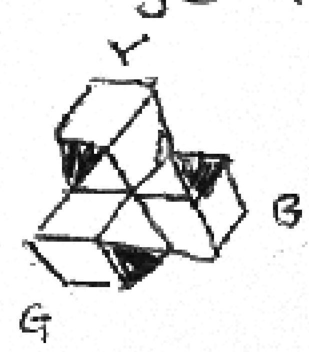
1a. (4cor)  ccw 1-2-3 cw 4-5-6



1b " " " reverse order 1-3-2 4'-6'-5'



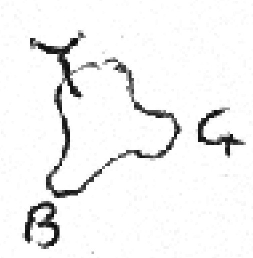
2a. change all 1a end-for-end (triangles)



ccw 1'-2'-3' cw ~~5'-6'-4'~~ 4'-5'-6'

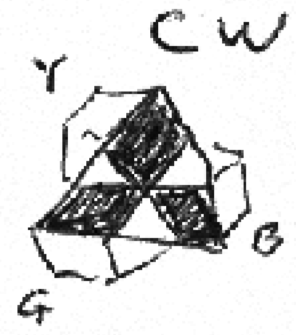
#6

2b. change all 1b end-for-end, (~~[illegible]~~ triangles)



ccw 1'-3'-2' cw 4-6-5

3. a change 1a: ccw to cw cw 1-2-3 ccw 4-5-6



(~~[illegible]~~ fan)

b. " 1b " " cw 1-3-2 ccw 4'-6'-5'

Y G
B

4. a. change 2a. ccw to cw (outer) cw 1'-2'-3' ccw 4'-5'-6'

b cw 1'-3'-2' ccw 4-6-5

Y
G B

#7

Copyright:

March 20, 1971

DESCRIPTION OF PUZZLE NO. ~~16~~ 7, <u>JUPITER, The Super Spider-Slider</u>

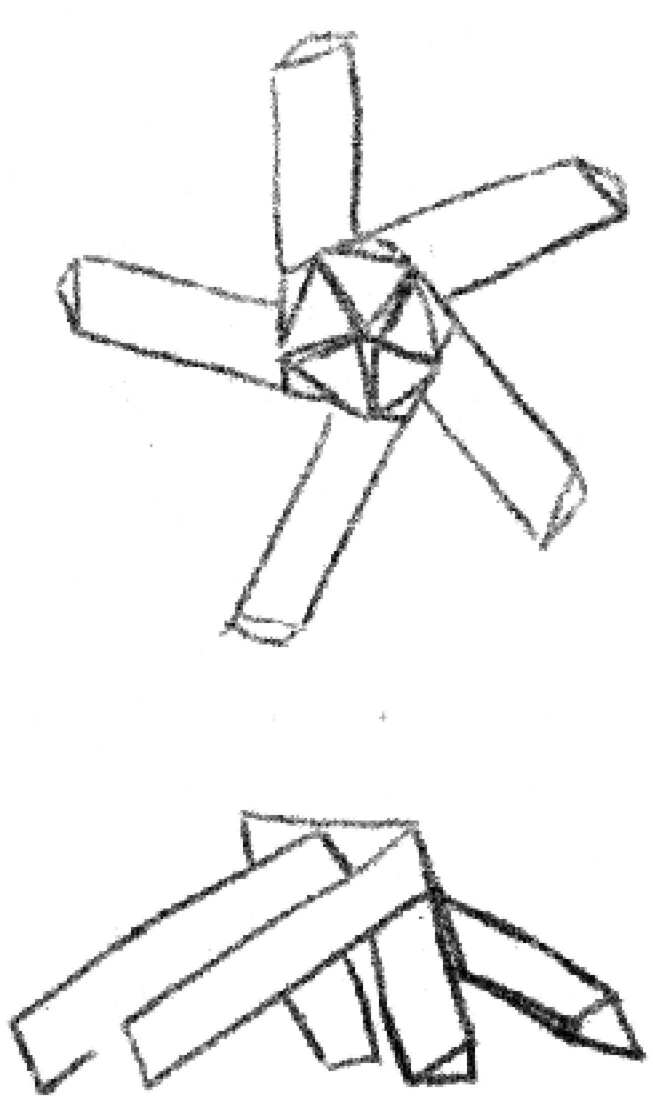
Puzzle No. 16, JUPITER, consists of twelve pieces which are identical in shape. Each piece is made up of five arms, which are joined at one end, and radiate outward in a symmetrical spider configuration. Each arm is prismatic shaped with oblique end faces, and having the cross section of a 36-54-90 degree triangle. The twelve pieces can be assembled together to form a symmetrical polyhedral solid. The pieces are oriented as are the faces of a regular dodecahedron. The hollow interior has the shape of a triacontahedron. The sixty arms are positioned such that they form thirty pairs of parallel adjacent arms. Furthermore, each pair of arms is parallel to four other pairs, forming a group of five parallel pairs. The axis of each group is at an angle of 63 degrees 26' to the axes of the other groups.

The puzzle is assembled by first forming two identical halves of six pieces each, and then mating them together. Because of the symmetry, this mating action in assembly and disassembly can take place along any one of six independent geometrical axes of the structure.

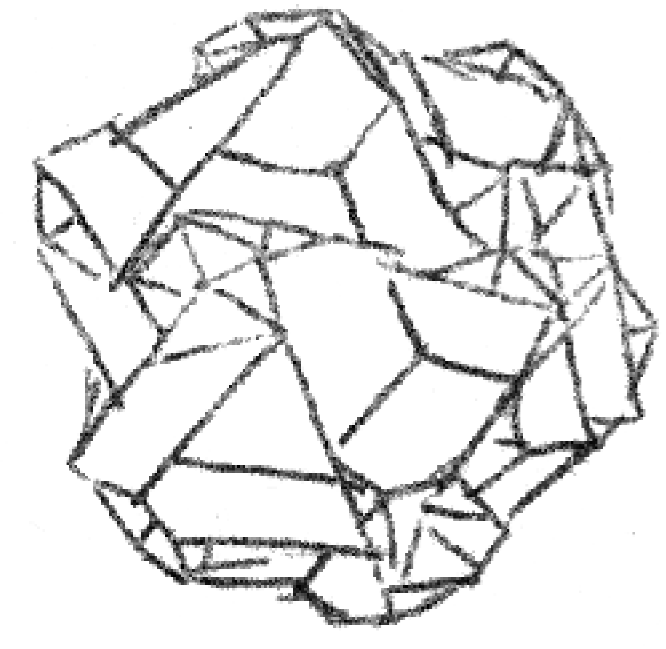
A further peculiarity of this puzzle is that the halves are formed by first making one sub-assembly of four pieces and one sub-assembly of two pieces, and mating them together. Because of symmetry, this mating action in assembly and disassembly can take place along any one of five independent axes.

By making the individual arms of different colored material (or different types of wood) according to the following order: 12345, 14625, 25631, 31642, 42653, 53614, 54321, 52641, 13652, 24613, 35642, 41635, it is possible to arrange the pieces in five different symmetrical patterns, known as the Parallel, Large Double Ring, Pinwheel, Small Double Ring, and Equatorial solutions. In each of these, piece no. 1 is opposite 7, 2 opposite 8, etc., and each pattern is obtained from the previous one by rotating each piece in the same direction one-fifth of a circle.

#7



PIECE



ASSEMBLY

#7-A

Copyright:

Feb 24, 1973

Description of Puzzle No. 16-A, PLASTIC JUPITER

Puzzle No. 16-A, PLASTIC JUPITER, IS QUITE SIMILAR TO Puzzle No. 16, JUPITER, except that a few minor changes have been made in the shape of the pieces so that they can be fabricated easily by injection molding. Specifically, a small section has been removed from the end of each arm and attached instead to its mating piece. This not only allows the piece to be molded with simple mold action, but it also produces a beautiful symmetrical five-pointed star pattern when the pieces are made in contrasting colors.

Also, in order to be able to manufacture the pieces economically, without the need for blowing agents or long mold cycles, the overall size of the assembled puzzle has been reduced from 6 inches to 4 inches in the model submitted with this description. Any further reduction is not recommended, since the puzzle is decidedly hollow, so there is little to gain. The puzzle could be made larger, and the pieces could be cored out from the inside if necessary.

Another optional change incorporated in this model is the addition of raised lands on four of the five arms of each piece. This makes the puzzle much harder to assemble and disassemble. Another even more difficult version is possible, in which the lands are made higher, but are only three arms of each piece, and there are two types of pieces, depending on the location of the lands.

This version of the JUPITER puzzle should be made in six contrasting colors, two ~~xxxxxxxxxxxxxxxx~~ pieces of each color. The obvious way to assemble the puzzle then is to have like colors opposite. If it were found that for some reason it was not practical to make the puzzle in six colors, then the only alternative is to make it in one solid color, or perhaps two colors - six pieces of each. Any other number of colors results in a non-symmetrical arrangement. The two c olor version has one interesting possibility, in that it could be made in two halves of opposite color, and it could be assembled so that it could or could not be disassembled into these particular halves.

#7-A

I have developed this particular version of the JUPITER puzzle and made a painted wooden model during the past week.

Stewart T. Coffin
Feb. 24, 1973

8

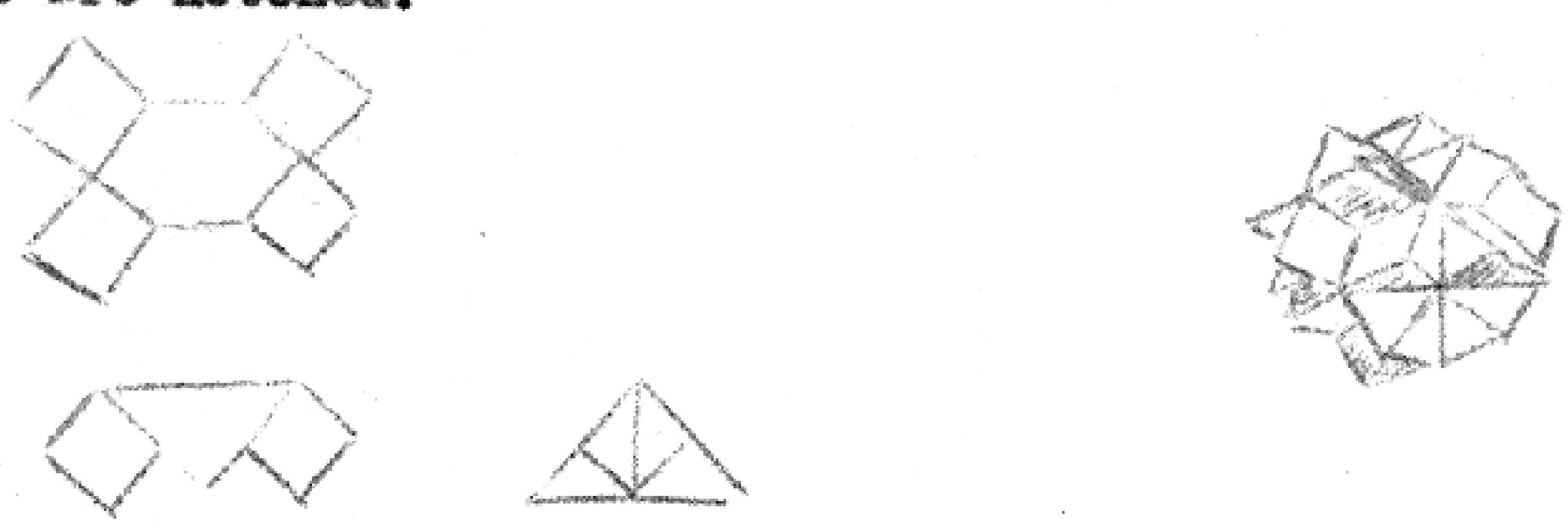
COPYRIGHT:

December 13, 1971

DESCRIPTION OF PUZZLE NO. 22-A, NOVA

Puzzle No. 22-A, NOVA, consists of six identically shaped pieces. Each piece piece has essentially the same shape as a piece of Puzzle No. 21, VEGA, except that where the VEGA piece has a pointed projection at each end, the ends of the NOVA pieces are cut by a groove of right angle V cross section. This results in the assembled puzzle having the shape of one of the stellated forms of the rhombic dodecahedron, in which each of the 24 projections has three faces - two triangular and one rhombic. The object of this is to produce a shape that is both artistically attractive and geometrically interesting, as well as being a challenging assembly puzzle. The assembled shape has an added degree of symmetry as compared with most other puzzle designs of this type, so that careful inspection is required to determine which way to pull to disassemble the puzzle.

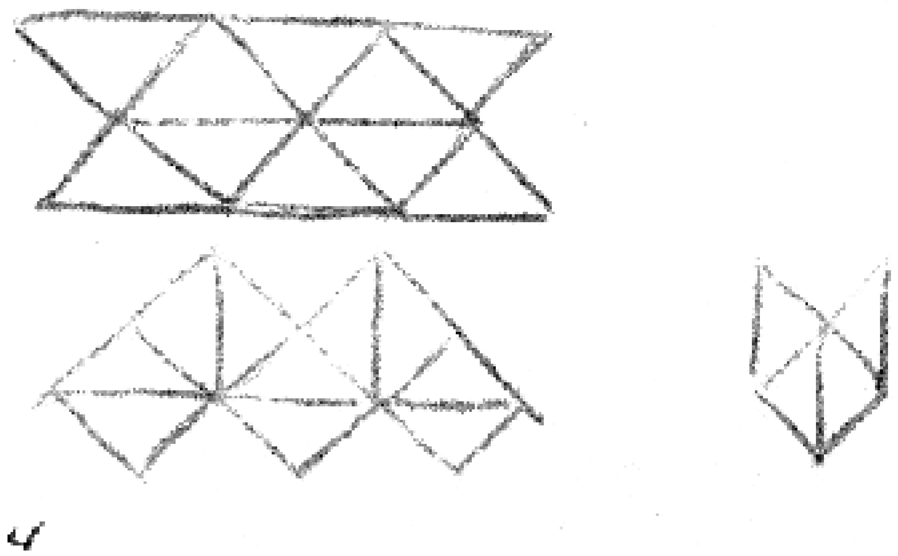
This design was conceived by me on this date, and I have also constructed a wooden model on this date. This puzzle lends itself especially to wooden construction, since each piece can be fabricated of three sections of square cross section and diagonal end cuts, all identical except that the two end sections are notched. #8



#8-A

DESCRIPTION OF PUZZLE NO. 22-B, SUPER NOVA

Puzzle No. 22-B, SUPER NOVA, has the same external shape assembled as NOVA above. The shape of a piece is similar to that of Puzzle No. 15, STAR, except that it has eight triangular-pyramidal projections, all identical in shape, one on each of the four end faces, and four on the outside faces remaining. This version has the advantage that the pieces lend themselves readily to injection molding, and can be cored entirely from the inside, and ejected without side action. If molded in three contrasting colors, especially attractive symmetrical multi-color patterns are produced, and these might be further enhanced by use of translucent materials and choice of suitable reflective or refractive internal walls.

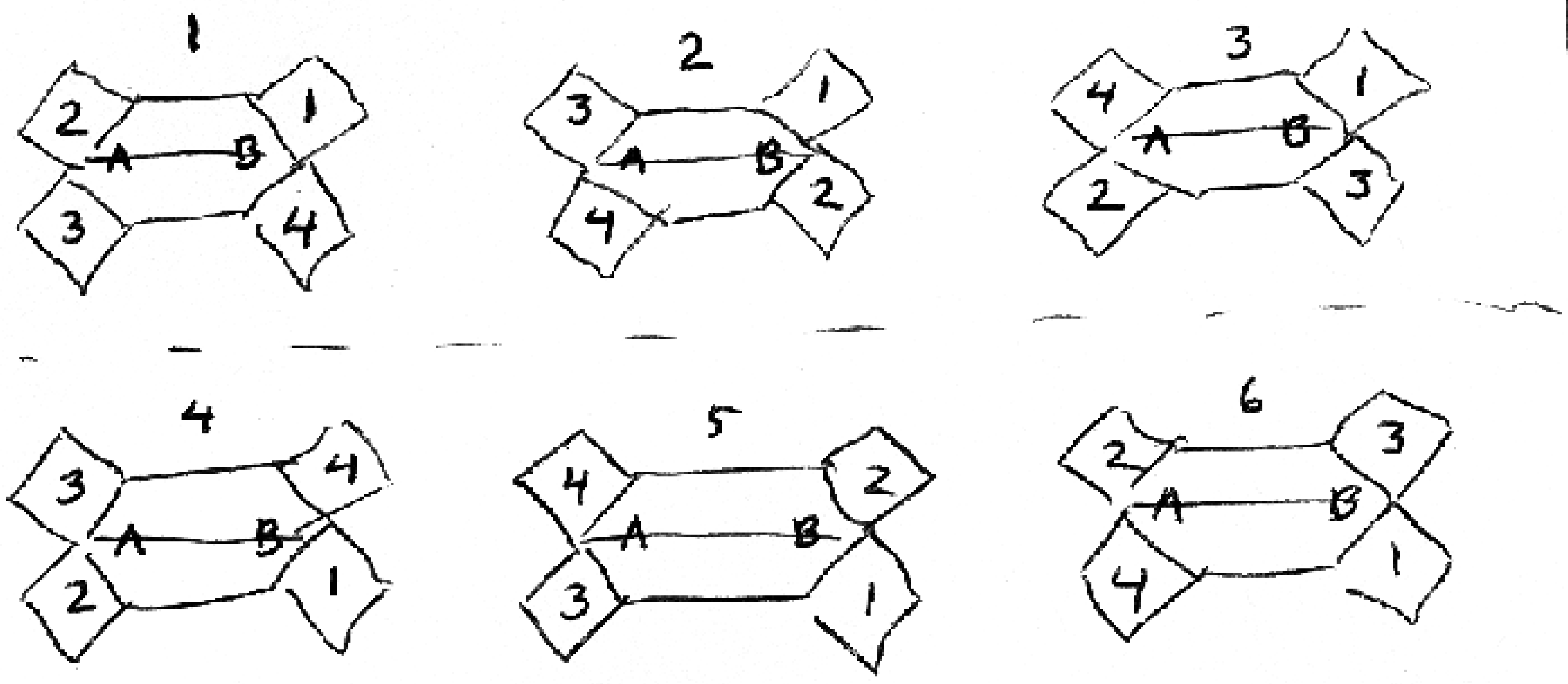


Both of the above invented by me on this date, and wooden models made.

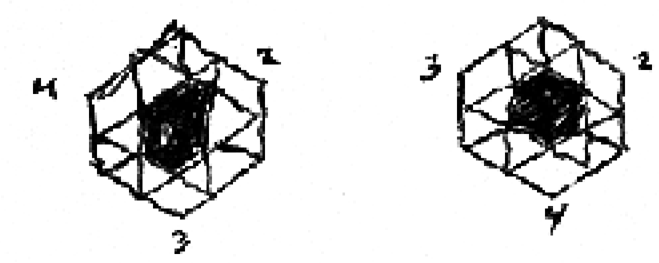
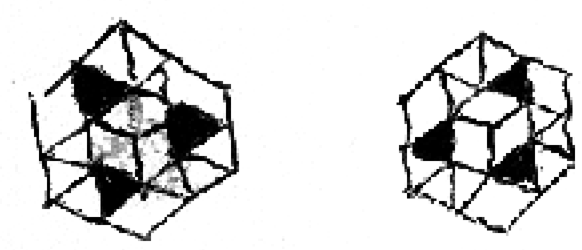
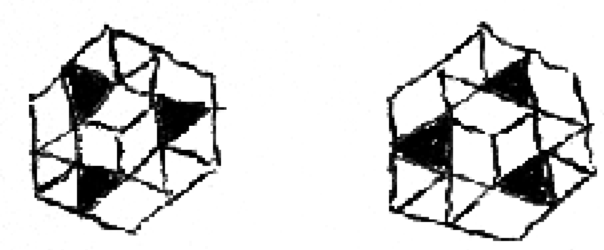
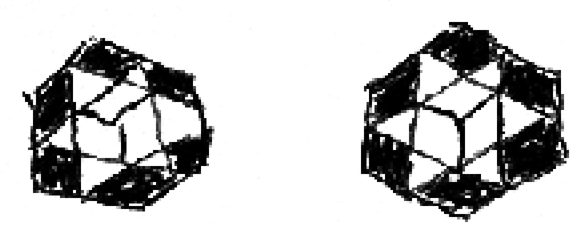
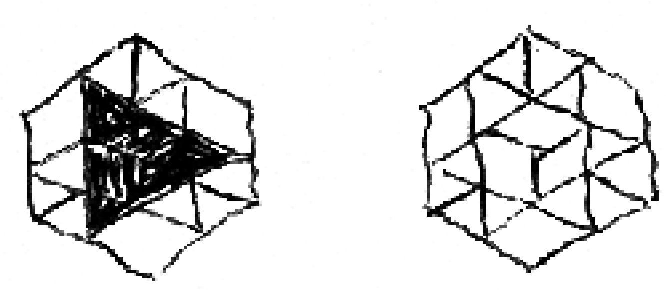
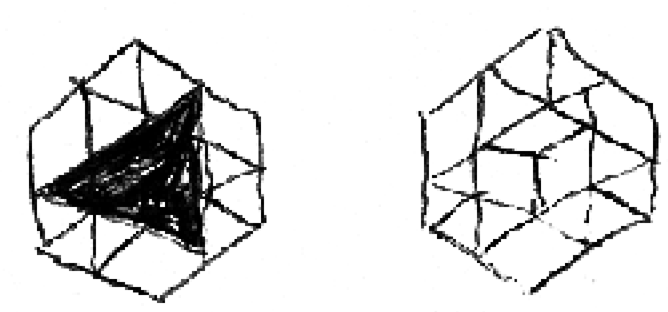
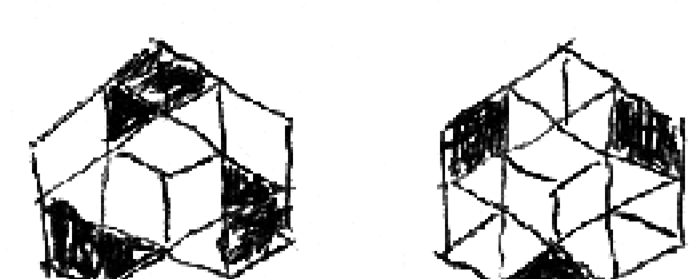
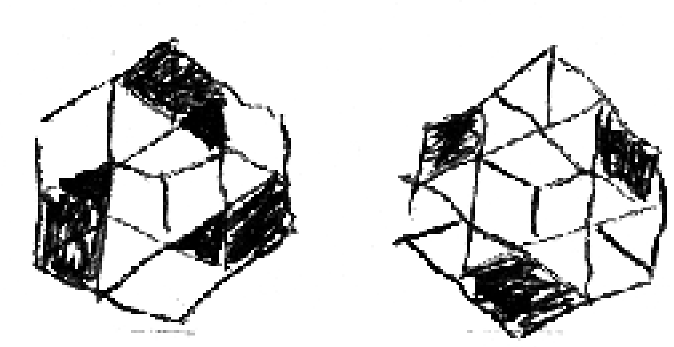
cc Lankton Dec. 14

8-B (see also # 50B)

Analysis of 4-color Second. Stell. Sept 30, 1987



piece 1 always opposite 4
" 2 " " 5
" 3 " " 6

	CCW	CW		
1.	1A-2A-3A	4A-5A-6A		DIMPLE 1
	turn all #1 end-for-end			
2.	1B-2B-3B	4B-5B-6B		Little triangles 2
	change #1 cw to ccw			
3,	4A-5A-6A	1A-2A-3A		" "
	turn all #3 end-for-end			
4.	4B-5B-6B	1B-2B-3B		RING 3
5,	1A-3A-2A	4B-6B-5B		4 solid triangles 4
6.	turn all #5 end-for-end			
	1B-3B-2B	4A-6A-5A		" " " (mirror of #5)
7.	change all #5 cw to ccw			
	4B-6B-5B	1A-3A-2A		complicated 5
8.	turn all #7 end-for-end			
	4A-6A-5A	1B-3B-2B		"

So either 5 or 6 forms, depending if #6 and #7 counted as one or two

#9

Copyright:

August 10, 1973

Description of Puzzle Family No. 37. The SQUARE KNOT Series of Puzzles

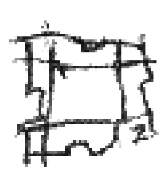
The basic Square Knot Puzzle consists of 12 identical pieces, each piece being a square cross-section rod with three notches, as described in U.S. patent No. 430,502 of W. Altekruse, June 17, 1890. In the Altekruse version, the length of the pieces is four times the width.

A slightly different version of this puzzle was designed by me in 1972, manufactured and sold, and is described and illustrated in its instruction sheet "The SQUARE KNOT Puzzle" dated 4-72. In this version, the end sections are made slightly longer than half the width of the pieces. This places more constraint on the order in which the pieces must be assembled, making the puzzle slightly more difficult.

This puzzle is most unusual in that the assembled puzzle is symmetrical in form, and the pieces are identical, yet it has multiple mechanical solutions of varying difficulty. No other type of puzzle is known to have this feature. (My Puzzle No. 30, LYNX, is based on the same principle as this family, but modified for injection molding. It has two types of pieces.)

The Square Knot Puzzle may be thought of as consisting of three intersecting square rings, each ring made up of four pieces. In all of the various solutions, the first step in disassembly is the sliding of ~~mf~~ one ring with respect to a secon while the third ring comes apart. The solutions can be analysed in terms of the different rings and ring combinations.

If the letter <u>A</u> is used to denote a piece with center notch facing outward, and <u>B</u> inward, then the various types of rings may be described in terms of consecut order of pieces around the ring:



AAAA　　AAAB　　ABAB　　AABB　　ABBB　　BBBB

In order for the first two rings to slide apart, they both must have A and B on opposite sides. The three rings having this property are: AAAB, AABB, and ABBB. Taking all combinations of these, we have:

1. AAAB, AAAB
2. AAAB, AABB
3. AAAB, ABBB
4. AABB, AABB AABB
5. AABB, ABBB
6. ABBB, ABBB

~~7. ABAB, ABAB~~

Combination No. 1 above is the simplest and most obvious solution. The two rings are assembled together, slid slightly apart, ~~and~~ the final four pieces are set in place, and then slid together. Disassembled in reverse order.

Combination No. 2 produces a solution which has the interesting property of sliding apart on either of two different axes. It is slightly more difficult than No.1 in that the order of assembly of two of the pieces is reversed, or rather, they are inserted as a pair.

difficult because two pairs of pieces must be inserted as pairs.

Combination No. 3 leads to a solution with one axis, similar to No. 1, but is more

Combination No. 4 is the most interesting. It produces what is known as the "Symmetrical Solution", which slides apart along any one of the three axes. It is the most difficult, especially in the Square Knot version, as the pieces must go in a certain order, and are hard to hold from falling apart.

Combination No. 5 turns out to be the same as No. 2, since the third ring becomes AAAB.

Combination No. 6 appears to be impossible to assemble in either the Altekruse or Square Knot version.

It is also possible to assemble 14 Square Knot puzzle pieces into an interlockin cubic solid. Although this solid does not have quite the total symmetry of the original solution, it does have three ~~axes~~ planes of symmetry, one axis of symmetry, is interesting to look at, and rather difficult to solve. It was discovered by me about a week ago. This startling discovery has led to a consideration of oth possible constructions with these pieces. I have come to the conclusion that th are probably no other possible constructions which engage all notches, except th listed above.

Variations of Square Knot

The simplest variation, already suggested on page 1, is variation of the length of end section. When made slightly longer than half the piece width, the puzzle becomes more difficult. Other than this, the end section can be shortened as much as strength considerations allow, or lengthened indefinitely, and the only effect is in appearance. It would also be possible to make the end sections in as many as six different lengths, the problem then being to match them in the assembly, but that seems rather pointless.

A second variation is to space out the notches, instead of having them immediate adjacent to each other, opening up the assembly. If the notches are spaced one width unit apart, a 3x3x3 cubic hollow is left in the center. Other than the fa that this produces a new and different looking design, I see no advantage to it. It has the disadvantage that the tolerances become more critical, so that any looseness in the fit produces a shaky wobbly assembly that comes apart easily.

A variation of the above is to mix long and regular pieces, eight of one and fou of the other in either order, producing a rectangular assembly.

Another variation is to space out the notches on one end only. There are two types of pieces, six of each, one set being the mirror image of the other. This version is confusing to assemble, but the assembled puzzle lacks symmetry and looks incomplete - not recommended.

The assembled puzzle can be made more solid looking by filling the eight corner spaces with cubic blocks attached to the adjacent pieces. The simplest way to do this is to attach a pair of blocks to each of the four pieces which make up the third ring. The blocks can be the same scale as the rods, producing a checkerboard effect on the faces, or they could extend to the ends of the rods, producing a distinct solid cubic assembly. They can be any size, for that matte ~~without affecting any of the solutions~~. Also, their outside corner could be beveled off to produce an octahedral effect. The addition of these blocks must make the puzzle more difficult, because generally in such puzzles the largest an most complex pieces are put in place first, not last.

#9

STEWART T. COFFIN
Copyright
Puzzles
OLD SUDBURY RD. RFD 1 LINCOLN, MASS. 01773

August 24, 1974

Description of Puzzle No. 37-A, Peanut-Joint Square Knot

This puzzle design is described briefly at the very end of my "Description of Puzzle Family No. 37, The SQUARE KNOT Series of Puzzles", August 10, 1973. The puzzle consists of 14 pieces which are identical in shape. Each piece may be regarded as being divided into three identical sections (or notches), and each notched section may be regarded as being made up of three square pyramids with their apexes together. The two end notches face in the same direction, and the center notch is rotated 90 degrees.

Twelve such pieces may be assembled into an interlocking solid which has the shape of a 3x3x3 cube with the eight corner blocks removed. There are several different solutions for this, which correspond exactly to the solutions of the original SQUARE KNOT puzzle, described elsewhere. Likewise, 14 pieces may be assembled into an interlocking solid which has the shape of a 3x3x3 cube with six blocks removed.

This version has two advantages over the original square-notched version. The assembled puzzle does not have ends of pieces projecting from its sides, as do most notched-stick designs, giving it the element of simplicity in design, originality of form, and surprise as to its internal workings. Also, the notches are more fully interlocked, in that they must be slid twice the distance to be disengaged.

The puzzle is greatly enhanced by making the pieces in bright contrasting colors. Various combinations are possible. In the particular version shown in the accompanying photos, there are 6 red, 4 yellow, and 4 blue. Setting aside two red pieces, the 12-piece solution can be made with either of two attractive color patterns - square rings made of solid colors (as shown), or all like-colored pieces parallel. Similarly, the 14-piece solution can be made with the yellow and blue pieces in parallel groups (as shown), or with yellow and blue rings at opposite ends.

The pieces readily lend themselves to plastic injection molding, and may be cored out internally if desired without affecting the external appearance of the assembled puzzle.

The color photos which accompany this description show the steps in assembling one solution of the 12-piece and 14-piece assembly, plus a few other simple structures.

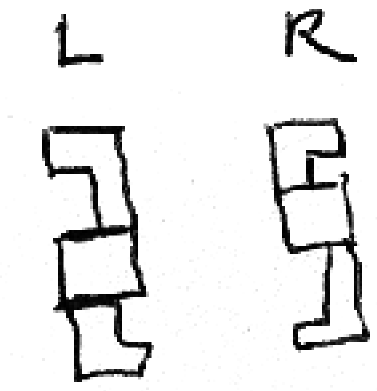
Note: With more pieces available (multiple sets), it should be possible to construct an intriguing 44-piece cross, and a fantastic 60-piece three-dimensional cross. However, I have not made these as I do not have enough pieces.

I developed this particular puzzle during July and August of 1973.

Stewart T. Coffin
Aug. 24, 1974

7 color photos, with captions, sent to Atwater Oct 31.

#9 Analysis of Altekruse using reverse pieces



12 pc version last 4 pc in must be standard

otherwise rings may be all std, or 2 std, 2 rev.

A B C D E F

with 4 std, A B C D E F possible

with 2 std + 2 L A, B, C, E, F but not D
" " " R " " " " " "

with 2 std L + R A, B, C, D, E, F all

so not much difference if 8 std, 2 L, 2 R or 8 std 4 L

14 pc

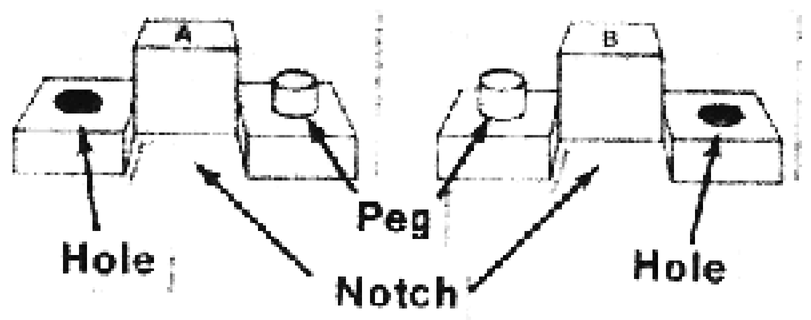
can be ass. with 9 std and 5 L

but not with 8 std and 6 L

can be ass with 8 std 5 L, 1 R if not over 4" long,

(harder but still possible with long pieces, R goes in center cross)

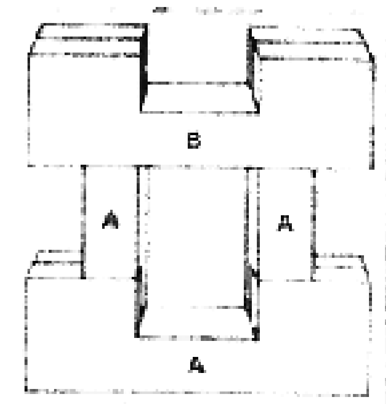
TO TAKE IT ALL APART . . .



Anything goes! You can twist, tug, push, pull— or whatever you choose—to separate Frantix into 12 puzzle pieces. Once apart, you'll note every piece has a peg at one end, a hole in the other, and a notch in the middle. Take a closer look, you'll see each piece is marked with an **A** or a **B**.

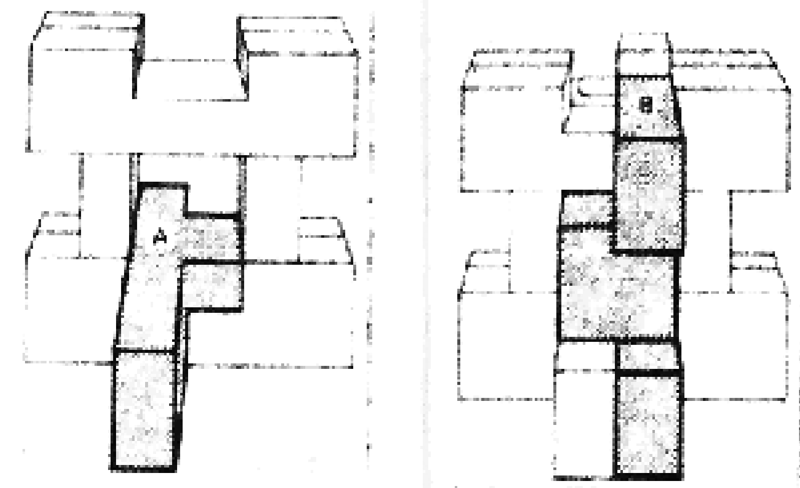
1

TO PUT IT ALL TOGETHER . . .



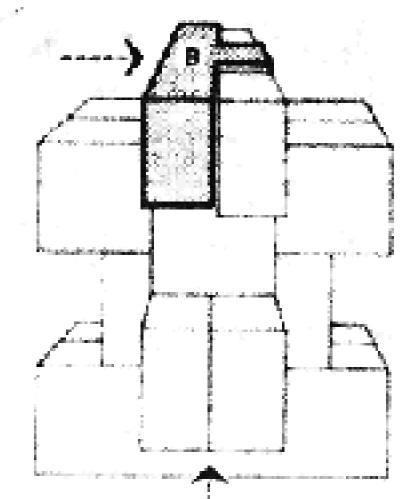
Place an **A** piece on table, notch up, peg side away from you. With notches facing outward—vertically engage 2 **A**'s with ends of first **A**. Join tops of vertical **A**'s with a **B**, completing first "ring" configuration.

2



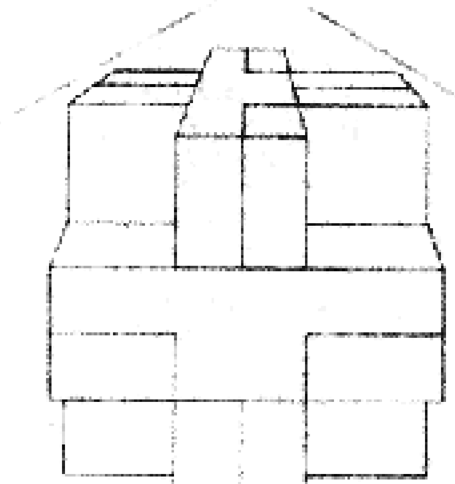
Peg end away from you, slip an **A** thru center hole, notch downward. Then—vertically engage 2 **B**'s, notches out, to ends of **A**.

3



Grasp notches of these vertical **B**'s and raise high enough to join tops with another **B**, completing second "ring." Then complete puzzle by forming third "ring" around center with 4 remaining pieces.

4



Slip **A**'s into side notches, raise second "ring" and simply slip **B**'s into remaining front and back notches.

CONGRATULATIONS! YOU'RE NOW QUALIFIED TO TACKLE THE PUT-TOGETHERS ON THE OTHER SIDE . . .

5

FRANTIX PUT-TOGETHERS . . .

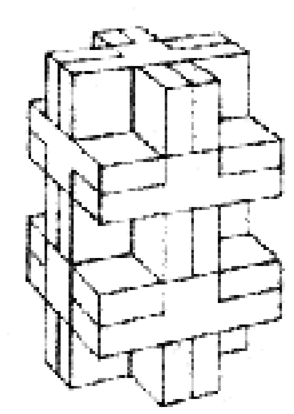
With a little help from the instructions on the other side, you took Frantix apart and put it back together. Now, see if you can do it without the instructions. After that, try putting it together a different way. There are at least three other ways to do it. Can you figure them out? If not, send a self-addressed, stamped envelope for instructions to: FRANTIX, 3M Company, Game Dept., St. Paul, MN 55101.

6

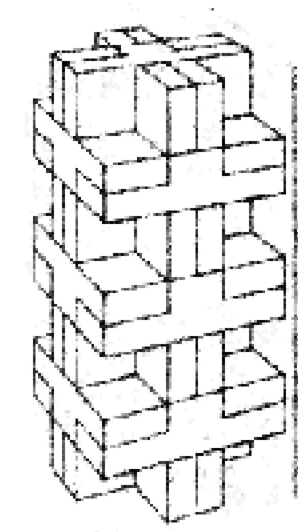
FRANTIX GET-TOGETHERS . . .

For get-togethers with your Frantix friends, pool your puzzles and try to put them all together into a single, super puzzle—using as few as 20 or as many as 60 pieces. Here are just a few of the many put-togethers you and your friends can create:

7

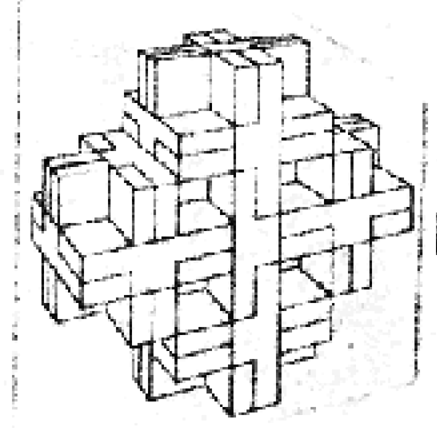


20-PIECE DOUBLER

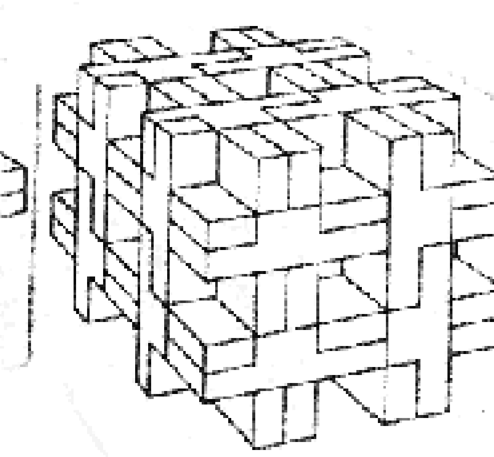


28-PIECE TRIPLER

8



44-PIECE FREE FORM



44-PIECE CUBE

9

IT'S ALTOGETHER FRANTIX

. . . especially when it's all apart and you're the one who's trying to put it all together again!

return to S. Coffin when finished with.

Feb 6, 1973

Description of Puzzle Invention No. 30

An OMNIDIRECTIONAL ORTHOGONAL PUZZLE SET

If a number of square rods are alternately notched on two adjacent faces, they may be fitted together into an orthogonal three dimensional lattice. This principle is used in the Altekruse BLOCK PUZZLE, U.S. patent 430,502. The Altekruse design uses twelve identical pieces, each piece having three notches, with the ends of the pieces extended a short ways un-notched in order to lock the assembly together. This design has the highly unusual property of having at least three distinctly different solutions of varying degree of difficulty, all of which produce the same symmetrical cubic assembly shape. I do not know of any other design which has this property except HECTIX, but HECTIX does not have all identical pieces. Surprisingly, this apparently unique property is not mentioned in the patent.

The same principle used in the Altekruse design can be used for designs of unlimited size and complexity. For example, a larger cube could be made using 24 pieces, each piece having five notches. Or, a rectangular solid could be made with four pieces with five notches, and eight pieces with three notches.

I have discovered what I believe to be a new and original ~~wayxim~~ design of puzzle piece which utilizes the principle described above, but which has several advantages. Instead of extending the ends of the pieces beyond the notches, as in the Altekruse design, I have cut the pieces off flush with the end of the outside notches, and equipped the notches with pins and sockets. Two types of pieces are required, one being the mirror image of the other. Twelve such pieces, six of each type, having three notches, will produce an assembly having essentially the same characteristics as the Altekruse design, but with a much simpler and cleaner appearance of form. The center notches do not require pins and sockets. If they were to have pins and sockets, then four different types of pieces would be required. This would make the puzzle exceedingly difficult, and it is questionable if this would be desirable, since it is difficult enough as is. The great advantage of this new design is that the same basic piece can be joined to itself end-to-end to produce larger sassemblies of unlimited size and complexity, not only to form interlocking puzzles ranging from fairly hard to exceedingly difficult, but also for use as a construction set for creating interesting three dimensional shapes which do not necessarily involve any difficulty in assembly or disassembly.

The puzzle could be sold as a set of twelve pieces assembled, as described above, each piece having three notches, with a pin in one end and a socket in the other, six of each type, with instructions describing the various challenging problems in assembling these twelve piece into the characteristic cubic shape in different ways, plus instructions for making more complex assemblies by combining two or more sets. This should not only provide a puzzle having an interest which should endure long after the basic assembly has been mastered, but has also the obvious advantage of encouraging multiple sales of puzzle sets.

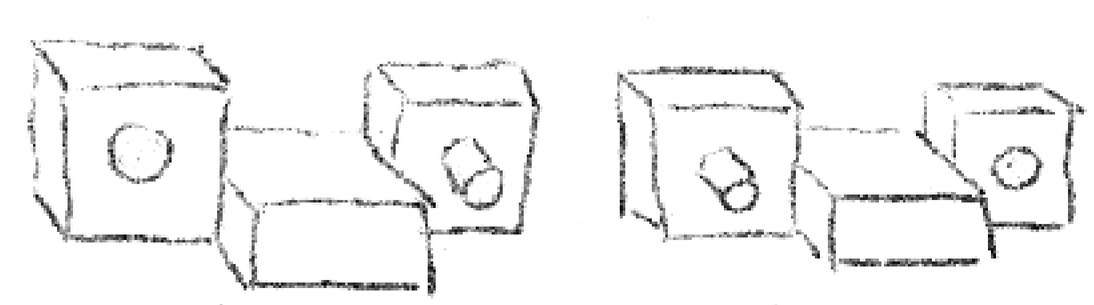
Description of Puzzle NO. 30 continued, page 2

This basic puzzle piece would seem to lend itself very nicely to mass production by injection molding, using a two-cavity mold or some multiple of it, to produce the two mirror image pieces required. My original model is made of solid one-inch square hardwood stock with 3/8 inch dia. pins. This is a nice size to handle, but it could be made slightly smaller, such as 7/8 inch square, for more economical production. For speed of injection molding, the pieces could easily be cored out without affecting the operation or external appearance. It would be especially nice to make the pieces in three contrasting colors, such as the transparent primary colors of the Geo-Logic line. This would permit beautiful symmetrical color patterns, such as all like colors parallel, as well as added challenge for those wishing it.

For one basic piece, the three notch piece would seem to be by far the most versatile. A small two notch piece does not by itself seem to have great possibilities as a puzzle piece, but it might be used in conjunction with the longer pieces to make up some interesting puzzle combinations, and it would also have some appeal as a simple but versatile construction set piece. A four-notch piece permits the intriguing construction of two or more intersecting and interlocking cubic assemblies joined together <u>diagonally</u>. A five notch piece essentially takes the place of two three notch pieces, but has certain additional capabilities, and it can also be used in place of a four notch piece in some situations. The pieces with even numbers of notches have the disadvantage that their end notches are at right angles to each other, and therefore would require side action of an injection mold to form socket holes, unless some ingenoius way can be found to avoid it.

I have invented, developed, and produced a working model of this omnidirectional, orthogonal puzzle piece and puzzle set as described above during the period from January 29 to February 2, 1973.

Stewart T. Coffin
Feb. 6, 1973

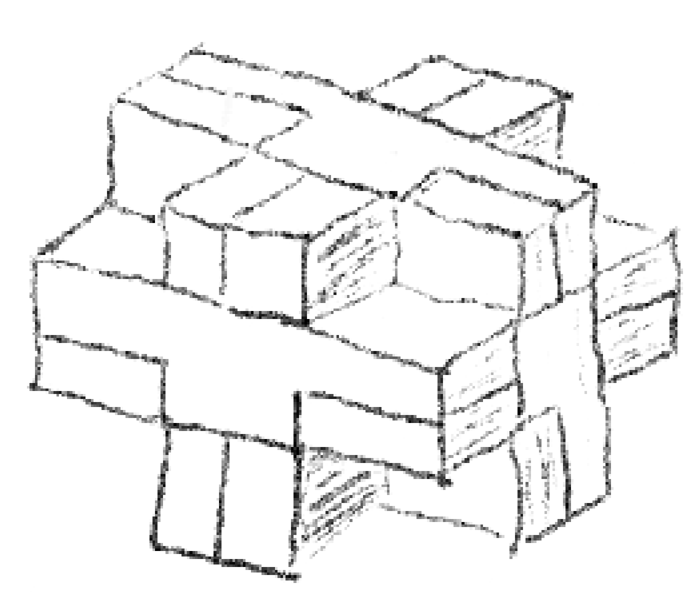


TWO TYPES OF THREE NOTCH PIECE

TWO TYPES OF TWO NOTCH PIECE

FOUR NOTCH PIECE

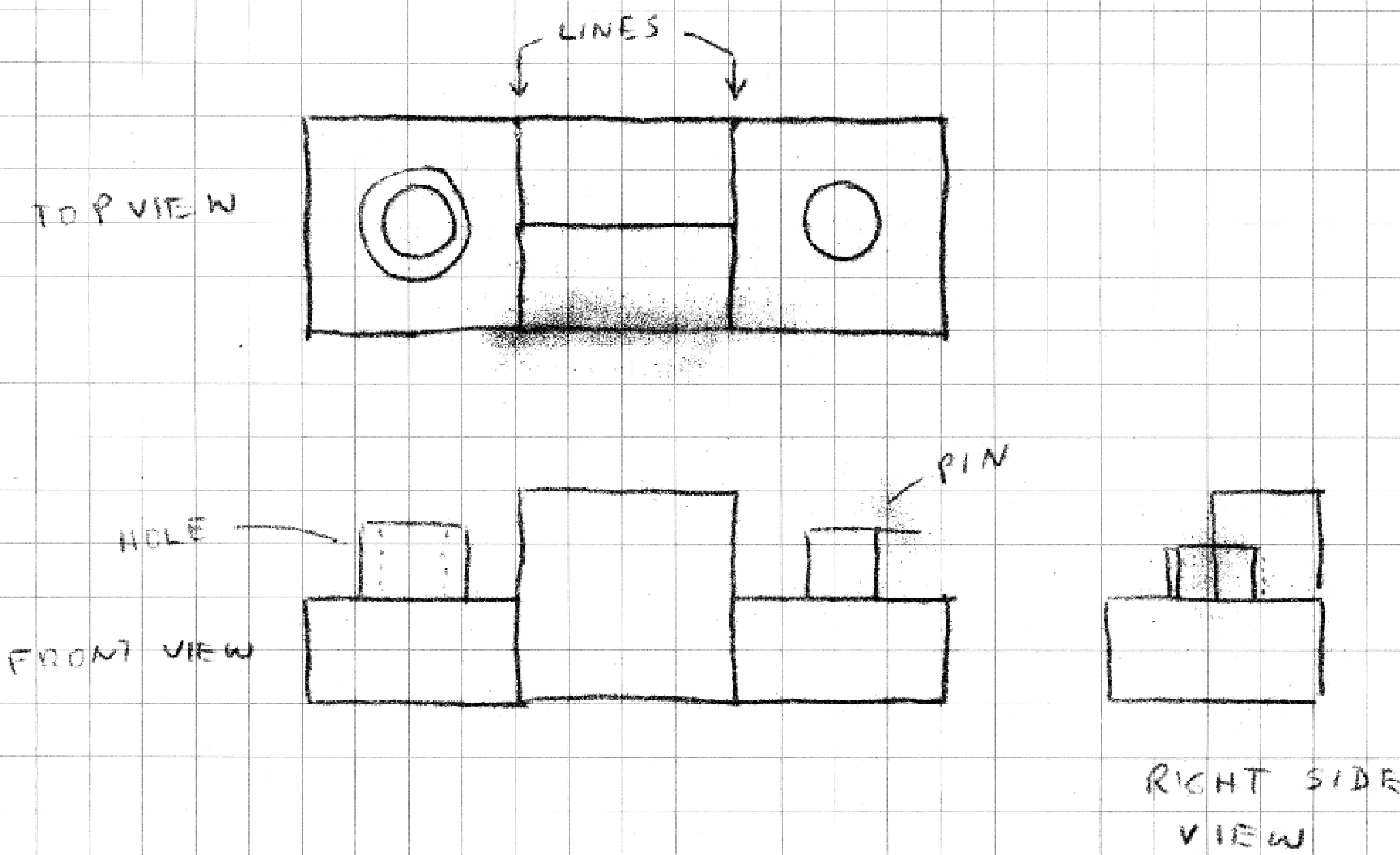
FIVE NOTCH PIECE



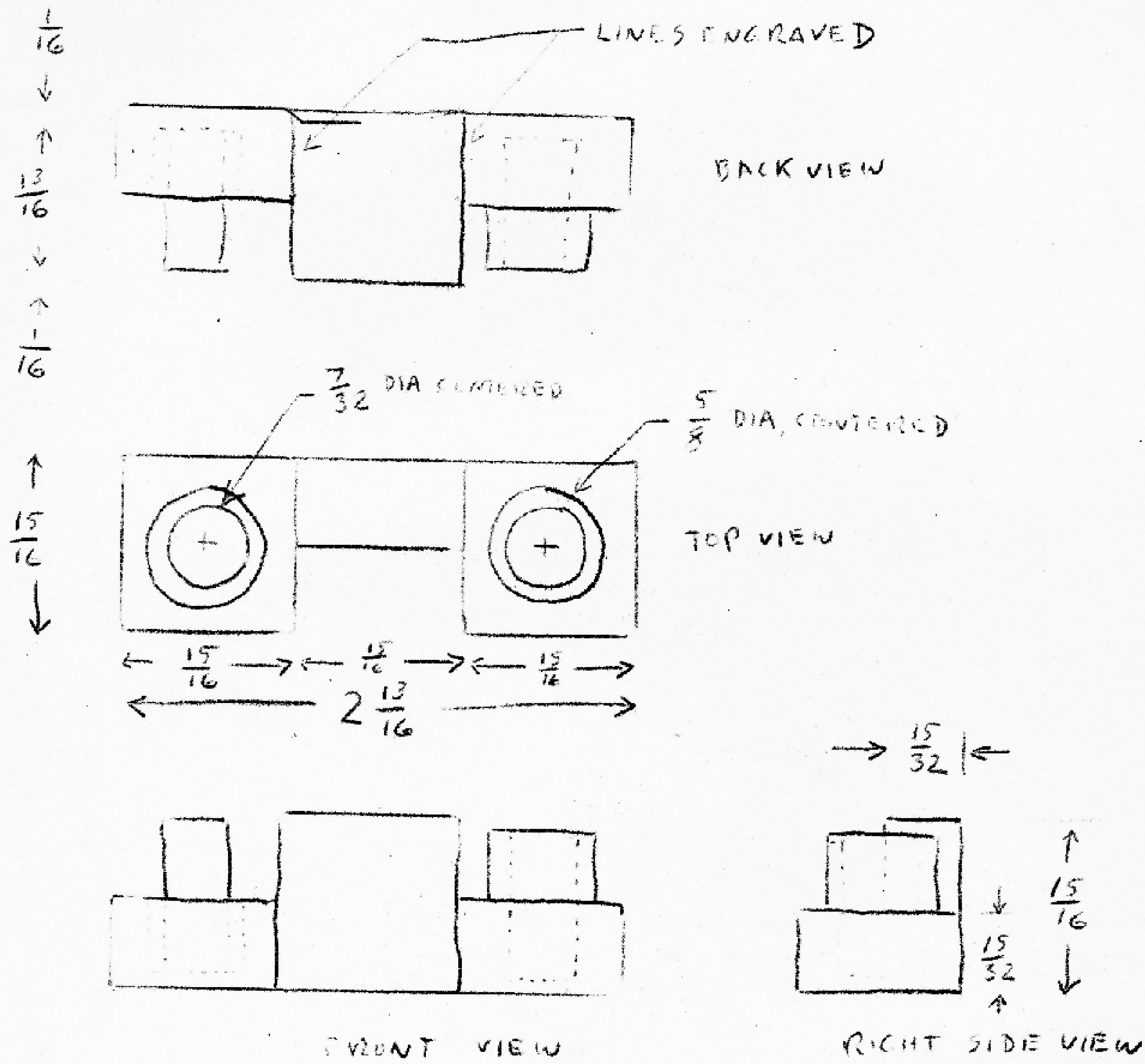
BASIC ASSEMBLY OF TWELVE 3-NOTCH PIECES

SKETCH OF FRANTIX PUZZLE PIECE FOR 3M

by S. Coffin, Sept. 20, 1973

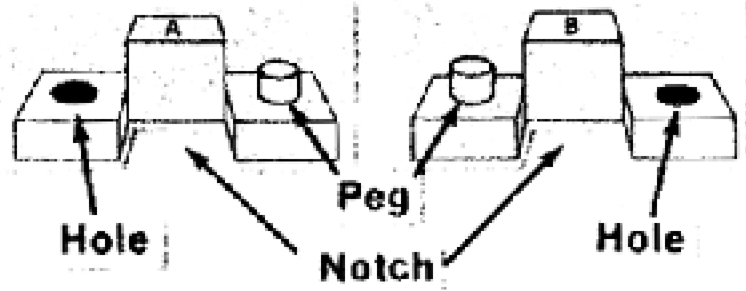


- Drawing shows "RIGHT-HAND" piece, mirror image piece is also required.
- Lines are engraved on back where shown by arrows.
- Coring would be from the top - not shown.
- Pin and hole are centered exactly on respective square surfaces - pin fits hole snugly without friction
- Drawn approximately to scale
- Break sharp edges and corners
- Refer to Memo Sept 20, 1973 from S Coffin to 3M



SKETCH OF LEFT-HAND FRANTIX PIECE, INTERMEDIATE SIZE
For 3M, by S. Coffin, Sept. 27 1973

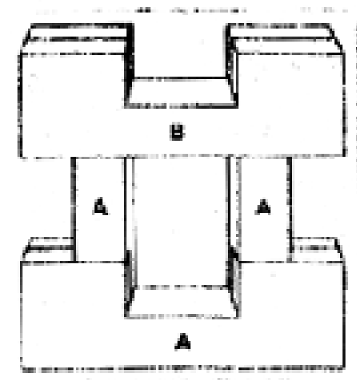
TO TAKE IT ALL APART . . .



Anything goes! You can twist, tug, push, pull—or whatever you choose—to separate Frantix into 12 puzzle pieces. Once apart, you'll note every piece has a peg at one end, a hole in the other, and a notch in the middle. Take a closer look, you'll see each piece is marked with an A or a B.

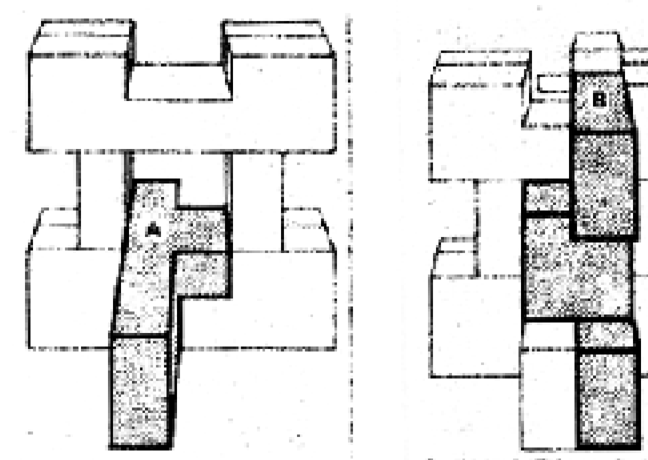
1

TO PUT IT ALL TOGETHER . . .



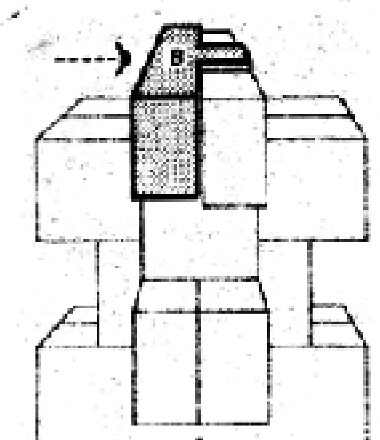
Place an A piece on table, notch up, peg side away from you. With notches facing outward—vertically engage 2 A's with ends of first A. Join tops of vertical A's with a B, completing first "ring" configuration.

2



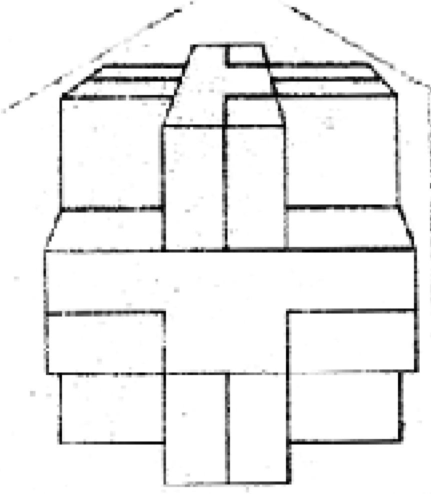
Peg end away from you, slip an A thru center hole, notch downward. Then—vertically engage 2 B's, notches out, to ends of A.

3



Grasp notches of these vertical B's and raise high enough to join tops with another B, completing second "ring." Then complete puzzle by forming third "ring" around center with 4 remaining pieces.

4



Slip A's into side notches, raise second "ring" and simply slip B's into remaining front and back notches.

CONGRATULATIONS! YOU'RE NOW QUALIFIED TO TACKLE THE PUT-TOGETHERS ON THE OTHER SIDE . . .

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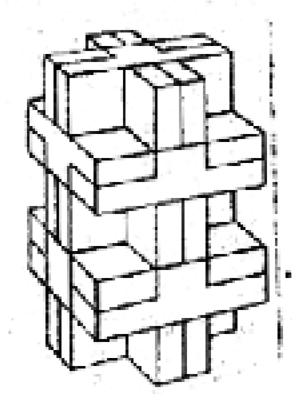
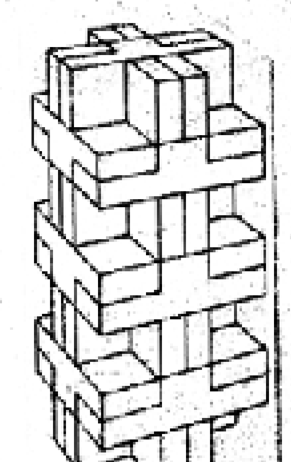
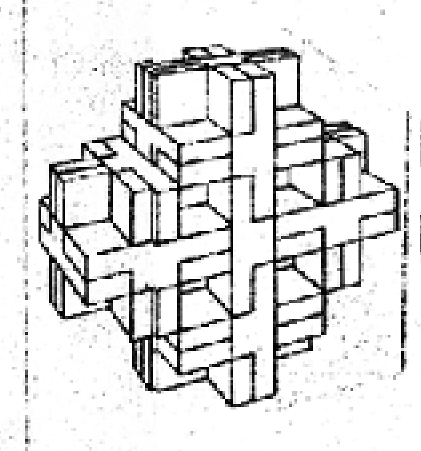


20-PIECE DOUBLER

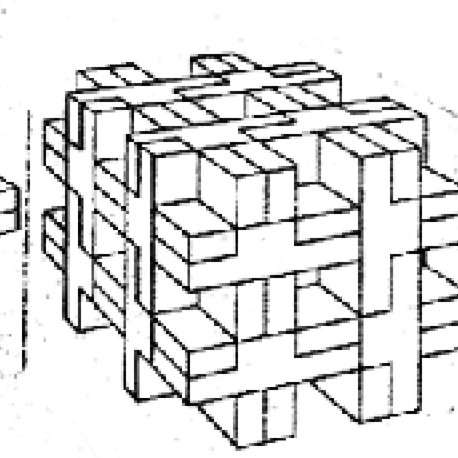


28-PIECE TRIPLER

8



44-PIECE FREE FORM



44-PIECE CUBE

9

. . . especially when it's all apart and you're the one who's trying to put it all together again!

AP-ART

The sculptural art that comes apart

Stewart T. Coffin
79 Old Sudbury Road
Lincoln, MA 01773
617-259-8348

23 Jan 1996

Dear

Enclosed is a wooden version of my Frantix Puzzle, No. 9-A. It was made around 1973. Only about three were made, in mahogany and birch. This puzzle was designed with the intention that it would be licensed to 3M Company to be manufactured in plastic as a sequel to Hectix. It was so licensed in 1973. I don't know how many were made, but not very many. They paid me a royalty, but I have discarded all those records. Later 3M sold the rights and inventory for both Frantix and Hectix to Avalon Hill, who so far as I know just sold off the inventory and did nothing more with it. They were very poorly made in styrene, with tapered pins and a poor fit. This wooden version is how they were supposed to fit. Since I never produced this puzzle for sale myself, I never did have an instruction sheet, but the one which accompanied the 3M version would apply. It is also described on pages 68 and 69 of my book, *The Puzzling World of Polyhedral Dissections.*

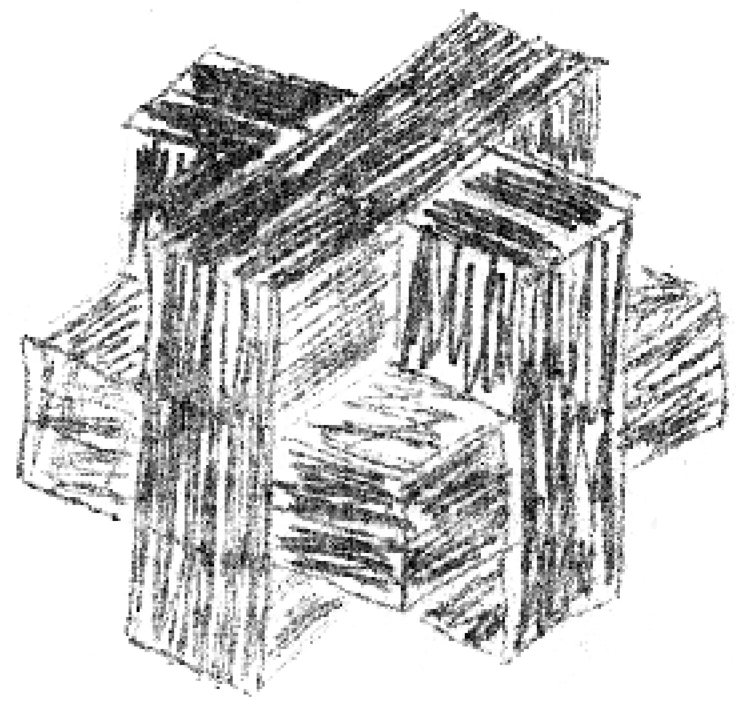
The $27 balance from previous transaction plus $35 for this makes $62 you owe now. More to follow soon.

Our plan is to rent a car in San Diego at the end of our AMC trip on March 31, make our way leisurely north, possibly visiting you on the afternoon of April 1 if that is convenient. Did you mention overnight lodging? We will have sleeping bags. Maybe I will have some puzzles for you in exchange. With all the maps we have, it should be no problem. Mary has relatives in Eagle Rock whom we might visit if we have time. The next day we head leisurely south to fly home from San Diego on April 3.

Sincerely,

First Draft

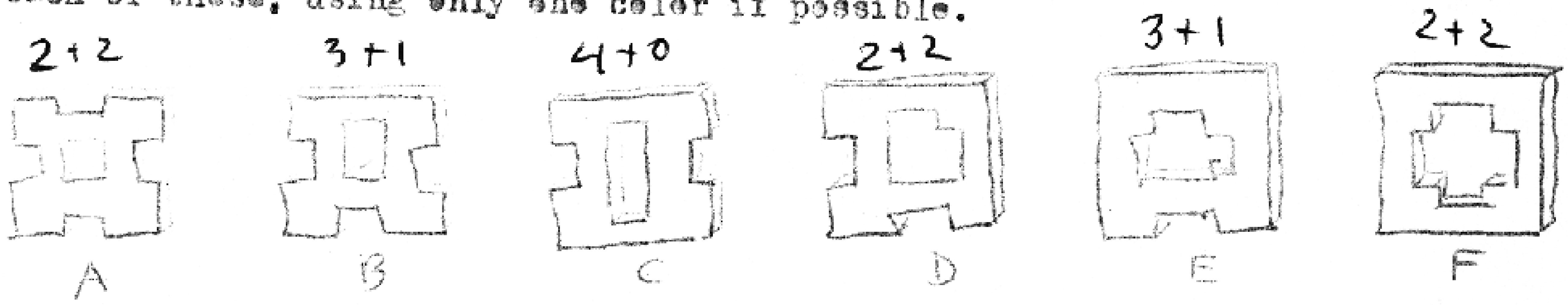
Instructions for <u>Lynx</u> Puzzle



The LYNX Puzzle comes assembled as shown above. Take a good look at it before disassembling. You may not see it exactly like this again for a while. Can you find the "key"? If you systematically push and pull on each piece, one by one, you may become convinced that it does not come apart at all, or more force is required. Wrong. Keep at it, and you will discover that it separated in an unexpected way.

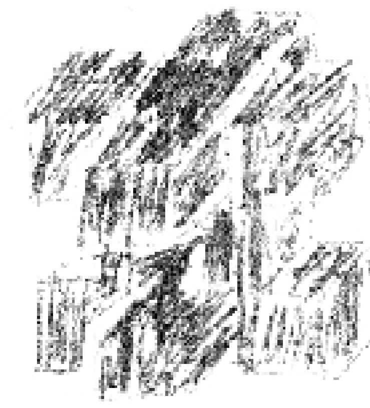
Lay the twelve pieces out, and note that there are only two types of pieces, one type being the mirror image of the other. And for each type, there are two of each color.

Practice exercises: The basic building block of the LYNX puzzle is a square ring made up of four pieces. The six possible types of rings are shown below. Practice making each of these, using only one color if possible.



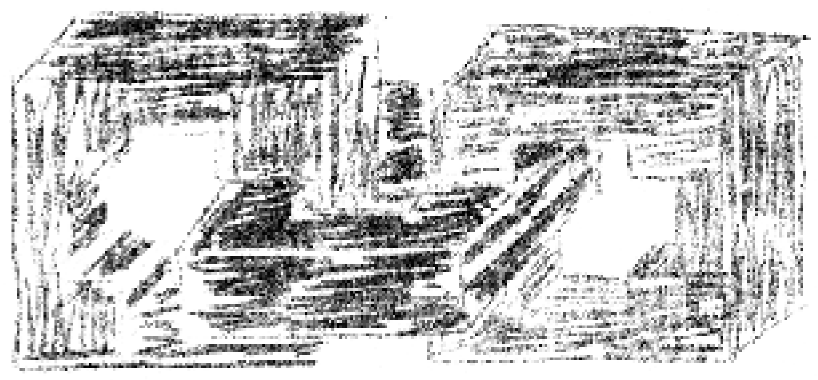
Now try making two interlocking rings. Ten different combinations of the above are possible, two of which are illustrated below. See if you can do the other eight too, again making each ring a solid color whenefer possible.

A-F



A-C

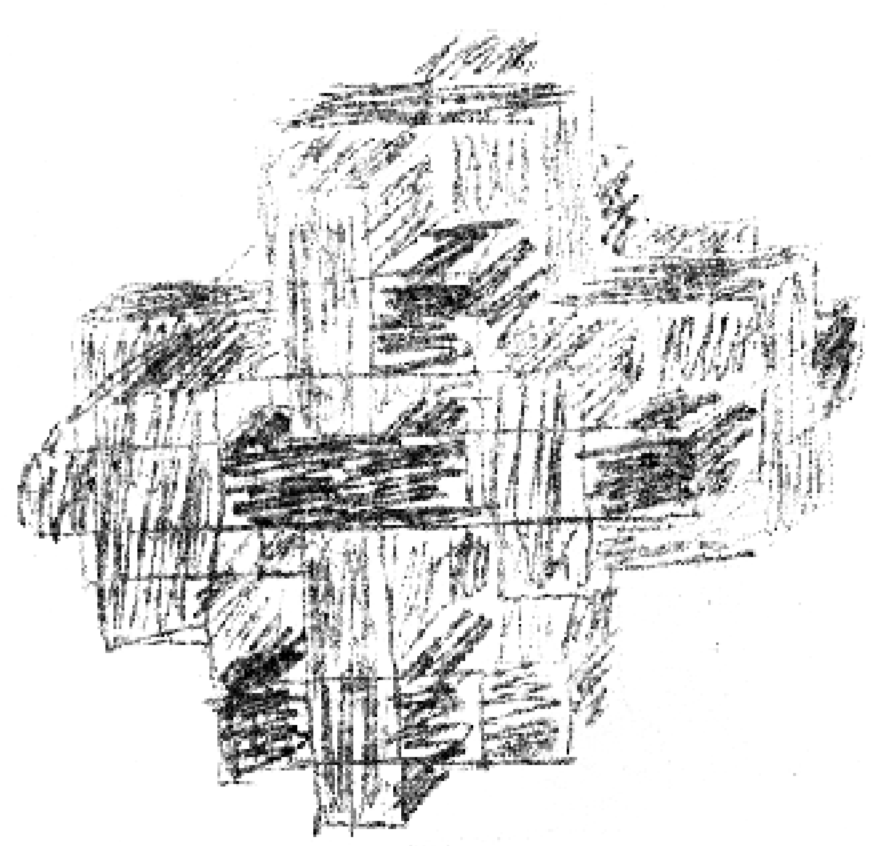
Now you are ready to attempt the LYNX assembly. It is hard. It may surprise you to learn that there are at least three distinctly different solutions. In one of them, probably the easiest, the puzzle can be disassembled only by sliding it apart along one axis - the same one it went together on, of course. There is a second solution, in which the LYNX can be disassembled along either one of two perpendicular axes. And finally, there is a third solution, known as the Symmetrical Solution, in which the puzzle can be slid together or apart along any one of its three axes. ~~This is the Ultimate~~. After you have mastered it, ~~assemble the~~ you are ready for the Ultimate Solution, which is a symmetrical solution in which each ring is a solid color, as illustrated at the top. For additional exercise, assemble such that ~~all like colored pieces are parallel~~ no like colored ~~pieces~~ faces come together anywhere. What other interesting shapes or color patterns can you discover? A few are illustrated below:

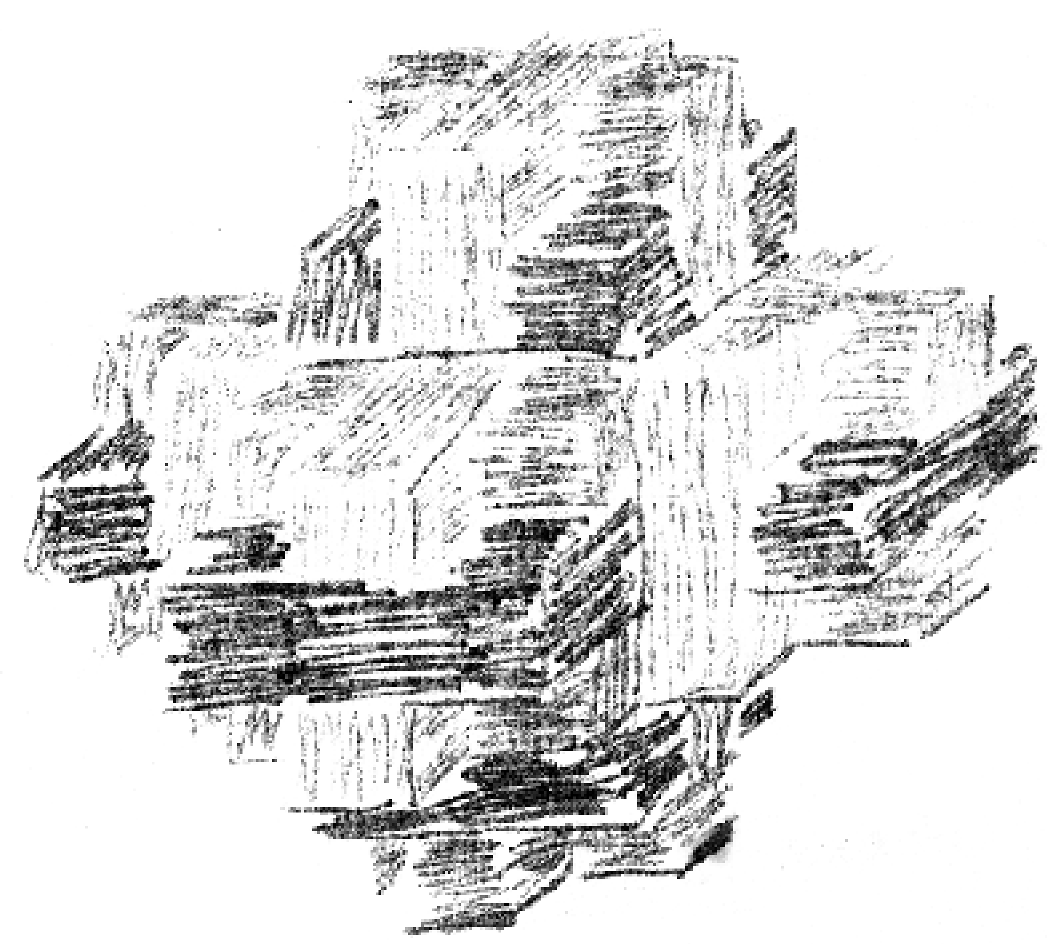


Problems with two puzzle sets: When two sets of Lynx pieces are available, more colossal structures are possible. The Lynx solution is basically cubic in shape, having a size of 3 x 3 x 3 units (inches). With two sets, it is possible to make a completely interlocking 3 x 3 x 5 rectangular solid, using a total of 20 pieces. What other shapes can you make?

If enough sets are available, even more difficult and beautiful puzzle shapes are possible, limited only by your imagination and perseverence. For a started, try the larger rectangular shapes, like 3 x 3 x 7 (28 pieces), or 3 x 5 x 5 (32 pieces). An obvious challenge is a 5 x 5 x 5 Super Lynx. (48 pieces) Again, try to make all the rings solid colors, if possible. impossible?

The Cross Lynx is challenging. It can be made with or without a hole in the center, and in either case requires 44 pieces. Finally, there is the stupendous and very difficult interlocking Super Triple Cross Lynx, requiring 60 pieces. Perhaps you can discover even more elegant structures, but as far as we are concerned, this is the Last Word.





#15

Analysis of Triumph — Feb 16, 1990

1. Six identical symmetrical pieces

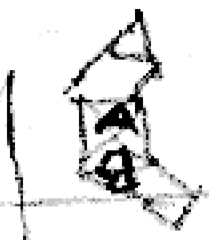
sym. sol.	CW	CCW	
1	AAA	BBB	column
2	BBB	AAA	star
3	AAA	AAA	} spire?
4	BBB	BBB	

other sol:

	CW	CCW	
5	AAA	AAB	non-
6	AAA	ABB	non
7	AAB	AAA	non
8	"	AAB	non non ~~non~~ spiral
9	"	ABB	non non star
10	"	BBB	non
11	ABB	AAA	non
12	"	AAB	non non column
13	"	ABB	non non spiral
14	"	BBB	non non non
15	BBB	AAB	non
16		ABB	non

#15-A

(Fusion-Confusion)



New Triumph

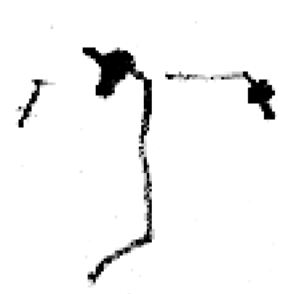
	CW	CCW	
Column	~~1B 2B 3~~ 1A 5A 3A	2B 6B 4B	
STAR	1B 2B 3B	4A 5A 6A	(x3)
SPIRAL	1A 4A 2A	3A 5A 6A	
	2B 3B 6B	1B 5B 4B	
	" " "	1B 4B 5B	

Column 3-6, 2-5, 1-4

STAR 3-6 2-5, 1-4

SPIRAL 4-5, 2-6, 1-3
4-6, 3-5, 1-2
1-6, 2-4, 3-5

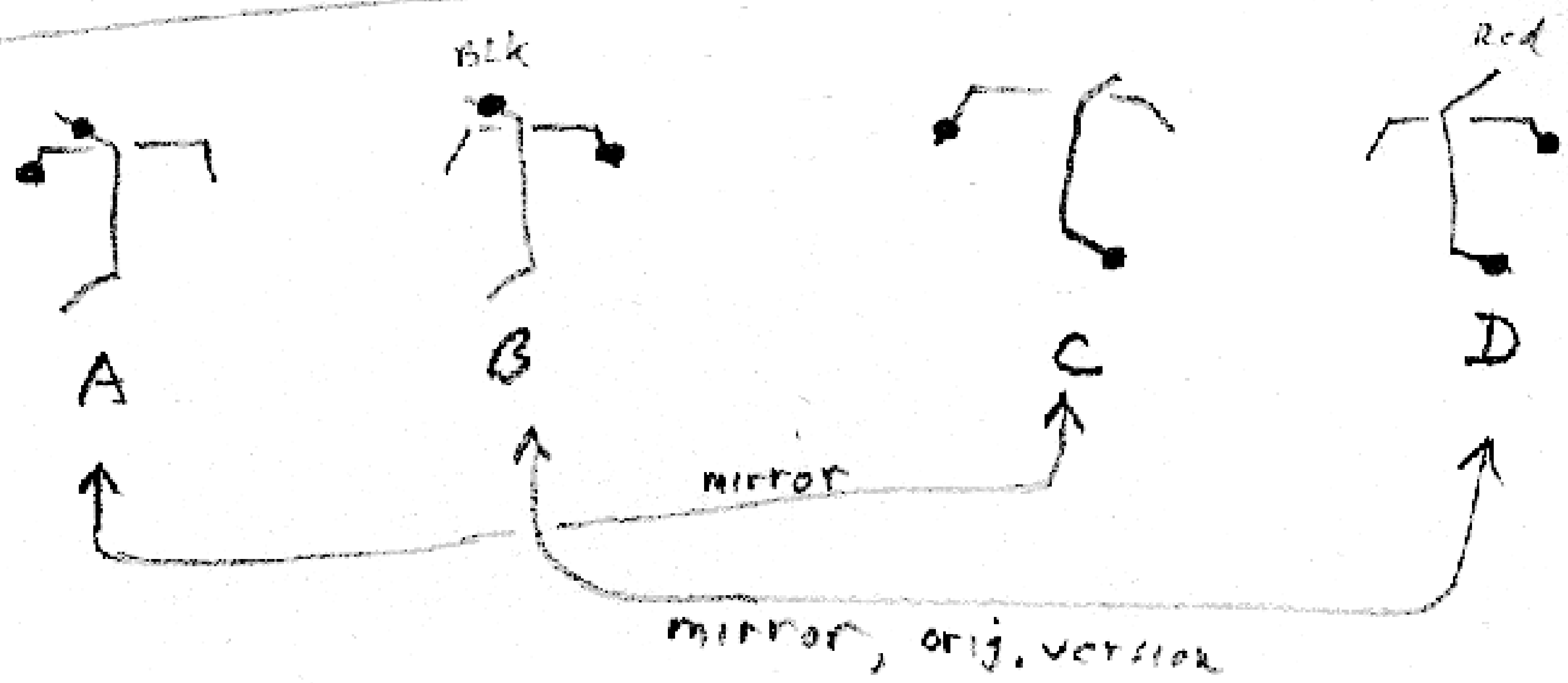
15-A

STAR  + mirror, or ~~same~~, or  diz's

column " + mirror, or same or " or 

spir. " " " " "

Kinds of pc



cw ccw

STAR B – D (~~sym~~ sym) 2xi2l)

A, C, D – A, B, C diz's

Column A, B, D – B, C D diz's

C – A 2xi2l

spir. C – D 2xi2l

A, B, D – A, B, C diz's

~~A-B or A-D~~

A B

~~A C~~

A D

B C

~~B D~~

C D

m

m

so, As A-B or A-D

The FUSION-CONFUSION Puzzle, No. 15-A

This is a vastly improved version of the old Triumph puzzle (1974), which consisted of six pieces identical in shape but dissimilar in coloring. In this new version, the six pieces are identical in shape <u>and</u> coloring, but two pairs of them are fused together, thus resulting in only four puzzle pieces.

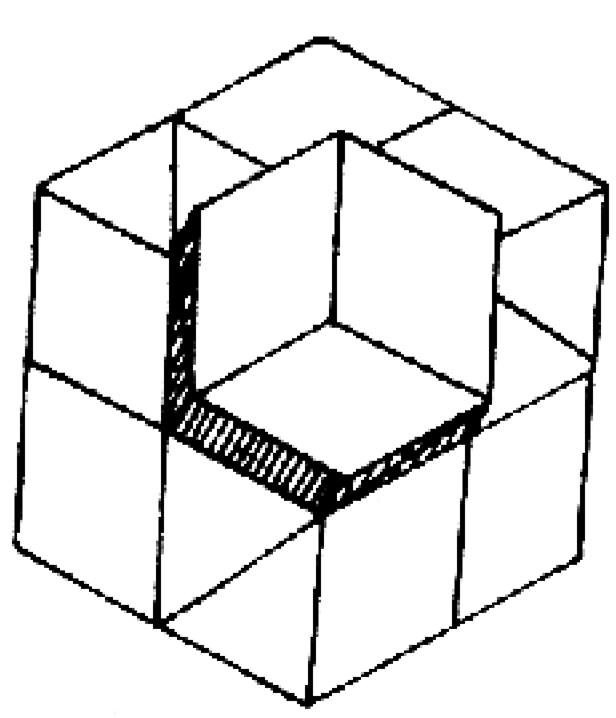
This slight modification creates the most utter confusion one can imagine. It also overcomes the tendency of the old version to fall apart when dry, as three of the four sliding axes are thus eliminated, leaving only one confusing diagonal axis of assembly.

The object of the puzzle is to assemble the four pieces to form any one of the three shapes shown below. The shape on the left could be described as a hexagonal column with a hexagonal ring around its center. The one in the center is a sort of Star of David prism. The strange shape on the right is harder to describe and is not the same top and bottom. Furthermore, it also occurs in the mirror image of the version shown, so there are really four solution shapes. All have a threefold axis of symmetry.

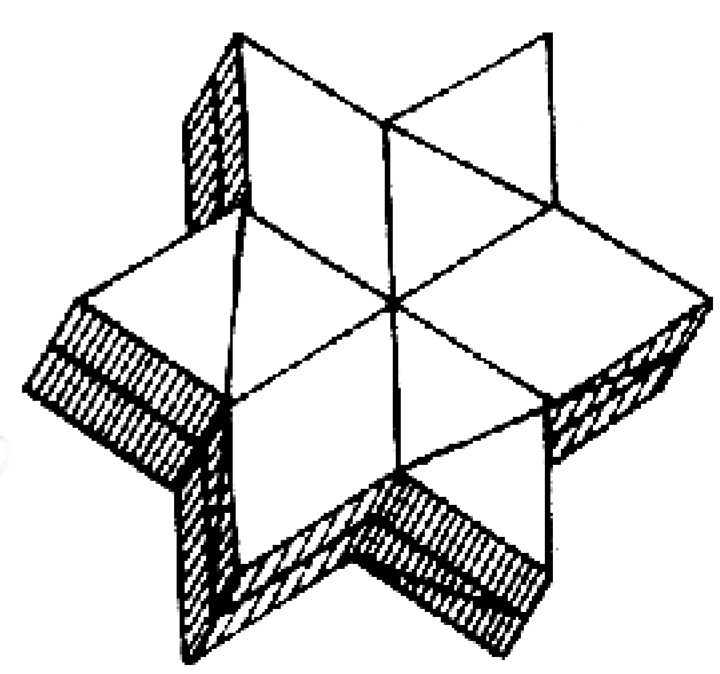
All solutions are made by mating two halves, with each half made up of one simple piece and one fused pair. There are essentially 18 different ways that the puzzle can be thus assembled. The COLUMN and STAR each have one unique solution with a confusing diagonal axis of assembly. The STRANGE shape as shown has two diagonal solutions. Its mirror image has one diagonal solution and one axial solution. The other 12 ways of assembly give rise to any one of four interesting but nondescript shapes with no symmetry.

The pieces are made up of contrasting woods in a manner such that each symmetrical solution will also automatically be enhanced by an intriguing pattern of multicolor symmetry. Furthermore, when woods with distinct growth rings are used, note that they are sawn and arranged in a manner such that symmetrical grain patterns appear in all solutions.

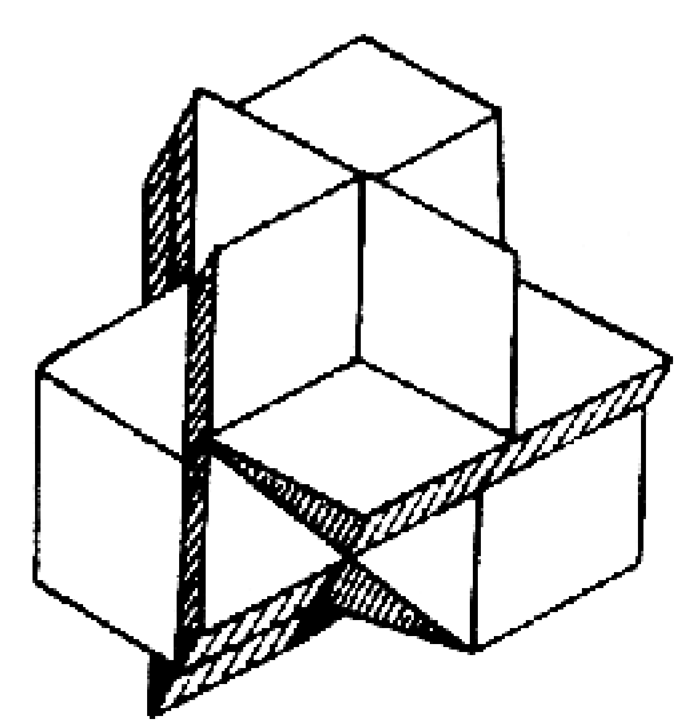
Additional exercise for the precocious puzzler: Can you figure out the peculiar logic in this particular design, and can you fathom the arcane laws of symmetry at work here? See if you can switch from one solution to another with the minimum number of moves.



COLUMN



STAR

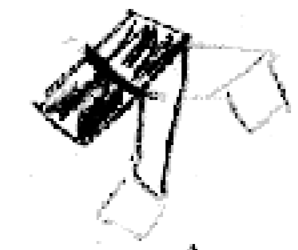


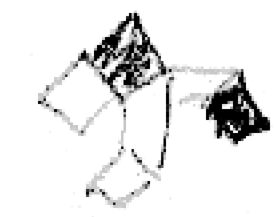
STRANGE

Stewart T. Coffin, 79 Old Sudbury Road, Lincoln, MA 01773 Feb 1990

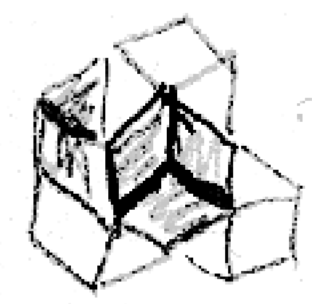
FUSION-CONFUSION

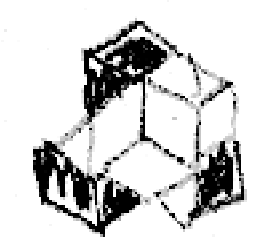
Analysis of 15 A


A

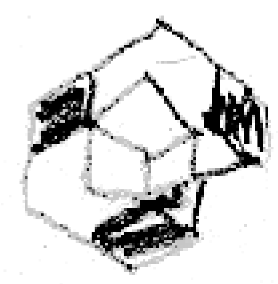

B

CW	CCW		
A-up	B-up	a, b, column (diag ✓)	3
A-up	B-down	spiral (diag) ⬡, b, c	3
A-down	B-up	d, c, spiral (diag) ⬢	3
A-down	B-down	star (diag ✓), a, b	3


a


b


c


d

B-up	A-up	b, b, b
B-up	~~A down~~	~~spiral (diag), d, c~~
	A down	axial spiral X3 black hex ⬢
B-down	A-up	spiral (diag) ⬡, d, c
B-down	A-down	a, a, a

---

totals column one sol., diag
star " " "
spiral 3 diag + 1 axial (X3)

a - 5
b - 6
c - 3
d - 2
—
22

cw	ccw			
1A	2A	hex + spiral	1	★
	2B	hex − Δ	2	
1B	2A	hex − Δ		
	2B	~~[struck]~~ STAR	3	✓
2A	1A	SQUAT Δ	4	
	1B	Δ + spiral Δ	5	
2B	1A	Δ + spiral Δ		
	1B	Δ + ring	6	✓

cw sq Δ
dented Δ

ccw "

hex

so. SD, SH, DD, DH (4)
✓ ✓

cw	ccw				
A	A	hex sp. + Δ sp.	✓	✓✓	✓✓✓
A	B	squat + dent Δ	✓	✓✓	✓✓✓
B	A	hex + den Δ	✓	no	no
B	B	dent Δ + star	✓	no	no

\#18

Copyright:

Feb. 1, 1975

<u>Description of Puzzle No. 12 - ABBIE'S PUZZLE</u>, also known as <u>The AWFUL WAFFLE</u>

This puzzle consists of six pieces, and a box which holds them, plus an instruction sheet.

Each piece consists of four cubes joined together, face-to-face. Two of the pieces are <u>T</u> shaped, two are <u>L</u> shaped, one is zig-zag, and one is straight. Thus, they are all flat shapes - that is, they will lie so that all of the cube elements rest on a flat surface.

The object of the puzzle is to-

1. Place the pieces in the box, which is a 2x3x4 solid assembly.
2. Make other rectangular arrangements with the full set of pieces. Two are possible - 1x4x6 and 1x3x8.
3. Make other shapes, as shown on the instruction sheet, such as a 5x5 square with hole in center, in corner, or along side.
4. By omitting pieces, make other rectangular solids.
5. Determine which shapes are possible and which are not, find the total number of solutions for each problem, and prove that there are no others.

Many other problems could be added, such as other geometric shapes, animated designs, etc.

Also, it would be possible to color the cubes alternately light and dark in checkerboard fashion, and require that in certain of the problems, no like-colored cubes could touch each other, thereby increasing the difficulty considerably.

The particular configuration of the pieces in this puzzle was devised by Abbie Coffin sometime around 1970, and demonstrated on television (ZOOM) on Dec. 9, 1973. The analysis was done mostly by myself.

In the particular version which we plan to produce, the edges of the cubes are all beveled at 45 degrees, giving the puzzle an interesting "waffle-iron" appearance, and making it look less like just another set of blocks. Another interesting variation would be to use spheres doweled together.

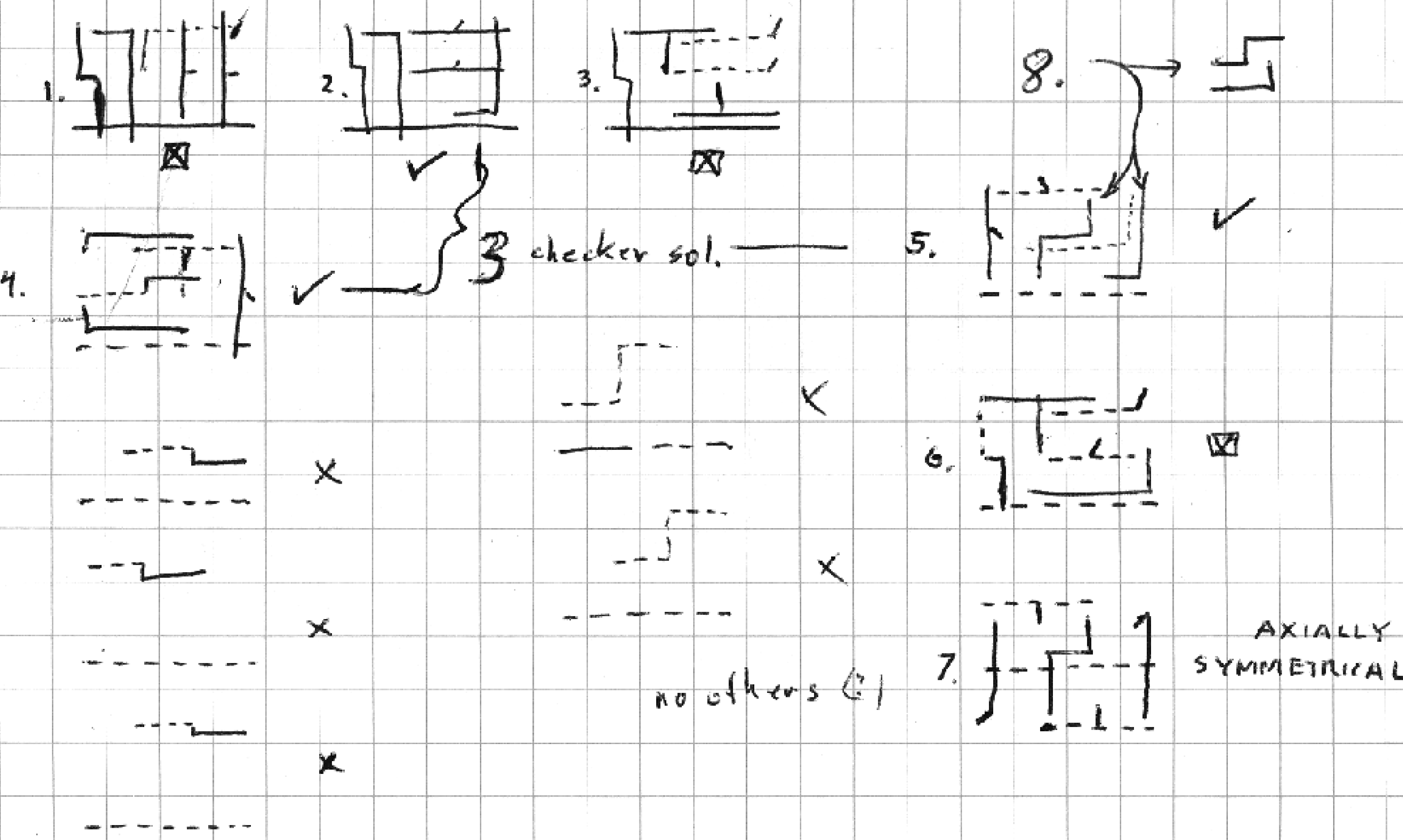
The instruction sheet is attached as part of this description.

(2) (2) (1) (1)

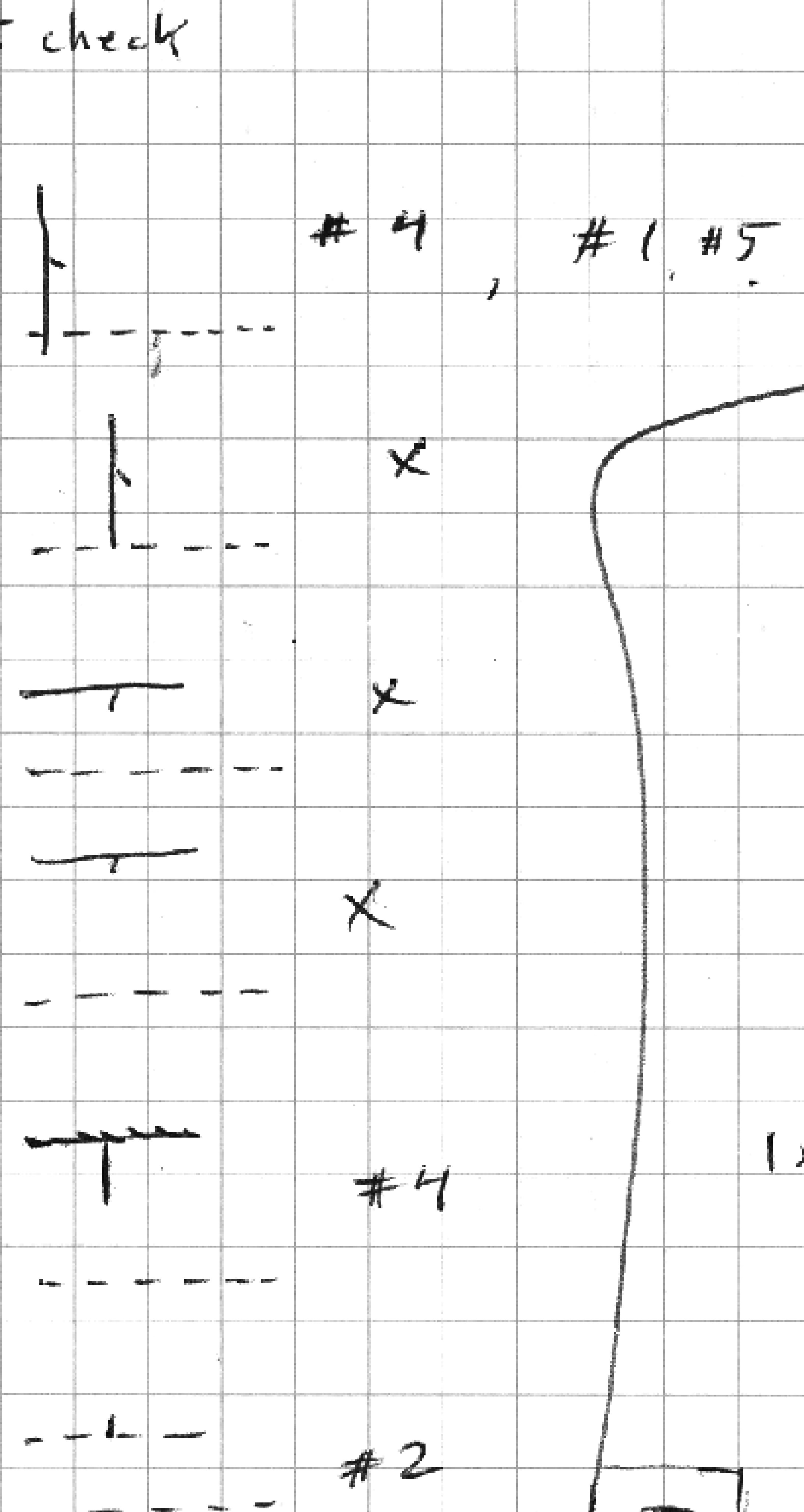
Stewart T. Coffin
Feb. 1, 1975

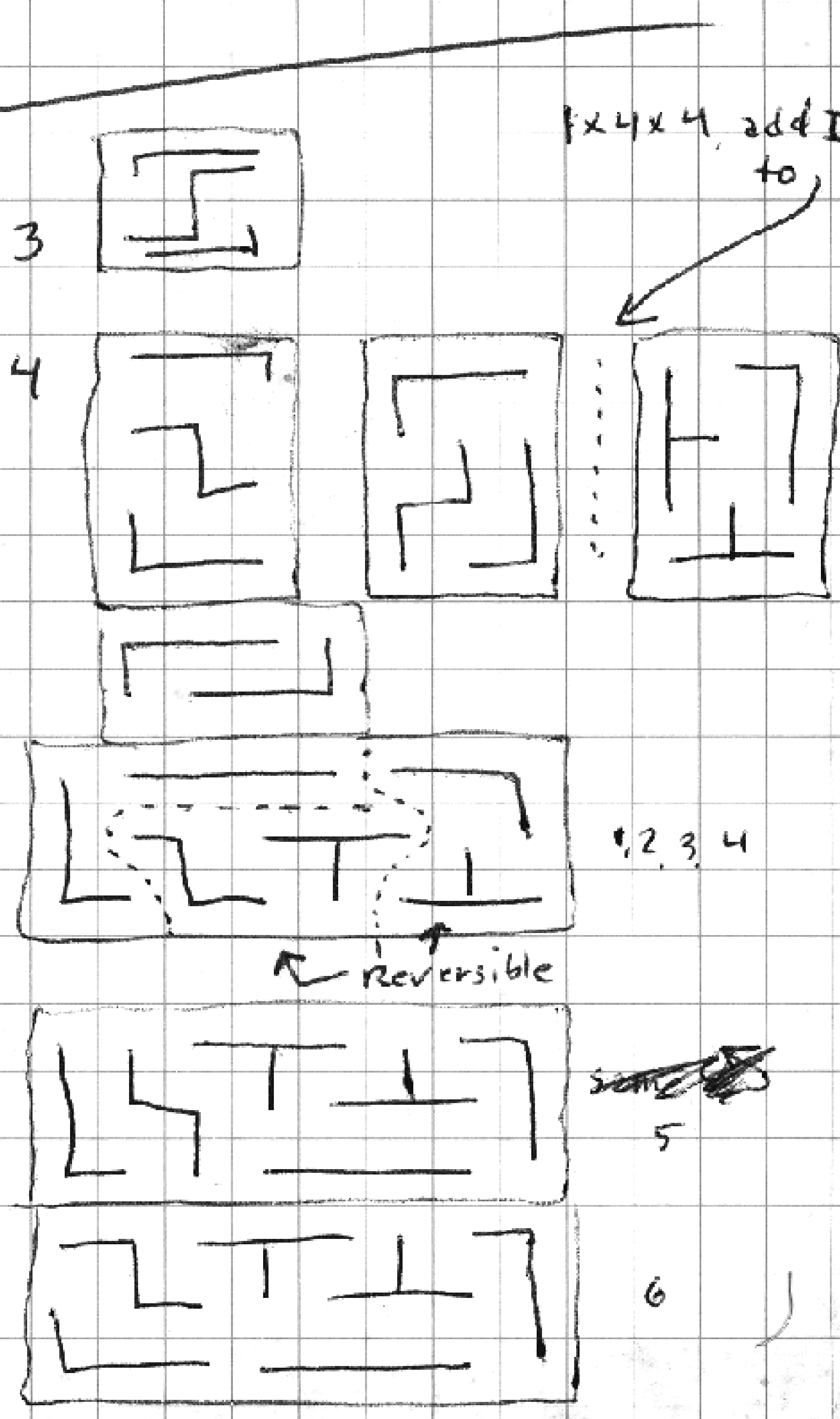
Complete analysis of Abbie's puzzle #18

1. 2×3×4

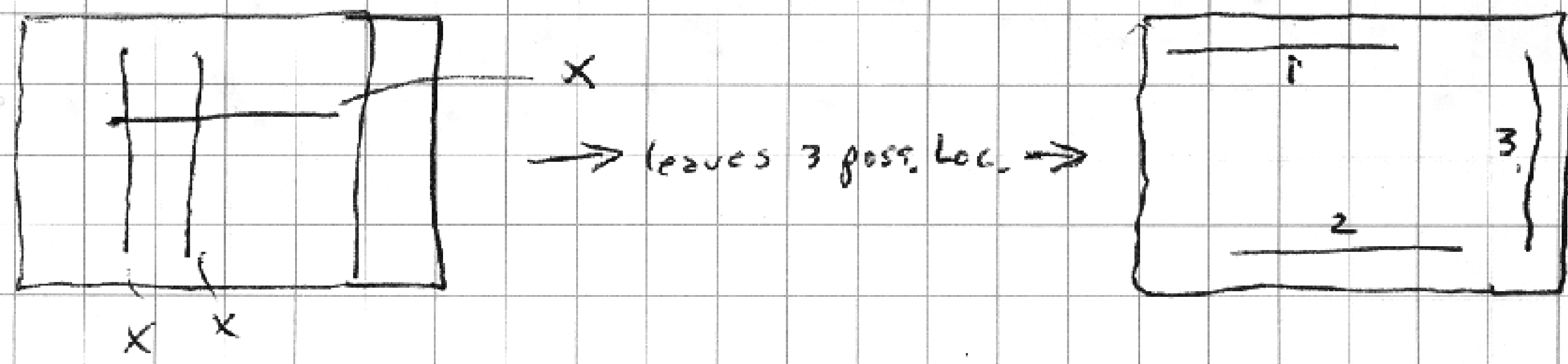


repeat check



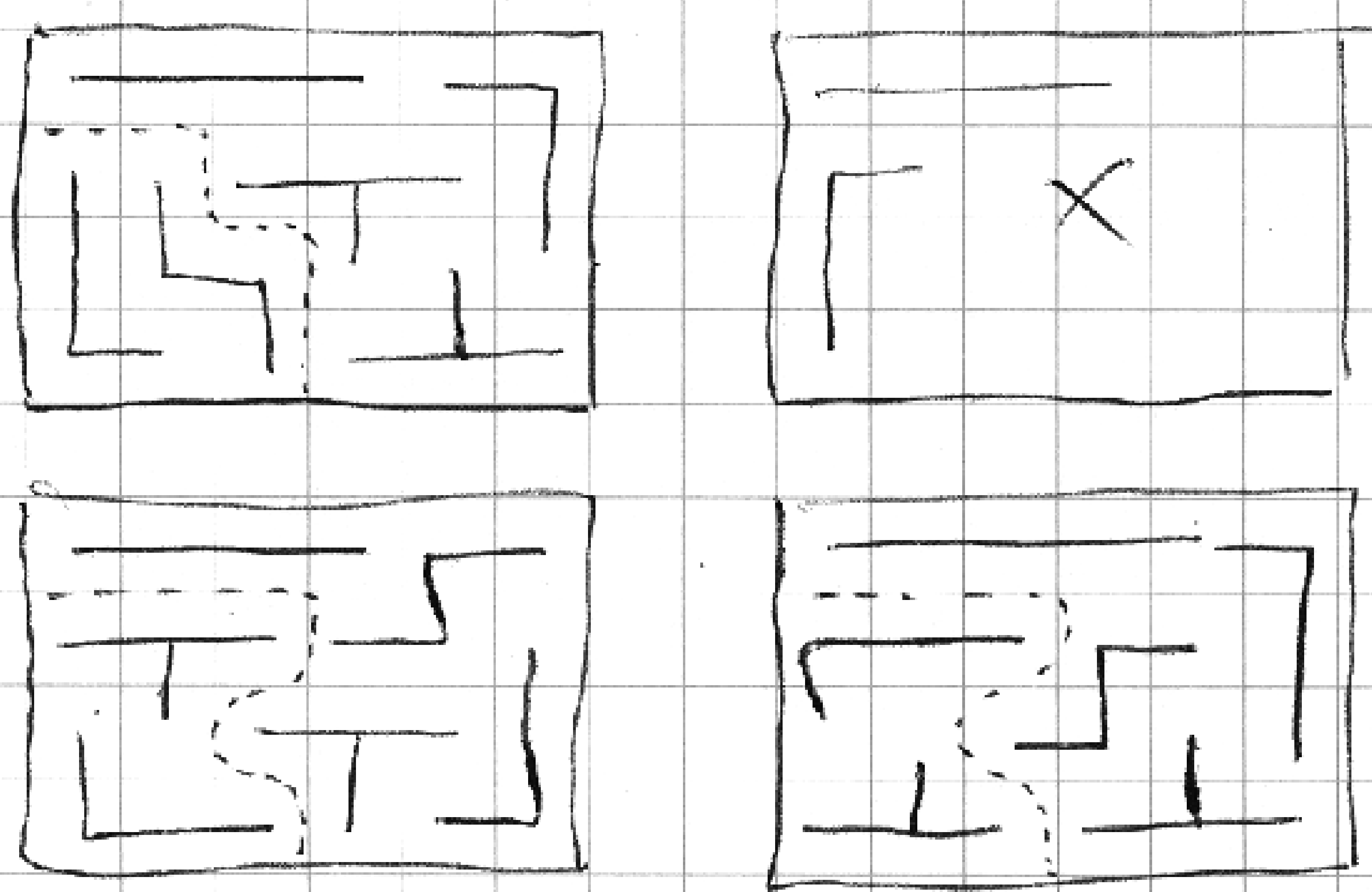


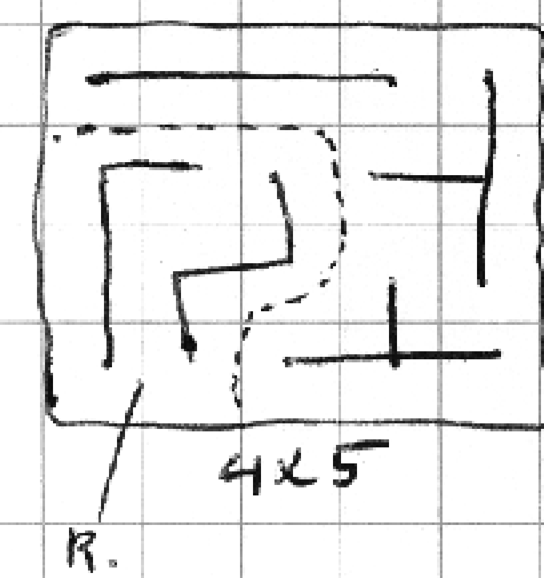
4x6



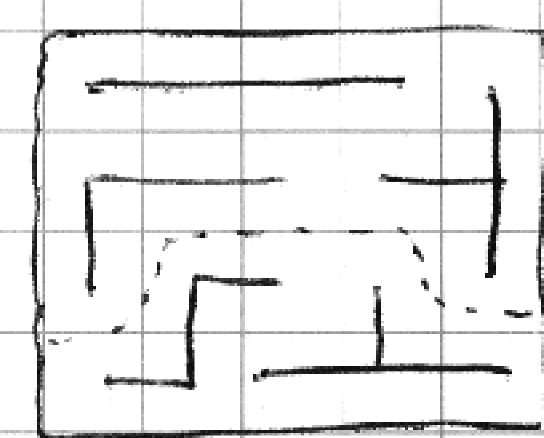
4x6

1.

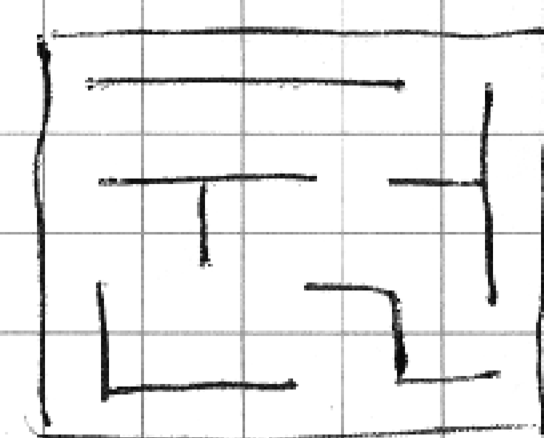




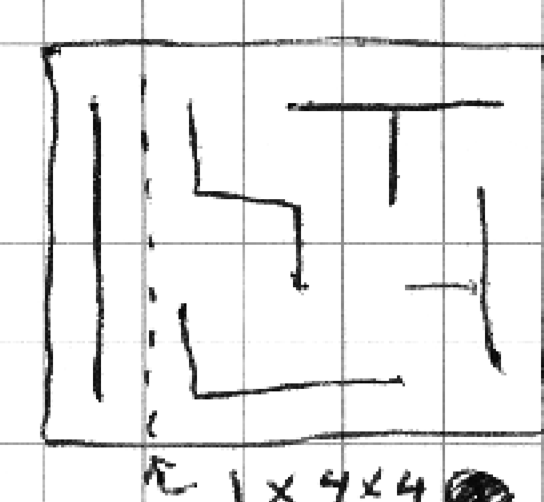
1. 2



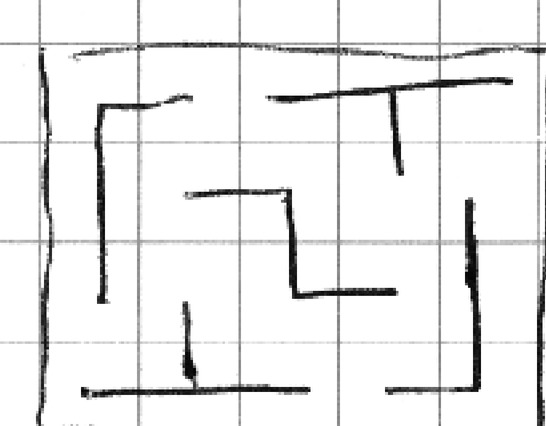
3. (2)



4.

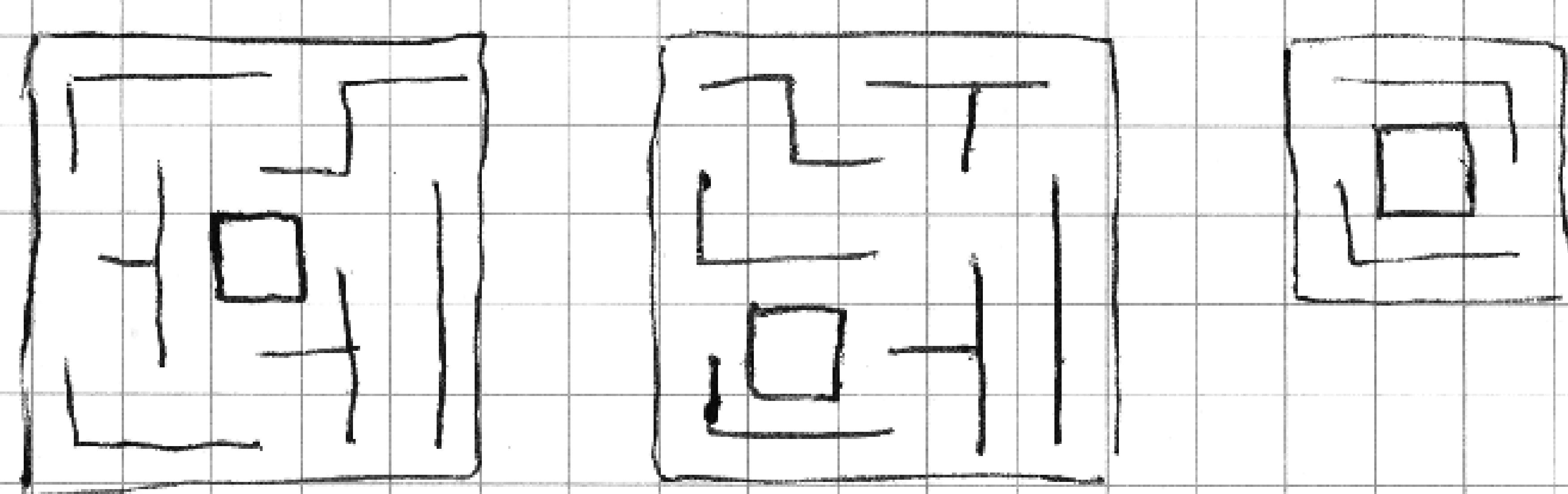


5, 6, 7, 8



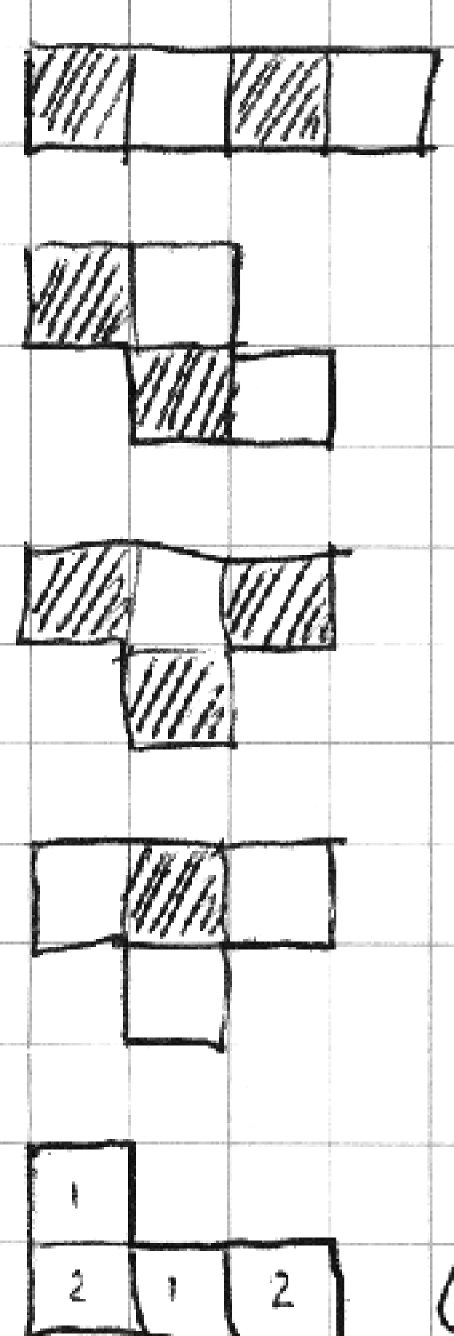
symmetrical 4x5

5 x 5



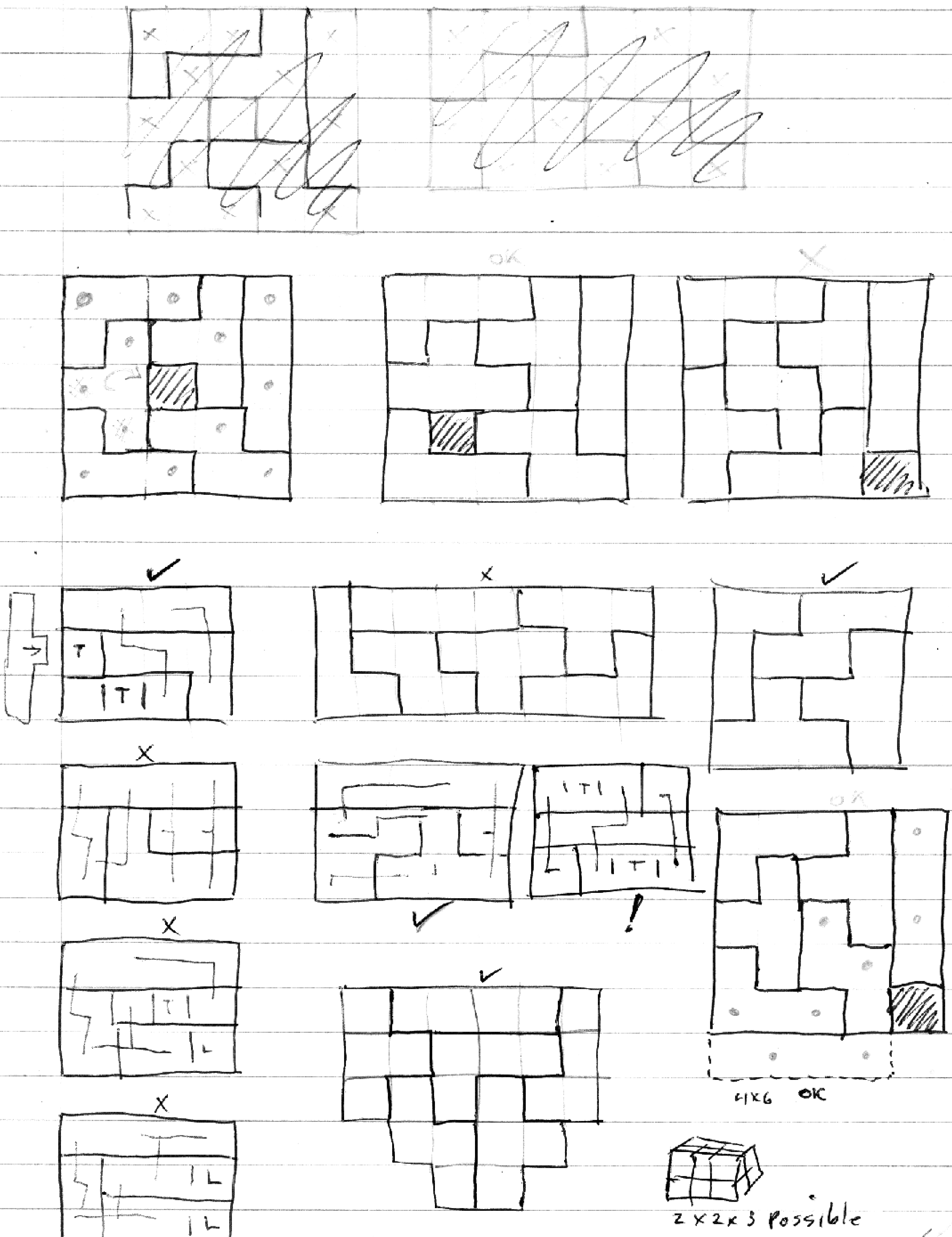
only one

2x2x4 impossible

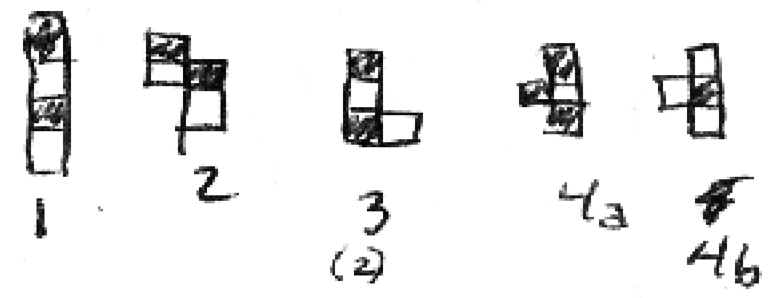


(2)

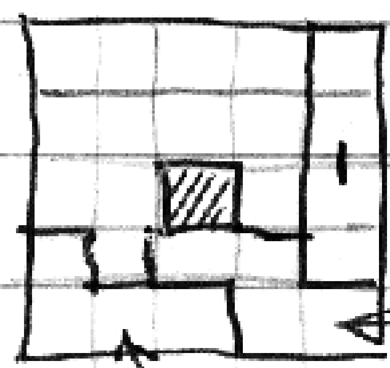
Abbie's puzzle



ABBIE'S PUZZLE

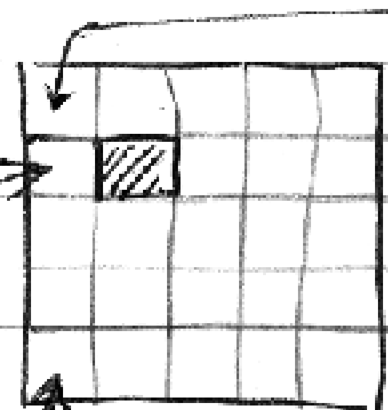


1. Hole in ctr.



1 must go here, then
2 " " " , "
3 " " "
} only 1 sol.

2.



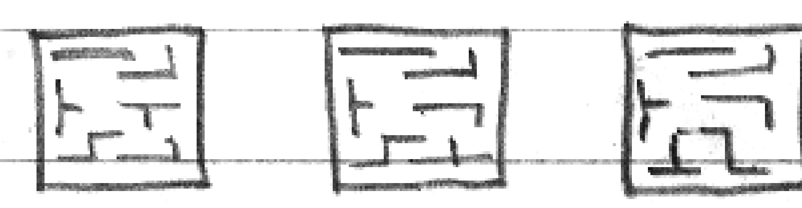
2. Hole not ctr.

must be 1 or 3,

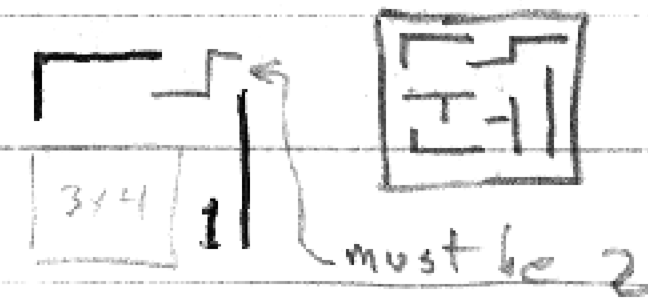
if 1, cannot be 3, must be 2 or 4

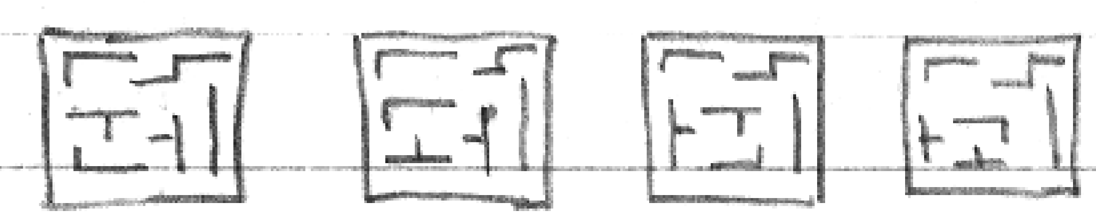
" if 2, must be 3, X

" if 4

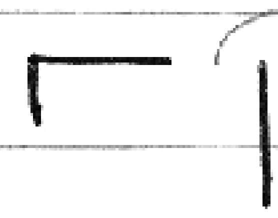


if 3

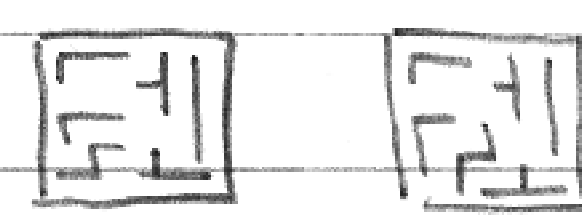




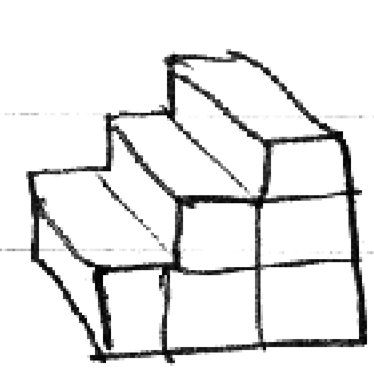
if 3



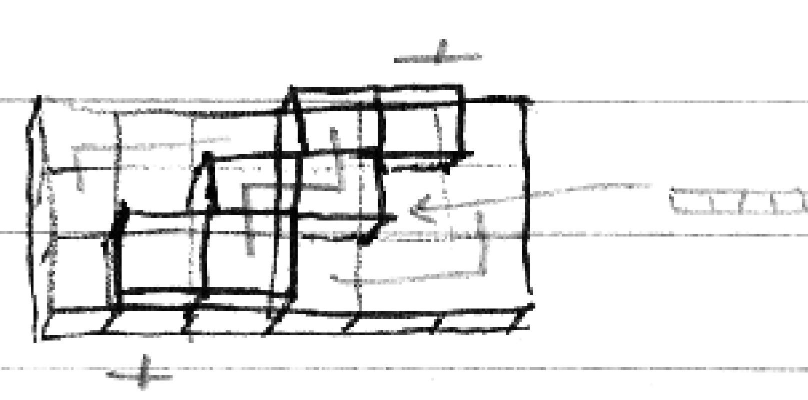
4



if

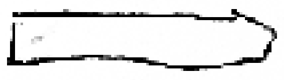
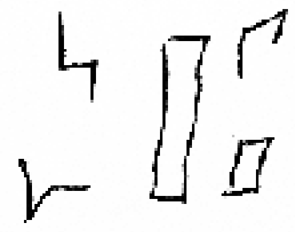
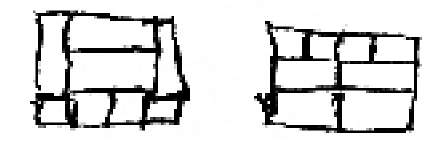


possible ?

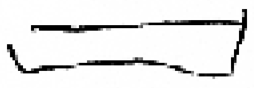
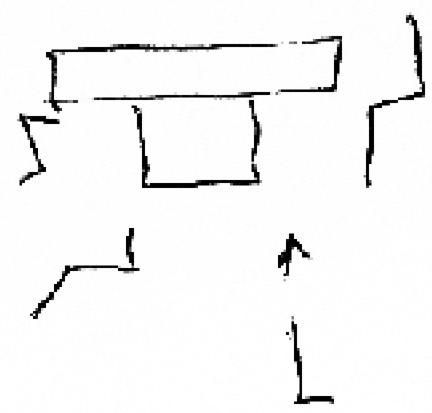


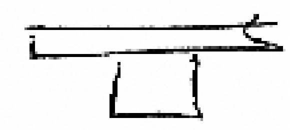
18-A Solutions to the 1×1×2 blocks puzzle

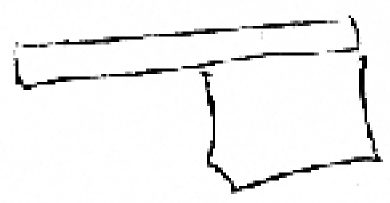
See PW page 50

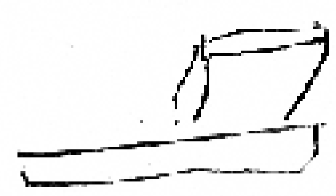
with  inside, one sol.  + mirror, no others 

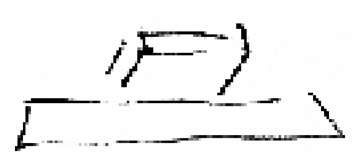
this one has mirror symmetry ←

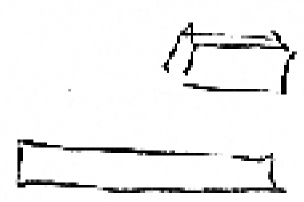
with  out  ×

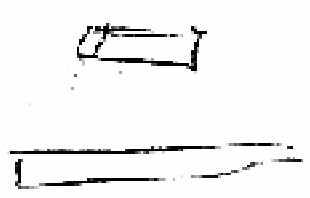
no others with 

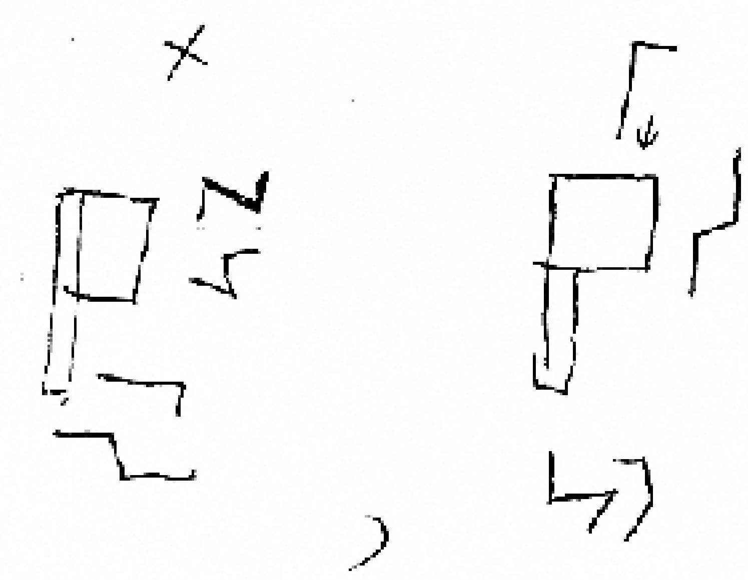
try  none

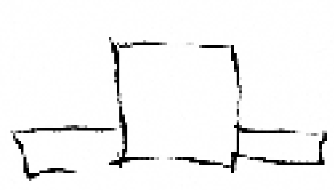
try  no

try  no

try  no

try  no ×

try  → 

 no

 → 

 no

5 solutions here, (may have missed some), plus reflexive pairs

18-A

#19

Feb 1, 1975

Description of Puzzle No. 13-C, PYRACUBE

Puzzle No. 13-C, PYRACUBE, consists of five pieces, a cubic box, and instruction sheet. The pieces are formed of 14 identical blocks joined together in different ways. One piece is a single block, one piece is made of four blocks, and the other three pieces each have three blocks. The way they are joined is shown on the instruction sheet. Each block is a cube which has its edges beveled at 45 degrees. In other words, it is a truncated rhombic dodecahedron.

The object of the puzzle is to assemble the pieces to form different geometric shapes, as illustrated in the instruction sheet. For example, a cubic shape just fitting the box using either 4 or 5 pieces, square pyramid, rectangular pyramid, and triangular pyramid. Many other problem shapes can be devised.

This puzzle is based on the same principle as Puzzle No. 13, CRYSTAL BLOCKS. However, it has fewer pieces, for lower fabrication cost, and also possibly greater appeal. Also, the slightly different shape of the blocks permits easier fabrication from wood, starting with cubes and sawing off the edges, then gluing. The pieces could also be cast or injection molded. The box could be of various materials, but transparent plastic is suggested as being perhaps the best choice.

Starting with the basic principle of the CRYSTAL BLOCK assemblies, this particular design was developed by me in December 1974, and a model made at that time.

The attached Instruction Sheet is part of this description.

Stewart T. Coffin
Feb. 1, 1975

#19

~~43A~~ #19

STEWART T. COFFIN

Puzzles

OLD SUDBURY RD. RFD 1 LINCOLN, MASS. 01773

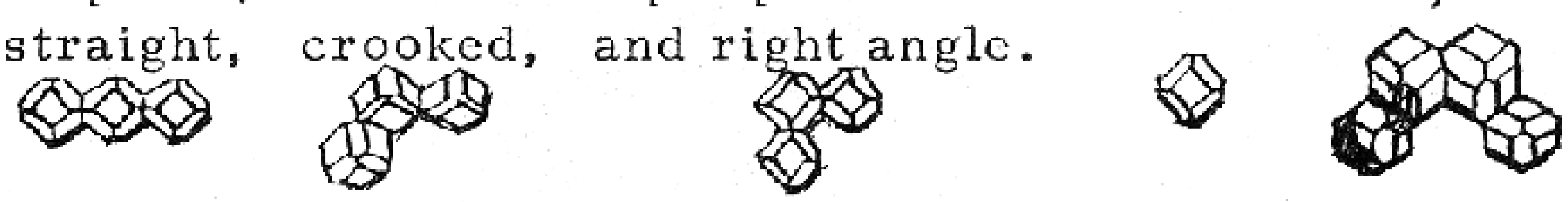
See Vander Poel letter in file V

Vander Poel ↓ 8 | 3

#19

Wonder Block Set No. 2 - PYRACUBE

This unusual puzzle consists of five simple pieces which pack neatly into a cubic box, and do a number of other confusing things. Start by dumping the pieces out and examining them. Note that the pieces consist of 14 identical blocks fastened together in different ways - one single block, one quadruple piece, and three triple pieces. We will identify the triple pieces as: straight, crooked, and right angle.



Problem #1 For a starter, fit the pieces back into the cubic box. How many distinctly different solutions can you discover? There are at least four.

Problem #2 Now, set the single block aside, and fit the other four pieces into the box in a totally symmetrical cubic configuration. The extra space has disappeared. Where did it go? Only one solution believed possible. (As a last resort, solutions for the various problems are illustrated on the back of this sheet. Only the assembled shapes are shown, not the location of each piece. But first try to do all of the problems without looking at these.)

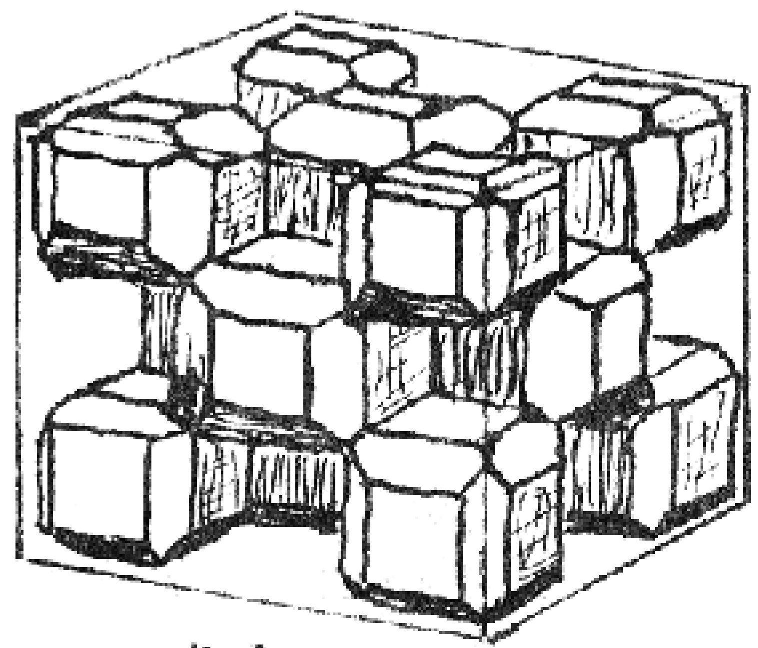
Problem #3 Using all five pieces, make a pyramid with square base. (It should be understood that the terms "pyramid", "cubic", etc., as used here, describe the general aspect of the figure being constructed, rather than its exact shape in the strictest sense, as the faces obviously cannot be plane surfaces. You might say that we are describing the shape of the container into which they would tightly fit.) Three solutions have been found for this problem.

Problem #4 Using all five pieces, make a pyramid having a rectangular base. A difficult exercise - only one solution is known.

Problem #5 Omit one piece and make a triangular pyramid (regular tetrahedron). This is probably the most difficult one. First, you must know which piece to omit. However, this can be done using logic. (Hint: think of the individual blocks as cannonballs. How would they be stacked, and how many would be required?) There is only one solution. Note that this pyramid fits neatly inside the cubic box!

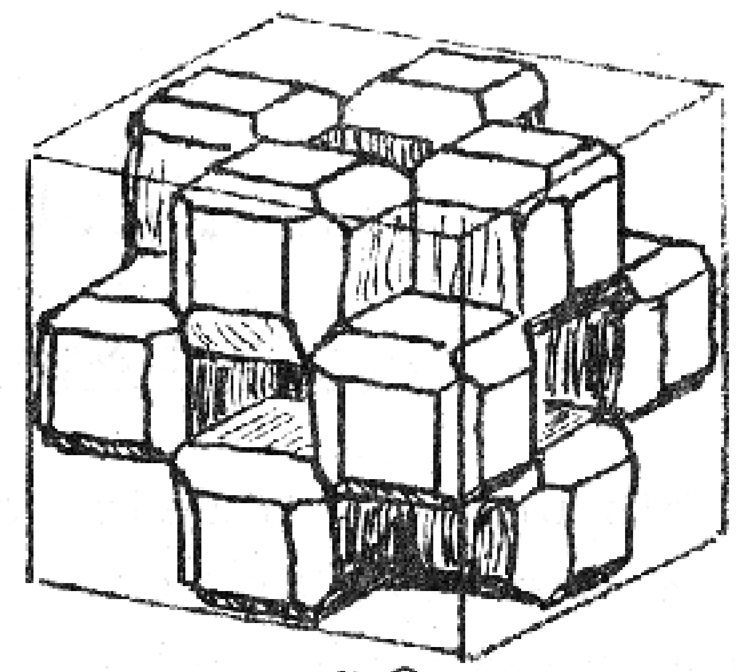
What other interesting shapes can you discover? A few are illustrated.

SOLUTIONS

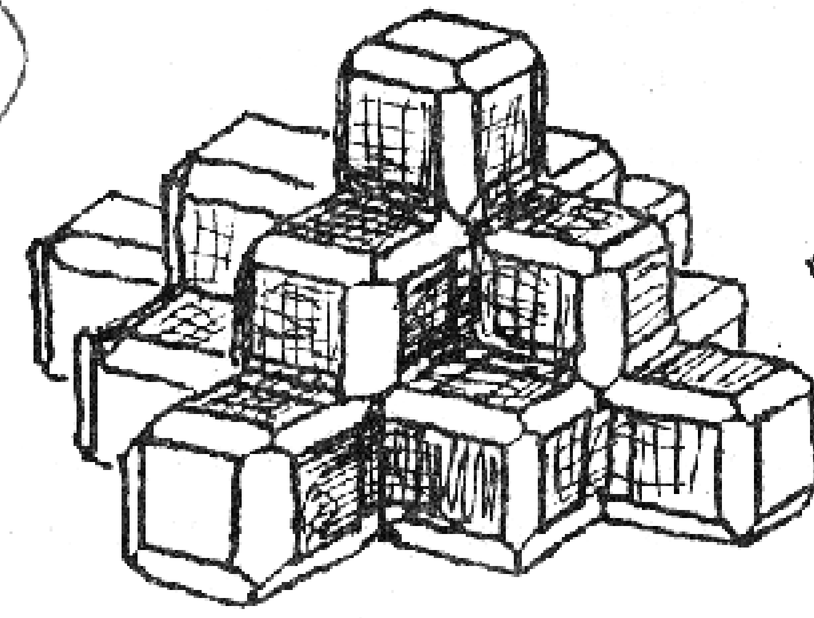


#1

(~~one~~ eight solutions-Van der Poel)

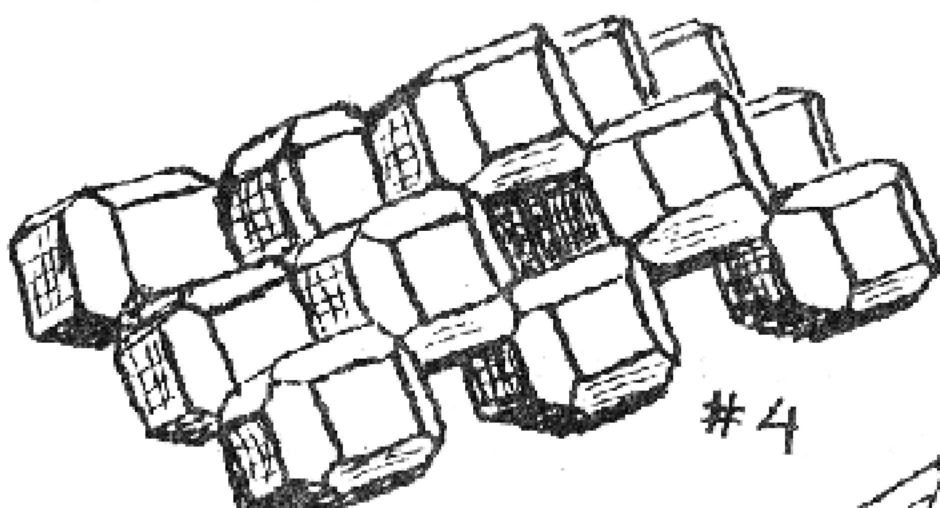


#2 (one solution-Van der Poel)

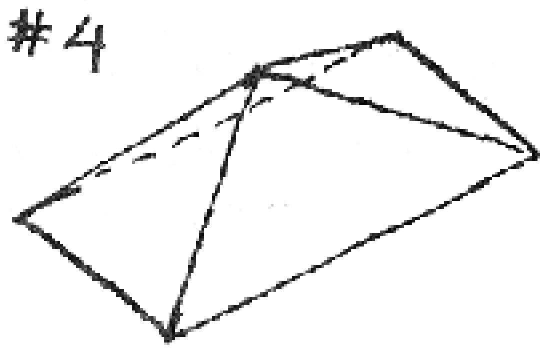


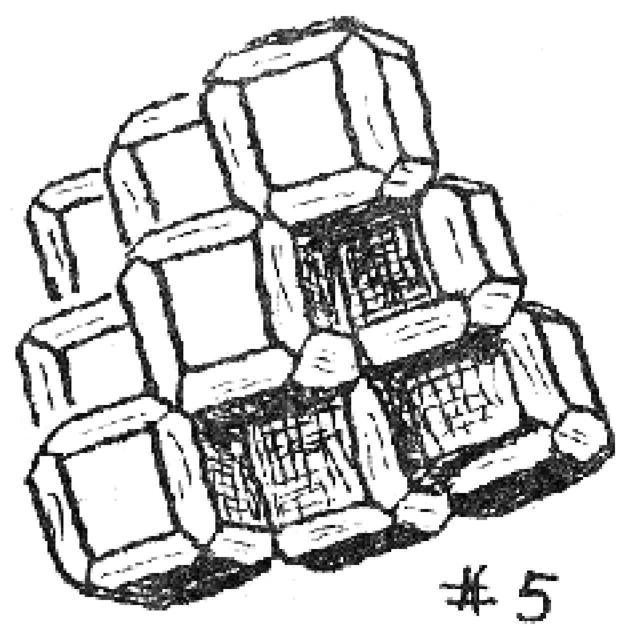
(3 solutions-Van der Poel)

#3

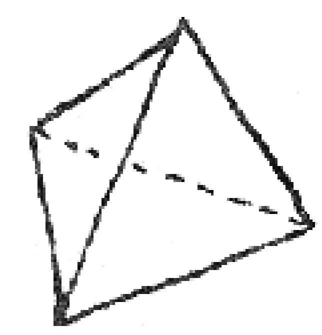


#4

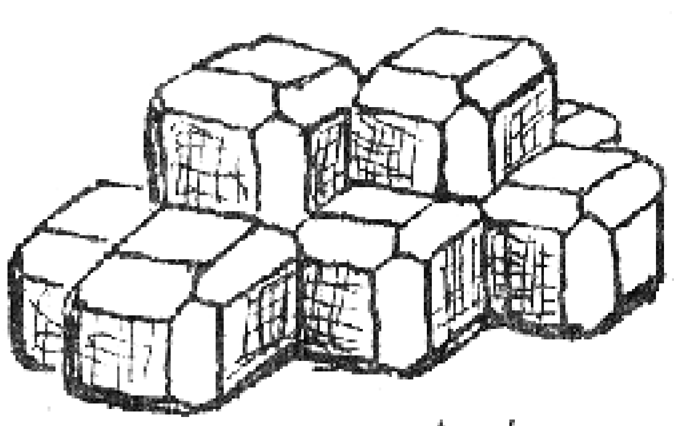




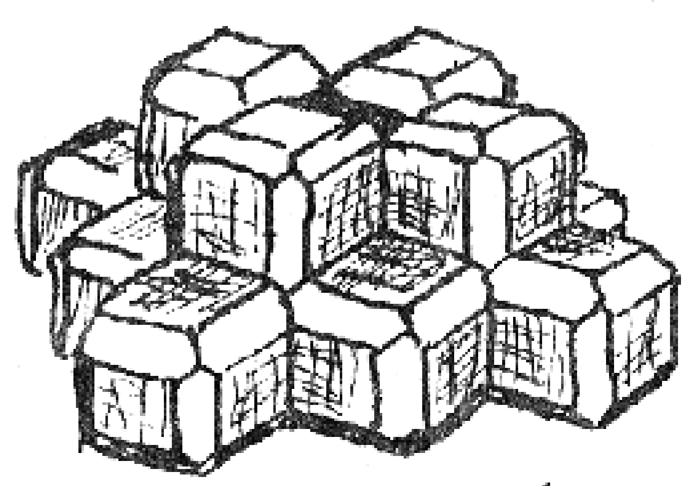
#5



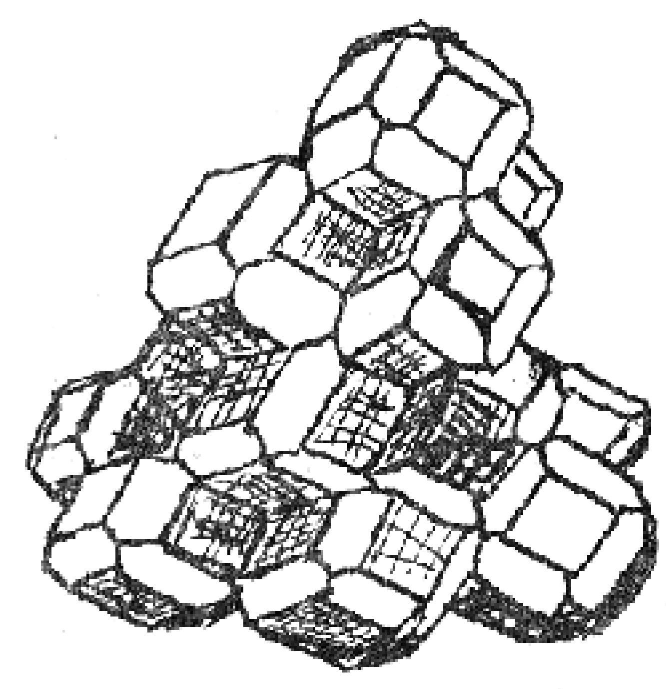
Other Figures:



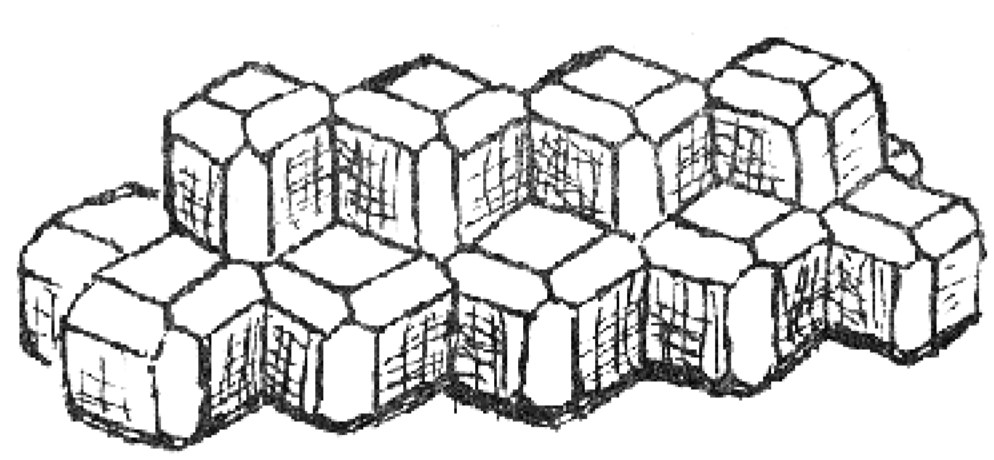
Bug – 8 blocks



Volcano – 13 blocks
(see #3 above)



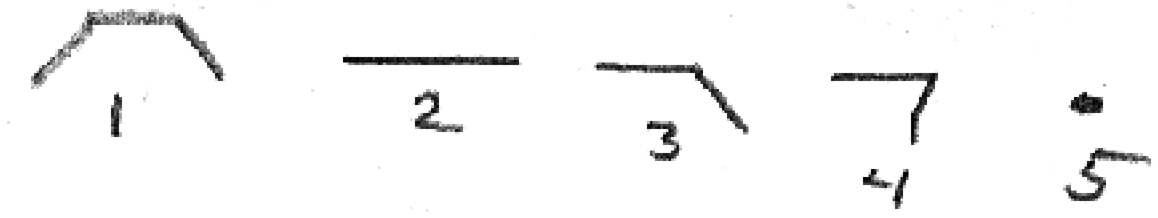
Tower – 14 blocks
(base is hexagonal)



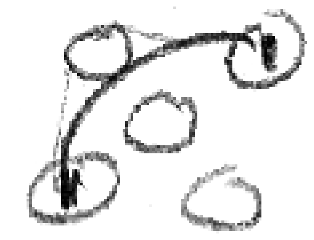
Ridge – 14 blocks
(2 solutions-Van der Poel)

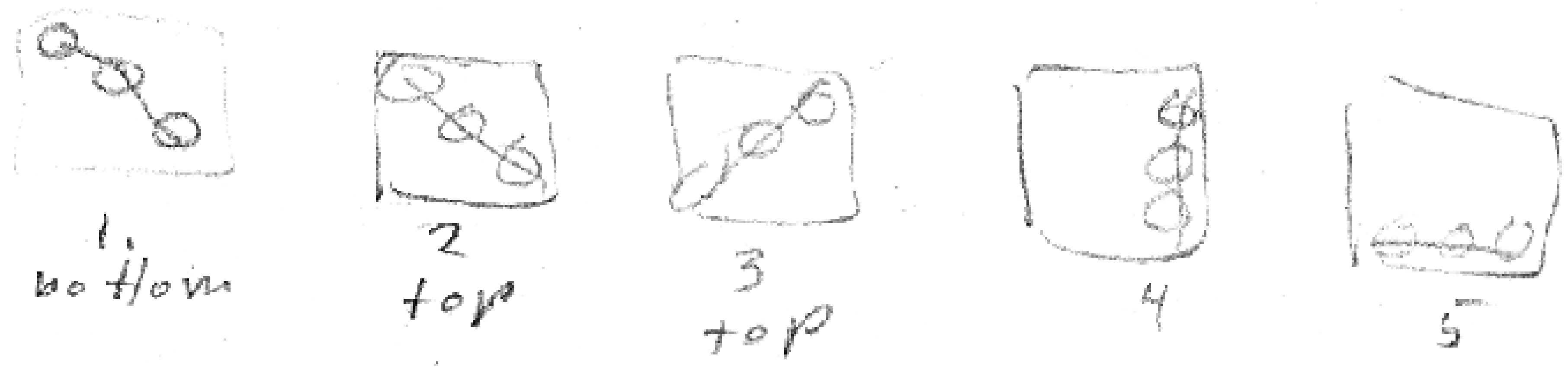
#~~43~~A #19

Analysis of Pyracube

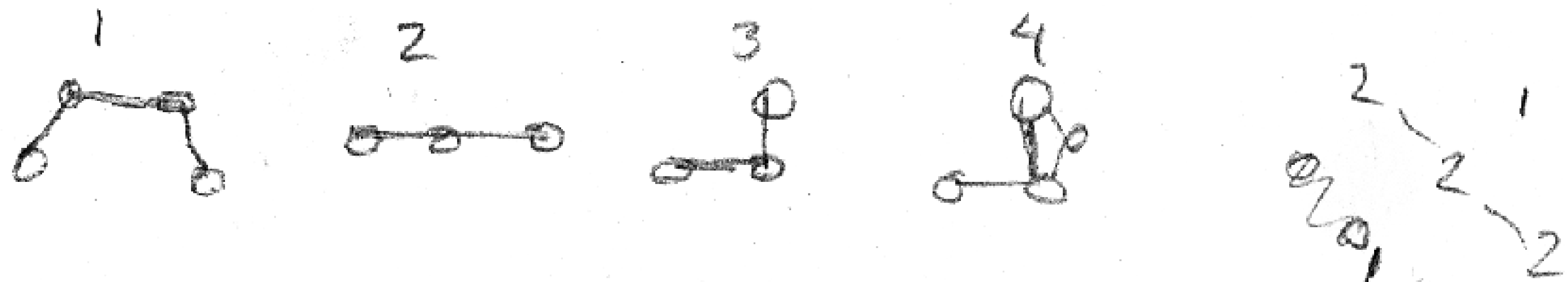


1. 14 block cube

pc 1 has only 1 position 

pc 2 has: 

1,

4 pc. 

make cube at ~~least~~ ~~one~~ two ways

and sq. pyr. ~~at least~~ ~~2~~ 3 ways

Mar. 2, 1980

(try with ~~balls~~)

Δ pyr is impossible

polished R-D- doweled,

2 colors, all solutions have color symmetry

ROCK PILE puzzle 

2-2-2 3-3 4 3 1-1	2 3-3 2 3 4 2 1-1	2-2-2 4 3 1 3-3 1

bottom layers of 2 sq. pyr. sol.

(OVER)

Muffin 4 2 3 / 4 2 3 / 2   4 3

Skewed hex - add piece #1 to Muffin

Swiss Chalet - same as above but shift piece # 1

Possible substitutes for PC#1 to make cube (2 sol)

Improved Pyracube

Dec 30, 1983

Pyr. 3 x 3 x 2.828 hi

Sq. 2.828^3

Rect = 2 x 3 x 2.828

Inside = ~~[illegible]~~ 2.828^3

$\sqrt[3]{2.828}$ .172 ≈ 3/16

1 — Δ possible

~~possible~~ ~~with balls only~~

2 1
2
3 2

1
4 1
3

4 4
4
3 1

at least 3 sol. by shifting 2 and 3 or 1 and 2

probably only ~~[illegible]~~

3 - 3 1
4 3 1
2 - 2 - 2

~~[illegible]~~

christmas tree, omit ooo

Projecting block

1 3 3 3 — bottom

4 2 1 4 1 — 2nd

2 4 1 4 — 3rd

2 — 4th

20 - A

December 16, 1975

Description of Puzzle # 45. KING PIN PUZZLE

This puzzle set consists of 6 long bars, 16 standard bars, two key bars, 18 long dowels, and 12 short dowels, plus a set of instructions.

In this particular version, the bars are 3/4" square. The long bars are 5-1/4" long, the standard bars 2-1/4". Both types have 9/32" dia holes, 3/8" from each end, not quite through, and holes 1-1/8" from the ends, all the way through and perpendicular to the first holes. The key bars are like the standard bars except that one of the end holes goes all the way through. The long dowels are 1-7/8" x 1/4", the short dowels 1-5/16" x 1/4".

The object of the puzzle is to fit the pieces together to form various interlocking solids illustrated in the instructions, such as:

Basic Block, requiring	0	long bars,	5	std bars,	1	key bar,	6	long dowels,	0	short dowel
Column	" 2	"	9	"	1	"	8	"	4	"
Cross	" 4	"	13	"	1	"	16	"	4	"
Grand Cross	" 6	"	16	"	2	"	18	"	12	"

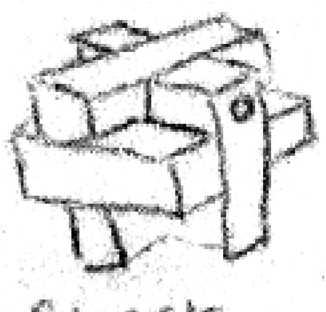
and to disassemble same, plus many other similar structures such as the "T", the "H", the "U", and about 20 other figures illustrated in the instructions, plus a practically limitless variety of other similar figures to be discovered by the puzzler, as well as various ways of making the same figure of varying difficulty. Considerable ingenuity can be used in devising various ways the parts lock together. For example, the Basic Block can be made with 6 standard bars, 2 long dowels, and 4 short dowels, with no key bar and no apparent way to disassemble it. To disassemble, the short bars must be moved by gravity or vibration until they are in the proper location for the puzzle to slide apart in two halves. This can be done on some of the other figures too.

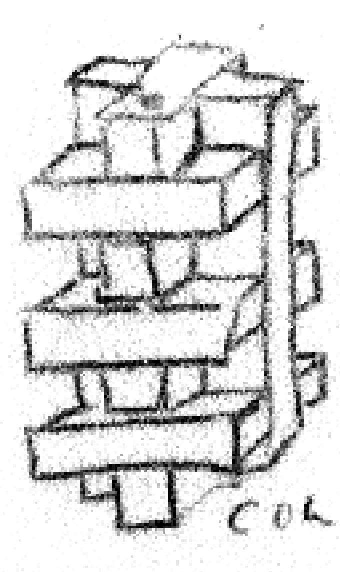
This puzzle set was invented, developed, and constructed by me on December 12-16, 1975, and I believe it to be new and original.

Notes on construction: The pieces (bars) can be made of any attractive hardwood such as maple, birch, cherry, or mahogany. They can be milled out inexpensively in quantity using production-type woodworking machinery, and the holes drilled fast and accurately using semi-automatic machinery and jigs for accuracy. The dowels can be sawed inexpensively from standard birch dowel, and for production they could probably be made even less expensively on automatic machinery. All the parts can be finished nicely by tumbling, as were my models. Some really nice sets could be made in Rosewood.

Notes on Assembly: I have not yet prepared any instructions. To disassemble the Grand Cross, first remove the two visible dowels by vibration and gravity, then remove whatever is loose. There is practically only one order of moves, so it is very difficult to assemble again unless you remember each move. However, by practicing on the simpler figures, you can gradually become familiar with the various tricks, and work up to it.

S. Coffin
Dec 16, 1975


BLOCK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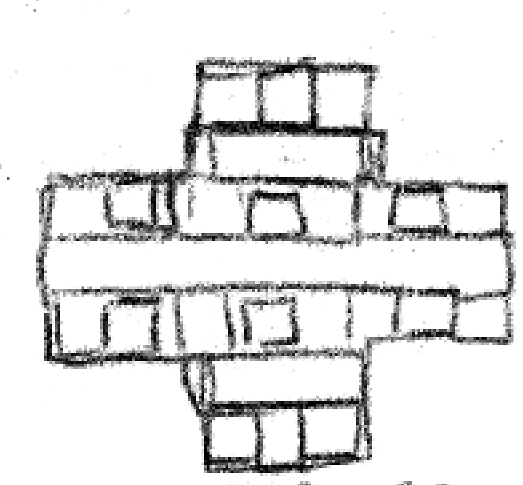
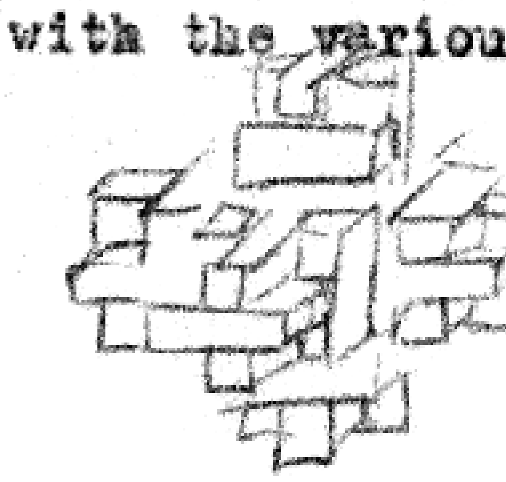
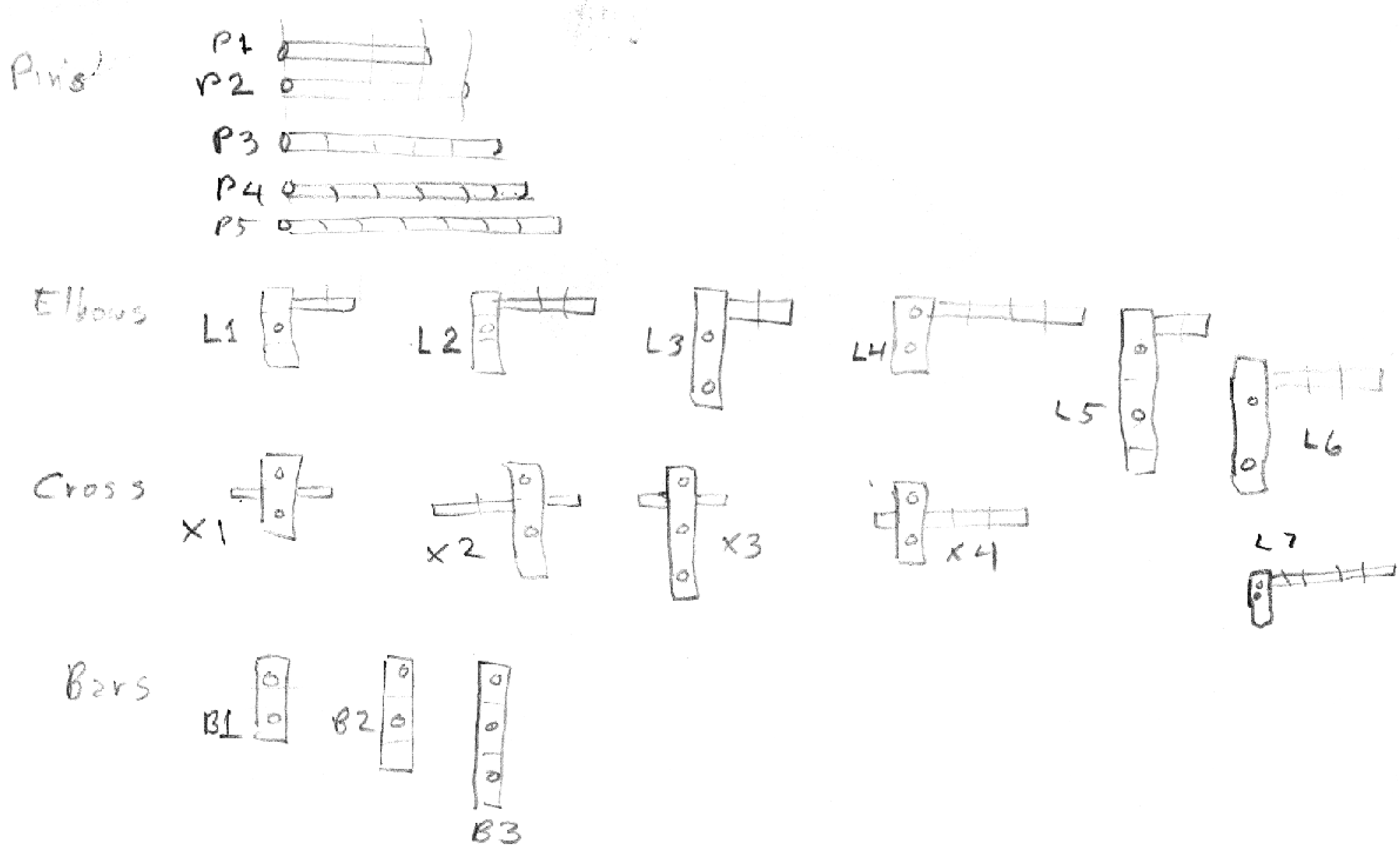

CROSS


GRAND CROSS

20 ~~# 16~~

Pin-hole parts



Analysis of face-joined pair

↓ end pin

1. P1 L4 L1-L1 L5 L4 L1 L1 X1 B3

2 P3 L1 L1 L5 L4 L1 L1 X1 X1 B3

3 ———————————————— L5 B1

4 ———————————— X1 X1 X3 B1

	P1	P3	L1	L4	L5	X1	X3	B1	B3
1.	1		4	2		1			1
2.		1	4	1	1	2			1
3.		1	4	1	2	1		1	
4.		1	3	1	1	2	1	1	

		P1	P2	P3	L1	L2	L3	L4	L5	X1	X2	X3	X4	B1	B2	B3
Corner	1.	1			2	1	1			2	2			1		
	2,9	1			3	1	1			1	2			1		
	3,5,10	1			4	1	1				2			1		
	4,11	1			4	2	1				1				1	
	6.	1			2	2	2									
	7.	1			2	3	3			1	1			1		
	8.	1			2	3	2			1				1	1	
Edge	1.	1			9			1								1
	2.	1			7			1		1		1		1		
	3.	1			8			1						1		
	4.	1			8			1	1			1		1		
	5.	1			7			1	1	1				1		
	6.	1			6			1	1	2				1		
	7.			1	10											
	8.			1	9							1		1		1
	9.			1	8					1		1		1		
	10.			1	9				1					1		
	11.			1	8				1	1				1		
	12.			1	7				1	2				1		

Analysis of edge-joined pair

1. P1 (goes thru end of B3) L1 L1 L4 L1 L1 | L1 L1 L1 L1 L1 B3

2. ———————————————————— X1 X3 B1

3. ———————————————————— L1 X3 B1

4. ———————————————————— L5 L1 L1 B1

5. ———————————————————— L1 X1 B1

6. ———————————————————— X1 X1 B1

7. P3 L1 L1 L1 L1 L1 B3 etc (sym)

8. ———————— L1 X3 B1 —

9. ———————— X1 X3 B1 —

10. P3 L1 L1 L5 L1 L1 B1

11. ———————— L1 X1 B1

12. ———————— X1 X1 B1

13. P1 (goes thru 2nd hole of B3) L5 L1 L1 L4 L1 B1

14. ———————— X4 X1 B1

15. ———————— L4 X1 B1

16. P1 (Parallel to) L1 L1 L1 X4 X1 B3

17. P1 L4 L1 L1 X1 X1 B5

18. ———————— L5 L1 B1

19. L5 X1 B1

20. P1 (Parallel to B3) etc did not do

Complete? analysis of corner-joined pin-hole

1.	P1	L1	L1	L2	X2	X2	L3	X1	X1	B1
2.	〃	〃	〃	〃	〃	〃	〃	L1	X1	B1
3	〃	〃	〃	〃	〃	〃	〃	L1	L1	B1
4	〃	〃	〃	〃	L3	L1	L1	L2	B2	X2
5								X2	X2	B1
6						L2	L3	X2	X1	B1
7								L3	L2	B1
8								X1	L2	B3
9.	P1	L1	L1	L2	X2	L3	L1	X_1	X_2	B1
10								L1	X2	B1
11.								L1	L2	B2

#20

~~PERPETUAL~~ PUZZLE ~~#16~~ Pin-Hole 1976

~~ENDLESS~~

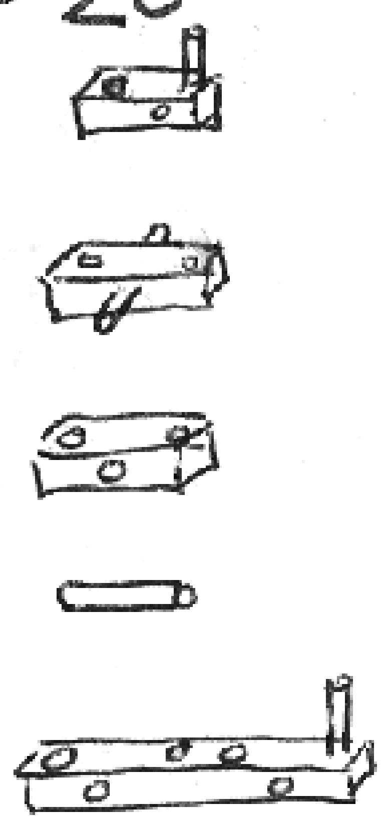
L

\+

I

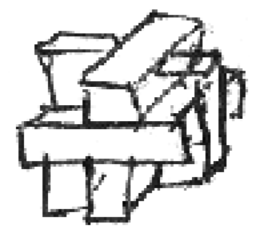
P

D



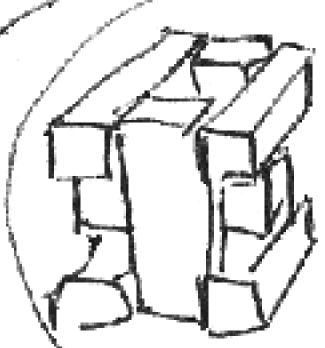
BASIC ~~Simple~~

$10 ~~$8~~ ~~$9~~



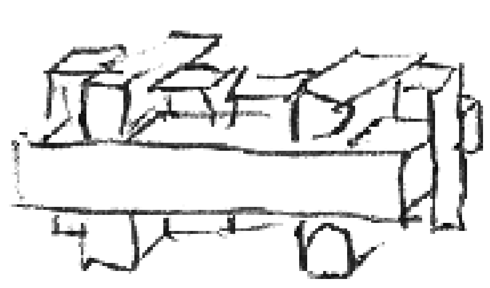
4 L
1 X
1 I
1 P

ADD-A-UNITS
$8 3L, 1+, 1P, 1D



4 L
1 X
2 I
2 P

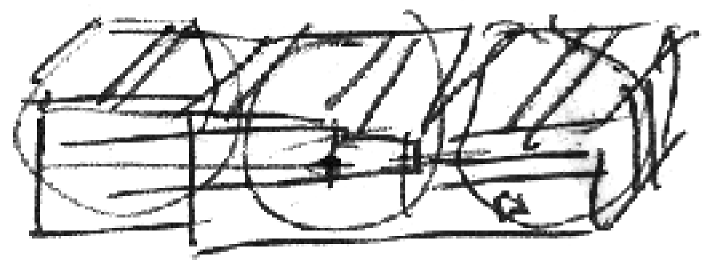
2



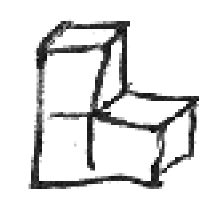
$18

7 L
2 X
1 I
2 P
1 D

3

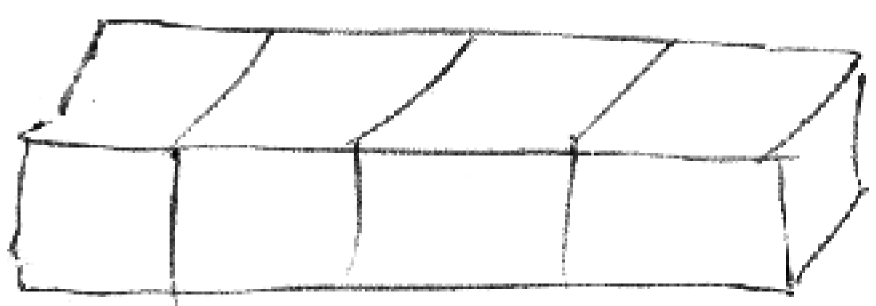


$26



10 L
3 +
1 I
3 P
2 D

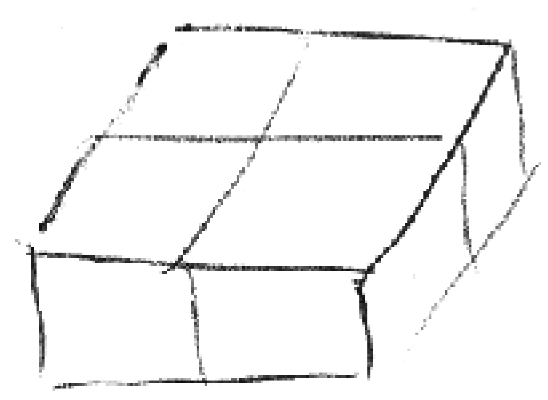
4



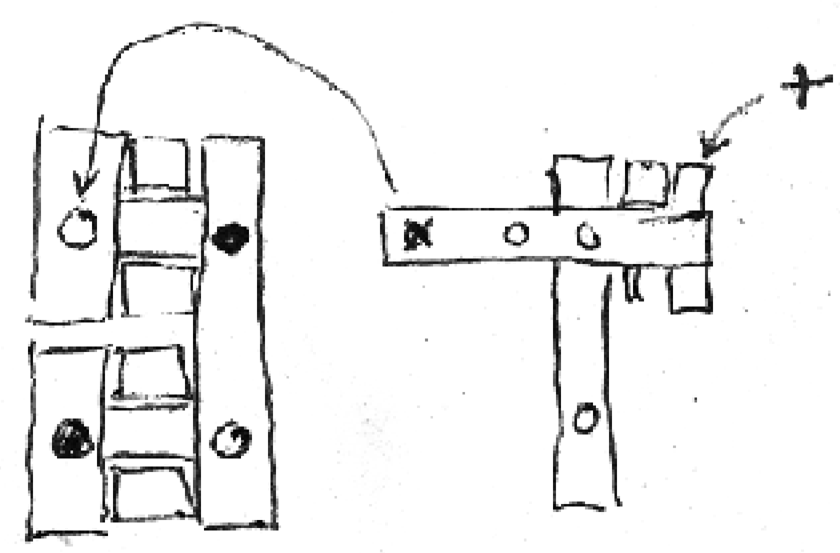
DIFFICULT $34

13 L
4 +
1 I
4 P
3D

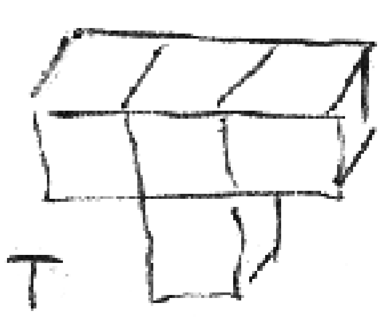
square



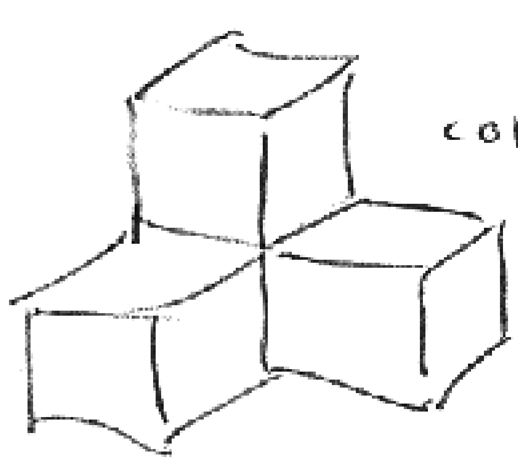
13 L
4 +
1 I
4 P
3 D



T



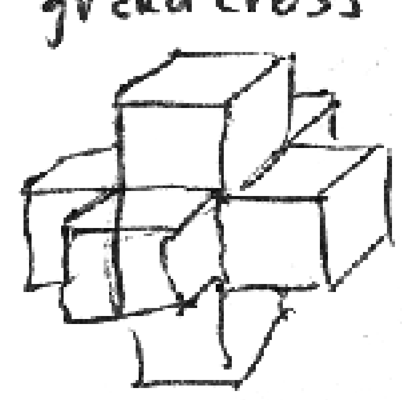
corner



"
same, easy

grand cross

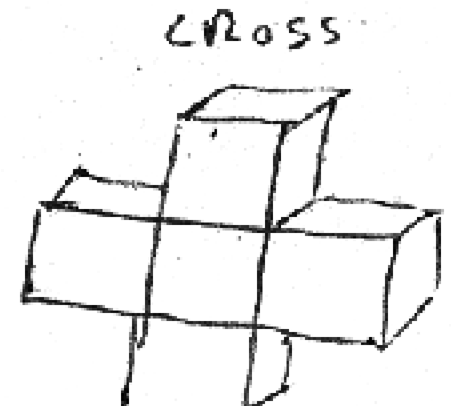
$58



22 L
7 ~~8~~ +
1 ~~2~~ I
7 P
6 D

POSSIBLE ~~??~~ YES!

cross

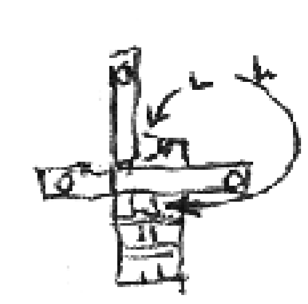


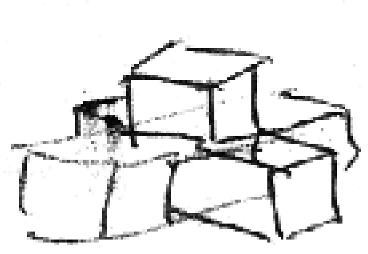
$42

very difficult

16 L
5 +
1 I
5 P
4 D

must start in middle

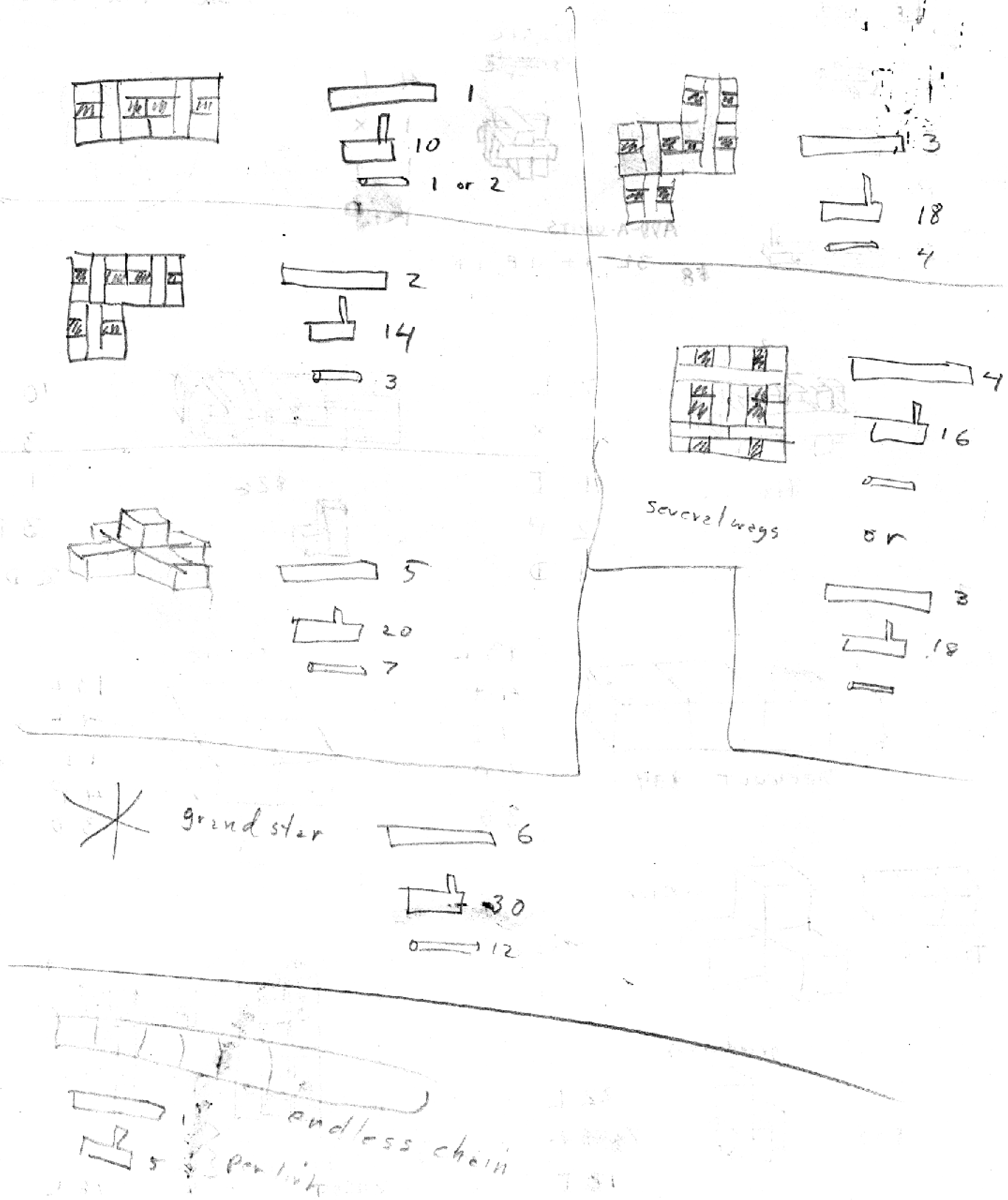




Pyramid
yes!

$ 50

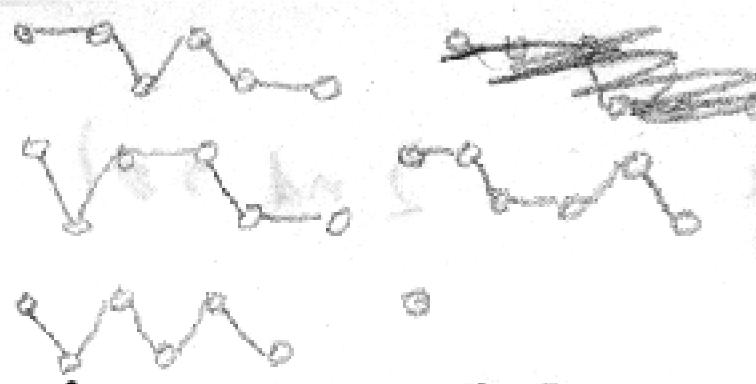
19 L
6 +
1 I
6 P
5 D



1
10
1 or 2
2
14
3
5
20
7
3
18
4
4
16
Several ways
or
3
18
grand star
6
30
12
endless chain
1
5 per link

ALVIN P. LEWIS

TELEPHONE 242



21

Meeting House Hill Poultry Farm

NEW HAMPSHIRES AND BARRED PLYMOUTH ROCKS

PULLORUM DISEASE FREE

BABY CHICKS -- HATCHING EGGS -- BREEDING STOCK

NEW BOSTON, N. H., ____________ 193__

Complete analysis of Cuckoo with 5 elbows

1. remove any top pin → 

2. remove top L or top Γ

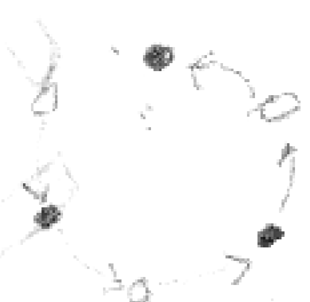
(1) top L or top V

- top L / bottom L / bottom L / bottom — A → (1)
- bottom L^k / bottom L / bottom L / top —^k B → (2) or bottom — C, top X^k B

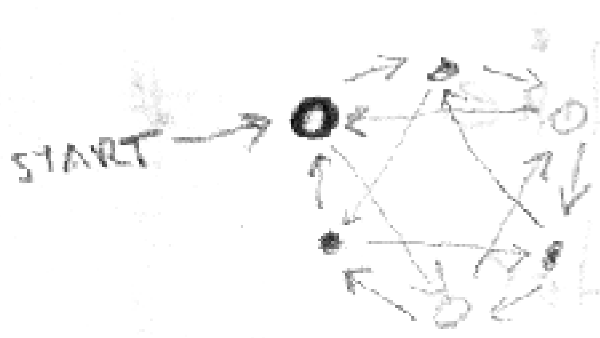
(from top Γ)

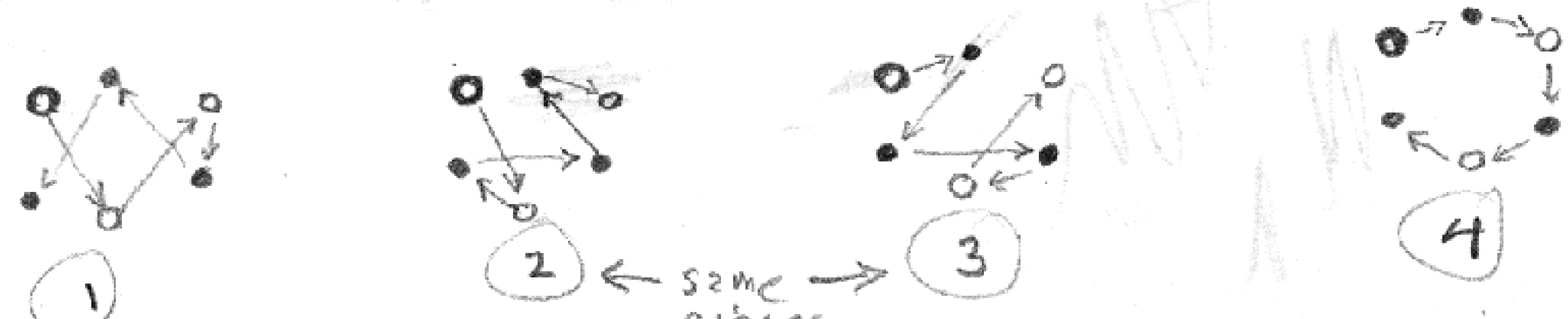
- bottom L / bottom L^k / bottom V / - - - - / top L / top —^k B → (3) or top — D, top X^k B
- bottom V / top V / bottom V / top V / bottom — A → (4)

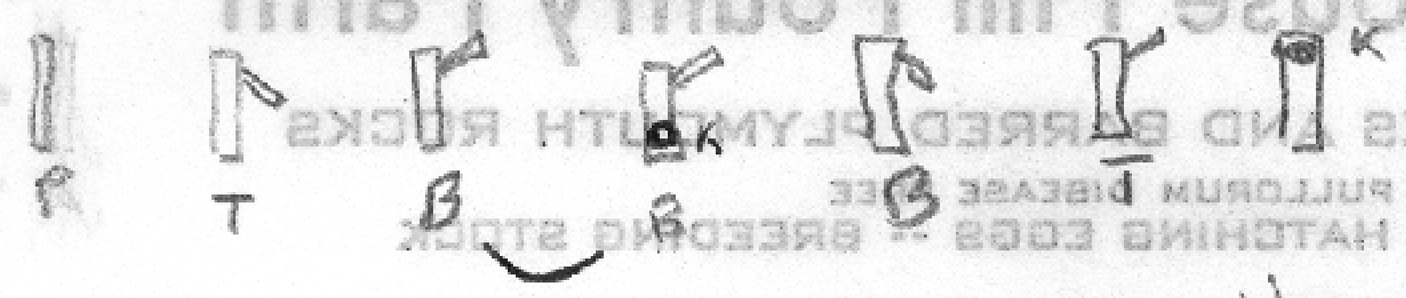
21



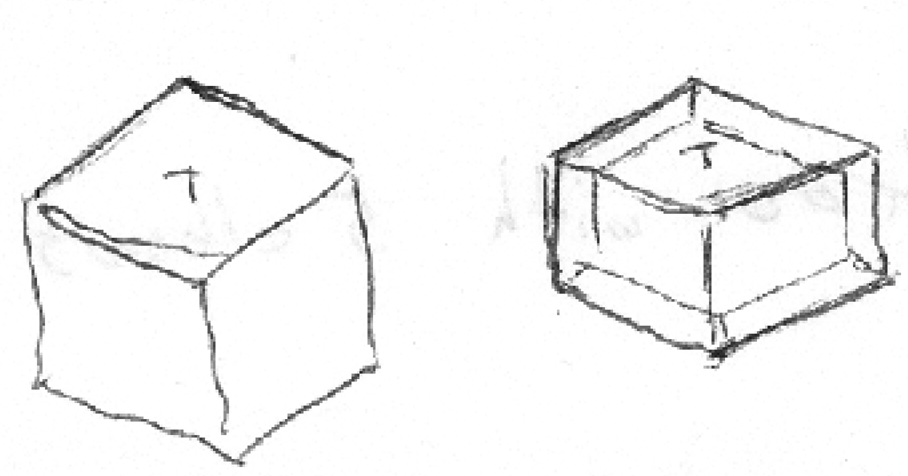
if using X and blind holes, then all pieces dissim and only one sol.

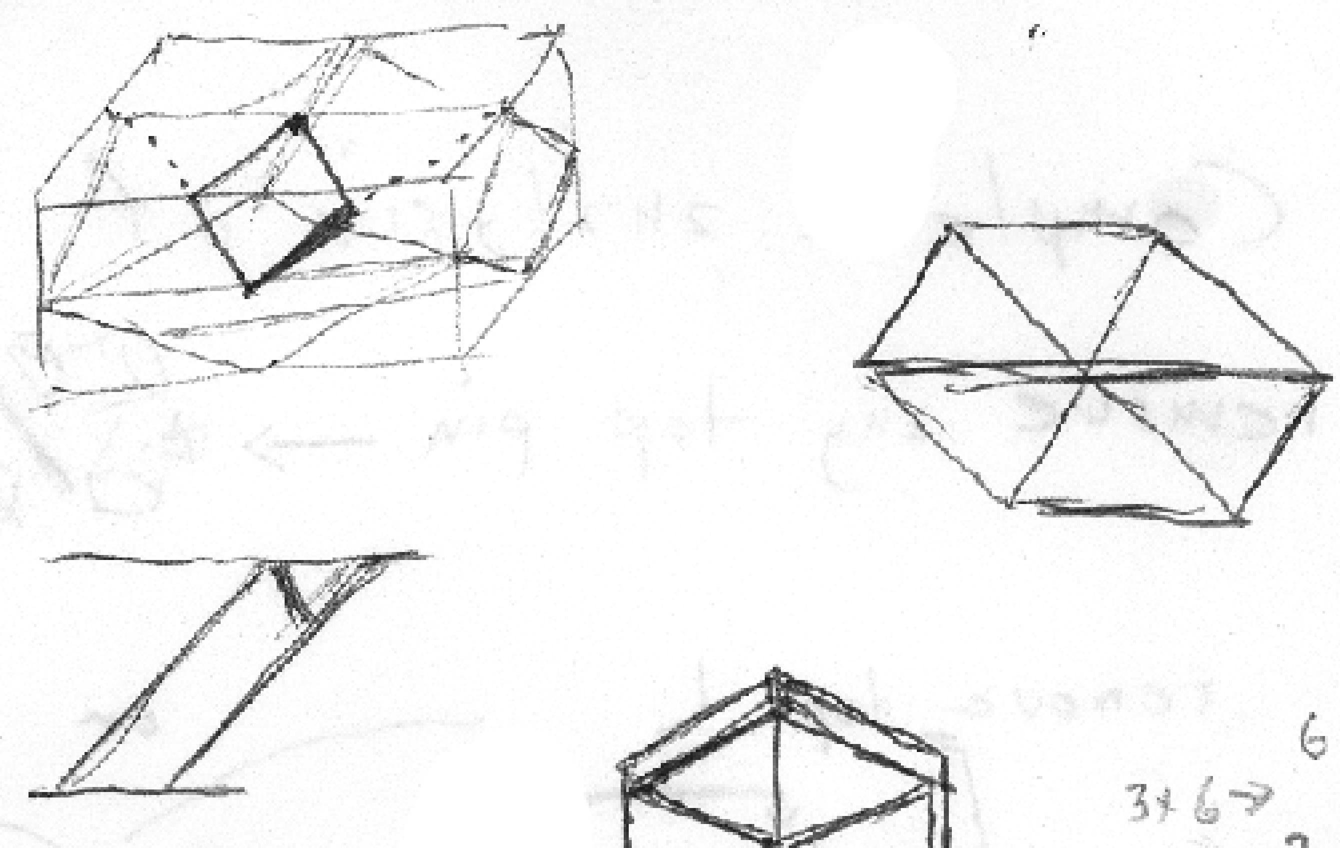


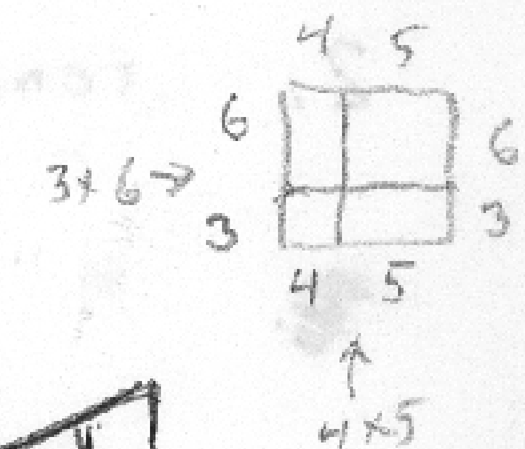




in 9 elbow version pin must go thru end of BAR

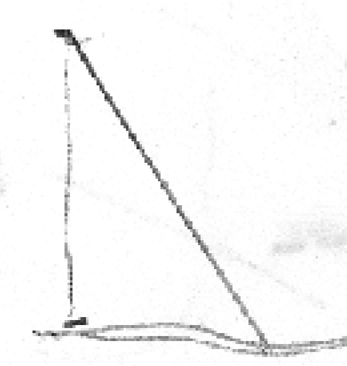


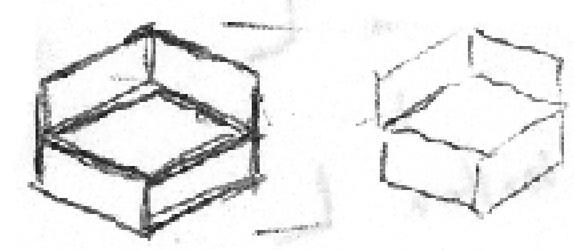




$3/4 \times 2/\sqrt{3} = \frac{1.5}{1.732} = .866$

$1 \times 2/\sqrt{3} = 1.15$

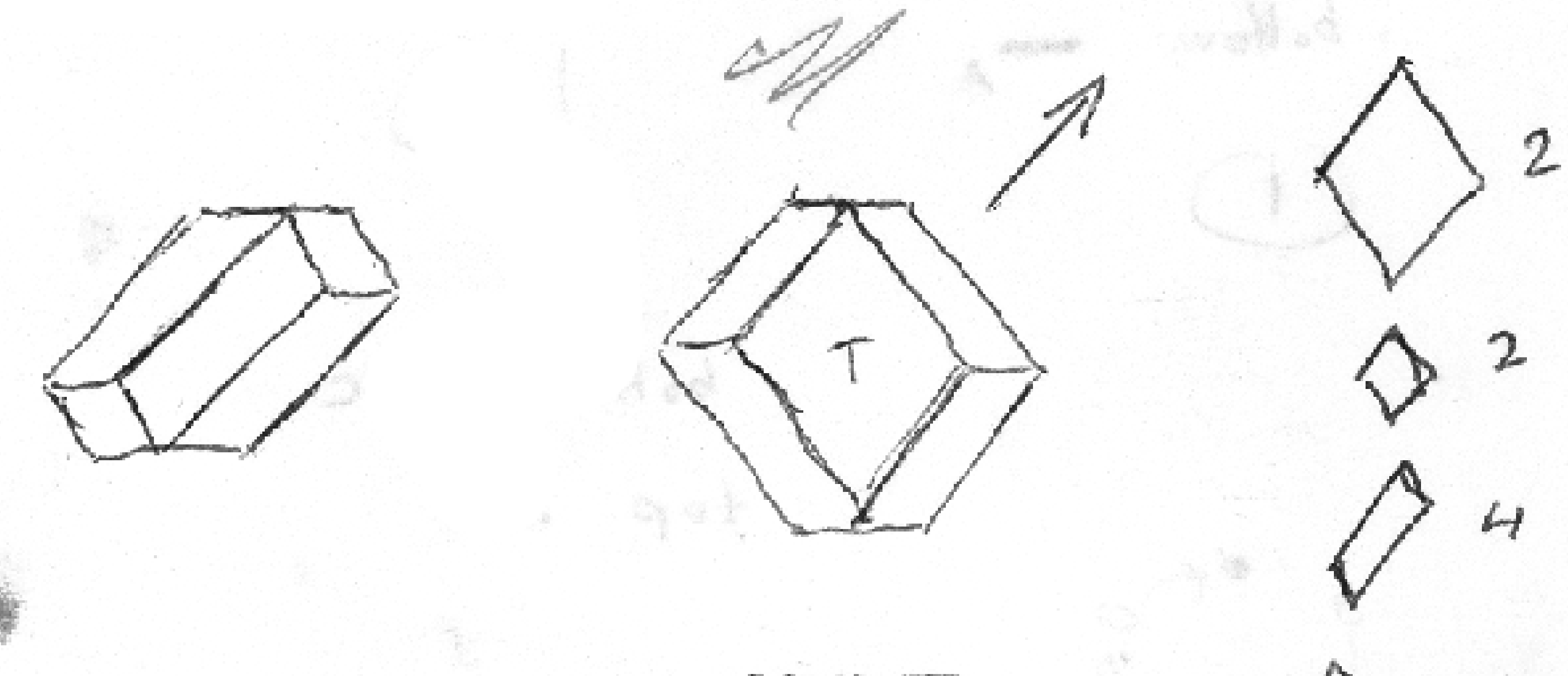


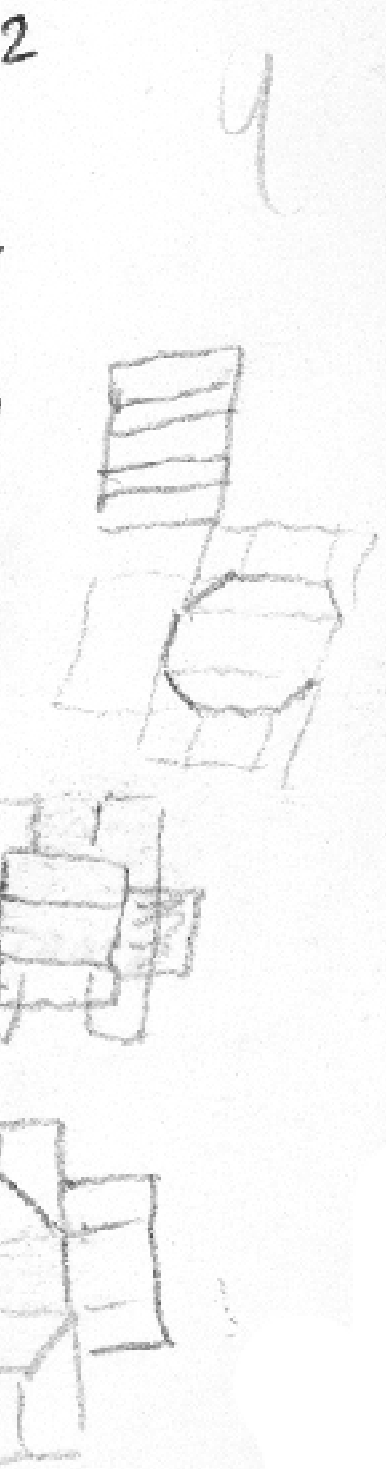


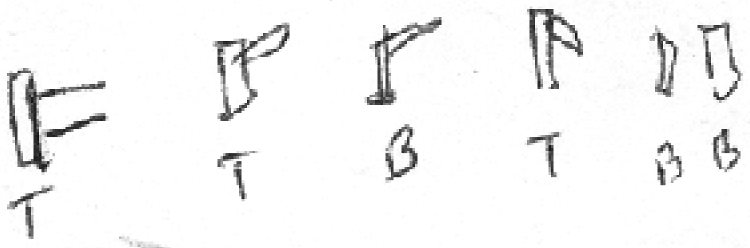
3 4 5 6
3 4 6 5
3 5 4 6
3 5 6 4
3 6 4 5
3 6 5 4

U cut first only 1 sol.

other T pin 2nd sol.







Dee Kline

Diz Astor

#22-A

12 hexagonal sticks with 3 holes each,

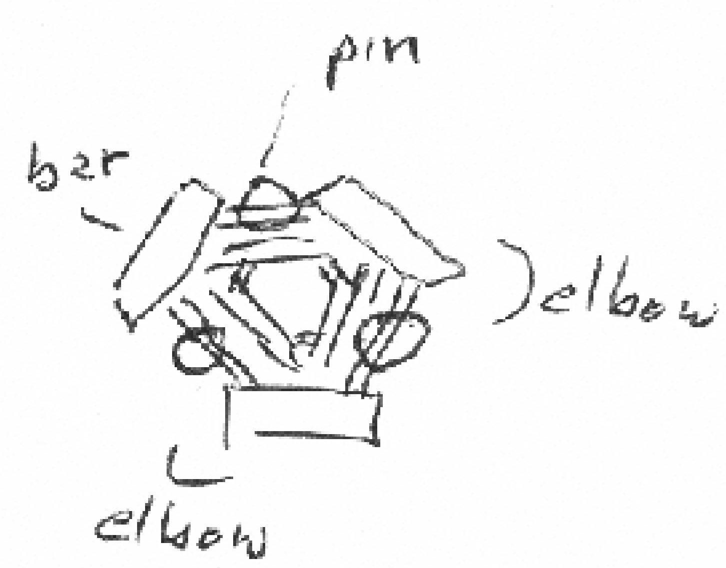
resembles #84 Obstructed Pins, but instead

has 8 elbow pieces
4 dowels
4 bars

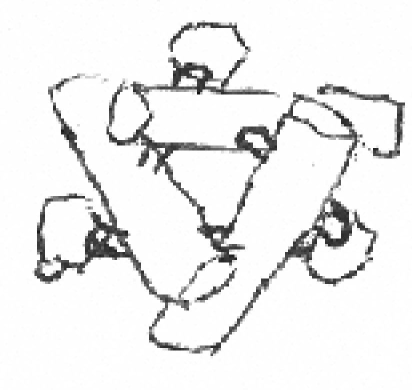
designed Jan 1988

only one solution known:

1.



2.



insert 3 elbows on top, then 3 pins

only one made, in Padauk + birch, 1988

22-B is two Lock Nests joined, see PW Fig 130a

believe only one made, in birch, around 1985

22-A, 22-B

INSTRUCTIONS FOR No. 22-B, Two Locked Nests Joined. No elbow pieces. Easy to assemble with illustration. Only one made. Birch, 1985.

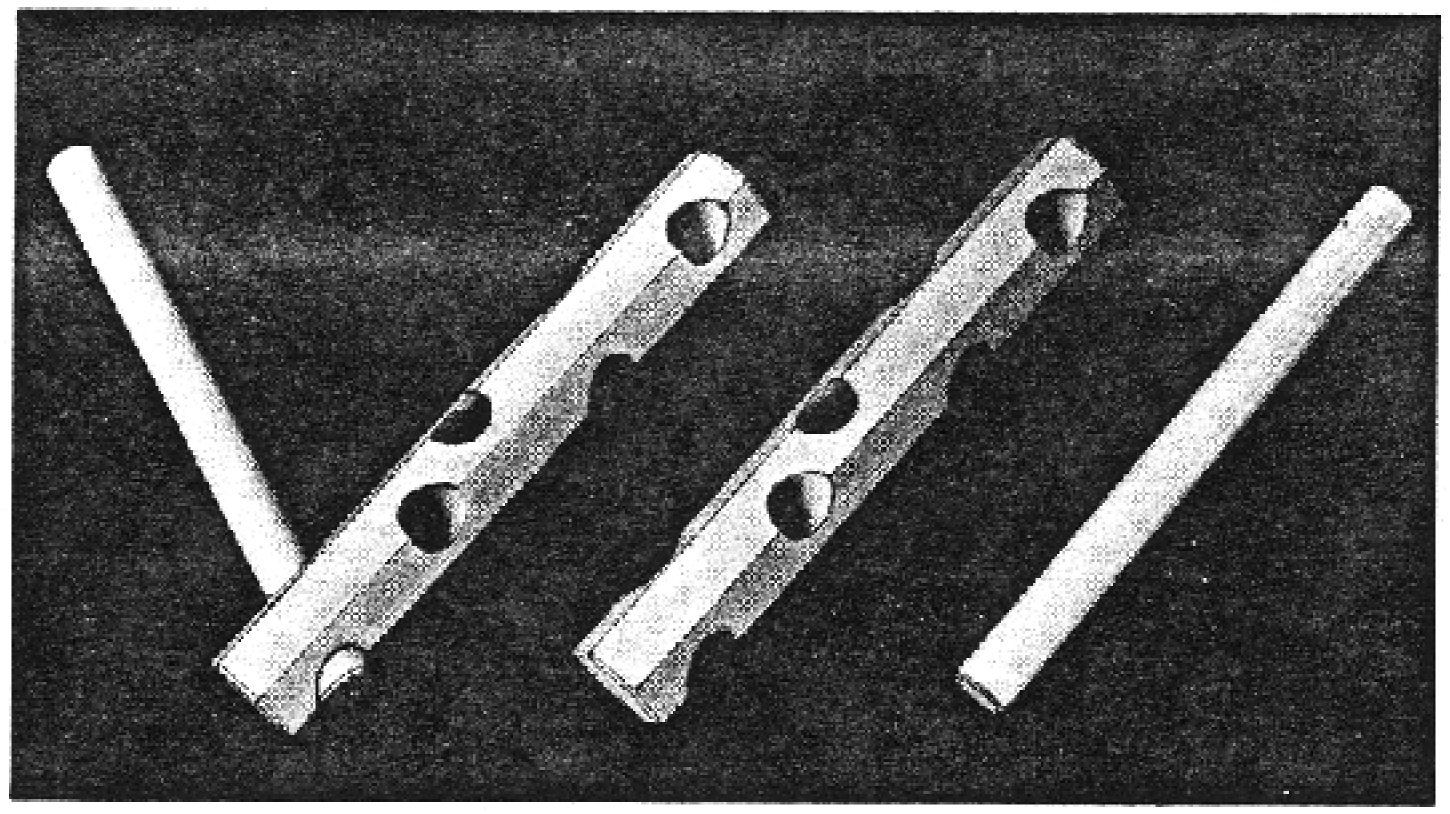


Fig. 129

Hexagonal sticks are easily made by first ripping planed boards into sticks of rhombic cross-section with the saw tilted 30 degrees and then making two more cuts. All of the holes are spaced equally apart, are at the same 70½-degree angle to the axis of the stick, and are arranged in helical progression. Thus, a simple drilling set-up can be used that positions the stick using the previously drilled hole, with the stick being rotated 120 degrees in the same direction each time. The spacing of the holes can be determined by trial and error to achieve a snug fit. If they are too close together, the puzzle cannot be assembled. Spacing them farther apart simply makes a more open arrangement. With an open arrangement on a large scale, what a delightful and attractive climbing apparatus could be made for a children's playground.

22-B

This lattice structure repeats itself indefinitely in all directions, so one can make larger assemblies with more and longer sticks and dowels. From among the infinite variety of such constructions, one example is shown in Fig. 130a. It is basically two clusters joined together along their threefold axes.

Another fascinating feature of this construction is that sub-units are also possible using fewer and shorter sticks and dowels. From among the many possibilities, one example is shown in Fig. 130b. It uses four sticks and four dowels, and each stick has three holes. As an assembly puzzle it would be rather too easy if given the illustration of the solution. However, this is easily corrected by joining one stick-dowel pair to make an elbow piece and another pair to make a cross piece. This construction might also be used to make a novel collapsible stand for a tabletop.

22-B

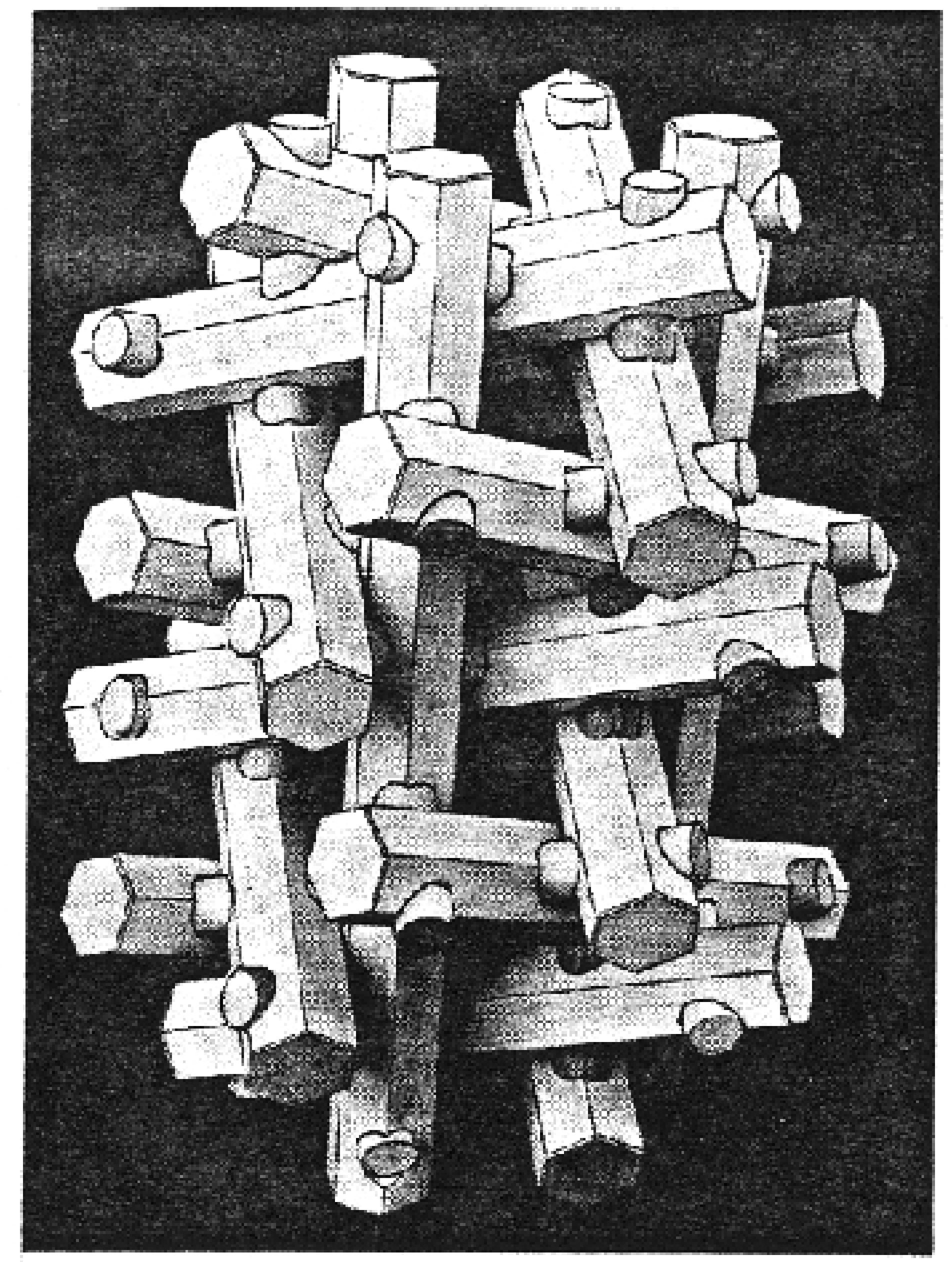


Fig. 130a

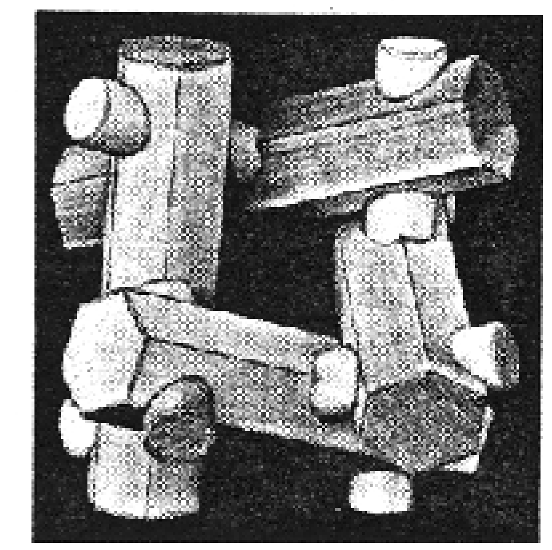


Fig. 130b

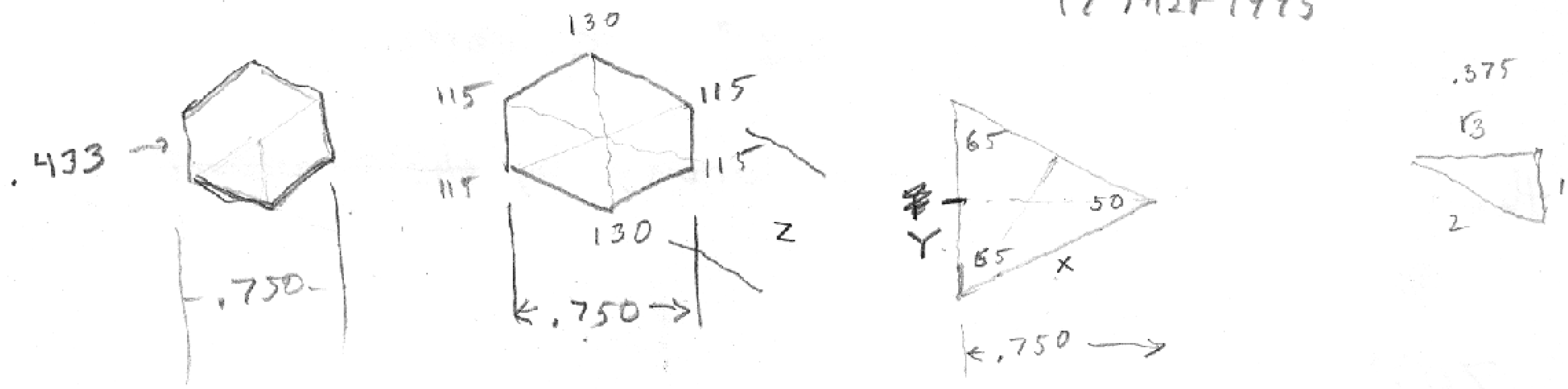
Yet another intriguing aspect of this system is its possiblities as a play construction set. Imagine having many sticks and dowels of each size from two-hole to five-hole and then discovering all the possible symmetrical constructions starting with the smallest and building upward. A few of these are shown in Fig. 131. What a marvellous plaything this might make for some curious youngster.

The Cuckoo Nest Puzzle

By making the arrangement of the holes alternate rather than helical, one obtains a different sort of lattice structure, which likewise can be extended indefinitely in all directions. Constructions made with it can have an axis of symmetry but not isometric symmetry. The version shown in Fig. 132 uses six sticks and six dowels, with each stick having three holes. It has a threefold axis of symmetry. If five stick-dowel pairs are joined together to make elbow pieces, it is a surprisingly difficult assembly puzzle with two solutions. Rather than show how the pieces are formed, we let the curious tinker enjoy the task of rediscovering them. Minor variations are possible, but there is no way to avoid having two

22-C , a flattened Locked Nest.

17 Mar 1995

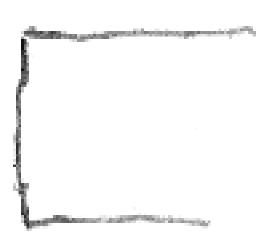


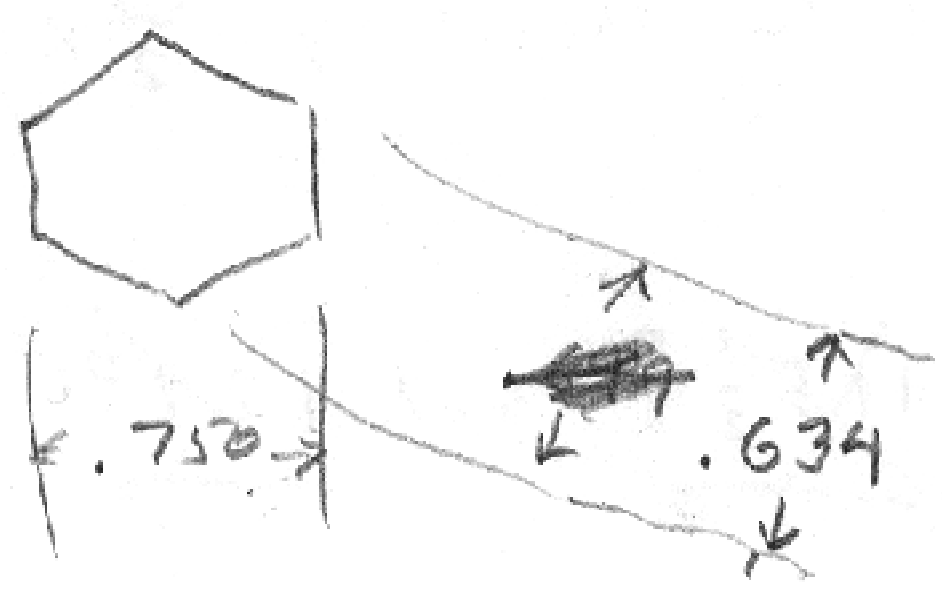
sin 65 = $\frac{.75}{X}$, X = .8275, $\frac{1}{2}$X = .414

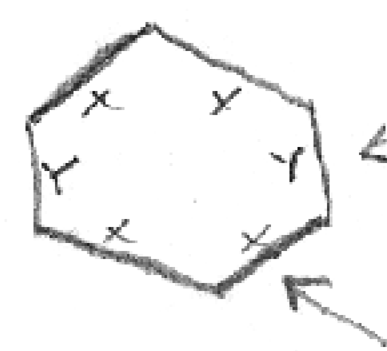
tan 65 = $\frac{.75}{Y}$

Y = $\frac{.75}{\tan 65}$ Y = ~~.699~~

.3497



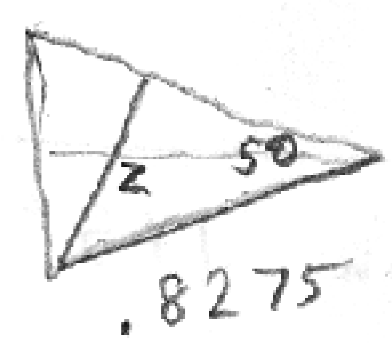




ratio of old Y to New Y is .8076

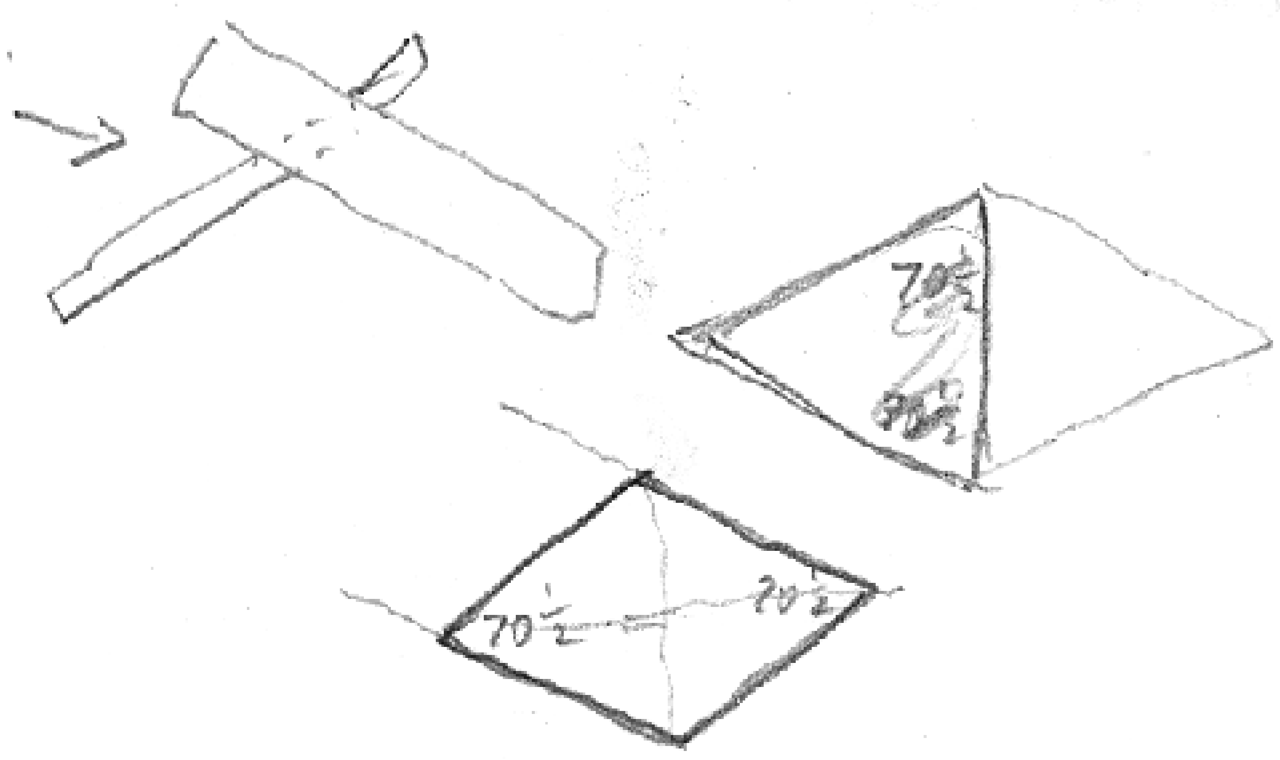
22-C

3



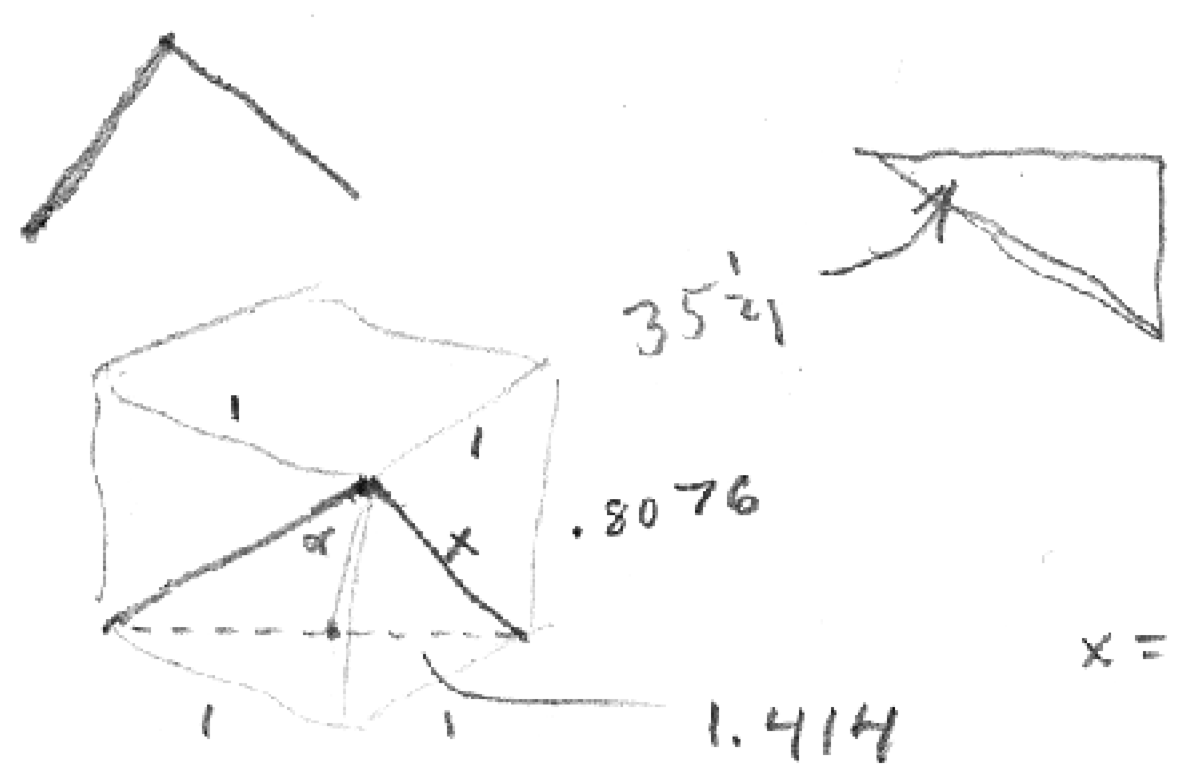
sin 50 = $\frac{Z}{.8275}$, Z = .634

70½



180
141
39

180
70½
109½ ÷ 2 = 54¾



tan = .7067 × .807 = .571 = 29.716°

×2 = **59¾°**

x = $\sqrt{1 + .8076^2}$ × 1.1285

sin α = $\frac{.707}{1.1285}$ α = 38.8° × 2 = **77.6°**

over

made mistake,

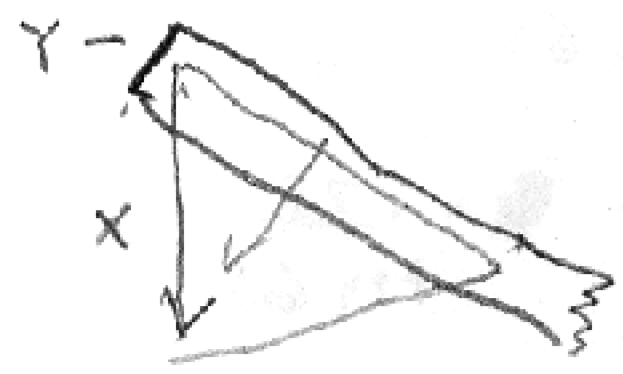
assume $59\frac{3}{4}°$ and $77.6°$ are correct,

then 115° and 130° are wrong by ~~slight amount~~

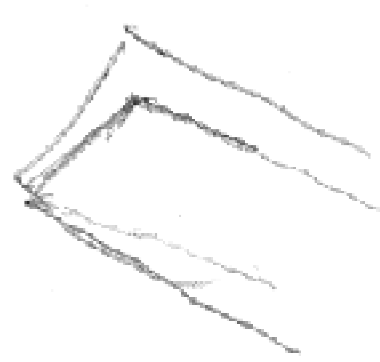
$70\frac{1}{2}°$ 120°

60°

0



if X reduced by .8076, then Y by $\frac{\sqrt{3}}{2} \times .8076 = .6994$



, so try ~~$115\frac{1}{2}°$~~ and ~~129°~~

---

or retain 115° and 130° and adjust hole angles
(by measuring on No. 101)

(apparently never made)

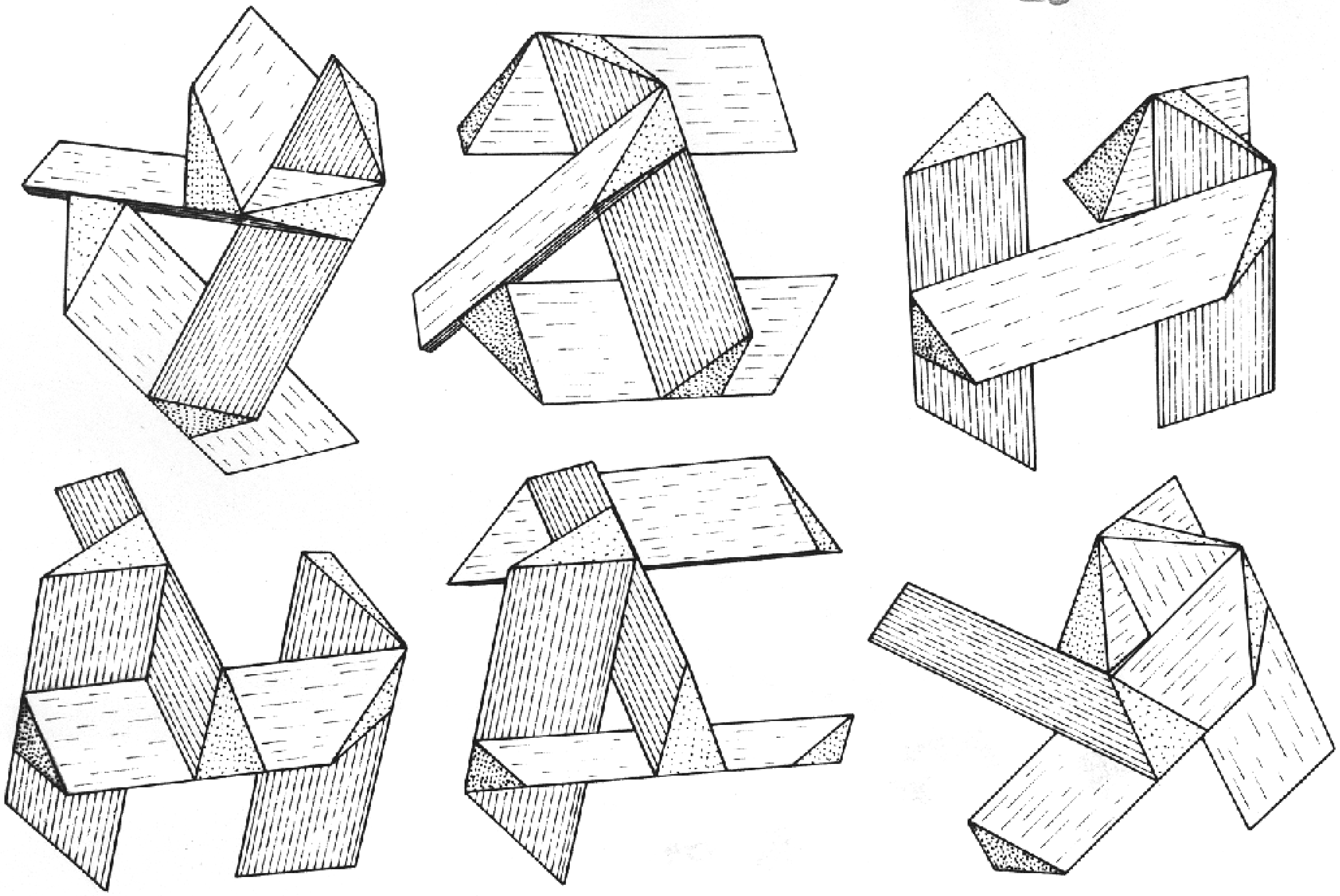


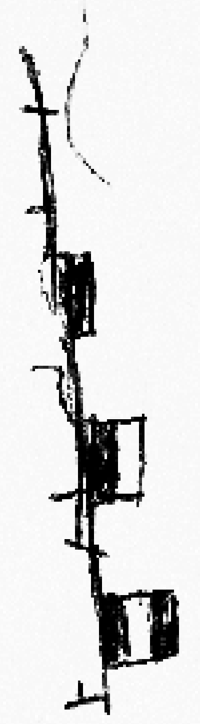
FIG. 137

23-X

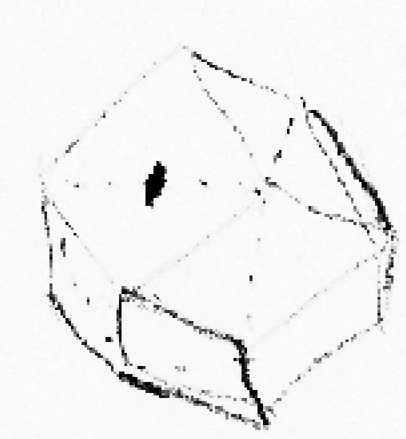
1	2	3	4	5	
A	B X				
	C X				
	D	C	B	E	F ☆
				F x	
			E X		
			F X		
		E x			
		F	B x		
			C x		
			E x		
	E	B ✗			
		D	B	C x	
				F X	
			C	B	☆
				F X	
			F X		
		F X			
	F X				

2 sol.

23-X



Complete analysis of Scorpius with different thicknesses 1, 2, 3, 4 which must total 5 allways

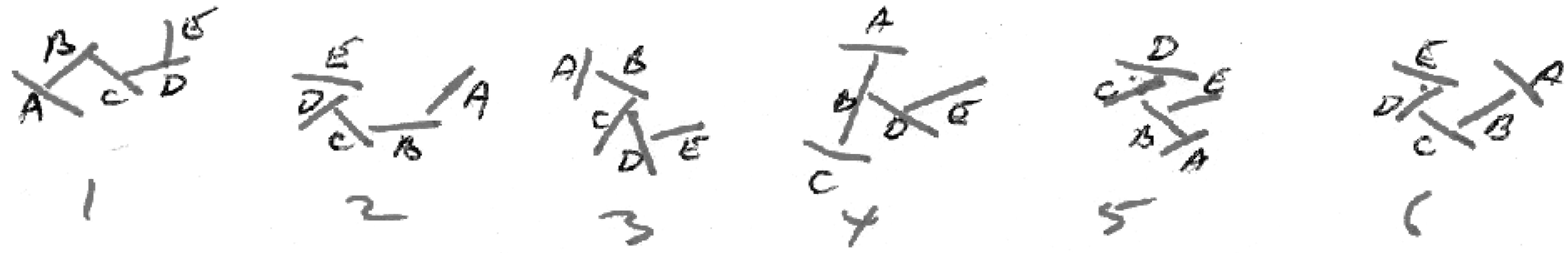


or 0, 1, 2, 3, which must total 3

Analysis of Scorpuis same as other side except one axis equals 6

1	2	3	4	5	6	
A	B	F	C x D x E x			
	C	B x D x E x F	B x E x D x			
	D	B x C	B	E	F ★	2 sol
				F	E ★	
			F x F x			
		E x F x				
	E	D	B	F x		
			C	B x F x		
			F x			
		F x				
	F	B x C x D	B	C x E x		
			C	B - x E x		
			E x			
		E x				

2 sol. again



STAN ISAACS SOLUTIONS TO SATURN

Solution 1 (S Coffin)

5E//4D

6E//5B

2A//4C

1C//5D

3E//6D

Solution 2 (a) (Isaacs)

3C//6C (and 3A//6B)

2D//3D (+ 2C//6D)

1B//3B (+ 1E//6A)

Then: 4D//5E

and join the first group to the second:

5B//6E + 5C//1D

note: this half does not mate with STC half

2(b)

6D//1C

2E//6B (+ 2A//6A)

3E//2D (+ 3B//1B)

Then put 4+5 together as above, + join them as above.

2(b) comes apart along a ~~e~~ <u>second</u> axis!

(over)

When taken apart this way, pieces 1+3 switch places (i.e. 1+3 switch with 1A+3A, your numbering). This new pair of halves, I think, is the solution you talked about on the phone - ~~a~~ each half is rotationally symettric (and therefore produce 5 solutions, one of which is 2(b).)

The symettric solution:

Solution 3:

Make 3 groups of 2:

A) 5E // 4D (+ 5A // 4E)

B) 6A // 2A (+ 6B // 2E)

C) 3B // 1B

Combine B with A: 3A // 4B, 3C // 4A, 1E // 4C

Combine C with A: 6E // 5B

Note also, a ~~two~~ 2(a) half can be combined with a 2(b) half. Thus (I think) we now have 9 solutions: 1, 2(a), 2(b), 2(a+b), + 5 from #3

December 3, 1969

DESCRIPTION OF PUZZLE NO. 1, HECTIX (Revised)

Puzzle No. 1, HECTIX, consists of twelve interlocking pieces in four colors, three pieces of each color. Each piece has the shape of a hexagonal prism. Nine of the pieces, referred to as the Standard pieces, each have two diagonal trapezoidal notches, and are identical in shape. The other three pieces, referred to as the Odd pieces, each have a third diagonal trapezoidal notch near their center, but are otherwise identical in shape to the Standard pieces. The three Odd pieces are all the same color.

The object of the puzzle is to assemble the twelve pieces to form a symmetrical solid configuration around a hollow core which has the shape of a rhomb-dodecahedron. The pieces are thus positioned in four groups of three, the three pieces in each group being parallel to each other. Or, they may also be considered positioned in four groups of three again, but the three pieces in each group forming an interlocking star, and the four stars being positioned as the faces of a regular tetrahedron.

There are at least three distinctly different procedures for assembling the puzzle, which result in different relative positions of the Standard and Odd pieces and different order of assembly.

Of the gfeat many different color patterns which are possible in assembly, two are of particular importance, not only because they are the most logical and aesthetic, but also because they lead to the three different solutions.

Pattern No. 1 Four stars, the three pieces in each star being like color. Or, stated another way, no parallel pieces being like color. This condition is uniquely satisfied by Solution No. 1.

Pattern No. 2 All parallel pieces being like color. Or, stated another way, no like colored pieces touching each other. This condition is uniquely satisfied by Solution No. 2.

Neither Pattern 1 nor 2 No parallel pieces are like color, and no three like colored pieces form a star. This condition is uniquely satisfied by Solution No. 3.

Copyright:

December 3, 1969

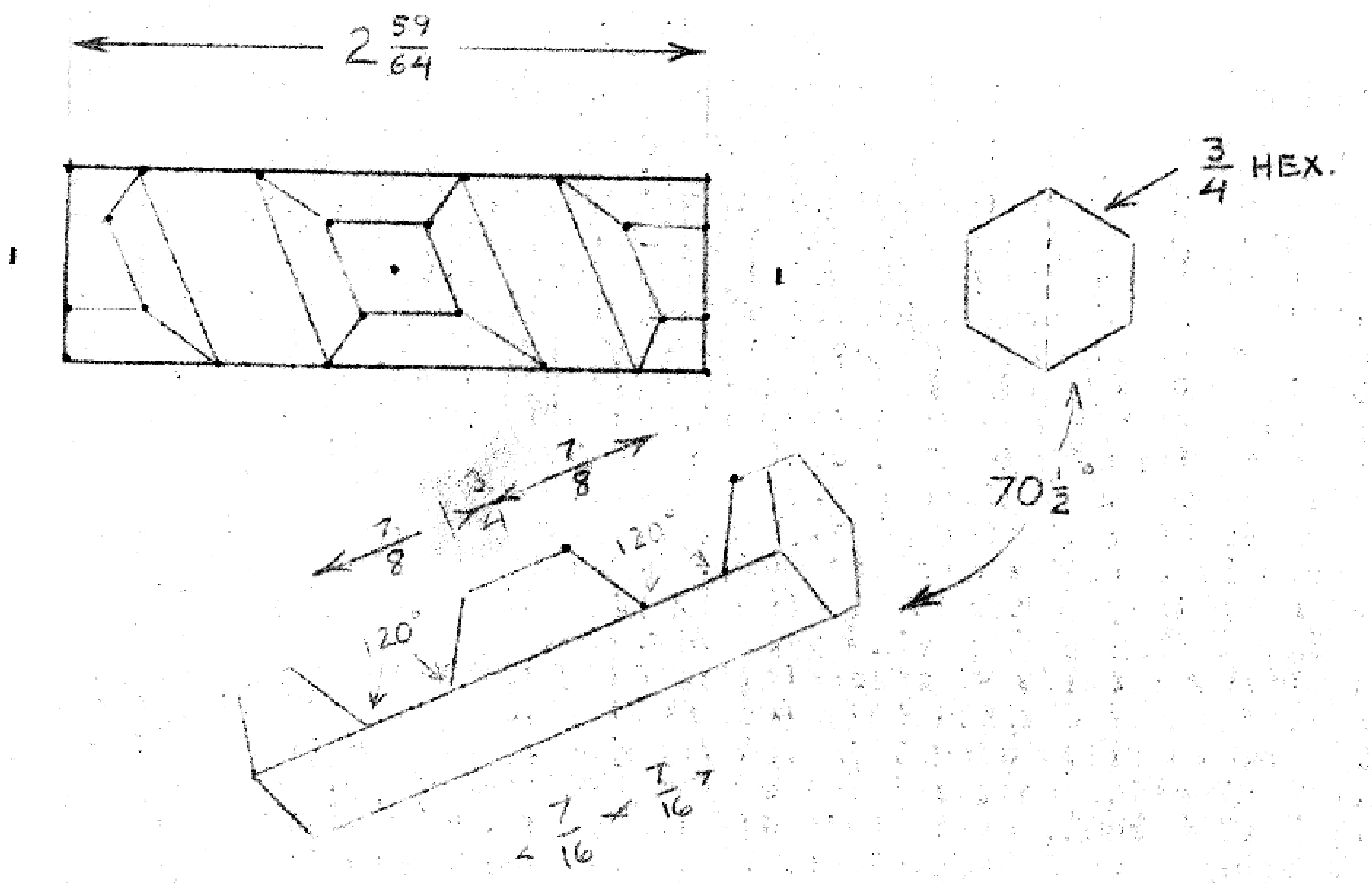


FIG. 1 - HECTIX PUZZLE STANDARD PIECE

December 3, 1969

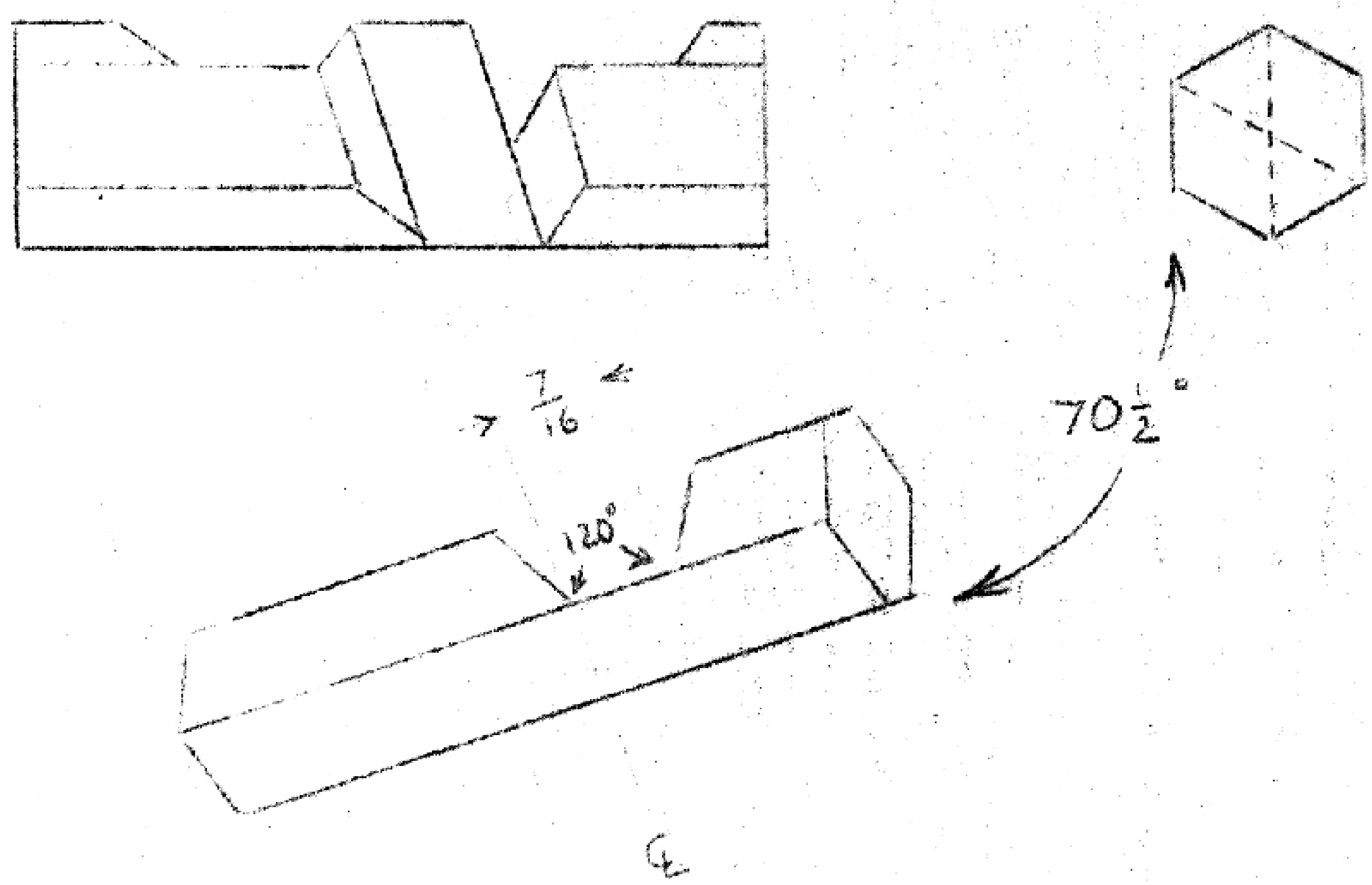
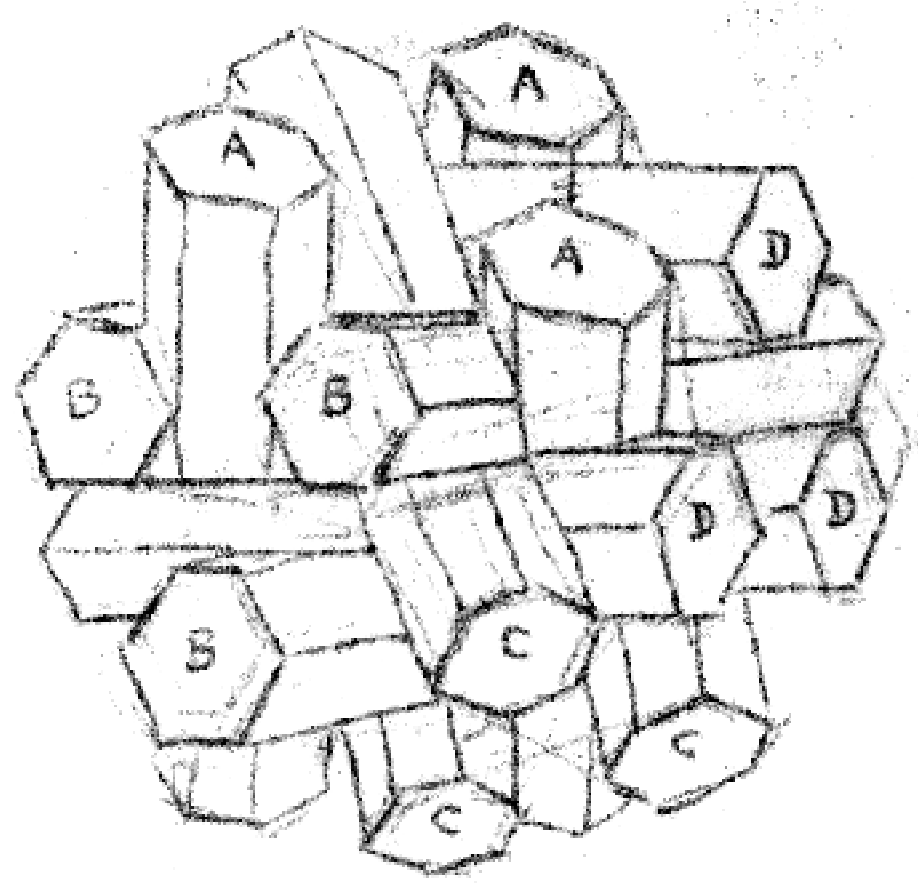


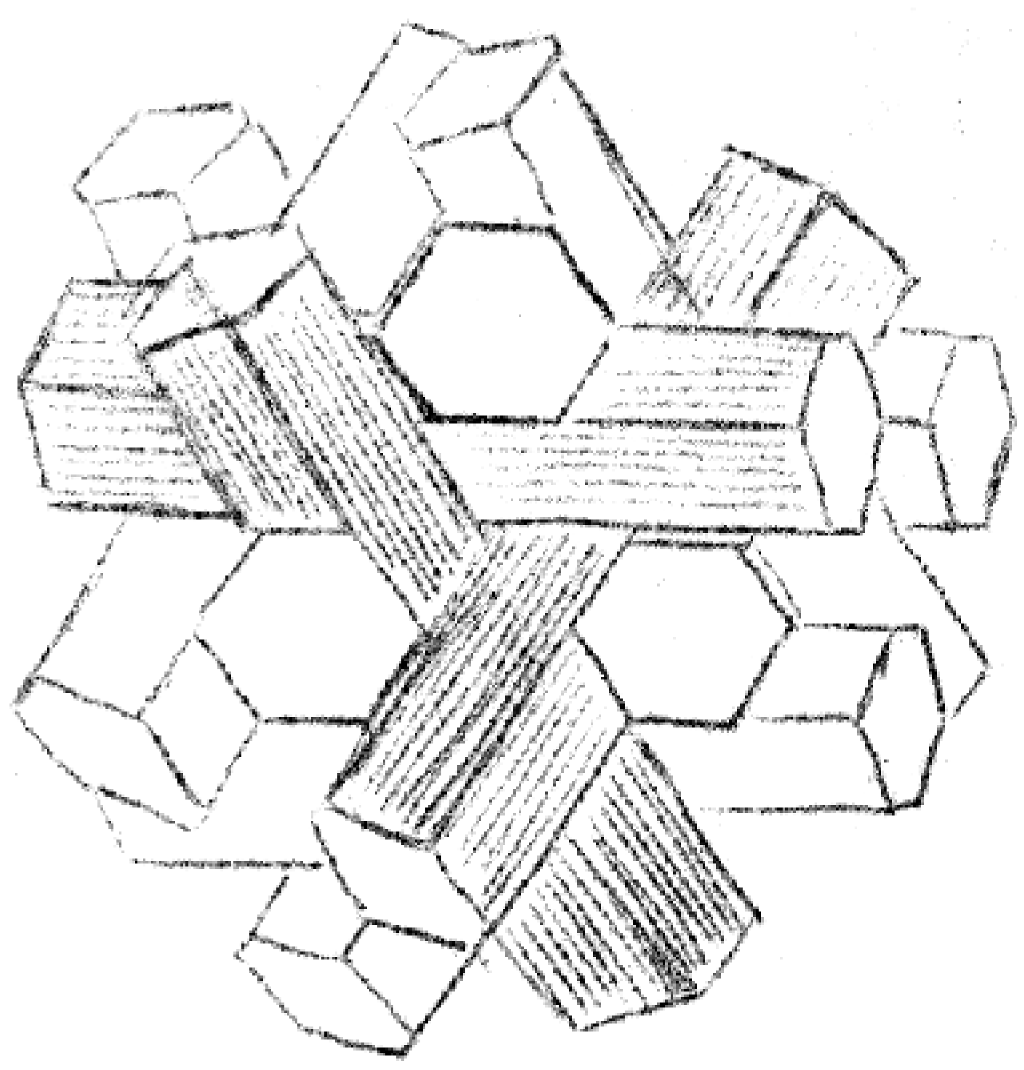
FIG 2 · HECTIX PUZZLE ODD PIECE

Note: All other dimensions same as Standard Piece, Fig. 1.

December 3, 1969



OBLIGUE VIEW OF ASSEMBLY SHOWING PARALLEL GROUPS



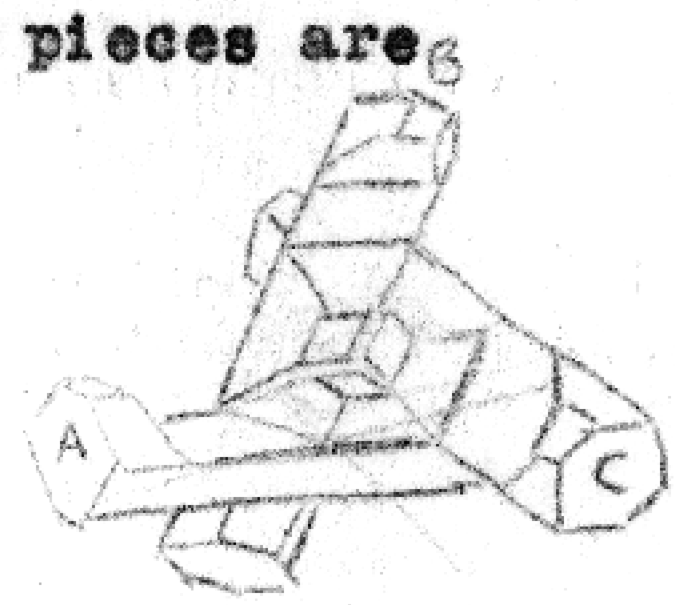
TOP VIEW OF ASSEMBLY SHOWING STAR CONFIGURATION SHADED

FIG. 3 HECTIX PUZZLE ASSEMBLY

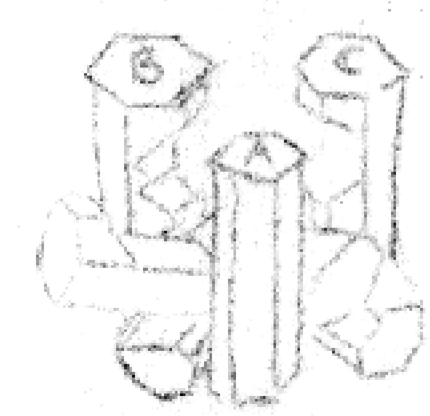
December 3, 1969

HECTIX SOLUTION NO. 1

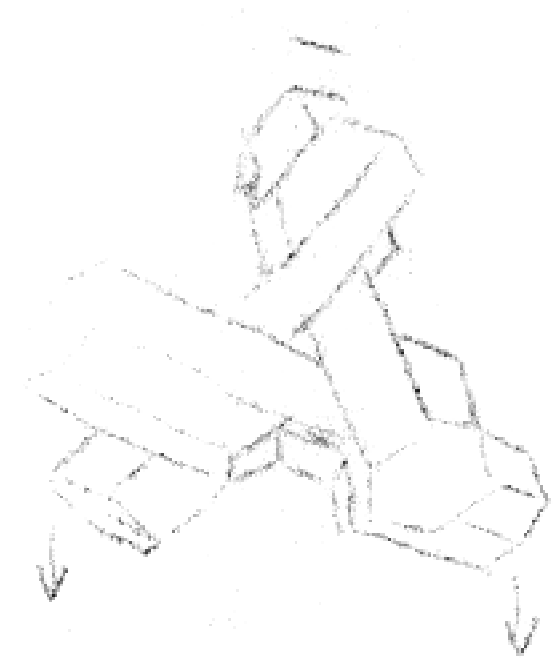
To assemble the pieces so that no two like colored pieces are parallel to each other.



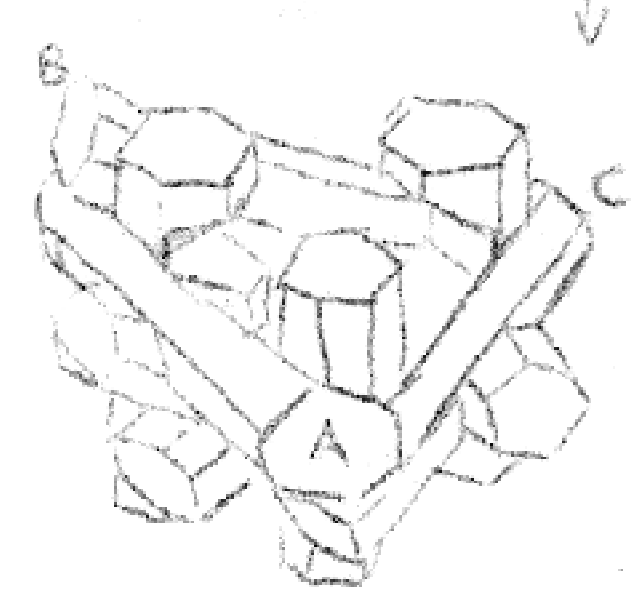
1. Three Standard pieces, no two the same color, are assembled to form an interlocking star, and placed on a level surface, notches facing upward.



2. Three more Standard pieces are positioned vertically, withnthe lower notch of each piece fitting into one side of its like colored piece in the star.



3. The three remaining Standard pieces form a triangle around the vertical pieces, and fall as a unit into the notches of their like colored pieces in the star.

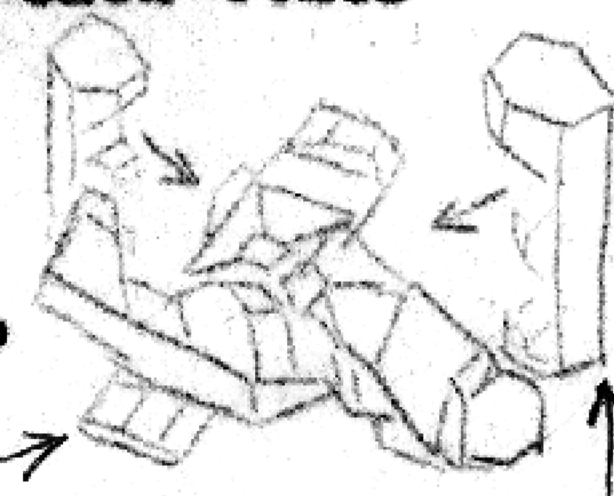


4. The three Odd pieces are separately assembled to form another star, center notches all facing outward; and with concave side facing downward, they are slipped between the vertical pieces, completing the assembly.

December 3, 1969

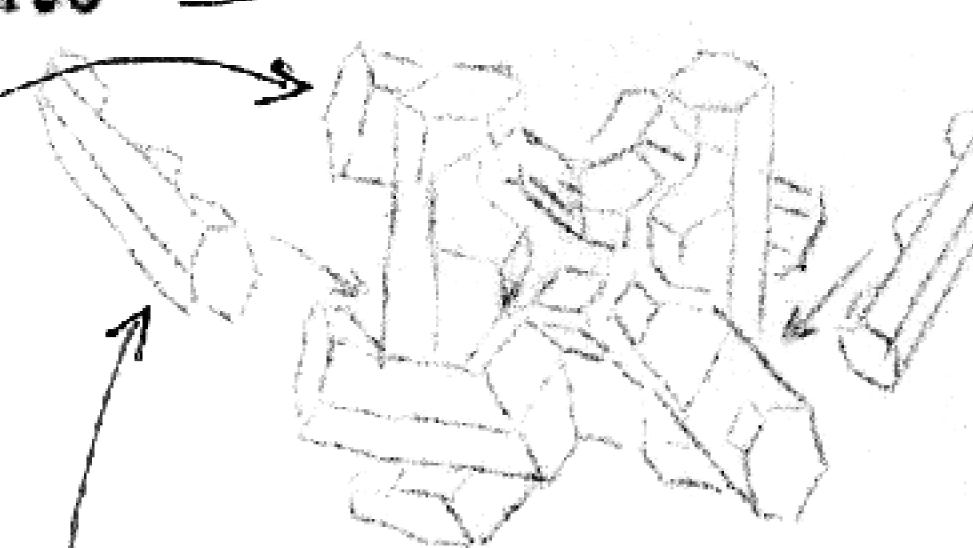
HECTIX SOLUTION NO. 2

To assemble the puzzle so that all pieces parallel to each other are the same color.



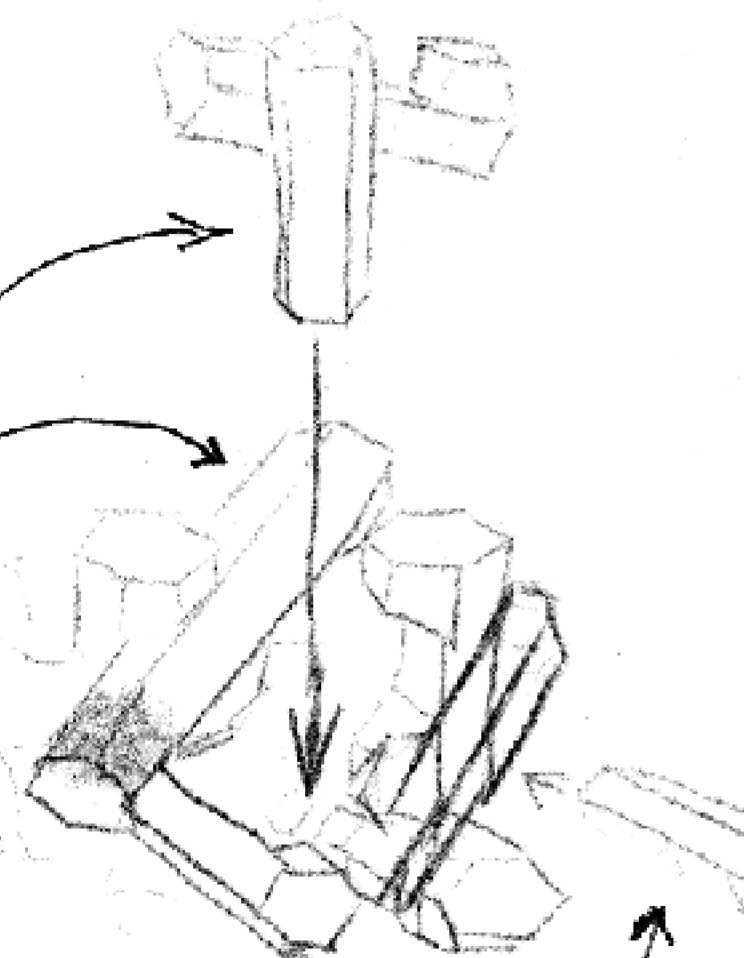
1. Two Standard pieces of unlike color and one Odd piece are assembled to form an interlocking star, with the center notch of the Odd piece facing outward, and placed on a level surface, other notches facing upward.

2. Two Standard pieces of like color, different from any color in the star, are positioned vertically, with the lower notch of each piece fitting into each of the two Standard pieces in the star.



3. An Odd piece is placed spanning the two vertical pieces, with its center notch facing upward.

4. Two more Standard pieces are placed in the two remaining notches of the star, such that pieces of like color are parallel.



5. A Standard piece is positioned with its upper end between the two vertical pieces, again maintaining like colors parallel.

6. The remaining Odd piece is fitted into a notch of the remaining Standard piece which is same color as vertical pieces, and inserted as a unit, leaving an opening through which the remaining Standard piece is passed.

December 3, 1969

HECTIX SOLUTION NO. 3

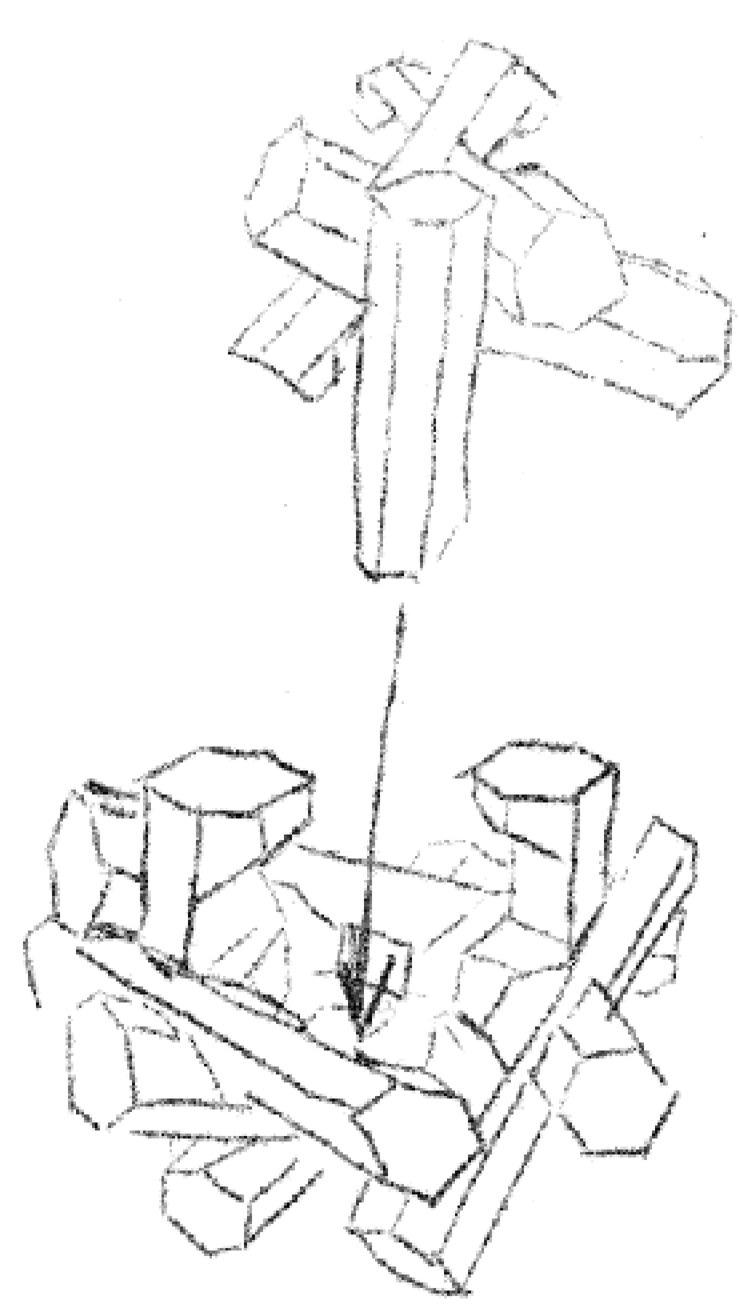
To assemble the puzzle so that no two pieces parallel to each other are like color, and no three like colored pieces form a star.

1. Same as step No. 1 of Solution No. 2.

2. Same as step No. 2 of Solution No. 2, except that the vertical pieces are same color as their mating pieces in the star.

3. Three Standard pieces form a triangle around the vertical pieces, and rest in the notches in the star. The piece spanning the vertical piece is the same color as either one of them, and the other two are alike in color, but unlike any others in the assembly thusfar.

4. The two remaining Odd pieces and the remaining Standard piece which is the same color as one of the vertical pieces are assembled separately to form a star, and the remaining Standard piece is placed so that one of its notches engages the Standard piece in this star. This four-piece sub-assembly is then mated with the rest of the assembly.



Regarding Hectix: It has always been surprising to me how little feedback I received over the years regarding solutions to AP-ART puzzles. Sometimes I would find a mistake in one of my own publications made many years before and widely circulated that no one ever noticed and brought to my attention.

One of the rare exceptions to this has been Hectix solutions. Back in the early 1970's there was a woman at 3M who handled fan mail on puzzles, and occasionally she would receive a letter from someone with a fourth solution and forward a copy to me. In every case, she found that it was the result of having an extra loose set of pieces, as is the case with Dahlman's fourth solution. With an accurately made set of pieces, I am pretty sure that his 4th solution is impossible. In fact, I have often wondered if my solution with key piece is even possible with a mathematically exact set. I wouldn't know how to determine this analytically, although someone like Bill Cutler might.

There is a little story behind this never recorded. When Nylon Products started molding Hectix pieces, after molding several thousand sets, because of a slight miscalculation or shrinkage, it was discovered that the puzzle was too tight and could not be assembled. In a rush for production, without consulting with me, the president of Nylon Products took it upon himself to order 0.010 inches ground off one surface of the 12-cavity mold, when with just a phone call I could have told him that was way too much. So then they ended up with another large batch of pieces too loose. This was one reason for the meeting that I mentioned in Part One. What I left out was that when my kids assembled the first 20,000, it was with this batch of too tight and too loose pieces, which we had to mix to get the right fit. I even have a photo which shows piles of pieces on the benches labeled "too tight" and "too loose", and I had to juggle them to not only get a good fit but use them all up. Consequently, some sets went out that were probably too loose, hence some of the alternate solutions reported. Now I am wondering if perhaps Dahlman was one of those who reported this to 3M in the early 1970's. I did not save any of that correspondence.

Bill Cutler Puzzles, Inc.

405 Balsam Lane ~ Palatine, IL 60067 ~ USA
Phone (847) 705-1186 ~ e-mail 74627.1230@compuserve.com

November 30, 1996

Dear Stewart,

A belated thanks for the copy of the letter to Nancy Allegro of Bits & Pieces about their version of Hexsticks.

When I came up with the idea for this burr, I made two different versions of the piece notches. One of them has 3-3-notch pieces, 6-2-notch pieces, and 3-1-notch pieces. This has two solutions which are equivalent to 2 of the solutions to Hectix. The other (and earlier) version had 3-3-notch pieces, 6-2-notch pieces with parallel notches, and 1 each of: 2-notch piece, notches not parallel; 1-notch piece, and solid piece. I don't even know if I have a copy of this first design.

I have always regarded extra notches in burrs which are easy to take apart as inferior designs. This is, of course, a personal preference. On the other hand, for burrs with many moves to take out the first piece, extra holes/notches are usually required, so the more the merrier, if it makes the puzzle harder without sacrificing stability.

I don't believe I ever gave a name to either of these internal designs for the Hexsticks shape. At one point, a college acquaintance of mine had 1000 of the later version made with instruction sheets calling it "Gamex no.1". I enclose a copy of the sheet. I don't know if you have seen this before. This was done sometime in 1970 or 1971.

Barb is due to graduate from MIT in June. However, our trip there will be extremely short as Beth graduates from high school 2 days later. Barb will be staying at MIT for a fifth year, so there will be other opportunities to travel to Boston.

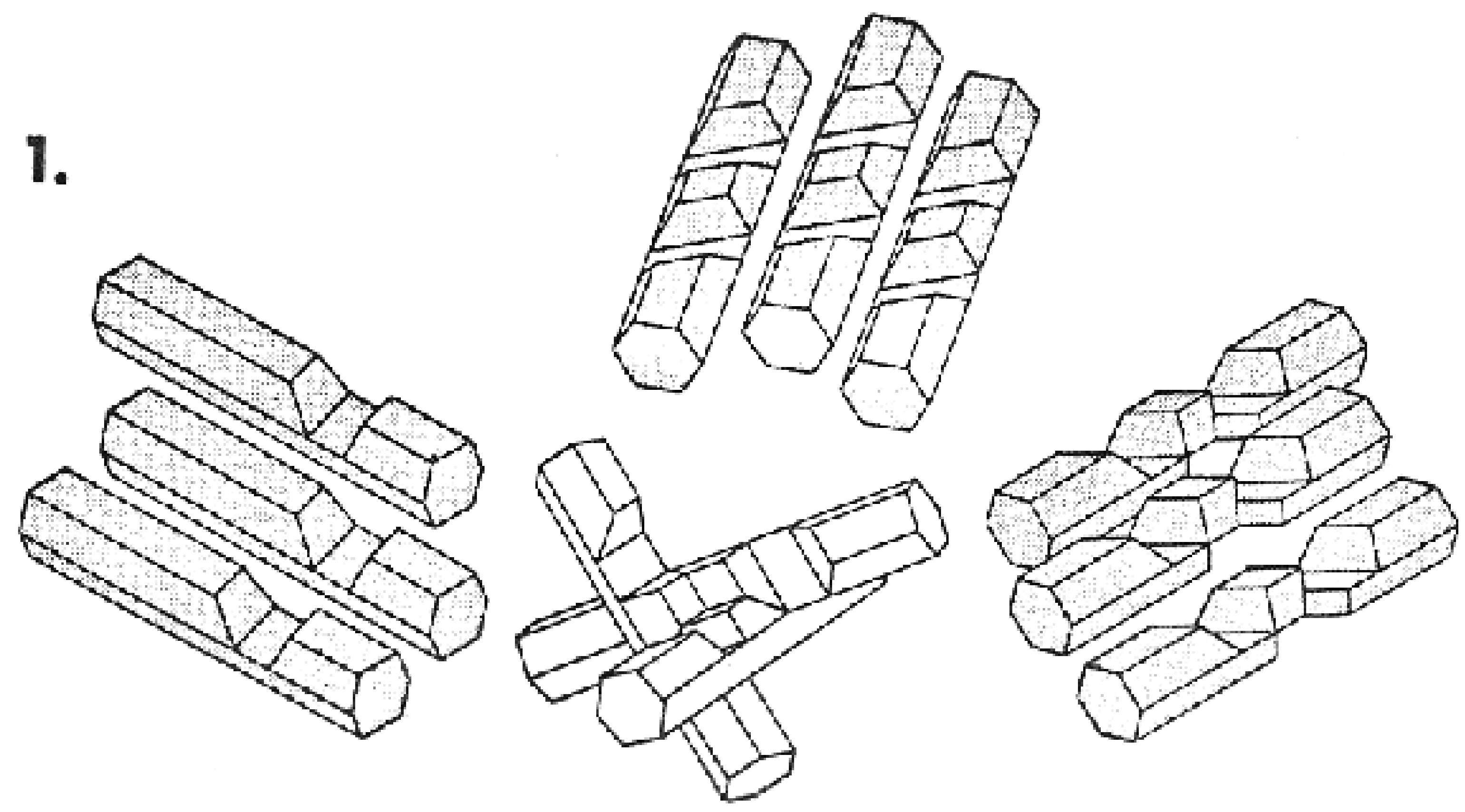
Happy holidays and best wishes for 1997.

Sincerely,

Bill

GAMEX no. 1

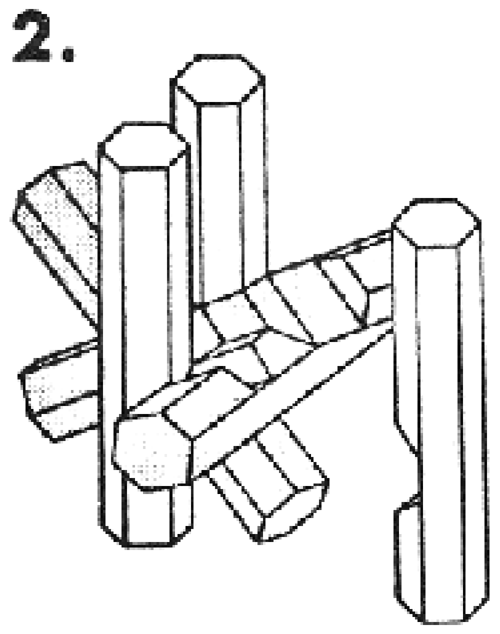
1.



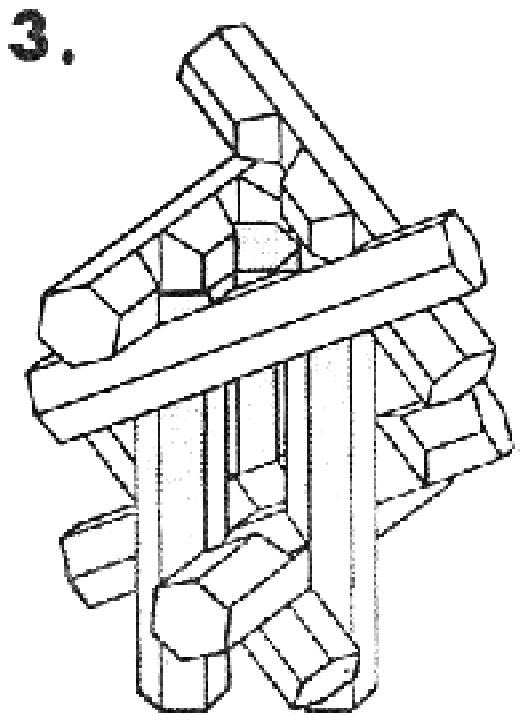
1. Check to see if you have all the parts. Assemble three of the two-slotted pieces as shown. (Diagram #1)

2. While holding this assembly from underneath, add three one-slotted pieces to the angles formed in the first assembly. (Diagram #2)

2.



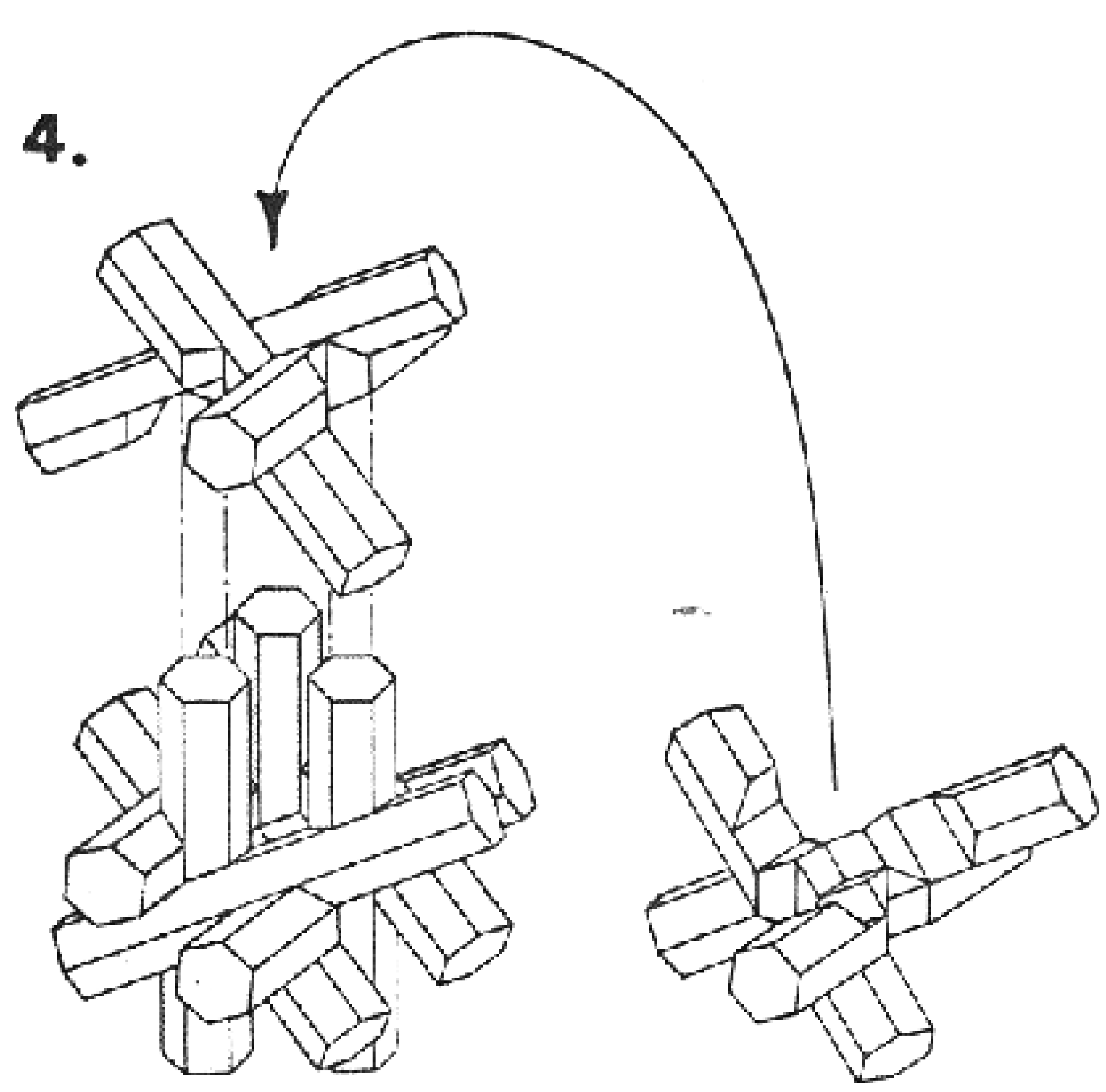
3.

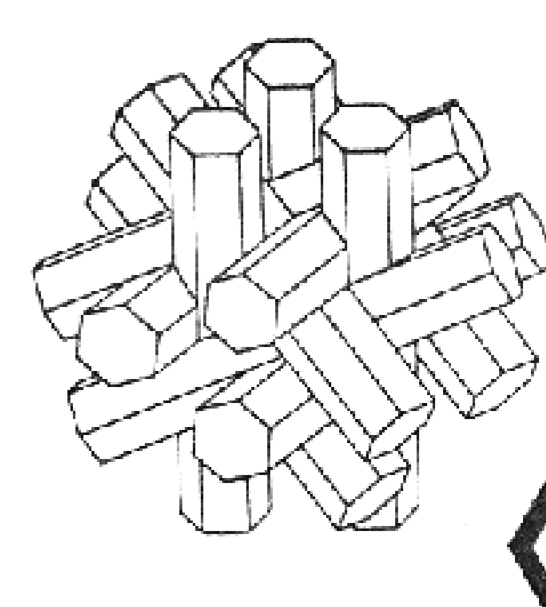


3. Next, place the three remaining two-slotted pieces loosely in a circle around the three upright pieces. Push these three loose pieces into place by squeezing them inward and down at the same time. The resulting assembly is stable and will not fall apart if kept in an upright position. (Diagram #3)

4. Now take the three three-slotted pieces and assemble them in the same manner as the three two-slotted pieces in step one. These last three pieces will fit into place by inverting them and fitting them in-between the three upright pieces. (Diagram #4)

4.





gamex by Cutler & Wood

#27 Three Pairs

Copyright:

#27

27

May 24, 1973

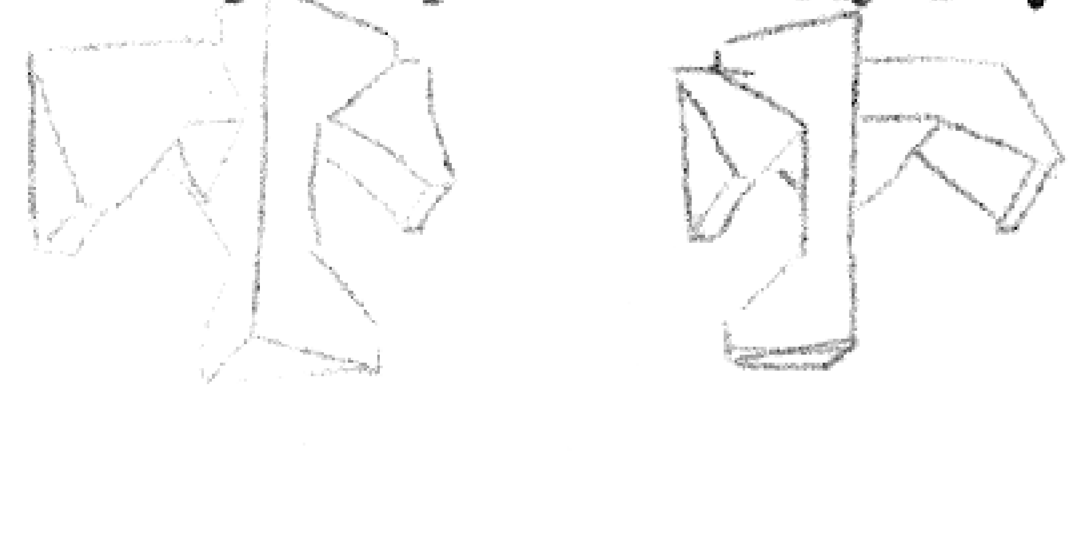
Description of Puzzle No. ~~36~~. (Little Giant)

Puzzle No. 36, Little Giant, consists of six pieces. There are two types of pieces, three of each. One set is the mirror image of the other. The pieces can best be described with reference to puzzle 4-B, Seven Woods Puzzle, which has six identical pieces, each piece having two notches. If each of these six pieces are divided into two identical halves by a longitudinal plane, and the resulting 12 pieces are fastened together in pairs which are at right angles to each other, the result will be Little Giant pieces. The assembled puzzle has the shape of three mutually perpendicular square prisms intersecting each other, with six square faces and eight triangular prisms. Similar to the GeoLogic series of puzzles, the end faces of the pieces can be cut at various angles to produce a variety of interestin geometric shapes. In the particular version of the puzzle described here, the end faces ~~are~~ of each piece are isosceles right triangles, perpendicular to the axes of the pieces, the idea being to produce a simple shape that looks deceptively easy as well as not imitating other designs on the market.

This puzzle is unusual in that it is extraordinarily difficult to assemble, especially if not disassembled by the person trying to solve it. There are two ste The first step is to subassemble three identical pieces into a subassembly, and the other three identical pieces into a second subassembly, which is a mirror image of the first. This step involves the simultaneous manipulation of three pieces in a precise way that is not obvious. The last step of assembly involves mating the two halves, exactly like the Seven Woods and GeoLogic puzzles. Disassembly is also rat intriguing. The parting axis of the puzzle must be discovered by trial and error, as it cannot be fathomed by visual inspection or logic. Unlike most other puzzle o this type, the three pieces in each half do not fall apart, but appear to be fasten permanently together, and they are separated by a curious sliding and expanding mot

The puzzle could best be fabricated by injection molded plastic. The pieces ca be cored from the inside if desired, without affecting the external appearance. Th puzzle could be enhanced by using various colored pieces. From symmetry considerat it would seem to make the most sense to make the pieces either six different colors or all one color or clear. If it were practical to make each piece in two parts of different color, such as by snapping or bonding together in some manner, then the most desirable color combination would be four colors,-all four on each face, or three colors - each face a solid color. I am submitting herewith a model made of unfinished wood, which can be colored later if desired to simulate plastic. It is scaled to be compatible with the ~~other~~ interchangeable puzzle pieces in the GeoLogi line (3/4").

This puzzle was designed to meet the demand for a really hard puzzle, especiall for those who have observed that when one has mastered one of the GeoLogic puzzles, one has pretty well mastered them all. I have invented this puzzle, and I believe its mechanical principle is totally new, original, and unique.



Stewart T. Coffin
May 24, 1973

#27

Copyright:

17

March 29, 1974

Description of Puzzle No. ~~36~~ (Revised)

(Supersedes original description dated May 24, 1973 - Little Giant)

Puzzle No. 36 consists of six pieces. There are two types of pieces, three of each. One set is the mirror image of the other. The pieces can best be described by reference to Puzzle 4-B, Seven Woods, which has six identical symmetrical pieces. Divide each of these pieces into halves by a longitudinal plane, and join the resulting 12 pieces in pairs at right angles to each other.

This puzzle is remarkable in that it is surprisingly difficult to assemble, especially if not first disassembled by the same person. The first step is to subassemble each of the three identical sets into two sub-assemblies. This involves the simultaneous manipulation of three pieces in a precise way, which is not the least obvious. It is fascinating to watch the three pieces slide together or apart. The final step of assembly is to mate the two halves.

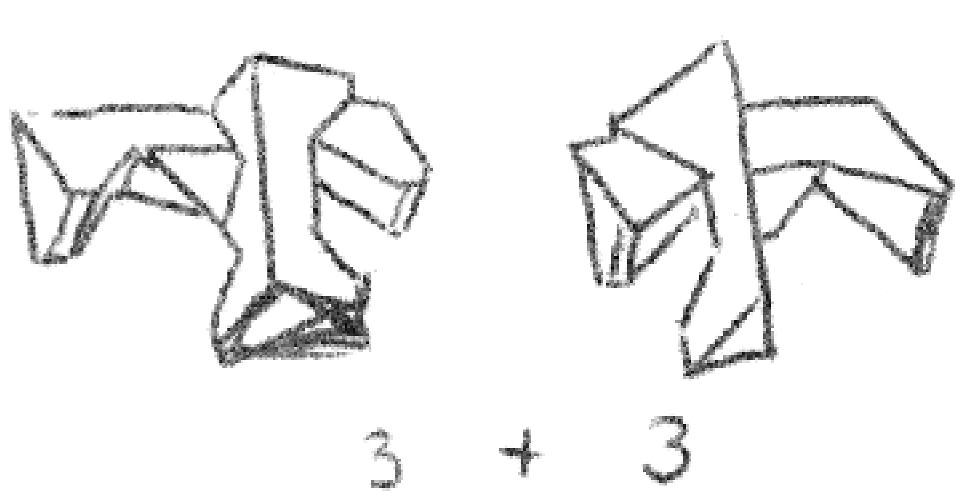
Disassembly is also intriguing. The sliding axis of the puzzle must be discovered by trial and error, as it cannot be fathomed by visual inspection or logic. The three pieces of each half appear to be locked together, but slip easily apart, almost as if by magic, if touched at the correct three points.

There are various versions of this puzzle, all based on the exact same internal geometry, having different external shape and aesthetic qualities. The original model has the simple shape of the Seven Woods Puzzle, of three intersecting square prisms with square end faces, and slightly beveled edges. A second version has the shape of the second stellated form of the rhombic dodecahedron (Nova) - model submitted March 5, 1974. A third version is made by rounding the exterior of either of the above versions so that the shape is spherical, except for eight triangular indentations - model submitted March 5, 1974. A fourth version has the shape of the first stellated form of the rhombic dodecahedron (Star) - sample pieces submitted March 5, 1974. Various other shapes are possible. It is considered preferable to chose those shapes in which the dissecting planes do not cut external faces, but rather occur on edges.

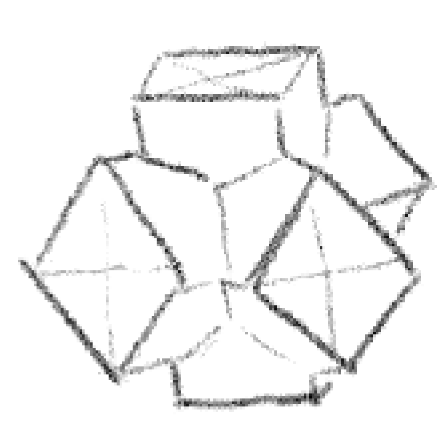
The puzzle could best be fabricated by injection molded plastic, using a simple 2-cavity mold. The pieces can be cored out from the inside if desired, without affecting the external appearance. The puzzle might be enhanced by using multiple colored pieces, but from symmetry considerations it would seem to make the most sense to make the pieces all one color, or clear.

I have invented this puzzle. I believe its mechanical principle is totally new, original, and unique. I feel it is one of my most intriguing and difficult puzzle designs, yet one of the easiest to fabricate.

Stewart Coffin
March 29 1974

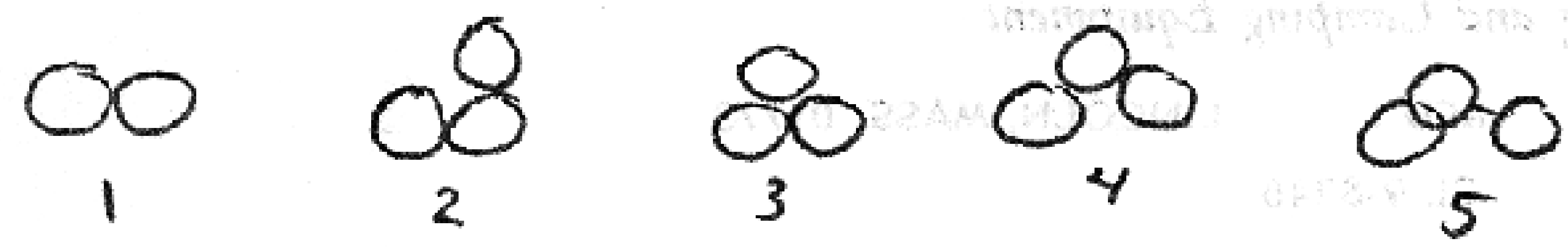


3 + 3



#28

Analysis of Truncated Octahedron Puzzle #43



5 block square pyramid 1 – 3, no others

5 block rhombic pyramid 1–2, 1–3, no others

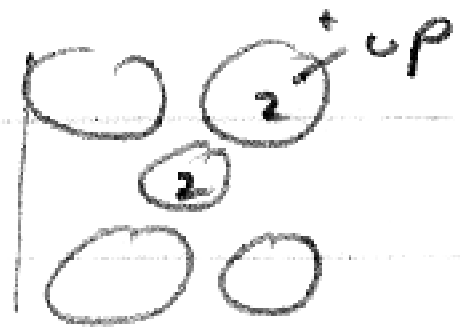
6 block flat jack 2 – 3, no others

14 blocks in box 11 solutions (see 4 pages) (confirmed by VanderPoel)

14 block sq. pyramid 3 " (" ")

P-1

PC 2



1 U.L

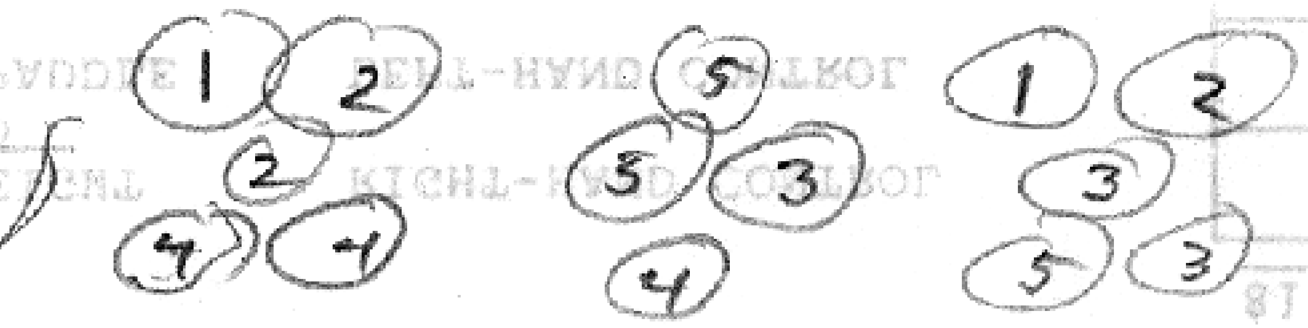
3 LL ↑ X — (10)

" " ↗ X

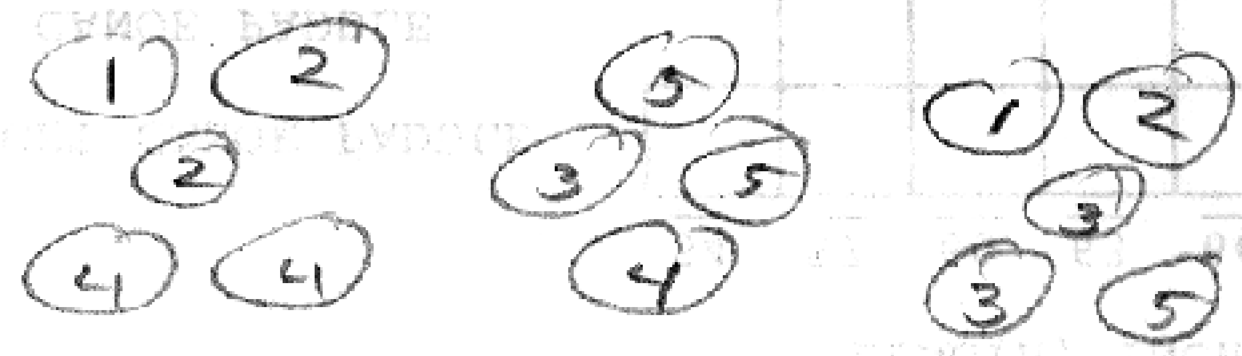
" " → X

4 LL

down

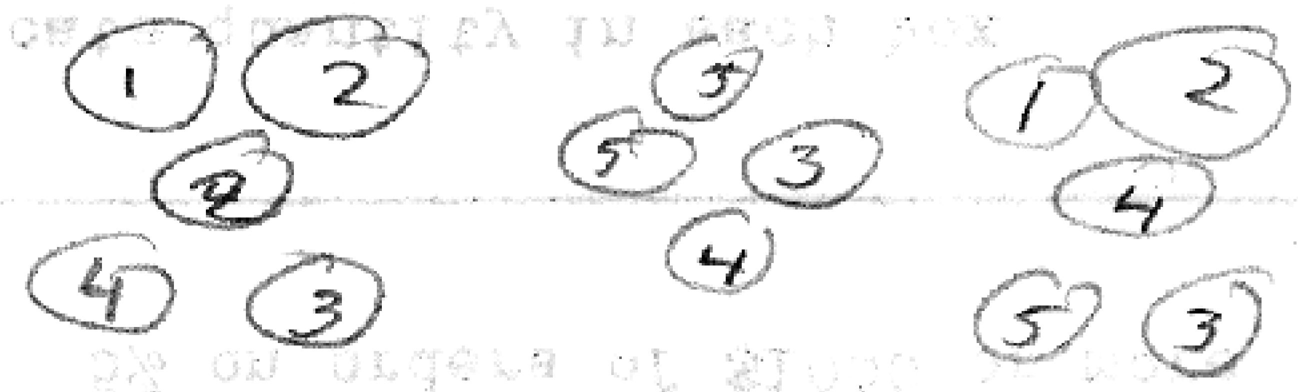


4 ✓



5 ✓

4 LL front



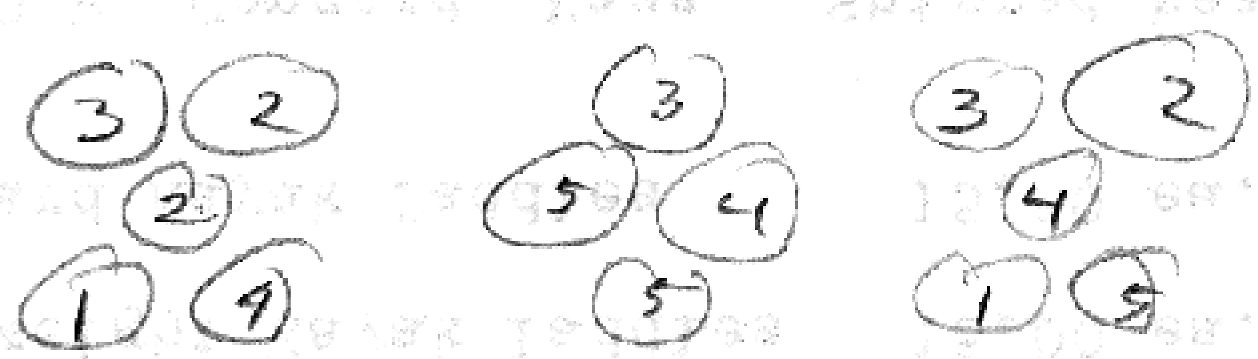
6 ✓

4 LL L+ X

5 LL L X

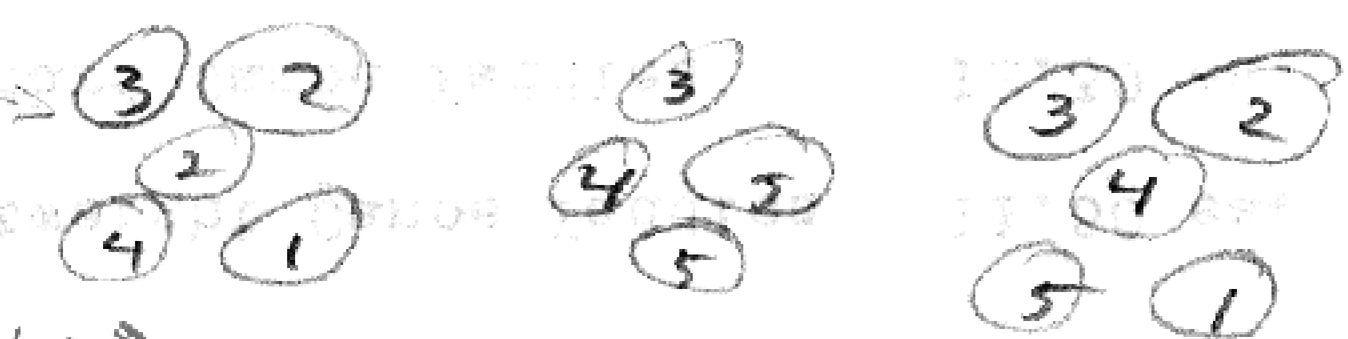
3 U.L →

1 LL



7 ✓

4 LL ↑



(6)

4 LL → X (6)

5 LL X

3 U.L. ↘ 1 LL X

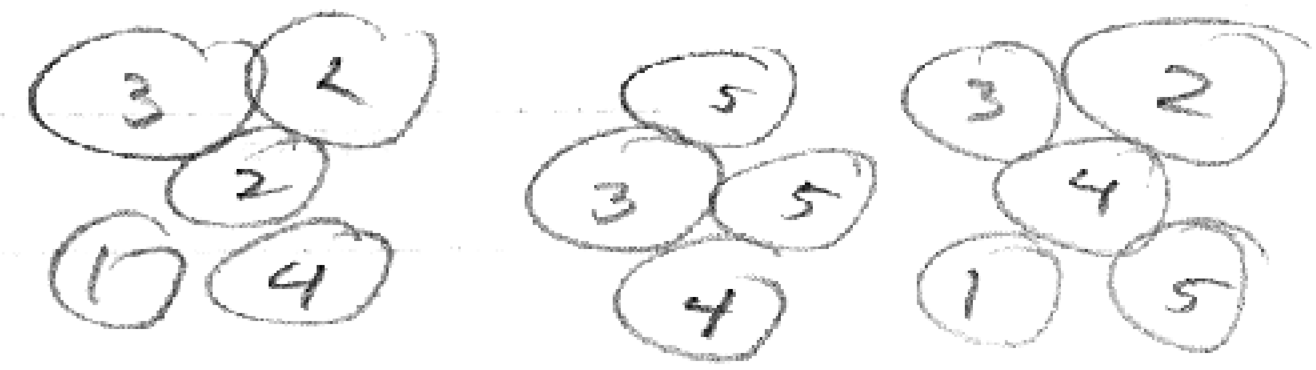
4 LL X

5 LL X

p. 2

3 U.L ↓

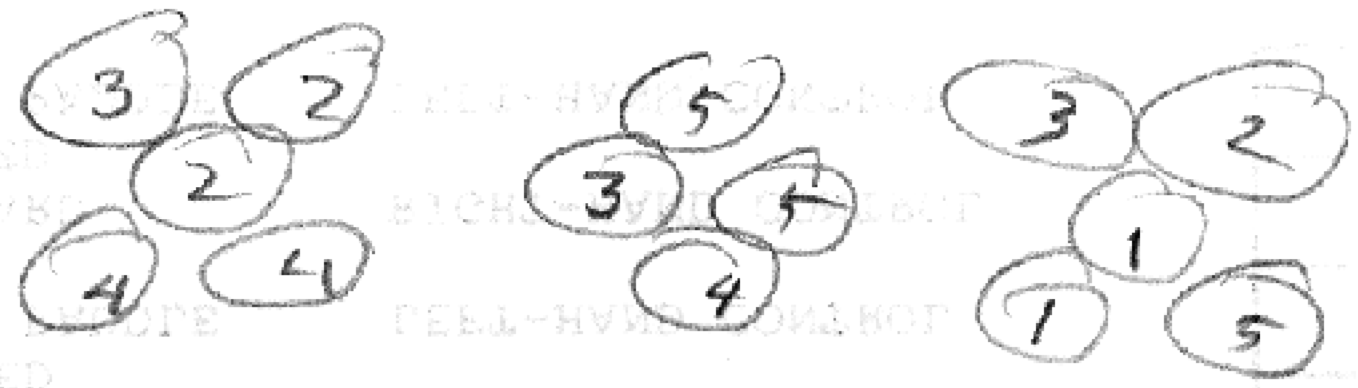
1 LL



8 ✓

4 LL

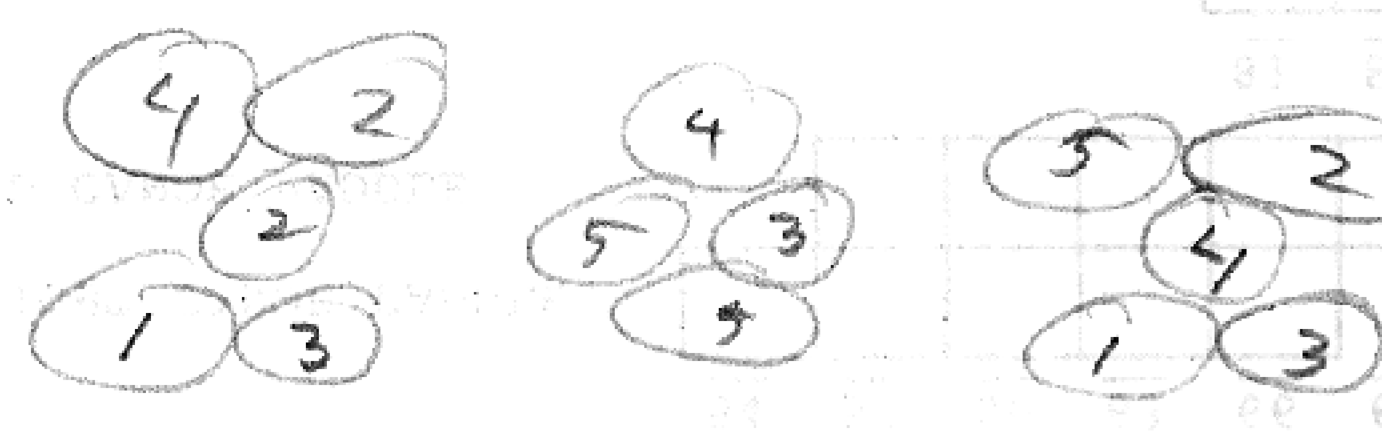
5 X



9 ✓

4 UL →↘

1 LL

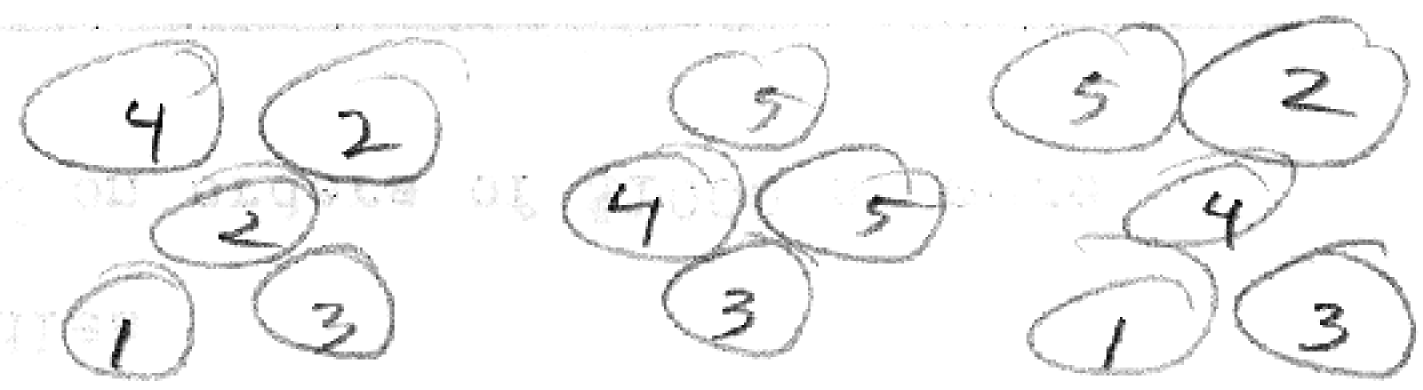


(7)

3 LL X

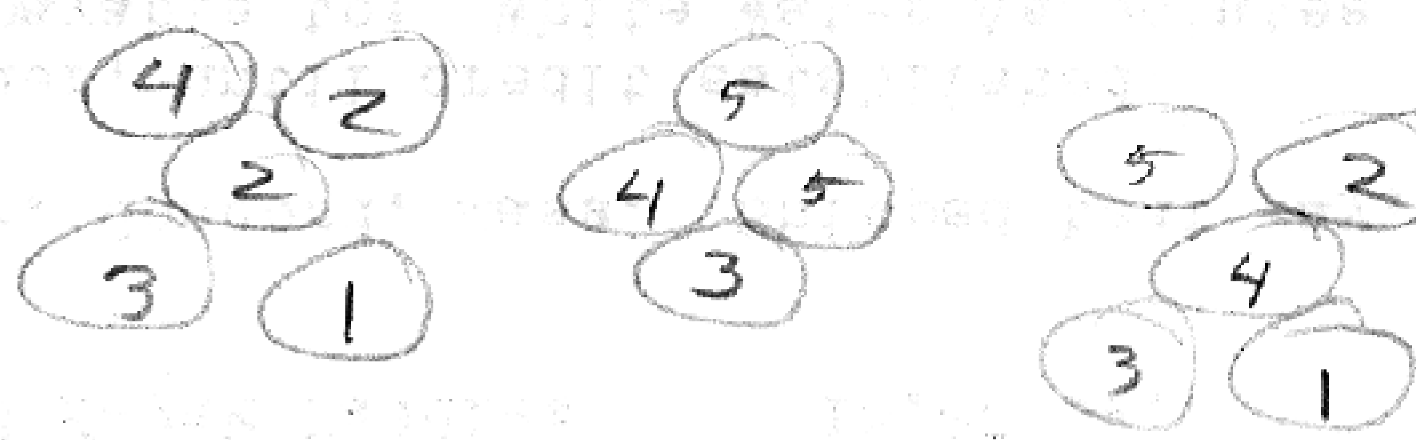
5 LL X

4 L→ 1 LL



(8)

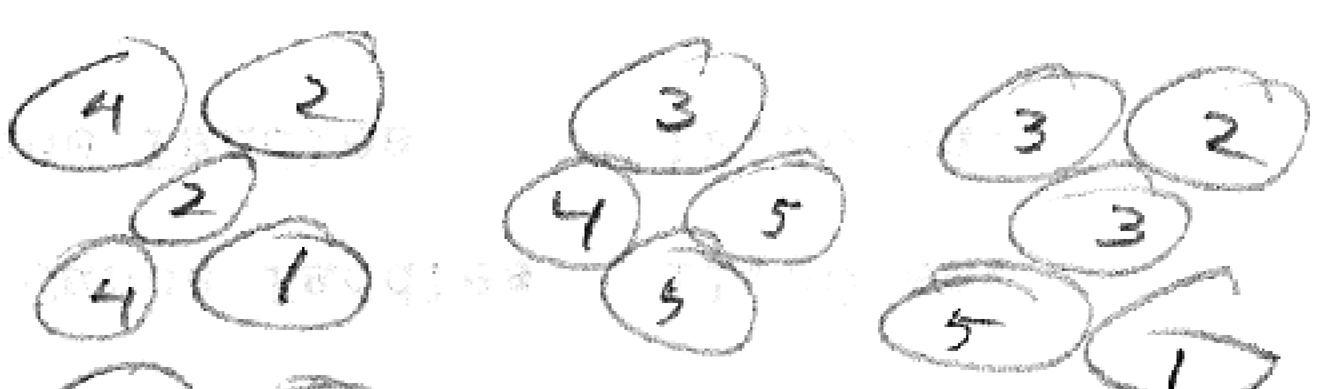
3 LL



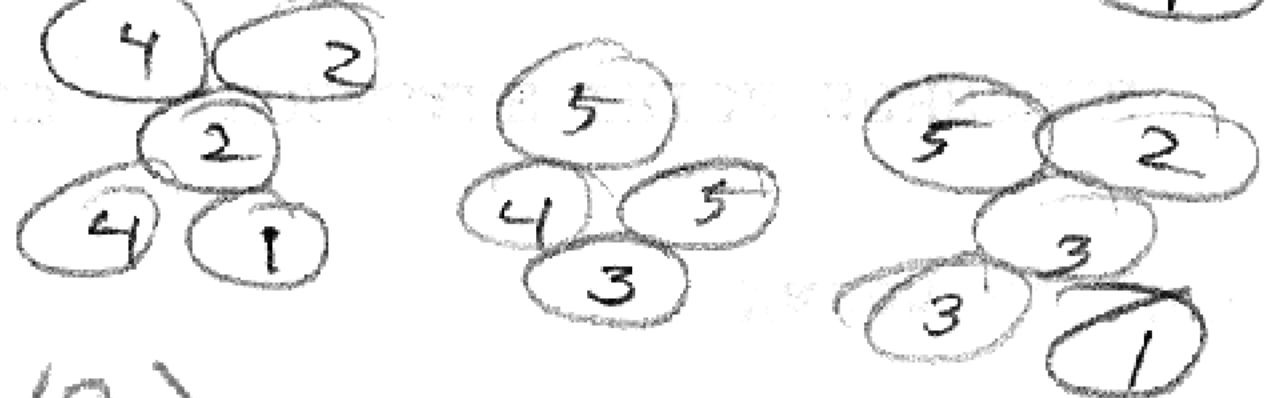
10 ✓

5 LL X

4 ↓ 1 LR



(4)



(5)

3 LR (9)

5 LR X

P-3

5 U, L, →

1 LL X

3 LL ↑ X
↗ X
→ X

4 LL X

5 ↳ 1 LL X

3 LL X

4 LL X

2 ctr

1 UL

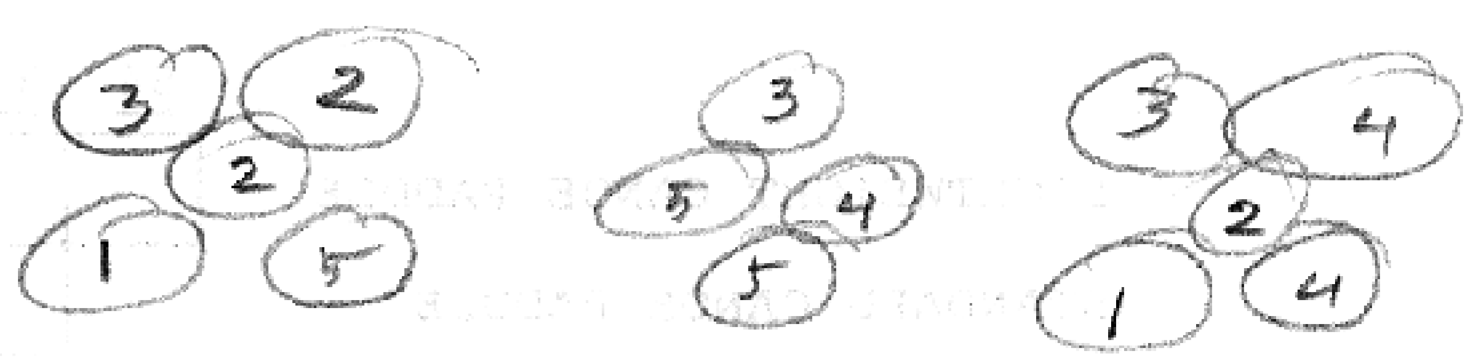
3 LL ↑ X
↗ X
→ X

4 LL X

5 LL X

3 UL →

1 LL



//

4 LL X

5 LL X

3 UL ↘ X

U UL ↓ 1 LL X

4 LL X

5 LL X

5 UL →

1 LL X (11)

3 LL X

4 LL X

4 UL + LL ↓ 1 LR X

3 LR X

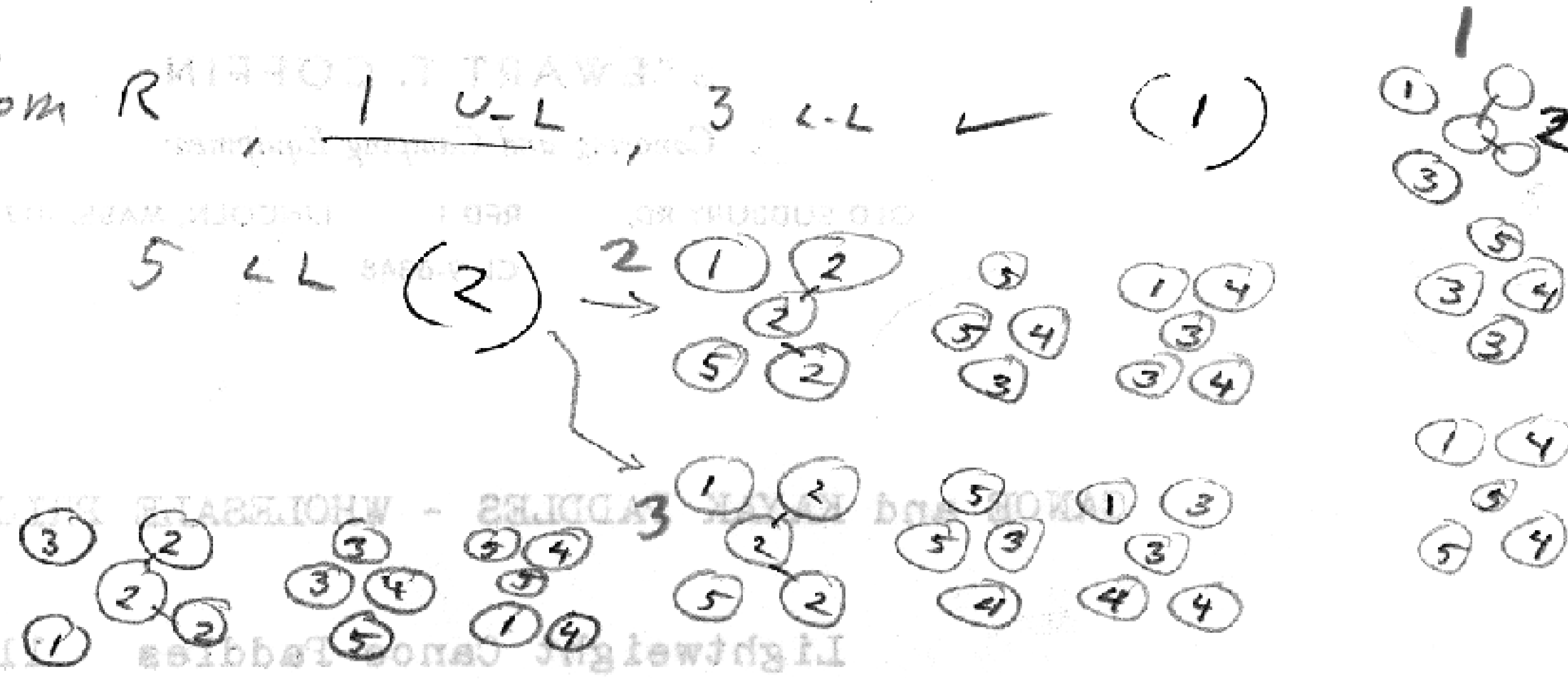
5 LR X

2 in 2nd Layer X

P-0

1. pc 2 on bottom R, 1 U-L, 3 L-L ✓ (1)

4 LL X 5 LL (2)



3 ~~2~~ U-L sym

~~4~~ LL (1)

4 LL X

5 LL X

3 U-L across back

1 LL X

4 LL X

5 LL X

3 U-L across L

1 LL X

4 LL X

5 LL X

4 U-L across back + up

1 - LL X

3 - LL X

5 - LL X

4 U-L across L + up

1 - LL X

3 - LL X

5 LL X

4 on bottom X

5 U-L across back

1 LL X

3 LL X

4 LL

5 U-L across L

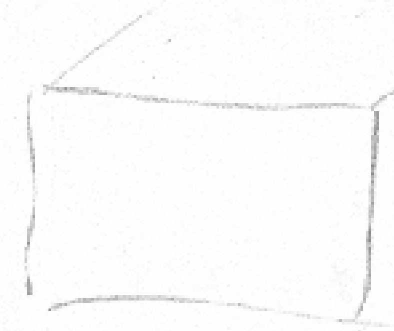
1 LL 2 (see above)

(2) (3)

March - Susan

15% for 1 year

size for $1\frac{1}{2}$" ~~[illegible]~~ stock



3" high

$3\frac{3}{4}$" sq.

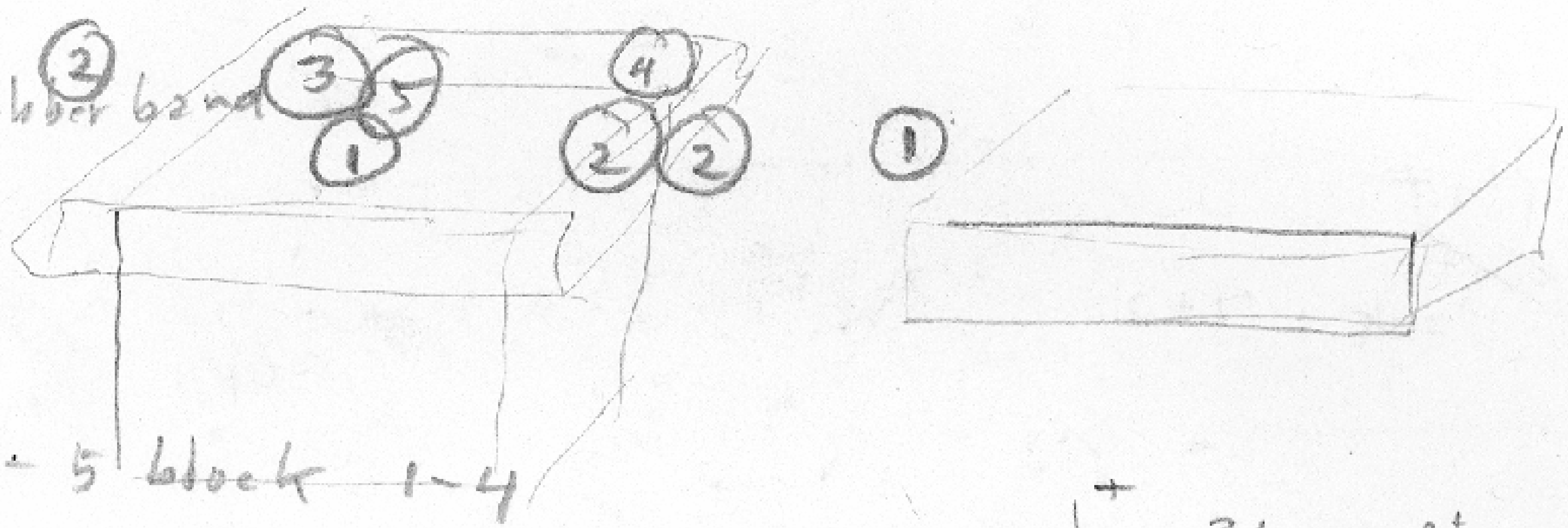
(8)(9) (6)   (9) (8)(7)   (6)   (2)(7) (8)   (9) (6)(7)   (2)

requires rubber band

2nd sol. doesn't need rubber band

(3)(4) (5)   (4) (3)(5)

(2)   (3)(5) (1)   (4) (2)(2)   (1)



$4\frac{1}{2}$" sq. $+\frac{1}{8} = 4\frac{5}{8}$

propellor - 5 block 1-4

$4\frac{1}{2}^{+} - 3\frac{3}{4} = \frac{3}{4}^{+} \div 2 = \frac{3}{8}^{+}$

very flat square — 9 blocks — 7 6 8 / 7 8

Eiffl tower — 11 " — add pc. #2 on top of above

~~jack — 6 " — 6 + 7 (if will fit)~~ (over)

small rhombic pyr — 5 — 2 + 7

3 fold sym

tower 9 blocks ? — 9 / 9 (7) — (9) — 9 8 / (7) — 8 — 8

(2nd sol. with 6-8-9)

little tower 8 block — (9) / (9)(6) — (9) — (2)(8) / (6) — (2)

dome 11 block — (6) / (2)(7) — (7) — (9)(6) / (2) — (9) / (9)(7) — (6)

2nd sol. — (6) / (6)(2) — (8) — (6)(2) / (8) — (8) / (9)(9) — (9)

3rd sol.

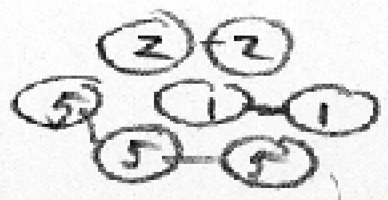
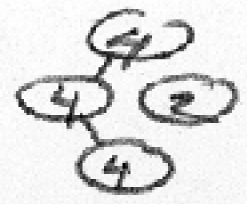
(9)

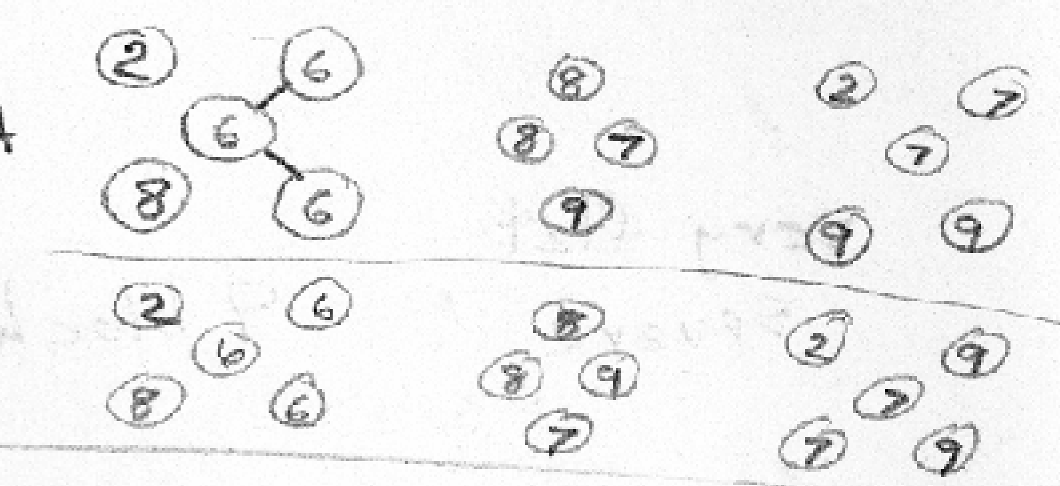
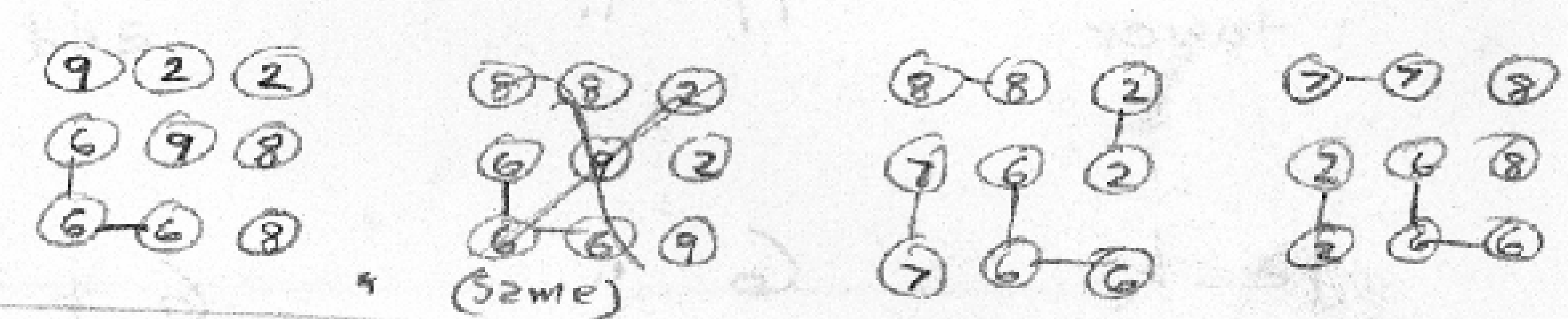
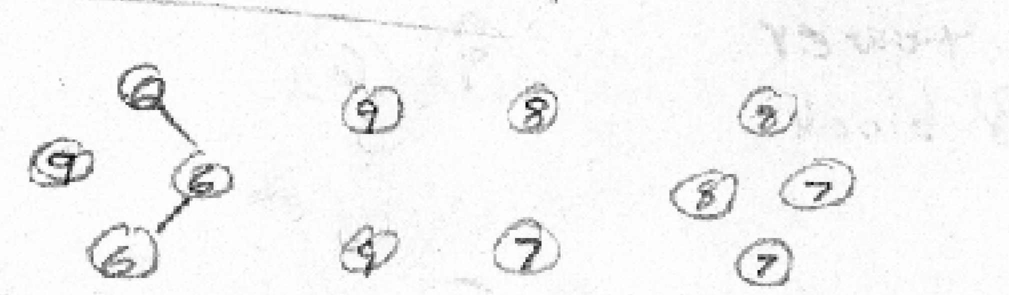
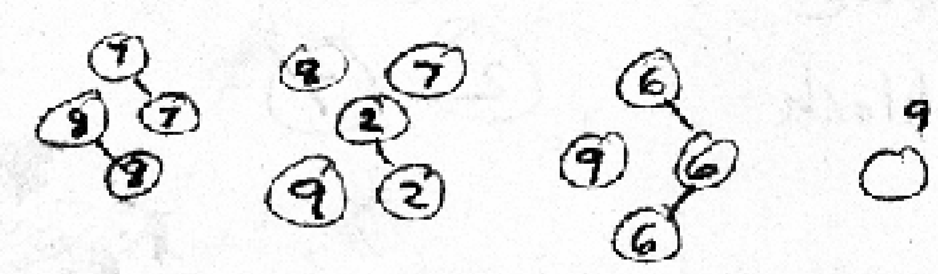
(9) (7) (9)

(6) (2) (7)

(7)

(6) (2) (6)

Budah or table   pc 3 on top or bottom

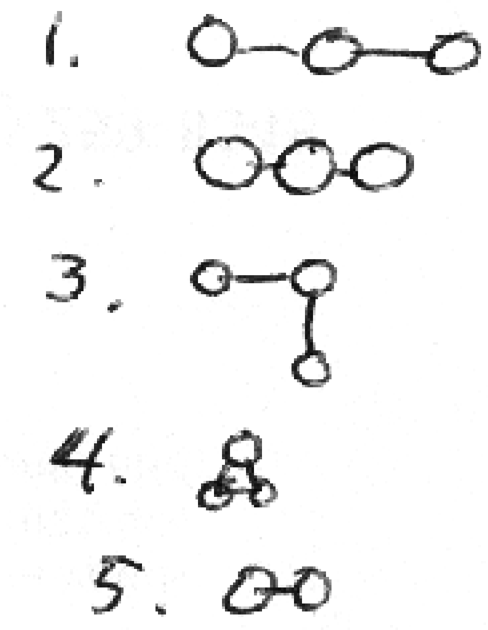
size	desc.	system	sol.
5	sq. pyr	4+1	2-7, ~~3-6~~
5	rect. pyr.	3+2	2-7, 2-6, ~~3-9~~, ~~3-7~~
6	flat ~~flat~~ jack	4+2	~~2-2-2~~, 2-~~3-3~~, 6-7 if fit ~~7-7~~, ~~9-9~~
14	flat cube	10+4	2-6-7-8-9 A 
14	sq. pyr.	10+4	2-6-7-8-9 
14	rhombic ~~rect.~~ pyr.	8+6	probably impossible (confirmed by Van der Poel)
14	hollow cube-oct	8+6	impossible (proven)
12	Hollow flat cube	8+4	6-7-8-9 
14	dome or ~~tower~~	8+6	add 2 to above or 

(more over)

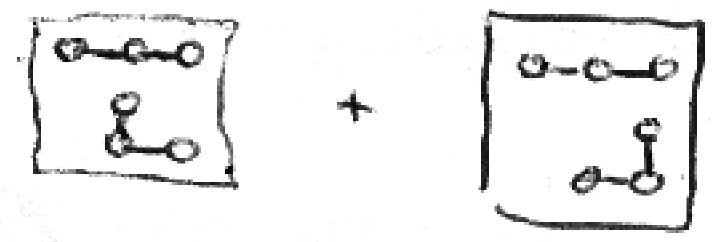
<u>TRUNCATED OCTAHEDRA</u>

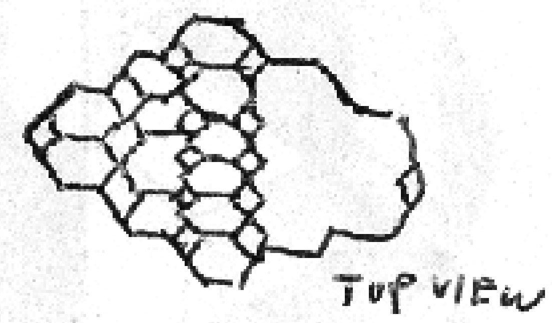
Problems for the <u>Curse of Kirsch</u> Puzzle

#28



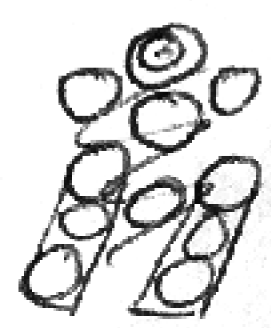
1. Rect. box – one sol. only

2. (14 block) Sq. pyr – 2 sol. only 

3. Rhomb. pyr. – 6 sol. 

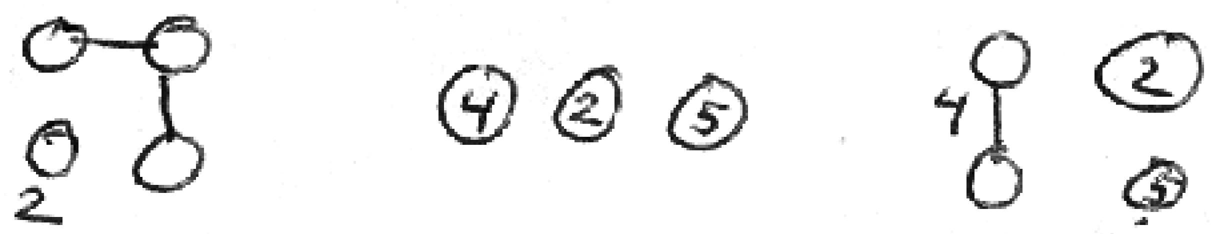
4. 5 block sq. pyr – one sol

5. 6 block jack – one sol. (if can make fit)

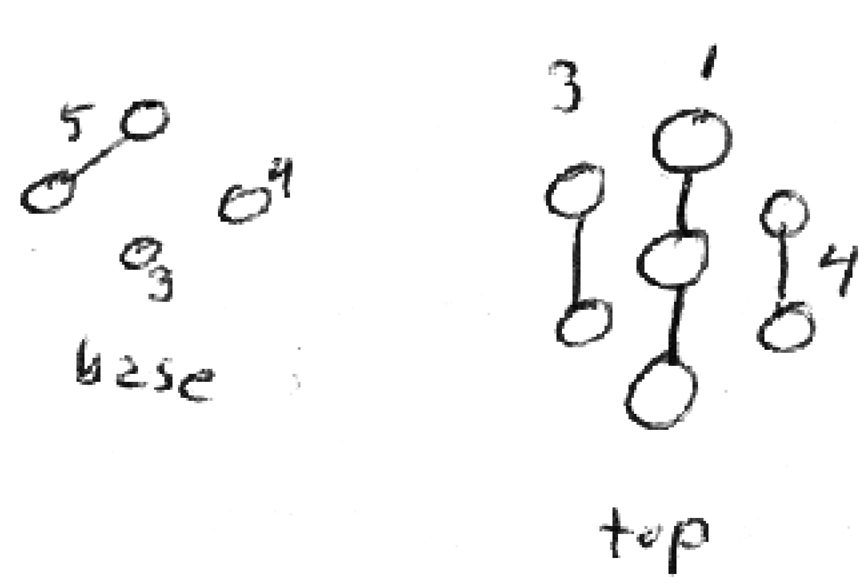
6. Hex tower on 3 legs stands up ok 

pc#2 vertical for one leg.
" #5 " " second "
" #1 base of 3rd leg, + thru ctr,

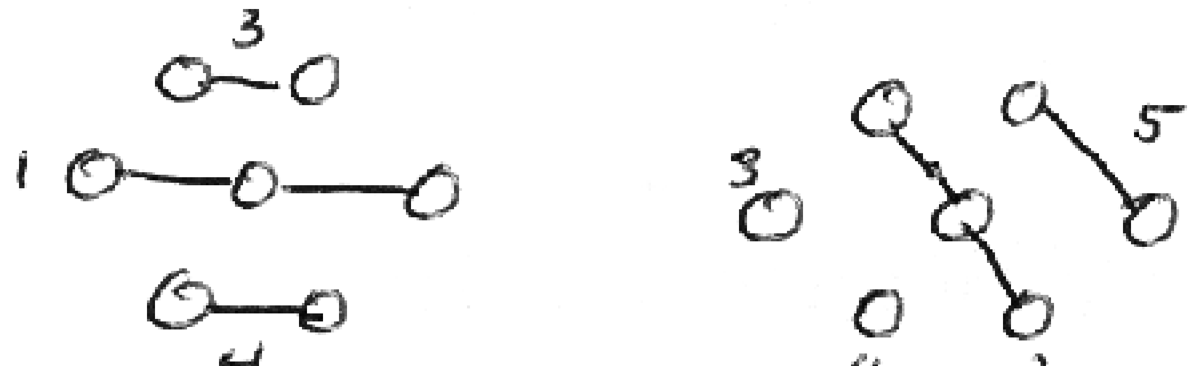
7. Tree = 5 block sq pyr (#4) on top of pc # 1

8. 11 block football 

9. will balance on pc # 1 to make tree, other way up makes tower, etc.

10. Hexagonal table (11 block) 

11. Slanting hexagonal prism



#28
(#43 in old list)

STEWART T. COFFIN

Puzzles

OLD SUDBURY RD. RFD 1 LINCOLN, MASS. 01773

TO BE REVISED

Feb. 4, 1975

Description of Puzzle No. ~~43~~. ULTRAMID

Puzzle No. 43, ULTRAMID, consists of five pieces, a rectangular box, and instruction sheet. The pieces are formed of 14 identical blocks joined together in different ways. Each block is a truncated octahedron, having six square faces and eight regular-hexagon faces.

Piece #1 has three blocks joined by their square faces in a straight line.
Piece #2 has three blocks joined by their hexagonal faces in a straight line.
Piece #3 has three blocks joined by their square faces at a 90 degree angle.
Piece #4 has three blocks joined in triangular configuration so that each block is joined face-to-face with the other two.
Piece #5 has two blocks joined by their hexagonal faces.

The object of the puzzle is to assemble the pieces to form different geometric shapes, as illustrated on the instruction sheet. The three primary problem shapes are (1) a rectangular assembly which just fits inside the box, (2) a square pyramid, and (3) a pyramid having a rhombic base. (These are not perfect pyramids in the geometric sense, of course, since the faces are not plane surfaces.) According to my analysis, there are 6 distinct solutions for the rhombic pyramid (not counting rotations and reflections), 2 solutions for the square pyramid, and one solution to the box form. Other illustrated problems might be included as well.

This puzzle might be enhanced by having a cover for the box which would also serve as a base for the square pyramid. With suitable design, it might even be a base for the rhombic pyramid as well, since they both have the same width, however this might be too complicated.

The piece could be made of wood, or cast, or molded of some material. The mold would not require side-action. The box might be of transparent plastic.

This puzzle design is quite similar to one shown to me by J. Kirsch of Cambridge a few years ago, and believed to have been invented by him. My contributions are the following: (1) Design change - his puzzle had six pieces; my Piece #3 is two of his pieces joined together. This makes the puzzle assemblies more stable, and the solutions somewhat fewer and more difficult, (2) Discovery of rectangular solution. (3) Analysis of all solutions. (4) Additions of box to contain puzzle, and cover of box to serve as base for pyramid. (5) Printed instruction sheet. I did all of these during the month of January, 1975, except that the instruction sheet is not yet completed. When it is, it is to be attached as part of this description.

Stewart T. Coffin
Feb. 4, 1975

[#43C] #28-X

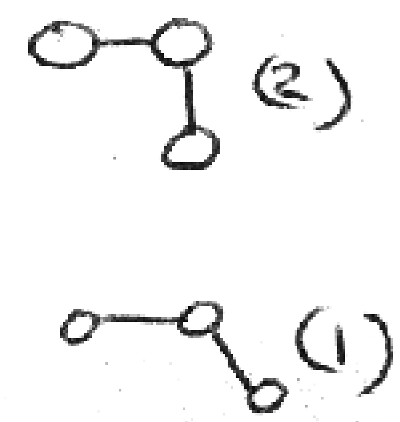
STEWART T. COFFIN

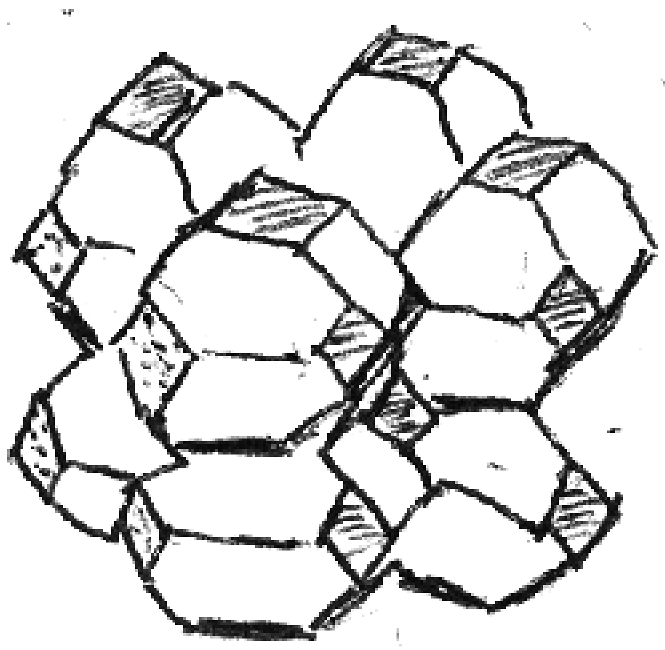
OLD SUDBURY RD. RFD I LINCOLN, MASS. 01773

259-8348

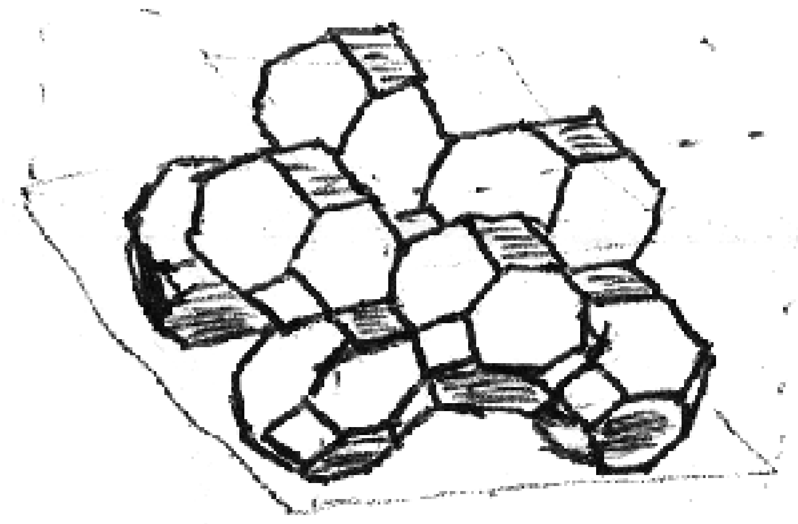
Nov 26, 1979

Some figure possible with 3-pc TRU-OCT puzzle:

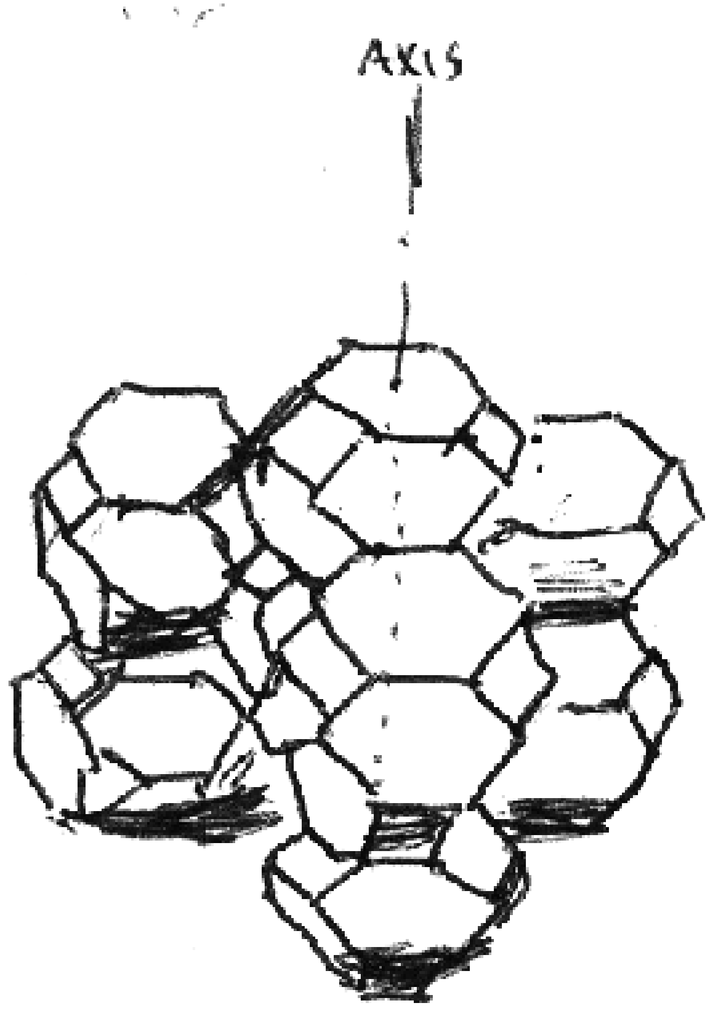




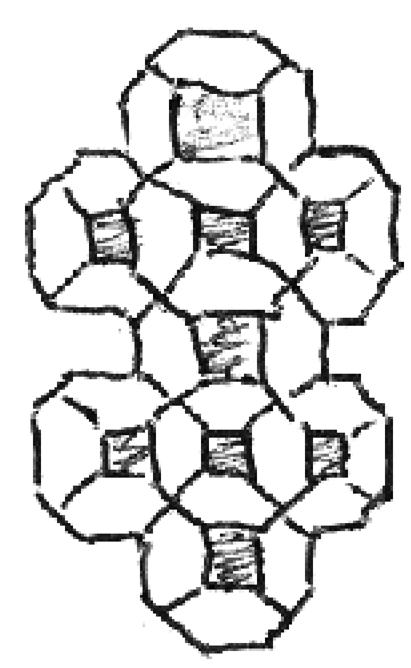
~~SQUAR~~ CUBIC CLUSTER



SQUARE PILE



TRIANGULAR TOWER



CROSSES

Plus many others

CHRONOLOGICAL ORDER CONVOLUTION

BILL CUTLER PUZZLES

1020 Augusta Ave • 715/845-7054 • Wausau, WI 54401

(August ?, 198)

#30

Stewart –

Regarding 'Convolution'

(4x4x4 disrection) –

if my arithmetic is correct

(trigonometry mainly), you + I

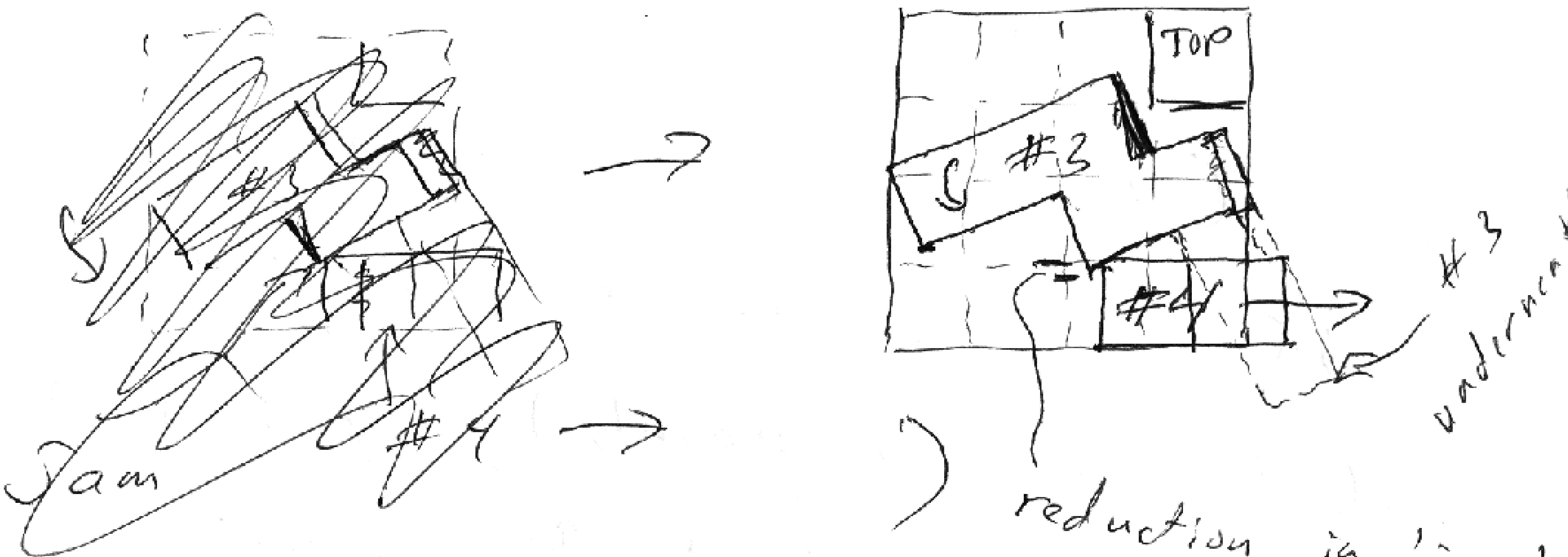
were ~~are~~ each about 2/3 right:

~~It~~ On the 3rd piece out – moving down 1 unit and then twisting alone is "impossible" for removal of piece (actually, in theory, cannot twist at all, though worst jam at about 25°, with about 1/10 unit distance too much). (Your guess)

However, ~~piece~~ if piece #3 is moved 1 unit down ~~out~~ ~~before~~ ~~(as is necessary)~~ ~~twisting?)~~ and then #4 is moved

(OVER)

(right)
linearly ^ at same time as #3 is
twisted (View at ~ 2[illegible]° :



) reduction in jam!

the jam is reduced (in
theory about 50%, in actuality
makes the jam unnoticeable
because of ~~[illegible]~~ rounding at
edges
~~corners~~)

So puzzle is actually "impossible",
but I did notice move which
makes it "less" so, just didn't
make the move right when playing
with your model in Lincoln. (anyone with a computer program to find such ways of taking apart is ↑.)

(Hope someone understands all this!) STC

Convolution

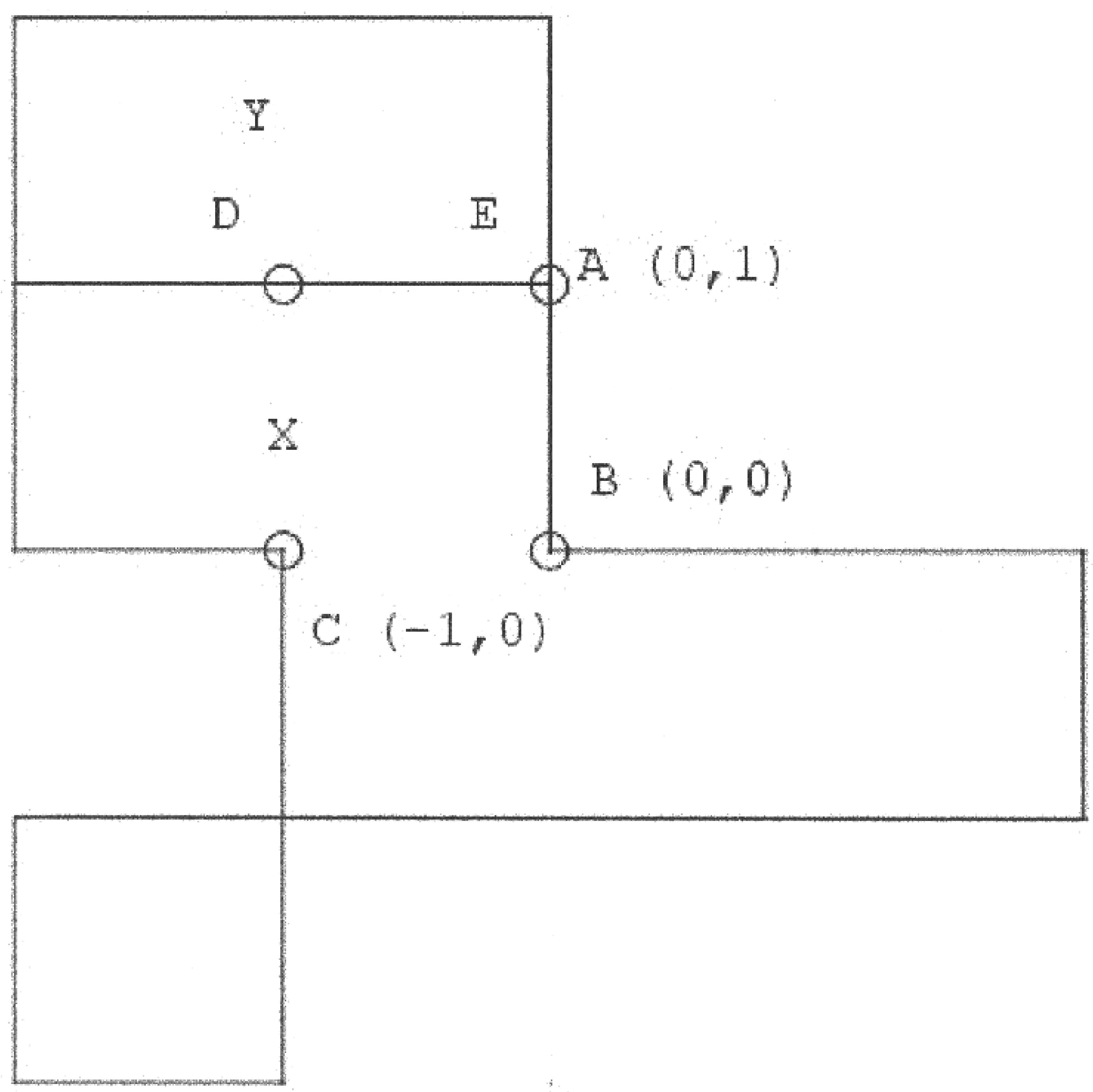
Stewart Coffin's Convolution is a dissection of a solid 4x4x4 cube into 7 pieces. In order to take the puzzle apart, at one point a twist move is required. The move is not 'fully-legal'. If the pieces are perfectly cut from a completely rigid material, with no extra space between the pieces, then the move cannot be physically made.

There is an additional 'coordinate motion' move that can be made at the same time as the twist move. Although this reduces the amount of 'jam' in the twist move, it does not eliminate it, and so this move is also not fully-legal.

This paper gives the mathematical analysis of the movements.

Simple Twist

Figure 1 shows the top level after the first two pieces have been removed. Piece X has been shifted up one unit, and now must be twisted counterclockwise about 45 degrees, after which it can be removed upward. (This paper does not include the complete design for Convolution – in order to fully understand the paper, one must have a model of Convolution available, or else must have additional information about the complete puzzle.)



30

Figure 1

Points A, B, and C are points on piece X. Points D and E are on piece Y.

The twisting of piece X is done as follows:

1) Point A is moved to the left, remaining tangent to the lower horizontal line of piece Y.
2) The line from A to B, when extended, will continue to pass through the original position of point B.

Figure 2 shows the position of piece X at a rotation angle of about 30 degrees. Points A', B' and C' are the new locations of points A, B and C. The 'jam' occurs at the new location of C – when this point is to the right of the original location of C, there is a jam on the next lower level of cubes.

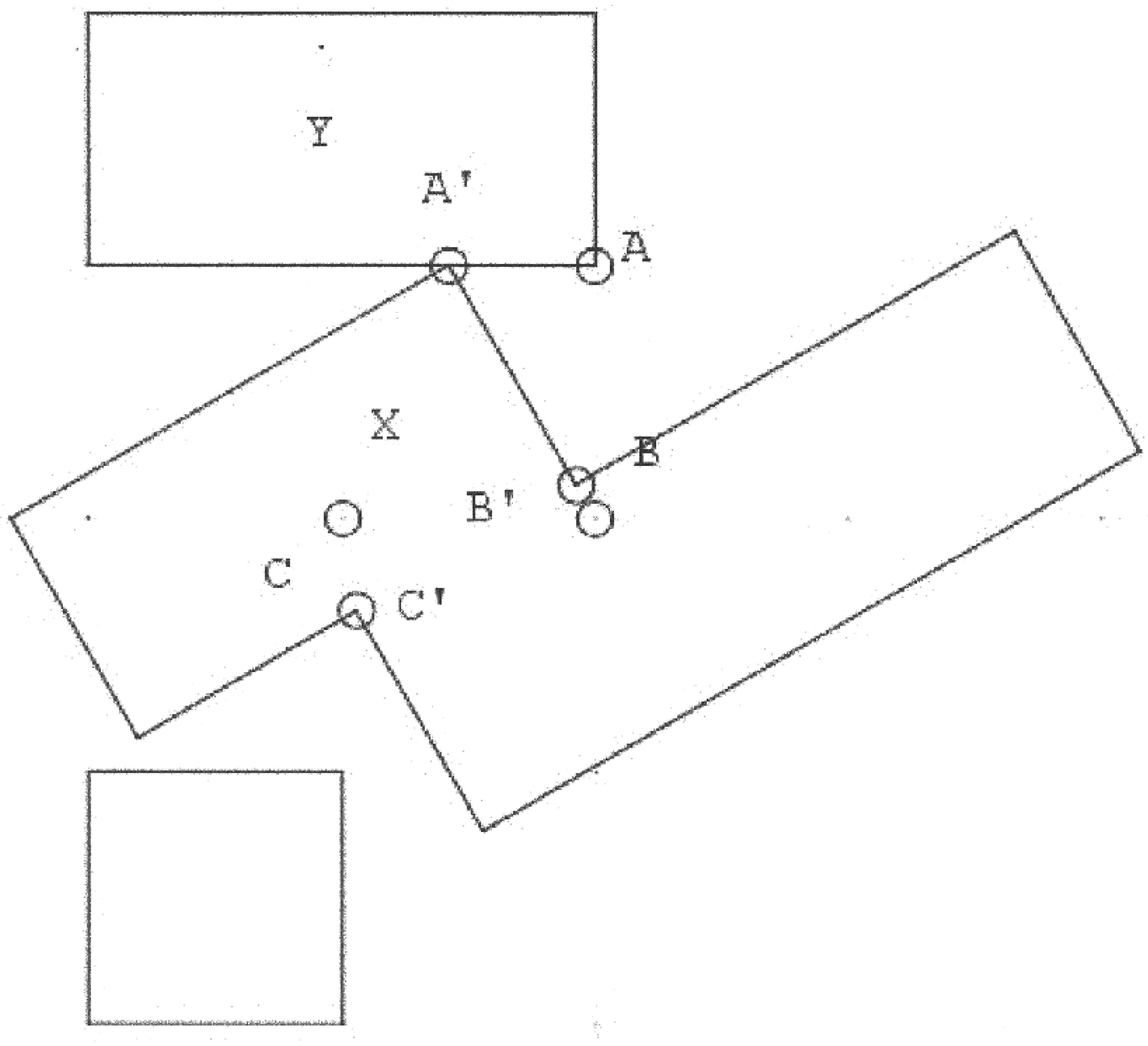


Figure 2

Mathmatical analysis of simple twist:

Let t be the distance that point A has been moved to the left. The unit size is the length of a small cube.

Coordinates of A' : (-t,1)

Let Theta be the rotation angle:

Theta = arctan (t)

The x-coordinate of C' is given by:

Cx = -t – sqrt(2) (sin (45 degrees – Theta))

= -t + (t-1) / sqrt(1+t^2)

The 'jam' is given by:

jam = 1 + Cx

At Theta = 0 or 45 degrees, Cx = -1. For Theta between 0 and 45 degrees, Cx is greater then -1. The maximum 'jam' is at:

t ~= .61 ; jam ~= .057

Twist Plus Coordinate Motion

Figure 3 shows the twist move plus the addition of a linear move of piece Y to the left. The movement of Y is restricted by cubes attached to pieces X and Y on the second level of the cube. This is illustrated by a line extended vertically (in the original orientation of X) from point C. This line must intersect the lower horizontal edge of piece Y at its midpoint (D) or to the left of D.

The motion of the pieces is described as follows:

1) Piece Y is moved to the left
2) Piece X is twisted counterclockwise, keeping the following constraints in place:
    a. The line from A' to B', when extended, will continue to pass through the original position of point B.
    b. The line from C' perpendicular to the line from C' to B' passes through D' (piece Y).
    c. Point E' (piece Y) is tangent to the upper edge of piece X.

The addition of the coordinate motion allows piece X to move slightly upward and to the left, which reduces, but does not eliminate, the amount of jam at point C'.

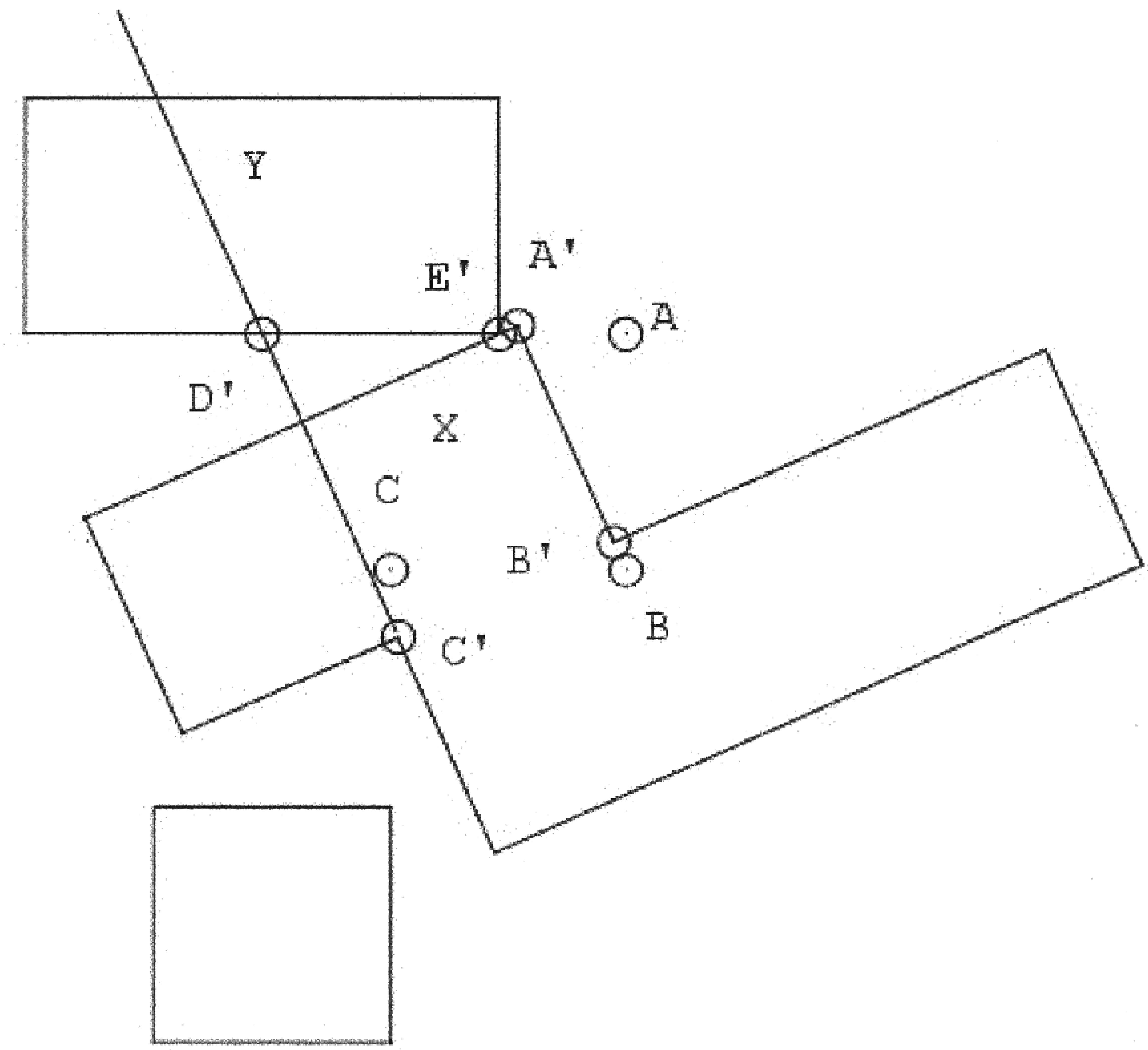


Figure 3

Mathematical analysis of twist with coordinate motion

Let t be the amount that piece Y is moved to the left.

The angle of rotation of piece X is now given by:

tan (Theta) + secant (Theta) = 1 + t

This reduces to:

Theta = arccos ((2 + 2 t) / (2 + 2 t + t^2))

The x-coordinate of E' is given by:

Ex = -t

The horizontal distance from E' to the intersection of the A'B' line with the D'E' line is given by:

s = t – tan (Theta)

The x-coordinate of A' is given by

$$Ax = Ex + s \ (\cos(\Theta))^2$$

The x-coordinate of C' is given by

$$Cx = Ax - \sqrt{2}\ (\sin(45\text{ degrees} - \Theta))$$

The maximum jam occurs at:

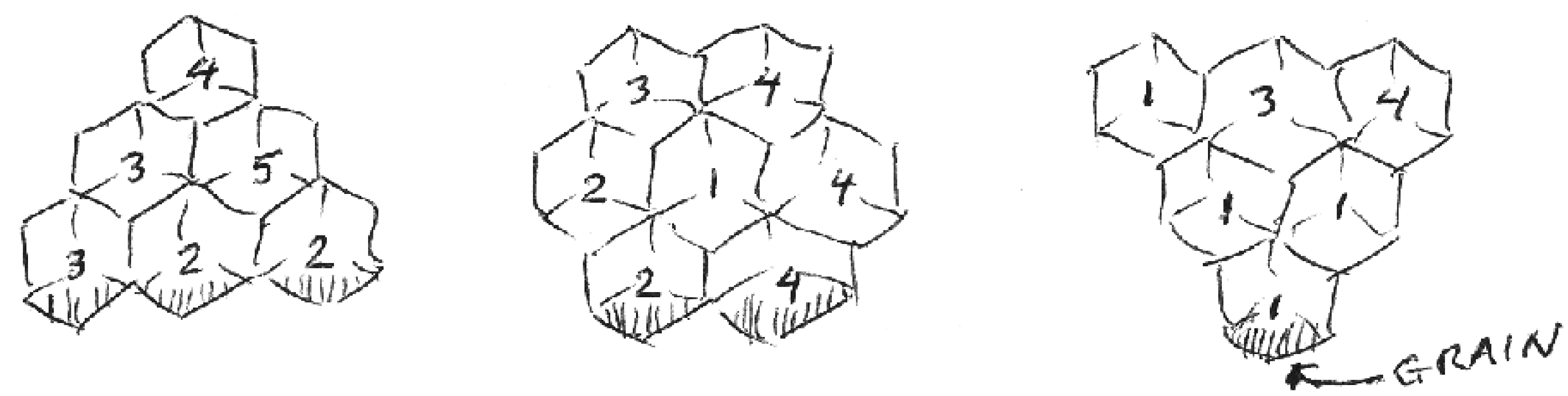
T ~= .51 ; Theta ~= 23.3 degrees ; jam ~= .033

31-A

Variation of Octahedral Cluster

designed Feb, 1980

see page 120 of comp. book



Top layer — middle layer — bottom layer

5 dissimilar pieces, serially interlocking

pieces 3 and 5 are symmetrical

Key piece 5 has silicone rubber bumpers on opposite faces

presumably only one made, in 1¼" limba, and sold to N. Starr. Returned May 1994 for repairs and then assigned # 31-A

Made 3 more in 1994

Made 3 in Jan 1997 in multi-woods, one-inch 61-A type blocks

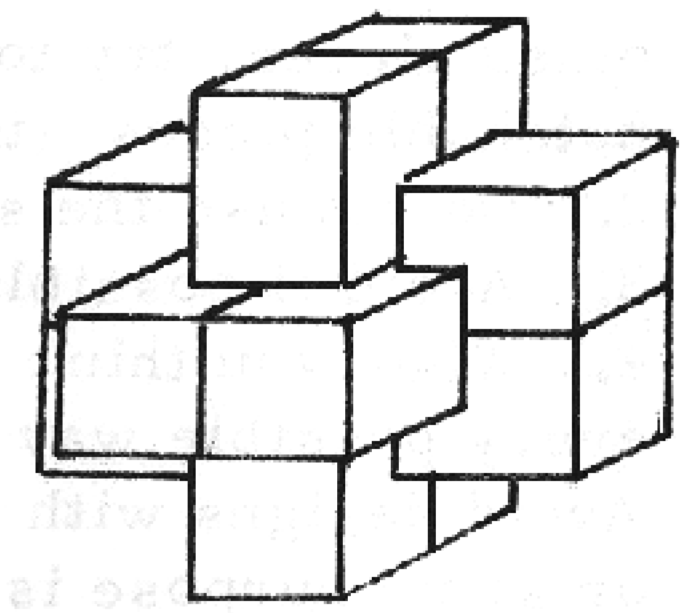
woods:
1 - cherry
2 - almond
3. ash
4. afzelia
5. oak

Next time, make accurate jig starting with a 3x3 square layer. 

In Jan 1997, spent hours looking for improved version, but did not find one.

#35 + #36

Instructions for the SIX-PIECE BURR PUZZLE, including Burr #305, Coffin's Improved Burr, and the Set of 25 Notchable Pieces



It seems reasonable to assume that most persons are already familiar with the basic six-piece burr puzzle, which over the years has probably enjoyed the greatest all-time popularity of any three-dimensional puzzle. A section in my Puzzle Craft II (1981) is devoted to it. For further reading, I recommend "The Six-Piece Burr" by William H. Cutler, which appeared in the "Journal of Recreational Mathematics, Vol. 10(4)," and is summarized in "Scientific American" Jan. 1978.

To summarize briefly, the six-piece burr consists of three pairs of symmetrically and orthogonally arranged mutually intersecting notched square sticks. All notches are made within the regions of intersection by removing descrete cubic units which measure one-half the width of the sticks. If one limits the notchings to those which can be made with simple saw cuts, without the necessity of carving out blind corners and edges, there are said to be 59 possible pieces. If one furthermore limits the design to only those which can be assembled solid, without internal voids, there are only 25 usable pieces, and these are known as the set of 25 Notchable Pieces. These may be assembled 314 different ways if duplicates and triplicates of certain pieces are available, and if the same set of pieces assembled a different way is counted as a different combination. (In order to assemble all 314 combinations, duplicates are required of pieces 4, 5, 6, 9, 10, 12, 14, 15, 16, 17, 19, 22, 23, and triplicates are required of pieces 2 and 3, for a total of 42 pieces.)

From among these 314 combinations, I have chosen one - Burr #305 - for inclusion in my 1981 catalog. Why was it chosen? To begin with, if we eliminate from this list those combinations which use symmetrical pieces (1, 2, 8, 9, 18), those which contain multiple pieces alike, and those in which the same set of pieces can be assembled more than one way, we are left with only 18 combinations. But 16 of these involve the rather common and uninteresting 4-12 or 3-10 two-piece "key." The two remaining are clearly more unusual and interesting, and since they are a reflexive pair, I arbitrarily chose the first in Cutler's listing - #305. It uses pieces 6, 12, 14, 21, 22, and 23.

Nearly everyone who has systematically investigated the six-piece burr has limited their investigations to solid assemblies. Combinations which have large amounts of hollow space tend to be easy and less interesting, with many possible solutions, and also tend to fall apart or rattle. However, there is a type of design which involves the shifting of pieces to assemble or disassemble, which in my opinion is clearly the most interesting type, and these necessarily must have at least one hollow space inside. The reason these have not been systematically studied yet is that it is exceedingly complicated to do so. Someday, someone will program a computer to do this.* In the meantime, I propose a contest to see who can come up with the cleverest design. After a few hours of tinkering, I have come up with <u>Coffin's Improved Burr</u>, which is included in my 1981 puzzle line. See if you can come up with a better one., and send me a sketch of it. From all those submitted, I will choose the best one and put it in next years catalog, with credit to the inventor. Rules (over):

* Note: Bill Cutler has now done this!

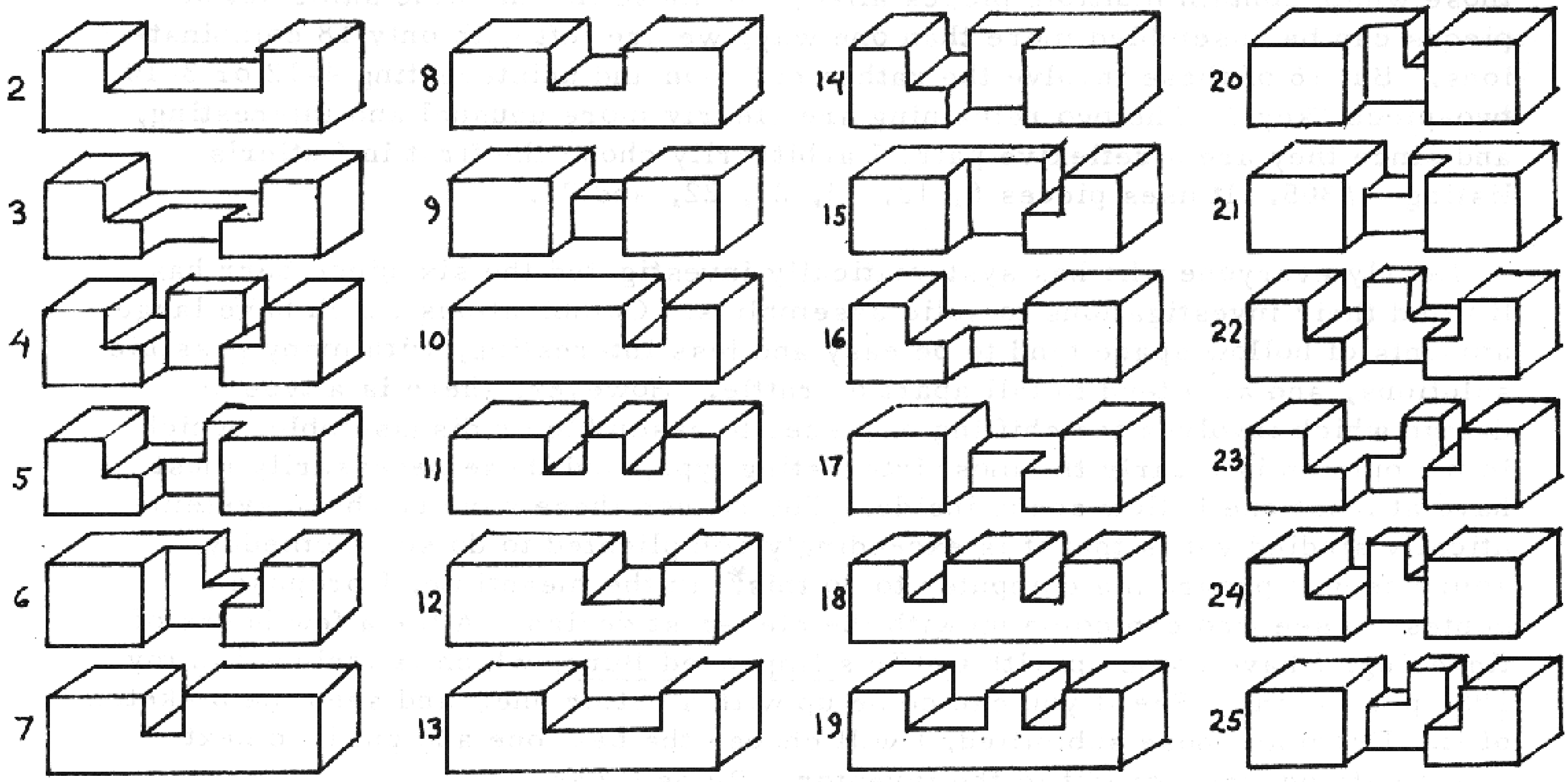
Rules and suggestions for designing better burrs:

1. Try to use the 25 notchable pieces in-so-far as possible. If you must use other pieces, try to use ones that are relatively easy to make by modifying notchable pieces (there are 369 possible pieces).
2. Do not use the same piece twice.
3. Avoid if possible using pieces having an axis of symmetry (1, 2, 8, 9, 18).
4. When you think you have discovered a clever design, systematically check every possible way to make sure it does not go together another easier way. Avoid designs with more than one solution unless all solutions are intriguing, or some purpose is served by having more than one.

Since it takes a skilled puzzler only a few minutes to solve most common burr puzzles, and only slightly longer to analyse them for all possible solutions, the object here is to design burrs which are clever, tricky, difficult, unusual, surprising, or amusing to assemble. Since all of the solid burrs - be they the 314 notchable ones or Cutler's 119,979 in the general category - come directly apart by sliding out the key piece (or pieces), I would think they would all have to be rejected as being too simple. The alternative is to design burrs with internal voids. A burr which meets all of the criteria above, and in which one piece slides one unit to release another piece, is rather easy to design, and would not be considered a serious submission. Much better would be one in which the second piece also slides to release the third (see my Sliding Burr designs, next page.) Avoid having too many voids, because as their number increases, so also does the liklihood of other easier solutions.

Note that with solid burrs, the length of the pieces is arbitrary, and has no bearing on the puzzle. With hollow burrs, this is not the case. The end sections of my present pieces are all 3/4-inch. If they were shortened to 1/2-inch, certain solutions would be possible which are impossible with the longer pieces.

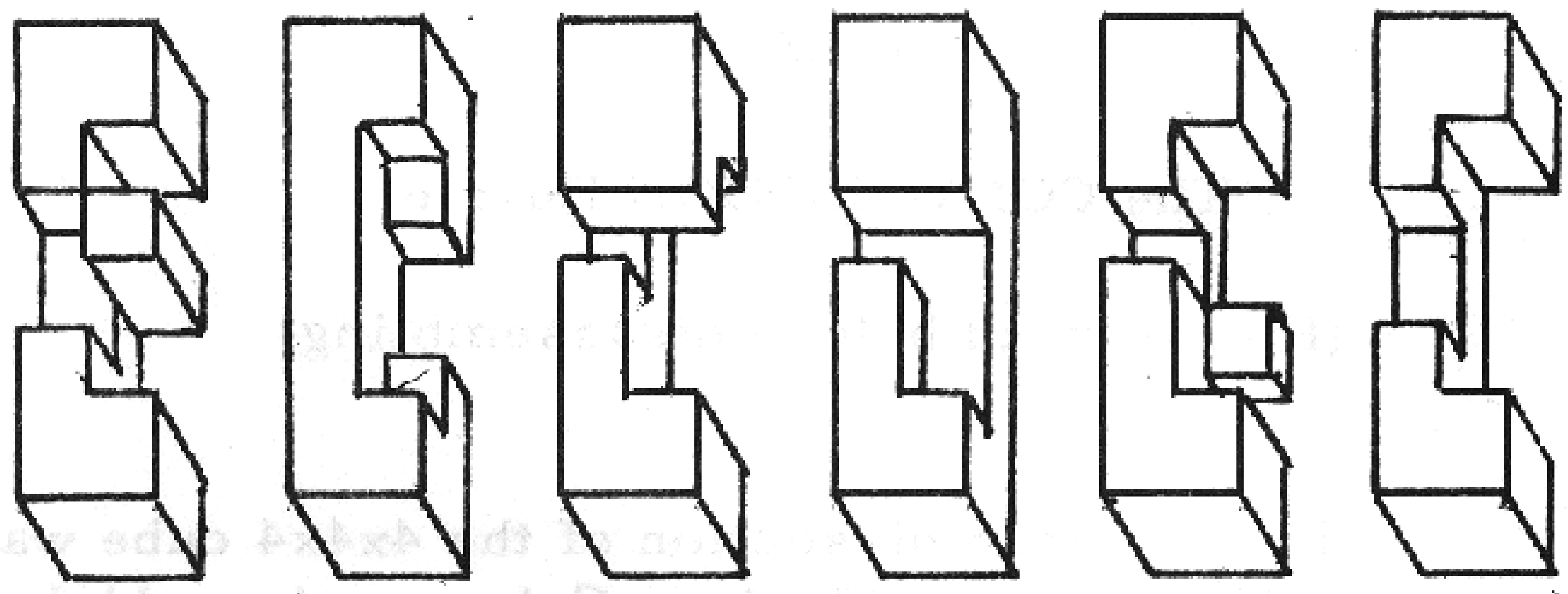
1 HAS NO NOTCHES



THE 25 NOTCHABLE PIECES

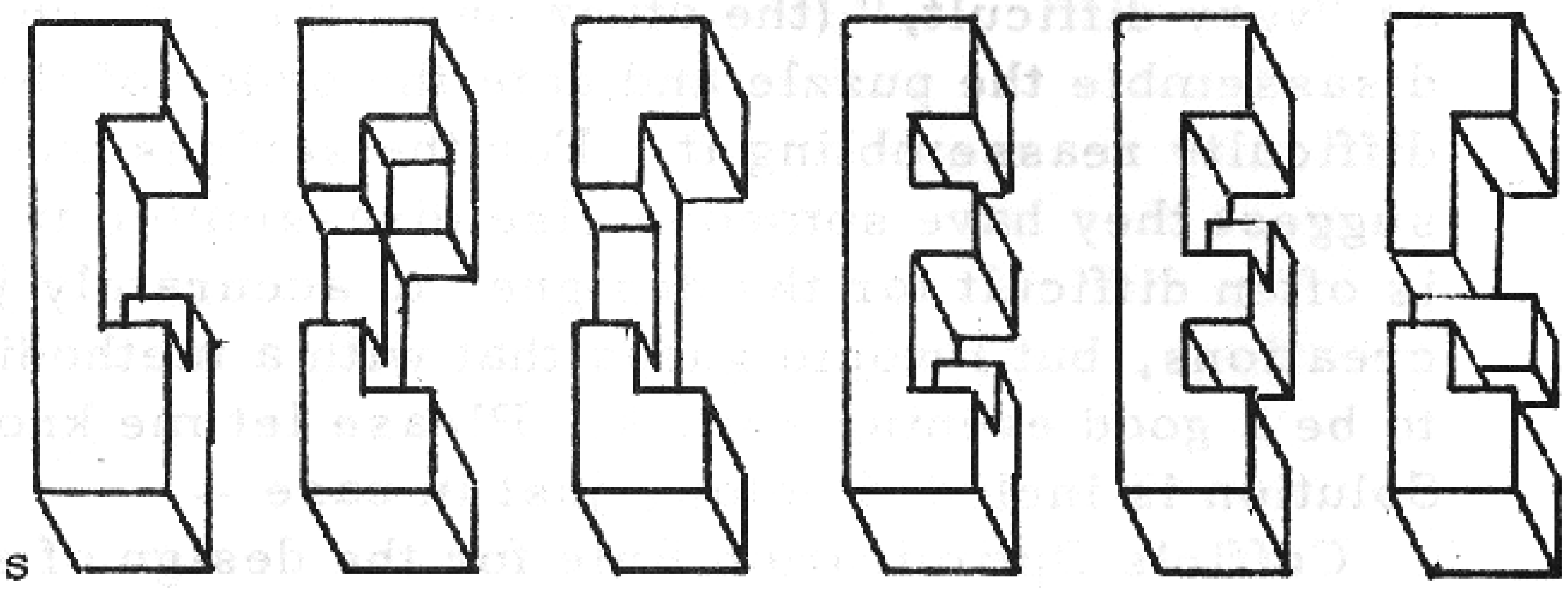
#40

Burr #1, Interrupted Slide



This is the first burr I designed. It has several interesting features. There are nine apparent solutions but only one way that it will go together, involving a complicated slide. If the end sections are shortened slightly to be one unit in length, there is a second solution which is quite perplexing, and totally unlike the first. Unfortunately, only one of the pieces is notchable, and it is fairly difficult to fabricate. There must be better ways of doing it.

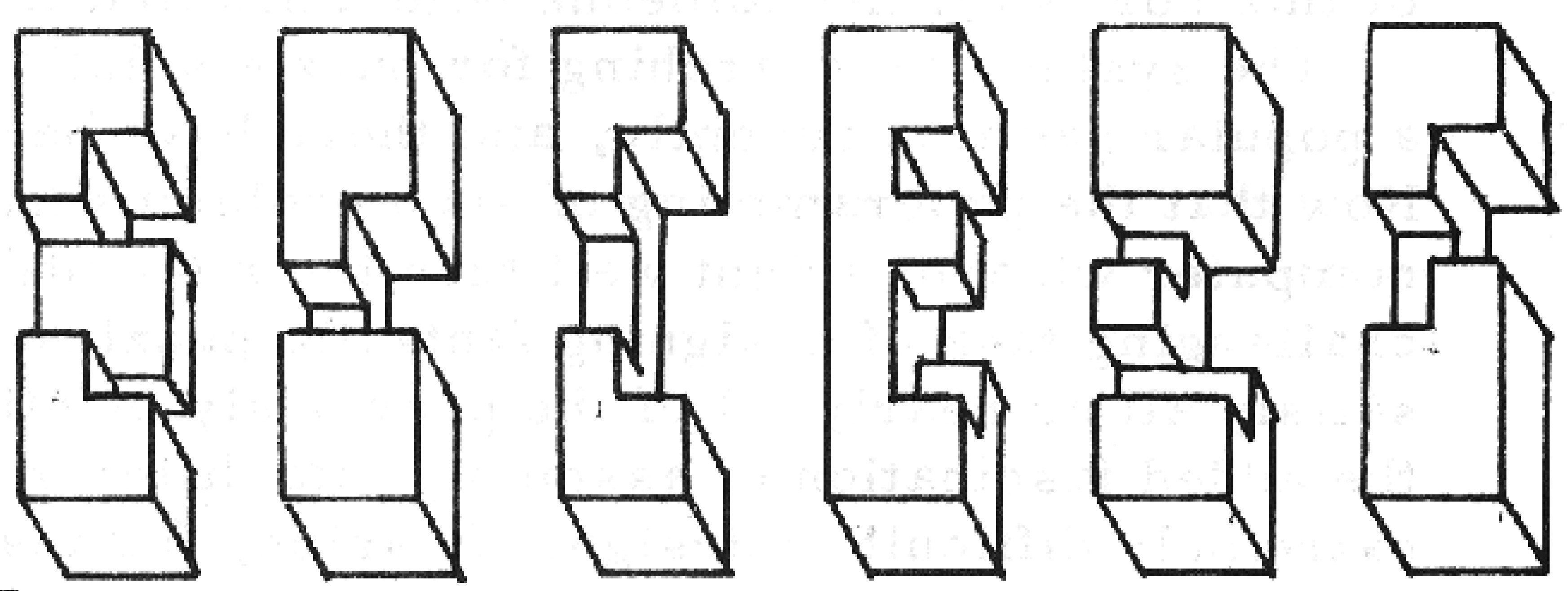
Burr #2, Triple Slide



This design has a most unusual sliding action to assemble. It has never been completely analysed, so other solutions may exist. Only two of the pieces are notchable. The piece on the right is an example of a piece which is notchable on a saw, but is not included in the set of 25 Notchable Pieces. A design which has the same sliding action, but with simpler pieces, would be a worthy contribution to the art of burr puzzle design.

36

Burr #3, Coffin's Improved



This is the one I have chosen for production in 1981. Two of the pieces are not notchable, but they are easily made from notchable ones by the addition of three cubic blocks glued on. For production, I find this easier and more precise than gouging out, but perhaps someone has a better way of doing it and could let me know. Incidentally, if you have my Set of 25 Notchable Pieces, you can make up a close approximation of this puzzle which behaves nearly the same way. This puzzle is probably less difficult than either of the two above. Surely someone can come up with an improved design for next year.

Stewart T. Coffin
79 Old Sudbury Road
Lincoln, MA 01773

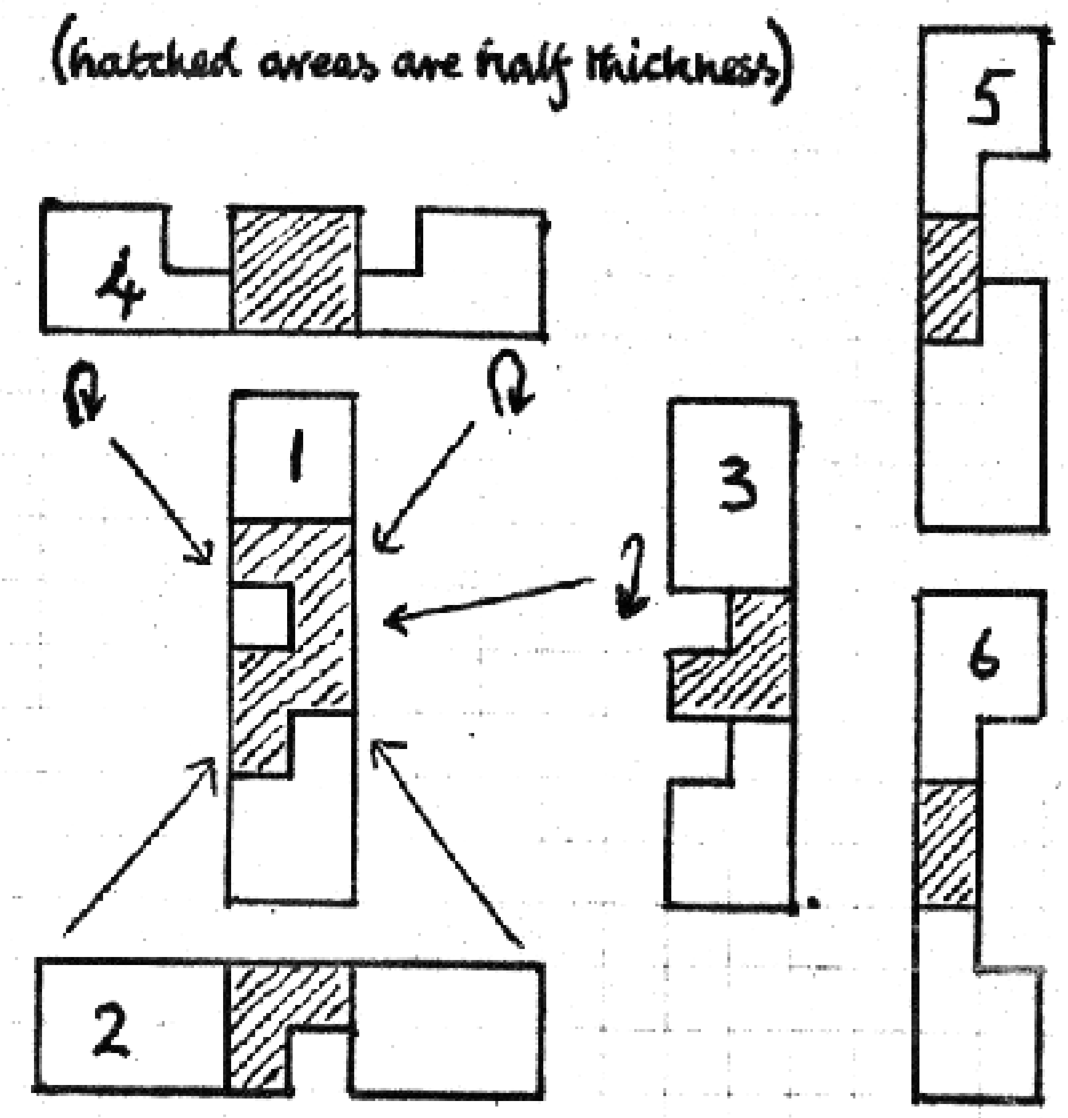
Jan 1981

From E. Hordern, July 1981 #36

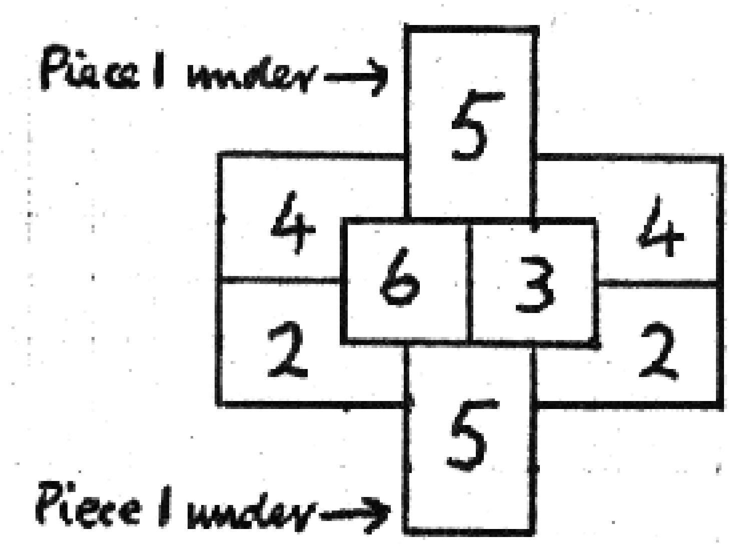
COFFIN'S IMROVED BURR – Instructions for assembly/disassembly.

PIECES

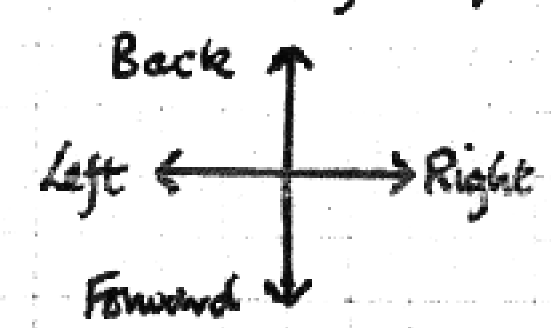
(hatched areas are half thickness)



PIECE POSITIONS (top view)



MOVEMENT OF PIECES (top view)



ORIENTATION OF PIECES DURING ASSEMBLY

Pieces 1, 2 are shown in their correct orientation as to be assembled
Pieces 3, 6 need to be tilted up towards you (back up to top)
Piece 4 needs to be rotated 180° (turned upside down)
Piece 5 is shown randomly, but its orientation will be obvious

ASSEMBLY

In order: 1 + 2 + 3 + 4
Slide 3, 4 right together
Place 5 (from top)
Slide 3, 4 left together
Slide 3, 4, 5 back together
Place 6 (from left)
Slide 3, 4, 5 forward together

DISASSEMBLY

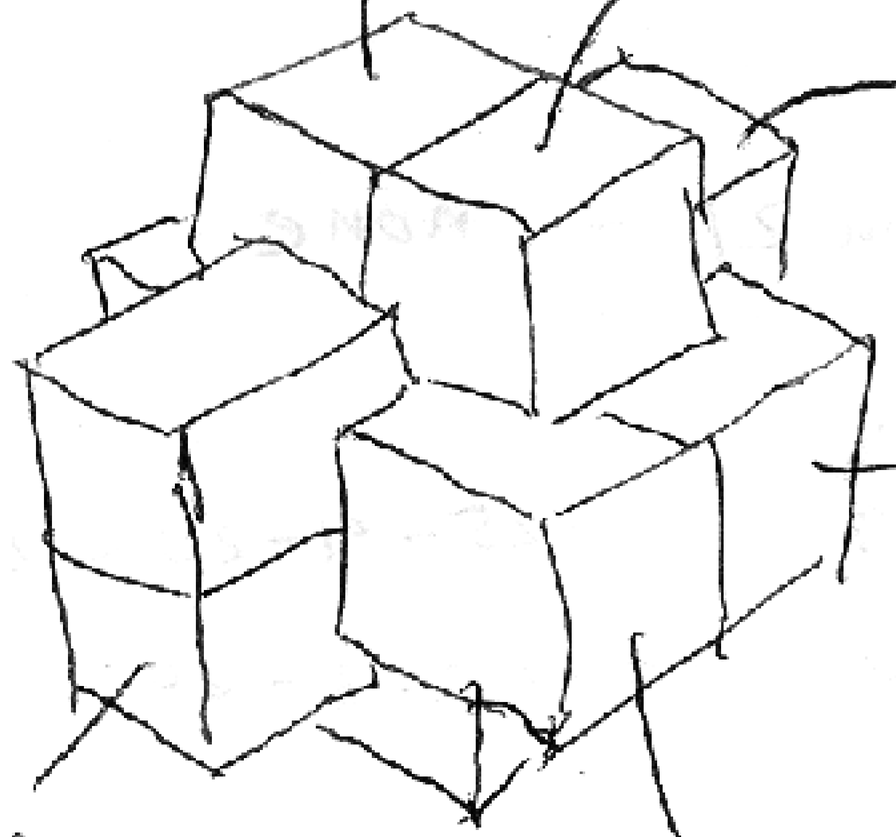
Slide 3, 4, 5, 6 back together
Remove 6 (forward then left)
Slide 3, 4, 5 forward together
Slide 3, 4 right together
Remove 5 (upwards)
Remove 1 (downwards)
2, 3, 4 will now fall apart

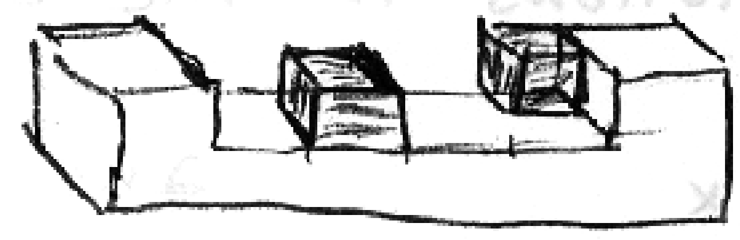
NOTE: Assembly and disassembly are not the reverse of each other. The easiest assembly and disassembly use slightly different methods.

~~#51B~~ #36
Coffin's Improved

Dec 6, 1980

5+ (see over)





1967 p253

Analysis

#21 totally ambiguous

2 L on bottom ~~3L on bottom~~	front	Left	right	back	top
	~~4 up~~	~~5 front~~			
	3 up	4 front	5 front 5 back 21 24		
		4 b			
		5 f 5 b 21 24f 24b			
	3 dx				
	4 u	~~3f~~			
	~~4d~~ ~~5u~~ ~~5d~~ ~~21~~ 24d				
2R	3! 4d 5d 21 24d				

only one, I guess?

#36

Solutions to the 6pc burr using non-sym notchable pc.

and 2-4 or 3-3 sol.

1 x
2 x
3
4
5
6
7
8 x
9 x
10
11
12
13
14
15
16
17
18 x
19
20 ⊗ Ambiguous
21 ⊗ Ambiguous
22
23
24
25

A. using both pc 20 and 21 — none

B. using pc 20
229: 12-25-4-20-22-5 (2.4) (12-4) slide
230: 10-25-3-20-22-5 (2.4) (10-3) "

#300 6-14-15-3-12-5 (3.3 - 3.1.2)

~~#165 12-15~~

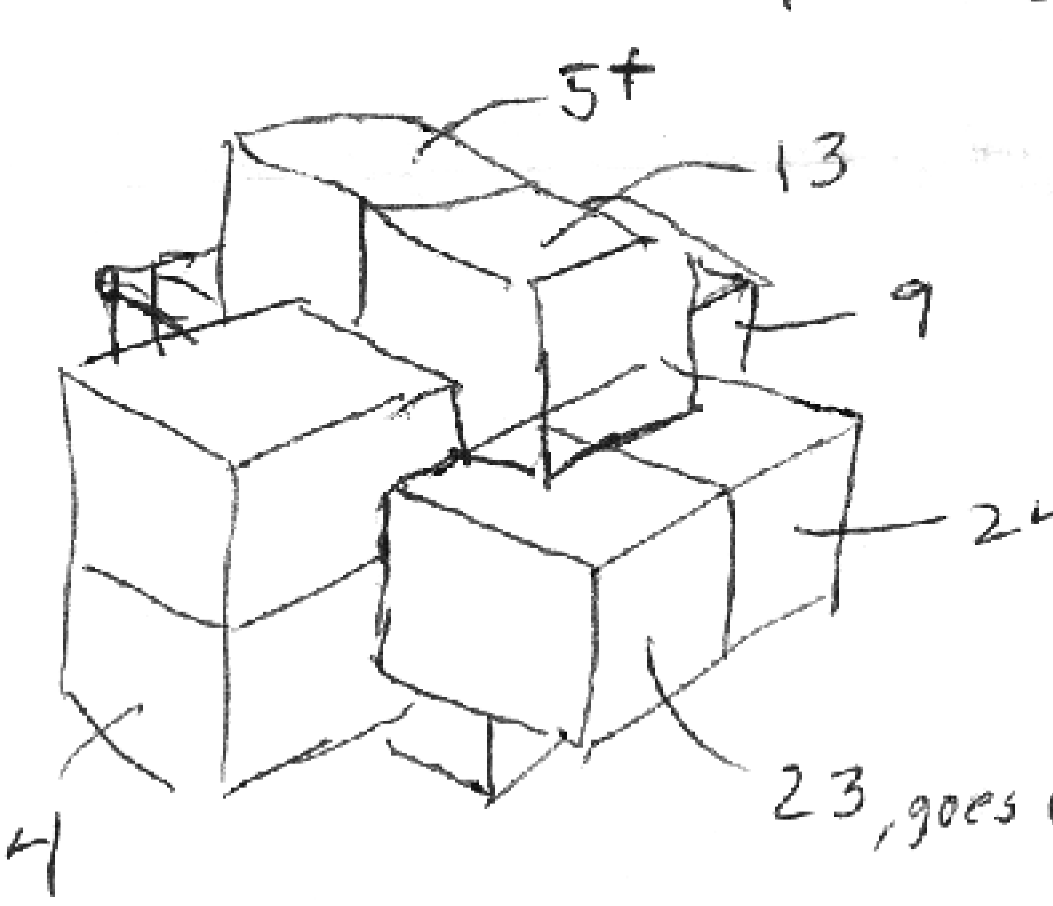
#163 12-~~15~~ 5 -~~5~~ 15 -14-6-3 (~~2.3~~)

~~coffin's favorite~~ ~~both halves totally interlocking~~

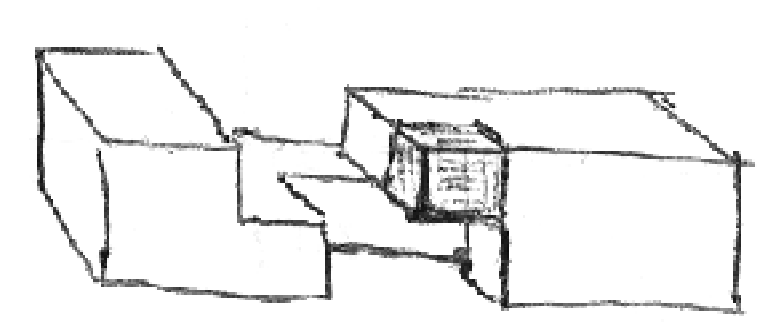
#305 12-14-23-21-6-22 (3.3)

favorite

New burr, designed Dec 6, 1980



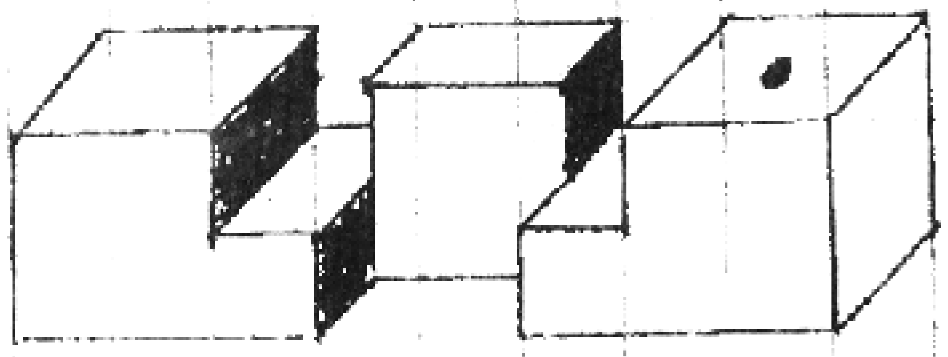
5+

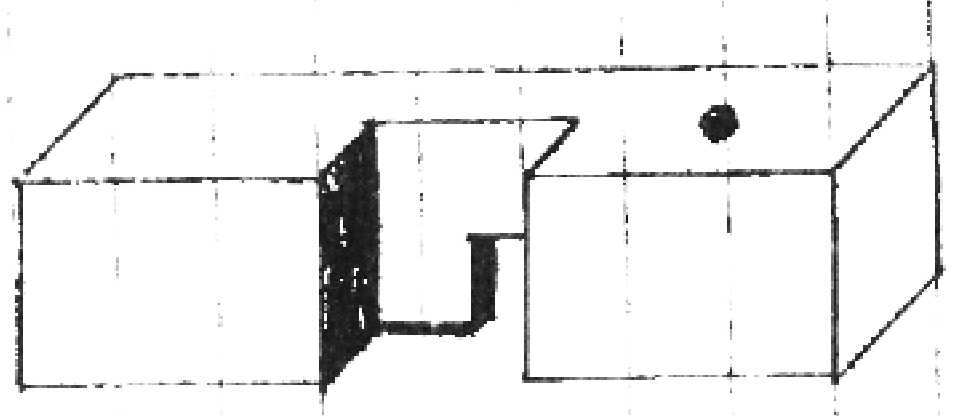


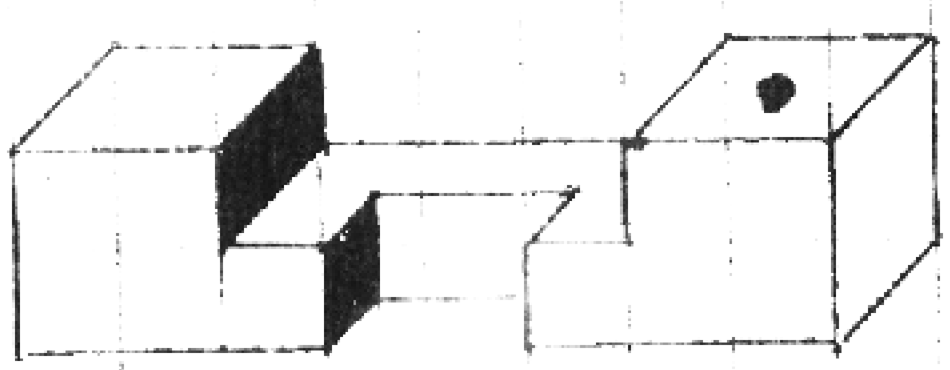
(improved design, over)

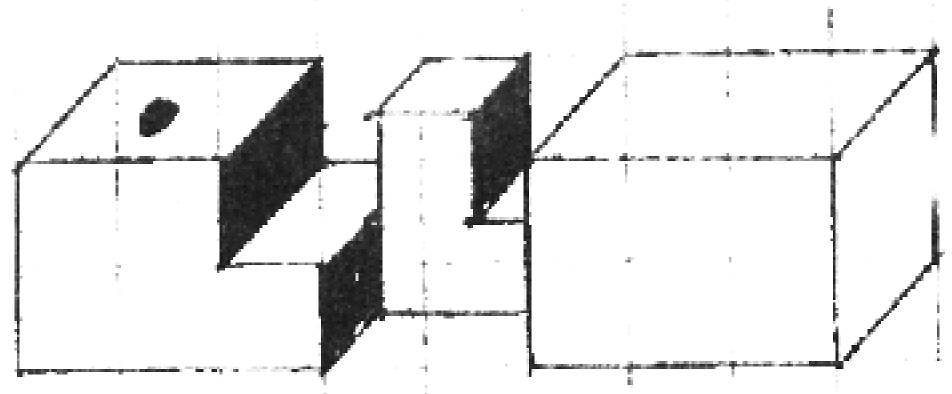
#36

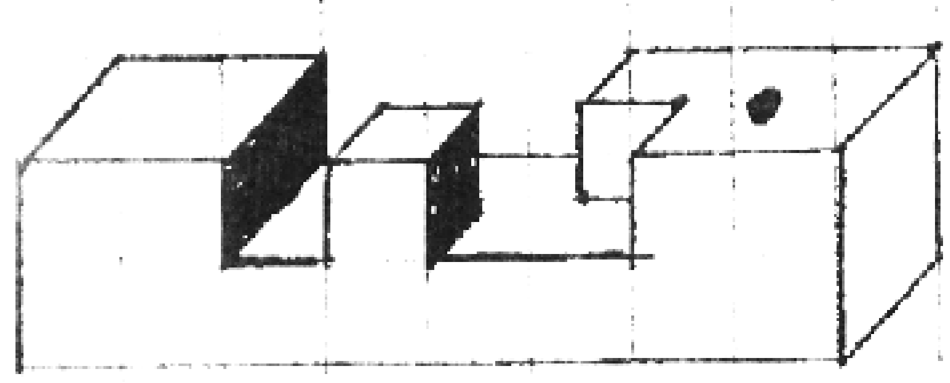
COFFINS "IMPROVED" SUPER BURR #I

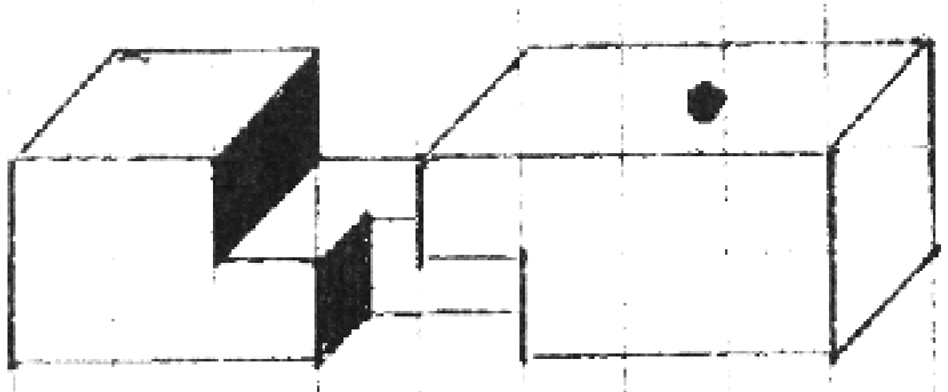
#1

V2

#2

K1

#3

Y3

#5

S1

#4

#271

#6


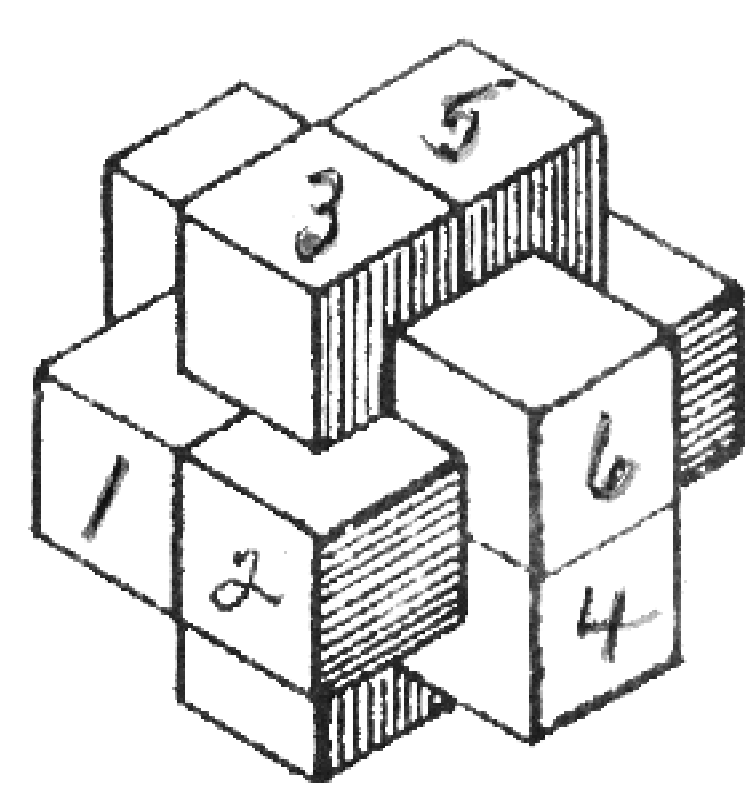
TO DISASSEMBLE:

1. ORIENT PUZZLE AS SHOWN BELOW
2. GRIP 4&6 & PULL THEM APART
3. SLIDE #3 OUT ALONG #2
4. PUSH 4&6 TOGETHER, GRIP 1&2 & PUSH THEM A APART
5. LIFT OUT #6
6. PUSH 1&2 TOGETHER & SLIDE OUT #1
7. REMOVE #5 BY SLIDING ALONG #2
8. LIFT #2 OUT OF #4

#36

TO ASSEMBLE:

1. HOLD #4 CUT SIDE UP
2. LAY #2 ON RIGHT ACROSS #4
3. SLIDE #5 ALONG #2 (CUT SIDE IN)
4. SLIDE #1 ALONG #4 (CUT SIDE DOWN)
5. MOVE #1 BACK 1 NOTCH & LAY #6 ON #4 & RETURN #1 IN PLACE
6. MOVE #4&6 APART & SLIDE #3 ALONG #2 THEN RETURN 4&6 TOGETHER



SIX-PIECE BURR

from Donald Knutson
17 Apr 1995

* PAIRS ARE: 1&2, 3&5, 4&6 (DOTS "TOUCH" ON PAIRS)

#37

OLD Star-of-David

Symmetrical solutions

Star

	CW	CCW	axial or diag.
1.	LA R'A SA	RA L'A MA	diag
2.	L'A RA SA	R'A LA MA	diag

SQUAT

	CW	CCW	axial or diag.
3.	RA R'A SB	LA L'A MB	axial
4.	R'A RA SB	L'A LA MB	axial

SPIRAL

	CW	CCW	axial or diag.
5.	LA L'A MB	RA R'A SB	axial
6.	L'A LA MB	R'A RA SB	axial
7.	RA L'A MA	LA R'A SA	diag
8.	R'A LA MA	L'A RA SA	diag

#37

Bilateral

9. LA R'A MB RA L'A SB

10. L'A RA MB R'A LA SB

+ from RA to LA
+ 1 ok
2 can't ass
3 can't ass
4 can't ass
(may be others)

+ LA to RA
1 ok
2 X
3 X
4 r

#37

move ① in sol. 1 from R to S
" 2 imposs.
3 non-sym
4 non-sym

Q from MB to SA ? 1, 2,
+ " RA+LA 1, ~~3~~

center blocks, mah. , under 1.000
Acor blocks, p-v. , over 1.000
ends , dark color

32-A
can't hook

sp	3A	3A	4B	4B	— X
	3B	4B	4A	3A	
	4B	4A	3A	3B	
	4A	3B	3B	4A	

Hook
3A + 4B
| A+
B+
(4A B−) (3A A−)

~~#61~~ #37-A

Improved STAR OF DAVID Puzzle, designed Dec 25, 1980

CW

LA LA' MA ~~non sym~~ bilateral

1.A LA LA' MB Δ RING (axial) or L'A LA MB (1B)

LA RA MA non sym

LA RA MB non sym

(same — Δ RING and SPIRAL)

2.A LA MA R'A SPIRAL (diag.) ~~2B~~ or L'A MA RA (2B)

LA MB RA non sym

LA L'A SA non sym

LA L'A SB non sym

3.A LA R'A SA STAR of DAVID (diag.) or L'A RA SA (3B)

LA RA SB non sym

LA SA RA non sym

LA SB RA non sym

RA R'A MA non sym

RA R'A MB non sym

RA R'A SA non sym

4A RA R'A SB SQUAT (axial) or R'A RA SB (4B)

opposite pieces are: L:R, L':R', M:S

#37

with Δ? out

~~with Δ~~

1. all blocked
2. 1 diag
3. all blocked
4. " "
5. 1 ~~diag~~ (axial)
6. 1 axial
7. 1 diag
8. none

X move R'B to L'A and RB back to LA

1A can't be blocked
1B " " "

1 ~~2~~ ~~diag always~~, but B blocks one 1 diag
~~2. " "~~ 1 diag
3. 1 diag
4. 1 diag
5. 1 axial
6. 1 "
7. 1 diag
8.

37-A ~~SOLOMON'S~~

Complete analysis of new Star of David, Feb 16, 1990

1 A must always appear cw, and ~~1A ccw~~ 2B ccw

so cw	ccw	sym	action	color sym
1 A 3A 3A	2 B 4B 4B	spiral	axial	Yes
3B	4A	bilateral + 2 fold		NO
3B 3A	4A 4B	bilateral + 2 fold		NO
3 B	4A	none	—	
3A 4A	4B 3B	none	—	
4B	3A	bilateral + 2 fold		NO
3B 4A	4A 3B	bilateral + 2 fold		NO
4B	3A	spiral	diag	YES
4A 4A	3B 3B	none		
4B	3A	bilateral + 2 fold		NO
4B 4A	3A 3B	STAR	diag	YES
4 B	3A	none		
4A 3A	3B 4B	none		
3B	4A	SQUAT	diag	YES
4B 3A	3A 4B	bilateral + 2 fold		NO
3B	4A	none		

37-A

1 always opp 2
3 " " 4
A " " B
(but other ways are possible lacking symmetry)

Summary: SQUAT, one sol. diag
STAR " " "
SPIRAL one diag. + one axial
BILAT. 6 sol.

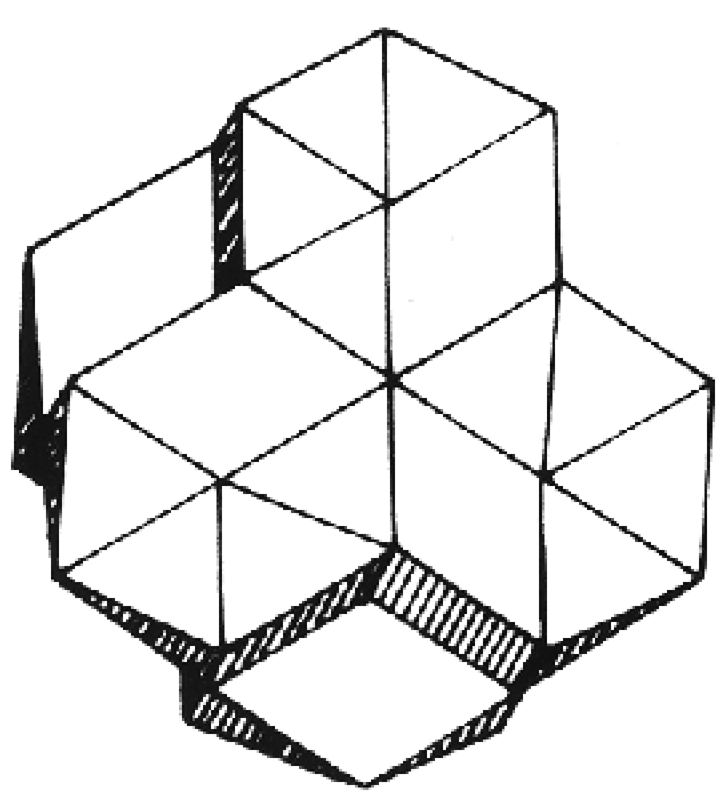
The STAR-OF-DAVID Puzzle (improved version) #37-A

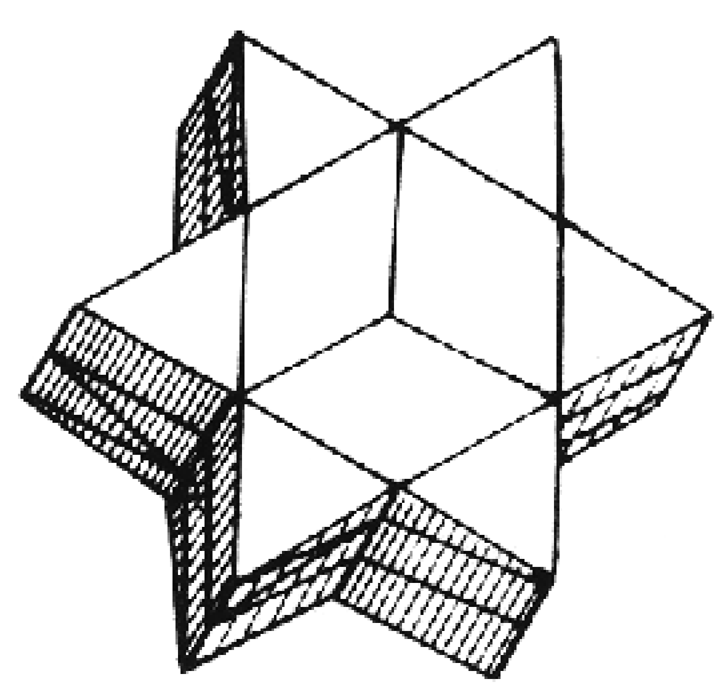
These instructions apply only to the improved (1990) version of the Star-of-David Puzzle, and not to the original (1981-1983) edition. When assembled, it can be distinguished from the original version by its two contrasting woods, whereas all of the original version were in solid mahogany. The assembled solution shapes are the same for both, but the new version has pieces of simpler design that are marked differently. But believe it or not, this version is even more confusing to solve than the original version. By popular request, this version comes with explicit assembly directions (see other side).

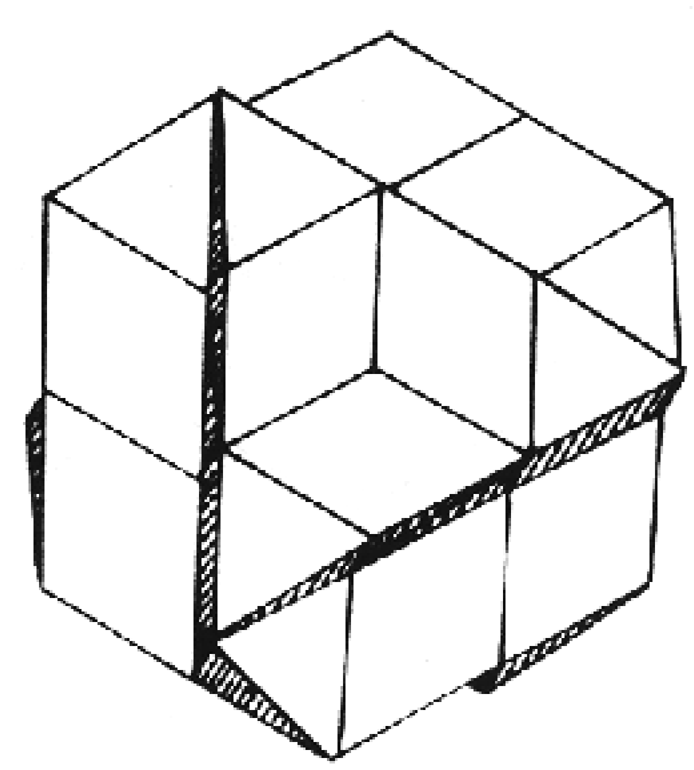
The first object, if the puzzle is assembled, is to disassemble it. This may require some random pushing and pulling in various directions to separate the two halves, since most solutions do not separate along the axis of symmetry as might be expected.

This puzzle has the most unusual property that its six interlocking pieces can be assembled into four different symmetrical shapes. Three of these intriguing polyhedral solids have a threefold axis of symmetry and are shown below. The fourth shape, not shown, has bilateral symmetry plus a twofold axis. The STAR and SQUAT have only one solution each, with a confusing diagonal axis of assembly. The SPIRAL has two solutions, one assembled axially and one diagonally. The BILATERAL shape has six solutions. There are also many ways the pieces go together to form interesting but nondescript shapes, as you will discover.

Another fascinating property of this version is that the pieces are bicolored in such a way that each symmetrical solution will also create a pattern of color symmetry, which serves to further accentuate the geometrical symmetries of these intriguing polyhedral shapes.

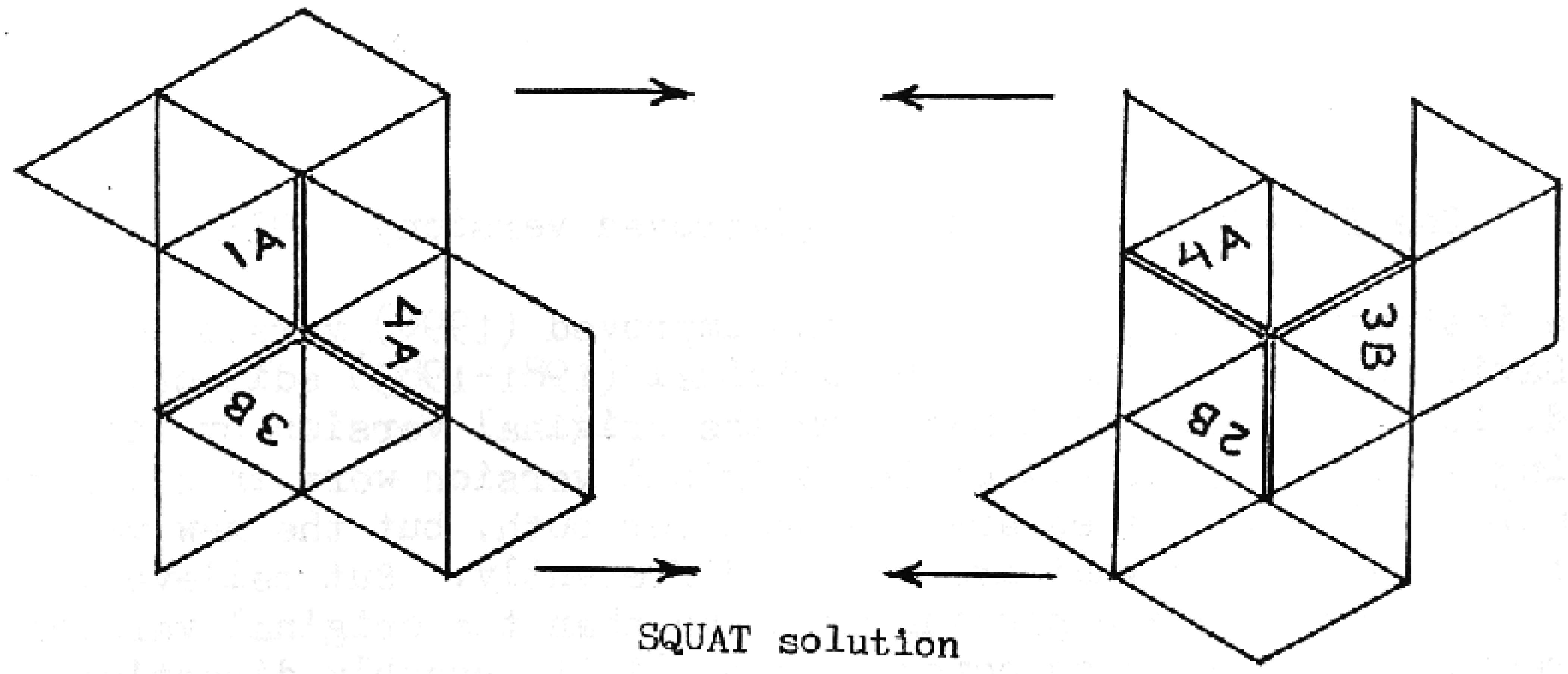

SQUAT


STAR

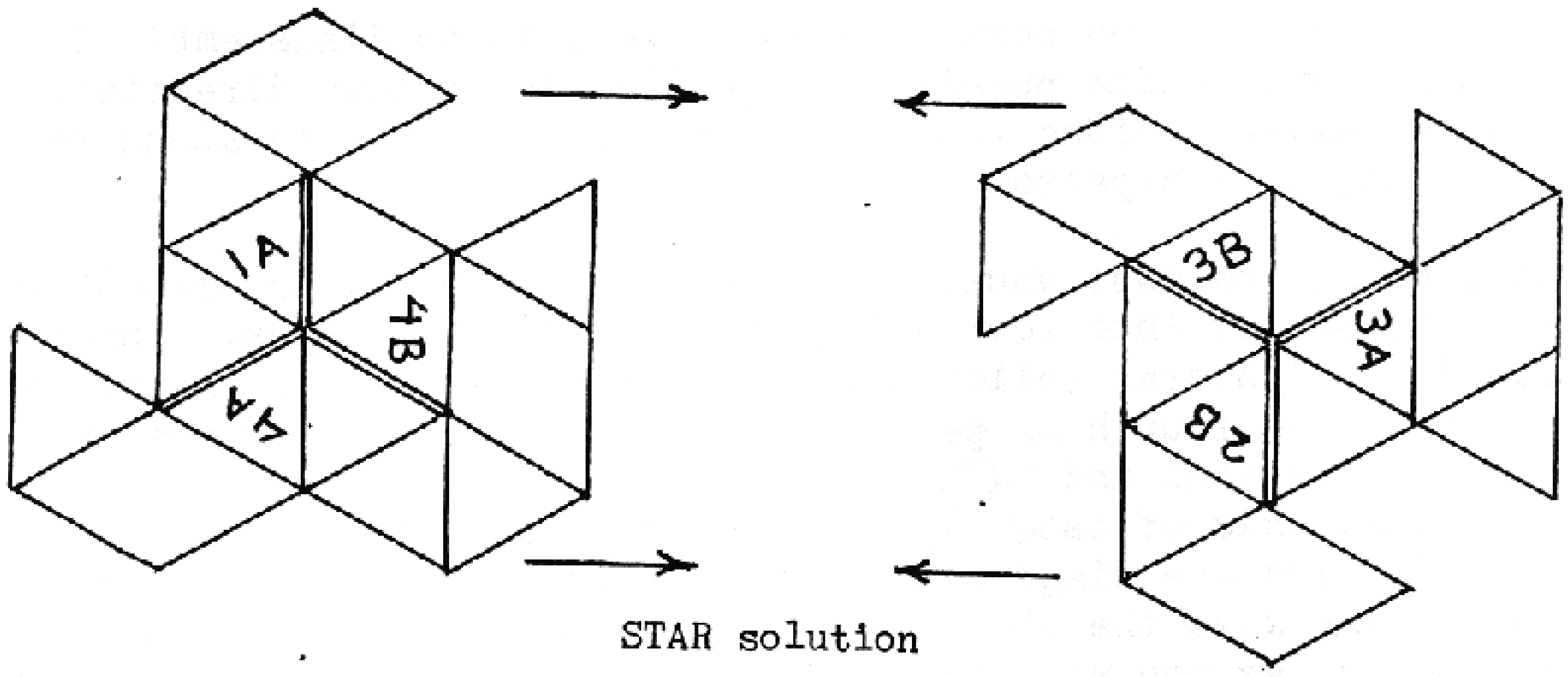

SPIRAL

The SQUAT and STAR solutions appear essentially the same shape top and bottom. The bizarre SPIRAL shape appears as its mirror image from the opposite side. In all cases, the colors are reversed top and bottom.

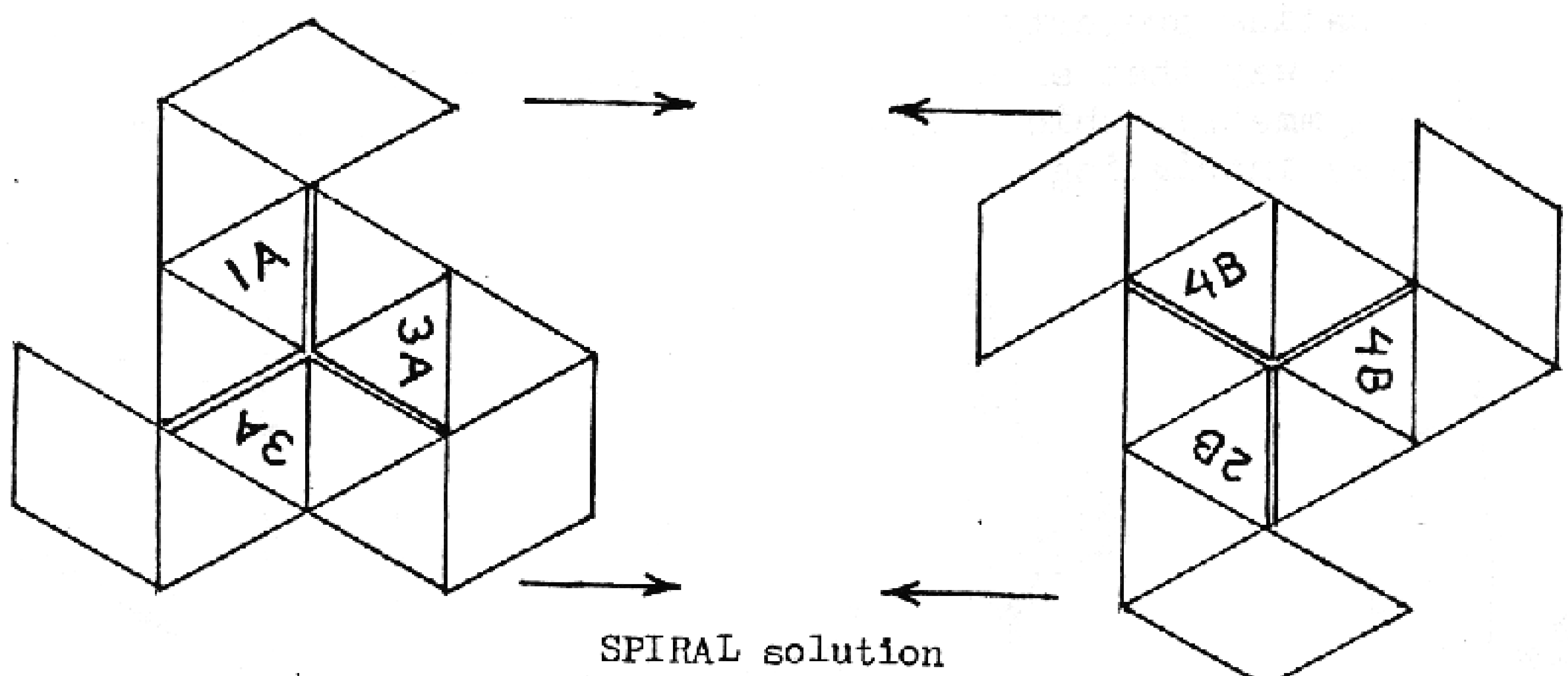
Stewart T. Coffin, 79 Old Sudbury Road, Lincoln, MA 01773 Feb 1990



SQUAT solution



STAR solution



SPIRAL solution
with axial assembly

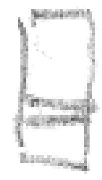
The six puzzle pieces are identified by the numbers 1, 2, 3, and 4. There are two each of pieces 3 and 4. The two ends of each are marked A and B. All solutions are made by first assembling two halves of three pieces each according to the diagrams above, and then mating the two halves.

For additional recreation, try to discover the other SPIRAL solution and one or more of the BILATERAL solutions. See if you can figure out the strange principles of mechanics and symmetry upon which this design is based that make these amazing transformations possible. Find the simplest way to shift from one solution to another.

#40 ~~#51~~

Complete analysis of Burr #1

May 5, 1980

1 always on bottom, so 

on left	right	front	back
2 x			
3	2 upright	4 x	
		5	4 x
			5 x
			6 x
		6	4 x
			5 x
			6 x
	2 rev.	4 x	
		5	4 x
			6 x
		6	4 x
			5 x
	4	2 x	
		5 x	
		6 x	
	4 Turn	2 x	
		5 x	
		6 x	
	4 rev	2 x	
		5 x	
		6 x	
	5	2 x	
		4 x	
		6 x	
	6 up	2 x	
		4 x	
		5 x	
	6 rev	2 x	
		4 x	
		5 x	

Left	right	front	back
4 x			
5 up	2 up	3 x	
		4 x	
		6	3 x
			4 x
	2 rev	3 x	
		4 x	
		6 x	
	2 turn	3 x	
		4 x	
		6 x	
	3 up	2 x	
		4 x	
		6 x	
	3 rev	2 x	
		4 x	
		6 x	
	4 up	2 x	
		3 x	
		6 x	
	4 turn	2 x	
		3 x	
		6 x	
	4 rev	2 x	
		3 x	
		6 x	
	6 up		

Left	right	front	back
	6 up	2 x	
		3 x	
		4 x	
	6 rev	2 x	
		3 x	
		4 x	
★ 5 rev Cutler #2	2 up	3 —	6 — 4 top
		4 x	
		6 x	
	2 rev	3 x	
		4 x	
Cutler #3	2 turn down	3 R	6 — 4
can't assemble → Cutler #4	2 turn down	4 L —	6 — 3
		4 R x	
		6 x	
	3	2 x	
		4 x	
		6 x	
	3 rev	2 x	
		4 x	
		6 x	
CUTLER #7	4 up	2 x	
can't assemble		3 —	6 — 2
		6 x	
CUTLER #5	4 turn	2 x	
		3 L x	
!! →		3 R —	6 — 2

L	R	front	back	top
5 Rev	4 rev.	2 X		
can't assemble	4T down →	3 R	6 —	2
CUTLER #6		6 X		
	6 up	3 L X		
		3 R X		
		4 X		
	6 rev	2 X		
		3 X		
		4 X		
6 up	2 up	3 X		
		4 X		
		5 X		
	2 rev	3 X		
		4 X		
		5 X		
	2 turn	3 X		
		4 X		
		5 X		
Cutler #9	3 up	2 X		
2nd sol ☆ →		4 X		
		5 X		
	3 rev	2 X		
		4 X		
		5 X		
	4 up	2 X 3 X 5 X		

4 slides thru, opp 5 " " " 5 5 2

4 turn	2 X
	3 X
	5 X
4 rev	2 X
	3 X
	5 X
5	2 X
	3 X
	4 X

L	R	fr.	b	t
6 down	2T down	4 L	5	3
"	"	4 L	5	3
can't ass.		5 X		
	2 turn			
" → 4		2	5	3

CUTLER #8

CUTLER #1

#41 UNHAPPY CHILDHOOD ~~#63~~

STEWART T. COFFIN

79 OLD SUDBURY RD. RFD I LINCOLN, MASS. 01773

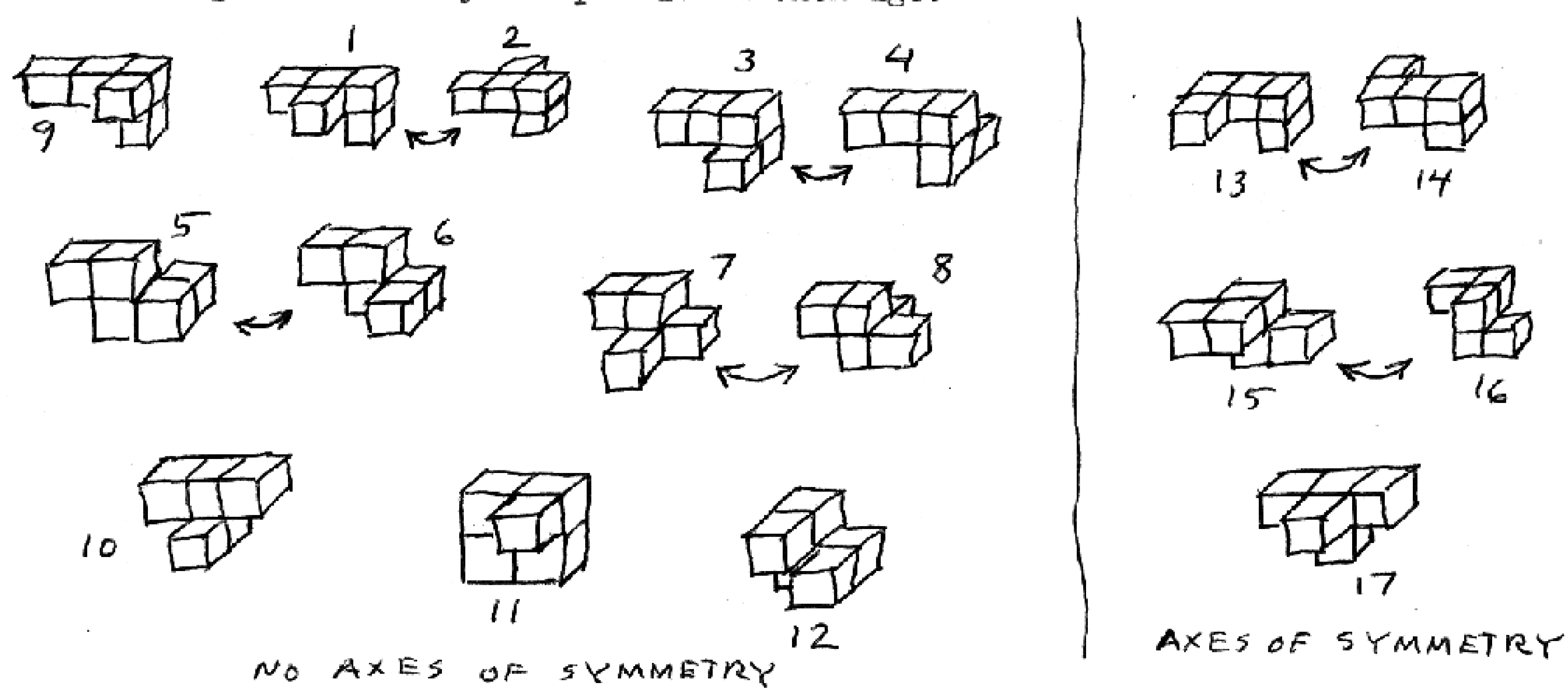
259-8348

May 12, 1981

To: Michael Beeler, Bill Cutler, Willem van der Poel, etc.

According to my hasty analysis (which could be wrong), there are 29 ways in which five cubes can be joined together face-to-face. Twelve of these are the familiar "solid pentominoes," and the other seventeen I refer as the <u>non-flat</u> ones, shown below. Of these seventeen non-flat ones, twelve do not have an axis of symmetry. I am curious to know if these twelve non-flat, non-symmetrical pieces can be assembled into any rectangular solid (3x4x5, 2x5x6, or 2x3x10). I have tried to assemble them into the 3x4x5 without success, but suspect it is possible.

What I would like to know is whether or not it is practical to analyse this problem by computer. If so, and if a small number of solutions do exist, does the computer simply say they exist, or can they be printed out? If any of you are interested in solving this problem and sending me the results, I would be glad to send you a puzzle in exchange.



#41

Here is another idea which is probably much more difficult to analyse. According to my analysis, which again could be wrong, there are ten reflexive pairs of ways in which six cubes can be joined together which are non-flat, not axially symmetrical, and <u>linear</u>. (A linear piece is defined as one in which the blocks form a continuous string, i.e. the two end blocks have five faces exposed, and all others in between four faces.) Find a combination of ten pieces, preferrably without reflexive pairs, which can be assembled into 3x4x5. Now omit one piece and assemble into 3x3x6. Now omit another piece and assemble to 4x4x3. Maybe even 7x2x3, etc. Probably impossible. If so, omit linear requirement. If still impossible, omit non-flat requirement, etc. The possibilities here are almost limitless.

Sincerely,

Stewart Coffin

↔ indicates reflexive pairs

(all others have plane of symmetry)

Addendum to "A Strange Pentacube Puzzle of Stewart Coffin's"
January 1982

This note follows up the results on Stewart Coffin's strange pentacube puzzle. We wish to use the pieces which make the 2 x 5 x 5 box with a unique checkerboard coloring, shown below, to make smaller boxes while maintaining the checkerboard pattern.

```
          G G G I I     B,E,G,H,I white;
          B B A E L     unique solution.
          A A A E E
  BOTTOM  K J J E F
          J J H H H

  TOP     G B I I L
          G B I L L
          K B A L F
          K K H E F
          J K H F F
```

The available pieces are:
A, F, J, K, L - black (3 black cubes, 2 white cubes)
B, E, G, H, I - white (3 white cubes, 2 black cubes)
C, D - not used
With these we seek solutions to smaller boxes, omitting some of the pieces. In particular: SOLUTIONS, checkered
a 2 x 2 x 5 box using 4 pieces (omitting 6 pieces), or —— 0
a 2 x 3 x 5 box using 6 pieces (omitting 4 pieces), or —— 15
a 2 x 4 x 5 box using 8 pieces (omitting 2 pieces). —— 5

2 x 2 x 5 — no solutions with desired properties 2x5x5 — 1

If we allow pieces C and D, or do not require the checkerboard coloring given above, there are three types of solutions. First, there are "step" solutions. These combine two "step units". Twelve different step units can be made, each from a pair of pieces: A-K, A-L, B-G, B-H, C-D, C-E, C-F, C-I, C-J, E-I, and F-J. (The C-D pair makes two step units, mirror images of each other.) A 2 x 2 x 5 solution can be made from any two step units which don't use the same piece in both units; instead of the theoretical 66 pairings, this reduces it to 45. 44 of these solutions are mirror image pairs, arising from 22 distinct solutions. The last of the 45 is self mirror, namely the solution using E, F, I and J. Thus there are 23 distinct step solutions.

Second, there are some "prong" solutions. Prong units can be made with any of the pairs of pieces C-D, G-K, and H-L. Each selection of two prong units creates a distinct 2 x 2 x 5 solution. There are three distinct prong solutions. Each can be assembled two ways, by rotating one prong unit half a turn.

41

Third, there is one solution which is neither step nor prong.

```
A K B B B     C D D K G     A A A G C
K K G G G     C C K K G     D D A C C

A A A B G     C D G G G     D D A G C
A K K B G     C D D K K     D G G G C

   step         prong        neither
(1 of 23)     (1 of 3)      (1 of 1)
```

Of the 27 distinct 2 x 2 x 5 solutions with restrictions relaxed, none fit the criteria of avoiding pieces C and D and having the required checkerboard coloring.

2 x 3 x 5 -- 15 distinct solutions

If we permit use of C and D, and impose no checkerboard requirement, the 2 x 3 x 5 box can be made in many ways. There are 924 ways to select 6 pieces from the set of 12, but only 607 of these six-piece sets have solutions. The chart below shoes some statistics on these 607 piece sets. Here solutions are counted as distinct if they differ in more than orientation and reflection. 75 distinct piece sets have only one solution; one piece set (A,B,C,D,G,H) has 32 distinct solutions, the maximum.

	with C and D	without C or D	total
mirror piece set pairs	462 piece sets (231 pairs) 1147 distinct solutions 9176 total solutions	126 piece sets (63 pairs) 164 distinct solutions 1312 total solutions	588 piece sets (294 pairs) 1311 distinct solutions 10488 total solutions
self-mirror piece sets	14 piece sets 94 distinct solutions 376 total solutions	5 piece sets 22 distinct solutions 88 total solutions	19 piece sets 116 distinct solutions 464 total solutions
total	245 distinct piece sets 476 total piece sets 1241 distinct solutions 9552 total solutions	68 distinct piece sets 131 total piece sets 186 distinct solutions 1400 total solutions	313 distinct piece sets 607 total piece sets 1427 distinct solutions 10952 total solutions

Disallowing pieces C and D reduces the theoretical possibilities to 210 piece sets, of which 131 have solutions. Applying the checkerboard requirement reduces the number of piece sets still further. Three pieces can be chosen from the five black pieces in 10 ways, and similarly three white pieces can be chosen in 10 ways. This yields a theoretical limit of 100 piece sets. Of these, only 10 have solutions. Seven of the ten have a unique solution; two have two distinct solutions, and one has four distinct solutions. The total is 15 distinct solutions to the 2 x 3 x 5 box with C and D unused and proper checkerboard coloring. It happens that none of these solutions has a mirror image with proper coloring.

E F A A A	A A A L E	A A A E F	A A H H H	A A E J G	
E E B B A	A B B E E	A G G G J	A G H E L	A I I J J	
E L G G G	H H H F E	H H H J J	A F E E E	A F I I J	
F F F B A	A B L L E	A E E E F	A G G G L	A E E E G	
L L F B G	H B F L L	H G E F F	F G H L L	F E G G G	
E L L B G	H B F F F	H G J J F	F F F L E	F F F I J	
G G G I I	G G G K K	A A A I I	A A A K K	B I I L E	- found
A E K K F	A E I I F	A E K K F	A E I I F	B B J E E	BOTTOM
A A A K K	A A A I I	H H H K K	H H H I I	B J J F E	
G E I I F	G E K K F	A E I I F	A E K K F	I I L L E	
G E I K F	G E I K F	H E I K F	H E I K F	I B F L L	TOP
A E E F F	A E E F F	H E E F F	H E E F F	J J F F F	
A A G G G	A I I K K	G I I K K	H A G G G	G J J L L	
A H H H I	A G G G F	G A A A F	H A A A I	J J L L I	
A F K K I	A A H H H	G A H H H	H F K K I	H H H F I	
A H G I I	I I K K F	I I K K F	H H G I I	G G J I I	
F H G K I	I G H K F	I A H K F	F A G K I	H G F L I	
F F F K K	A G H F F	G G H F F	F F F K K	H G F F F	

2 x 4 x 5 — 5 distinct solutions

As before, we first permit use of C and D, and impose no checkerboard requirement. There are 495 theoretically possible piece sets for the 2 x 4 x 5 box. 493 of these have solutions; only A,B,E,F,I,J,K,L and B,D,E,F,I,J,K,L do not. The chart below summarizes statistics for this case. The minimum number of distinct solutions for any piece set is three, made by B,E,G,H,I,J,K,L (and its reflexive pair, B,F,G,H,I,J,K,L). The maximum is 686 distinct solutions, made by A,B,C,D,E,H,I,L and its reflexive pair.

41

906 Harston Lane
Erdenheim, PA 19038

May 27, 1998

Stewart Coffin
Old Sudbury Road
Linclon, MA 01773

Dear Mr. Coffin,

I am writing to you regarding the checkered pentacube puzzle you describe starting on page 47 of *The Puzzling World Of Polyhedral Dissections*. I'm a little confused as to how you arrive at the total of 512 for the number of checkerings. At first I thought that since there are 10 pieces and each can be checkered in 2 ways you took 2^{10} and divided by 2. This division by 2 is due to the fact half of the checkerings are arrived at by swapping dark cubies for light cubies. This, of course, makes them uninteresting for solving this puzzle.

Recently there has been a discussion in the puzzles newsgroup on the internet and we came to realize that a checkered 5x5x2 solution is only available when the number of dark cubies and light cubies is the same. That is 5 of the 10 pentacubes have 3 dark and 2 light cubies. The other 5 have 2 dark and 3 light cubies. Now we need to see how many ways we can pick 5 pieces from a total of 10.

$$\binom{10}{5} = \frac{10!}{5!\,(10-5)!} = 252$$

This number can be divided by 2 to get rid of "mirror sets". e.g. if the first 5 we pick are (1,3,5,7,9) then (2,4,6,8,10) will be left. At some point we will pick a set of (2,4,6,8,10) leaving (1,3,5,7,9). The total number of checkerings that can create a checkered 5x5x2 box is now 126. As you can see this number is less than 512 and represents the number of checkerings that may be solvable. How do you account for this difference? Did we do something wrong in approaching this problem?

Also, some have claimed that computer programs they use to solve these "cube packing" puzzles have found 2 checkerings with a single solution and not the single one that you claim exists. Of the set of 126 there is only 1 with no solution. I've yet to finish my program and can't verify that this is true.

One last thing. I wrote to you about 3 years ago regarding the purchase of the second edition of *Puzzle Craft*. At that time it was available but my life took some interesting turns that put those projects on hold. I would now be interested if this book is still available.

answered June 16,
126 is correct

147

Thanks for all the confounding joy your puzzles have brought me over the years.

Sincerely,

Joel Coltoff

#42

Copyright:

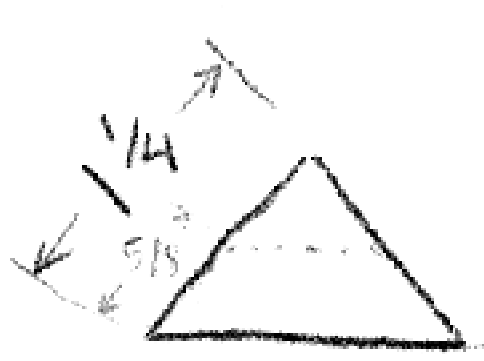
November 10, 1969

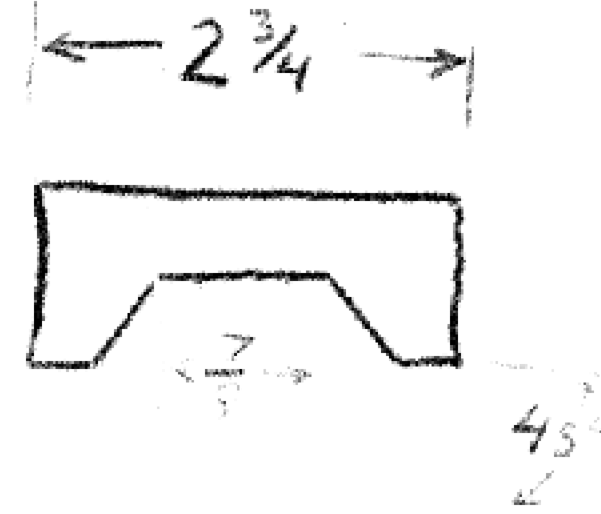
DESCRIPTION OF PUZZLE NO. 4

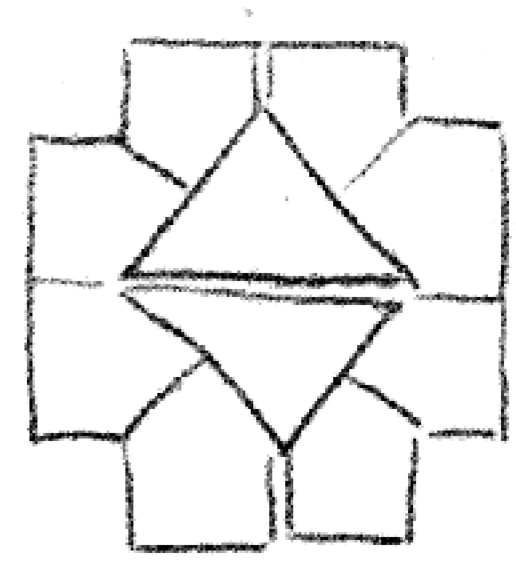
Puzzle No. 4 consists of six interlocking pieces in three colors, two of each color. All six pieces are identical in shape. Each piece consists of a right-triangular prism, with a trapezoidal slot in the hypotenuse face. When assembled, each pair of like-colored pieces fit together to form a square prism, and the whole assembly has the appearance of three mutually perpendicular square prisms.

The object of the puzzle is to disassemble and assemble it.

To disassemble, work any pair of pieces loose by sliding them back and forth over each other, and the whole assembly falls apart. There are two techniques which may be followed to assemble. One is to place one pair of pieces in position on a level surface, with a third piece in the space between them. Place another pair of pieces in position horizontally. Now carefully draw the two vertical pieces apart just far enough to allow the remaining piece to be dropped into position, and squeeze the assembly together. The second method is to sub-assemble the pieces into two groups of three mutually perpendicular pieces, and then slide them diagonally together.







#42

#42

Copyright:

May 5, 1970

<u>Description of Puzzle No. 4-A, PLUTO</u>

(Supercedes Description of Puzzle No. 4 dated Nov. 10, 1969)

Puzzle No. 4-A, PLUTO, consists of six pieces, all identical in shape. Each piece has essentially the shape of a prism of right-isosceles triangular cross section. A slot of trapezoidal cross section extends from the hypotenuse face to half way into the prism, ~~xxxxxxxxxxxx~~ perpendicular to the axis of the prism, and equidistant from the two end faces of the prism. In this particular version, the prism end faces are perpendicular to the axis of the prism.

The object of the puzzle is to fit the six pieces together to form a symmetrical solid assembly having no apparent voids. When thus assembled, the pieces are grouped in three mutually perpendicular pairs. A hollow cubic space is thus enclosed in the center of the assembly. Each pair of pieces fits together with their hypotenuse sides facing each other, thus forming a square prism.

The six pieces are in three colors, two of each color. In the preferred solution, the paired pieces are like-colored, thus giving the appearance of three intersecting rectangular blocks of different color.

#42

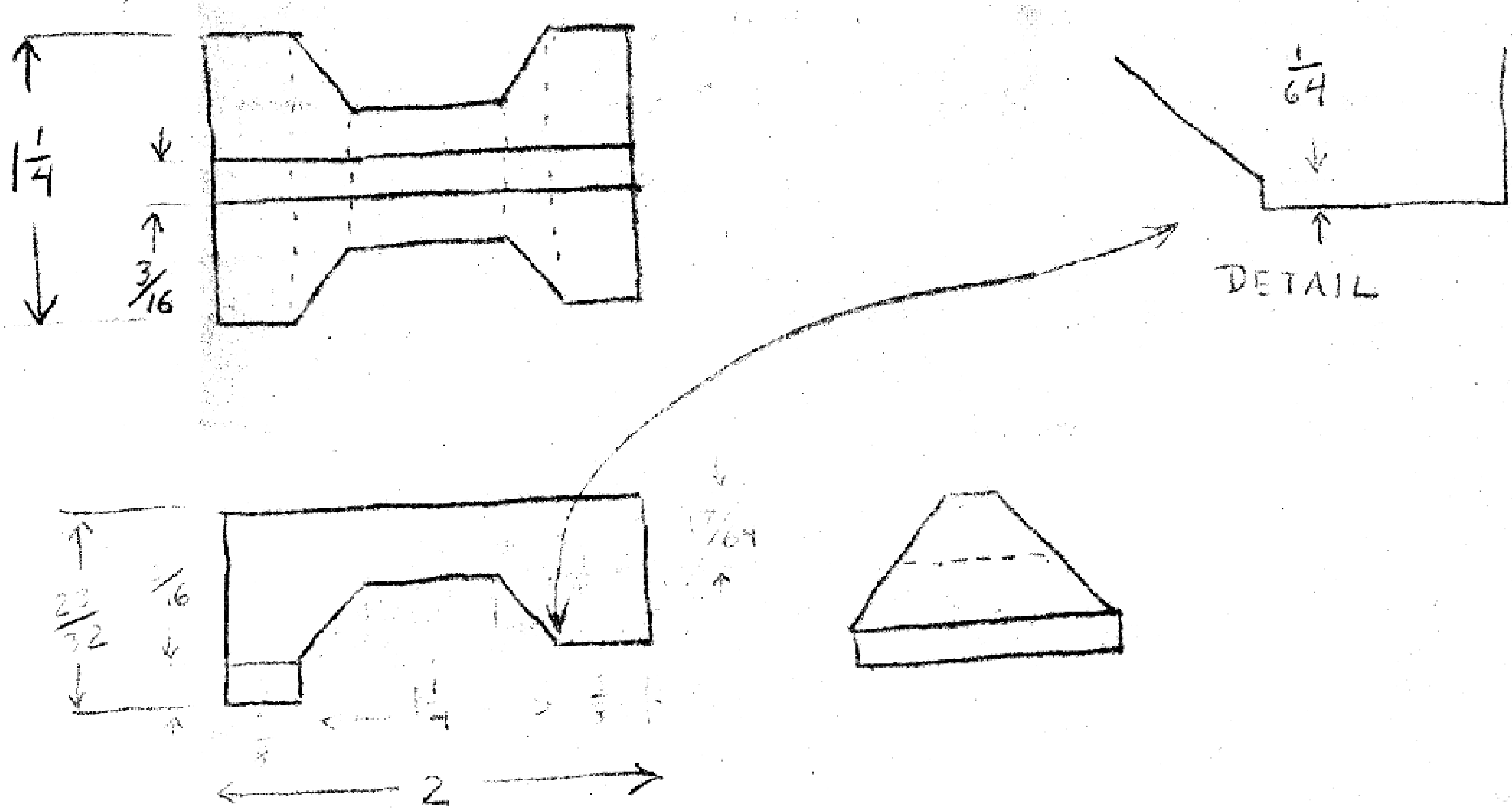
In order to increase the difficulty and novelty of the puzzle, each piece contains the following anomolies from the geometry described above. The right-angle lateral edge of each piece is beveled at 45 degrees. One end of each piece is augmented by a rectangular land which engages the beveled edge of another piece in the assembly. The opposite end of the piece is diminished by a corresponding volume to allow space for the land, and it also engages the beveled edge in assembly, but by a much smaller degree.

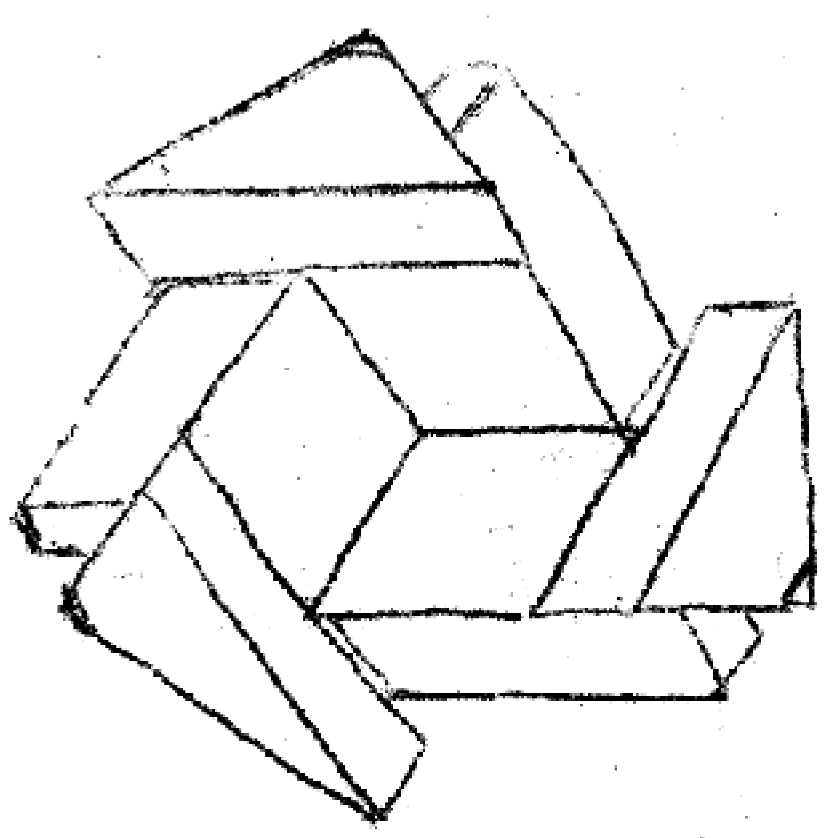
There is only one order in which the pieces can be assembled, and only one orientation which will produce the desired color pattern, which is as follows: Three unlike-colored pieces are positioned mutually perpendicular, such that the land of each piece engages the beveled edge of another, and this three-pronged sub-assembly is placed on a level surface. A second sub-assembly is made similar to the first, except that whereas the prongs appear to spiral upward clockwise in one, they must spiral counterclockwise in the other. Lands which engage a particular color in one sub-assembly must do so in the other also. One sub-assembly is now inverted and placed vertically over the other, rotated until like-colored pieces are parallel, and then the two are mated, completing the assembly.

The small bead on the end opposite the land engages the beveled edge when the mating is complete, thus preventing the assembly from slipping apart without deliberate effort. To disassemble, one must first determine the axis of disengagement by inspection, and gradually work the pieces loose opposite to the direction of assembly.

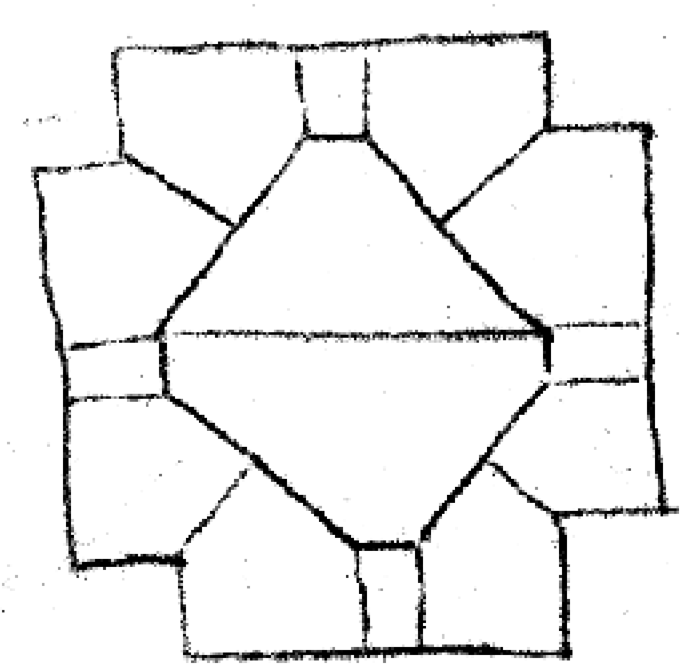
#42

(Page 2, Description of Puzzle Nor 4-A, PLUTO, May 5, 1970)





SUB-ASSEMBLY



ASSEMBLY

Copyright:

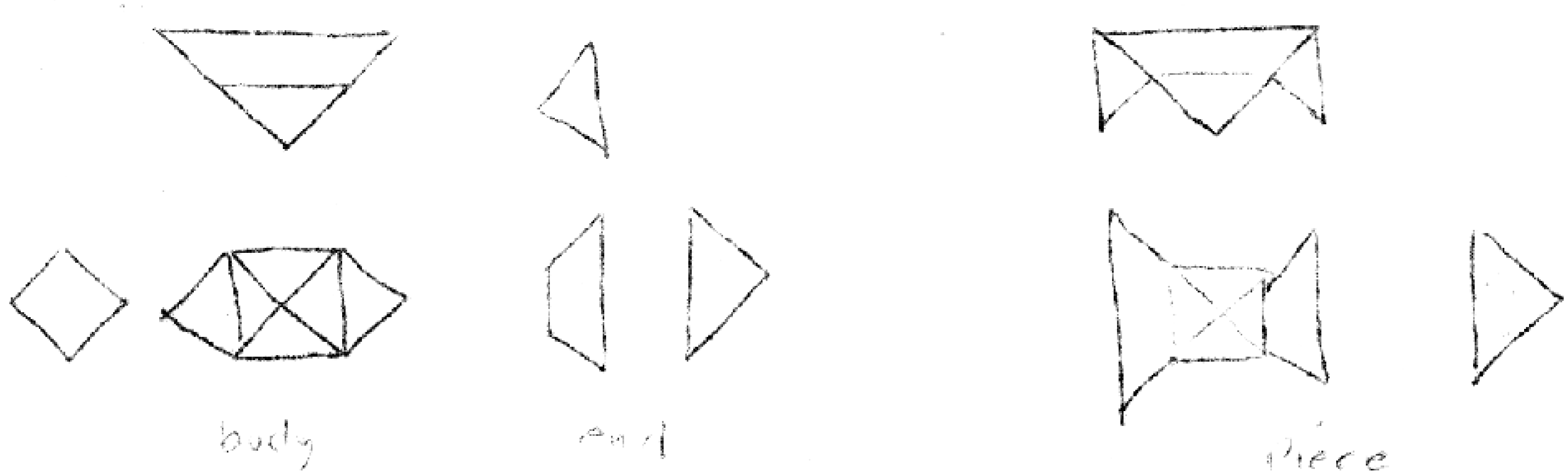
February 9, 1971

DESCRIPTION OF PUZZLE NO. 4-B, WOODS

Puzzle No. 4-B, WOODS, consists of six pieces which are identical in shape. Each piece consists in turn of three sub-pieces which are bonded together. Two of the sub-pieces are identical in shape, and are called the ends. The third sub-piece is called the body. It has a square cross-section and beveled end faces. The end faces are mutually perpendicular, and have a common point. The end sub-pieces have right-isosceles triangular cross section, and they likewise have mutually perpendicular end faces with a common point. Two end pieces can be made by cutting a body sub-piece in two lengthwise. The end sub-pieces are bonded to the beveled end faces of the body sub-pieces. The pieces are assembled in three mutually perpendicular pairs to make an interlocking assembly, in the classic configuration, similar to puzzles No. 4, 4-A, and 15.

The unique innovation in this particular version of the puzzle is in the additional challenge provided by matching end sub-pieces of similar type. For example, because of the method of construction, the end sub-pieces could be of three or six dissimilar colors or types of wood, and the problem would be to match them in the assembly. It might be feasible, furthermore, to match heartwood with sapwood, end grain with cross grain, etc. Many such schemes are possible which would have obvious educational values, especially if used in conjunction with explanatory printed material.

If the pieces were to be molded or cast, rather than sawed from wood as is the present model, objects such as seeds, shells, or other nature materials could be included within a transparent plastic material.



42-A

ALVIN P. LEWIS

TELEPHONE 242

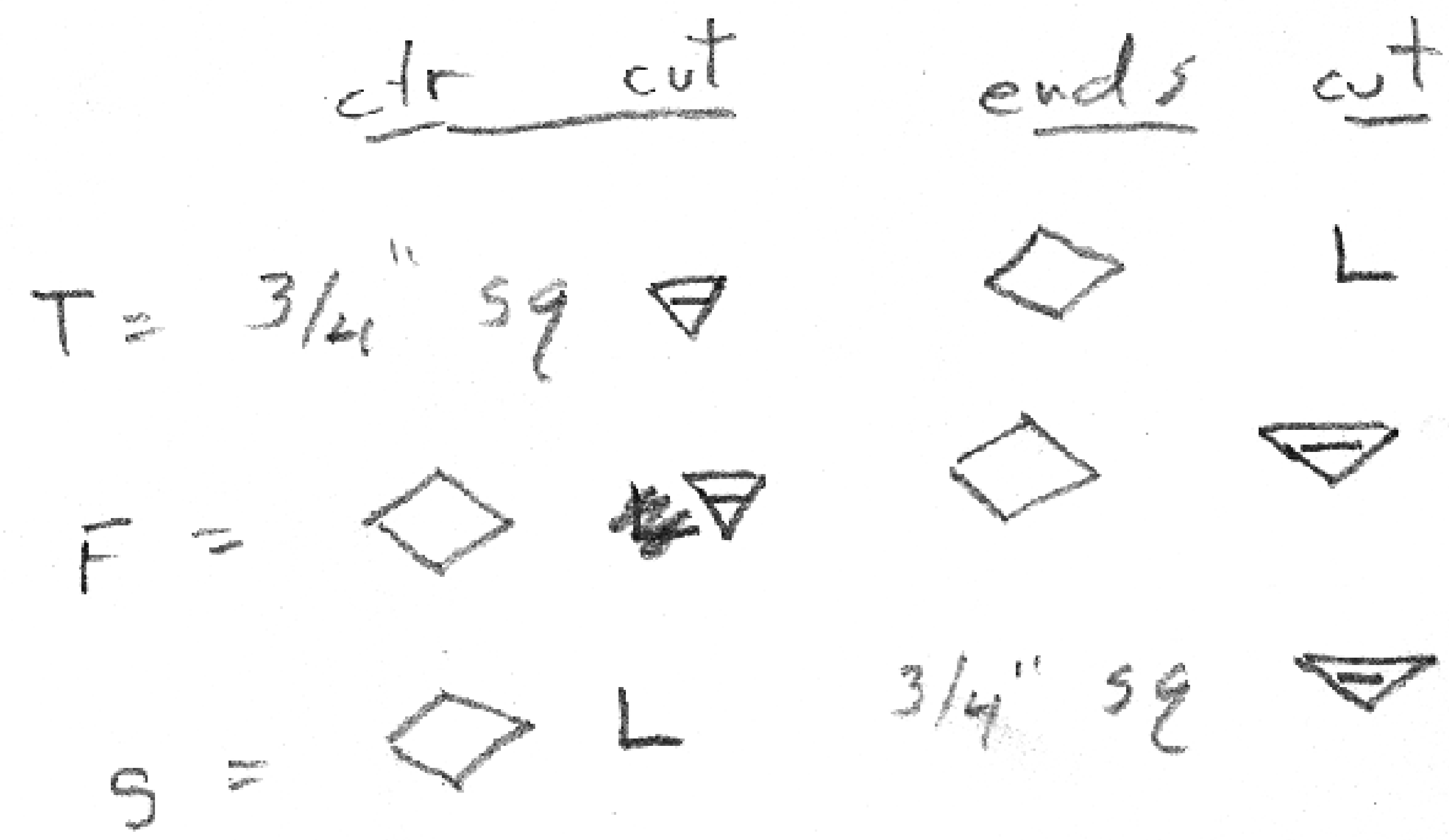
Meeting House Hill Poultry Farm

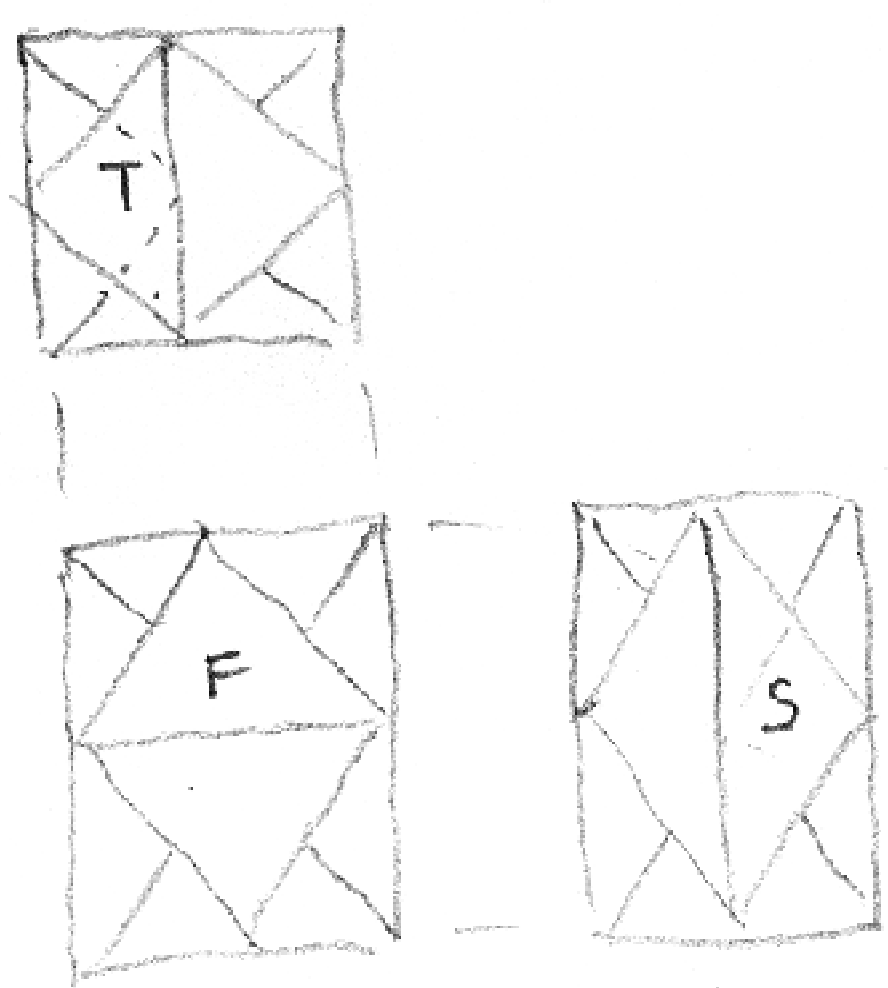
NEW HAMPSHIRES AND BARRED PLYMOUTH ROCKS

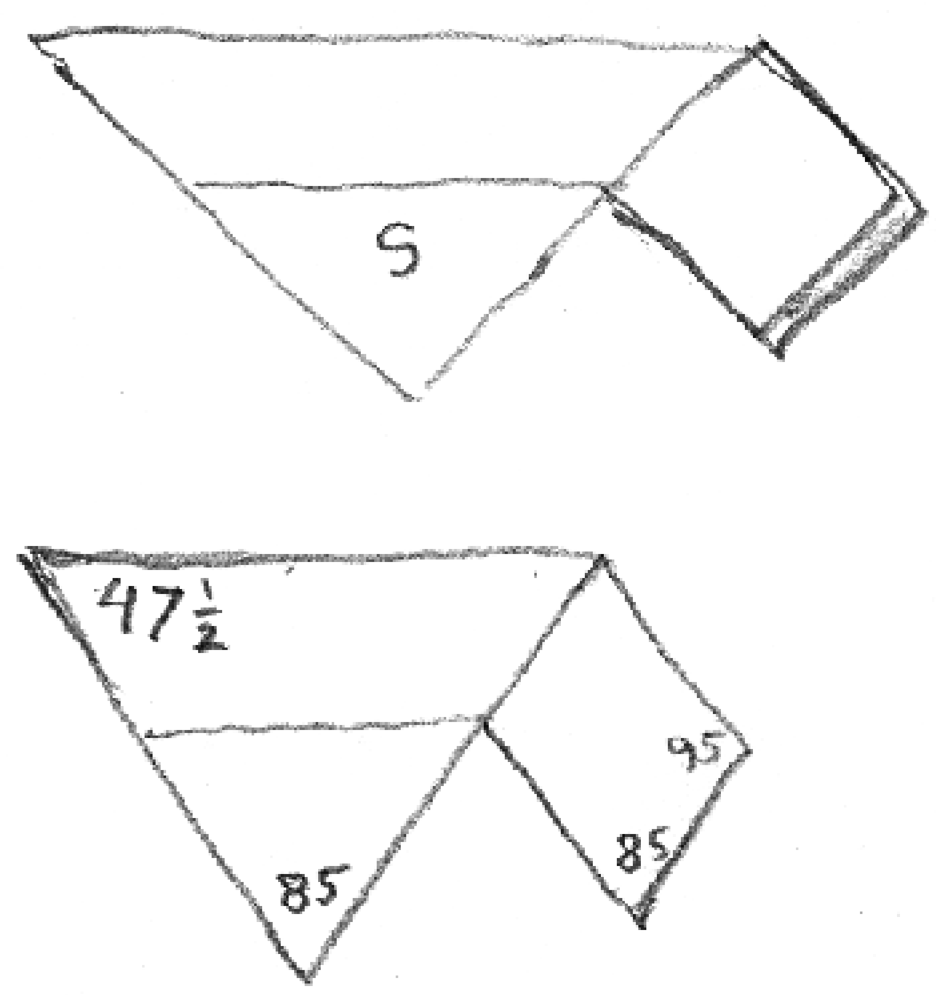
PULLORUM DISEASE FREE

BABY CHICKS -- HATCHING EGGS -- BREEDING STOCK

NEW BOSTON, N. H., ____________________ 193__

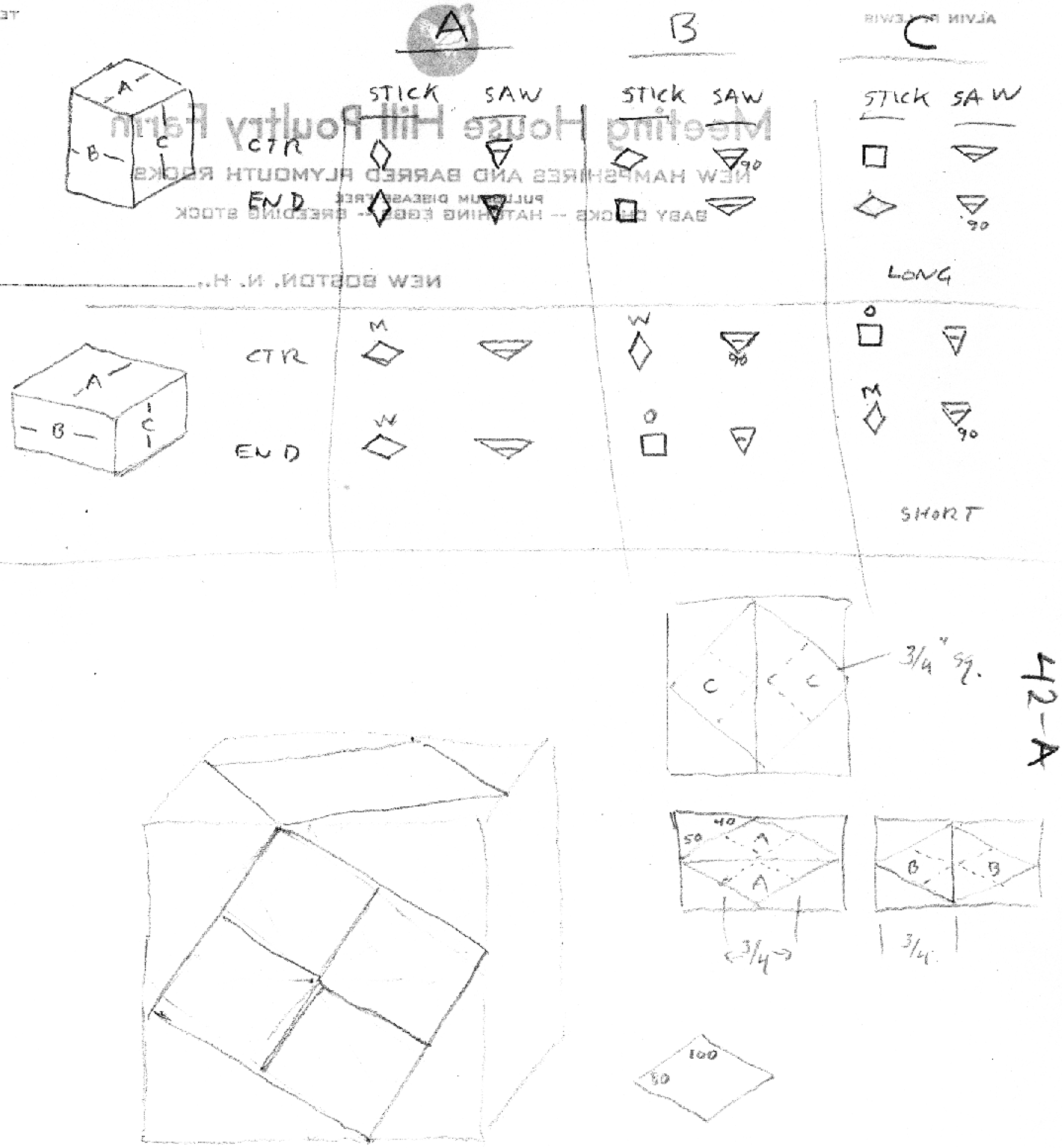






42-A

42-A



#46

COPYRIGHT:

December 13, 1971

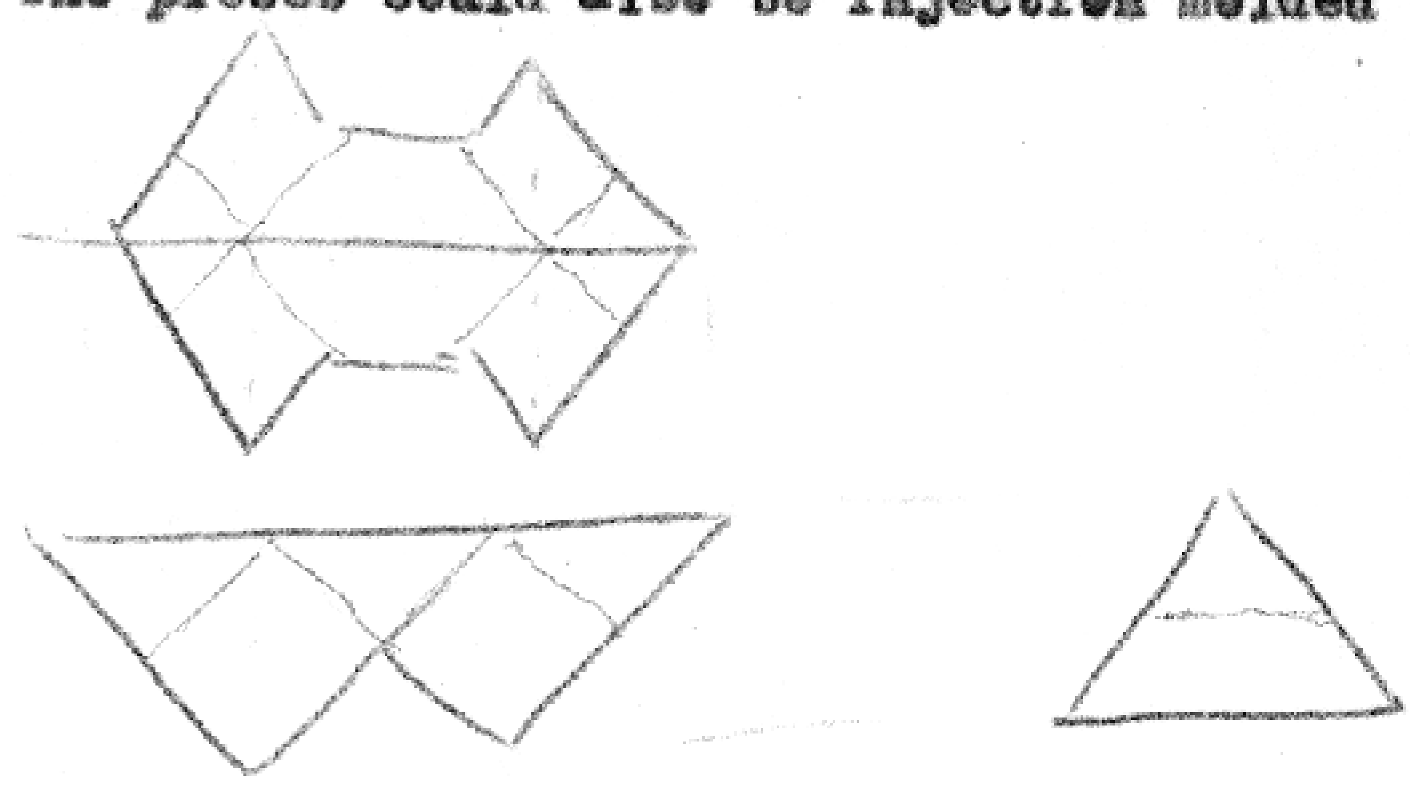
DESCRIPTION OF PUZZLE NO. 21, <u>VEGA</u>

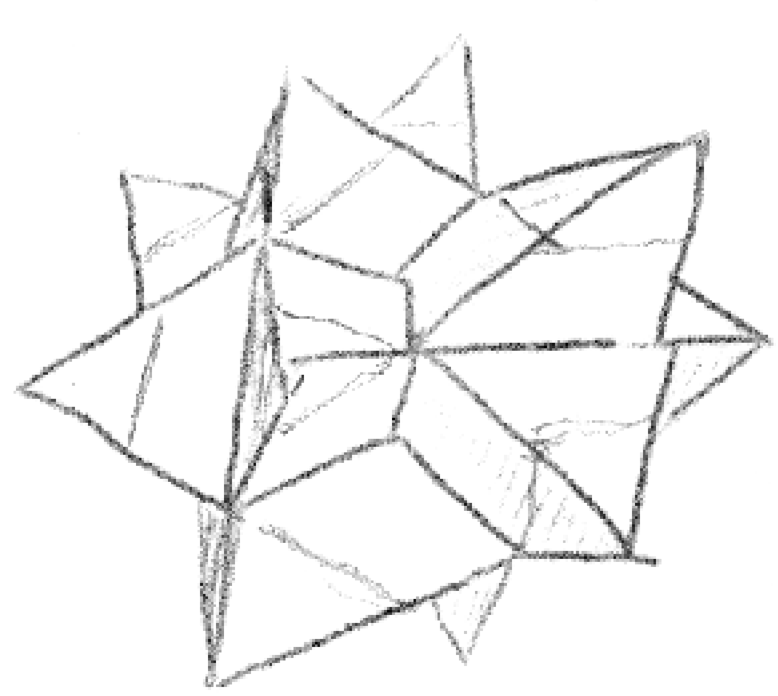
Puzzle No. 21, VEGA, consists of six identically shaped pieces. The shape of a piece is similar to that of Puzzle No. 4, TRIPLE CROSS, except that the end faces slant at an angle such that a concave right angle is formed with the end face of the adjacent piece, producing a shapp triangular point at both ends of each piece. This changes the appearance of the puzzle altogether to an unusual and interesting stellated shape.

This design was conceived by me on this date, and I have also constructed a wooden model on this date.

The pieces readily lend themselves to fabrication of wood. The pieces could be made of sections of dissimilar woods glued together, with the points of the puzzle a contrasting color for beautiful effects.

The pieces could also be injection molded by suitable coring.





#46

cc Lenkton Dec 14

#47

Copyright:

March 29, 1974

Description of Puzzle No. 42, CLUSTER-BUSTER

Puzzle No. 42, CLUSTER-BUSTER, consists of six identical pieces. Each piece may be thought of as consisting of a diagonally cut square prism center section, on either end of which are fastened at right angles similar sections, with the two ends of each piece consisting of diagonally cut triangular prism sections, one being the mirror image of the other. Thus, each piece has a plane of symmetry. The assembled puzzle has the apparent shape of a cluster of six rhombic dodecahedrons.

This puzzle is particularly difficult to disassemble. One must first inspect it carefully, paying particular attention to the diagonal dissecting plane which separated opposite piece, to discover the sliding axis. Then, one must place three fingers of one hand on the ends of three pieces, and likewise with the other hand on the opposite three pieces, and push. The usual and common method of grasping and pulling is to no avail. Of course, if fairly loose, it may be started by shaking and spinning. It separates into two halves, and then the three pieces of each half come apart readily. Assemble the opposite way - that is, mate two halves of three pieces each. However, there are some subtile difficulties. First, one half must be a "clockwise" arrangement, and the other half "counterclockwise". Secondly, each piece has a right and wrong direction to aim, so the chances of randomly choosing the correct way are only one in 64 for the whole set. Finally, after the two halves are correctly arranged, they must be manipulated together patiently, as they have a tendency to wander into the wrong stall at six points. #47

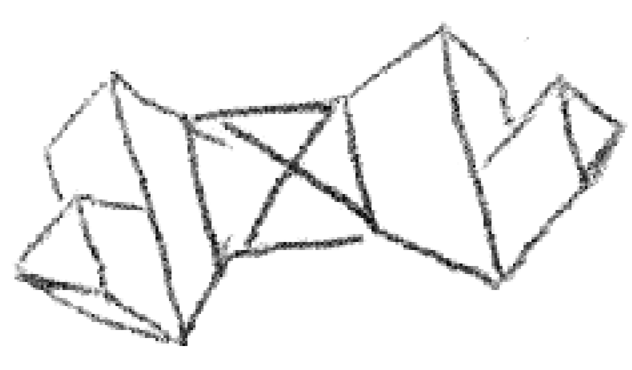
One variation of the basic design is to truncate the six pyramidal vertices. When this is done, there is practically nothing to push against, and so it must be disassembled by spinning. Another variation is to round the outside, so that it has the shape of a sphere with eight triangular indentations, model submitted March 5, 1974. There are other versions in which the pieces are non-identical; these are more difficult but somewhat less appealing I feel.

The pieces can be fabricated by injection molded plastic, using a simple mold. They can be partially cored from the inside if desired.

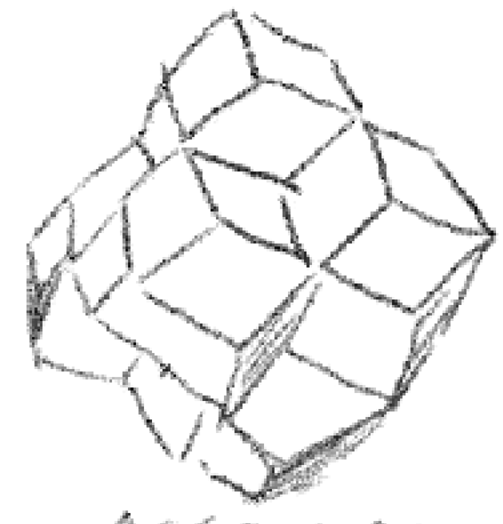
The puzzle can be enhanced by using multicolored pieces in three colors, two of each. Then there is the added problem of assembling in symmetrical patterns. If opposite pieces are like color, a simple color pattern emerges. If the two halves are rotated and reassembled, a more intricate zig-zag color pattern appears.

I invented the basic principle of this puzzle in 1973, which I believe to be new and original. The spherical version was suggested by Tom Atwater.

Stewart Coffin
March 29 1974



INSIDE VIEW OF PIECE



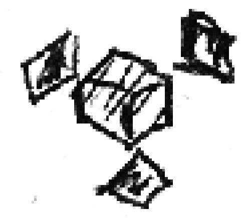
ASSEMBLY

#50-B
(see also #8-B)

Analysis of 4color 3rd Stell.

1. Parallel colors ccw 1A 2A 3A cw 4A 5A 6A

2. turne #1 end for end
ccw 1B 2B 3B

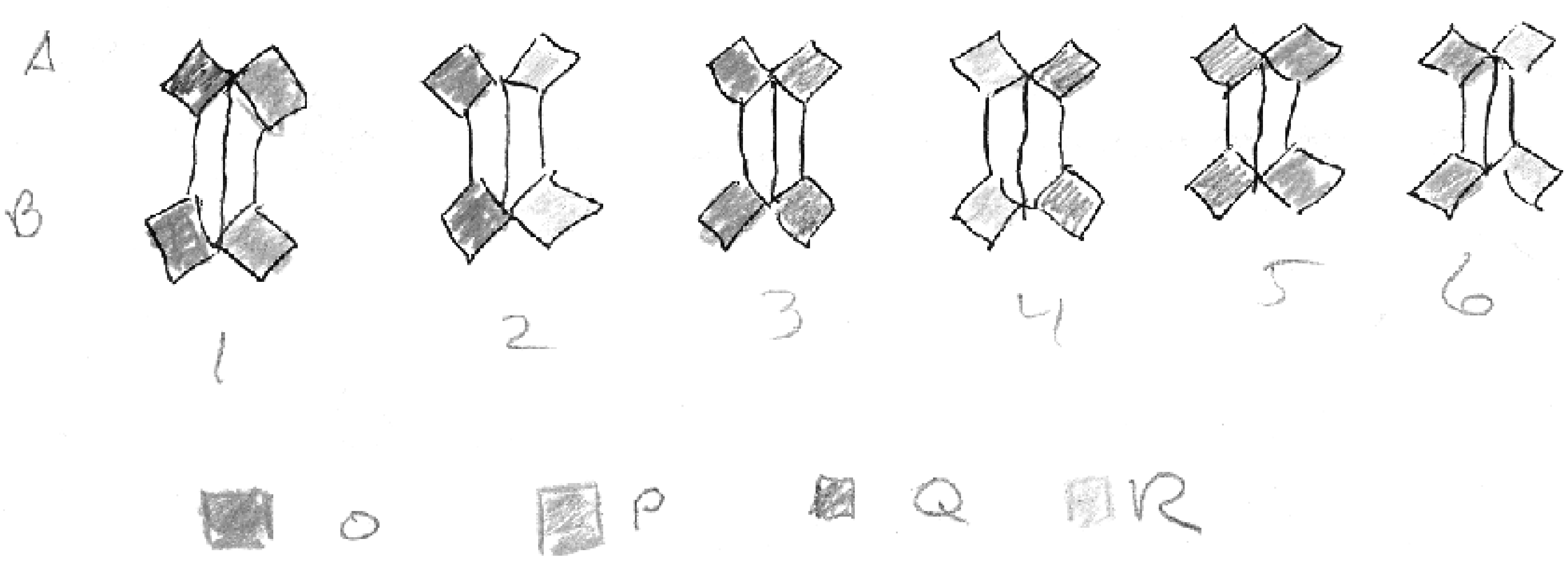


3. change ccw to cw same as 2
cw ~~1A 2A 3A~~ 1A 2A 3A

4. turn #3 parallel colors in Nova, but ring clamps in 3ST
cw 1B 2B 3B

5. 1A 2A 3A ccw 4B 6B 5B cw parallel colors!

6. turn end. same as 2



1. essentially ~~one~~ two solutions, and mirror images - parallel
2. " " " "

---

no others

4 ways of assembling parallel solution
1. ccw 1A 2A 3A
2. " 1A 3A 2A
3. cw 1A 2A 3A
4. " 1A 3A 2A

#50-B 4color

Repeat analysis of 4-color Nov 2

∪ = opp
T = together

1. CCW 1A-2A-3A CW 4A-5A-6A 8 dimples solid color O

2. turn all #1 end for end
CCW 1B-2B-3B CW 4B-5B-6B  6 separated triangles O

3. ~~reverse order of #1~~
change ccw to cw
CCW 4A-5A-6A CW 1A-2A-3A  " O

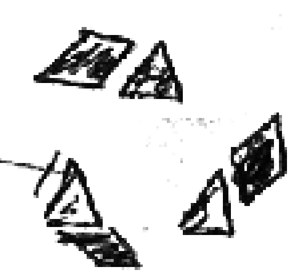
4. turn all #3 end for end
CCW 4B-5B-6B CW 1B-2B-3B  Rings O

5. ~~same as #1 1A-2A-3A ccw~~ CW 4B 6B 5B  4 solid triangles T
1A-3-A-2A ccw

6. turn all 5 end for end
1B-3B-2B ccw CW 4B-6A-5A  4 solid triangles mirror T

#8

7. ~~4A 6A 5A~~ ccw CW 1A-3A-2A 
4B 6B 5B

8. turn all 7 end for end  mirror of

See improved version of Sept 30 1987, filed as 8-B

#52

August 10, 1971

DESCRIPTION OF PUZZLE NO. 18, <u>PENNYHEDRON</u>

This puzzle was invented by Margaret Dionis Coffin, and improved by Abbie M. Coffin and Stewart T. Coffin. Description written by Stewart T. Coffin.

Puzzle No. 18, PENNYHEDRON, consists of two pieces, each of which is a mirror image of the other. When mated together, they form a rhombic dodecahedron.

In the preferred version of this puzzle, each piece is made up of six rhombic pyramids bonded together. These are made of dissimilar types of wood, of contrasting colors. In one version, four different types of wood are used, three pyramids of each type. When assembled correctly, no like types of wood will touch each other, either along their edges or at their corners. In a second version, three different types of wood are used, four pyramids of each type. When assembled correctly, no like types of wood will be adjacent to each other.

This puzzle has the unusual peculiarity that it is extremely easy to assemble, but very difficult to disassemble, just the opposite of most geometrical puzzles. If made carefully, so that the glued and unglued joints are indistinguishable, one has only the wood types to indicate the sliding axis in the four-wood version, and not even that in the three-wood version. Also, the natural tendency of holding with two fingers of each hand makes it virtually impossible to slide apart - three fingers of each hand, properly oriented, must be used. The non-orthogonal geometry adds a further element of confusion.

This peculiarity of the puzzle suggests its use as a toy "piggy bank" or other security device. If the rhombic pyramids are truncated, a hollow space in the center will be produced, having the same shape as the exterior. The puzzle might be sold with a penny inside, hence the name "Pennyhedron".

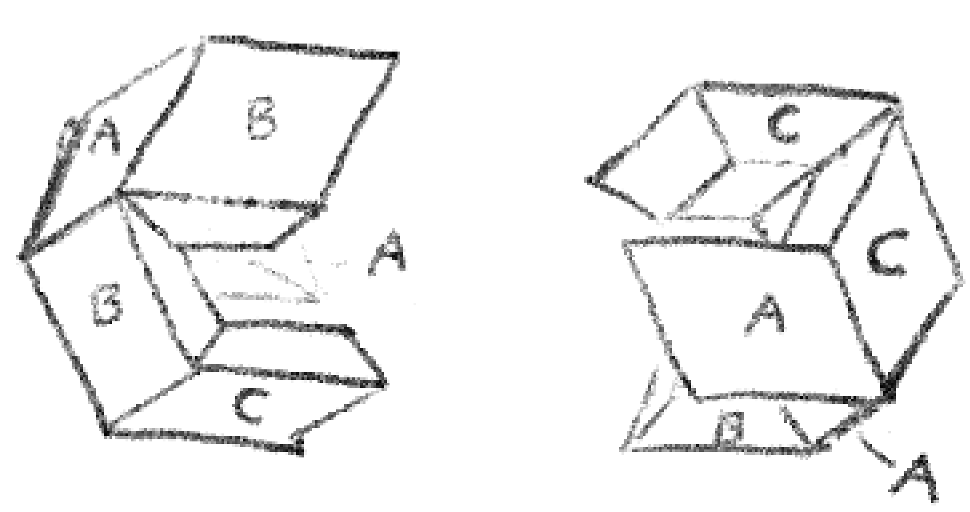
It might also be used as a trick link in a chain by attaching a link to each half, withnthe axis if tension perpendicular to the sliding axis. Other possible versions are earrings, pendants, keychain-type amusements, etc.

If made of plastic rather than wood, the individual pyramids could be injection molded and then bonded together by some expedient process, or simply molded in solid pieces of one color.

By truncating the external rhombic dodecahedral shape, many interesting variations can be created, such as a cubic or octahedral shape, or an infinite variety of polyhedral shapes between these two extremes.

#52

Stewart T. Coffin

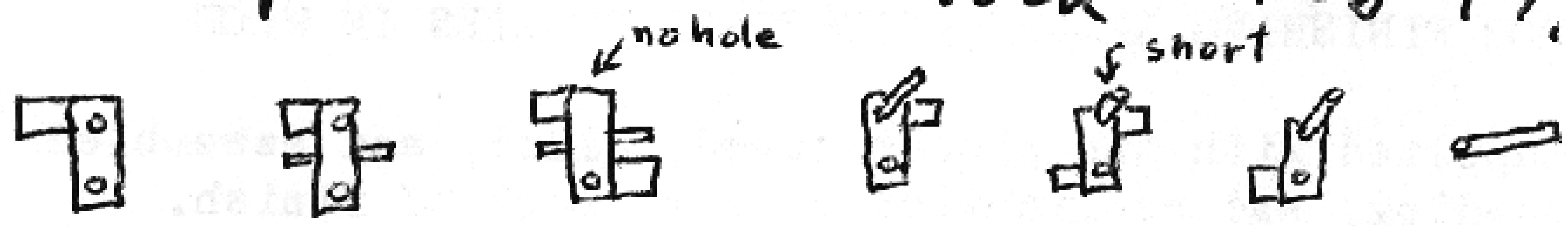


THREE-WOOD VERSION

#59

experimental

~~New Improved~~ Corner Block Feb 17, 1985

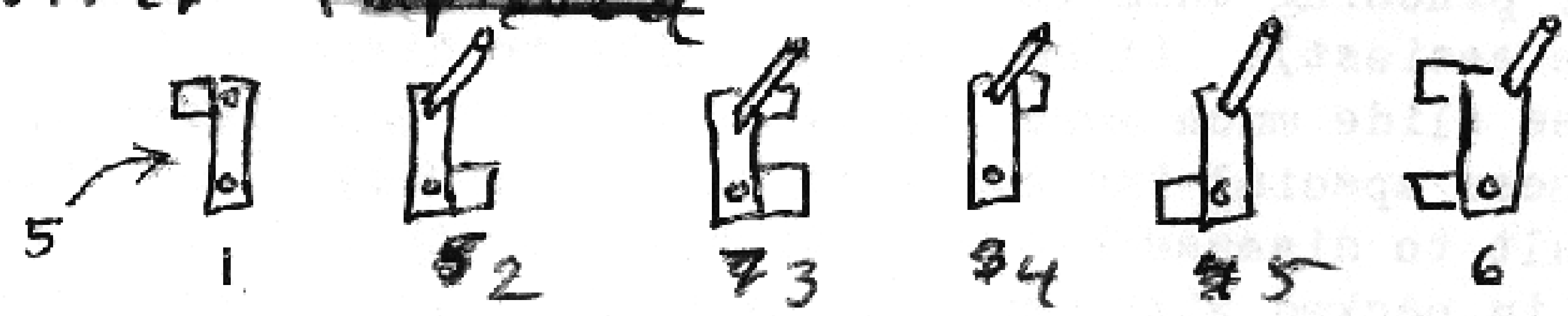


all pieces dissimilar and non-sym.

only one sol. ?

(not made
not very good)

~~Another Improved~~ CORNER BLOCK #59



one solution with minor variation

~~1-5-7-3-4-6~~

~~" - " " " " -6-4~~

sol. 1-2-3-4-5-6

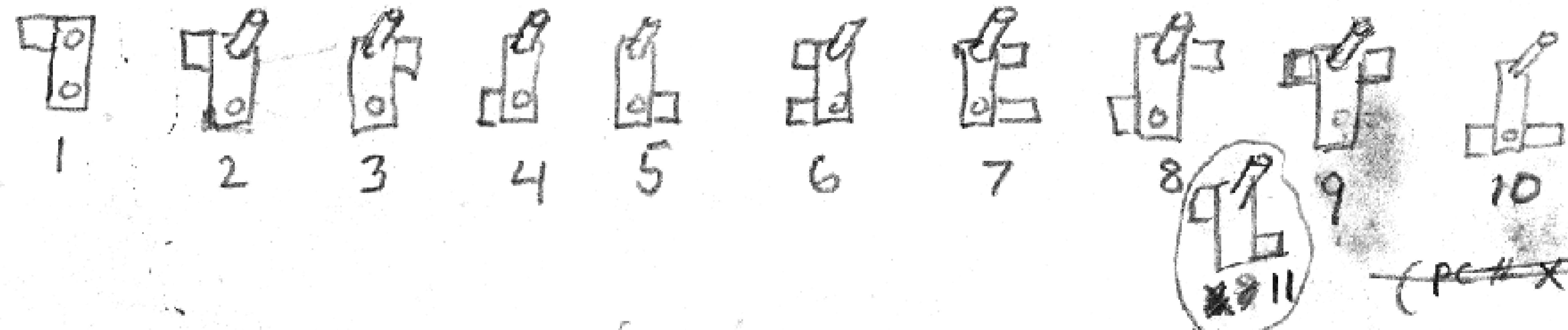
variation 1-2-3-4-6-5

no others

also on page 137 of comp. book

#59

\# 59



~~(pc # x is left out because of symmetry)~~

1-2-3-4-6-7 (1-3A-2B-4-7-9) 1-3B-4B-6-2-7
(1-3A-4A-7-2-9) 1-3B-6B-4 2-7
(1-3B 4B-2-6-10

1-2-3-4-6-8 } x (no sol.)
1R " " " " "

1 2 3 4 8 11 has at least 2 sol.
and 1 2 4 5 8 11 " " " " "
so no need to list #11

1-2-3-4-8-9 } x (1-3B-9A-2-8-5)
1R " " " " " (1-3B-2A-9-8-5)

OLD
\# 59

1-2-3-4-9-10 { 1-4A-3A-9-10-2
1-4A 9A-3-10-2

1R-1-2-3-4-9-10 x

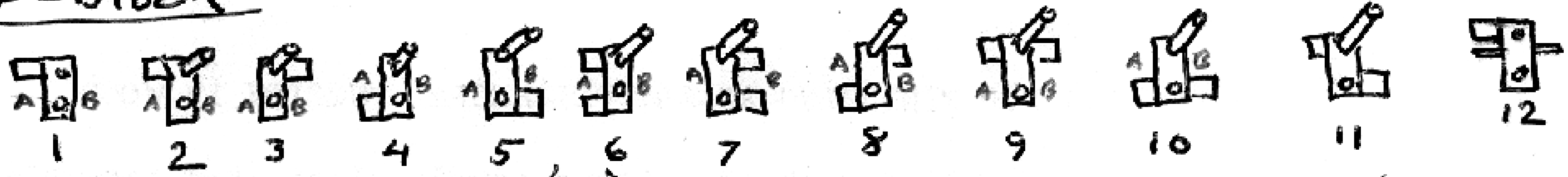
~~NEW~~ DESIGN
CORNER-BLOCK PUZZLE
1980
(now superseded)

Difficulty Index pc #1 can go 4 ways
next pc 5 choices
3rd pc 4 choices x 2 ways 8
4th 3
5th 2
6th 1

4 x 5 x 8 x 3 x 2 =

160
6
960 ÷ 2 = 480

Corner-Block ~~4CA~~ # 59 OBSOLETE



Must use pc#1, must use 3 singles, and 2 doubles

1-2-3-4-8-11 and 1-2-4-5-8-11 both have more than 2 sol,
so no need to use #11 because of symmetry.

1A 2A 3B 4A 6X
7X
8X
9X
10X
5A 6 9 * (has at least 2)

the two doubles will have either no twist or double right twist - if #8 used.
∴ 3 singles + key must have 0 or 2 L twist
∴ Key cannot have R twist if #8 used

---

with #12 1C-12A
1C-12B (2 ways)
1D-12A (2 ")
1D-12B (2 ")
1E-12A
1E-12B (2 ")
1F-12A (2 ")
1F-12B (2 ")

1C-12A-2- 3- 10-6 *
10 X
6 X
3 2X
3 6
3 10 ~~2~~ *

12A 5 3 6X
7X
8X
9X
10 7 *
7 10 3 *

7 4 9

~~1 8 2~~
1-8-6- -2-3-5
-5-2-3

1-8 2- -6-4-5
-4-6-5

1-8-2- 4X
-6-5-X
-10X

1A 2 3 5 7X
8X
9X
10X
2A 4 3 9X
5X
6X
7X
8X
9 5 7 * 9 7 5 *
10X

1B - 5A- 4-3-2-8 *
8X
8X
2X
5A 3 2 4 8 *

#59
~~46A-1~~

OBSOLETE

STEWART T. COFFIN

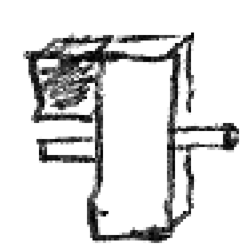
79 OLD SUDBURY RD. RFD I LINCOLN, MASS. 01773

259-8848

Early version of Corner-Block puzzle. Only one made. Has at least three solutions, and for that reason design was shelved in favor of newer version that has only two solutions.

Cherry + Rosewood.

S.T.C.
Sept 1980

pc. # 1, 7, 3, 2, 8, + , (the

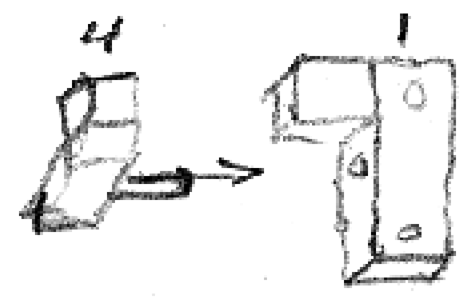
To Art Martin, Christmas 1980

#59 - variation

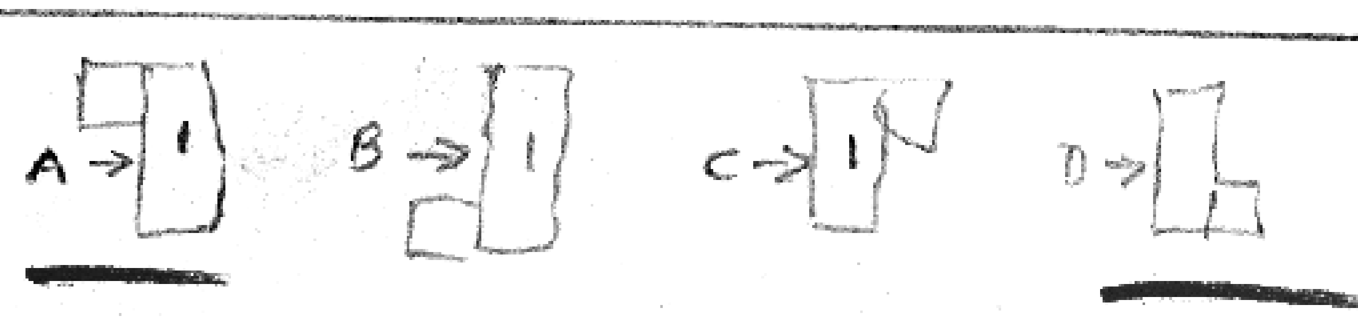
~~New~~ Corner Block, designed?, recorded 17 Oct 1990

order of disassembly: 5, 11, 2, 8, 4, 1

first step ass:



Complete analysis



Ind. 1A
- 2: 4 x, 5 x, 8 x, 11 x
- 4: 2 ← other sol. 4, 2, 8, 11, 5 ✱; 5 x; 8 ← sol 4, 8, 2, 11, 5 ▲; 11 x
- 5 x
- 8 x
- 11: 2 x, 4 x, 5 x, 8 x

Ind. 1B
- 2 x
- 4: 2 x, 5 x, 8 x, 11 x
- 5: 2 x, 4 x, 8 x, 11 x
- 8 x
- 11: 2 x, 4 x, 8 x, 5 x

1C
- 2: 4 x, 5 x, 8 x, 11 x
- 4: 2 x, 5 x, 8 x, 11 x
- 5: 2 x, 4 x, 8 x, 11 x
- 8: 2 x, 4 x, 5 x, 11 x
- 11: 2 x, 4 x, 5 x, 8 x

1D
- 2: 4 x, 5 x, 8 x, 11 x
- 4: 2 x, 5 x, 8 x, 11 x
- 5: 2 x; 4 ← 2 8 11 ✱; " ← 8 2 11 ✱; 8 x; 11 x
- 8: 2 x, 4 x, 5 x, 11 x
- 11: 2 x, 4 x, 5 x, 8 x

#59

so, has 4 solutions

only one rough model made. for sale Oct 1990. Labeled 59-X

~~#64~~ #60

K - 1 2 5 6 - symmetrical

A - 1 2 5 7 - dislocated in SCR

D - 1 2 5 8 - Δ hole in SCR

G — 1 2 9 8 new pc. (not used in SCR because can't ass.)

B - 1 2 9 11 - Σ in SCR

C - 1 2 9 10 Δ in SCR

1 2 10 13 - same as 1 2 9 8

H — 13 10 9 new pc. (not used in SCR because can't ass.)

13 10 13 same as 1 2 5 8

I — 13 12 14 new pc. (don't know why not in SCR)

E 13 12 13 ⊥ used in SCR

14 15 14 same as

F - 12 5 10 ⊥ used in SCR

ABC - in SCR many ways

H can be used only with B, D, or ~~X~~

HBE - next C, D, or F

HBF - ACB - ★ but uses 2 Bs - ~~[illegible]~~

no others - CD + special key 4-2 

HD in slot A×, B×, C×, D× E× F× G× I×

HDE - CBA - 4-2 (CE key) ★ or (BA)

HG X

A~~B~~ in slot ~~B~~ C_1? C_2× D★ (AB key)

mate E + F, lock with D (same as SCR!)

AD - B_1× B_2× E× F× G× I×

AE - B× F× G×

AF - B×

AFD + DEK
(↑ FREE)

A I_1 B× C× D×

A I_2 E G, Augment E_1, Key is broken with pin

or instead of G, use augmented C

B A_1 a, C_2, D E F I×

BD A×G

BDG + CGI
Good except for double G

B E_1, E_2 F G× I

C - B

C - D_1× D_2

C D_2 I - CBE

C F_1 A — DEG ★
C locks A+F G locks D+E

C F_2 B one as. but G is free

C G_1 I C G_2

C - next A×, D×, F×, F×

C I

D

ABC - DEF locks best

EF - CCDI locks good ★

#60

4 February 1984

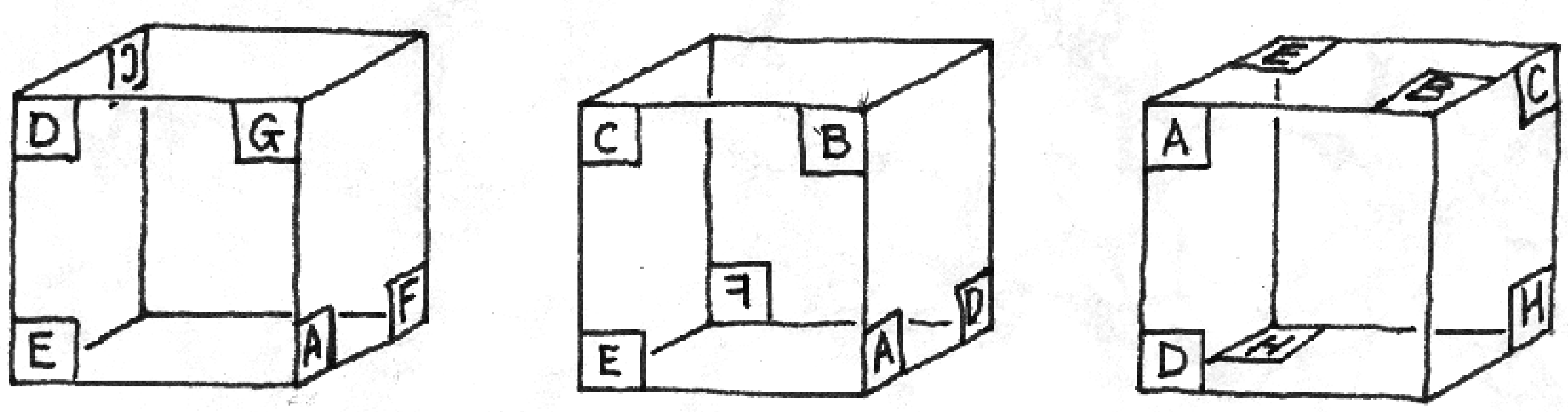
Dear Stewart,

Thank you very much for the Garnet fragments! They actually make a great puzzle as a set of ten.

Although I know I'll be spending a lot more time with them, I thought I'd relate my experience so far. Basically, it has been like yours: I kept stumbling across CFA-DEG, ABC-DEF, and HD-AB-EC, but no other "good" solutions (ones constructed from pieces **A** through H without duplication). Also, I came across several which use the X piece (ABF-EIX, DIG-CBX, HBE-CIX, and the double solution HBE-DIX/HD-BE-IX), but none of them is dependent upon X being a key piece.

I have the hope of going through the possibilities systematically. I've found it helpful to use pencil and eraser on one of your 1" rhombic dodecahedra with an inked line on each face. With a pair of pieces penciled on, it's usually possible to see where things must lead. Unfortunately, there are a lot of pairs to start with. I'll carry it around with me and work on it when I can!

I'm also thinking of a way to program it, based on the fact that in any solution involving only the nine asymmetric pieces, each piece garners at least one of the eight 3-vertices by occupying at least 2/3 of it. (C occupies a whole vertex, and H and I occupy two vertices each.) Thus, with the convention that C is labeled by the "opposite" pair of legs, your three "good" solutions might be designated



Thank you also for the new puzzle list. I will respond to it in my next letter.

Sincerely,

John (LOESER)

P.S. I'm also thinking about Peanut.

#60

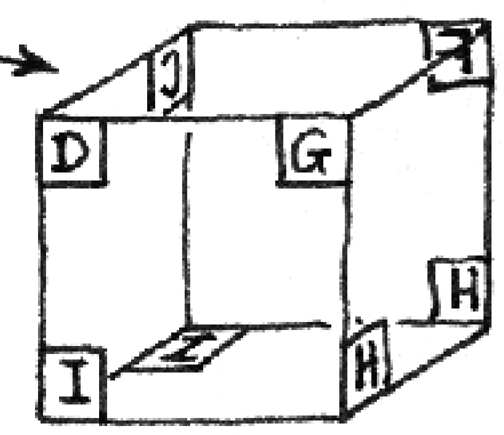
From John Loeser

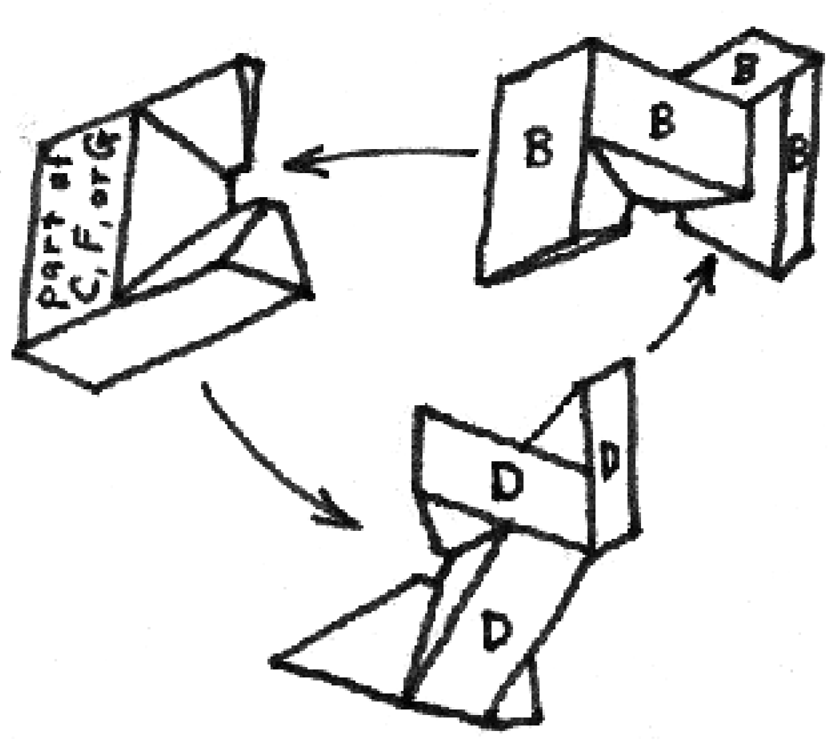
12 February 1984

Dear Stewart,

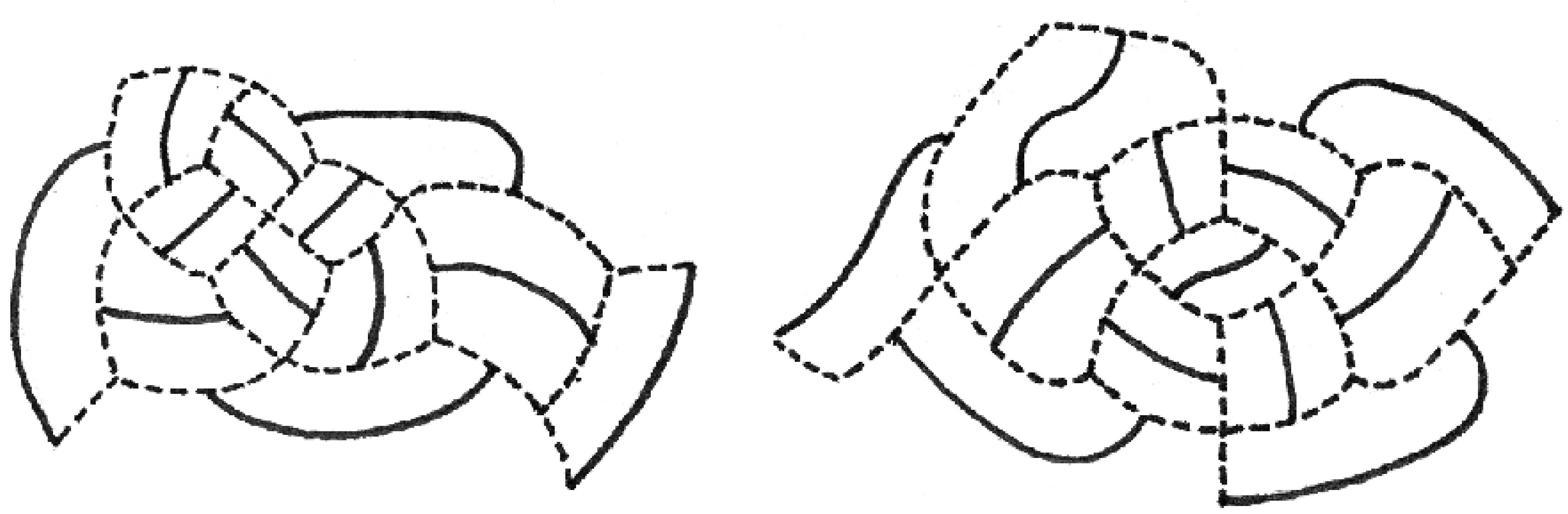
I've gone through the possibilities for Garnet by hand. If I did it right, there are no other good solutions. More specifically, there are no solutions using six of the nine asymmetric pieces which contain piece I, and your HD-AB-EC and CFA-DEG are the only two containing H or G. I haven't started with one of A through F yet, since I assumed that was a well-studied set. However, since there may have been geometrical constraints in Scrambled Scorpius not present here, I think I'll look at that, too.

Speaking of constraints, I should mention that I did find several "solutions", like CDFGHI, which are impossible to construct. I don't know just how many of these there are, since I didn't pursue paths involving constructs with H which I knew were impossible. On the other hand, I didn't find any "solutions" involving more subtle impossibilities, like , and therefore don't think there are any (involving G, H, or I, at least).





In case it's of interest, I found it useful to use planar maps, xeroxed several to a page, to work through the possibilities after some piece was placed. For example, for dodecahedron minus G and minus I, I used these:

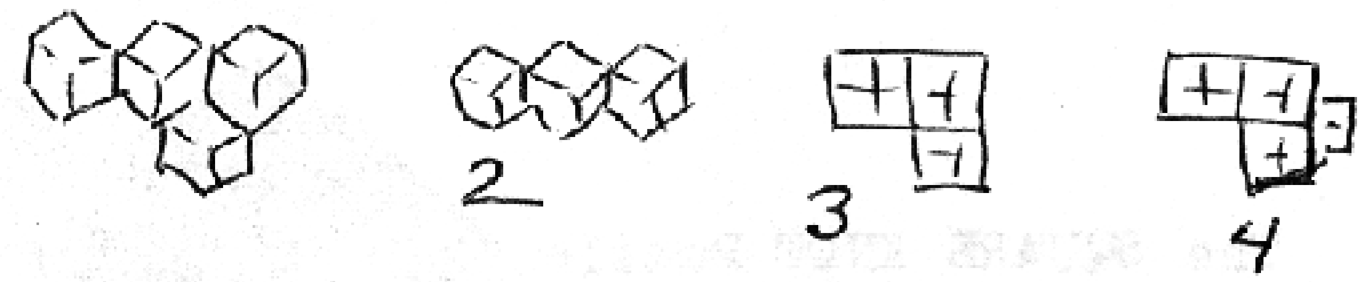


Then it became a matter of drawing five snakes, each winding through four regions in a different way, while never crossing a solid line, etc. With the exception of edge pieces, it's not too hard to see what pieces you're working with, after a while. (By the way, in my last letter, did I say it's usually possible to see what will happen after two pieces are placed? I take that back!)

#60

~~#65~~ 61

SETTING HEN

1. 

1. Setting hen

```
  3
1    3        4     2        2          2
  3             1            4    1
               4    1          4
bottom
```

2. Box, cube

```
2    1          1           4    4
  2          4     1           4
3    2          3           3    1
```

two other solutions by shifting 2 and 3 or 1 and 2

edge-beveled cube will fit better

3. Sq pyr.

```
3 — 3   1
    |   |
4   3   1
2 — 2 — 2
```

etc. edge-beveled cube ok

4. Triang. pyr., omit pc. # 4 edge-beveled cube in box better

5. a. 3 × $2\frac{1}{2}$ × 2.828

edge-beveled cube changes only)

```
1  3                    3-3
            4  1-1                2 - 2 - 2
4-4                     4-1
bottom      2nd         3rd       4th
```

(same start as setting hen, i.e. pc 1+3)

b. 3 × 2 × $2\frac{1}{2}\sqrt{2}$ by shifting pc. 2
(3.535)

Volume of box = $16\sqrt{2}$ = 22.62

" " " 5a + 5b = $15\sqrt{2}$ = 21.21

5a also fits in cylinder $\pi r^2 \times h = \pi\ 1.5^2 \times 2\frac{1}{2} = 18.86$

$2 \times 3 \times 2\sqrt{2}$

```
2 — 2 — 2                   4   1-1
4   3   1       4   1       4   3-3
bottom          middle      top
```

#61

61-A Distorted Cube

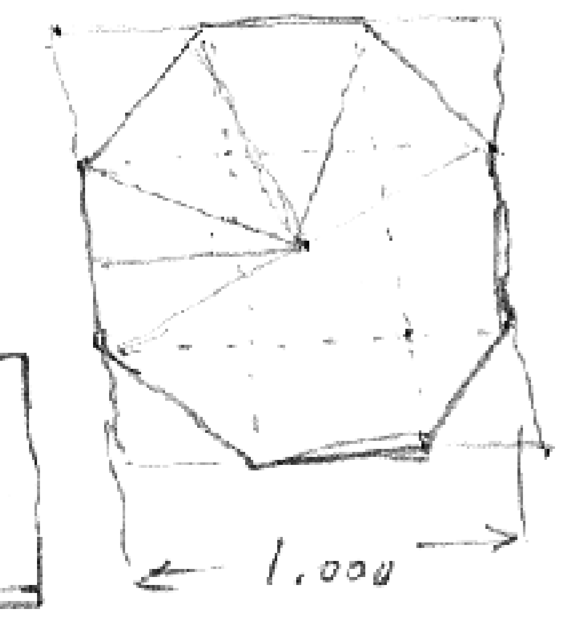
22 Dec 1996

see Puzzle Craft 1992, page 45, for directions on how to make

14 one-inch cubic blocks, edge-beveled to exactly one inch across flats

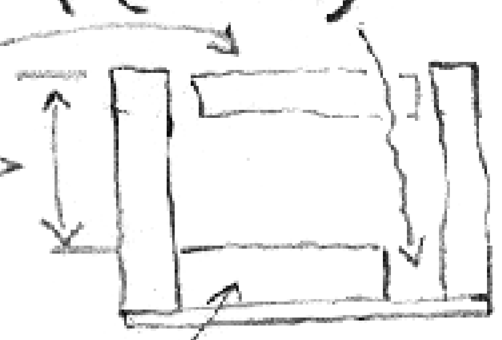
box inside dimensions are $3^+ \times 2.414^+$

(plus approx. 1/16" for clearance)

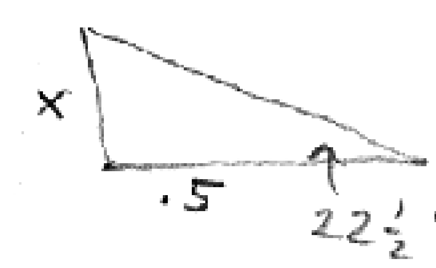


depth is 2.586 to top of bottom block (+.586)
(total 3.172)

top block is 3 x 2.414 x 0.586



bottom block is 2.414 x 2.414^+ x .586

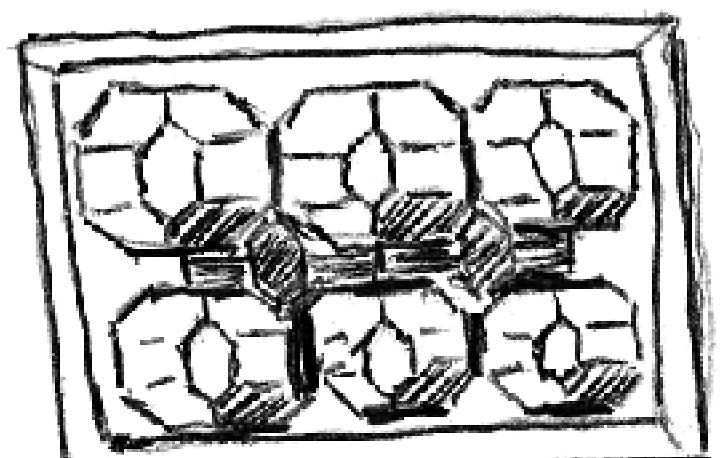


$\tan x = \frac{x}{.5}$

x = .207
2x = .414

solutions

1.

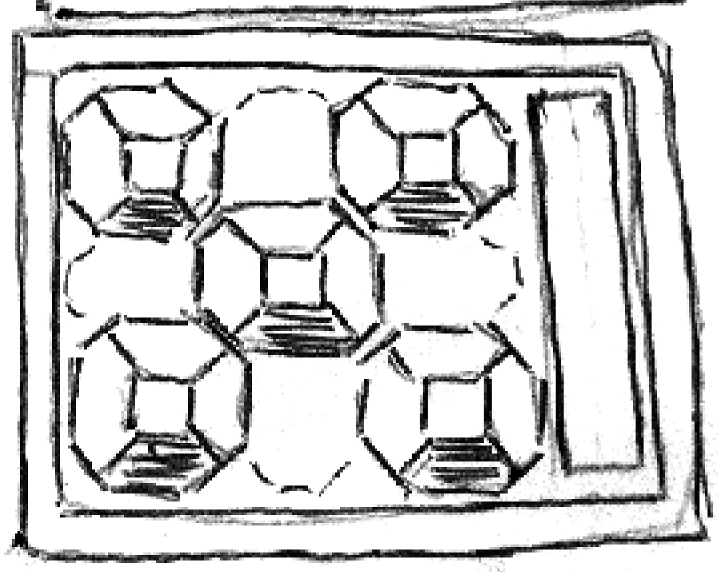


1 1 1
4 3 2
bottom

4 2

4 2 2
4 3 3
top

2.



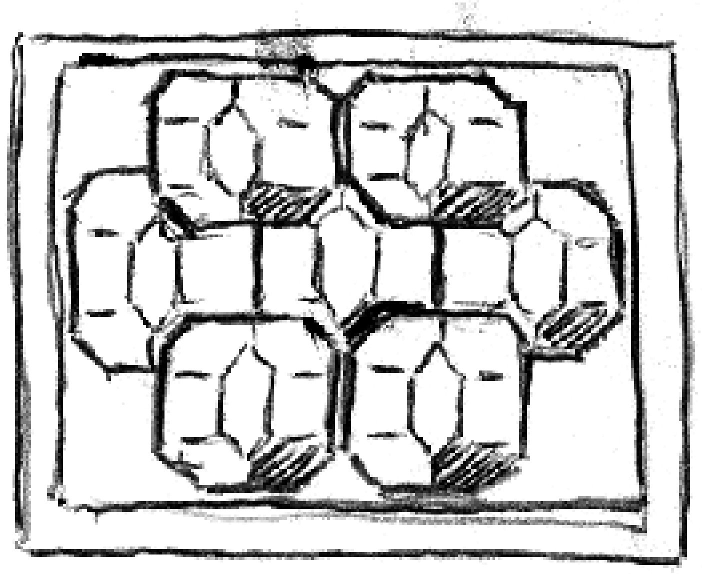
1 2
2
2 3
bottom

1
2 3
4

4 1
4
4 3
top

there are two other solutions by shifting 1 and 2 or 1 and 3

3.



1 1 1
bottom

4 2
3 3

4 2 2

4 4
2 3
top

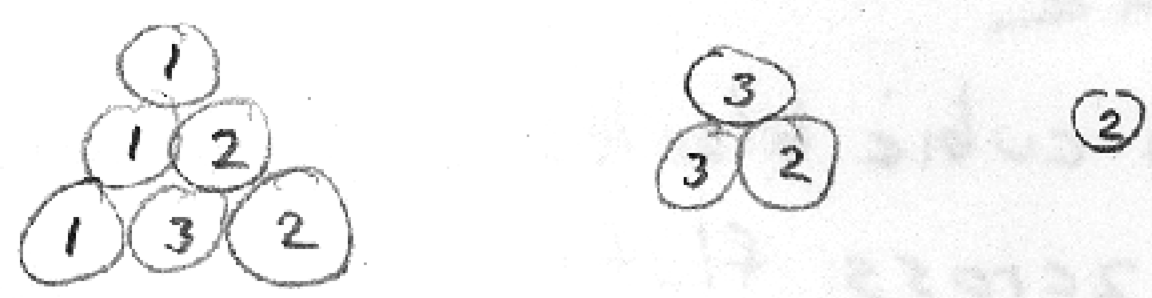
4. square pyramid

3 3 2
4 3 2
1 1 1
base

4 2
4 4

2
top

5. Triangular pyramid, omit piece #4



#63

December 13, 1971

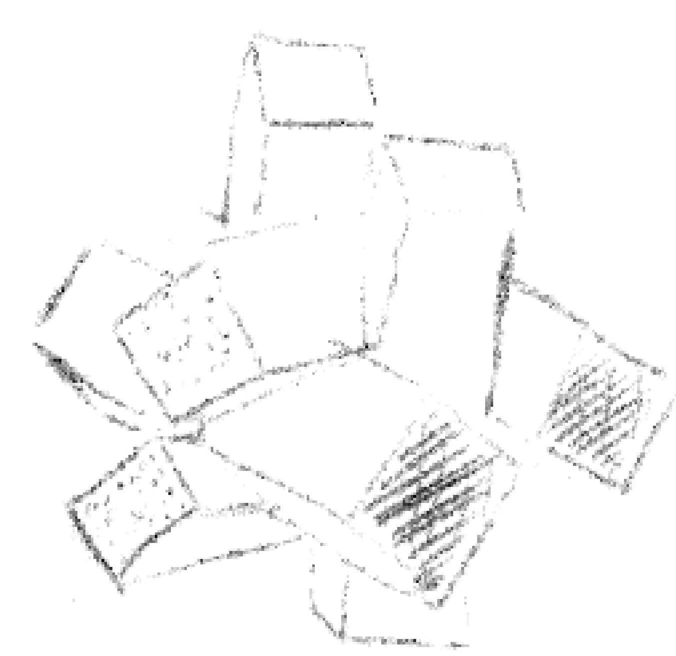
DESCRIPTION OF PUZZLE NO. ~~19~~. TRIXTIX

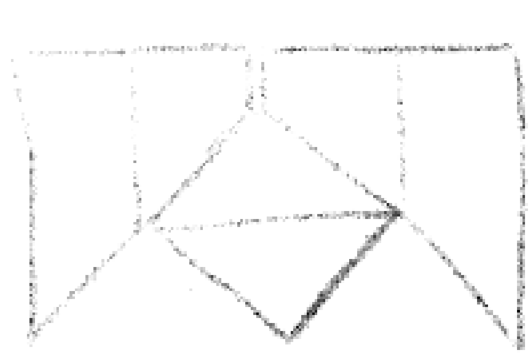
Puzzle No. 19, TRIXTIX, consists of six identically shaped pieces. The shape of a piece is similar to that of Puzzle No. 15, STAR, except that two bumps of square cross-section project from the back of each piece - that is, along the edge farthest from the center of the puzzle.

The effect of these bumps is to produce the illusion of the familiar notched stick puzzle. One is immediately tempted to poke one apparent end-face after another to discover the non-existent sliding "key" piece. More astute puzzle enthusiasts may then suspect that the pieces are notched in the symmetrical Ford-O'Brien configuration. But, the procedure normally followed to disengage the Ford-O'Brien configuration by separating parallel pairs produces the unyielding sensation that the two pairs are bonded together, and close visual inspection reveals that this is indeed the case. Disassembly of the puzzle then appears to be totally impossible. The actual solution, after it is finally discovered by random manipulation or very astute reasoning, is startling. Even after the mechanics of disassembly have been mastered, the visual illusion is so deceptive and surprising that the puzzle should provide a source of perpetual entertainment. #63

The essentially novel aspect of this puzzle and its physical configuration were conceived by me in their entirety on this date, and I have constructed a model on this date of wood.

The pieces readily lend themselves to injection molding, and can be cored entirely from the inside, and ejected without side action.





cc Lonkton Dec 14

#63-A

Copyright:

March 20, 1972

DESCRIPTION OF PUZZLE NO. 19-A, <u>OMNILOCK</u>

This puzzle is a revised and improved version of Puzzle No. 19, TRIXTIX, described on a sheet dated December 13, 1971.

The only geometrical difference between this puzzle and N. 19 is that the square end faces are replaced by notched ends. These notches are right angle (90 degrees) shape, and run parallel to the long axis of the puzzle piece, so as to constitute, in effect, one continuous notch running through the two projecting bumps.

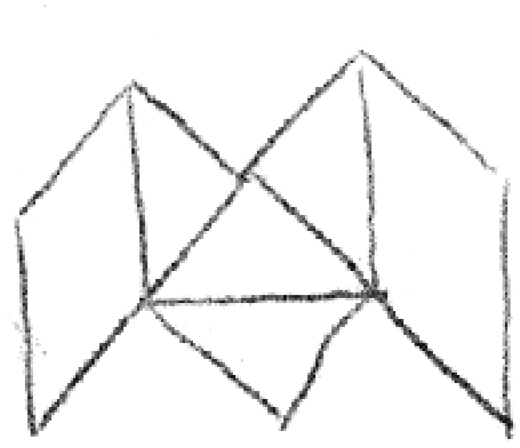
The advantage of this version is that it allows two puzzle pieces to be joined together back-to-back by a friction fit. Two puzzle assemblies can be joined together thusly. In fact, they can be joined together infinitely in all directions, limited only by the number of pieces available.

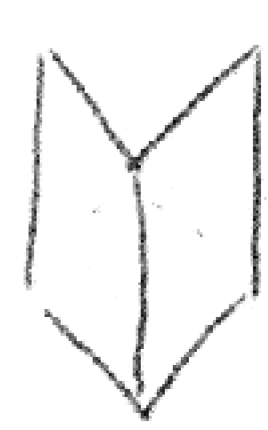
It is furthermore interesting to note that the resulting assembly has no apparent holes or voids, and is perfectly symmetrical.

I am not aware of any previous puzzle designs which combine these features of symmetry, interlocking assembly, and omnidirectional building. I believe, therefore, that this puzzle design is the first to have all of these features, together with another similar design which I developed concurrently with this one, described on a separate sheet and called UNIVERSAL Puzzle Piece.

This improved version was invented by me on March 19, 1972, and I have constructed a wooden model of it today, March 20, 1972.

Stewart T. Coffin
March 20, 1972





#63-A

#66

Copyright:

January 2, 1971

DESCRIPTION OF PUZZLE NO: ~~13~~ 66, CRYSTAL BLOCKS

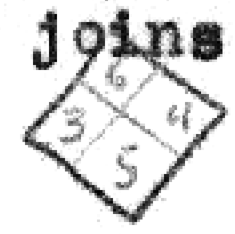
(Revision of original description dated December 12, 1970)

Puzzle No. 13, CRYSTAL BLOCKS, consists of six dissimilar geometrically shaped pieces, and an instruction booklet.

Each piece has the shape of four rhombic dodecahedrons joined together face-to-face in different configurations, except for piece No. 1 which has only two rhombic dodecahedrons (hereinafter abbreviated <u>R-Ds</u>). In order to describe the shape of each piece, it will be useful to first number each face of the R-D for reference purposes, which is done arbitrarily as follows:

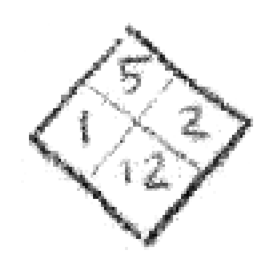
Orient a R-D such that the top and front views are both square. Then, in the front view, the face on the left is 1, and on the right 2. In the top view, the face on the left is 3, on the right 4, toward the front 5, and toward the rear 6. Adding 6 to the number of each of these faces gives the number of its opposite face.

Now, if two such R-Ds are oriented and numbered in this manner, and joined face to face, it follows that the numbers of the two faces thus joined must also differ by six. Thus, the first piece is described arbitrarily as <u>7</u>, meaning that face 7 of the first R-D is joined to face 1 of the second R-D. Piece No. 2 is described as <u>7-6-3</u>, meaning that face 7 of the first R-D is joined to face 1 of the second R-D, face 6 of the second R-D joins face 12 of the third R-D, and face 3 of the third R-D joins face 9 of the fourth R-D. The six pieces are then:



TOP VIEW

Piece No.	
1	7
2	6-6-3
3	7-7-5
4	7-7-3
5	7-2-6
6	7-2-5



FRONT VIEW

It is possible to join four R-Ds together in 28 different configurations. Four of these are such that they cannot be made by joining together two pairs (No. 1 pieces). From the remaining 24, the above five were selected as being the most versatile dissimilar combination, together with Piece No. 1, for constructing a large variety of interesting geometric shapes with a minimum of pieces, as illustrated in a preliminary version of the instruction booklet, which is attached to this description.

The object of the puzzle is to assemble two or more of the pieces together to construct various solid geometric shapes, as shown in the booklet. The particular significance of using the R-D as the basic building block is that it is the only non-orthogonal isohedral (semi-regular) solid capable of filling space completely without voids between units.

Copyright:

(page 2, Revised description of Puzzle No. 13, CRYSTAL BLOCKS, January 2, 1971)

The names given to the various shapes thus constructed generally correspond to the geometric figures which would result if imaginary lines were to be drawn connecting the centers of the outside layer of R-Ds, for example: tetrahedron, octahedron, squafe pyramid, truncated tetrahedron, etc.

The total number of R-Ds in the six pieces is 22. The largest regular polyhedron possible with this set is a tetrahedron using 5 pieces, (20 ~~pieces~~ blocks) Larger and more complex shapes could be constructed by combining two or more ~~kits.~~ sets.

The pieces could be made of any suitable material, such as wood or plastic.

Optionally, a base could be provided to mate with the bottom layer of pieces and prevent them from slipping about, thereby facilitating assembly. However, most of the shapes do not require this, and alternately a rubber band will hold the few unstable assemblies securely .

The size of the pieces in the original model is 7/8 inch across flats; however they could be scaled to any size. For example, a set two or three times this size would appeal to children, and also be useful for class demonstrations. A set 10 to 20 times this size might be suitable for outdoor playground equipment or sculptural display.

Small scale sets could be fabricated most readily by injection molding. Since Pieces No. 2 through 6 can all be made by joining together two No. 1 pieces, an economy in tooling costs is possible by making only No. 1 pieces and then bonding them together. Piece No. 1 lends itself to injection molding, since there is one natural parting plane along eight edges, extending nearly around the piece. The larger scale sets could be made of lighter weight materials such as plastic foam, or of hollow construction using such materials as wood or cardboard. In the latter case, they could be supplied ~~xx~~ in kit form. Also, it might be possible to disassemble the pieces for storage; for example, if a hollow Piece No. 1 were to come apart along the parting line described, the two halves might nest.

The choice of number of pieces and shape of each is virtually limitless in making up a set. The six pieces listed offer great versatility. For reasons of simplicity and economy, especially in the large scale sets, fewer pieces could be used. In particular, a set made up of Pieces#1, 2, and 3 will build many interesting shapes, including a tetrahedron. Another possibility is a set composed of Pieces No. 1, 4, and 5.

Possible names: CRYSTAL BLOCKS, MENTAL BLOCKS, CITY BLOCKS (large set), SUPER-CITY BLOCKS (largest set), DODEC BLOCKS.

OBSOLETE, SAVE FOR REF. #66-X

Copyright:

December 12, 1970

DESCRIPTION OF PUZZLE NO. 13, <u>DODEC</u> ~~ME~~CRYSTAL BLOCKS

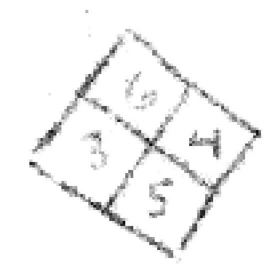
Puzzle No. 13, <u>DODEC</u> ~~ME~~CRYSTAL BLOCKS, consists of ten dissimilar pieces, an instruction booklet, and a base to set the pieces on.

Each piece has the shape of four rhombic dodecahedrons (hereinafter abbreviated <u>R-Ds</u>) joined together face-to-face in different configurations, except for Piece No. 1 which has only two R-Ds. In order to describe the shape of each piece, it will be useful to first number each face of a R-D for reference purposed, which is done arbitrarily as follows:

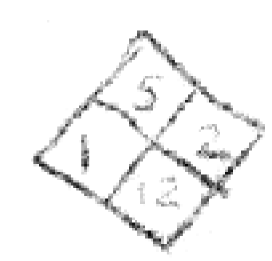
Orient a R-D such that the top and front views are both square. Then, in the front view, the face on the left is 1, and on the right 2. In the top view, the face on the left is 3, on the right 4, toward the front 5, and toward the rear 6. Adding 6 to the number of each of these faces gives the number of its opposite face.

Now, if two such R-Ds are oriented and numbered in this manner, and joined face-to-face, it follows that the numbers of the two faces thus joined must also differ by 6. Thus, the first piece is described as 7-1, meaning that face 7 of the first R-D is joined to face 1 of the second R-D. Piece No. 2 is described as 7-1, 5-11, 7-1, meaning that face 7 of the first R-D joins face 1 of the second R-D, face 5 of the second R-D joins face 11 of the third R-D, and face 7 of the third R-D joins face 1 of the fourth R-D. The ten pieces are then: #66-X

Piece No. 1	7-1
2	7-1,5-11,7-1
3	7-1,2-8,3-9
4	7-1,3-9,2-8
5 -5	7-1,2-8,6-12
6	7-1,8-2,4-10
3 7	7-1,7-1,5-11 -2
8	7-1,7-1,3-9
9	7-1,2-8,5-11
10	7-1,8-2,3-9



TOP VIEW



FRONT VIEW

It is possible to join four R-Ds together in 28 different configurations. Four of these are such that they cannot be made by joining together two pairs (No. 1 pieces). From the remaining 24, the above nine were selected as being the most versatile dissimilar combination for constructing solid symmetrical geometric shapes, as illustrated in a preliminary version of the instruction booklet which is attached to this description.

The object of this puzzle is to assemble two or more of the pieces together to construct various solid geometric shapes, as shown in the booklet. The particular significance of using the R-D as the basic building block is that it is the only non-orthogonal symmetrical solid capable of filling space completely without

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(page 2, Description of Puzzle No. 13, DODEC Mental Blocks, Dec. 12, 1970)

voids between units.

The names given to the various shapes thus constructed generally correspond to the geometric figures which would result if imaginary lines were to be drawn connecting the centers of the outside layer of R-Ds, for example: tetrahedron, octahedron, square pyramid, truncated tetrahedron, etc.

All symmetrical figures constructed thusly may be classified into three groups, depending on whether the center of the figure is a point where four R-Ds come together, a point where six R-Ds come together, or a point in the center of a R-D. Since any such symmetrical construction having one unit in the center must necessarily contain an odd number of R-D units, it follows that no such shapes may be constructed with any or all of the ten pieces listed, since they all have even numbers of units, unless the center unit is left hollow.

The total number of R-Ds in the ten pieces is 38. There are at least nine symmetrical polyhedral shapes which can be made with these. Larger and more complex shapes could be constructed by combining two or more kits.

Many other interesting figures may be constructed having other types of symmetry or geometric form, some of which are shown in the instruction booklet.

Smaller or larger kits could also be offered for economy or variety. For example, most of the smaller shapes can be made with pieces 9 and 10 omitted. A cube is impossible with this kit, but could be made possible with the addition of one piece.

An exhaustive investigation of possible constructions may reveal that minor changes should be made in the shape or number of pieces described here to achieve the optimum.

The pieces could be made of wood or plastic, preferably injection molded plastic in clear or translucent colors.

The base is optional. It is simply a sheet of material, such as plastic, which is essentially flat but contains a mating rhombic pattern to hold the bottom layer of pieces in the various shapes and prevent them from slipping about, thereby facilitating the assembly.

First Draft - Preliminary   December 12, 1970

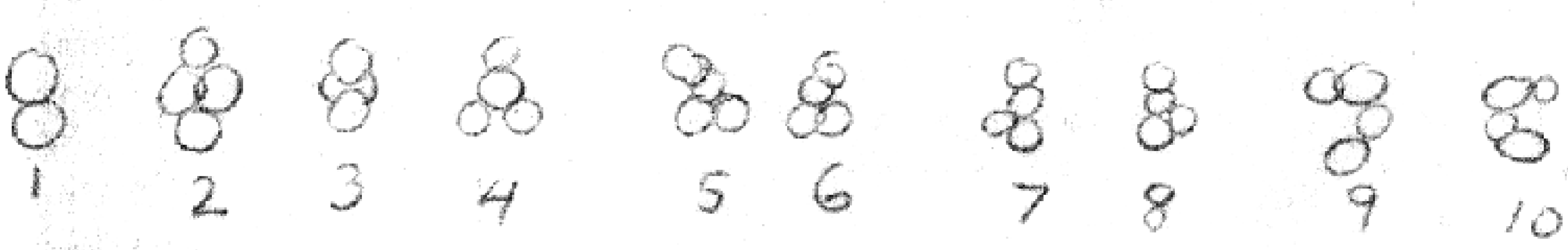
DODEC

CRYS~~Men~~tal Blocks

The ultimate three-dimensional puzzle

Based on geometric properties of solids ~~known~~ discovered by to the ancient mathematicians of Gree~~ks~~ ~~mathematicians 2000 years ago~~, and made possible by the miracle of modern injection molding ~~plastics~~.

The DODEC Puzzle contains ten pieces, no two alike. For reference purposed, they are numbered as follows:



Notice that Piece No. 1 has the shape of two blocks joined together, and all the others have four blocks, making a total of 38 blocks. These blocks are rhombic dodecahedrons. They have an amazing property of fitting together in space in a manner which is baffling, to say the least.

Before we become too deeply involved in the geometrical perplexities of the rhombic dodecahedron, you probably want to test your skill assembling ~~the pieces~~ some pieces. Of all solid geometrical shapes, the most intriguing are the regular polyhedra-the Platonic solids. The simplest of these is the tetrahedron, shown in Fig. 1. Now take Piece No. 4 and imagine ~~lines~~ straight lines joining the centers of each of the four blocks in this piece. This piece represents the tetrahedron of ~~size~~ size 1, meaning that the length of each edge is one unit - the distance between centers of adjacent blocks.

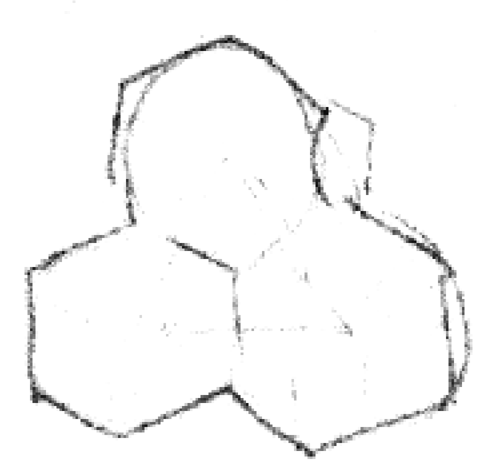


FIG 2
TETRA

of size 1
Next in order of complexity is the octahedron, Fig. 3. This is extremely simple, requiring only two pieces, and having only one solution.

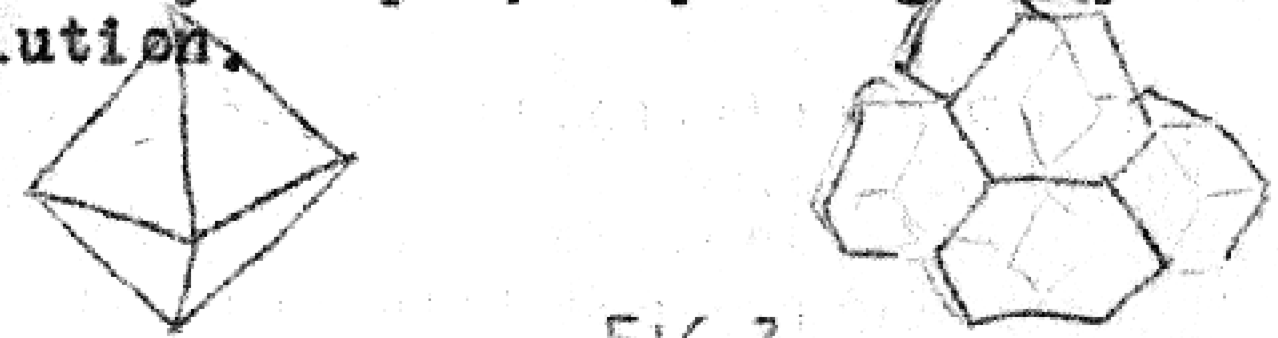


FIG 3
OCTAHEDRON SIZE 1

The next larger polyhedron, in terms of number of blocks, is the size 2 tetrahedron, Fig. 4. Here is a hint before trying this or any of the more complex figures which follow: Study the illustration and figure out exactly how many blocks are required. This will tell you not only how many pieces to use, but also whether or not to use Piece No. 1. How?
There are 11 solutions to this one. How many of them can you find?

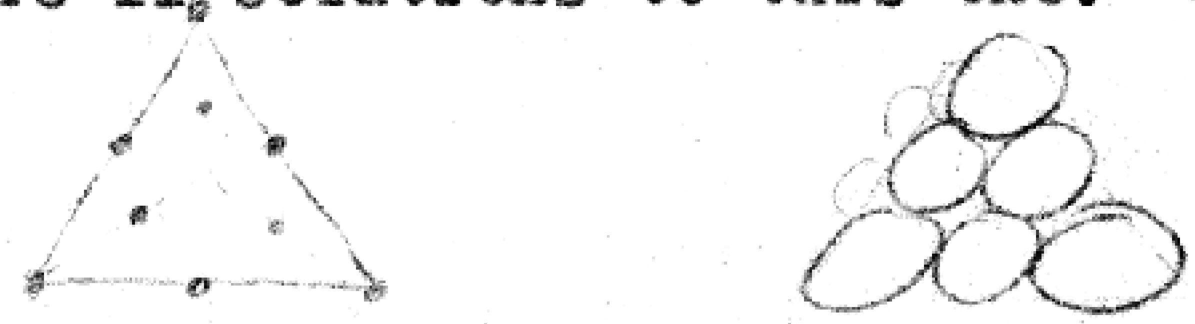


FIG 4 TETRAHEDRON, SIZE 2

~~Next in order of size would be the 14-block cube of Fig. 5. It has been proven impossible to construct with this set. Can you figure out how this was proven?~~

Next in oder of size is the truncated octahedron of size 2, Fig. 5. Truncated means with the apexes cut off. It is also a truncated cube. One of the interesting relationships between these two solids is that as you truncate one, you approach the other. This figure is half way between the two.

Remember our hint about counting the blocks? In the view shown, there are three hidden on the bottom layer, apparently seven on the second, and three on the top. But all of the pieces have even numbers of blocks. What is the only way this shape can be constructed so as to maintain symmetry and appear solid on all sides?

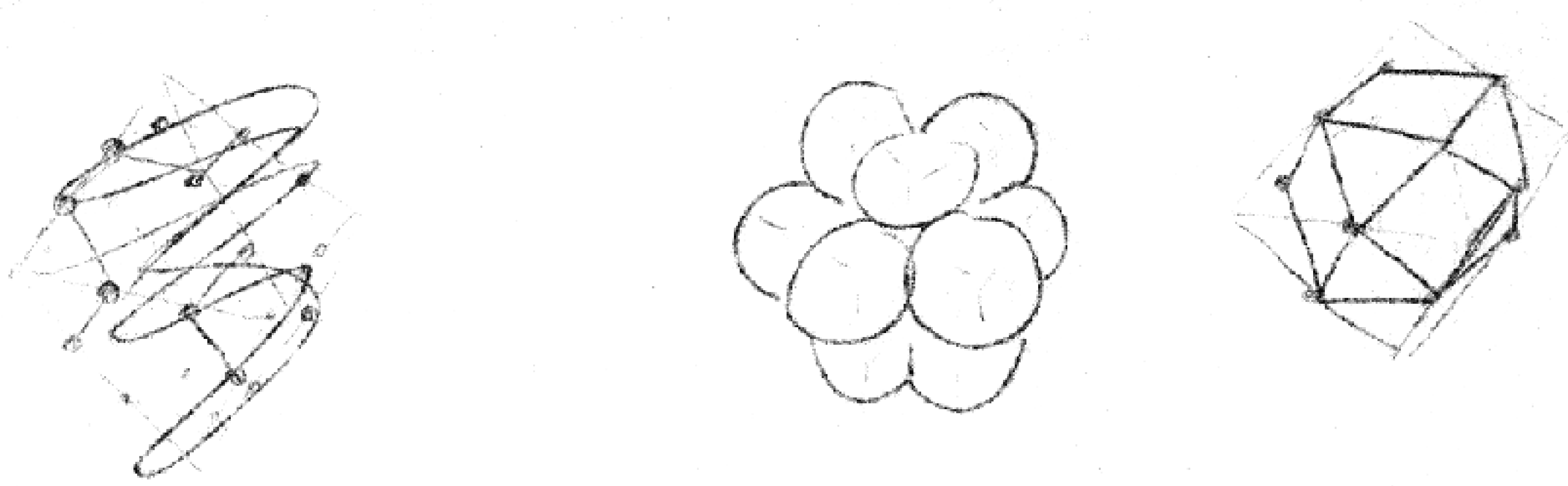


FIG. 5
TRUNCATED OCTAHEDRON, SIZE 2

Now we are ready to discover an interesting property of the rhombic dodecahedron which will prove useful to know. It has two types of apexes - one where three faces come together, and one where four faces come together. How many of each? Now pack some pieces together and notice that like types of apexes always come together at a point. They will not fit any other way. Exactly how many of each type of apex come together at a point when the surround space is filled? Count them carefully.

Now go back to each of the polyhedra we have constructed and find the center of the figure. If it is a point where ~~thxx~~ four apexes come together, we call it TYPE 1. Six apexes - TYPE 2. If it coincides with ~~thexcentexxofxaxxhmmkt~~ the center of a ~~kkmm~~ rhombic dodecahedron, ~~we~~ it is TYPE 3, and we know from the preceding problem that this space must always be hollow. All of the symmetrical polyhedra we construct must be one of these three types.

TYPE 1 Family

The simplest solid in this family is the size 1 tetrahedron, represented by Piece 4.

~~Next is the~~ truncated size 3 tetrahedron, Fig. 6. ~~Unlike the cube and octahedron, when the tetrahedron is~~ ~~txxxxxxxd~~ increasingly truncated, it approaches becoming another one of itself inverted. (For an understanding of why this is so, count the numbers of faces and apexes of the three figures.) it first becomes an octahedron and then

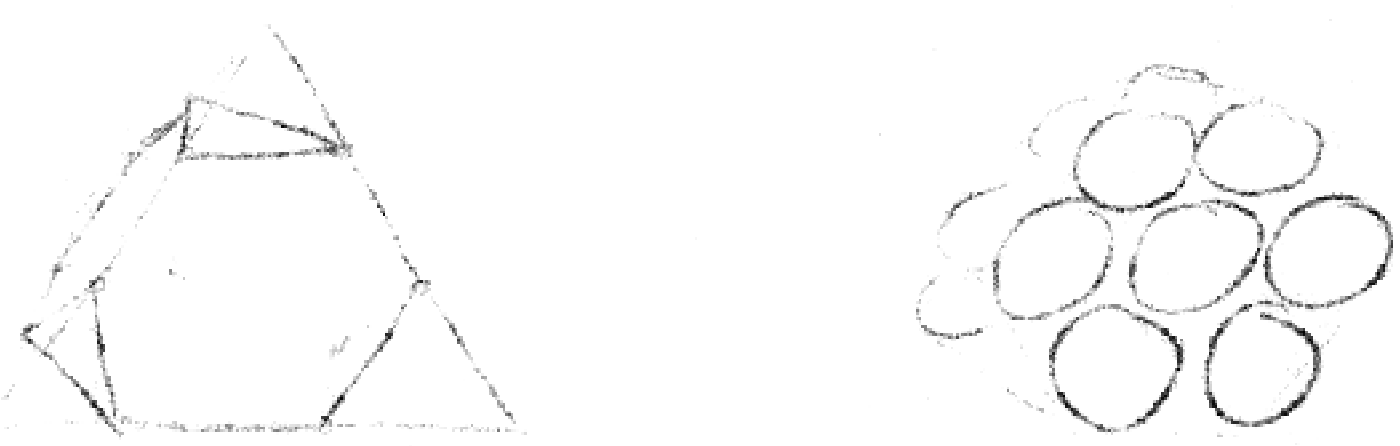


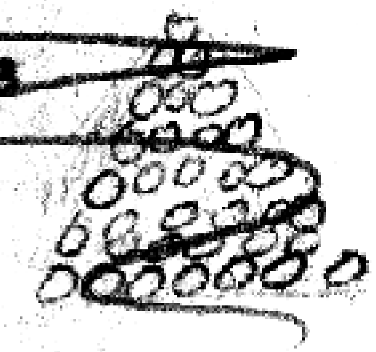
FIG 6

Now add ~~thexfaxx~~ a block to each of the four apexes of the above figure to obtain the size 3 tetrahedron. It may not be quite that simple, but it is possible. In fact, there are several solutions. This beautiful figure is also illustrated on the cover of this booklet. Fig 7

FIG 7 TST 9/2/83

Adding three blocks on each face of the size ~~xxx~~ 3 tetrahedron produces the 32-block truncated cube, Fig. 8. This is the largest symmetrical solid of TYPE 1 possible to construct with this set of pieces. By combining two or more sets, the following are theoretically possible:

~~Size 6 tetrahedron 84 blocks~~



<u>TYPE 2 Family</u>

Size 1 octahedron, see Fig 3

Size 2 tetrahedron, see Fig 4

The next figure in this family would be the 14-block cube shown in Fig 8. It has been proven impossible to construct with this set. In fact, it would even be impossible with an entire set of No. 1 parts. Can you prove this?

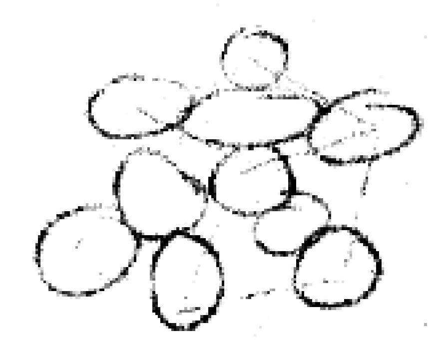


FIG 8 CUBE

Adding four blocks to each face of the cube above produces the truncated octahedron of Fig. 9. This figure requires all ten pieces and is extremely difficult (may be impossible).

FIG. 9

<u>TYPE 3 Family</u>

Trunacted size 2 octahedron, see Fig 5

Octahedron, Fig 10

Truncated tetrahedron size 4, Fig. 11

Size 4 tetrahedron Fig 12

Also, catalog of many other interesting figures, discussion of symmetry, reflections, etc., with suitable illustrations.

~~See also Beeler folder~~

#67

Copyright:

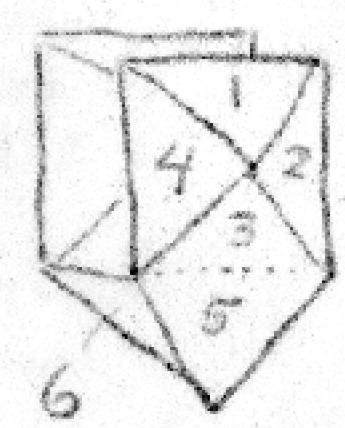
March 18, 1973

Description of Puzzle No. 13-B. ~~PEANUTS~~

Puzzle No. 13-B, PEANUTS, consists of a set of puzzle pieces and an instruction booklet. Each piece consists of two identical halves joined together. Each half consists of half of a rhombic dodecahedron, produced by tesselating a rhombic dodecahedron with planes which cut eight of the faces along their short diagonal. Two such halves nest together with a sliding frictional fit. Different types of pieces are generated by joining the halves by different faces.

The object of the puzzle is to assemble some or all of the pieces to form various geometric or animated figures, as illustrated in the instruction booklet, similar to Puzzle No. 13 - Crystal Block, and Puzzle No. 13-A - Shatterblock. This new design has the advantage over these previous two of being more versatile, and is also easier to mold.

In order to describe the various pieces, it is useful to arbitrarily number the various ~~fxxm~~ external faces of half of the tesselated rhombic dodecahedron, as shown at right:



The various pieces may then be described by giving the numbers of the joined faces. There are six such faces, and they may be joined in a total of 20 different ways. Of these, pieces 1-1, 1-3, and 1-5 are rejected because their interlocked shape makes them impossible to assemble. Also, piece 5-6 is less favored because it cannot be easily cored out in molding. The remaining 16 pieces have been analysed by arduously studying the multitude of interesting shapes that can be assembled with the various pieces in different numbers and combinations. The most versatile set would contain all 16 pieces, and would have astronomical numbers of possible assembled forms. However, it would lack the elegance of simplicity and symmetry. At the other extreme, a set containing equal numbers of only 2-4 and 3-3 pieces, or possibly 2-4 and 3-6 pieces, would be capable of making most of the desired shapes.

There are two distinctly different types of solutions to the puzzle problems. In one, the pieces form one continuous chain which closes on itself and produces a totally interlocking assembly. In the other, the pieces are first subassembled into basic shapes such as triangles and squares by this same interlocking assembly, which in turn are fitted together without interlocking action to produce the desired form. These are referred to as interlocked and divided solutions respectively.

A set containing two each of pieces 1-6, 2-4, 2-5, 3-4, 3-6, and 4-6 was sconsidered ~~sixmxm~~ studiously, and was found capable of making every geometric shape sought for except the 10-block tetrahedron. However, because of the large variety of piece, three of which lack any form of symmetry, the larger solutions were mostly a matter of trial and error, with little if any logic or symmetry. Therefore, this combination was finally discarded in favor of a set containing three each of pieces:

1-6, 2-4, 3-3, and 3-6
yel blu grn red

This set is capable of making the 2-block "Peanut", 3-block "Triangle", 4-block "Square, 4-block "Tetrahedron, 4-block "Diamond, 5-block "Square Pyramid", the 6-block "Octahedron" unfortunately only in divided solution, the 10-block "Tetrahedron" in divided form, and the 12-block "Cuboctahedron". The Cuboctahedron

#67

uses all the pieces, has an axis of symmetry in assembly, and is especially attractive if the four types of pieces are in contrasting colors.

This puzzle has not only the advantage of a large number of problems which should provide an almost perpetual source of amusement for the puzzler, but also a wide range of difficulty. The smallest problems are the easiest, starting with the 2-block "Peanut". As the number of block in a problem increases, the solutions become rapidly more difficult. The 4-block Tetrahedron is surprisingly baffling. One of the interesting aspects of this puzzle is that not only ~~the~~ must the correct pieces be selected and assembled in the proper location, but each piece has a choice of ends to use, and in most cases also a choice of rotation 180 degrees. Add to this the fact that in most problems, the pieces must also be assembled in the correct order, and one can begin to imagine why even the simple assemblies like the 4-block tetrahedron can be confusing. Another feature of this puzzle is that for puzzlers who are less adept, there is an easy way out for many of the problems, which is to solve them in divided form. For example, the 4-block Tetrahedron can be made with two Peanuts. However, the advanced puzzler would be encourage to seek the more difficult and elegant interlocking solutions. For those who have no inclination whatsoever for puzzles of this sort, it can be an interesting pastime to simply assemble the pieces in random order to form weird shapes. Even an infant could do this.

Another advantage of this puzzle is that one could proceed to problems requiring two or more sets. I have not investigated this yet, although I do know that a divided 20-block Tetrahedron is possible with two sets. This interesting capability is practically unique among interlocking puzzles to my knowledge, the only others being my Geo-Logic line and Lynx. It has the added advantage of encouraging more sales.

It would seem that there ought to be some interesting games that could be developed with one or more of these puzzle sets. I have not investigated this yet, but one which comes to mind would be more or less as follows. All pieces are placed in a pile, unassembled. Players in turn draw from the pile until all pieces are taken, and all players have an equal number. Players try to make an interlocked assembly using all their pieces. First to do so is winner. Players may swap pieces freely. Two, three, or four players could play with one set. For more players, use more sets. A variation would be to draw the pieces blindly out of a "hat".

The pieces would presumably be made by injection molding, and have been purposely designed so they can be molded easily. The wooden model I have made has blocks 1-1/8" across flats and is very nice to handle. I would prefer to see solid pieces this size, but if absolutely necessary for economy, they could be reduced slightly in scale, or cored out from the inside with no effect on the external appearance of the assembled shapes. The pieces should be in four contrasting colors, one color for each type. The puzzle would be sold assembled in the Cuboctahedron solution.

This puzzle is an original design of mine. I have developed it during the past two weeks, made a wooden scale model, and compiled a large list of solutions to the various problem shapes.

Stewart T. Coffin
March 18, 1973

First Draft - Rough Outline of Proposed Instructions for PEANUT PUZZLE

Cover: Illustration of Cuboctahedron solution

Introduction: Illustrate four types of pieces, label A, B, C, D.

Problems: ~~ixxxPeanutxProblem~~ Illustrate problem, describe shape, number of blocks (pieces), and number and types of solutions possible, degree of difficulty.

1. Peanut Problem- 2 solutions possible, 2 Peanuts made with one set.
2. Triangle " - 1 " " , 3 Triangle " " " "
3. Square " - 2 " " , 1 Square " " " "

At this point, explain two types of solutions - interlocked and divided. Square has one of each. Divided for novice, experts try interlocked.

4. Tetrahedron Problem, 2 solutions possible, 1 Tetrahedron made with one set.
5. Diamond " , 4 " " , 1 Diamond " " " "
6. Square Pyramid " , 3 " " , 1 Sq Pyramid " " " "
7. Octahedron " , 1 " "
8. Canoe " , 3 " "
9. Large triangle " , 1 " "
10. Hex Ring " , 2 " "
11. Large Triangle " , 1 " "
12. Cuboctahedron " , 1 " "

13. Problems ~~xxx~~ for which no solutions has yet been found.

14. Problems which can be proven insoluble.

15. Problems with multiple sets.

Games: Describe one or more games, give rules, strategy.

Copyright:

March 30, 1974

Description of Puzzle No. 13-C, PEANUT PUZZLE

This is a revised description of Puzzle No. 13-B, PEANUTS, dated March 18, 1973. The number of pieces is reduced from 12 to 6, and the types of pieces reduced from 4 to 3. Thus there are two pieces of each type.

For a description of the pieces, refer to 13-B, and to the wooden model submitted with this description. The pieces will be referred to as R, Y, and G, corresponding to their color in the model.

Twelve puzzle problems are illustrated in the accompanying color photos. Although many other constructions are possible with the set, these twelve symmetrical figures represent the most obvious and the easiest to describe and visualize.

Problems:

1. Peanut - make two with one set, YY and GG.
2. Triangle - make two with one set, RYG and RYG.
3. Tetrahedron - RGRG
4. Diamond - RGRG
5. Square - RYRY
6. Ring - two solutions, RYGYRG and RRGYYG.
7. Octahedron - made by stacking two Triangles, not joined together.
8. Jack - " " " " " " "
9. Canoe - has square base, up-turned ends, several solutions found using all six pieces.
10. Raft - rectangular base and up-turned ends, with diamond shaped hole in bottom, all six pieces, probably several solutions.
11. Leaning Triangles - RRGYYG.
12. Eskimo - RYYRGG

Suggestions for further problems:

1. Figures believed to be impossible, or known to be.
2. Figures with multiple sets: Pyramid, Large Triangle, 12-piece ball, etc.

Notes on fabrication: These pieces could be injection molded in plastic, using a simple 3-cavity mold. They could be cored out from the inside if necessary, but it would be desirable not to do so. Contrasting bright colors should be used, such as those in the model.

The puzzle would be sold assembled in one of the figures which uses all six pieces, probably the Ring, together with instruction sheet. The problems listed above are tentative, and will be revised if more interesting ones are discovered.

Stewart Coffin
March 30, 1974

67-A

Copyright:

March 7, 1973

Description of Puzzle No. 13-A , SHATTERBLOCK

Puzzle No. 13-A, SHATTERBLOCK, consists of five different kinds of pieces. The standard puzzle set would contain two of each, for a total of ten pieces. Each piece may be regarded as consisting of two equal halves, and each half is the mirror image of the other half in three of the kinds of pieces, but in the other two kinds of pieces the two halves are essentially identical to each other, but are mirror images of the halves of the other piece. Any two halves ~~which are mirror images of each~~ of any of the pieces are either identical to each other, or mirror images. If they are identical, they will not fit together. If mirror images, they will plug together to form a rhombic dodecahedron, exactly like Puzzle No. 18, Pennyhedron. For convenience, the halves are referred to as "right" or "left". If the outside face of the projecting section slants upward to the left, as shown in the illustration, the piece is defined as "left", otherwise "right".

Piece No. 1 consists of a right and left half joined side-by-side, both pointing in the same direction.

Piece No. 2 is similar to No. 1 except that ~~some of~~ the two halves point in opposite directions.

Piece No. 3 is similar to No. 2 except that the pieces are joined back-to-back.

Piece No. 4 consists of two left halves joined back-to-back so that they face in directions 109½ degrees apart.

Piece No. 5 consists of two right halves joined side-to-back so that they face in directions 70½ degrees apart.

67-A

In pieces 4 and 5, one of the faces of one of the halves may be omitted in order that the piece may be injection molded without requiring side action. In most of the puzzle problems, the voids thus created occur internally and do not show.

The object of the puzzle is to assemble some or all of the pieces to form various geometric or animated figures, as illustrated in the accompanying instruction booklet. In this respect, this puzzle is quite similar to Puzzle No. 13, Crystal Block. One of the reasons for this new version was to reduce the cross sectional thicknesses, as compared to Crystal Block, for faster mold cycle and lower production cost. Also, one less mold cavity is required. This puzzle is, if anything, even more confusing than Crystal Block. It also has the added interest of interlocking action, which Crystal Blocks lacked.

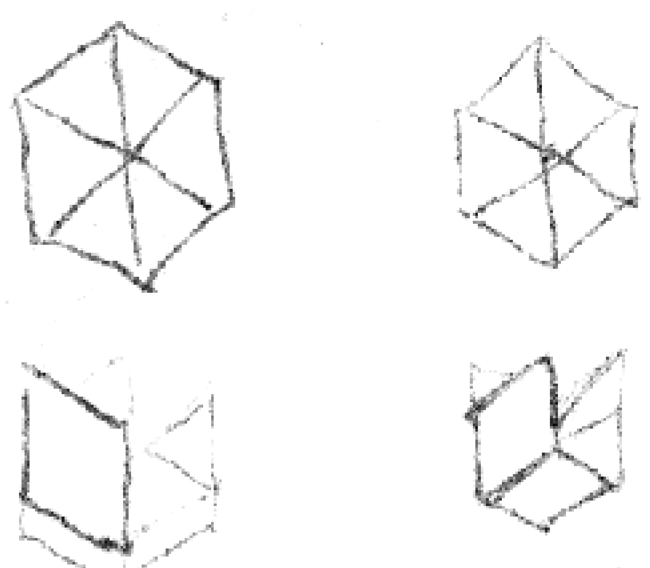
The pieces could be made of injection molded plastic. A block size of one inch across flats would probably be the best scale. The pieces could be in five bright contrasting colors, such as:red, yellow, green, blue, white. It could be sold assembled in the pyramid shape, which uses all pieces and is extremely difficult. This would made a pretty assembly about three inches high.

The method of joining pieces is omnidirectional, so there is obviously no limit to the number of pieces that could be used. The instructions could include some very challenging shapes for two or more sets. It may turn out to be possible to construct a 20-block giant pyramid with two sets, although I have not yet succeeded in doing it, as well as most of the other figures in the Crystal Block instructions. In addition, figures like rings or interlocking loops could be made, which were not practical with the Crystal Block pieces, both because of their shapes, and the fact that they did not lock together.

Considering the different sorts of puzzle sets that could be devised using pieces of this type, made up of identical or mirror image halves, joined on different fawes and at different angles, the possibilities are almost endless. Furthermore, the rhombic dodecahedron can be tesselated in different ways, making the number of possible combinations astronomical, even with only a few pieces. One such tesseletion was investigated in this study, other then the one shown. The problem with most such combinations is that either a large number of pieces are required, or else very few shapes can be made with the set. After considerable study, this five pair combination was selected as being the best choice, but further study is being made of this.

This puzzle was developed by during the past two weeks. A wooden model with $1\frac{1}{8}$ inch blocks has been made, but a smaller one would probably be more practical. A first draft of a proposed instruction booklet is also included with this description.

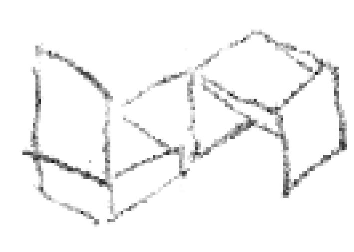
Stewart T. Coffin
March 7, 1973



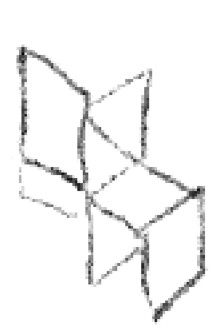
LEFT RIGHT

#1

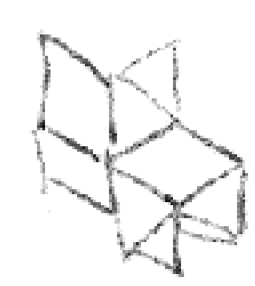
#2



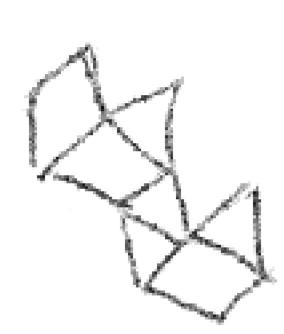
#3



#4



#5

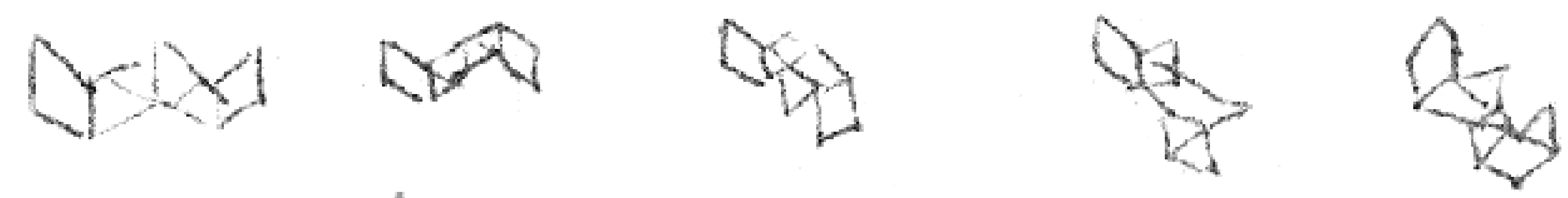


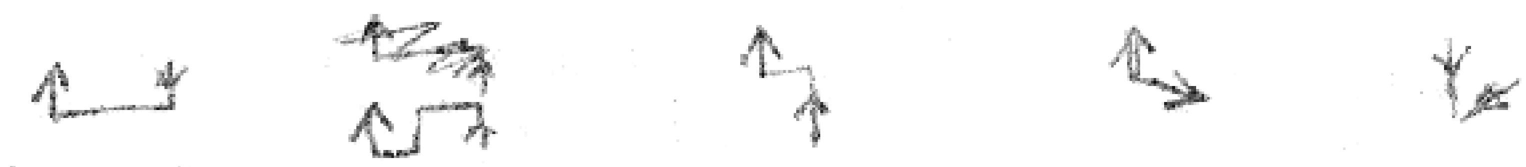
67-A

First Draft, Shatterblock Instruction Booklet, March 9, 1973

Note that the Shatterblock set contains five different kinds of blocks, two of each. For convenience, the blocks are numbered as ~~foxiaw~~ shown:

Number — 1, 2, 3, 4, 5





Symbolic represeatation:

The halves of two different blocks plug together to form a twelve sided solid (rhombic dodecahedron). There are two different kinds of halves, and only dissimilar pairs will mate.
Practice exercised: The object is to fit the ~~six~~ blocks together in various ways to construct the various problem shapes illustrated. Since all halves are to be mated to each other, the blocks are like links in a chain, and form a closed loop. The smallest and easiest shape to construct is a three-block triangle, ~~xhmmxx~~ Fig. 1. A slightly more difficult figure is the four-block triangular pyramid, or tetrahedron, Fig. 2. There is one other figure which can be constructed with four blocks - we call it the Rocking Horse, Fig. 3. You can make two pyramids or two rocking horses with one puzzle set (which ~~xaxaxmixt~~ contains a slight hint on how to make them) and fit them together in various ways to make other figures. The Rocking Horse is one of the few problems that can be solved in two entirely different ways. Can you find both?


FIG 1


FIG 2

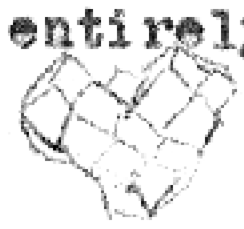


FIG 3

The Square Pyramid, Fig. 4, contains five blocks, and is considered more difficult than any of the preceeding. One apex block rests on a four-block base. For a hint on how to do it, try to discover the <u>only way</u> that five such blocks can be joined together in a closed loop, and proceed from there.


FIG 4,

Another symmetrical ~~xmtmxaxtimx~~ five block figures ~~is~~ are the Scoop, Fig 5, and Crowfoot, Fig. 6. See what other interesting five-block shapes you can make.

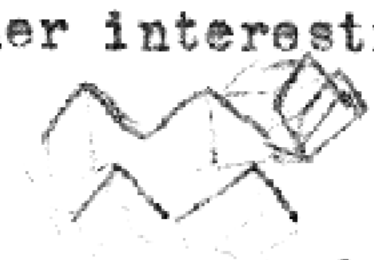


FIG 5

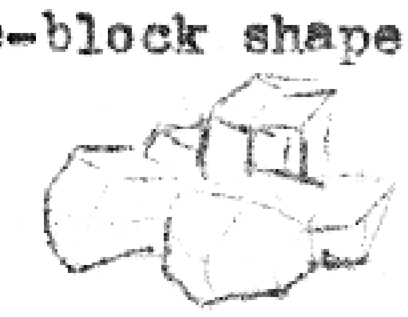


FIG 6

The six-piece Octahedron, Fig. 7, may be visualized as the square pyramid (Fig 4) with an apex block underneath as well as on top. Or, you can also consider it as, two triangles (Fig 1) nested together, and that is a good hint on how to start it. It is really hard.

Another interesting six-piece problem is the Turtle, Fig. 8. It is simply a square pyramid with a head added.

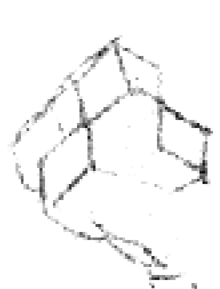
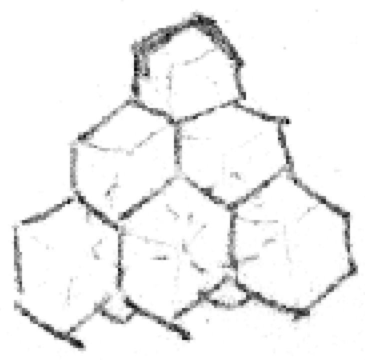


FIG 7

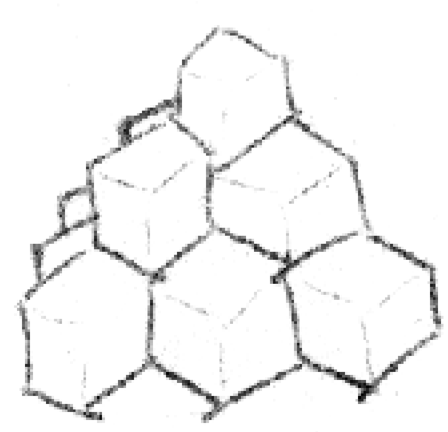

FIG. 8

Seven block problems (need some, haven't come up with any good ones yet)

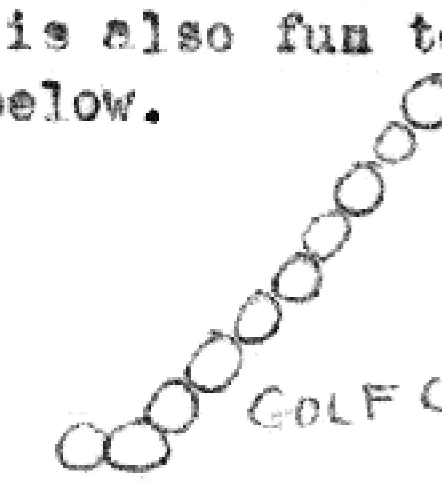
Eight blocks: Buddha, Fig 9 (use your imagination here). The back is a six-block triangle, with two blocks for the knees.

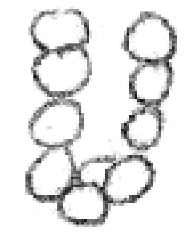


Of the numerous shapes which can be made with all ten blocks, the most intriguing is certainly the large triangular pyramid (tetrahedron). There are two distinctly different solutions, each of which has two slightly different versions (by interchangeing two pieces), making a total of four solutions. How many can you discover. Hint: There are only three different ways in which the ten blocks of the tetrahedron can be joined in a closed path. There are four corner blocks and six edge blocks. Each corner block must connect to two edge blocks. Therefore, two pairs of edge blocks must connect to each other. Two of the ways lead to solutions, the third way does not.



What other interesting shapes can you make with the pieces? Can you make a closed loop with a hole in it? There are several ways to do it. In almost any figure you choose to make, closing the loop with the last piece turns out to be the big problem. As you become more fâmiliar with the pieces, you will discover techniques ways to do this. It is also fun to make designs which do not close on themselves. Two are illustrated below.





If you master these problems and want to try something more challenging, combine two sets of blocks and try some of the shapes shown below. The ultimate achievement is a 20 block giant tetrahedron. So far, we have succeeded only in making one with 19 blocks, with a hollow in the center of the base. The first person to submit a perfect solution, assuming one exists, will receive a special citation as first Grand Master of Shatterblocks.

(Problems with more than two sets not yet investigated.)

End.

EH 14PC 12A+2B #68-A

6A + 8D (or 6C+8B)

or 2C, 4B, 8A.

note, a 12pc with 8A+4D is good

what about 4A+8D ?

Analysis of 14PC

ctrs can be A, B, C or D

if A, next 4 must be A or D

if B, " " " " A or D

if C, " " " " B or C

if D, " " " " B or C
skip

ctrs	next 4	last 8	
A	A	A	– NO
A	A	D	YES – HARD – length 5 any ! " – Baxter
B	A	A	YES – ~~HARD~~ – "
B	A	D	– NO
A	D	B	– NO
A	D	C	– or C B A (2 4 8) YES, NO TWIST, any length
B	D	B	– " " " "
B	D	C	or D B A – NO

✓ 12A + 2B
✓ 6A + 8 D } twist

✓ 8A 4B 2C } + confessional
✓ 10B + 4D } NO TWIST, 3 AXES

68-A

NICK BAXTER
801 NEWHALL ROAD
HILLSBOROUGH, CA 94010

September 11, 1994

Dear Stewart,

It was a pleasure to have the opportunity to purchase some of your puzzles at the Seattle Puzzle Party. I have been collecting for only about two years, and as I'm sure you know, it is rather difficult for newcomers to acquire examples of your work. On the other hand, I'm sure it is very satisfying for you that current owners of your puzzles are not willing to part with them - I believe that I have already become such a collector!

Your puzzles interest me for both their puzzling *and* artistic qualities, the combination of which makes them even more desirable; the *Confessional* proved to be no exception. The hoax of your self-described enfeeblement was almost as funny as the puzzle was difficult, and there may even be some who believe that your guarantee of a solution is part of the joke! I initially assumed that the slanted pieces would make this a modest challenge similar to *Teddy Burr*, but it was soon obvious that this was wrong. However, with a bit of effort and some luck, I was able to figure out the right configuration of the pieces and the tricky (but legitimate) rotation necessary for assembly.

Many times, once a puzzle is solved, the work is not yet finished. This was the case years ago with your well documented insight and extension of the original *Altekruse*, and this version proves to be no exception. My modest research shows some interesting results; I will only summarize since I I'm sure that you've already reached similar conclusions (I don't think it was an accident that you selected the most interesting case as the design for the *Confessional*). When trying use 12 of the same pieces, I discovered that the 2 different types of pieces did not behave the same: the *obtuse* pieces (for the inside angle between the notches) were profoundly easier to work with than the *acute* pieces. Eventually, I came up with the following:

Acute - Obtuse	Solution	Notes
12-0, 10-2	No	
8-4	Yes	*Confessional* - Hard
6-6	Yes	Moderate
4-8	Yes	Easy
2-10, 0-12	Yes*	Easy

*- I didn't have enough of the obtuse pieces to actually do these, but the conclusions appeared justified.

Obviously, the next thing to try was the 14-piece version. It was easy to determine that the 2 central crossing pieces had to be obtuse, and that all the rest were acute (12-2). Given the results for 12-pieces, the high number of acute pieces required did not look promising, but with a little work, I was able to get it done. The rotation required for the solution was smooth but tight, and may not have been theoretically legal - but there weren't any splinters when I was done, so it passed my test!

I enjoyed the other puzzles but seem to have taken too much space already with talk of the *Confessional*; I'd be happy to comment on the other designs at some other time.

I would like to get another cherry version of the *Confessional* (I currently have one cherry and one oak). My recollection was that you had a number of these left over after the party. Please let me know if some are still available. Also, I did not have the opportunity to get either the *Egyptian* or *Octahedral Cluster*. If you have occasion to make more of these, I hope that you will look favorably on my growing collection, and include me in your mailing list.

Best regards,

Nick

Nick Baxter

Sent Sept 15, 1994
~~owes $32~~
pd.

68-A

AP-ART
The sculptural art that comes apart

Stewart T. Coffin
79 Old Sudbury Road
Lincoln, MA 01773
617-259-8348

14 Sept 1994

Dear Nick,

Thanks for your interesting and informative letter. Here is the second set you requested. Please send $30 plus $2 for shipping.

You might be interested to know how this design was developed. When I started playing around with it last winter, my first version had six **A** and six **B** pieces. You rate this version "moderate" in difficulty, and I would agree. Then I considered all other possible combinations. The 8-4 combination particularly intrigued me because I could not get it together, but oh so close. So, using an old trick, I assembled it by breaking one piece and gluing it in place, to see if I could then disassemble it. Imagine my surprise and delight when it came apart with a twist!

I seem to have misplaced the original sheet of paper on which I made some notes on my analysis of this puzzle, but your results came as a surprise. Assuming they are correct, I think I made a big mistake. I analyzed the 12-0, 10-2, 8-4, and 6-6 combinations. But then I assumed that because of symmetry considerations, it was unnecessary to examine the 0-12, 2-10, and 4-8. I must say, it is very easy to get confused when working with these distorted burr pieces and trying to make generalizations concerning symmetry. When I showed this puzzle to Bill Cutler, he was intrigued by it and said he was going to analyze all possible assemblies by computer. We then started considering how many different pieces and combinations of pieces there ought to be, and found ourselves very confused. I don't know if Cutler went ahead with this. I am having a lot of fun with this whole concept, and I expect it should lead to many other interesting new puzzle designs. I am not doing anything more with puzzles, for the remainder of this year at least, as I have too many other projects and pastimes.

Incidentally, Cutler points out a minor defect of this puzzle. Theoretically, if precisely made, the step involving the rotation is impossible. I make the notches slightly oversized and spaced a few thousandths of an inch apart to overcome this, which you can see if you examine them closely.

Your report on the 14-piece solution, with rotation, comes as another surprise to me. My congratulations to you. I have not tried it yet. When and if I ever make some of these, or if I publish same, I will credit the discovery to you. (I feel that *discovery* is a much better word than *invention* in this game.)

S.T.C. double check Baxter's analysis

12 A – impossible

10 A + 2 B – impossible

8 A + 4 B – confessional

6 A + 6 B – hard ——

1st ring is conventional ABBB
2nd " " ABAB
final ring is AAA B_x

4 A + 8 B – easy, the STANDARD solution ABBB + ABBB + AABB

2 A + 10 B – " slight variation of 4+8 B

THE *LEANING* TOWER OF ALTEKRUSE

[The 105-year-old puzzle with a new *slant*]

Puzzle 1 ~ warm-up exercise:-
Choose 12 pieces (which ones?!) and make a 4×4×4 burr.

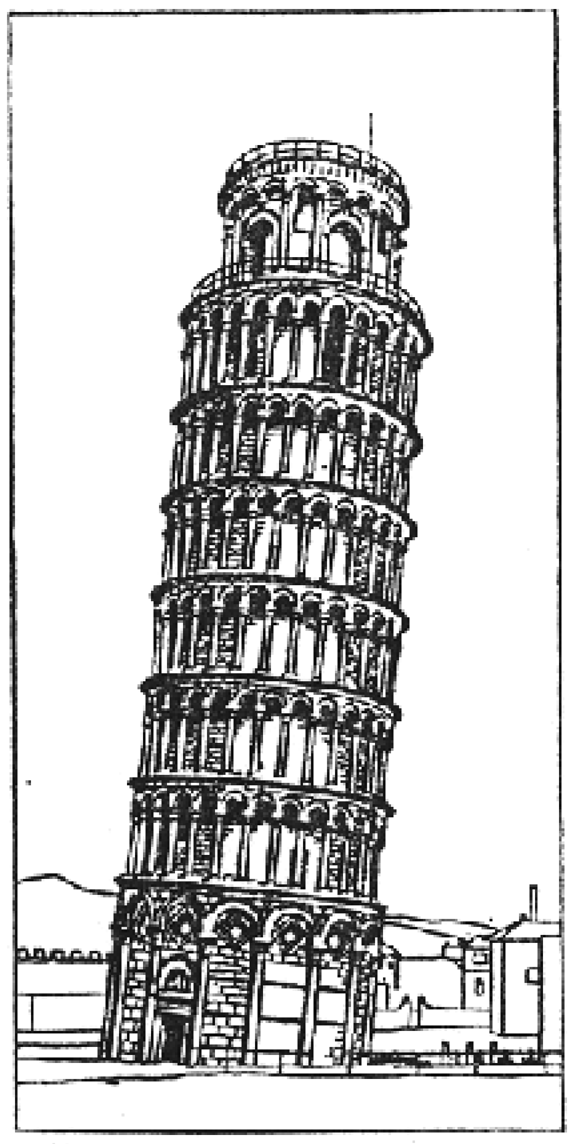
Puzzle 2 ~ the real challenge:-
Use all the pieces to make a 5×5×4 burr.

A Puzzle Souvenir for the 15th International Puzzle Party in Tokyo, April 15/16, 1995 from: Edward Hordern, Cane End House, Cane End, Reading RG4 9HH, U.K.

Historical and Technical Note

1. In 1890 William Altekruse first proposed a 4×4×4 burr using 12 identical straight pieces (US patent no. 430502). It is not known who thought of adding two more of the same pieces to make a 5×5×4 burr. **Stewart Coffin,** who made this puzzle for me, added the idea of a "slant". The puzzle is designed so that no force is required either theoretically or practically.

2. The world famous "Leaning Tower of Pisa" in the centre of Italy was originally built perpendicular. It soon started leaning and this continues to increase year by year. By 1890 (the year of Altekruse's patent) it leant 5°. This is the same as the puzzle enclosed. Hence: "The Leaning Tower of Altekruse".



THE LEANING TOWER OF PISA
Begun in 1174 and completed in 1350, the campanile is 179 ft. high and leans more than 16 ft. out of the perpendicular.

Phone call from Ed, Dec 18, do version # 2 (6+8), ship disassembled, but wait to hear from him by end of Jan., may pick up here.

wrote to Jan 18, all done

AP-ART

The sculptural art that comes apart

Stewart T. Coffin
79 Old Sudbury Road
Lincoln, MA 01773
617-259-8348

1 Dec 1994

Dear Ed,

When I received Nick Baxter's letter last September concerning the 14-piece version, I was occupied with other matters, so I filed it away for future reference, assuming that his report was correct. Now, after receiving your letter a few days ago, I have decided the time has come to look into this.

I find that his analysis, and yours, and mine, all seem to agree as far as they go. But, there is much more to this puzzle. It is no fault of yours, or his, for having not gone further, for you did not have all the pieces to work with. There are actually four types of pieces possible. There are the **A** and **B** pieces used in the Confessional Puzzle, and there are also the mirror images of these pieces, which I designate **C** (mirror of **A**) and **D** (mirror of **B**). I was not set up to make these until yesterday. 98 A, B

There are four possible combinations that assemble in the 14-piece version, and they are:

(1) 12 A + 2 B
→ (2) 6 A + 8D
(3) 8A + 4B + 2C
(4) 10B + 4D

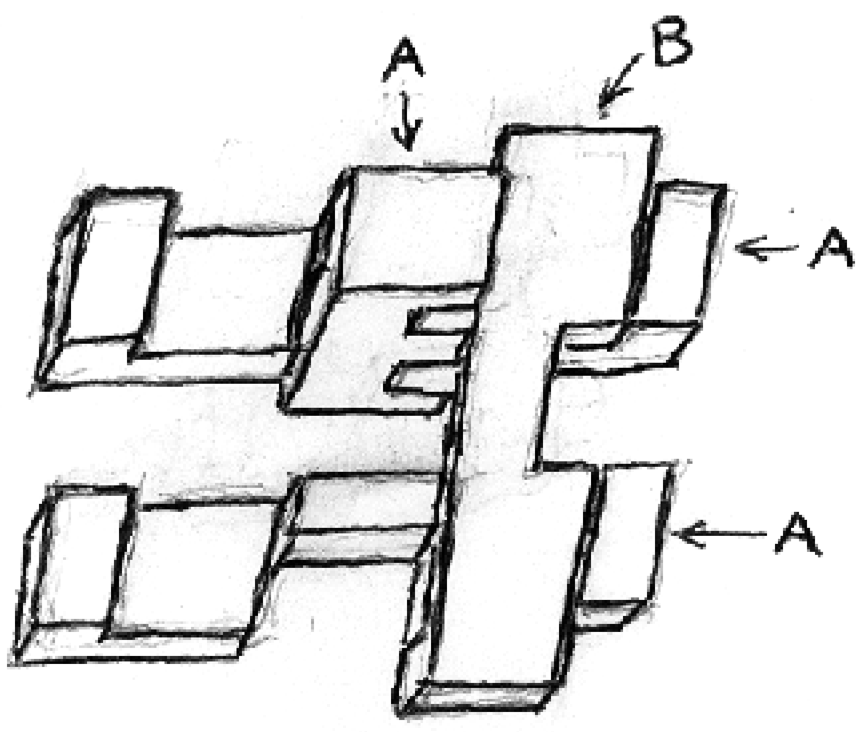
Solutions (1) and (2) assemble by the tricky twist method. Solutions (3) and (4) are easier as they do not require a twist, but they would not be considered easy by most standards. They are like the symmetrical version of the Altekruse in that they slide apart on all three axes.

Because of symmetry, there are of course four more combinations which are the mirror images of these (12C+2D, 6C+8B, 8C+4D+2A. and 10D+4B), but we will skip them.

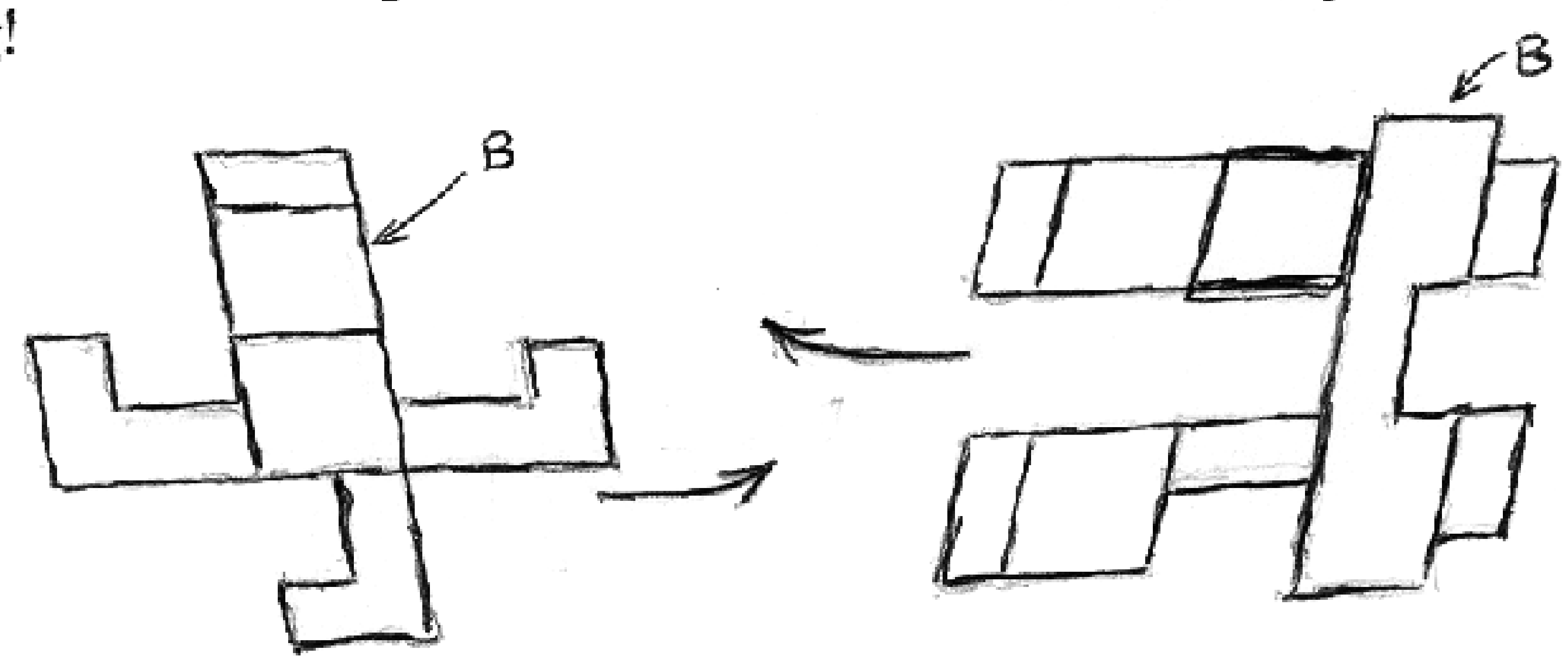
None of these solutions requires short pieces; they can all be assembled with long pieces, but not without some additional difficulty involving more twisting. Having discovered that, I went back to my Confessional Puzzle and discovered, to my surprise, that it too does not require short pieces, as I had thought when making it. Now I wish I had made the long version, as it is more entertaining.

Regarding the twisting and the use of the term "legal," let me expound. The twist

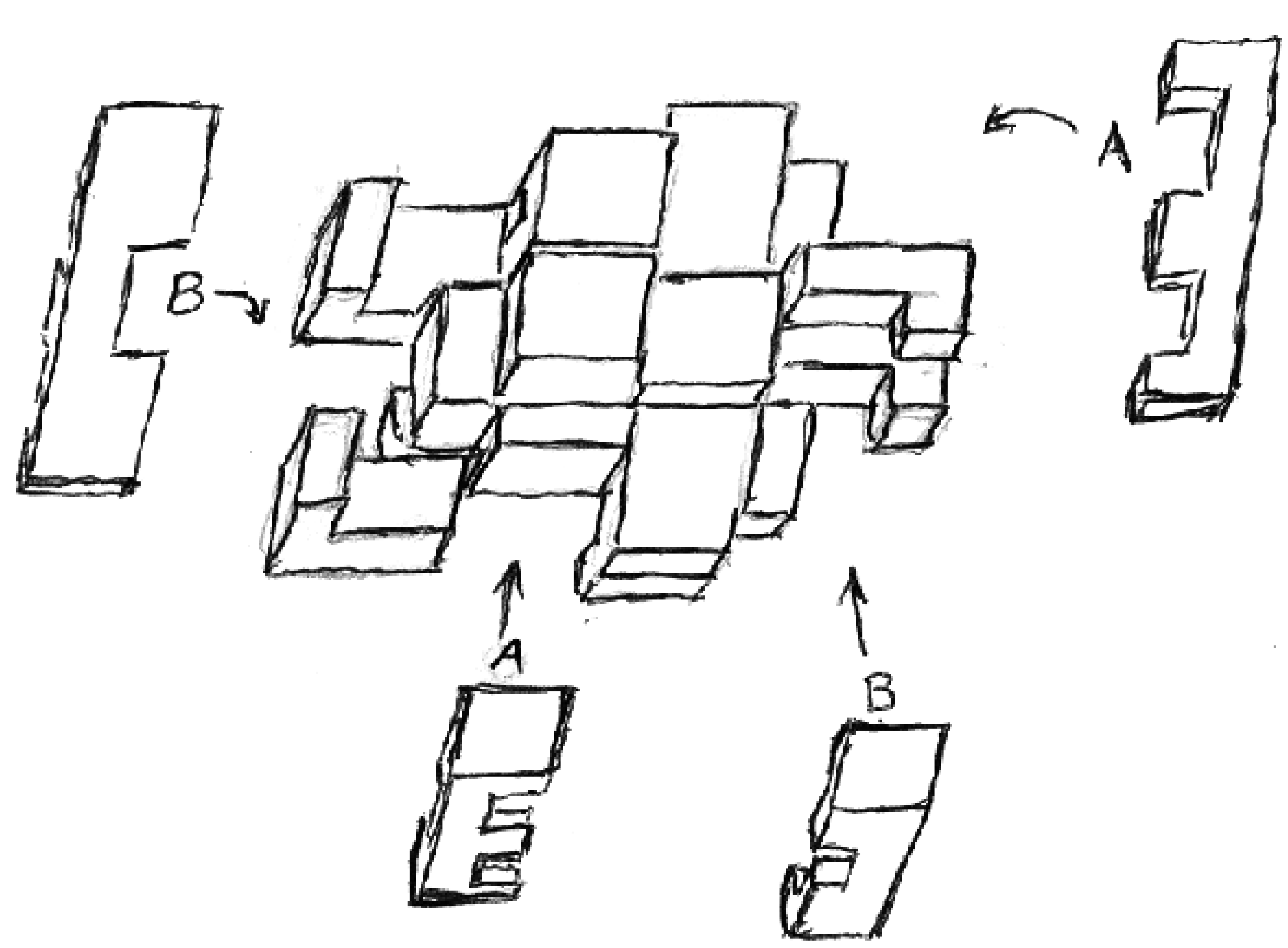
Make two identical subassemblies, each one consisting of three **type-A** pieces and one **type-B** piece, as shown below.



Now position them as shown below and bring them together while rotating them a quarter-turn with respect to each other, as indicated by the arrows. That's right, rotating!



The remaining four pieces then go in the empty spaces, and the two sub-assemblies slide and mesh together to complete the assembly



STC
Sept 1994

#71 STUCKSTICKS (see also #140 file)

std sol. 3  D + 3  A 3A + 3D

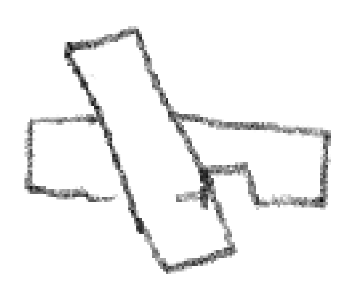
hard sol 2  C A or 2  B

Key sol. 1  A must 2 B "

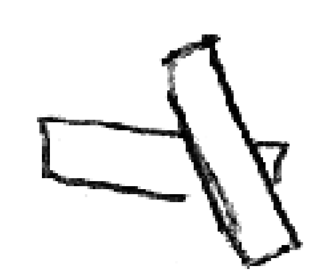
or A + B + C - HARD!

possible pairs


A


B


C

#71

D
4 std

can't do std with any C's
" " Key " 2 " if tight

new design: A + B + C + (D?) + 4 STD

#71

73-A

7 pieces, 2 of which are identical in shape, (unlike No. 73)

4 fancy woods, in parallel colors

Key piece is plain straight stick

First step of assembly is very tricky triple coordinate motion with rotation

73-A

made 6 in Dec. 1996 in Tulip, Satin, Imbuya, Mah. + (teak)

Do not plan to make any more, as ~~this design is superceded by 115, a stellated version of 115, which has 7 dissimilar non-sym. pieces~~

the original No. 73 was a better design, with all dissimilar pieces, but easier first step - coord. motion but easier - no rotation.

#74

Complete analysis of Square Face
with 6 dissimilar non-sym pieces   Oct 1987
starting with Pseudo Notched Sticks

(as shown in new book)

Into 1A   2 X

3 B

into 3C

4D X X

5 D X X

Sol #1 ⟶ 6B ~~☆~~ ☆ 5D into 6A, 4D into 1C, 1B into 2A

4 D   into 4C

Sol #2 ⟶ 6B   3B into 1C – ☆ ~~[illegible]~~,

5 D   into 1C

3B ~~X~~ ~~☆~~

4D X

6B X

6D X

6B X

6D X   so ~~only one~~ 2 solutions

#74

---

over for double check

Sol. #1   3B into 1A, 6B into 3C, 5D into 6A, 4D into 1C, 1B into 2A

" #2   4D into 1A, 6B into 4C, 3B into 1C, 1B into 6A into 2A

1B into 1A

3B —— ★ 6B in 3C

5D X

6D X

3B into 3C

4B X

5D X

6B X

4D into 4C

3B X

5D X

6D X

5D onto 5C

4B —— ★ 6B into 4C, 1B into 6A, 3B into 1C

6B into 6A

3B X

5D X

into 6A

4D

5D

#74-A

1987?

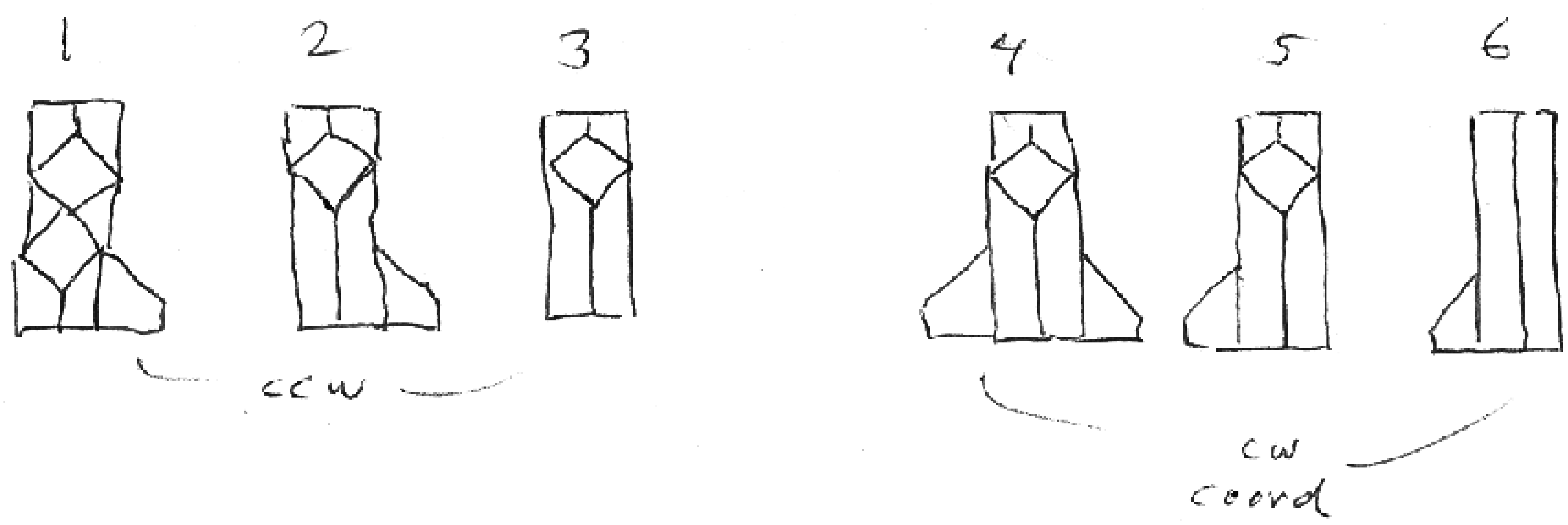
Interesting variation of Square-Face

Six dissimilar, non-symmetrical pieces,

essentially only one solution (3-fold rotation)

~~each~~ one half is coordinate motion - confusing!

start with diagonal burr



74-A

#76

(Beeler)

Dec 29, 1984

Dear Mike:

I have just received word from Dewdney that he does plan on another article on puzzles for Scientific American, and he will mention Puzzle Craft. This is very good news for me, because it will bring me many orders for Puzzle Craft, in anticipation of which I will completely revise and improve the book. One of the improvements will be a proper cover and binding. I planfull page photos on both front and back showing all puzzles I have made. First I have to make a complete set, and this will take a while. I don't expect the Sci. Amer. article until late 1985 at the earliest.

Specifically, Dewdney says he is interested in "assembly of mechanical puzzles by computer." He will probably want to ask you some questions. Would you rather he did this by letter or by phone, at your work address or home, or not at all? I will probably be sending him some more information and some models later.

At the end of last summer, our financial situation was bad, so I decided to send out a large puzzle mailing (price list) and start turning them out. Then the article came out in Fine Woodworking and Abacus. As a result of all this, I was utterly swamped with work all of Nov and Dec with no time to do anything but fill orders. I am now nearly caught up, and financial situation is much improved. I look forward to designing new puzzles this winter.

I have just received a commission of $150 to make a custom puzzle for an exhibit in San Francisco. Hope I can get more of these. Haven't decided yet what it will be.

You probably wondered what happened to the Peanut Puzzle. It is all set to go except for the instruction booklet. That represents a lot of work and time, but I hope to do it this winter.

At the end of Puzzle Craft, Part 4, I made a list of unfinished problems. One thing I forgot was an improved checkerboard dissection, mentioned in Part 1. This interests me very much now. Do you realize how many persons buy my puzzles and never take them apart? One of the things I always liked about the Snowflake puzzle is that no one finds it intimidating. I think I would like to come out with a checkerboard puzzle as a sequel, and have been giving the matter some thought. There are, I believe, 20 non-symmetrical hexominoes. I was thinking of selling a set of ten hexominoes assembled in a square 8x8 tray with corners blocked. It would not be checkered, just plain wooden pieces glued up from square tiles. It is fairly easy to find a set of 10 which does this. It is also fairly easy to find a set of 10 which assembled into a 10x6 rectangle. I have not yet found a set of 10 (all different of course) which does both. There are three pieces which I would prefer not to use - I am not sure exactly why except that I find them generally easier to use and perhaps therefore less "interesting." They are the ones which contain 2x2 (you probably already guessed).

Questions:

1. Is it possible to find a set of 10 dissimilar, non-symmetrical hexominoes which which will assemble in the tray and also 10x6?
2. Is the above possible without using the three objectionable pieces?
3. Do any of the above have unique solutions?

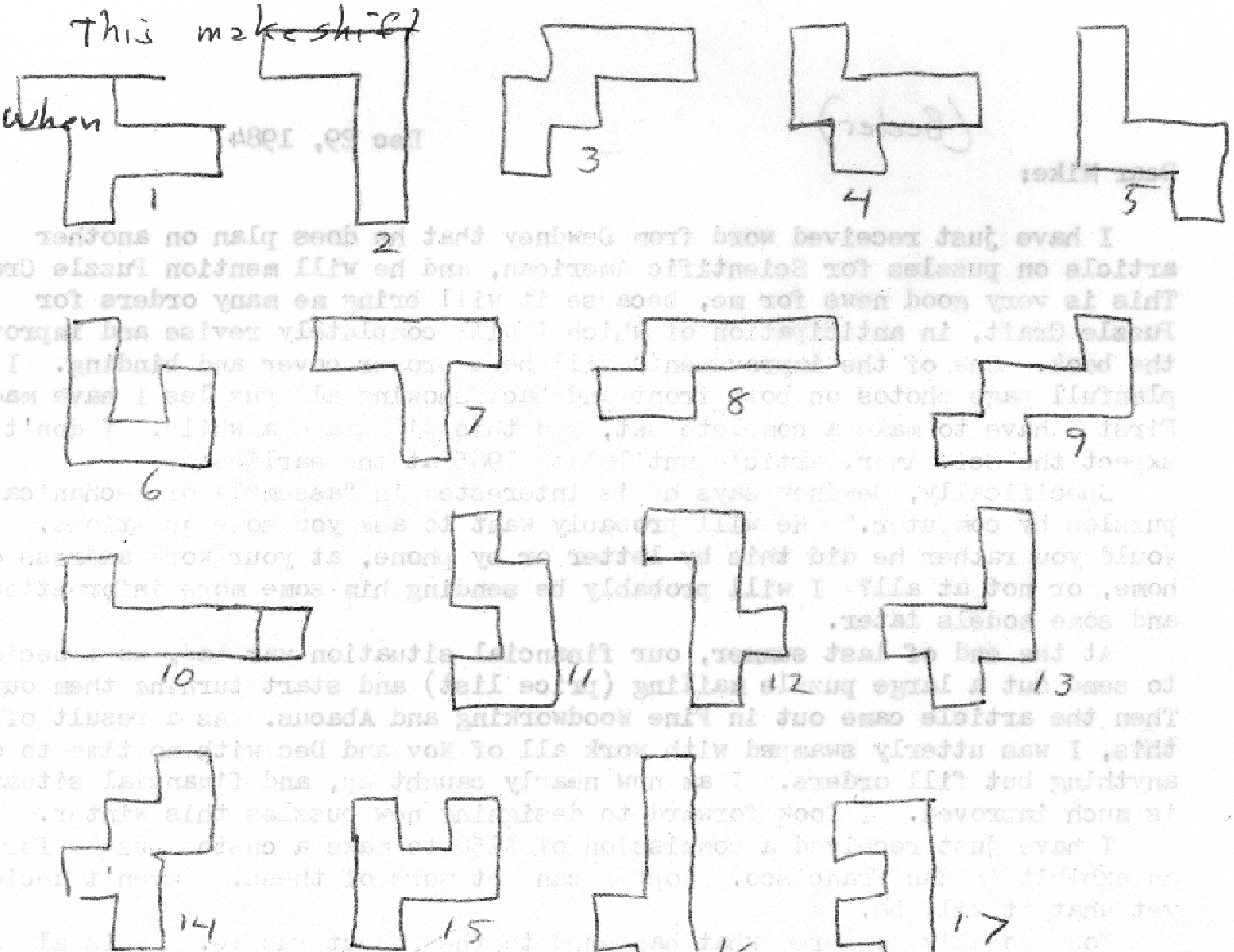
By the way, I do not have a home computer yet, and have no intention of getting one soon. Also, I know nothing about them. But I am curious to know just how large and expensive a computer is required to solve this sort of problem. Prof. Van derPoel says he does them on a pocket-sized computer. Hard for me to believe.

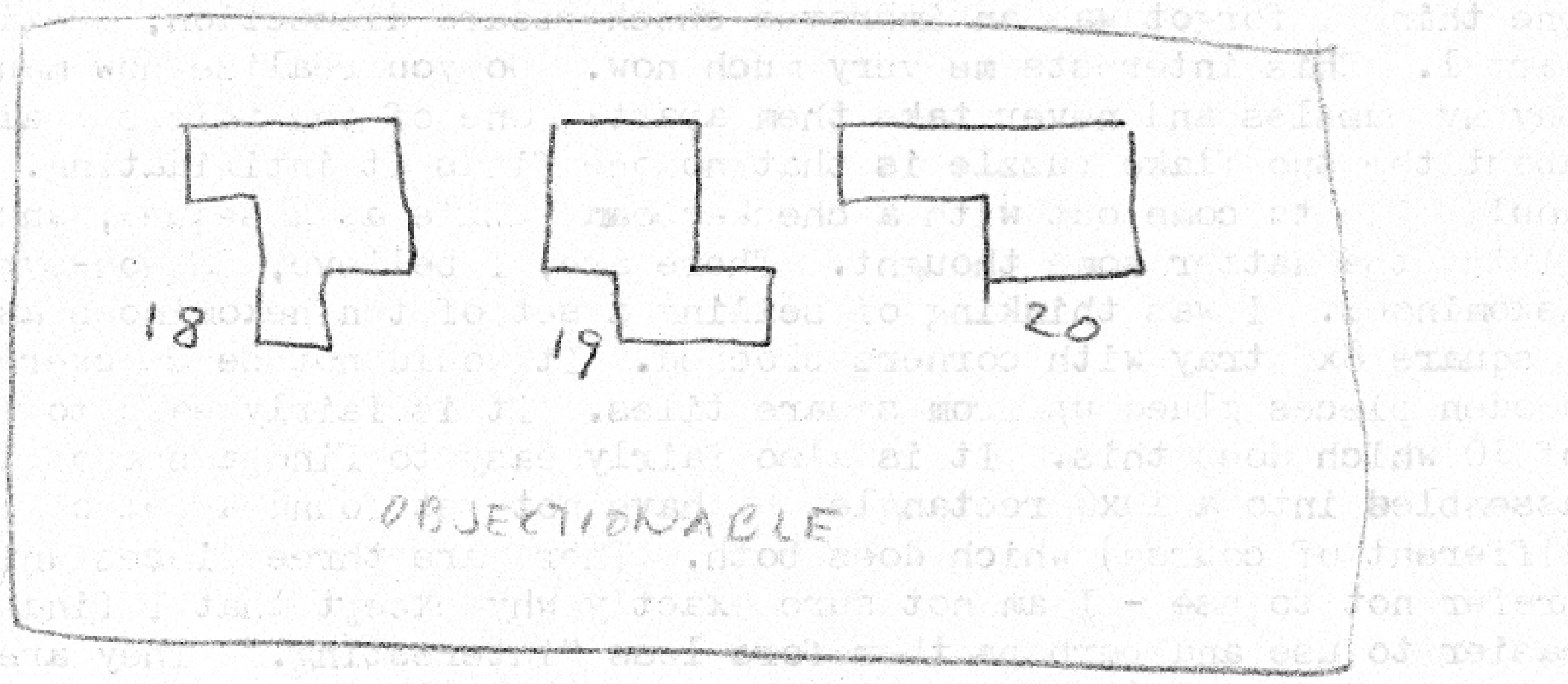
Sincerely,

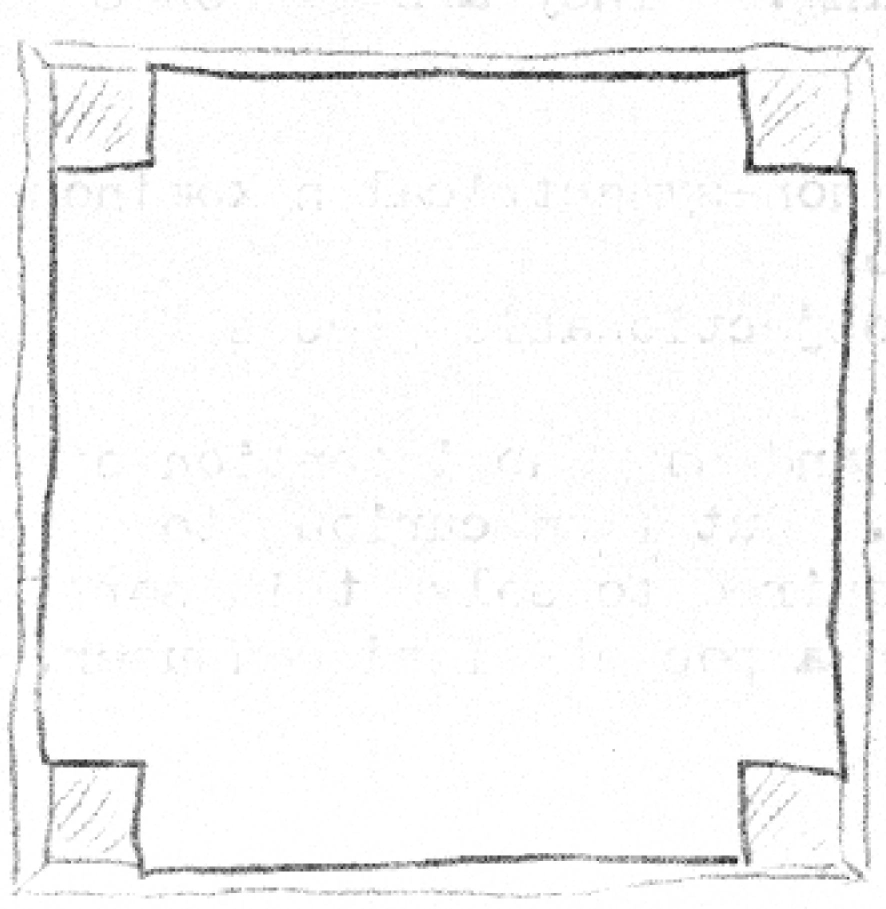
#76

This makeshift

When







8

TRAY - easy to make of wood

January 29, 1985

Dear Stewart,

Your suggestion of a joint venture in puzzles is intriguing, but I'm not sure whether I want to spend the effort to translate my program(s) to a personal computer. A PC has less powerful tools to edit, test and run programs with, and it is likely to be slower than the one I use for puzzle programs at work. On the other hand, it can sit and churn on puzzle problems for long amounts of time, while I'm restricted to 10 hours run time per 2 weeks of calendar time on the computer at work. Also, the computer time at work I get for free, and part of the understanding is that I won't use it for personal gain. A possible alternative is to simply write and run a design progam at work, and give you the results, as we did with Unhappy Childhood and the Peanut puzzles. I just don't know how I'll go with this, and at the moment I don't have much time to write a program for a new puzzle anyhow. We'll see, and I appreciate your suggestion.

Meanwhile, I've done a little theoretical work on the hexomino puzzle. I agree with all of your analysis -- of the 35 hexominoes, 20 are non-symmetric, and 3 of those are objectionable because they contain the 2 x 2. And there are 19,448 ways of selecting a set of 10 pieces from the 17 desirable hexominoes. But actually some of these sets can be eliminated by coloring arguments. The result I get is 5,159 sets -- still a lot to do by hand, but a useful reduction for computer analysis. Here's how the coloring goes -- pardon my pedantic tone, I'm trying to write this both to explain to you and to capture my notes in an understandable form.

Theorem 1: Any set of 10 pieces which has a solution must contain an even number of pieces from the subset {12, 13, 14, 15, 16, 17} (using your numbering of pieces).

Proof: Checkerboard color the tray and all 17 pieces. A solution has 30 black squares and 30 white squares; white and black are balanced. Eleven of the 17 pieces are balanced, 3 black and 3 white. The other six pieces have 2 squares of one color and 4 of the other, unbalanced. The empty tray is balanced (zero of each color), and placing any of the balanced pieces on the tray maintains the balance. Placing any of the unbalanced pieces upsets the balance, which must be restored if a solution is to appear. Restoration is accomplished only by another unbalanced piece. The unbalanced pieces are all 2+4 (none are 1+5, for instance), so each restorative action exactly cancels each unbalancing action. So the unbalanced pieces, which are those named in the theorem, must occur paired in any solution.

This coloring argument by itself reduces the number of sets to 9,746.

Theorem 2: A solution can have zero or two of the pieces {12, 13, 17}, but not one or all three of them.

Proof: Color the tray and the pieces with four colors, like this:

```
a b a b a b a b
c d c d c d c d
a b a b a b a b
c d c d c d c d
a b a b a b a b
c d c d c d c d
a b a b a b a b
c d c d c d c d   Tray before 4 corners are removed
```

Removing the corners leaves 15 a's, 15 b's, 15 c's, and 15 d's on the tray -- an odd number of each of the four colors. Each piece will have various numbers of each color, and exactly how many of each color it has depends on where we put the piece on the tray. Piece 3 placed in the upper left corner

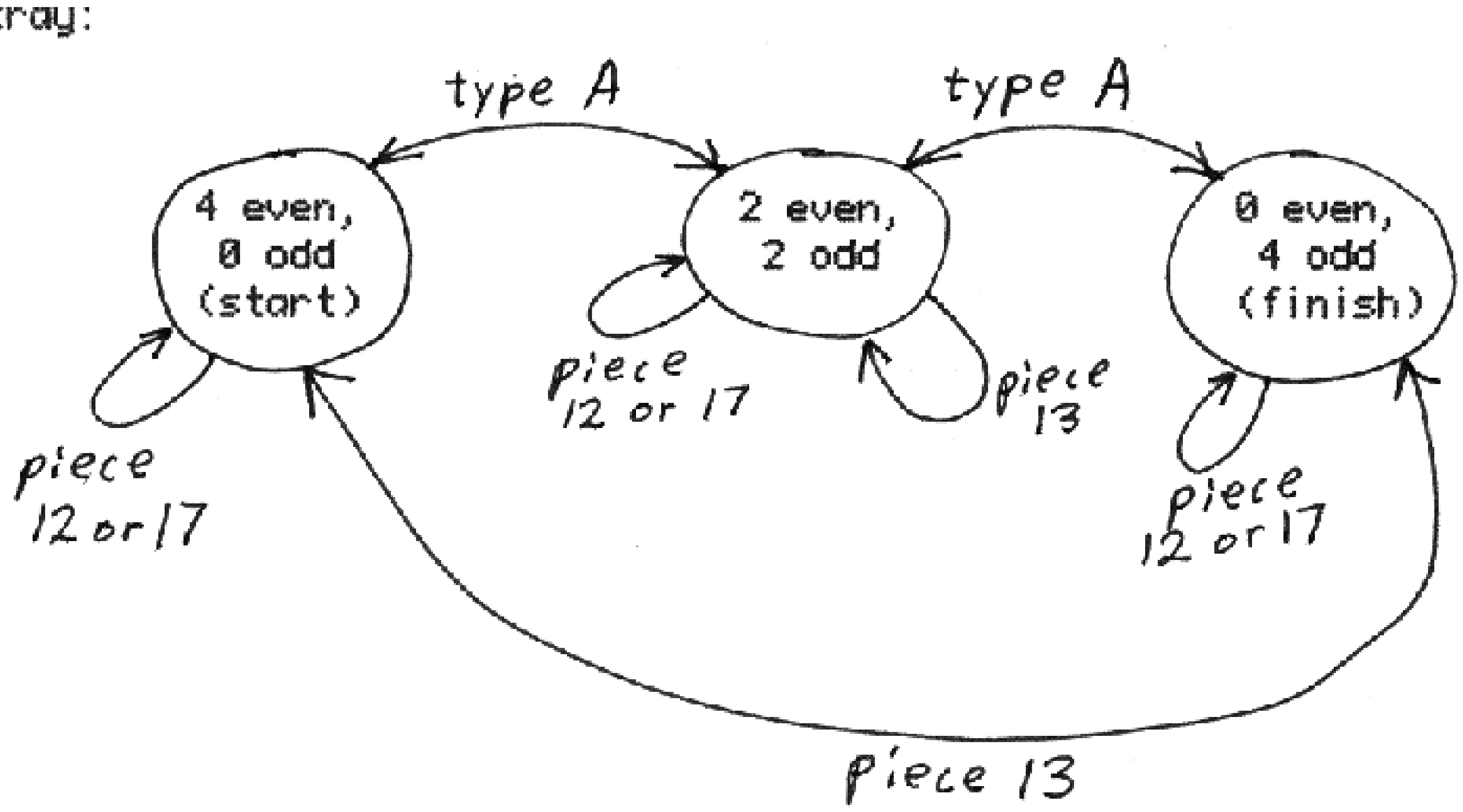
```
  b a b
c d
a
```

has 2 a's, 2 b's, 1 c, and 1 d. But let's look not at exactly how many squares of each color it has, but at the distribution -- 1 square of some color, 1 of another, 2 of another, and 2 of a last color. This description does not depend on where the piece is placed. Call this distribution 1+1+2+2. Classify the 17 pieces according to their 4-color distribution:

- 0+1+2+3 -- seven pieces (called "type A" in discussion below)
- 1+1+2+2 -- seven pieces (also called "type A")
- 1+1+1+3 -- one piece (piece 13)
- 0+2+2+2 -- two pieces (pieces 12 and 17)

The tray starts off empty, with zero squares of each color. As we place pieces, squares of the various colors accumulate. For example, after placing three pieces, there might be 4 a's, 5 b's, 5 c's, and 4 d's. But again, consider the distribution: 4+4+5+5. Actually, instead of this amount of detail, consider a further simplification: only whether each color has an even or odd number of squares accumulated: even+even+odd+odd, or "2 colors even, 2 colors odd".

The empty tray is in state "4 even, 0 odd". There are only two other states it can be in: "2 even, 2 odd" and "0 even, 4 odd". (The states "1 even, 3 odd" and "3 even, 1 odd" are theoretically possible but can't be created with the 17 pieces we care about.) This diagram shows how placing a piece changes the state of the partially filled tray:



We can now examine ways of placing 10 pieces, trying to get from "4 even, 0 odd" to "0 even, 4 odd". The order in which we place the pieces doesn't matter. We see that if the 10 pieces have an odd number of "type A" pieces, we get stuck in the "2 even, 2 odd" state, puzzle unsolved. Therefore there must be an even number of type A pieces, and 10-(even number of A's) leaves an even number of the other pieces, namely pieces of the set {12, 13, 17}.

Theorem 3: Only zero or two pieces from the set {14, 15, 16} can occur in a solution.

Proof: This follows from theorems 1 and 2. There must be an even number of pieces from the set {12 through 17}, and an even number from the subset {12, 13, 17} of that set, leaving an even number of the remaining subset {14, 15, 16}.

Summary:
Any solution must contain:
an even number of pieces from {1 through 11}, and
an even number of pieces from {12, 13, 17}, and
an even number of pieces from {14, 15, 16}.

We can enumerate classes of piece sets thus:

number from 1-11	number from 12, 13, 17	number from 14, 15, 16	count of such sets
10	0	0	11
8	2	0	495
8	0	2	495
6	2	2	4158
	total piece sets		5159

By the way, none of these arguments depended on the four squares that are removed to form the tray being the corners. In particular, any of the 16 (only 10 distinct) ways to remove four rotationally symmetric squares will remove 1 each of a, b, c, and d (and therefore two black and two white in 2-coloring). So your idea of letting collectors experiment with leaving other (rotationally symmetric) holes is very applicable.

Also, a 6 x 10 rectangle has the same distribution of squares, under either 2- or 4-coloring, as the tray, so again only these 5159 sets of pieces are candidates for solutions.

Well, that's it for now!

Regards,

Mike

May 1, 1985

Stewart,

Here's something on the hexomino puzzle I thought you'd enjoy. Bernie mentioned to me that he thinks the full set of 17 hexominos is more interesting than subsets of 10 of the 17, especially if it makes something interesting. (Perhaps the complete set of all 35 hexominos would be even more interesting, but that's not the question here.)

The 17 hexominos can't make 2 x 51 or 3 x 34 rectangles (easy to show), leaving the 6 x 17 rectangle as the only interesting shape (that we could think of). I expected that the 6 x 17 could be made in lots of ways, so I decided to look for ones that have some neat property. I decided to look for ones which can separate into a 6 x 7 and a 6 x 10. I searched a little bit, and found three divisions of the 17 pieces which have such solutions; my search was very incomplete, so I suspect there are lots more cases. An example of each of these three cases is on the back of this letter. They're summarized below.

If you offer people a "designer's set" of all 17 pieces, you could package them in one of these ways.

Regards,
— Mike *Mike*

case 1:

seven pieces: piece code = 375000, makes 6 x 7 in 3 distinct ways
ten pieces: piece code = 2777, makes 6 x 10 in 1 distinct way, also makes 8 x 8 A (8 x 8 with corners removed) in 2 distinct ways (not shown)

case 2:

seven pieces: piece code = 350414, makes 6 x 7 in 1 distinct way
ten pieces: piece code = 27363, makes 6 x 10 in 2 distinct ways, also makes 8 x 8 A in 1 distinct way

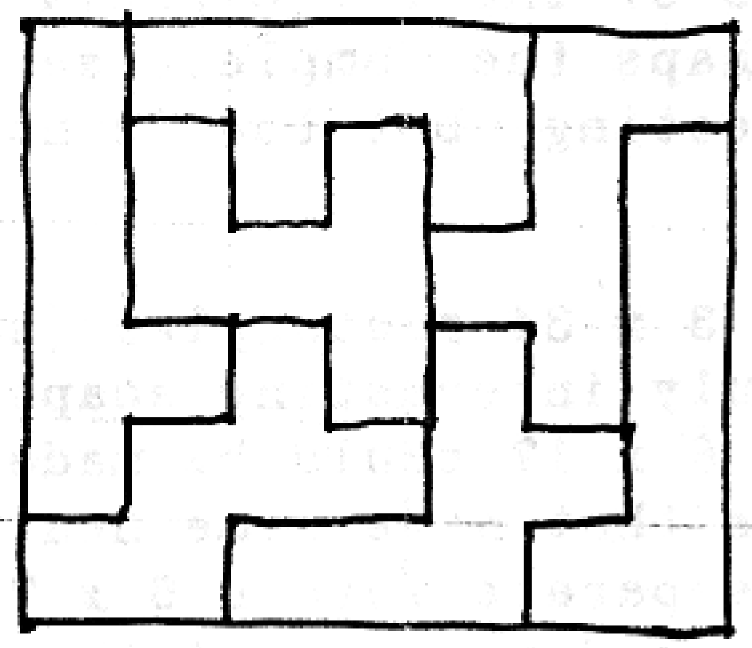
case 3:

seven pieces: piece code = 350320, makes 6 x 7 in 2 distinct ways
ten pieces: piece code = 27457, makes 6 x 10 in 1 distinct way, also makes 8 x 8 A in 1 distinct way

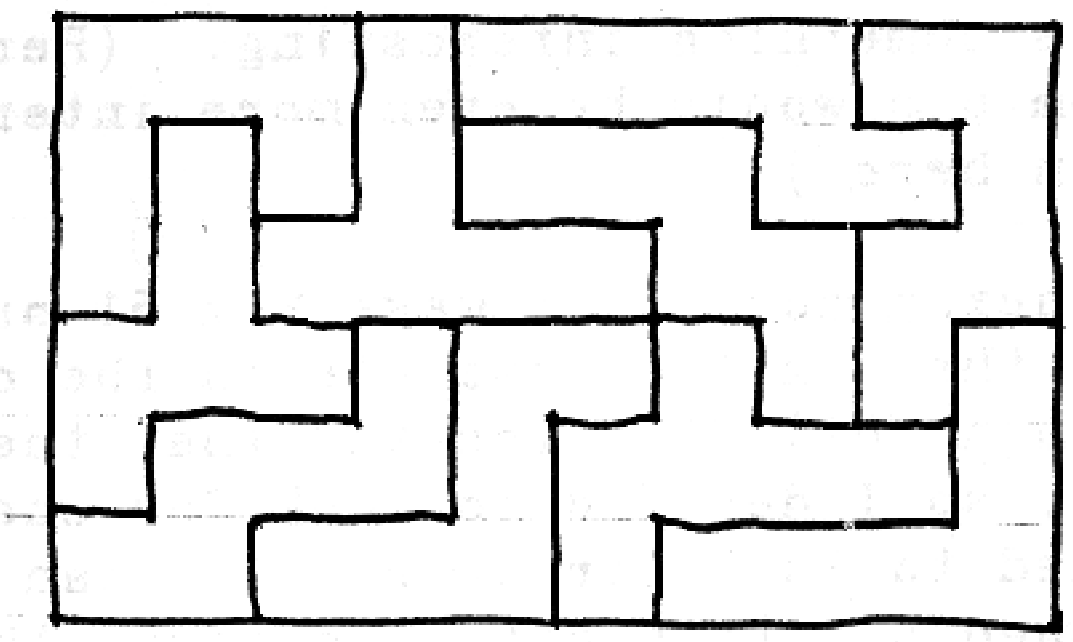
P.S. I'll have some more results on further 10-piece sets for you soon.

6x7 | 6x10

case 1

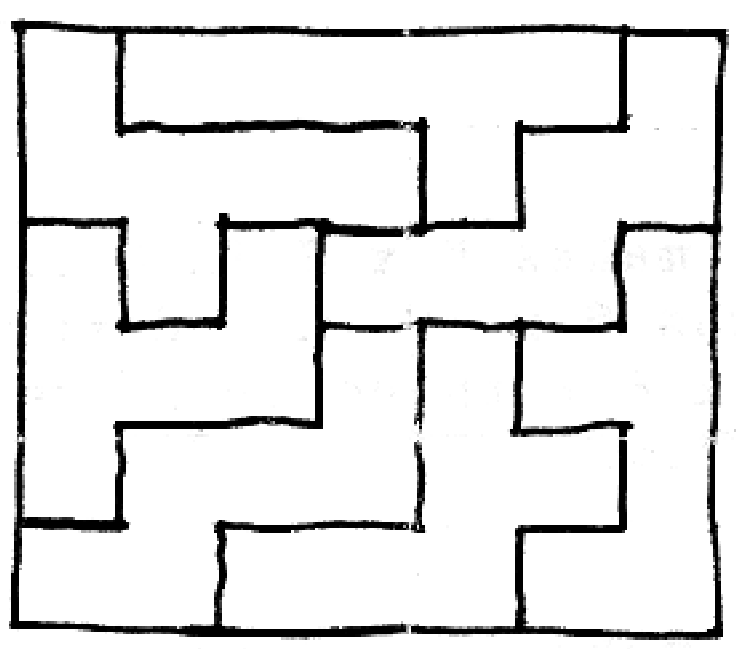


code 375000
3 distinct

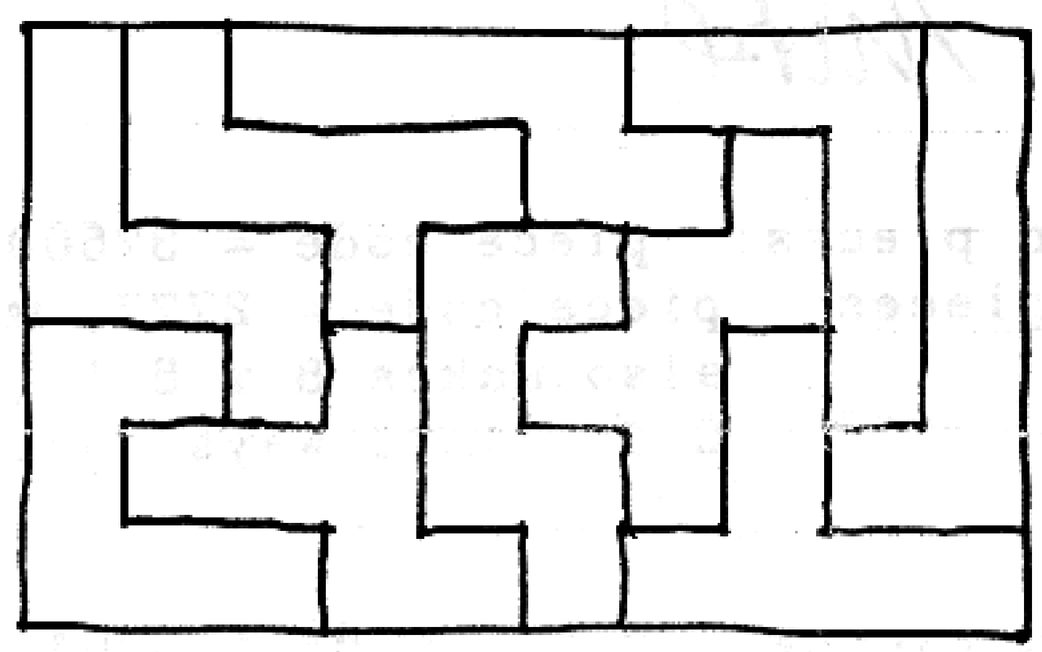


code 2777
1 distinct

case 2

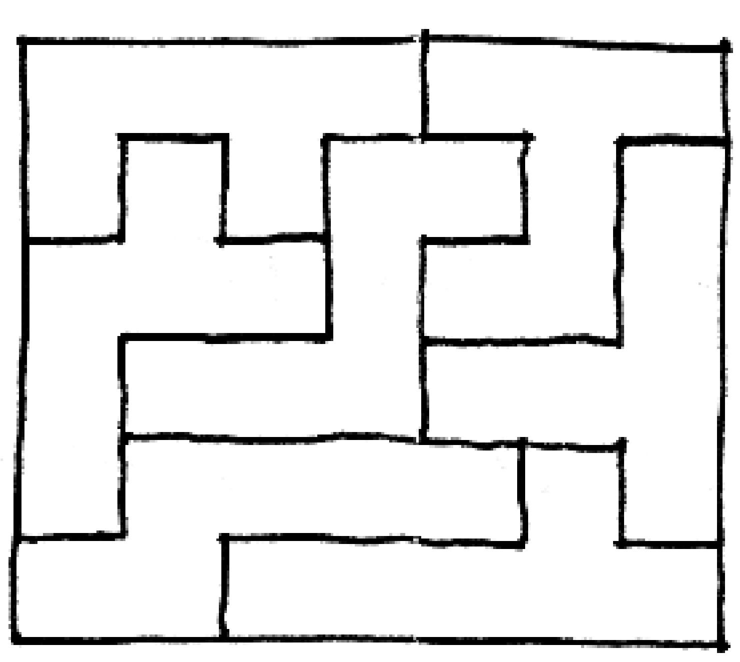


code 350414
1 distinct

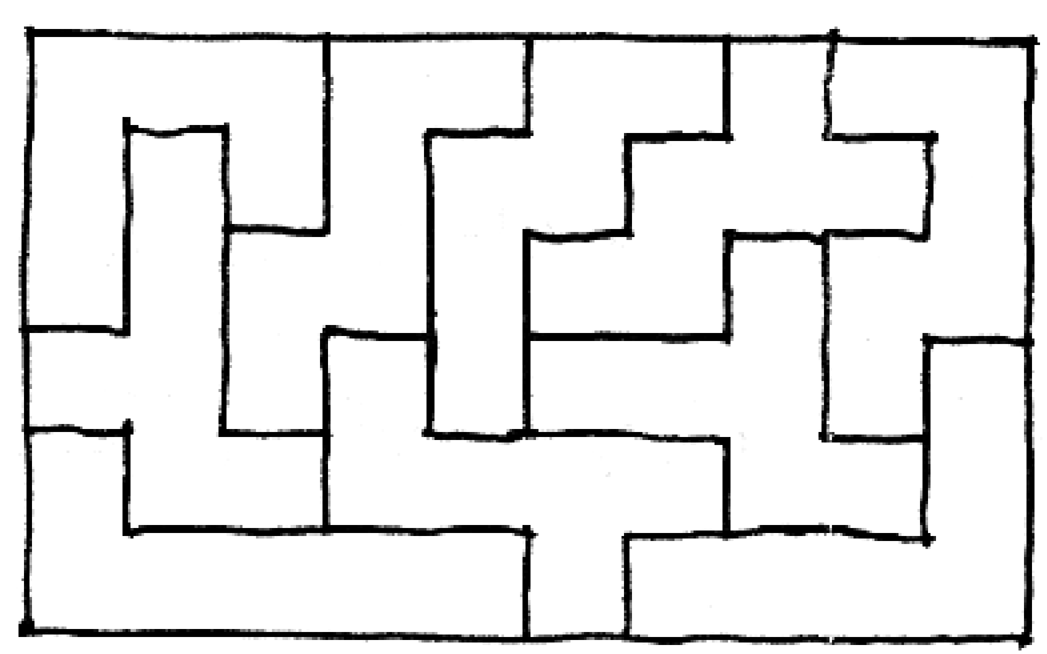


code 27363
2 distinct

case 3
⋮
many more probably exist



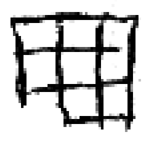
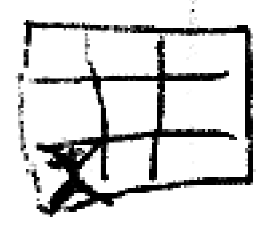
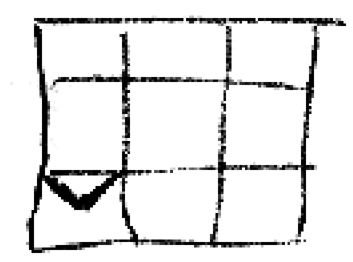
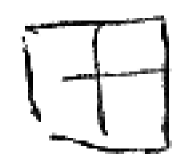
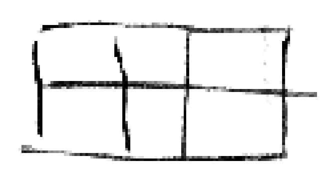
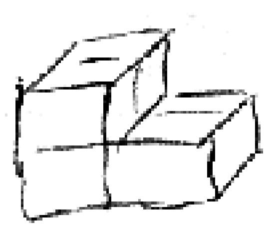
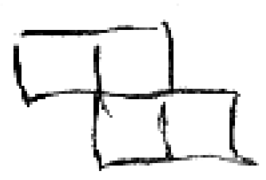
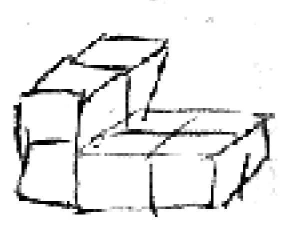
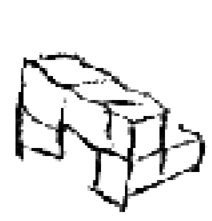
code 350320
2 distinct



code 27457
1 distinct

10 pc.

Comparison of: #77

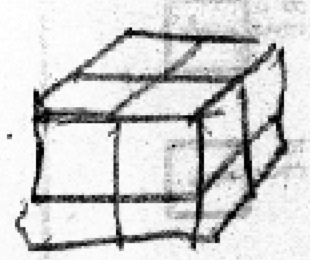
	ABCDEFGH	and BBCDEFGH
2×2×2 cube	11	~~2~~ at least 4
3 × 3 	 not solid 4 sol possible! one way only (4 minor var.)	 not solid 4 sol.
2 × 2	ABCG ABDG ADEC AEDG AECG etc 	X impossible
2 × 3	 several CFGDEH CFE DGH	 one + var.
2 × 4	impos.	impos.
	4 + more GAHDFC EAHDBG	4 ways
 zigzag	many	at least 2
twist	several AGFBDC (A is key)	2
bed 	possible	possible (hard)
penthouse 	possible many	possible.
 bench	possible	possible
 leaning tower	possible	possible

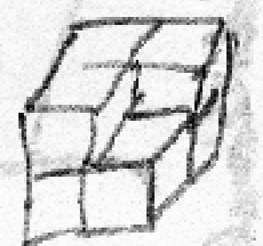
#77

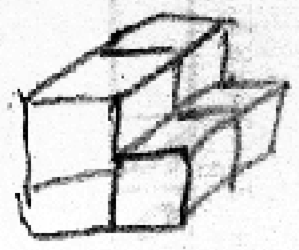
conclusion: make ABCDEFGH plus 2 half-pieces in 3×3 tray

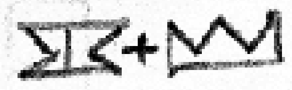
Possible Pieces-of-Eight solutions

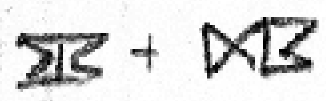
without 2 halves

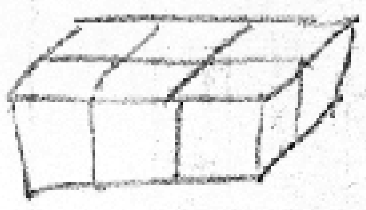
8 

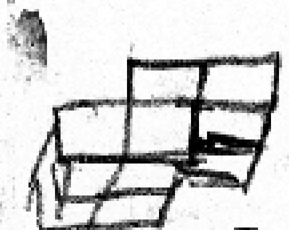
6 
Twist
(difficult)

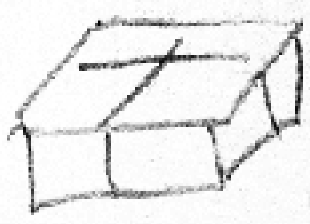
6  *

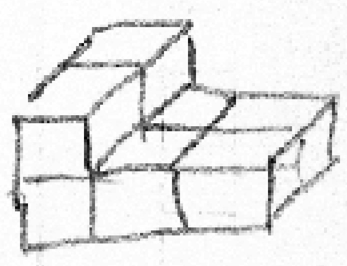
omit 

sol#2 omit 

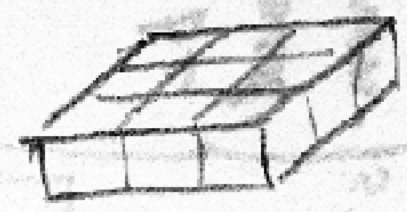
6 


zigzag
(difficult)

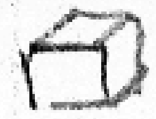
4  *
†

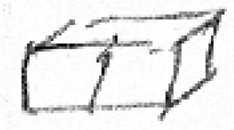
8  bed
(difficult

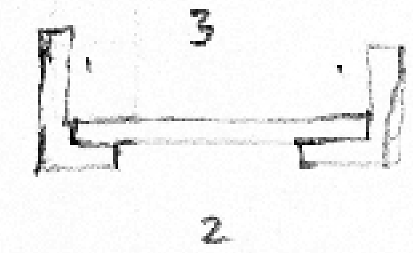
with 2 halves

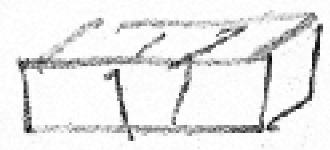
9 

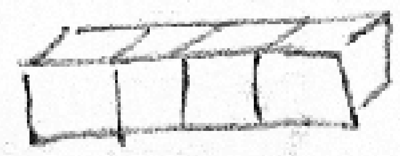

box

1 

2 

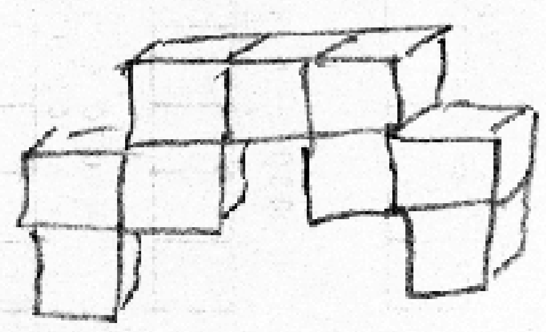


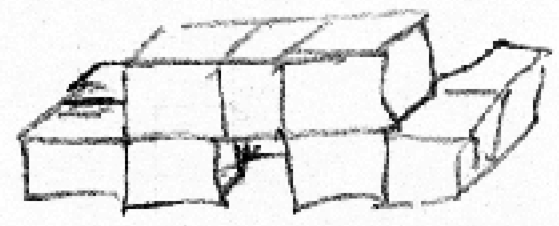
3 

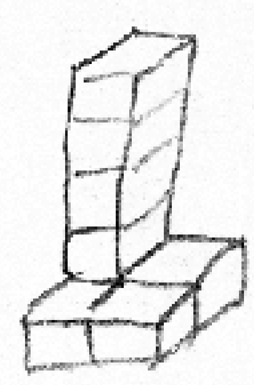
4 

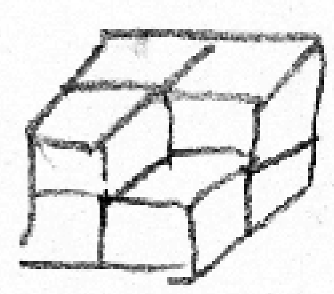
5 

8 

9  Arch

9  entrance
to fort

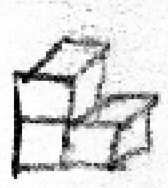
8  Tower

7 

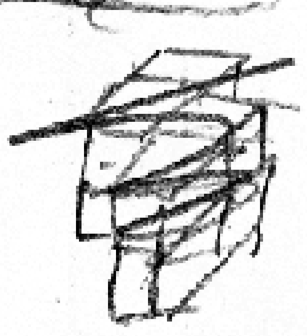
impossible

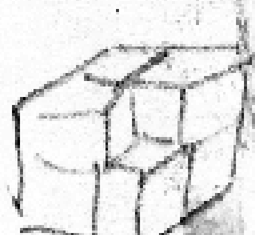
 8

 8

 3

~~unknown~~



 7

* only one way to start disassembly

† impossible to take apart
(probably only one)

try: B B C D E F G H

(E and F must still be as before) ~~but symmetry~~ still symmetry

E B D F C x

G x

H B G C (makes zigzag too) ★ 1.

H G C B (" " ") ★ 2. (has symmetrical subassy EBE) + FHG

E D H F C x

G x

(no more)

G is outside in both

Square CW

B B C G (can't ass x

B B D G (can't ass x

B C H G (can't ass. x

B D can't ass

B E x

B F x

B G x (can't contain B)

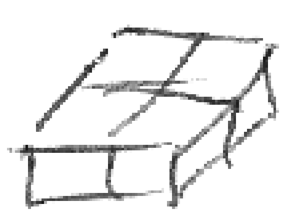
C D x

C E ✓

C F x

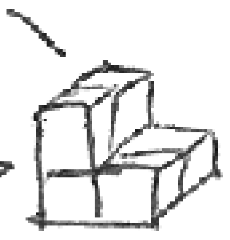
C G x

C H



D x

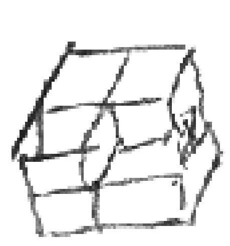
square is impossible



DF~~H~~ BCG (hard!) or DGHCFB

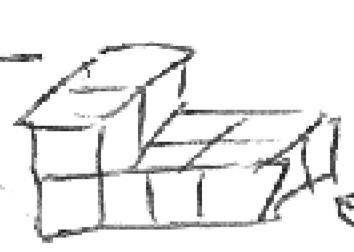
or DGFCHB

or DF BCGH



twist omit B and E (E can never be used)

(hard) GFDHCB, or GFBCHD

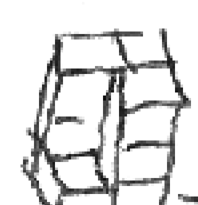


bed

DHFBBCGE

(hard)

Long twist



BEGCCFHD

A up B H F C H D (needs C)
G x
D C G (needs B)
H C (" D)
(H C G x) G
G H F C D —★ (one axis A + G outside)
D C —★ (2 " " " ")
H up D F C x
G x
G x
G C x
D x
H down C F x
G C x
C B D G x
H D H x
H G x
D F H x
G H F
H up B H
G x
H x
H down X
G B x
D H ~~F~~ H B ★
D B C G x
H C H
H x
C F H B
I ~~F~~ H B ★ stop

In sol. 1, 2, 3 change A to B and C to D

" " 4, 5 can't change A to B

" " 6 change A to B, C to D - can't assemble

" " 7 can't change A to B

" 8 change A to B and C to D - still makes Zigzag

" 9 change A to B - ~~st~~ - still makes Zigzag

" 10 change A to B and C to D

" 11 can't change A to B

DOUBLE CHECK: BBCDEFGH mirrorimage

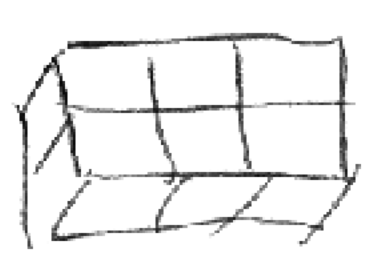
EBCF B x
D o x
G x
H x
HBGD —— ★ 1
HGDB —— ★ 2

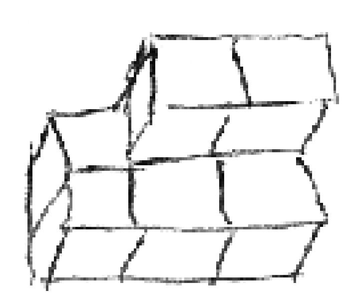
ECHF D x x

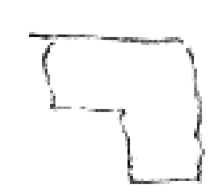
no more

---

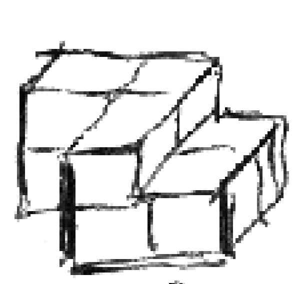
more shapes

2 x 3  rectangle essentially one way with minor var.

 Penthouse at least one



2x4 is impossible

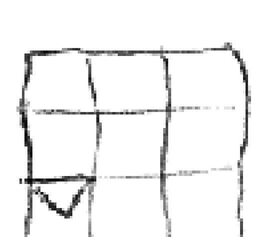
 Bldg at least one (has axis of sym)

 roof with hole

 bench at least one

---

~~Im~~possible to fit all pc in 3x3 tray!


-H
-E

or FGHECBBD
EHGFCBBD
or EHGFDBBC

EC ×

EDHF E: A, B, C, G,
F: A, C,

FA, EB ×
EC ×
EG, ×

FC, EA ×
EB — EDHFCAGB 10 *
EG ×

EGAF E: B, C F: C, D, H

EB, FC ×
FD EGAFDHCB 11 *
FH ×

EC FD ×
FH ×

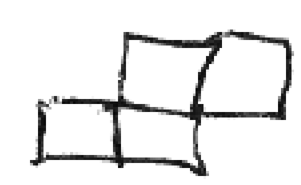
2x2x2 11 solutions total

EH ×

EBDH CFAG

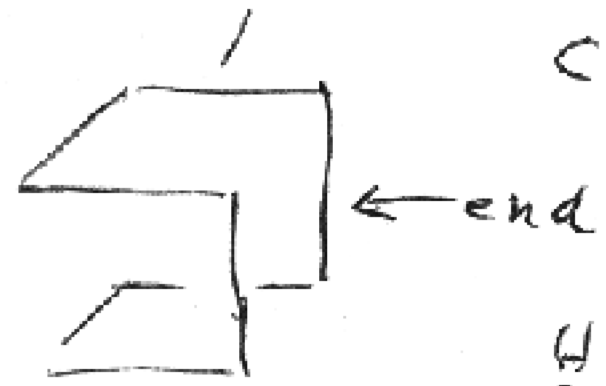
backwards is EGAFCHDB — mirror image of #11

---

note cube sol: #9 changes easily into zig zag 

---

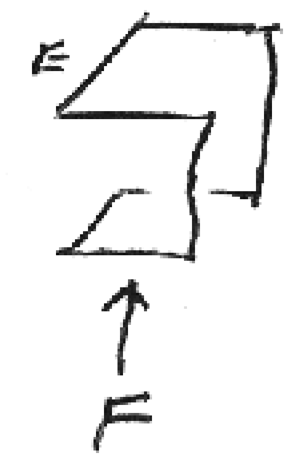
in cube, A always faces out



cube has 4 "ends" and 4 "sides"

H " " "
G
A can be either
B " " "
C " " "
D " " "
E must be end, one way only
F " " side one way only

E can't mate F, so only one way for E-F



E ~~AB~~ to F AB X

E AC X F D B H G ☆

EACF analysis E can take B or G
F " " D or H

E	F				
B	D	X			
B	H	☆	E ~~CA~~ AC F H D ~~BG~~ GB ☆	1	*
G	D		E ~~CA~~ AC F D B H G ☆	2	* and A is key
G	H		E ~~CA~~ AC F H B D G ☆	3	*

~~E A~~ ~~E B 1~~
EBDF

* one axis only

E ~~B~~	F		
A	A		
C	C		
~~B~~ G	H		
A	C	X	
A	H	X	
C	A	EBDFAHGC	4 *
C	H	EBDFHAGC	5 *
G	A	EBDFAHCG	6 or 7 *
G	C-	*EBDFCAHG and CHAG	8 *
G	H-	EBDFHACG	9 *

Double Check

OLD #

EABY
CF BX
DBHG ✯ 1 — 2 —— A is Key piece
H x
HBDG ✯ 2 — 3
DGB ✯ 3 — 1

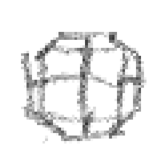
EBDFAGHx
HCG ✯ 11 — 6
HGC ✯ 4 — 4
CAHG ✯ 5 — 7 — A is Key piece
HAG ✯ 6 — 8
HACG ✯ 7 — 9
HAGC ✯ 8 — 5

EDHF A x
B x
CAGB ✯ 9 — 10

EGAF DHCB ✯ 10 — 11

* one axis

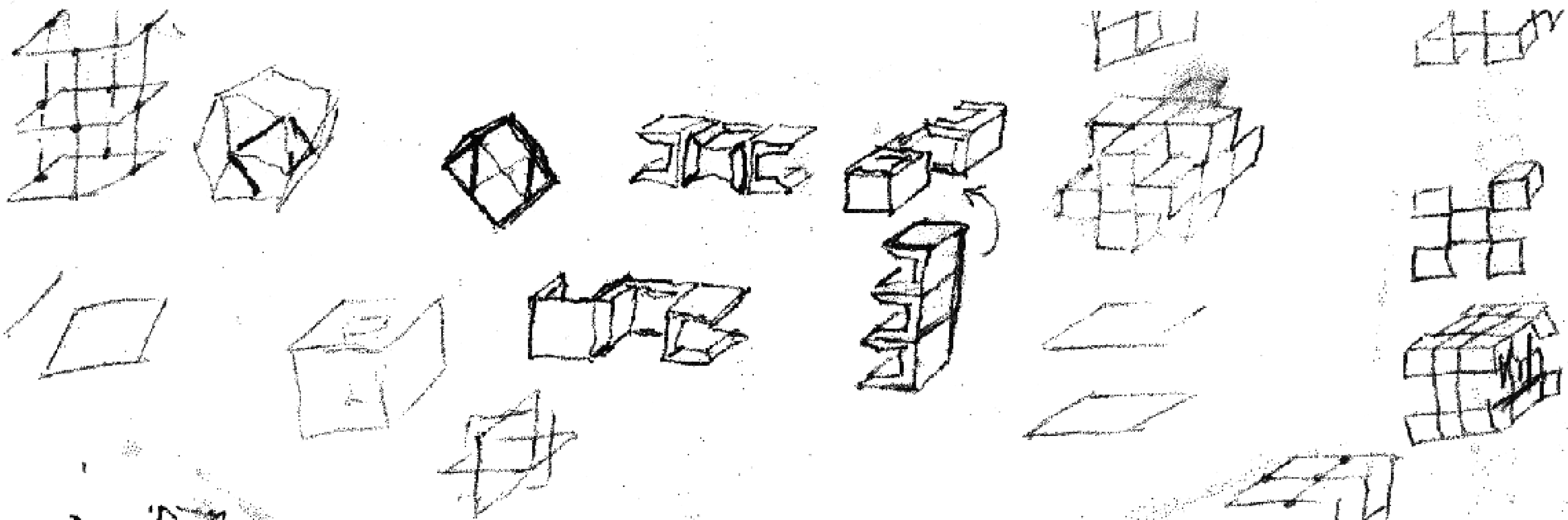
LIST OF SOLUTIONS

1. EACF DBHG — ~~A is key~~ AE key *
2. EACF HBDG — also makes zigzag *
3. EACF HDGB — also makes zigzag *
4. EBDFAHCG ← ~~[illegible]~~
5. EBDFAHGC
6. EBDFCAHG — A is key — 4-wood version (mirror) EBCFDAHG
7. EBDF CHAG
8. EBDF HACG — also makes zigzag
9. EBDF HAGC — augmented  solution is unique
— symmetrical grain — " " "
10. EDHFCAGB
11. EGAFDHCB
↑ ↑

Car Tracy
8 PM

Belmont Pub. Libr.
20 hr./wk

Kay Budman
489-2002



L R

1 A - A ✓ S

2 A - B ✓ N

3 A - C ✓ N

4 A - D ✓ N

5 B - B ✓ S

6 B C ✓ N

7 B D ✓ N

8 C C ✓ S 3×5

9 C - D ✓ N

10 D - D ✓ S

11 E A ✓

12 E B ✓

13 E C ✓

14 E D ✓

15 E E ✓ S

16 F A ✓

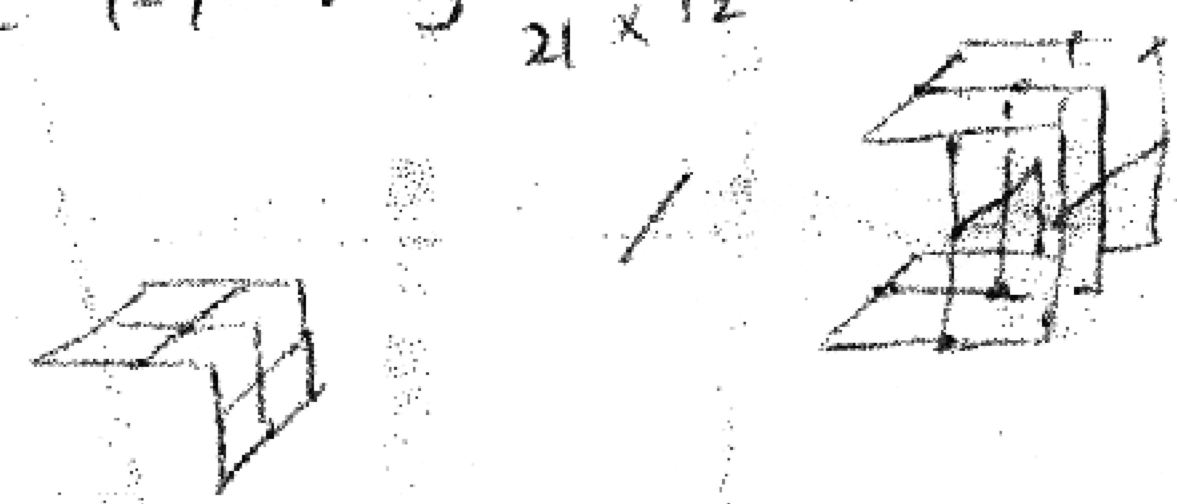
17 F B ✓

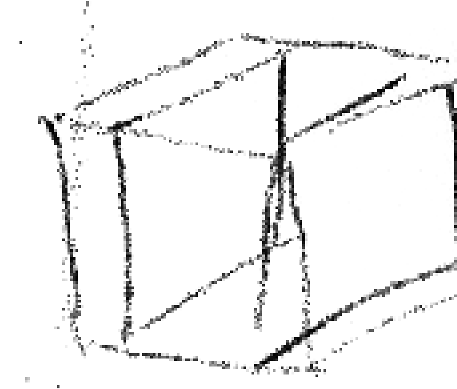
18 F C ✓

19 F D ✓

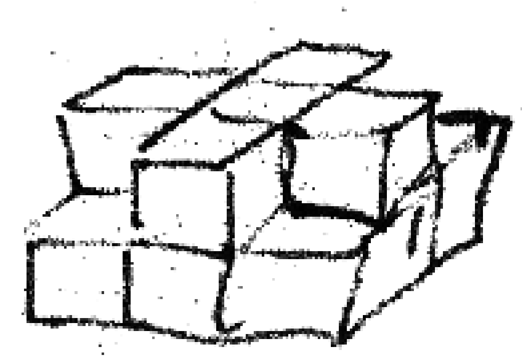
20 F E X

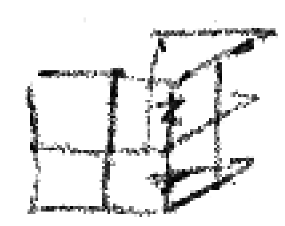
21 F F ✓ S $21 \times 1\frac{1}{2} = 31\frac{1}{2}$

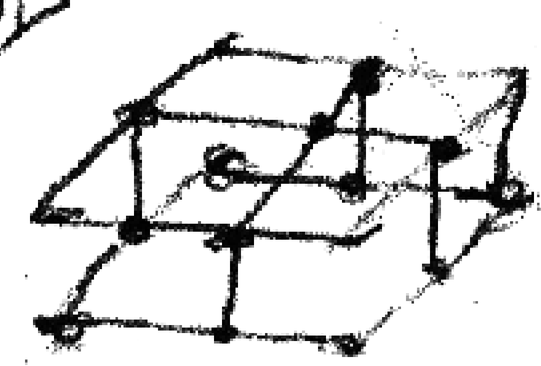




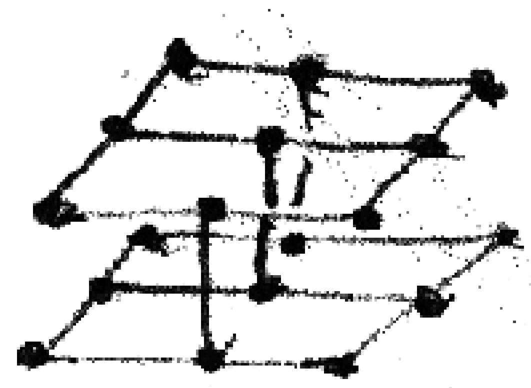
$10 \times 1\frac{1}{2} = 15 + 8 = 23$







$9 \times 2 = 18$



3 •—•

10 •—•—•

$18 \times 1\frac{1}{2} = 27$

TENYO CO., LTD. 5-13-5, TOYO, KOTO-KU, TOKYO, JAPAN 135 Tenyo ☎03(647)0361

Mr. Stewart T. Coffin
79 Old Sudbury Rd.
Lincoln, MA. 01773
U.S.A.

October 29,1986

Dear Mr. Coffin,

Thank you for your letter of October 9 and your splendid book, "Puzzle Craft".

We immediately made models of "Snowflake" and "Pieces-of-Eight" and enjoy them everyday. "Pieces-of-Eight" is really interesting for us and we think it must be one of the classics (We have found 7 solutions of the cube form for the present).

Although we still can't expect much sales of this puzzle, we would like to consider about the possibilities of the sales of "Piece of Eight" in Japan. To reach the conclusion, We will need at least one month for the investigation. Anyway, we will write you again as soon as possible (If you want to find a licensee in a hurry, don't wait for our answer and please contact with any other company). Of course, we never expose it to outside of our company. We would appreciate if you could tell us what you think of your conditions and send your own samples.

With regard to "Hectix", We hadn't heard from Dr. Atwater. We have not exported it at least these five years and will not do it hereafter, too.

Yours sincerely,

Hiroshi Kondo

Hiroshi Kondo

November 3, 1986

Hiroshi Kondo
Tenyo Co., Ltd.
5-13-5, Toyo, Koto-Ku
Tokyo, Japan

Dear Mr. Kondo:

With regard to my "Pieces-of-Eight" Puzzle, there is some news which you should be made aware of.

The idea for making puzzle pieces made up of cubes dissected in this manner and joined together first entered my mind in 1973. In July and August of 1973, I made models of puzzles using this idea and wrote a description of them. My agent, Thomas Atwater, kept the description on file and showed the models to manufacturers, none of whom were sufficiently interested to manufacture such a puzzle. The particular model shown to them had twelve puzzle pieces, and each piece consisted of three half-cubes connected in a line. All twelve pieces were identical.

In August of 1986, the idea occurred to me of joining these half-pieces in pairs all possible ways and seeing what they might construct. This was the beginning of the "Pieces-of-Eight" Puzzle. At that time, I believed that my idea was new and original, but I marveled that no one had thought of it before, it seemed so obvious.

I sent a description of the "Pieces-of-Eight" Puzzle to Jerry Slocum, who is a foremost authority on puzzles. In return, he sent me a copy of "Nob's Puzzle Report From Tokyo," No. 1, 31st Nob. 1985, edited by Nob Yoshigahara, Central Plaza 408, Iidabashi 4-10-1 Chiyodaku, Tokyo 102. It shows the eight pieces exactly like mine, assembled into a cube, "by Kozi Kitajima." That being the case, I cannot claim to have been the first to invent. If you should decide to manufacture this puzzle, then I think you will find some of the ideas on my instruction sheet to be useful, and I would accept some business agreement as a consultant.

I now have one large toy manufacturer in the U. S. interested in the "Pieces-of-Eight" Puzzle. My experience has been that they move very slowly, and it could be years before they decide to produce it if they do.

With regard to the "Hectix" puzzle, you say that you no longer sell it in the export market, but you do not say why, or if you still make it at all. I think it is a fine puzzle and wonder why you do not sell more. Can I buy a shipment of them from you for resale? Would you ever consider making it in four colors?

Sincerely yours,

Stewart T. Coffin

Stewart T. Coffin

NOB'S PUZZLE REPORT FROM TOKYO

PUZZLETOPIA

No. 1
ISSUED ON 31ST NOB. '85
EDITED BY NOB YOSHIGAHARA
STUDIO NOB/CENTRAL PLAZA 408
IIDABASHI 4-10-1 CHIYODAKU
TOKYO 102 JAPAN

Greetings. NOB

I am going to issue the first number of PUZZLETOPIA —— NOB'S PUZZLE REPORT FROM TOKYO. Estimated circulation is 50 copies for overseas. Almost none in Japan.

We have two organizations of puzzlers in Japan and many activities are found in their bulletins. Although I have imported many puzzle informations from the U.S. and European countries, I have been idle to export Japanese news. So I made up my mind to issue this tiny paper. But don't have a big expectation on this. As I am too busy, this will not be published periodically. Of course, all are edited by my arbitrary decisions. This is a non-official report from STUDIO NOB.

Fortunately, members of ARM-Japan willingly agreed to this plan. I want to write about not only Japan. I may write without your pemissions. Thanks for all your cooperations! And please try to undersatand this report. Some kind of puzzler's instinct might be needed to read this paper. As I am not talkative in English, please permit all kinds of misunderstandings, writing too severely, miswriting, jokes, etc.

Impudently enough, I want to get all kinds of informations on puzzles from the world. Please write to me your ideas, jokes, news, requests, answers, and every thing on puzzles in easy English or preferably in Japanese.

Letters can be received earlier at my STUDIO than at my HOUSE. Send to STUDIO unless it is thicker than 1 inch. Parcels can be received at my house only; HOUSE ADDRESS; 3-36-6 ONTA HIGASHIMURAYAMA TOKYO 189 JAPAN.

IM-IMPOSSIBLE?

NOB could put an egg into a Coca-Cola bottle at last. He sent its picture to Mr. Scot Morris in OMNI magazine. He wanted to get the Grand Prix but was late for the time limit. When some puzzle enthusiast saw NOB's bottle, he immediately said "The egg in a hen's body is unexpectedly soft. I saw it when I killed a hen. As it is soft it comes out in long and slender shape and the exposure to the oxygen will make its shell harder, otherwise such a big egg won't come through such a small path. So, purge inside of a bottle by nitrogen or helium gas and glue it at hen's exit directly using strong adhesives, the egg comes into the bottle easily." NOB's response for him was "Absolutely Nonsence!"

At first NOB refused to expose its secret, but finally he agreed; "In advance I brought up a hen in a bottle. I kept its head outside of the bottle for respiration. It took so much time to bring it up, that I was late for Morris's limit. When it laid an egg in the bottle, I pulled off the whole body of the hen using sharp steel wire. That's all." But the pertinacious man asked "How could you put the hen into the bottle?" NOB replied "It's easy. I put it when it was an egg!"

Miscellanies.

NOB opened his Puzzle Office in Tokyo. (STUDIO NOB Central Plaza 408 IIDABASHI 4-10-1 CHIYODAKU TOKYO 102 JAPAN. Tel 3 267 7623)

Mr.Takashima developed a new system for solving the SKEWB which needs only 31 moves at most. Those who want its details, write to him directly. ADDRESS; 2-1-6 SAKURA SETAGAYAKU TOKYO 156 JAPAN. Tel 3 428 6907

At the first "HIKIMI WOODEN TOY PUZZLE COMPETITION" last year, NOB's "FIFTH AVENUE" won the GRAND PRIX (¥300000). Second was Mr. Betumiya's "FRENCH CANCAN". His designs had been sold through Naef, Switzerland.

Cast puzzles from HANAYAMA have now 5 varieties; KEY, ABC, STAR, S&S, HORSE. They sell well. New versions of KEY, ABC, HORSE in DISNEY design were sold recently. Beautifully made. They cost between $6 to $8 each. If you want them, write to NOB.

A new maze park was opened in the suburbs of Kyoto. "GRAN-MAZE" They say that NOB could not get out the maze by himself, and cheated. Size; 60m x 60m. Fenced by timbers. Entrance fee is ¥500.

The 8th International Puzzle Party by Jerry Slocum will be held in Dec. '86 in Beverly Hills. NOB is going to take Kamei there.

L. Brokenshire in England moved (without using submarine) and wrote to me "Anyway, puzzles were relegated to bottom priority for a long while. I now have a new puzzle FILING system which is super. One room is MINE! puzzles and magics only! I can now get at any puzzle I wish!" In Tokyo, housing affair is worst in the world. We easily understand Laurie's feeling. Anyway clap our hands for Laurie!

The M.C. Escher Puzzle from Oskar Van Deventer in Holland made the ARM-Japan crazy! Many members tried to construct the puzzle and failed. Especially a professor of Yamanashi Univ. insisted on it, was frustrated. It is superb.

KAMEI .... etc.

Kamei designed a set of "NONSENCE BOX". #1 is a cube; it has six "doors". When you want to open one of them, hold the cube so that the door comes to the bottom. It does open freely. All other five doors are "locked". Its basic idea came from NOB. As the bottom door opens, nothing can be put in this box. It is purposeless!

#2 looks like #1 apparently, but in #2 the only top door opens always. This "NONSENCE BOXES" are not made commercially; Kamei made 5 sets only; NOB bought all of them. NOB has 3 extra sets now. Kamei will not make unless many orders come. NOB wants to sell them to three people who like such jokes. But expensive ··· ¥60000 (#1 & #2) plus P&H.

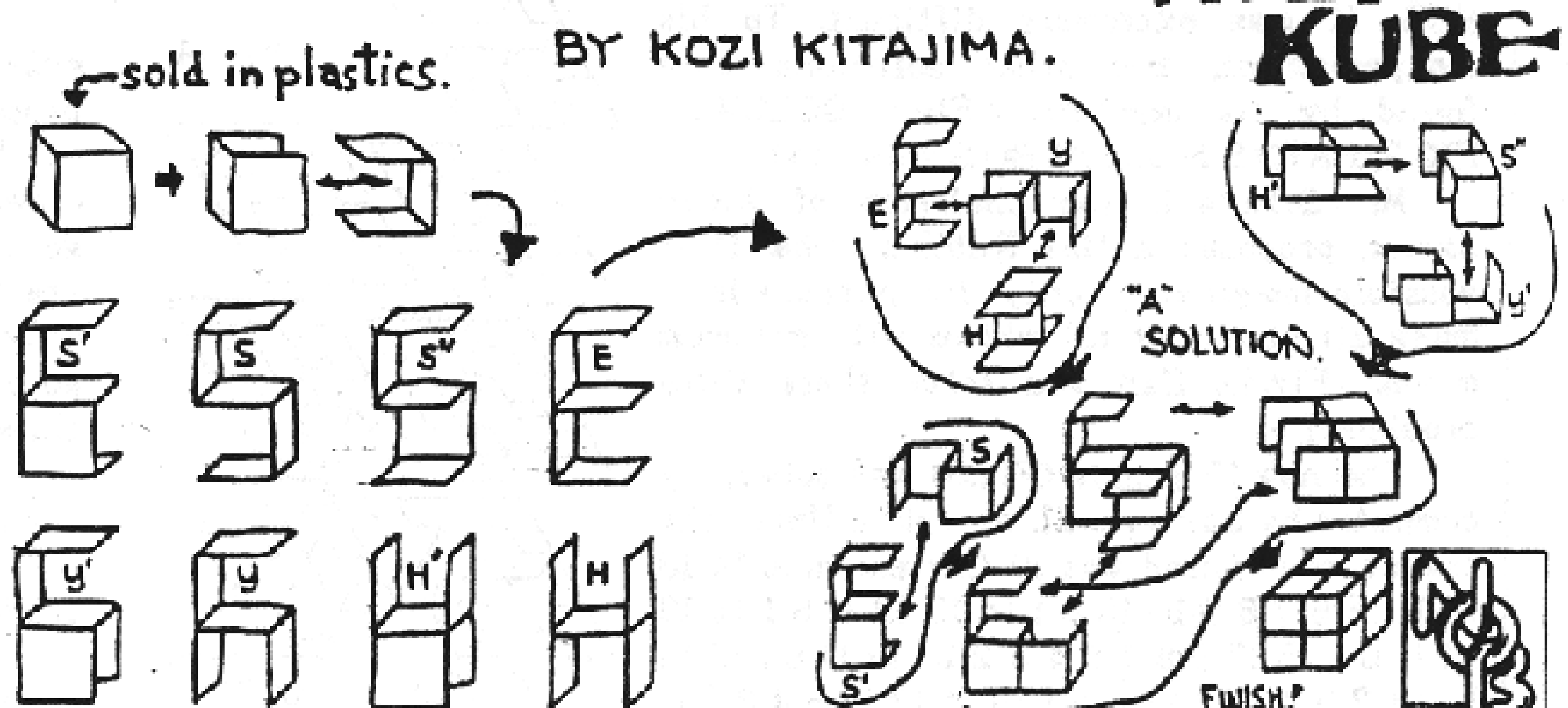
Two years ago, NOB made a catalog of Kamei's products, and sold to overseas collectors. Many orders came, but Kamei is still too busy, NOB has not completed all orders yet. He wants to express his apology for its delay.

Just after the Rubik Fevor, Japan was one of the best puzzle-making countries for a while, but now nothing new found. Very few exceptions are KAMEI, OGURO, TORII, ABE ··· all hand-made.

Japanese Yen is getting stronger and stronger especially than US$. Prices of almost all of Kamei's products are raised up. Postage affair in Japan is worst in the world. ···· All are bad for overseas collectors.

Do-It-Yourself Puzzle Corner: KOZY KUBE

BY KOZI KITAJIMA.

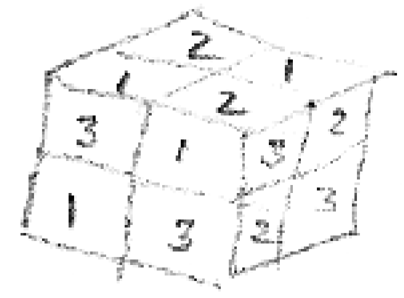


STEWART COFFIN NOTE

77-A

77-A

3-color PC8



1 1-2 3
2. x
3. x
4. x
5. x
6. x
7. x
8. x
9. x
10. x
11. x

□ 123
1 x
2 x
3 x
4. almost
5. almost
6. x
7. x
8. x
9. x
10. x
11. x

---

6 1-2-3 (no mirror color sym.) 1-16

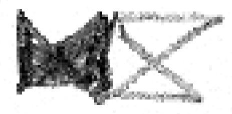
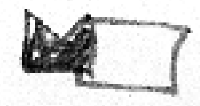
1. x
2. x
3 x
4 x
5. x
~~6~~
7. x
8. x
9. x
10. x
11. x

---

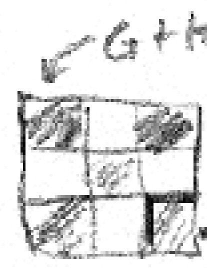
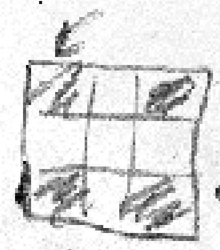
so, reverse C + G

6 grain pattern wrong

1. ok
2. ok
3. ok
4. x – H
5. x H, G, C
~~6~~
7. x H
8. ok
→ 9. x C, G
10. OK
11. x C, G, H

checkered PC 8  G.  H.

1

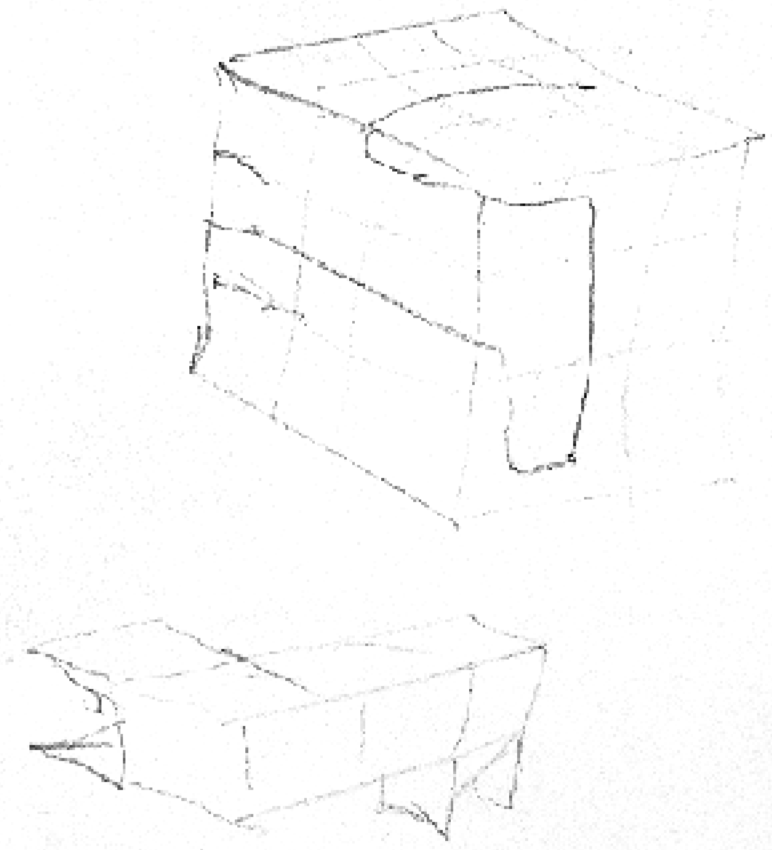
3x3  or 

Cube solutions

1. X
2. YES
3. X
4. YES
5. YES
6. X
7. X
8. YES
9. YES
10. YES
11. YES

with ABC colors

1. X
2. X
3. X
4. X
5. X (almost)
6. X
7. X
8. X
9. X
10. X
11. X

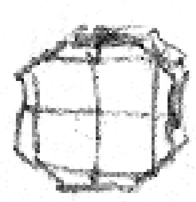


---

checkered for #2

4. prevent by ~~either A1 or~~ H2 dark

---

at PC 8 

6x4=24

16+10=26
or 25

1. ok
2. ok
3. ok
4. X
5. X
6. ok
7. X

8. ok
9. X
10. ok
11. X

4. ok
5. X (c) and G or H
7. ok
9. X
11. X

11. ok
1 X
2 X
3 X

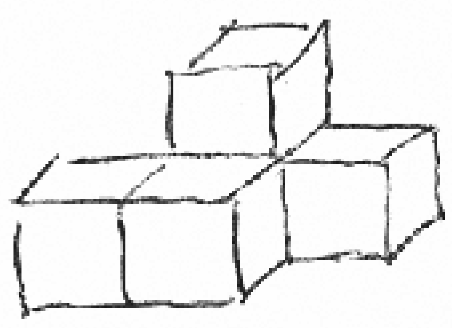
4 X
5. OK

11. ⊞
1. X
2. X
3. X
4. X

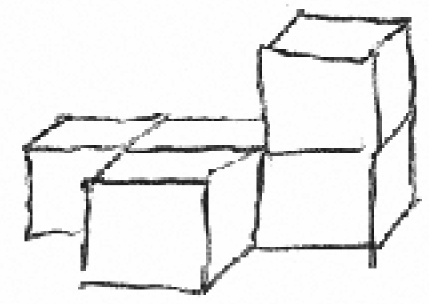
6. X
7. X
8. X
9. X

11. OK

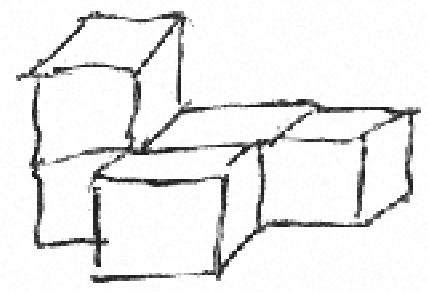
Pillars of Hercules #78



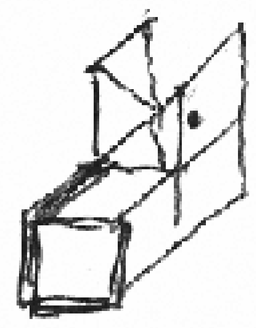
C



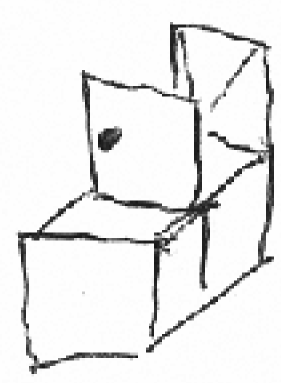
D



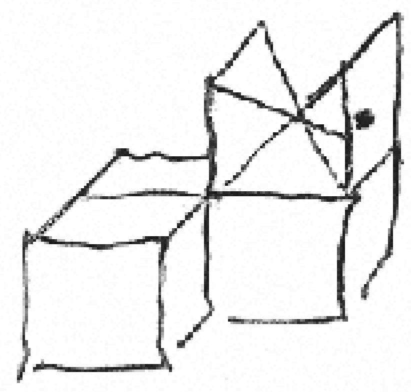
E



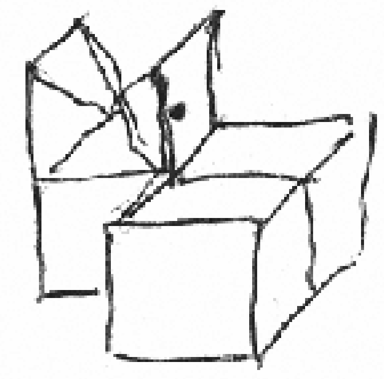
B-1



A-1

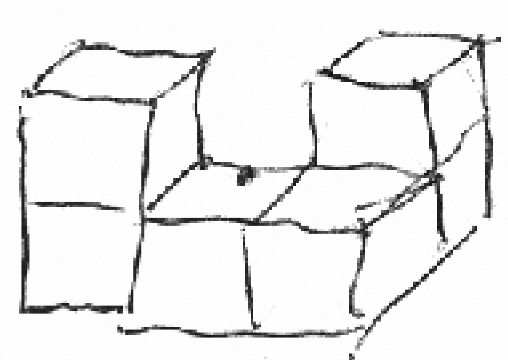


B-2

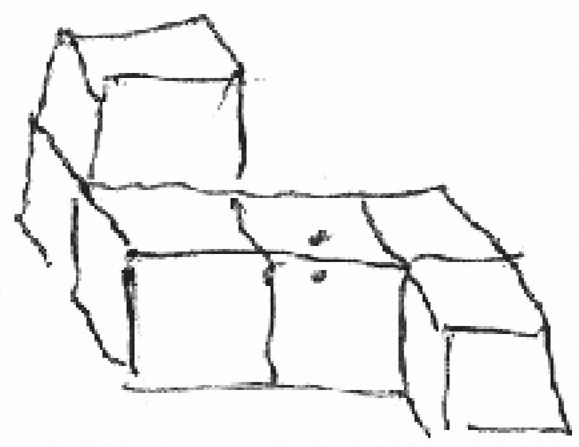


A-2

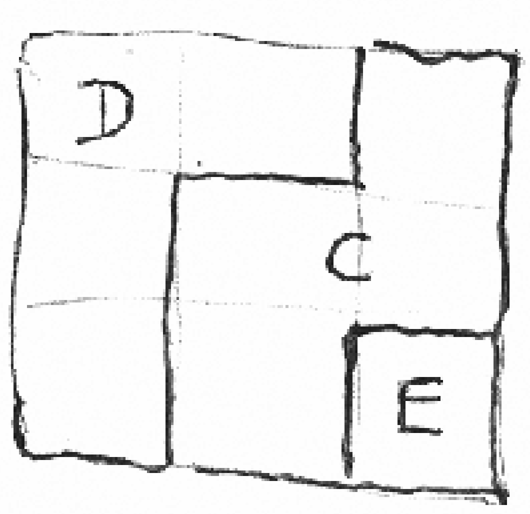
See <u>Puzzling World</u>, page ~~184~~ 166



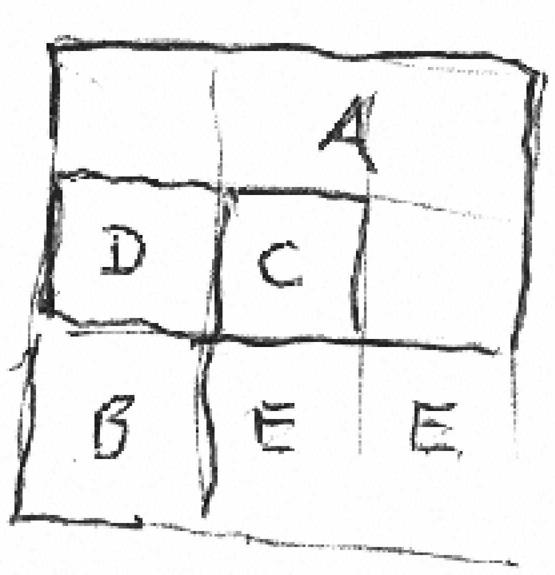
A

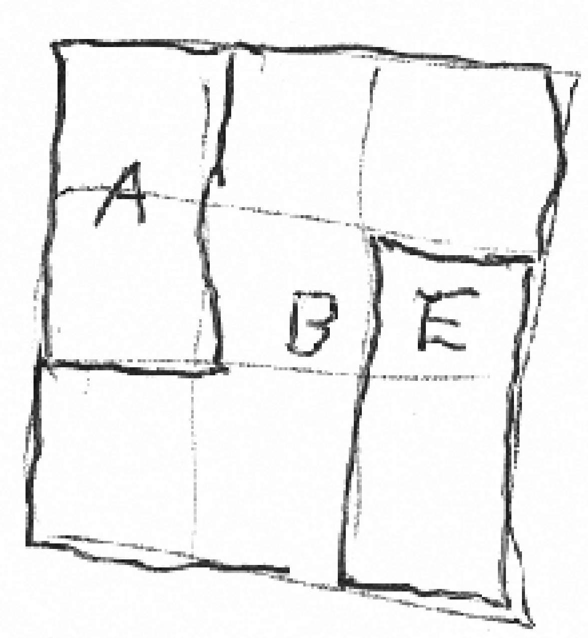


B



TOP



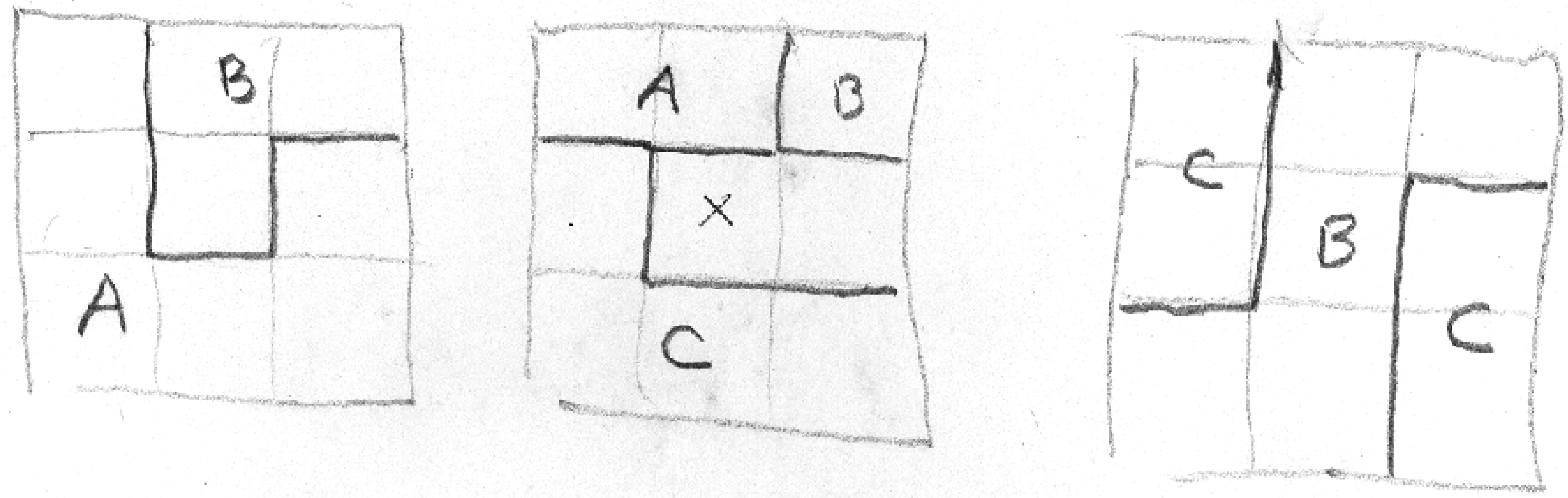


BOTTOM

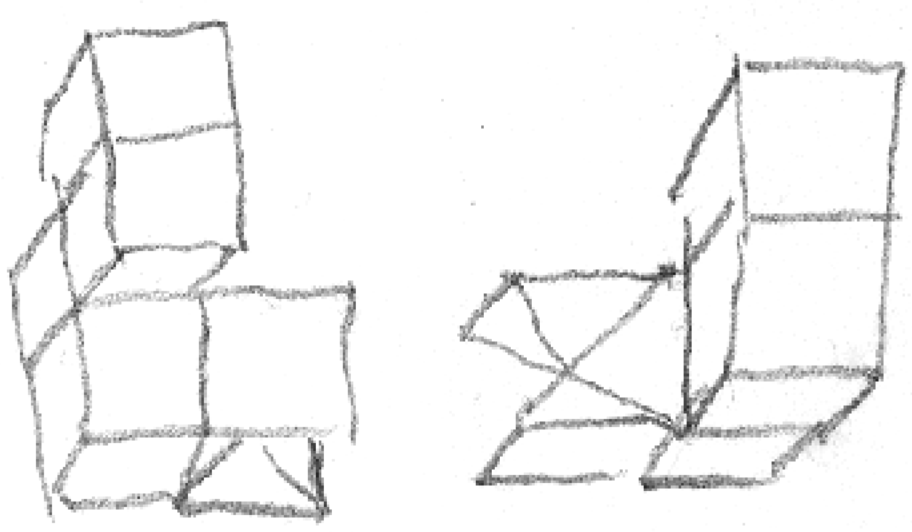
#78

78-A

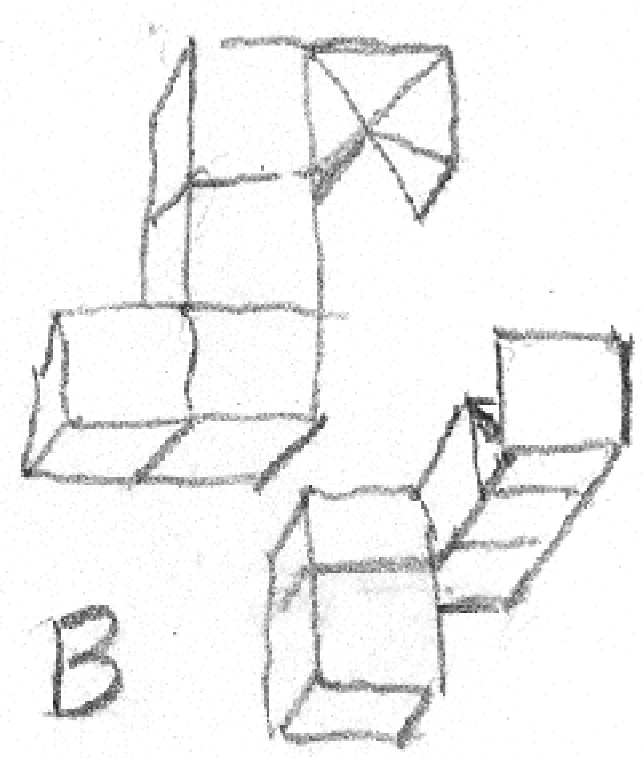
6 pieces, 3 peanut joints



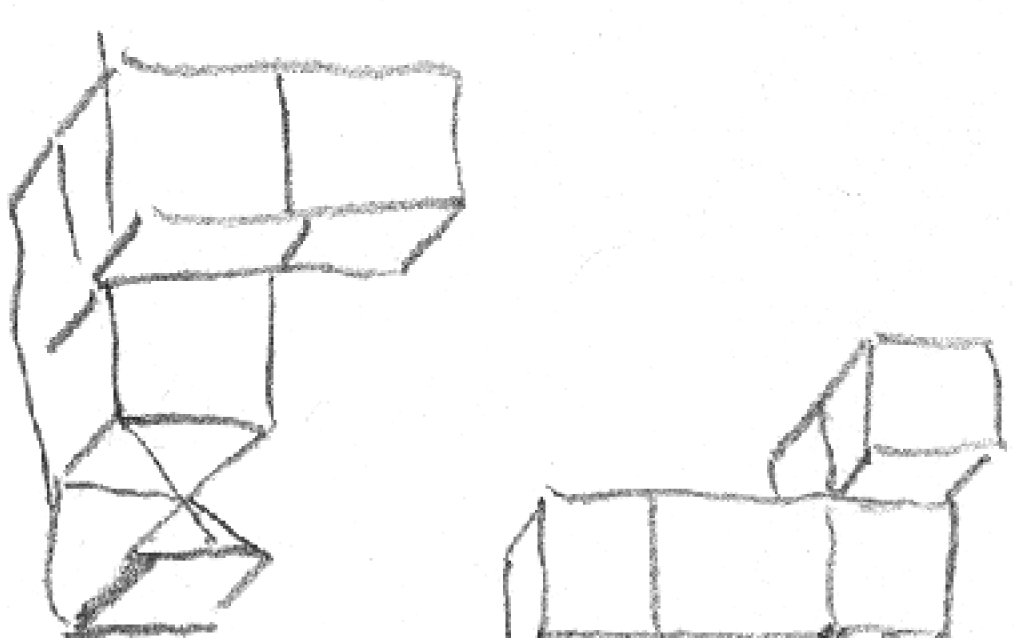
BOTTOM TOP



C C



B



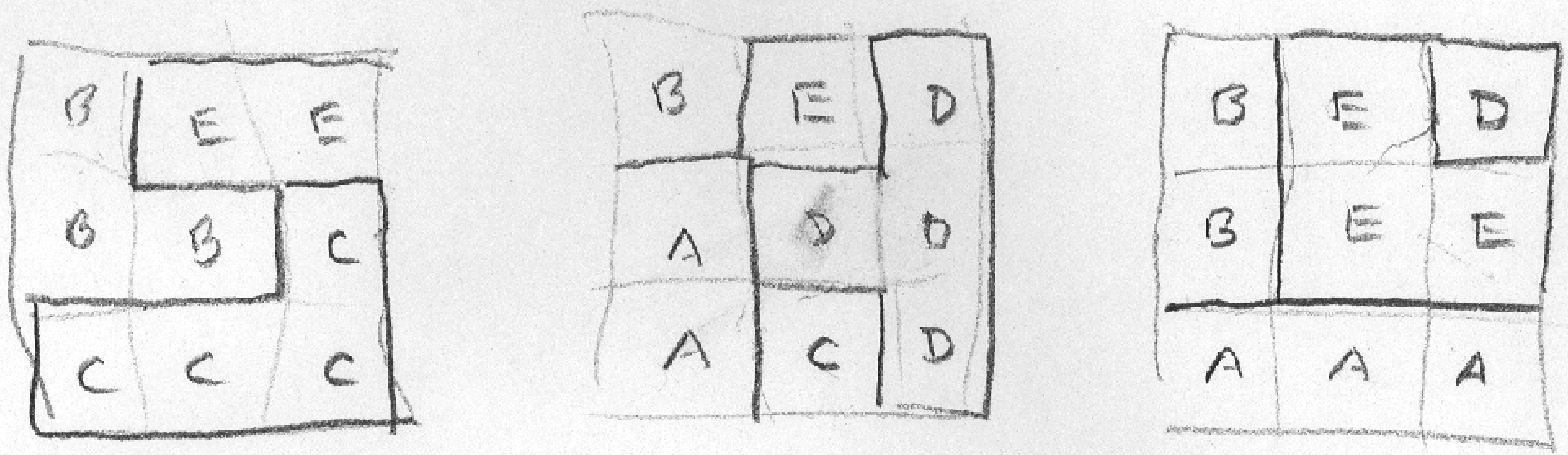
A

Piece A must be assembled last and come apart first

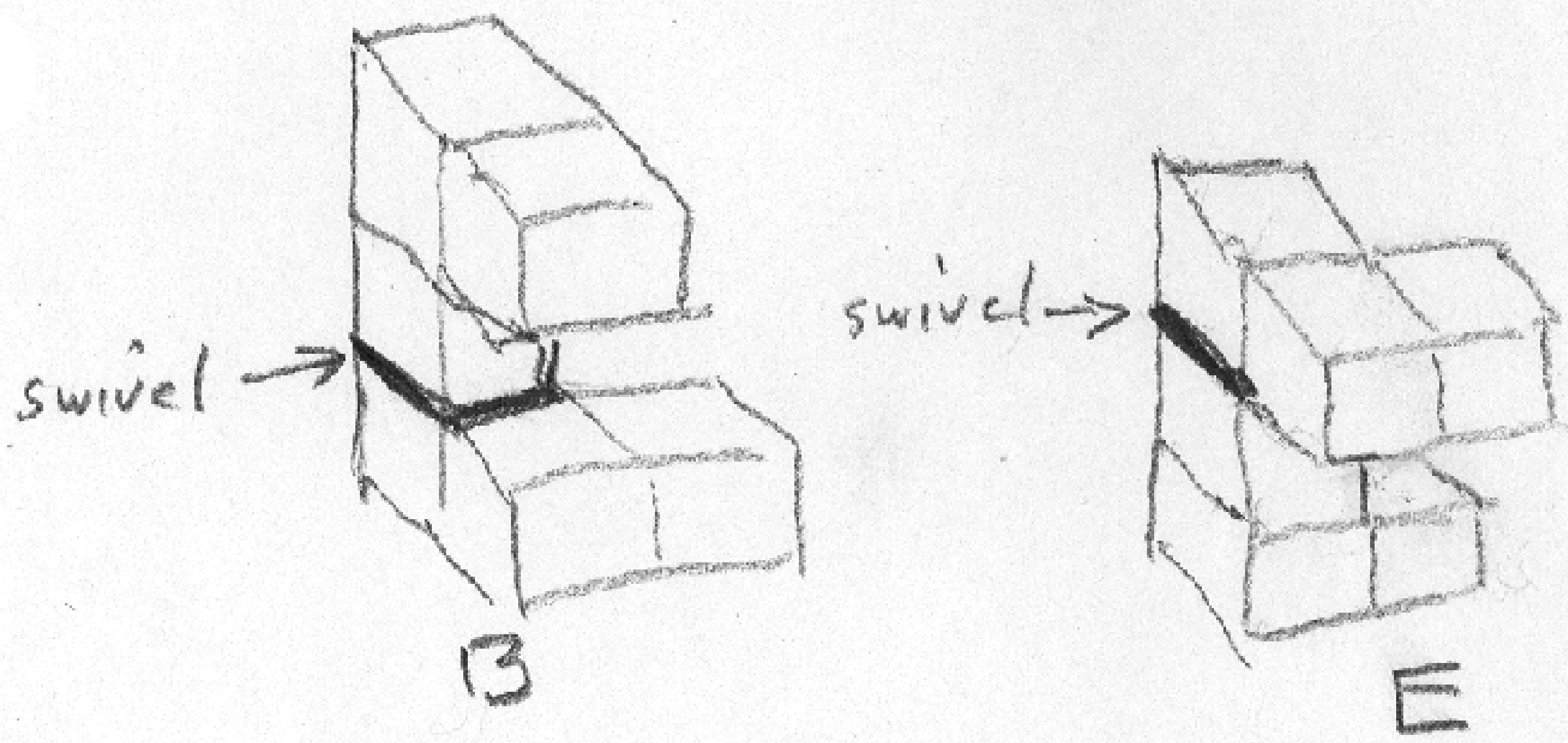
78-A

78-B   1990

5 pc 3×3×3 with 2 rotating joints



BOTTOM   TOP

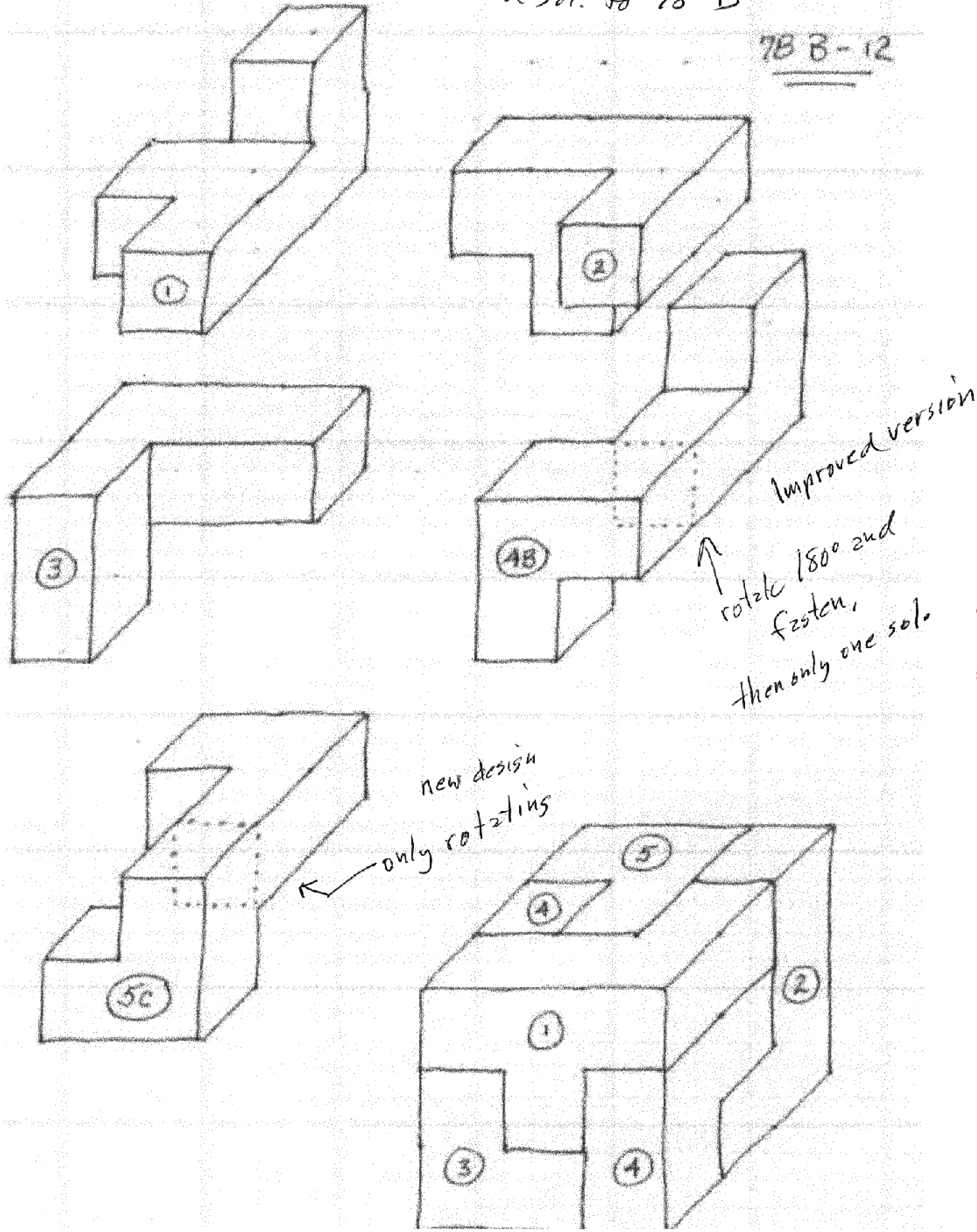


78-B

from Bob Finn

2nd sol. to 78-B

78 B-12



78-B

#80

30 pentagonal sticks + dowels

designed July 1987

7 holes in each stick

#80-A 5-hole version,

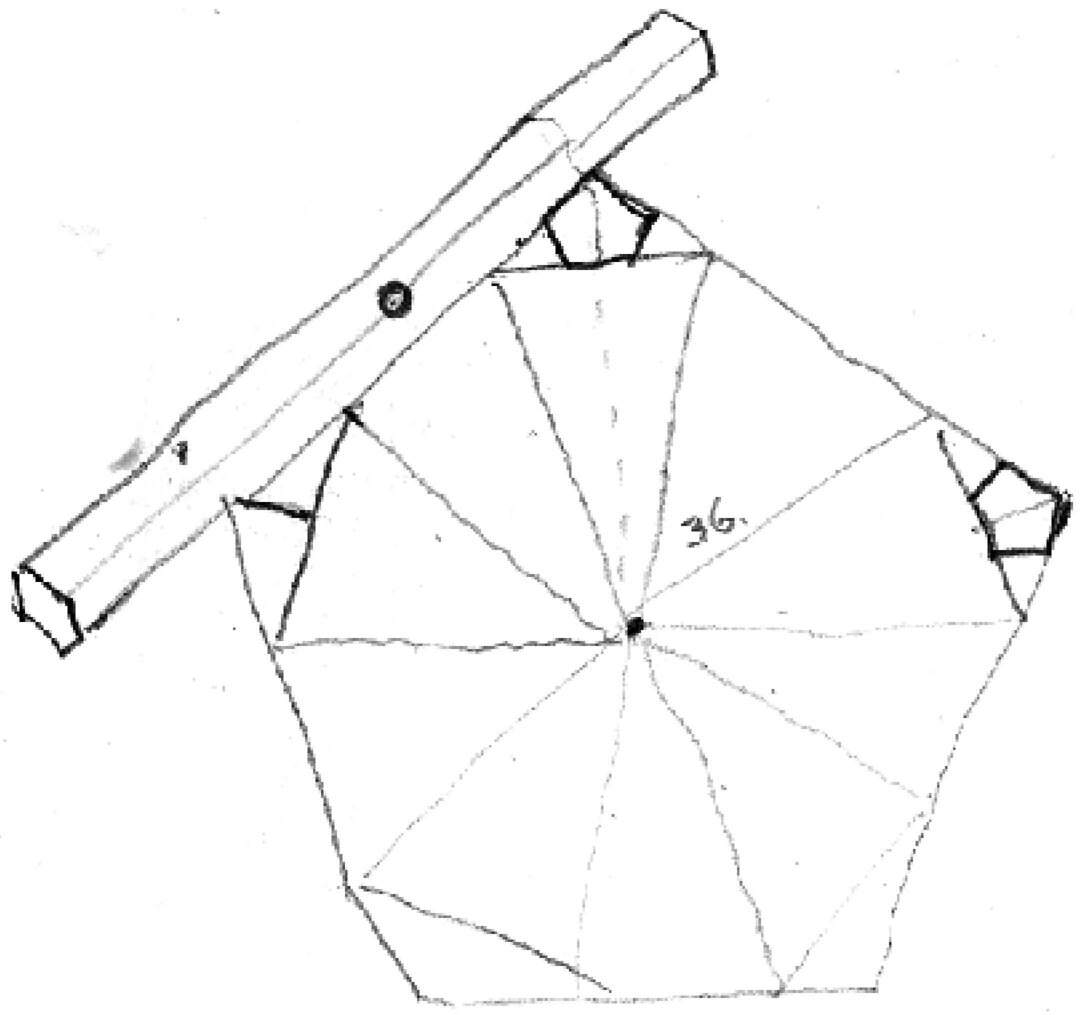
only one made, in basswood, 1988

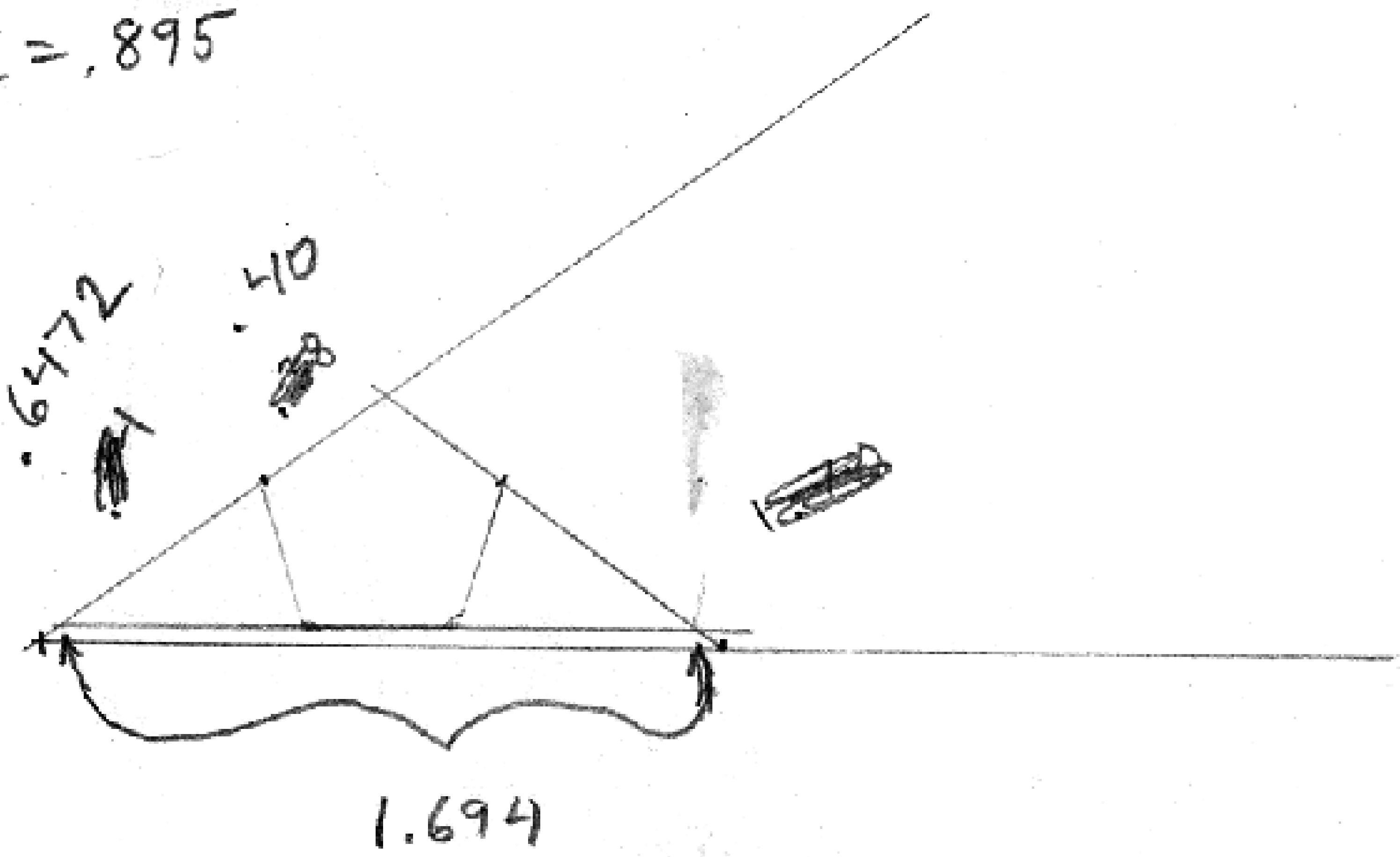
#80

R

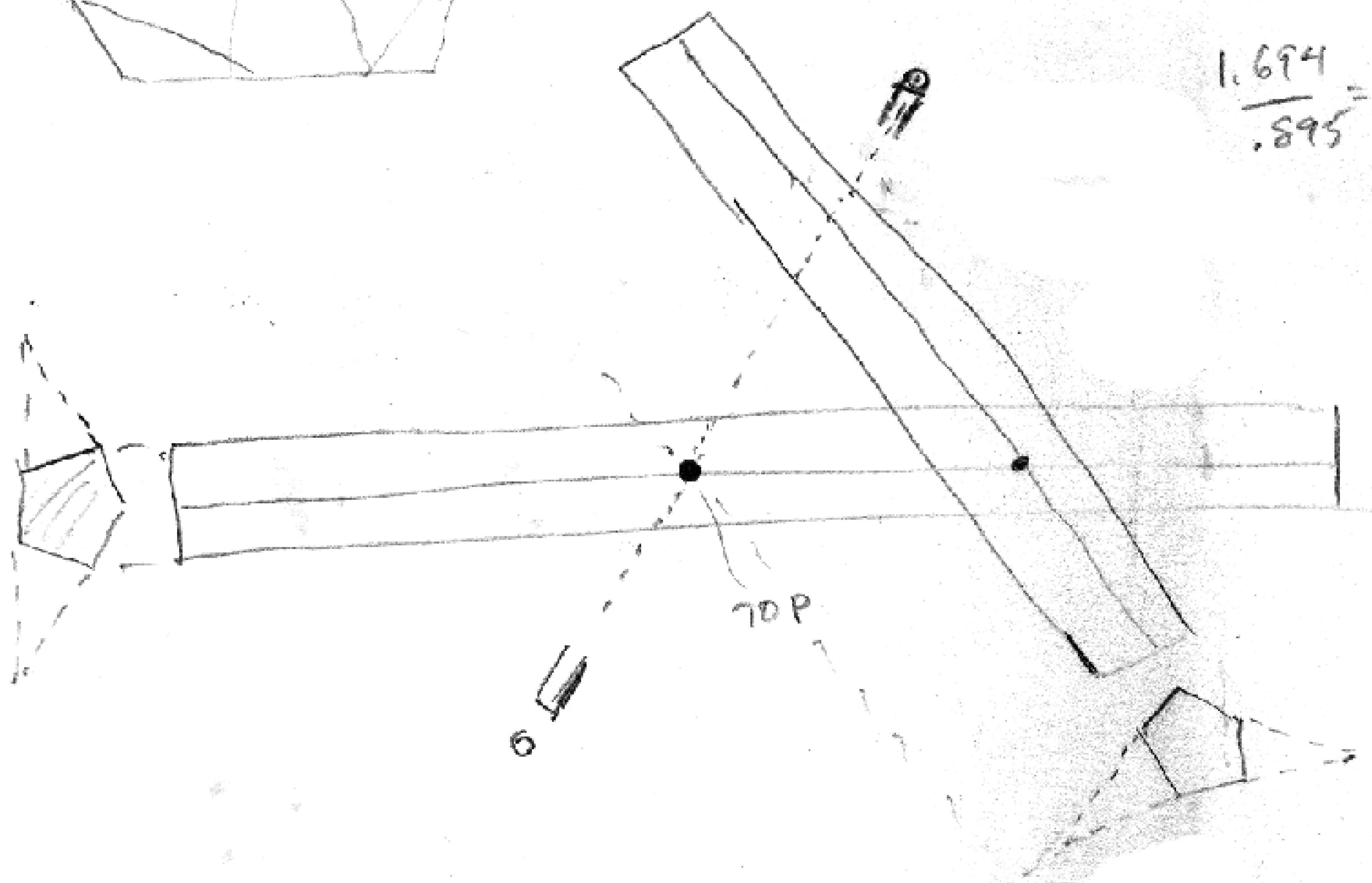
#80 July 1987

$\sin 63\frac{1}{2} = .895$



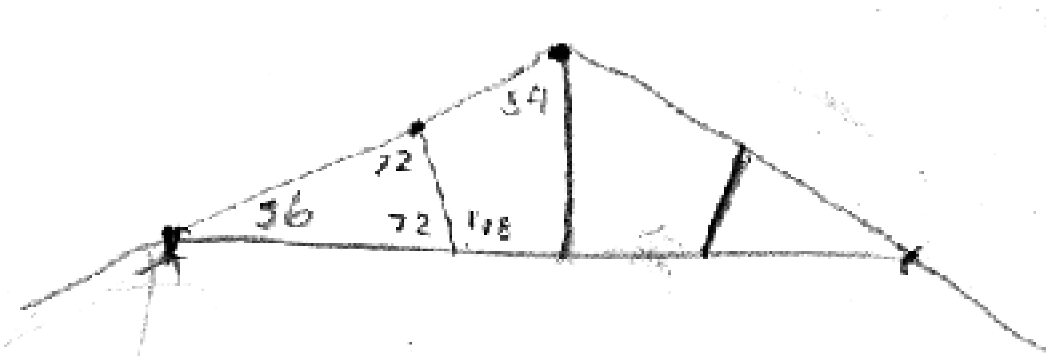


$\frac{1.694}{.895} = 1.892$

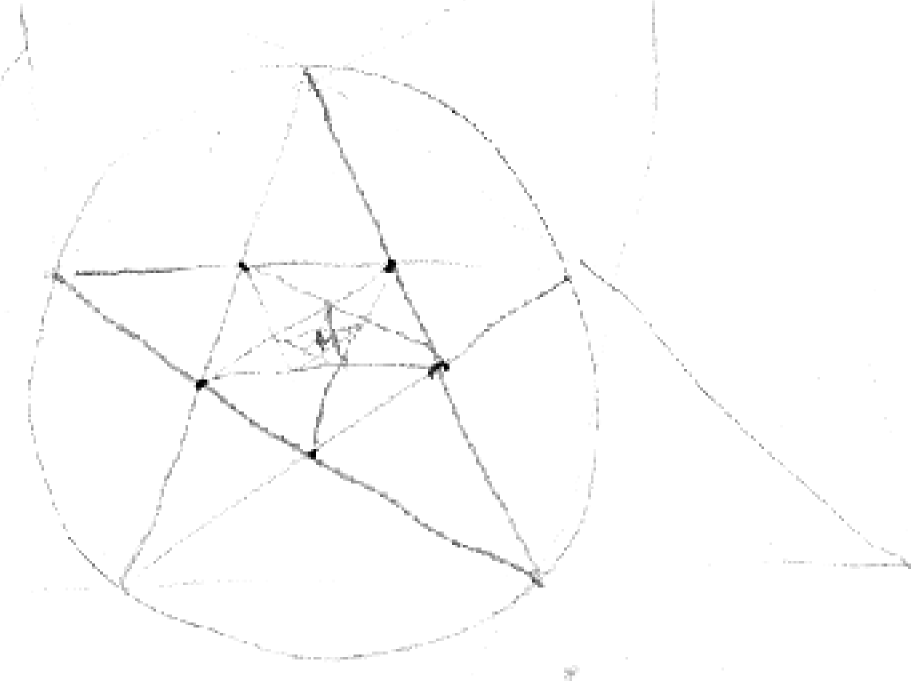


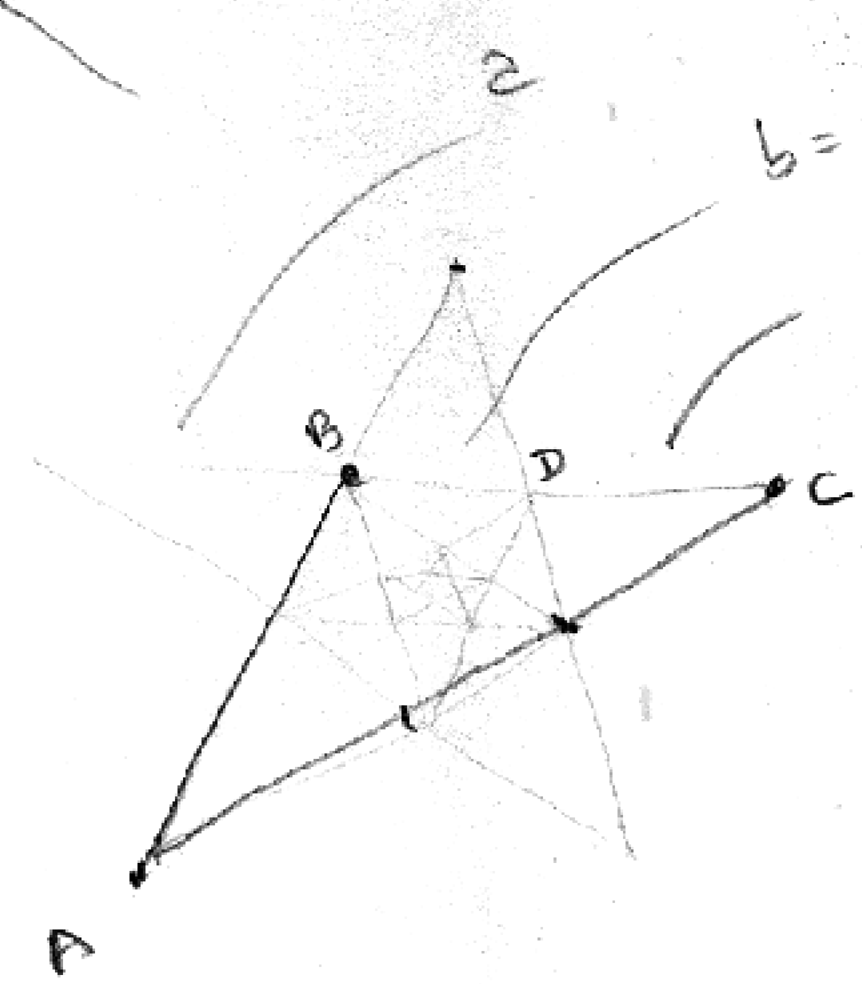
#80

$\frac{2}{3.236}$ $\frac{1.36}{x}$ $x = 2.20$



$\frac{a}{b} = \frac{\sqrt{5}+1}{2}$





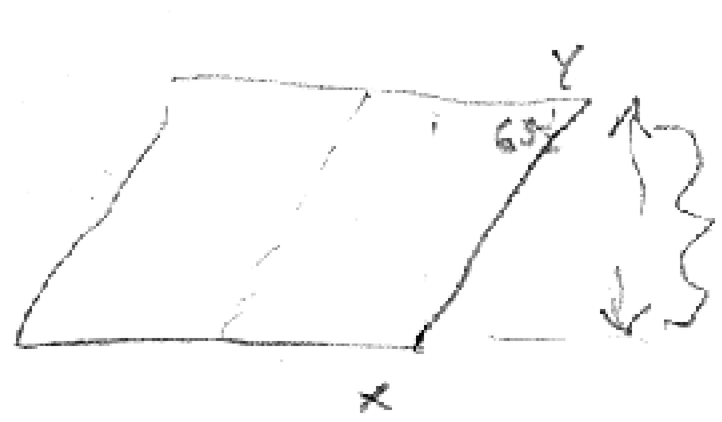
$b = 2$

$a = \sqrt{5}+1 = 3.236$

measured

$\frac{3}{8}" = \frac{.4 \; \text{~~.375~~}}{\text{~~1.125~~} \; 1.000} \stackrel{?}{=} \frac{2}{x =}$

$x = 5$



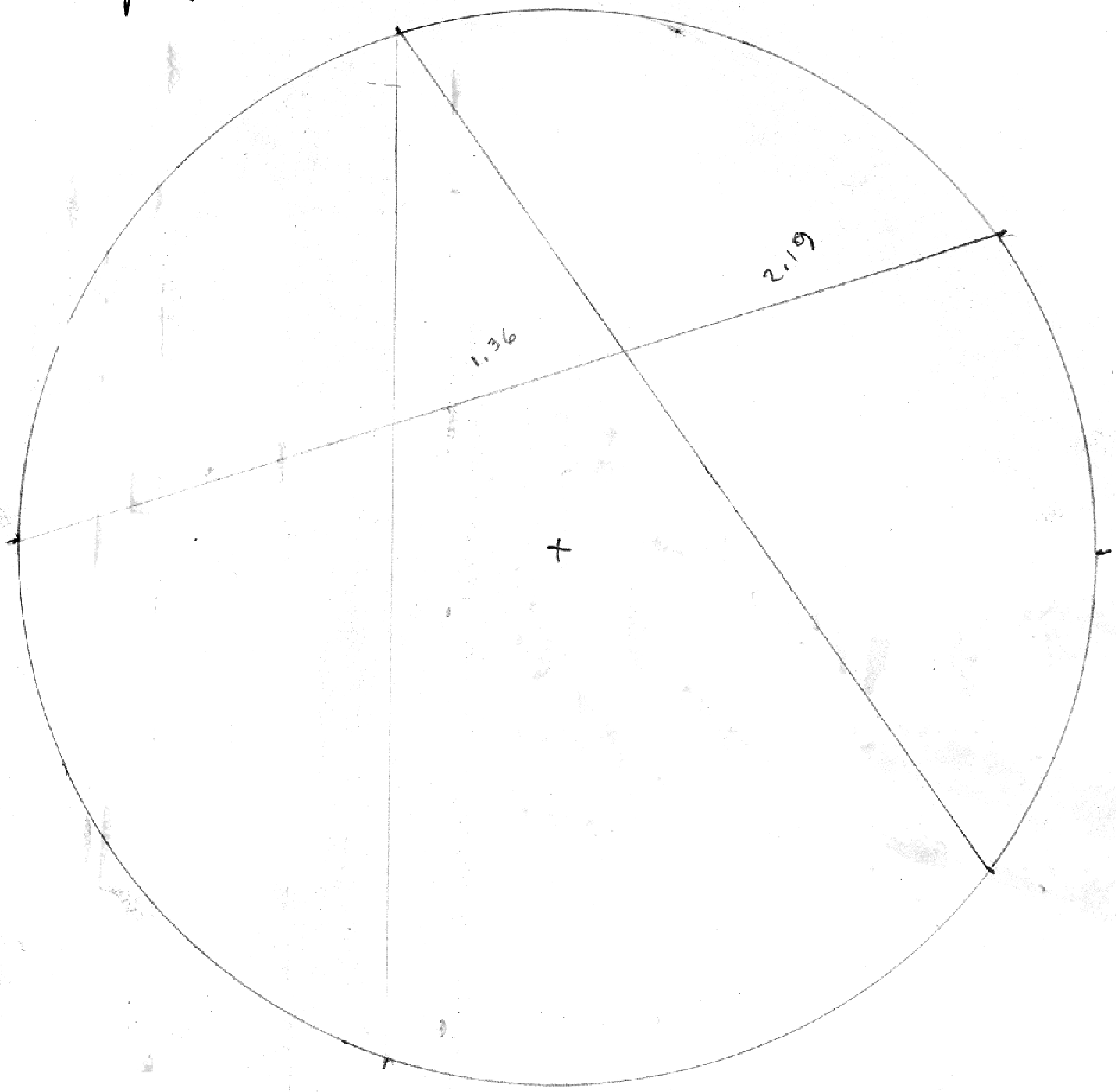
$BD = 2$

$BC = 3+\sqrt{5}$

$AC = 4+2\sqrt{5}$

$\sin 63 = \frac{4+2\sqrt{5}}{XY}$ $XY = \frac{4+2\sqrt{5}}{\sin 63} = \frac{8.472}{} =$ ~~5.0192~~ 9.466

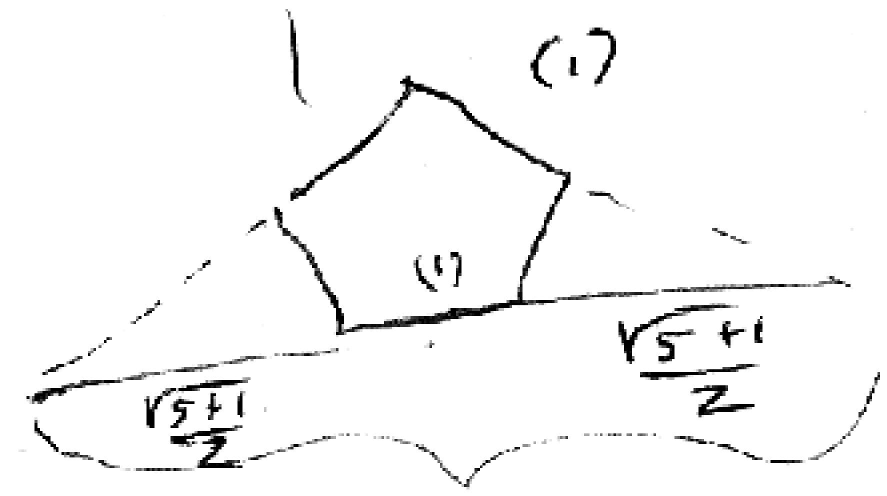
phyllotaxy



measured $1\frac{1}{8}$" + 5/8

7/16 = .4375

3.236
.4375
3.6735



3.

4.236 x

~~3.6735~~

$\frac{1.85325}{.895}$ x = 2.070

1.035

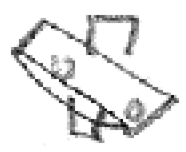
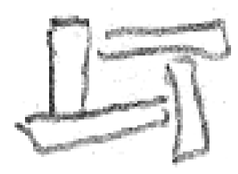
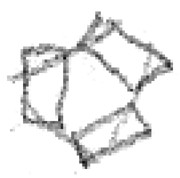
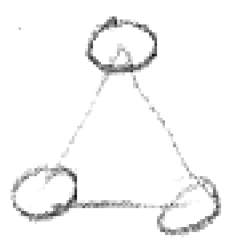
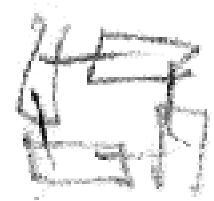
1.036

.518

#81

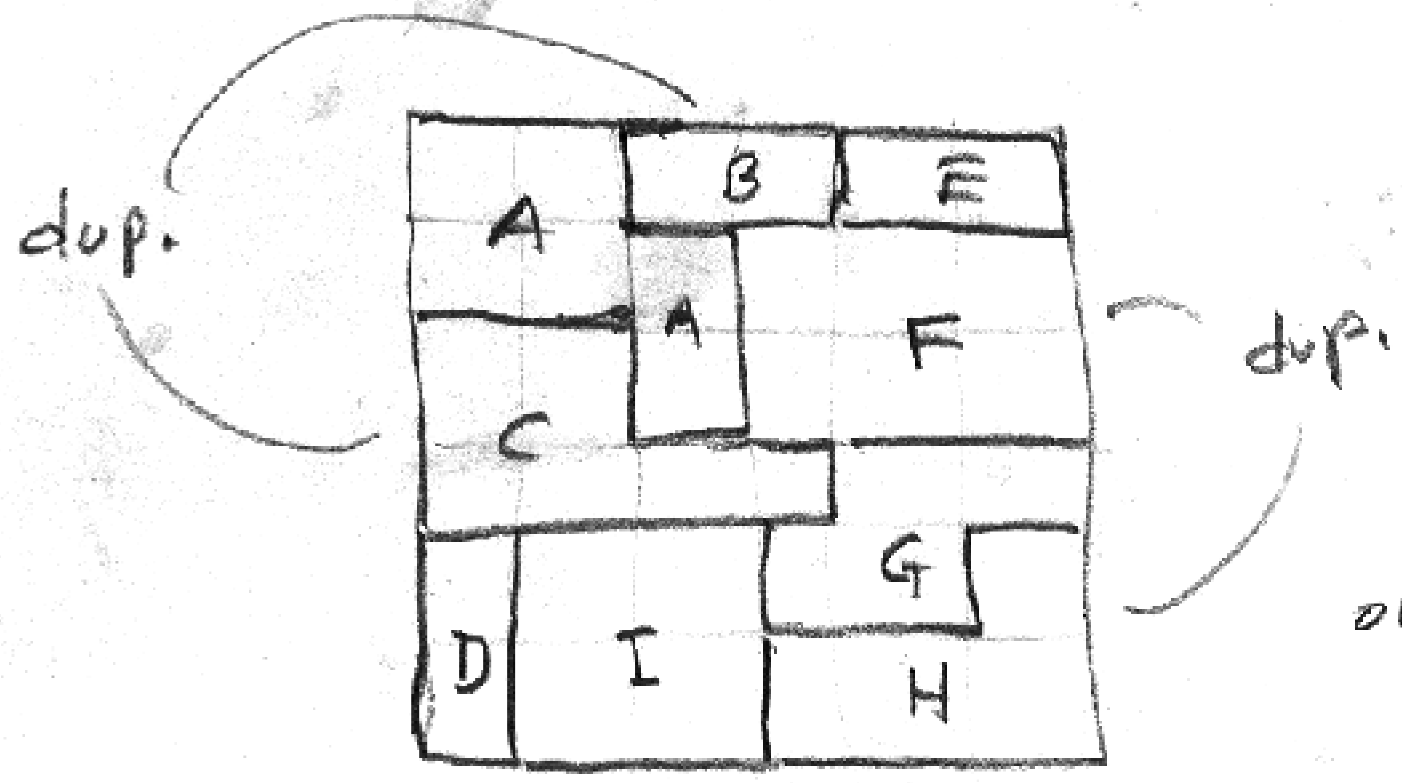
Nest Kit

July 1987

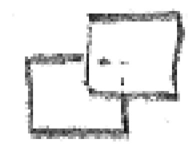
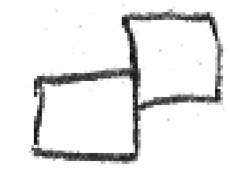
				2 	3 	4 
✓		2		2		
✓			4		4	
✓		3		3		
		6				3
		3			3	
		4		4		
			9		9	
✓		2	1	2	1	

#81

#82



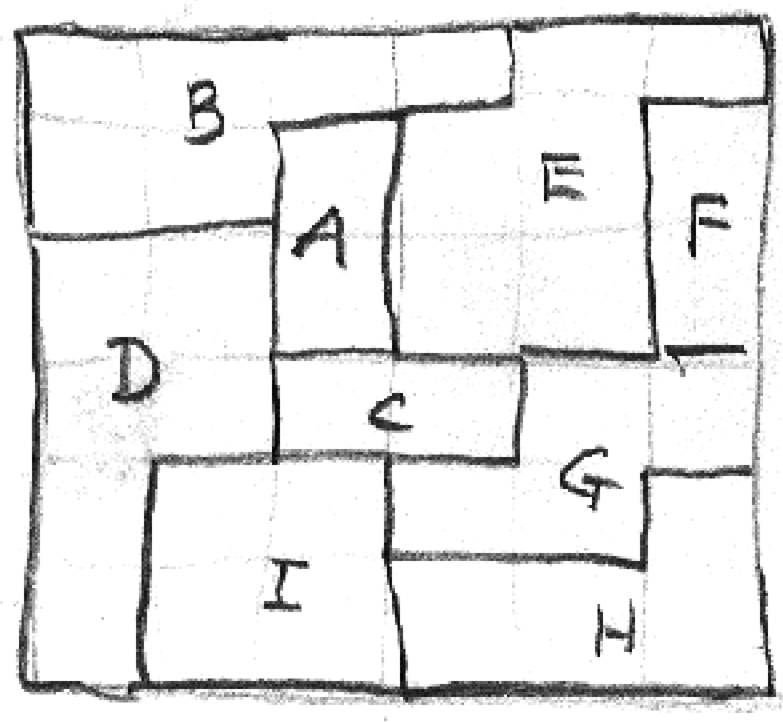
top

omit  and 

has two dup. and 2x2x2 cube

221
9
12

51
801
h5

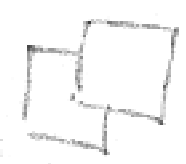


bottom

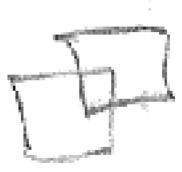
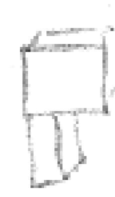
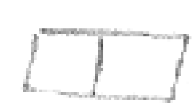
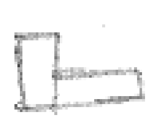
other cubes   has 2nd sol.

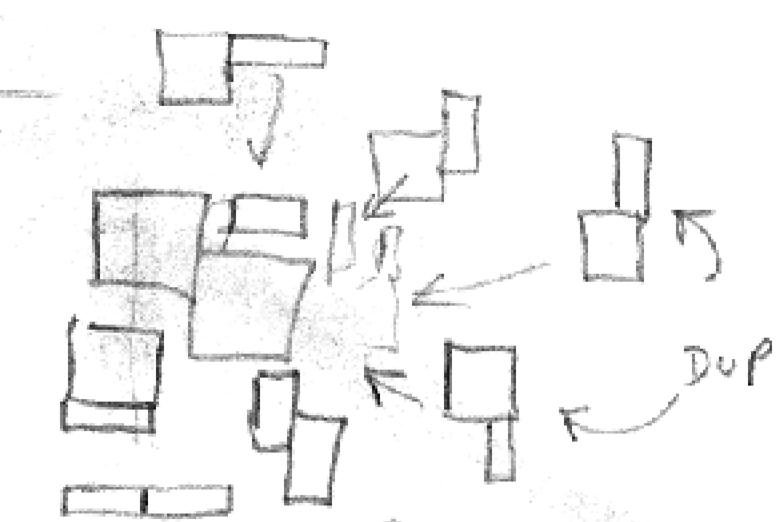
dup   omit

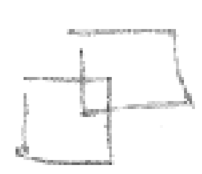
#82

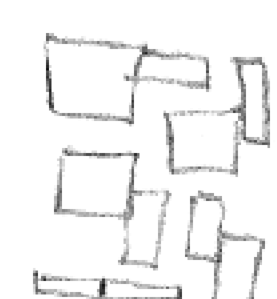
or. dup  and , omit  and , use cube

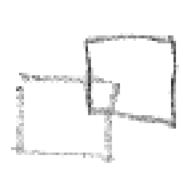
2x6x6

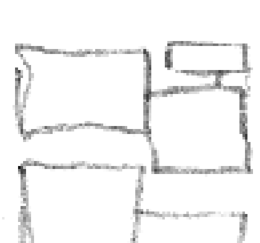
★ or omit , dup , use 
or  or 



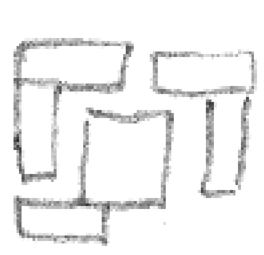
cube omit , dup  or 



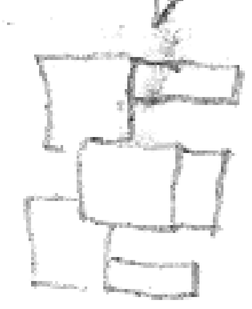
★ cube omit , dup , omit 



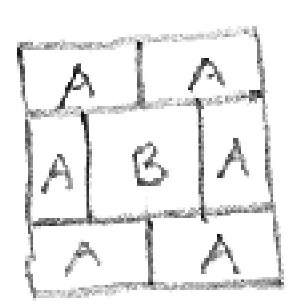
top

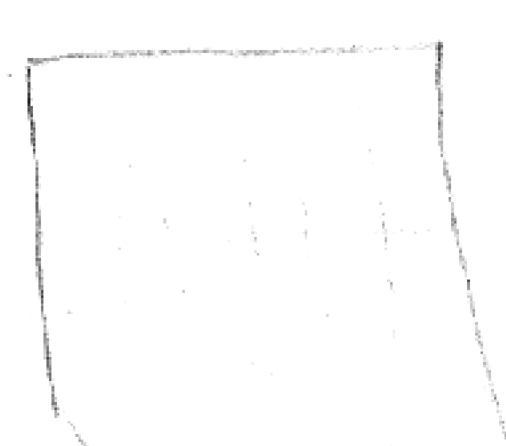


mid



bottom

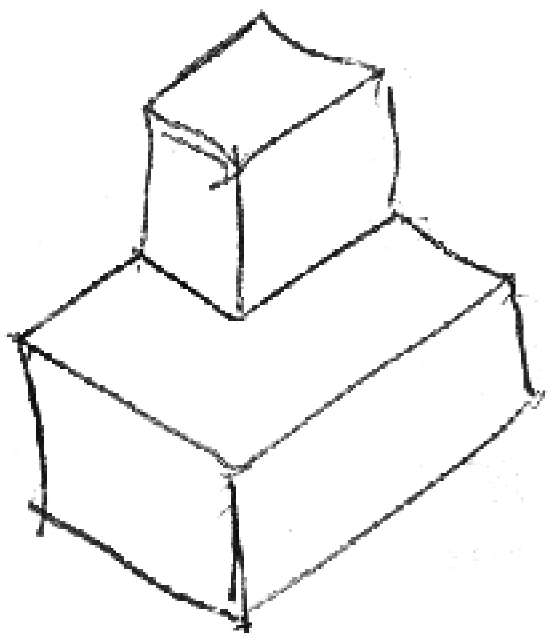


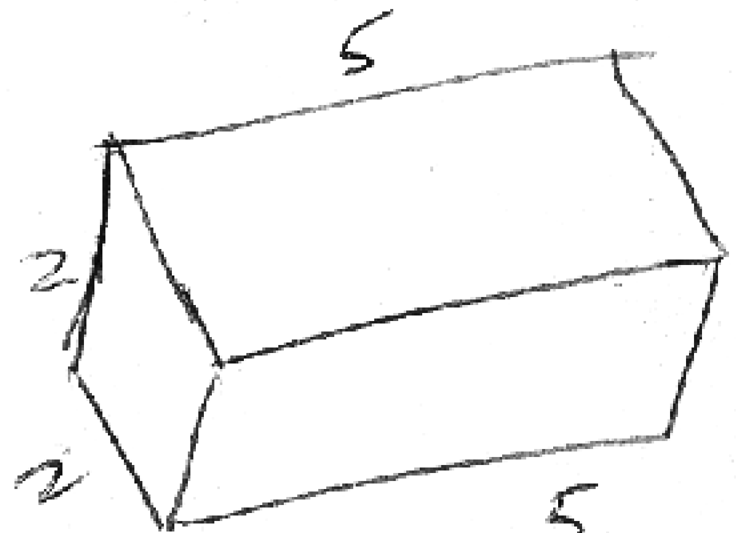


60 64 72
6x5x2 4x4x4 6x6x2

80 5x5x2

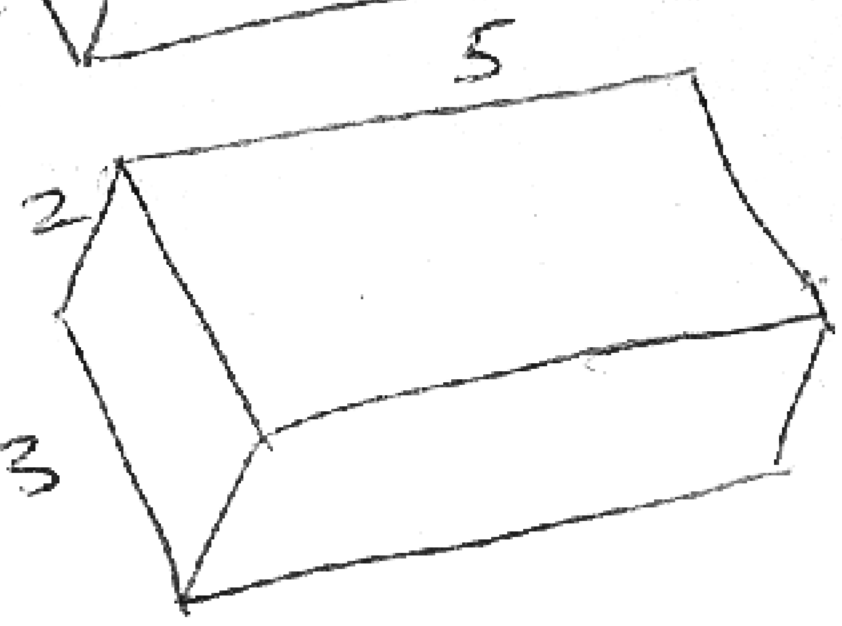
Beeler, ~~Jan~~ Jan 7, 1990



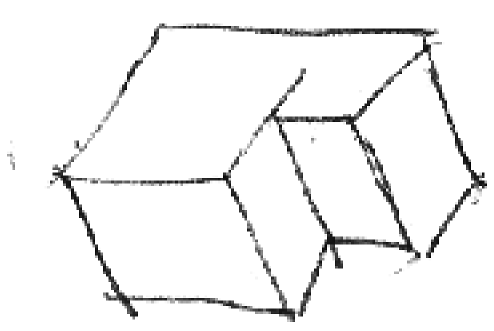


4 pieces

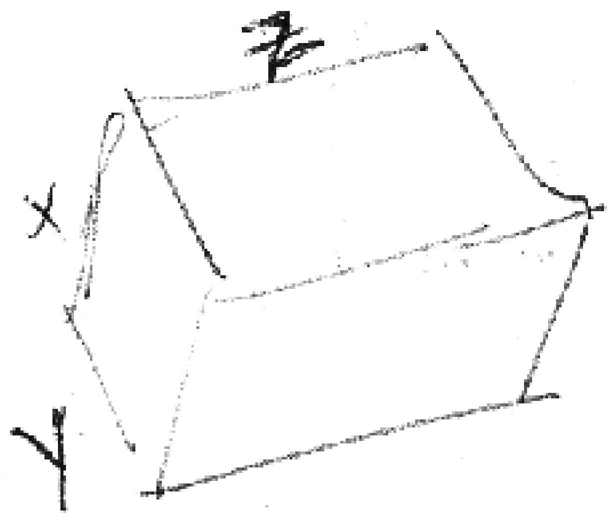
$\frac{11}{8} \times 16 = 2$



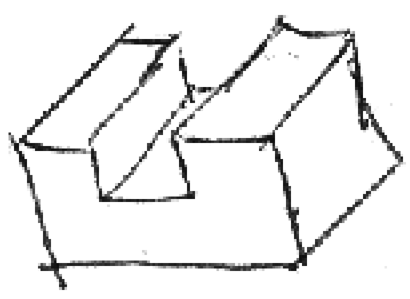
6 pieces $\frac{10}{8} = 10''$



step
2 ways

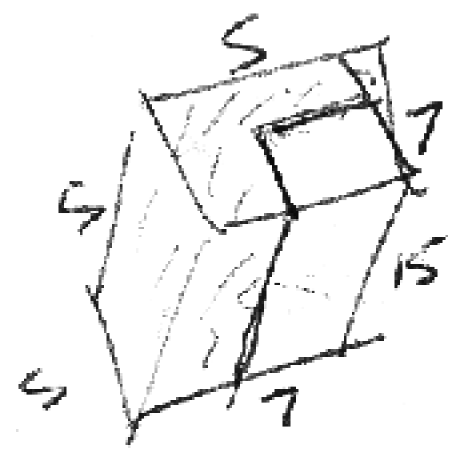


odd # of pieces?



trough
2 ways

couch
2 ways



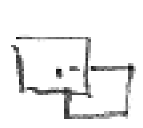
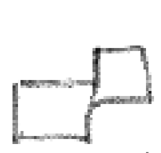
odd #?,
s = 15 smallest cube

4×4×4 = 64

≐ 8

4×4×5 = ~~60~~ 80
~~6×~~
2×8×5

4×4×4 =	64	8 pc
4×4×5 =	80	10
6×6×2 or 3×4×6 =	72	9
4×4×6 =	96	12
	88	11

6×6×2 omit , dup , use cube  or 

WBVR 603
02215
630 Comm Ave

From the Workshop of

CHARLES J. GANTT

111 S. Glenwood Ave.

Orlando, FL. 32803

Dear Stewart,

Nice to hear from you. The puzzle you refer to, I call Block Head, first came to me from Stan Isaacs of Palo Alto with the request to make him one. As you see it not a hard thing to do. To make the puzzle. To solve it is another thing. I tried for two weeks and began to holler for help. I sent copies to several friends of mine with a request for a solution, if they could find one. After a while I received two solutions. They were identical. One of these was from Jerry Gordon of Williamsville N.Y. who is the greatest puzzle solver I know. Some of us make puzzles, some design them, and then there are the blessed ones who collect them and pay money for them. May their tribe increase! Of course there are those who ignore them altogether. Jerry is solver. He admits he was stumped for a while and called on his brother Len Gordon of Chico CA who puts puzzles on his computer. He says it is easier than solving them by hand. In short his computer found fifty solutions. That is, there are 25 solutions and each has a mirrored image to make the fifty. Len also found an additional arrangement of a 4 X4 by 10 solution with a 2 X 2 block on top. I think I will package this one and call it Solution 51.

The origin of the puzzle came to Isaacs by way of Naef in Switzerland who call it Gemeni. They in turn got it from a Japanese whose name I do not know. Nob Yashigohari told me this and he would know. Further back than that I cannot go.

Jerry Gordon included some additional solutions, namely the cube you thought of. I will have copies of his work made and send to you Notice that his numbering of the pieces is different.

I like your puzzle design and will try it out when I get time. Right now I am up to my armpits in orders as a result of the new issue of the catalog. I dont make a lot of money but I always have something interesting to do.

So Long,

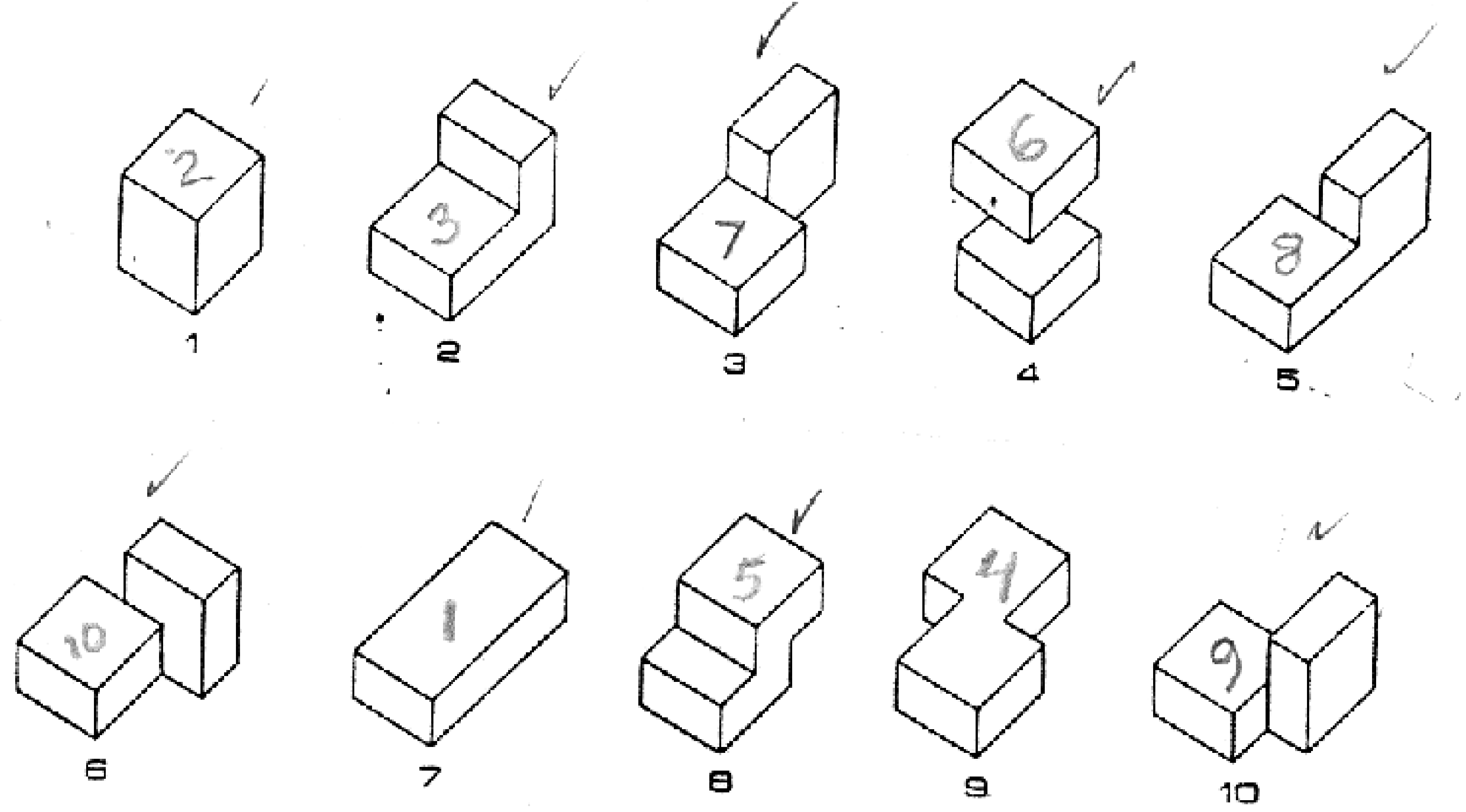
Chas J Gantt

P.S.

I have had a request for three of the burr puzzles (2,3,and 4) on page 83, Puzzles Old and New, by Jerry Slocum. I can make them but I do not know the solutions. Can you help?

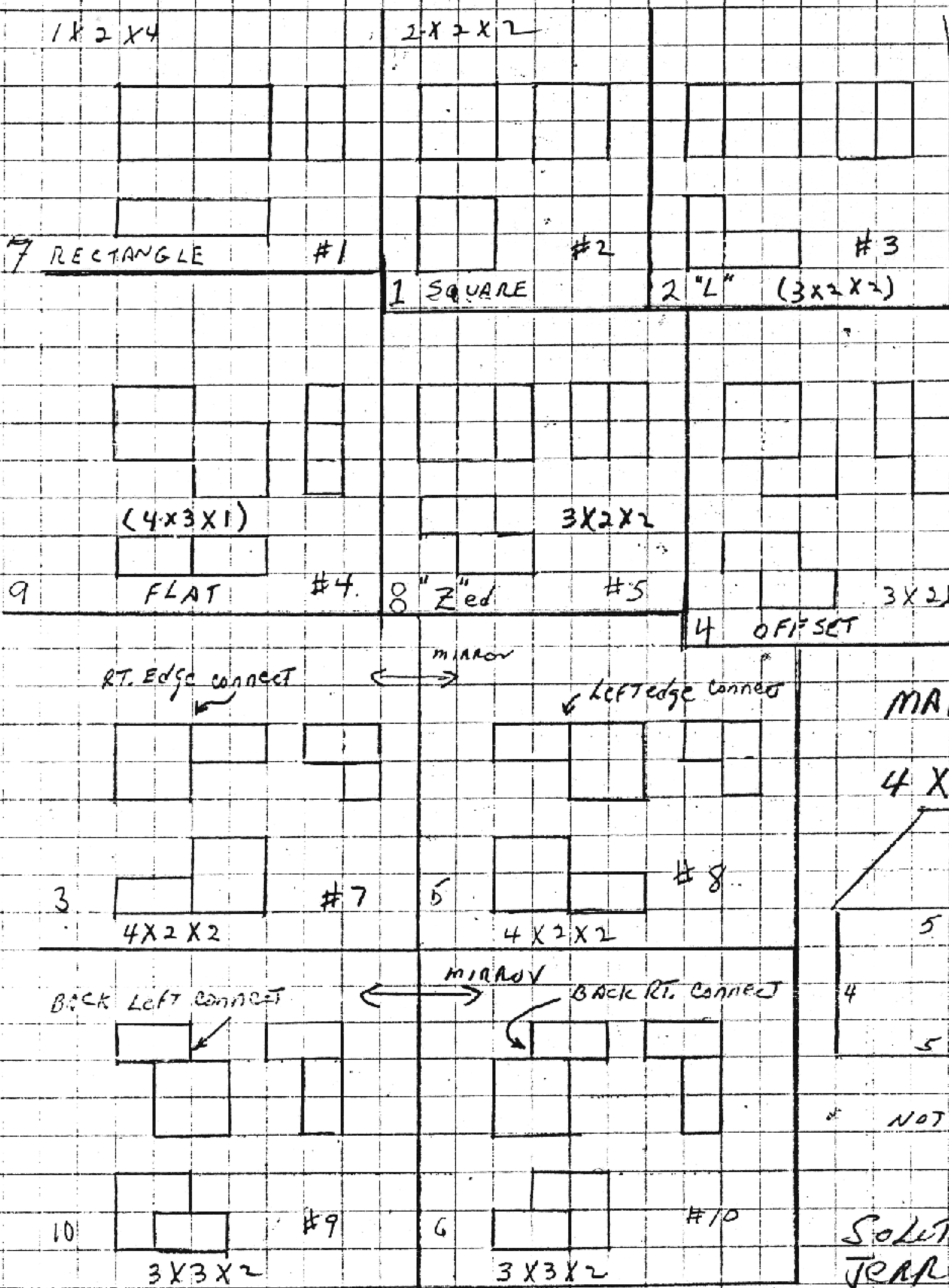
C

Ans Mar 4


1
2
3
4
5
6
7
8
9
10

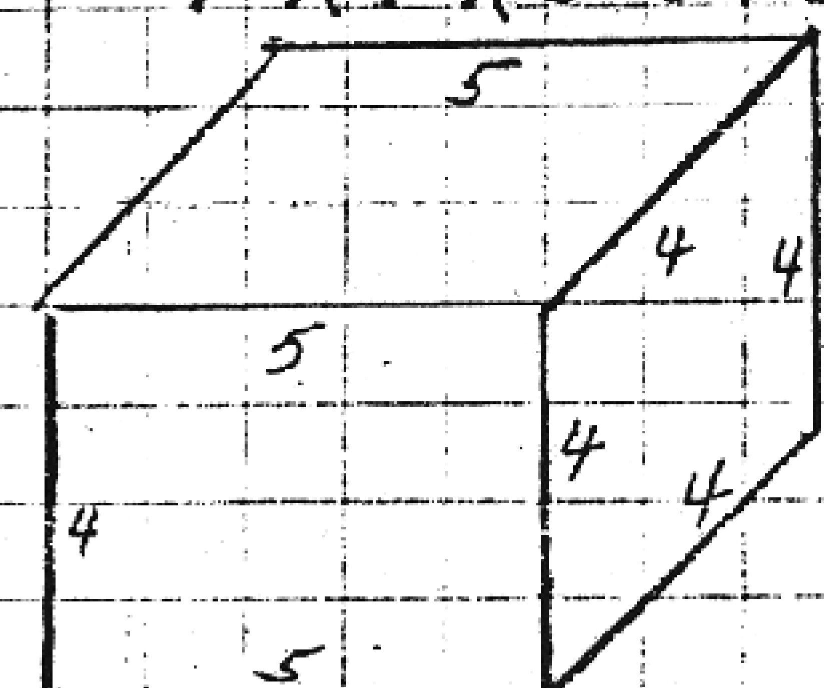
GANTT'S PUZZLE

10 PIECES EACH ARE: 8 UNITS VOLUME MADE OF TWO PIECES 2X2X1 GLUED IN VARIOUS SHAPES



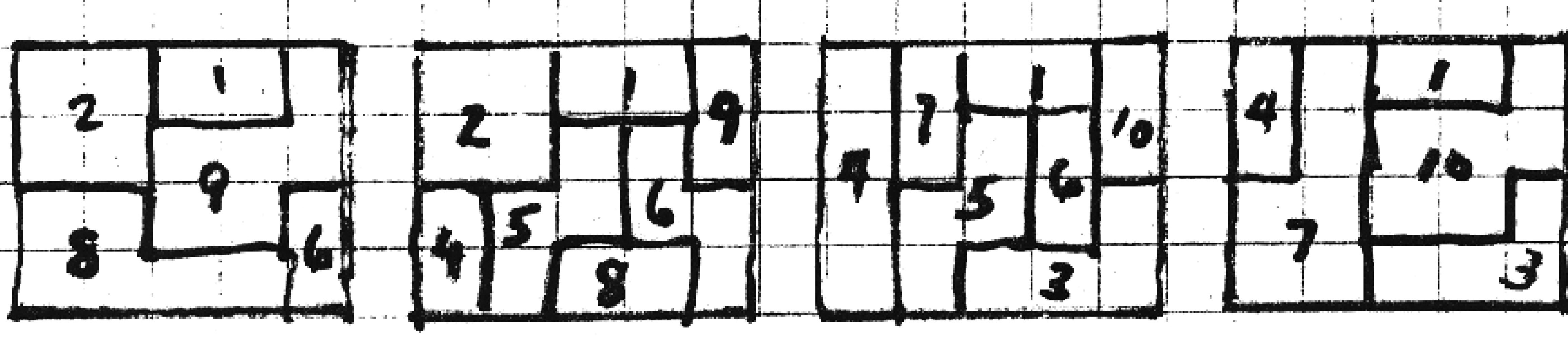
MAKES BOX

4 X 4 X 5 UNITS



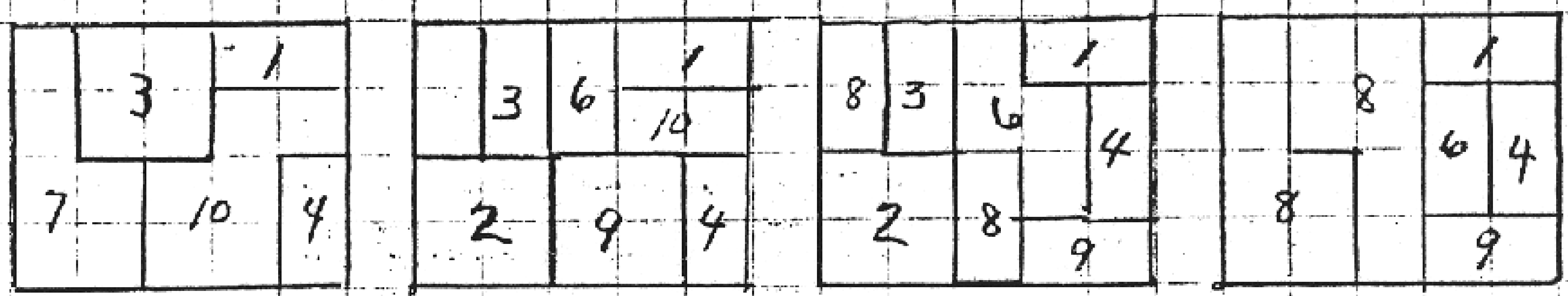
NOT TO SCALE

SOLUTION BY JERRY GORDON 5/5/86



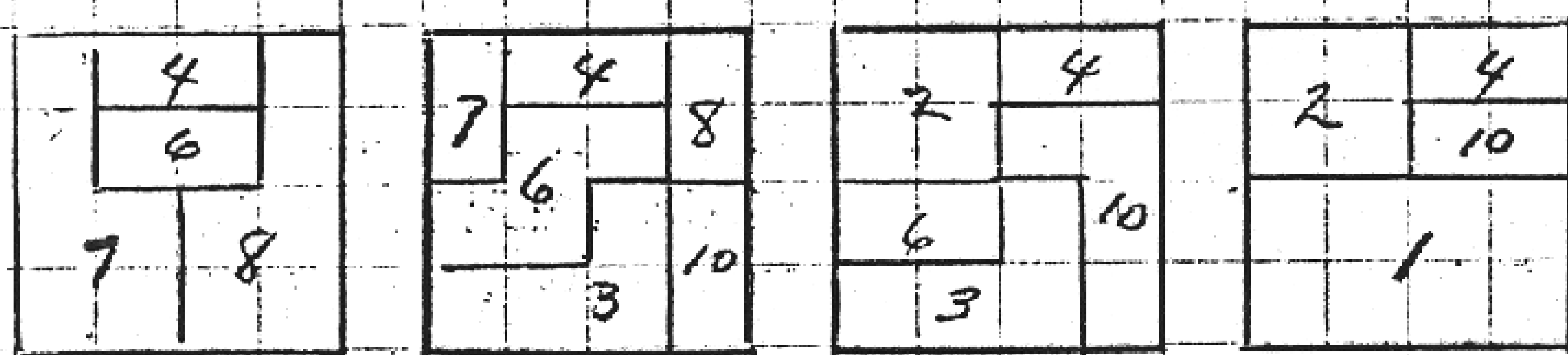
GANTTS' PUZZLE PIECES MAKE BOX or CUBE

FILL BOX WITH 1 2 3 4 6 7 8 9 10 8
NOT USE #5 (Z)



MAKE CUBE WITH 1 2 3 4 6 7 8 10 NOT 5, 9

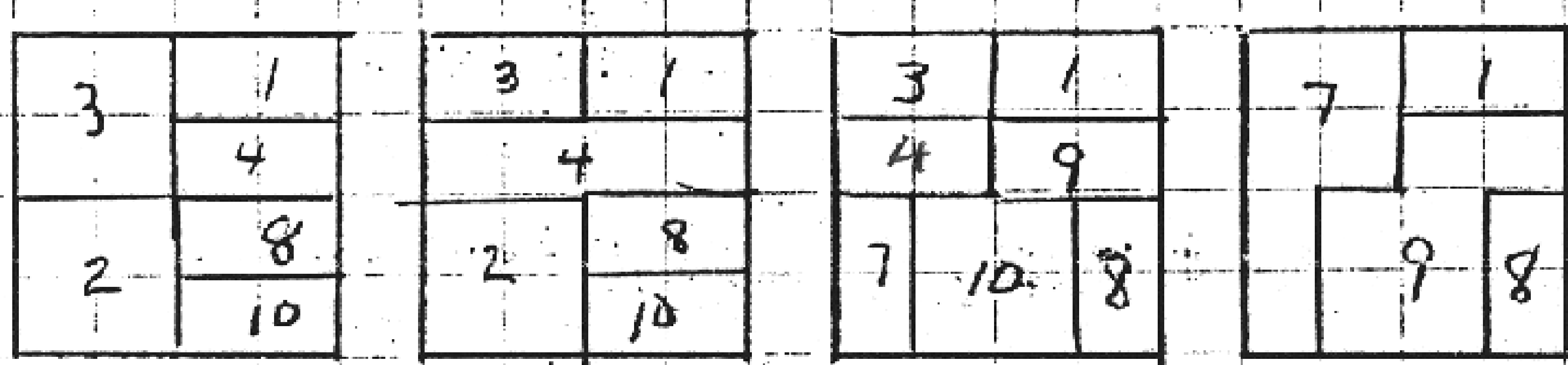
non-sym



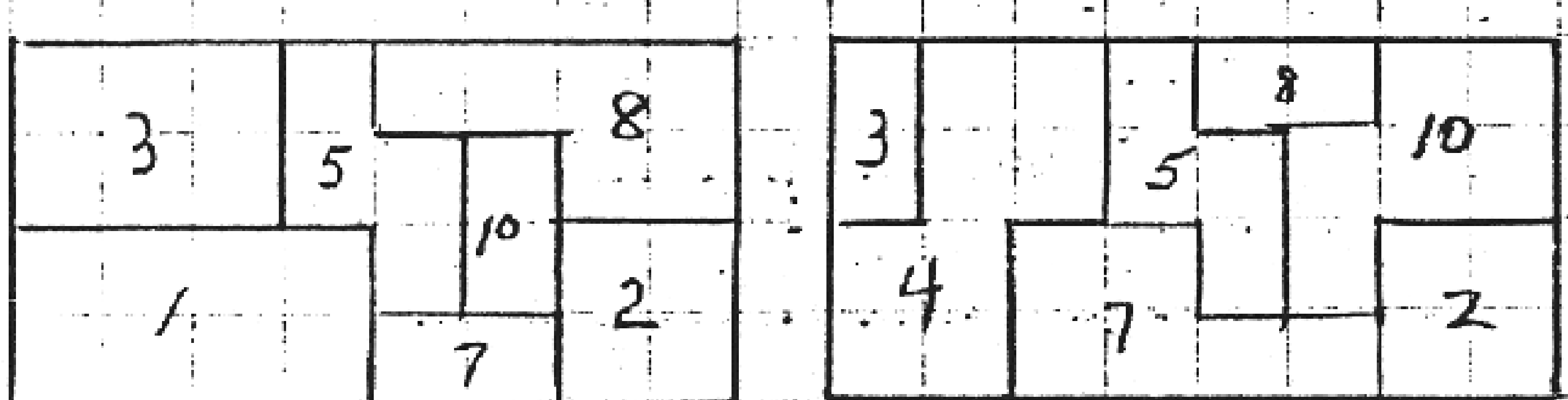
(could be with 10 instead of 9 if 7 & 8 changed pos.)

MAKE CUBE WITH 1 2 3 4 7 8 9 10 NOT 5, 6

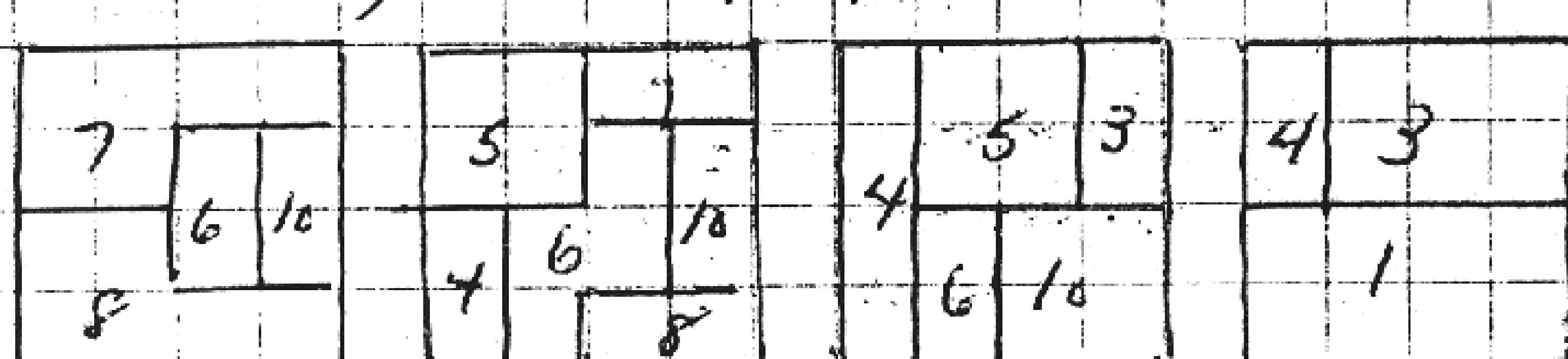
non sym

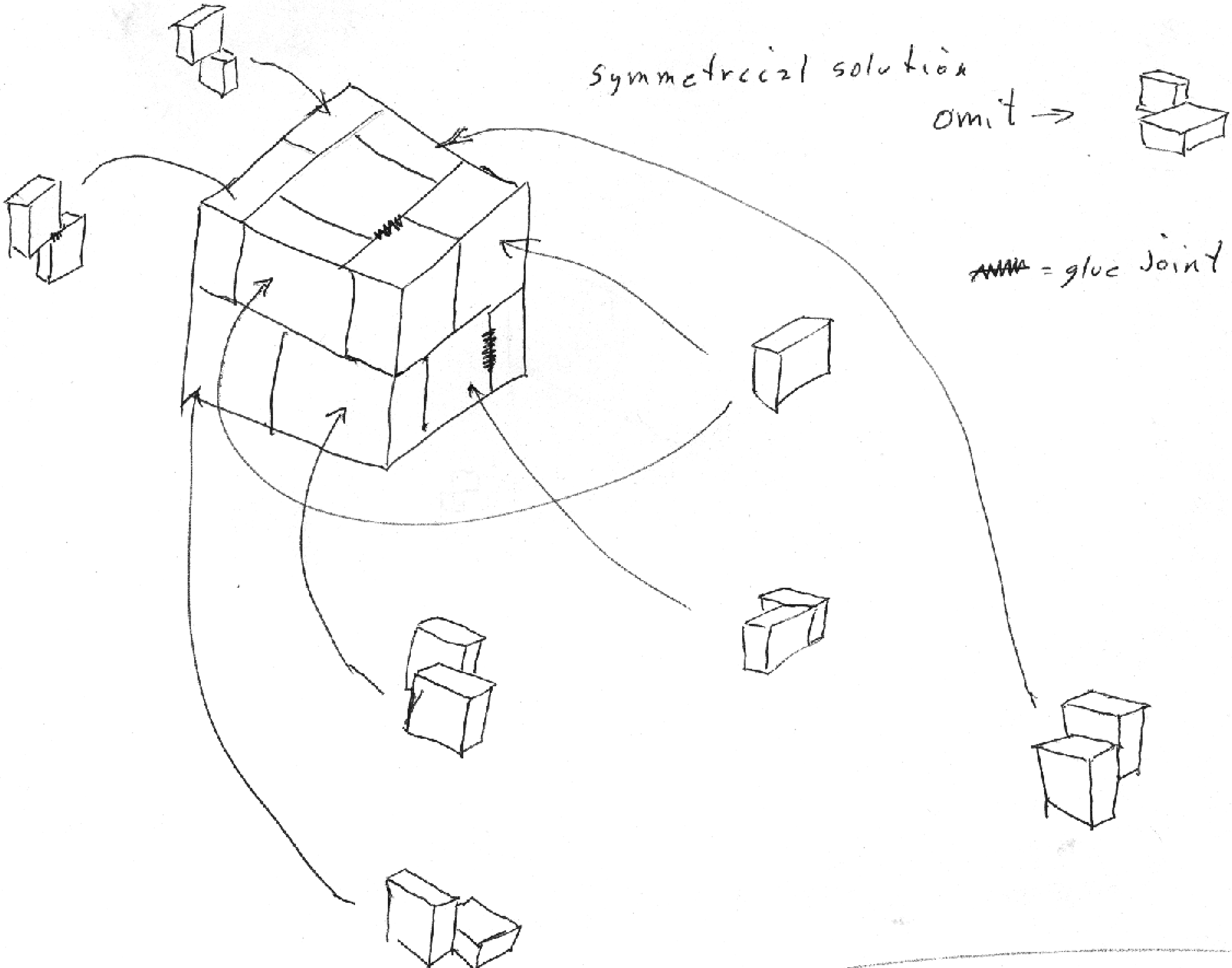


MAKE 2X4X8 WITH 1 2 3 4 5 7 8 10

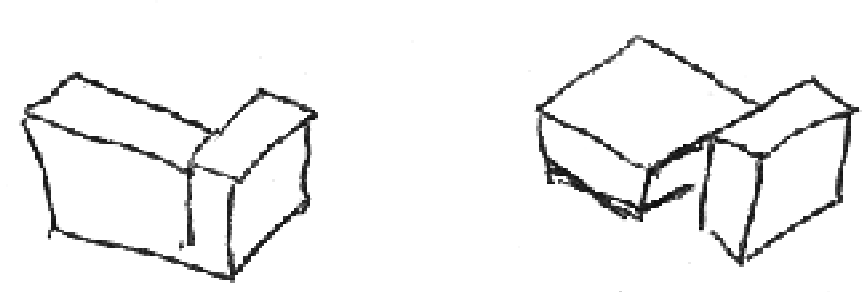


Cube, NOT WITH 2, 9

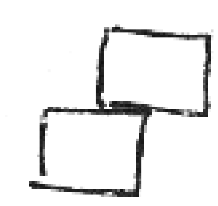
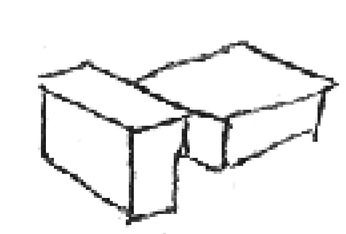


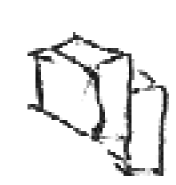
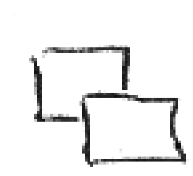


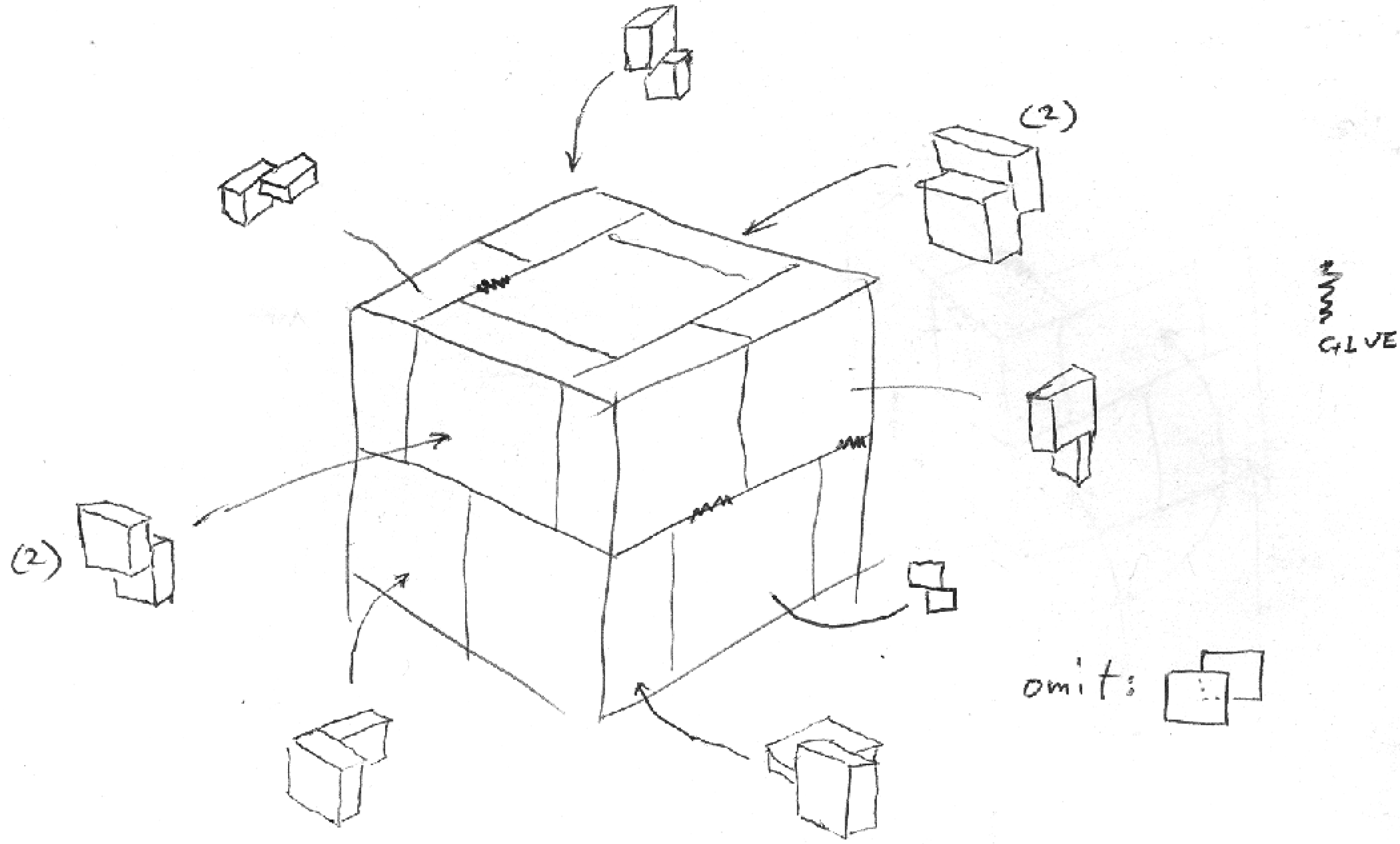
in other words, could be made using two of each of these:

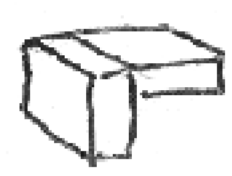
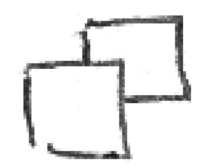


on second thought, __all__ solutions must be symmetrical

also found solution using 2 of these  and omit 

" " " " " "  " "  (over)



other ~~solutions~~ versions: 2 of  and omit  (almost same as above)

" " " " "  " " "

" " " " "  " " "

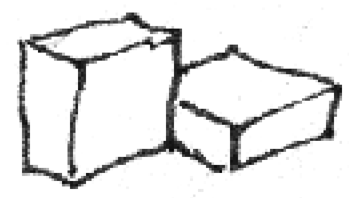
82

Version produced Mar. 1990

3 ~~4~~ sets made, in cocobolo. for: R.

H

– save, (S ?)

omit – 

duplicate – 

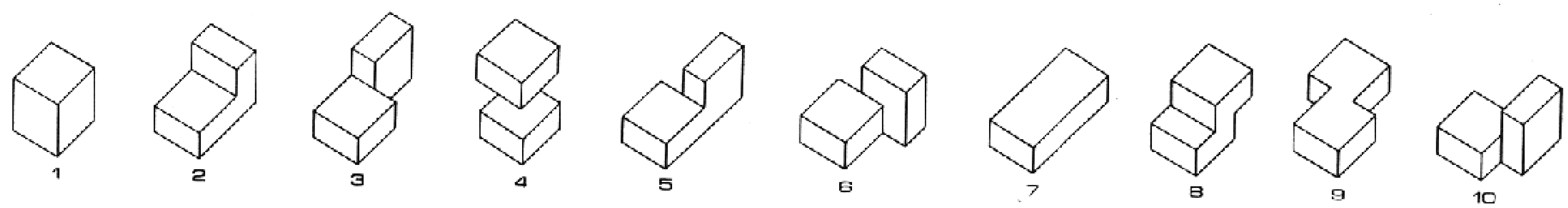
at least 2 solutions

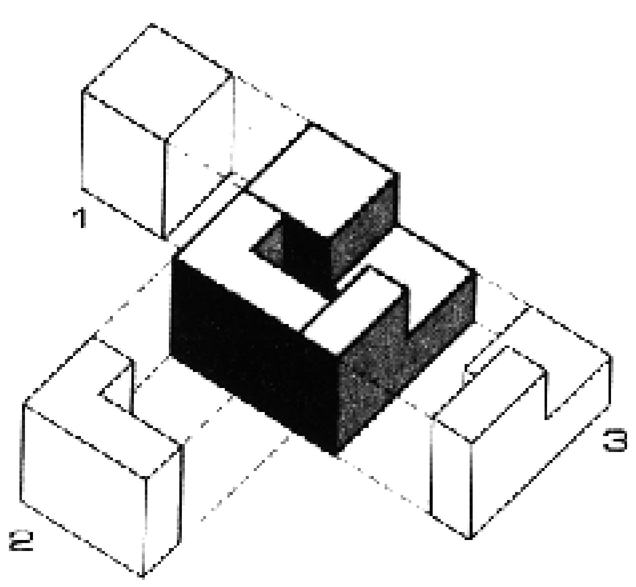
#82

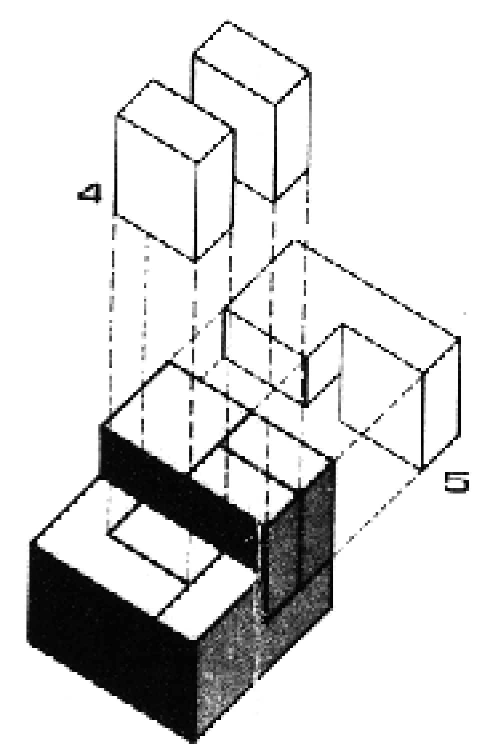
#82

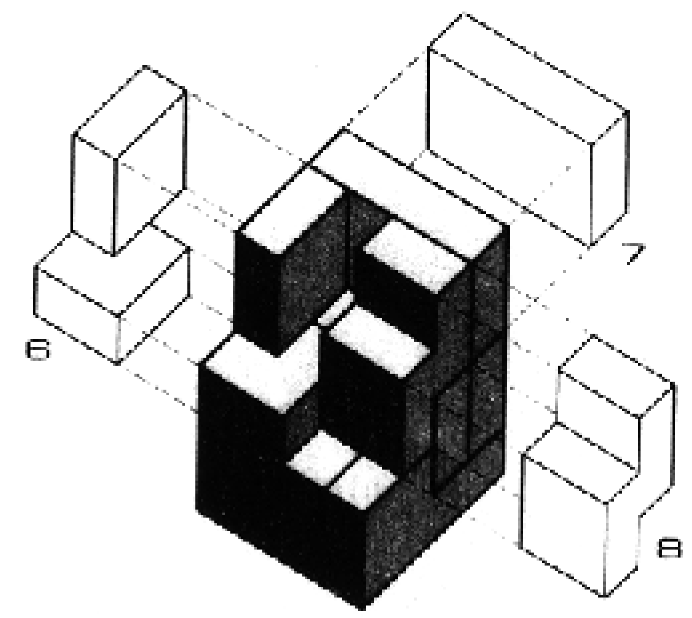
naef
Spielzeug

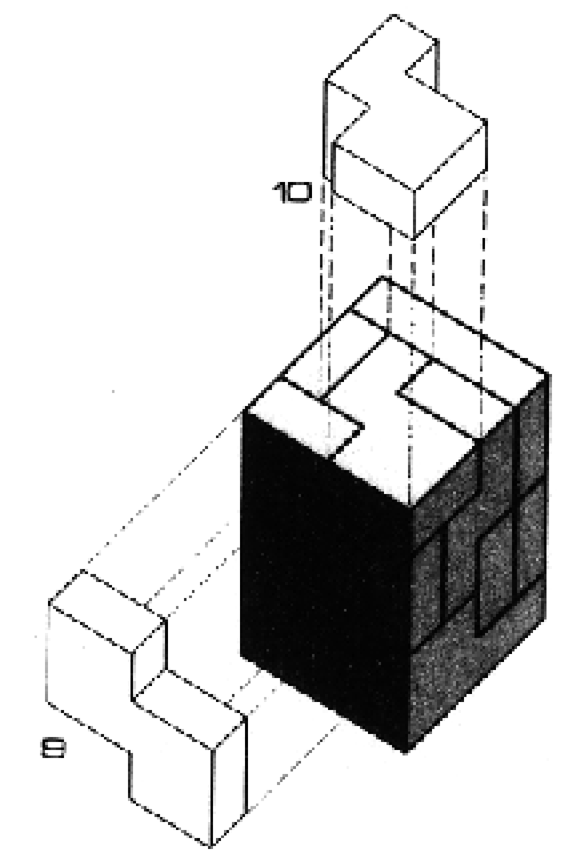
GEMINI
Nr. 9632
Design
Toshiaki Betsumiya
Swiss made
Kurt Naef
CH-4314 Zeiningen











#82

Jan 6, 1988

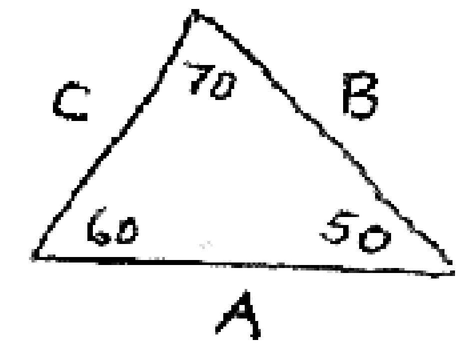
#84 is 12 hexagonal sticks of 3 holes each
and 12 dowels
3 of the sticks are slightly shorter on one end,
allowing 3 dowels to be removed.
one sent to Rodgers Dec 9, 1987 — $50
[2nd one now on shelf,) both oak
to J. Slocum 7 Nov 1990, $40

~~#84-A~~ same as above, except no shortened sticks,
change to
#22-A
8 elbow pieces, one solution known, may
be others,
one made in padauk

#84

change numbering
#84-A is 30 pentagonal stick version
one made in basswood 1988
offered to Slocum for $60.00 ppd. Sept 1992

Puzzle 85-A GEODYNAMICS



G	E	O	D	Y	N	A	M	I	C	S	K
1	2	3	4	5	6	7	8	9	10	11	12

Type A - pc 2, 4, 7, 10 EDAC
B - 3, 6, 8, 12 ONMK
C - 1, 5, 9, 11 GYIS

Sewing sequence for ends			edge of cut	ssc
A1 ~~A~~	makes	A1	v. good	VG
B1 ~~A~~	"	B1	good	VG
C1 ~~B~~	"	C1	good	VG.
A2	makes	A2	good	VG.
C2	"	C2	good	VG
B2	"	B2	fair	VG

C1 for A2 poor fit
B1 " C2 fair
A1 " B2 - poor
A2 for C1 - poor
C2 " B1 - v. poor
B2 " A1 - good

85 A

85-B

type A
" B
" C
} All $5\frac{1}{4}$" long

A2 makes B1 ok
B2 " C1 ~~poor~~ ok
C2 " A1 ok

A1 " C2 ok
B1 " A2 ok
C1 " B2

85 B

type A
" B
" C

} All $5\frac{1}{4}$" long

A2 makes B1 ok
B2 " C1 ~~poor~~ ok
C2 " A1 ok

A1 " C2 ok
B1 " A2 ok
C1 " B2

85-~~[illegible]~~ X

Disassembly of #85-~~X~~, Augmented version

1. remove Key pc. 12 ↙
2. 4 down, 11 ↘, 6 down, 8 ↘, 10 + 11 out →
   return 8, ~~#~~ 6
3. 9 down, 7 ↗, 4 down, remove 8 + 9 ↘
4. 1 ↗, remove 3 + 7 →
5. remove 6 down and out

A 10 or (11)
B (1) or 2 or 5
C 1 or (6) or 7
D 2 or 6 or (9)
E 3 or 4 or (9)
F ~~8~~ or 10 or 11

---

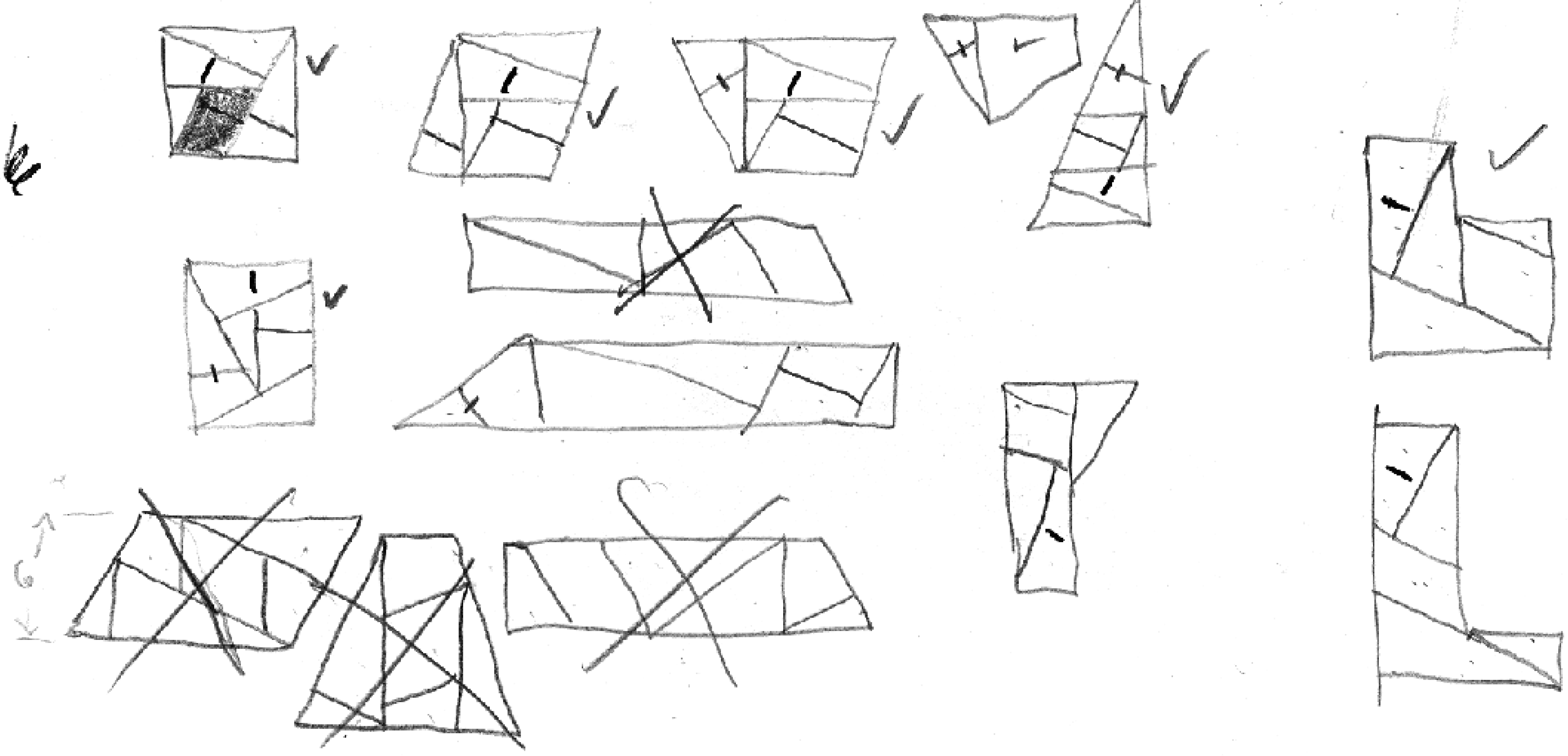
only one made - in Sitka Spruce,

put up for sale Nov 1990, $60.

Hordern got, and solved,
disassembled

~~[illegible]~~ 85-X

Puzzle # 87. Two-Sided Tray



This puzzle was not designed for maximum versatility of the pieces in constructing a variety of shapes. There are other six-piece dissections ~~that~~ in which the pieces fit together more ~~willingly~~ obligingly different ways. Quite to ~~on~~ the contrary, this puzzle was ~~laid out~~ planned for maximum ~~confusion~~ perversity. Merely constructing the rectangle and then reconstructing the square without ~~looking at~~ referring to the drawing should provide ample puzzlement and confusion. ~~for most~~ For this, I suggest a two-sided tray, square on one side and rectangular on the other. A sawing pattern for a 4-inch by 4-inch puzzle is given on the next page, together with plans for the two-sided tray.

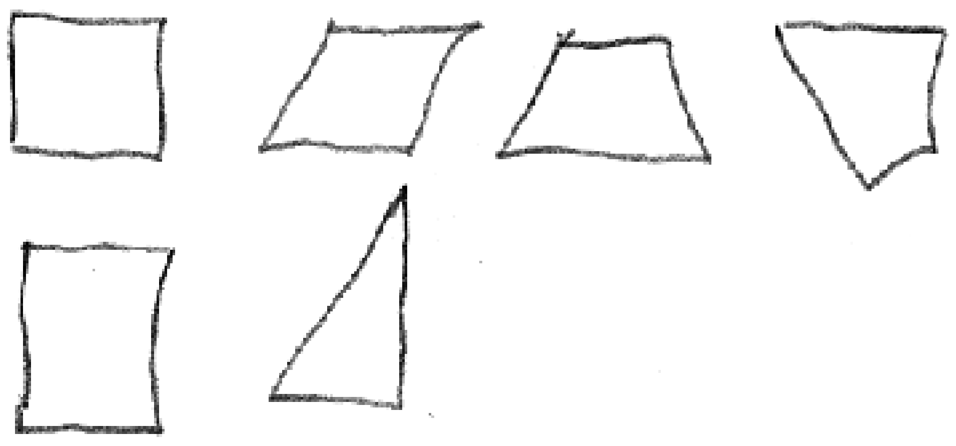
#87

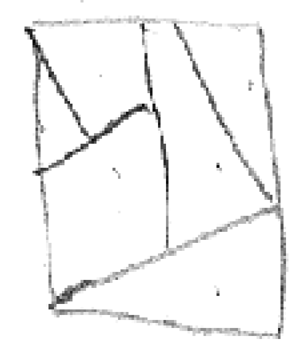
The sawing pattern will produce pieces in which the wood grain all runs in the same direction, thus making the square solution easier. To eliminate this giveaway, make two sets with grain running in different directions and then interchange the pieces.

$\sqrt{5}$ = 4.4721
3.5777

The two preceding puzzles, Loyd's Five-Piece and Modified Five-Piece, are quite easy to solve. They would probably be classified as good beginners' puzzles. Not so the next one. When the number of puzzle pieces is increased to six, and with a judicious choice of dissection lines, the increase in difficulty can be quite remarkable.

To lay out this puzzle, again start with a square, locate the midpoints of sides, and draw grid lines as shown below. The solid lines show the outlines of the six puzzle pieces. This new (1989) and original design, is published here for the first time. ~~The pieces can be~~

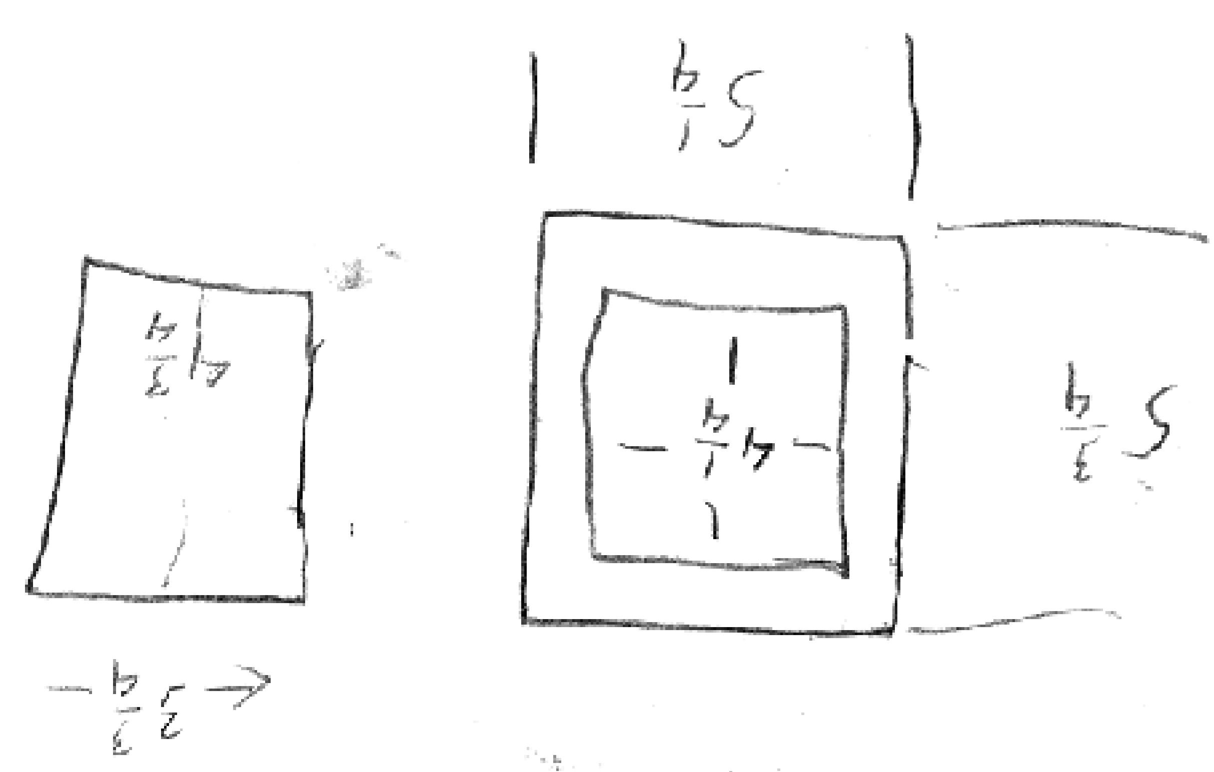




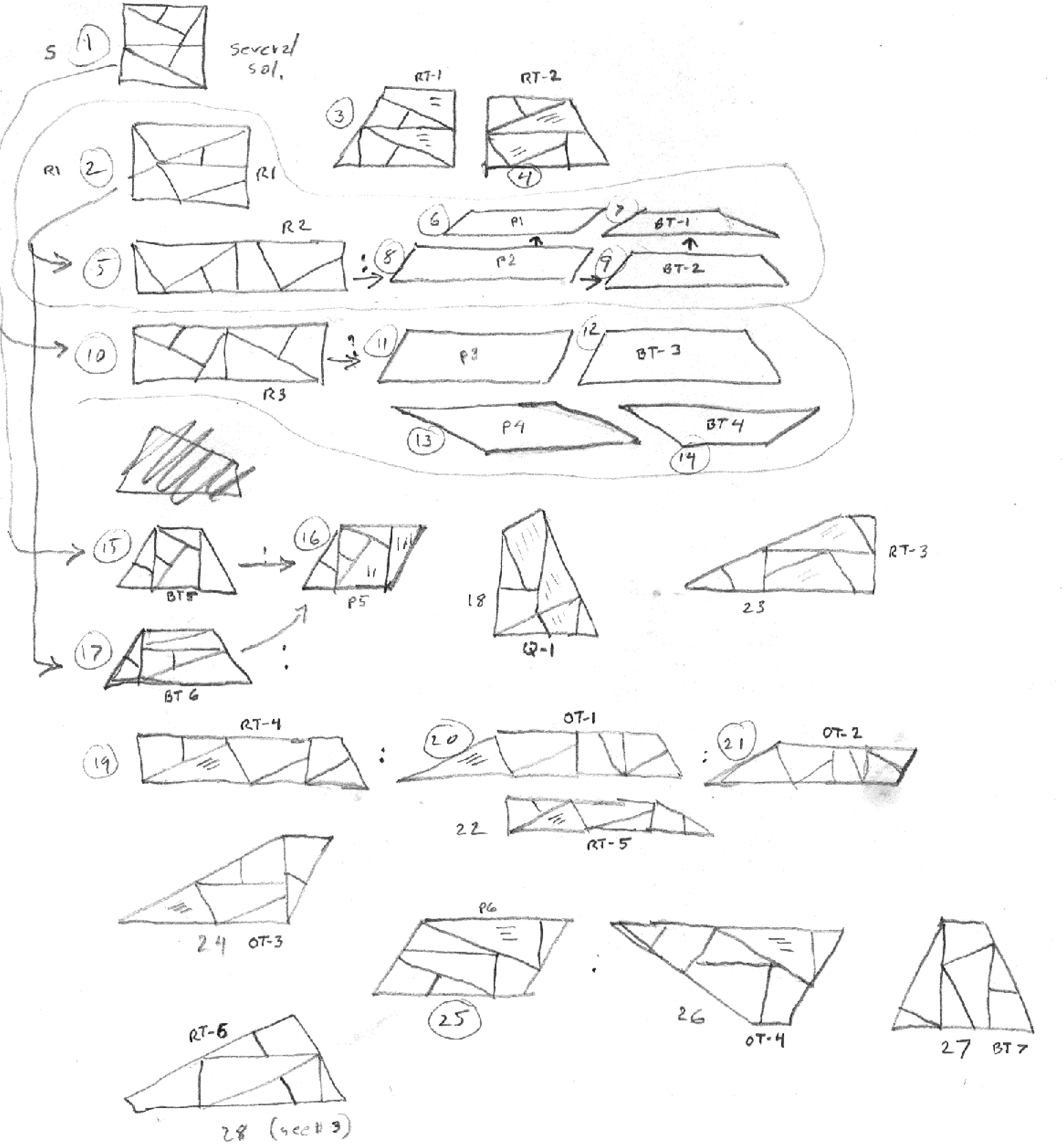
~~arranged to construct many of the problem shapes shown~~

~~on the preceding two pages~~

A few of the problem shapes that these pieces will construct are shown below, and probably many others remain to be discovered.



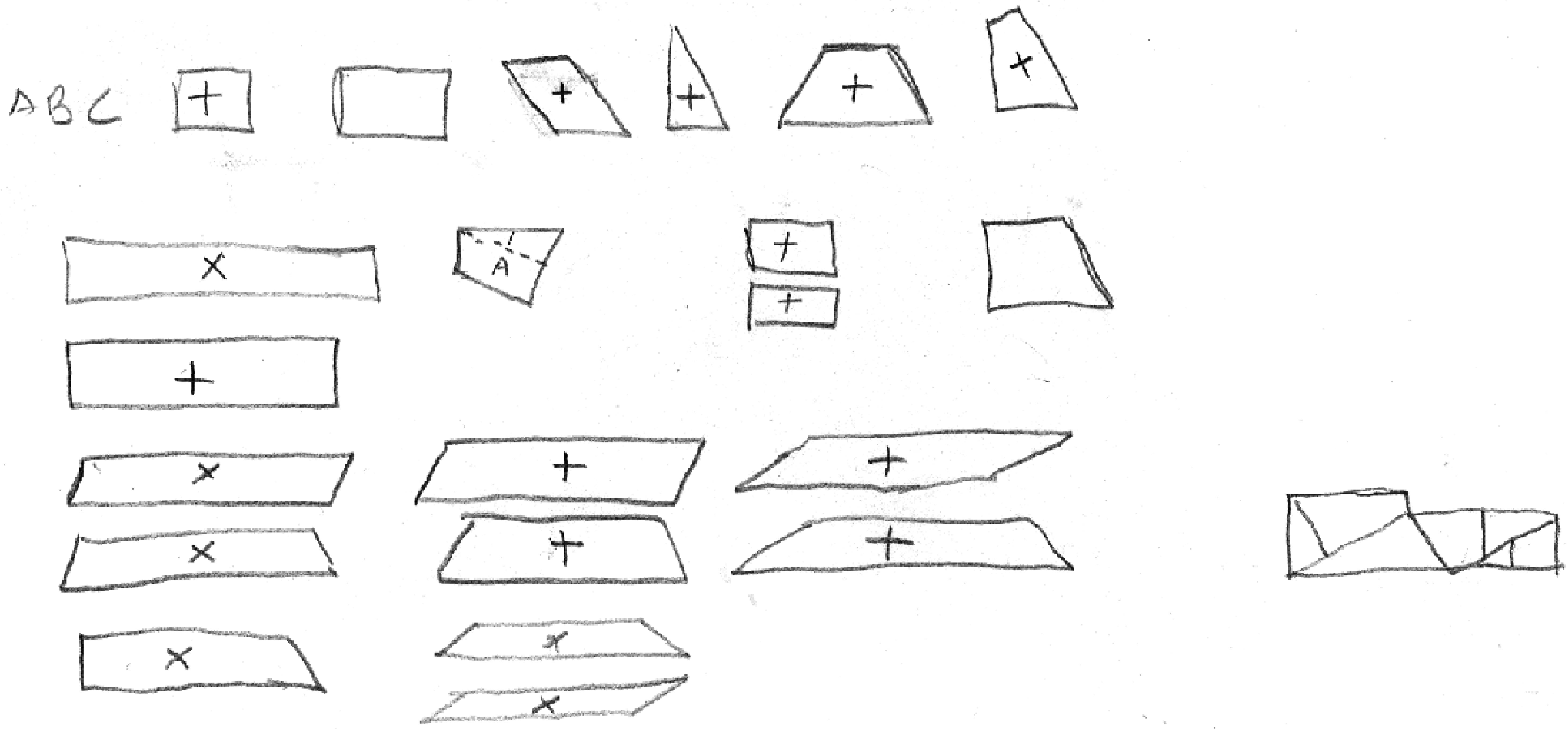
~~Quadrilaterals~~ Puzzle The Four-Sided Puzzle 87-A

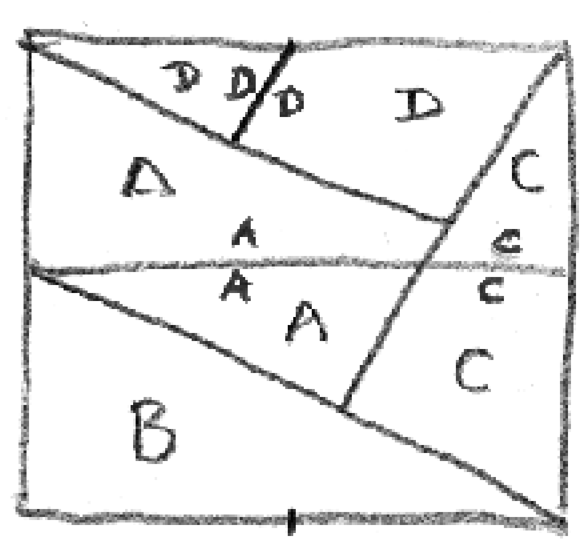


87-A

S 1 square
R 3 rectangles
P 6. parallelograms
17 trapezoids (of which 6 are right-trapezoids (RT) and 7 have ~~bilateral~~ symmetry (BT)) + 4 OT
Q 1 other quadrilaterals
28

Sent copy to Kevin Holmes
20 Mar, 1991





Coffin's Improved

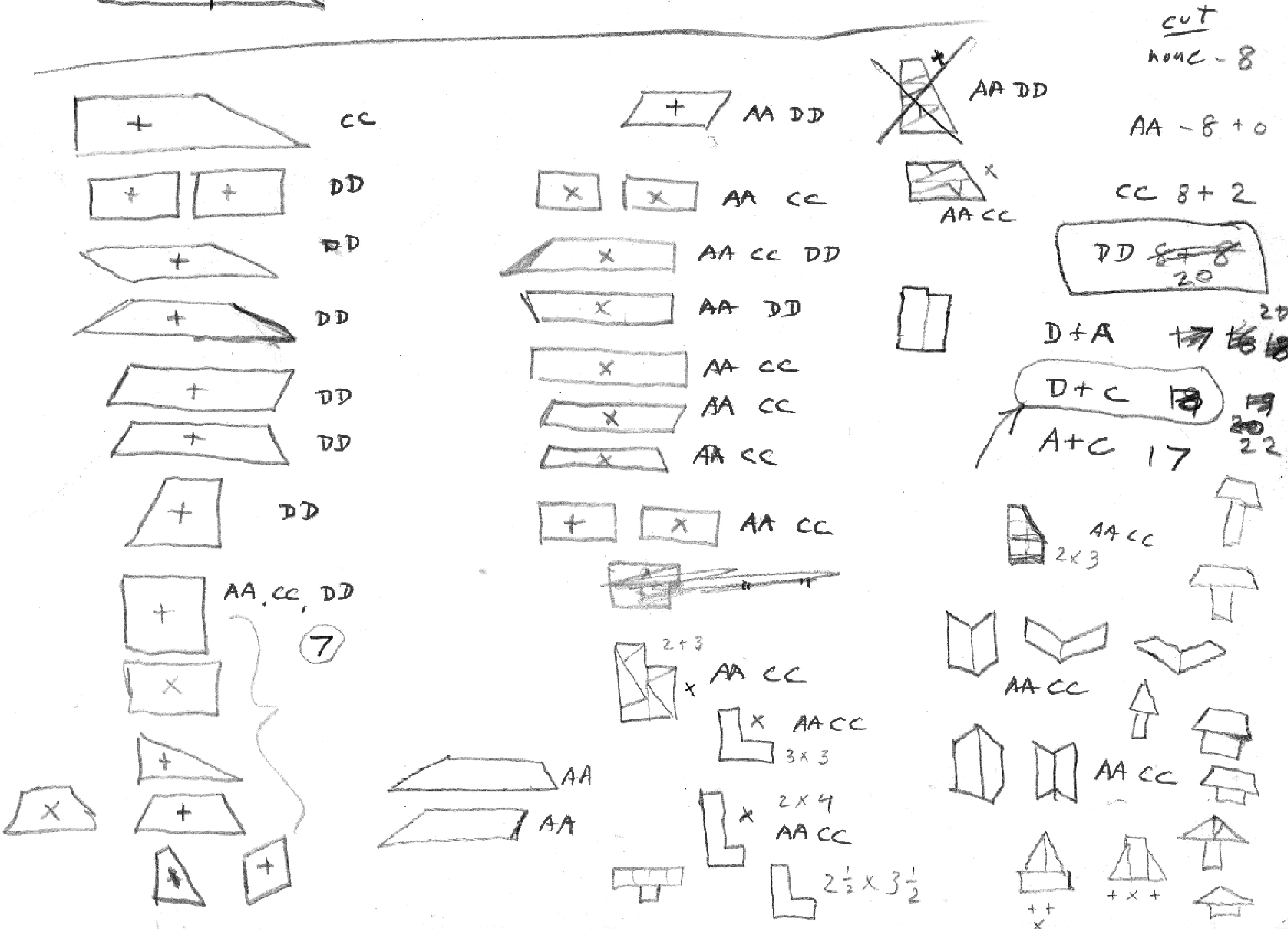
Stew's Square

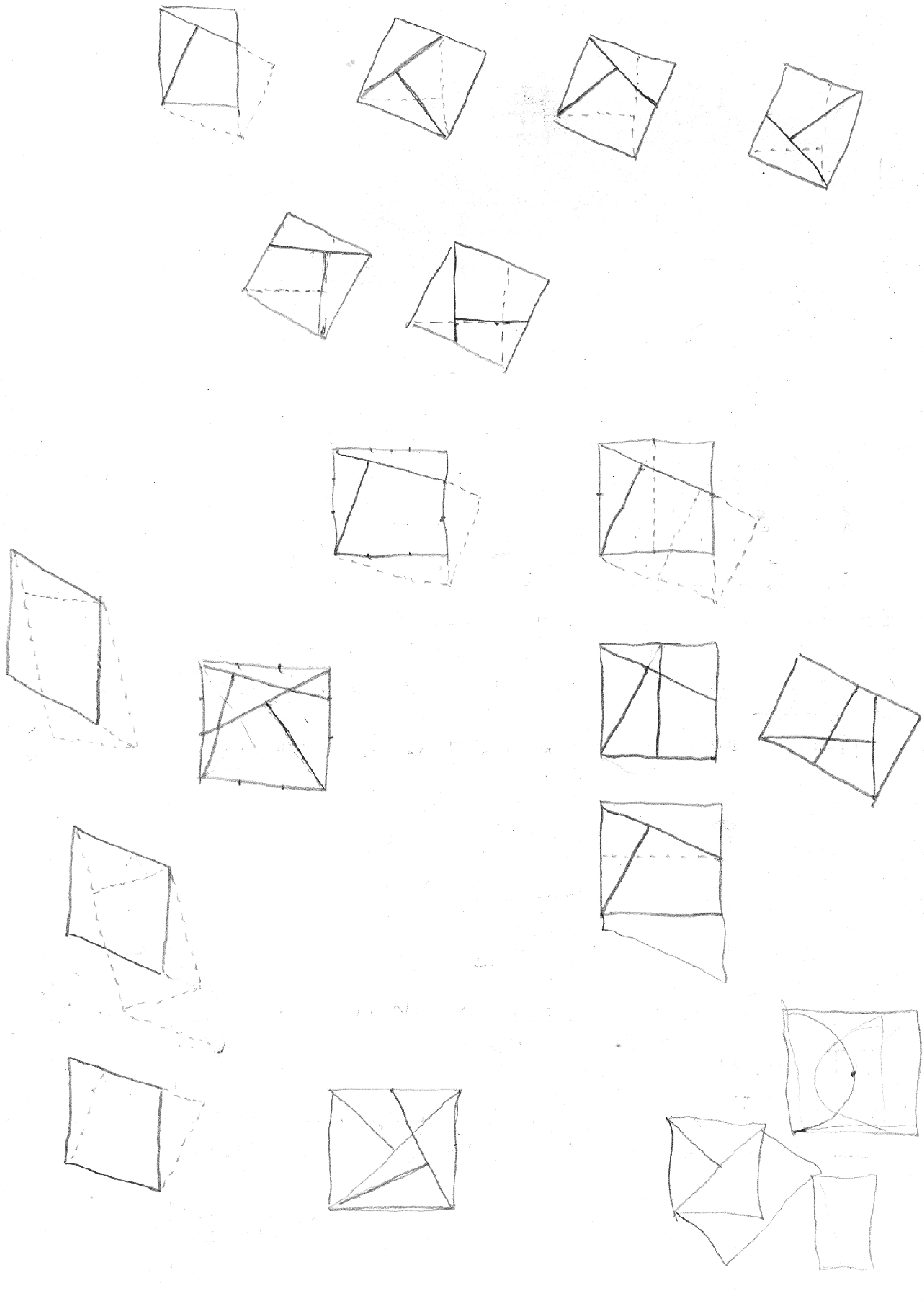
25

Francis Alspar

6-12 people

Bulloch Broom





June 1, 1989

Games Magazine
1350 Avenue of the Americas
New York, NY 10019

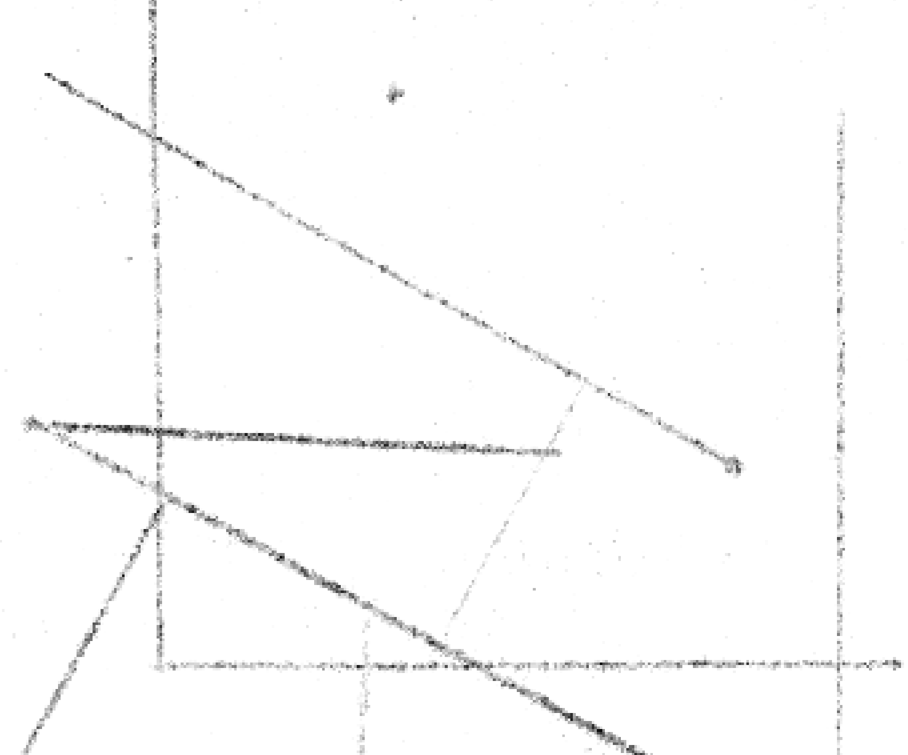
Attention of: Will Shortz

Greetings:

I thought your readers might like to amuse themselves with the seven-piece dissection of the square shown below. I came up with it while working on a revision of <u>Puzzle Craft</u>. By the way, I still plug your magazine in my book. Hope you are getting lots of subscriptions.

<u>A Quadrilateral Puzzle</u>

Starting with a square, locate the midpoints of sides and draw the appropriate lines as shown, and cut it into the seven pieces. The puzzle is to rearrange the pieces and see how many other quadrilaterals they will form. Any four-sided figure made with all seven pieces counts as a solution, but multiple solutions for the same shape are not counted. The pieces may be flipped over, but mirror images of the same solution are not counted.



It might be fun to let it run for a few months and see how many solutions readers can come up with. I have found 28 so far, and am not sure if that is all or not.

I have lots more in this vein if you are interested. If published, please be sure to mention that <u>Puzzle Craft</u> is available. Thanks.

Stewart T. Coffin

5 Nov 1991

Dear Kevin,

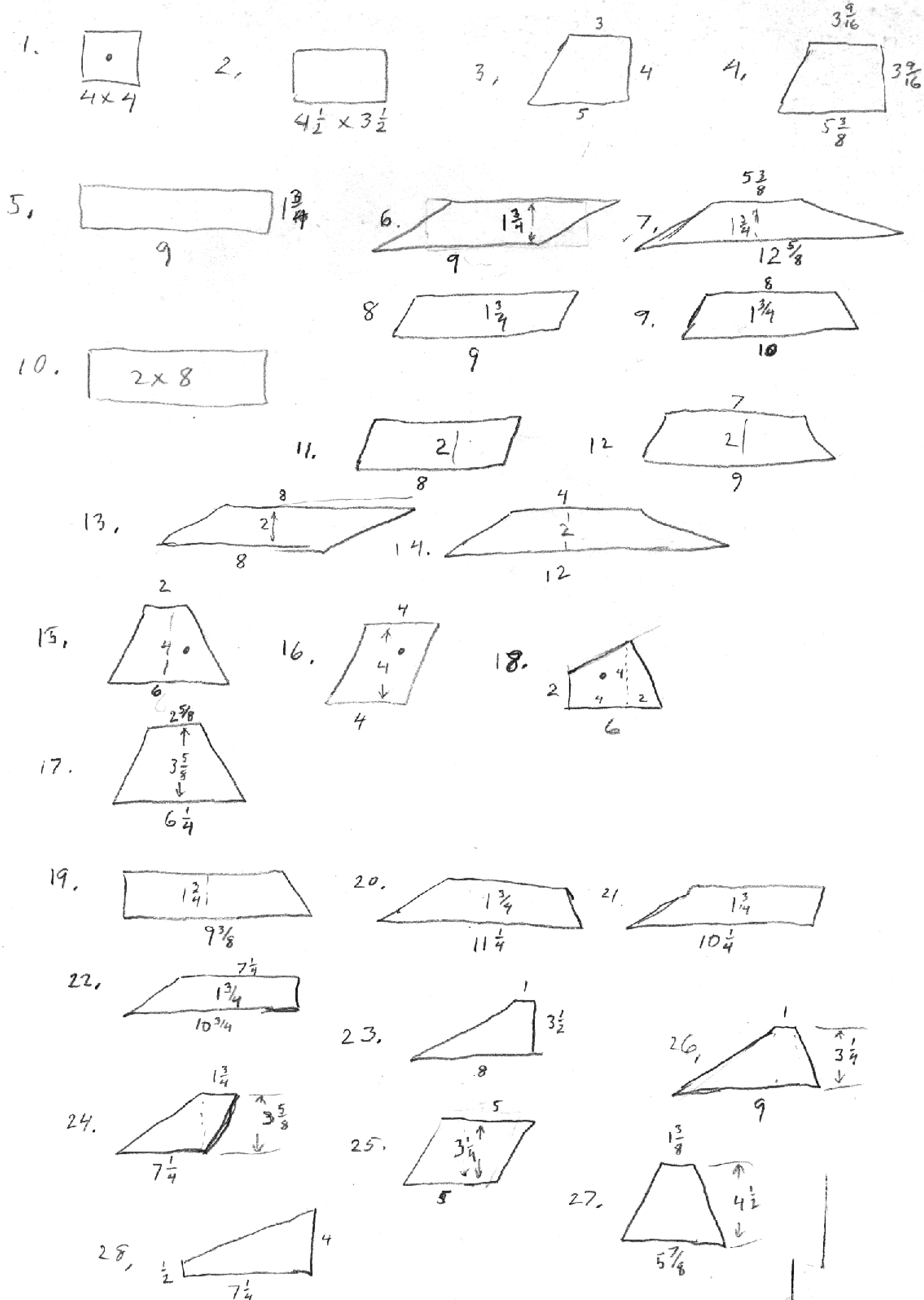
I have stopped making puzzles now. I still publish and sell Puzzle Craft as orders continue to trickle in. I also stocked up on the hardcover edition of Puzzling World and am selling them. This provides me with spending money. The present edition and printing of Puzzle Craft is nearly sold out. When it is gone, sometime this winter, I would like to come out with a completely new book with all new designs, not previously published, and I would like them to be mostly very simple puzzles that anyone can make. At least half of them would be flat (two-dimensional) that could be laid out on cardboard and cut out with knife or scissors, such as my Four-Sided Puzzle, also known by you as Coffin's Quadrilaterals. You sent me a few of them about a year ago, very nicely made of plywood, but lacking instructions. Last March, you asked me for solutions for the 28 solutions, which I then sent. By the way, recently I looked for more solutions but did not find any, so perhaps there are only the 28 I listed. I am now thinking of preparing a sheet, or page, of problem shapes and perhaps a second page of solutions. But perhaps you have already done that, and I could save all that work by copying yours.

I would welcome other suggestions from you as to other similar puzzles to include. My thought is to keep them simple enough that almost anyone can make without sophistácated woodworking techniques. It might also be a good idea to list you as a source for them, for those a bit harder to make or for those who do not want to be bothered even with simple cut-outs, or perhaps they just like the puzzle and want a better made one. I might also include a few simple puzzles made up of cubic blocks glued together, and perhaps a few simple six-piece burrs with notched square sticks. We ought to be able to work out some scheme where we compliment each other, publishing and manufacturing. I maybe making a few more puzzles sometime. I have a few interesting new designs never produced, and I have some nice wood to use up. My wife died last February. I now have a new companion. She has taken an interest in my puzzles, and it was she who suggested a new book for children. I don't like to use the term "children" in this context, so lets just call it a book of simple puzzles. She also likes to travel, and so we are considering the possibility of a trip to the U.K. in 1993, possibly to coincide with the international puzzle party somewhere in Europe. I am saving one new design to be produced for that occasion. I will call it the London puzzle, and it will be my last puzzle, number 104 in my numerical listing.

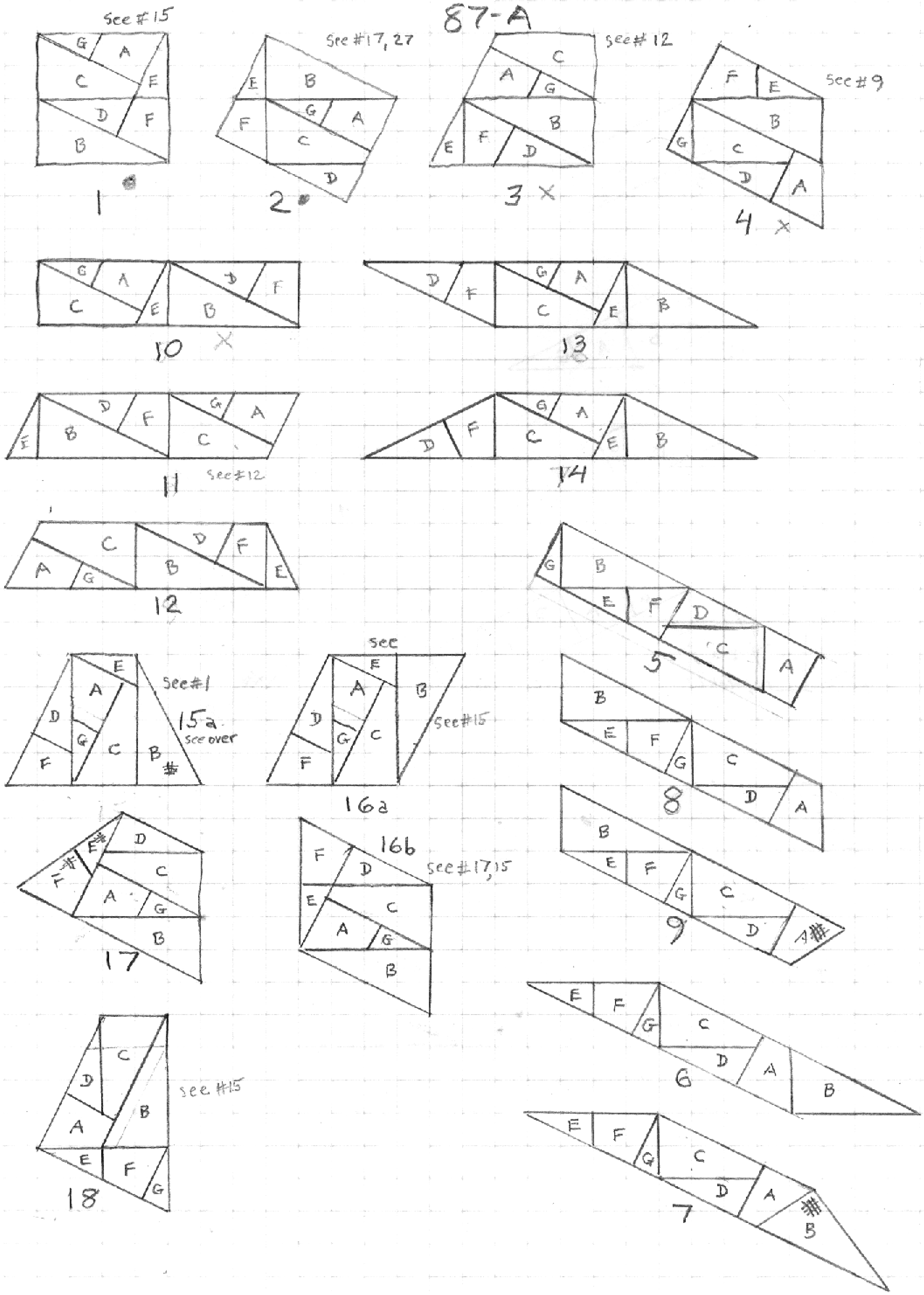
I believe Jerry MacFarland is now making my Hexsticks puzzle. I might have a special section of my new Puzzle Craft showing puzzles perhaps too hard for the reader to make, but available from either you or Jerry, even though they would not all be new and unpublished.

Sincerely,

Stewart Coffin

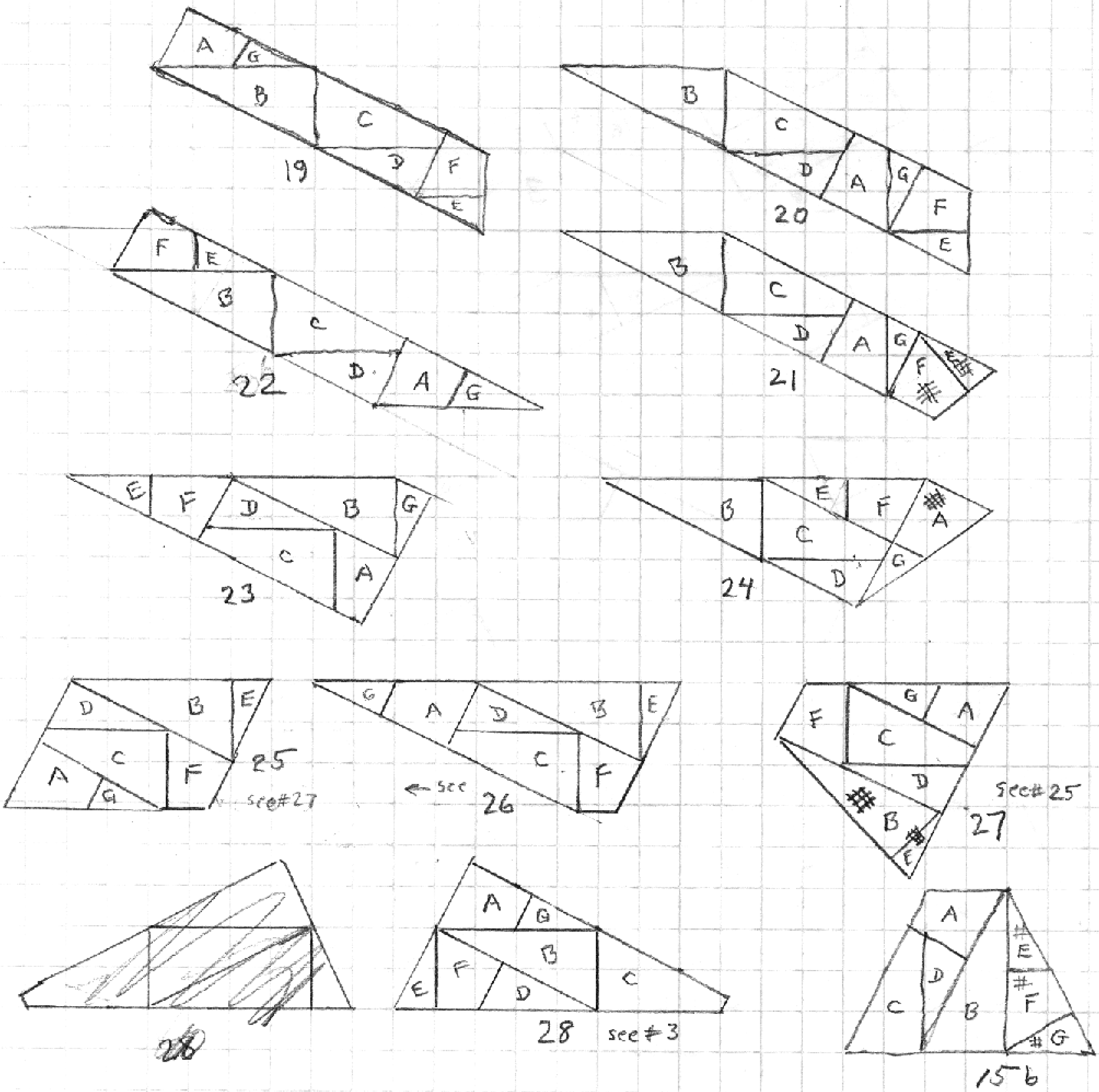

1. 4x4
2. 4 1/2 x 3 1/2
3. 3 4 5
4. 3 9/16 3 9/16 5 3/8
5. 1 3/4 9
6. 1 3/4 9
7. 5 3/8 1 3/4 12 5/8
8. 1 3/4 9
9. 8 1 3/4 10
10. 2x8
11. 2 8
12 7 2 9
13. 8 2 8
14. 4 2 12
15. 2 4 6
16. 4 4 4
18. 2 4 4 2 6
17. 2 5/8 3 5/8 6 1/4
19. 1 3/4 9 3/8
20. 1 3/4 11 1/4
21. 1 3/4 10 1/4
22. 7 1/4 1 3/4 10 3/4
23. 1 3 1/2 8
26. 1 3 1/4 9
24. 1 3/4 3 5/8 7 1/4
25. 5 3 1/4 5
27. 1 3/8 4 1/2 5 7/8
28. 1/2 4 7 1/4

87-A



See #15
1
See #17, 27
2
see #12
3
See #9
4
10
13
11
see #12
14
12
5
see #1
15a
see over
see
see #15
16a
8
16b
see #17, 15
17
9
see #15
18
6
7

87-A



Join eliminate

A-G 4 5 6 7 8 9 18 20 21 23

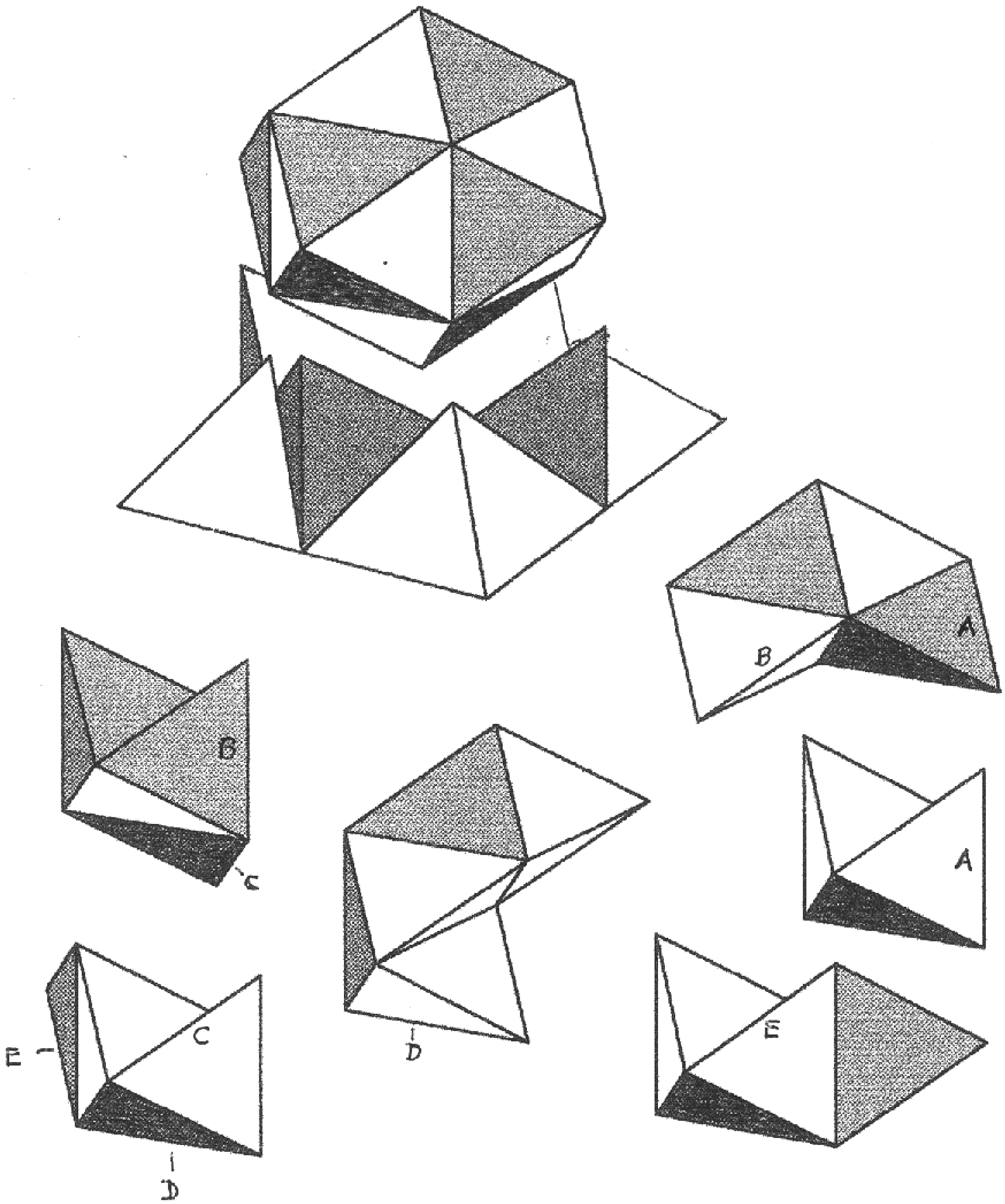
F-E 3 10 11 13 14 X X 19 20 21 25 26 27 28 21-6 = 15 + Δ

28-13 = 15

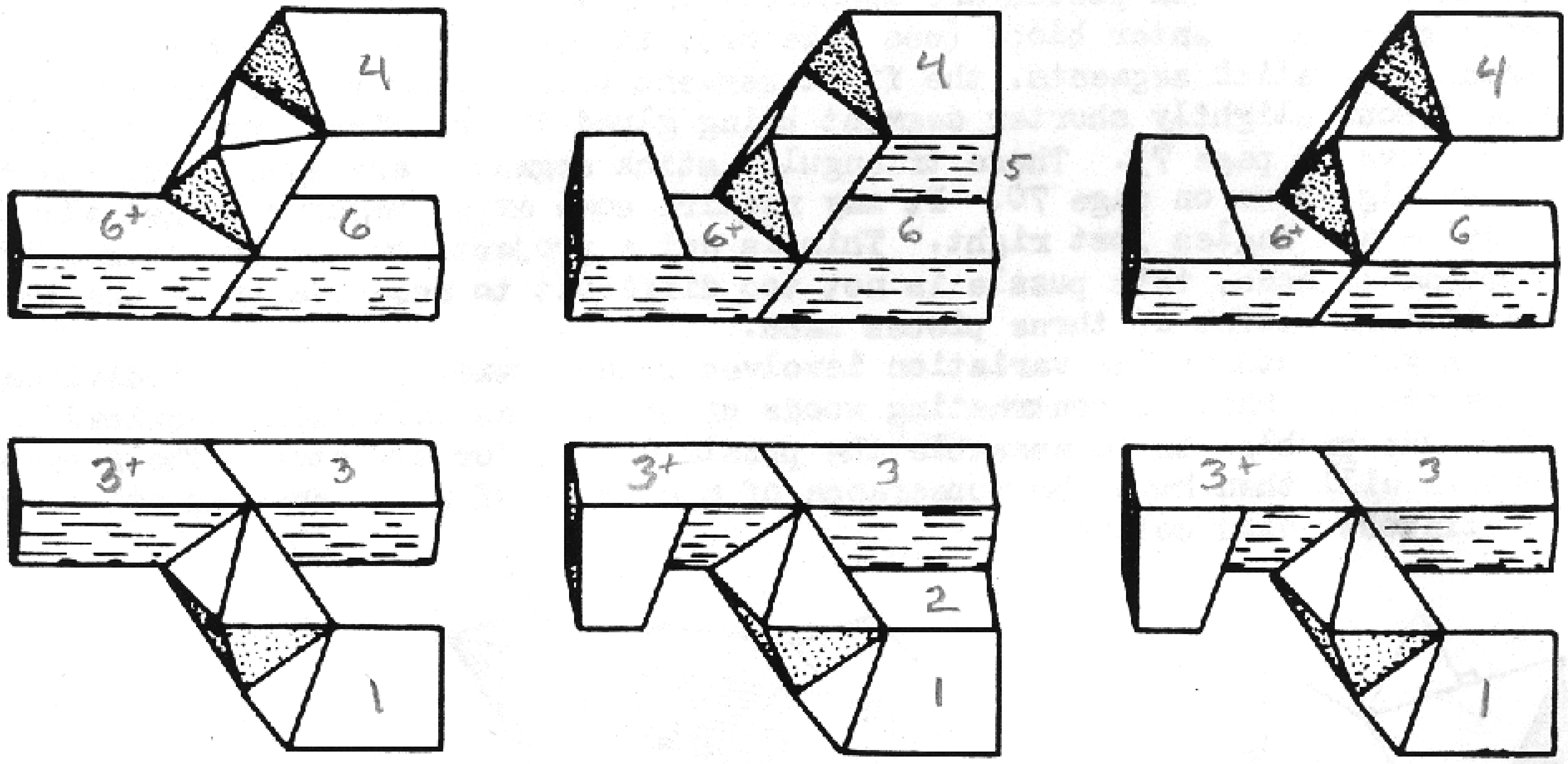
C-D 3 10 11 12 13 14 X 28 28-7 = 21 + Δ

88. Little Rocket

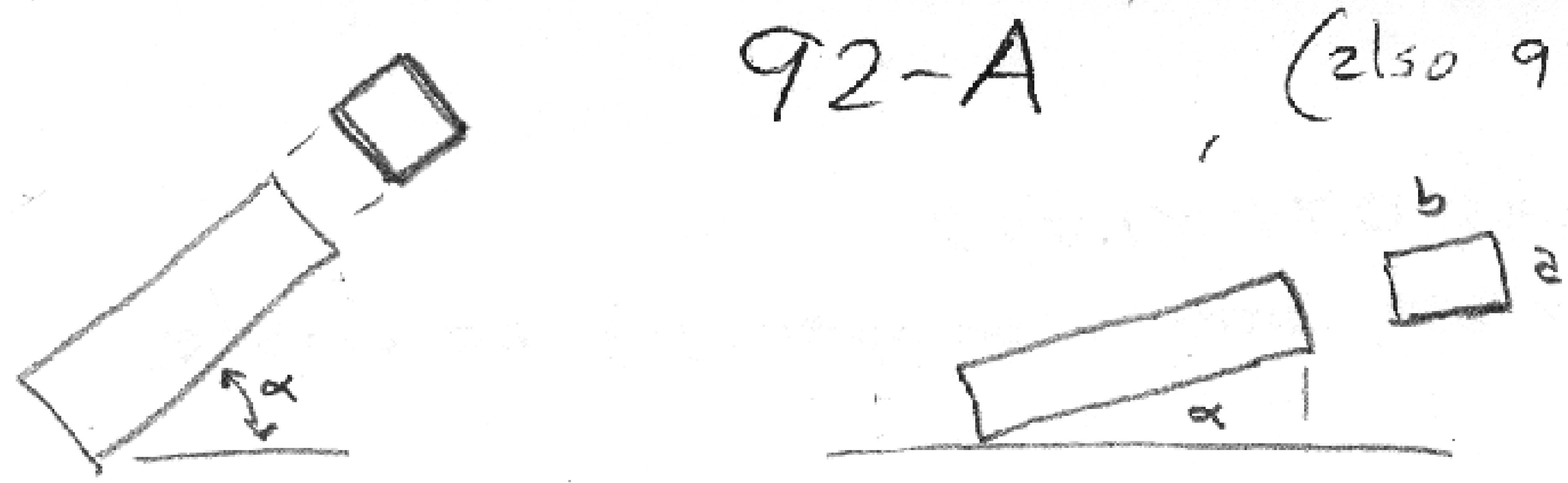
Shown approximately full scale. The two woods used are oak and walnut, indicated in the drawing by shaded and unshaded. There is only one solution.



A most interesting feature of this puzzle is that the first step of disassembly is a separation into two halves in a surprising manner along a diagonal axis. This is reminiscent of the popular novelty consisting of two blocks of wood joined by a seemingly impossible double dovetail joint.



92-A (also 97 and 107)



for regular diag. burr, angle $= \arctan \frac{1}{\sqrt{2}} = 35.26°$, $\frac{a}{b} = 1$

for vertically compressed, $\frac{a}{b} = \sqrt{3} \sin \alpha$, $\alpha = \arcsin .577 \frac{a}{b}$

% of compression $= \sqrt{2} \tan \alpha$, so $\alpha = \arctan \frac{\%C}{100} \times \frac{1}{\sqrt{2}}$

---

for #107, 15% compression, $\alpha = \arctan \frac{.85}{\sqrt{2}} = 31.01°$

" " $\frac{a}{b} = \sqrt{3} \sin 31.01 = .892$

---

for #97 $\frac{a}{b} = \frac{\frac{3}{4}}{\frac{7}{8}} = \frac{6}{7} = .857$, $\alpha = 29.66°$, 19.5% comp.

---

for 92-A $\frac{a}{b} = .750$, so $\alpha = 25.65°$ (for diag. saw jig)

22 % compression

52

35-55

---

for 99 $1\frac{1}{4} \times 1\frac{1}{2}$ $\frac{a}{b} = \frac{5}{6} = .833 \times .577 = .481$, $\alpha = 28.7°$

"

92-A (also 97 and 107)

92-A ctr blocks 0.750x1.000
sawn out directly on spec. jig, no waste

	#req'd		
R1	3	Osage	ok
L1	3		
R2	3	purple	add $\frac{1}{8}$
L2	3		
R3	3	Almond	ok
L3	3		
R4	3	Breadnut	ok
L4	3		
	24		

Special jigs used Dec 1999 to make 4, then discarded

92-A

4 pc serially interlocking

#93

1	1	3
1	2	2
1	1	2

BOTTOM

2	1	3
2	2	3
4	3	3

MIDDLE

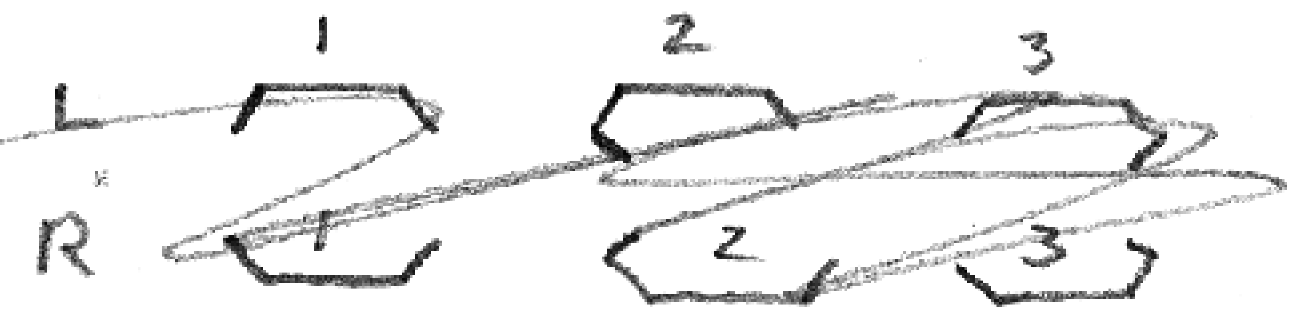
4	1	1
4	4	4
4	3	4

TOP

95

Analysis of ALLSTAR interlock

types of pieces



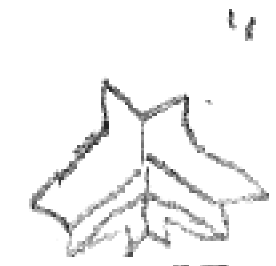
L always opp R, A with B

types of pairs - no hook
LB hook
RB hook
LB and RB hook

with no hook, 4 axes
with one hook, 2 axes
with LB+RB hook pair, still 2 axes
with ~~any two unpaired~~

Analysis

cw ✱ 1 R1A R2A R3A SPIRAL, axial
✱ 2 R1A R3A R2A " "
✰ 3 R1A R2A R3B B1 BILAT



4 R1A R3B R2A B2 " "

✰ 5 R1A R2A L3A - A1 BILATERAL

~~[illegible]~~ ANIMAL

6 R1A L3A R2A A2 " "
7 R1A R2A L3B - non
8 R1A L3B R2A - non

95

CW

	9	R1A	L2A	R3A	A3 BILAT animal
	10	R1A	R3A	L2A	A4 " "
	11	R1A	L2A	R3B	non
3	★ - 12	R1A	R3B	L2A	SPIRAL - DIAG
	13	R1A	L2A	L3A	non
	14	R1A	L3A	L2A	non
4	★ - 15	R1A	L2A	L3B	STAR - DIAG
	16	R1A	L3B	L2A	B3 BILAT BIRD
	17	L1A	R2A	R3A	A5 BILAT - animal
	18	L1A	R3A	R2A	A6 " "
5	★ - 19	L1A	R2A	R3B	SPIRAL - DIAG
	20	L1A	R3B	R2A	non
	21	L1A	R2A	L3A	non
	22	L1A	L3A	R2A	non
	23	L1A	R2A	L3B	B4 BILAT BIRD
6	★ - 24	L1A	L3B	R2A	STAR - DIAG
	25	L1A	L2A	R3A	non
	26	L1A	R3A	L2A	non
	27	L1A	L2A	R3B	B5 BILAT - BIRD
	28	L1A	R3B	L2A	B6 " "
7	★ - 29	L1A	L2A	L3A	SQUAT - AXIAL
8	★ - 30	L1A	L3A	L2A	" "
	31	L1A	L2A	L3B	non
	32	L1A	L3B	L2A	non

cant hook

R1A
R3B SP
L2A
~~R3B~~
~~L1A~~
R1A ST
L2A
L3B
L1A SP
R2A
R3B
L1A
L3B
R2A

summary

STAR 2 DIAG

SQUAT 2 AXIAL

SPIRAL 2 AXIAL, 2 DIAG

BIRD 6

~~FLOWER~~ ANIMAL 6

non - 12

95-X

ALVIN P. LEWIS

TELEPHONE 242

Meeting House Hill Poultry Farm

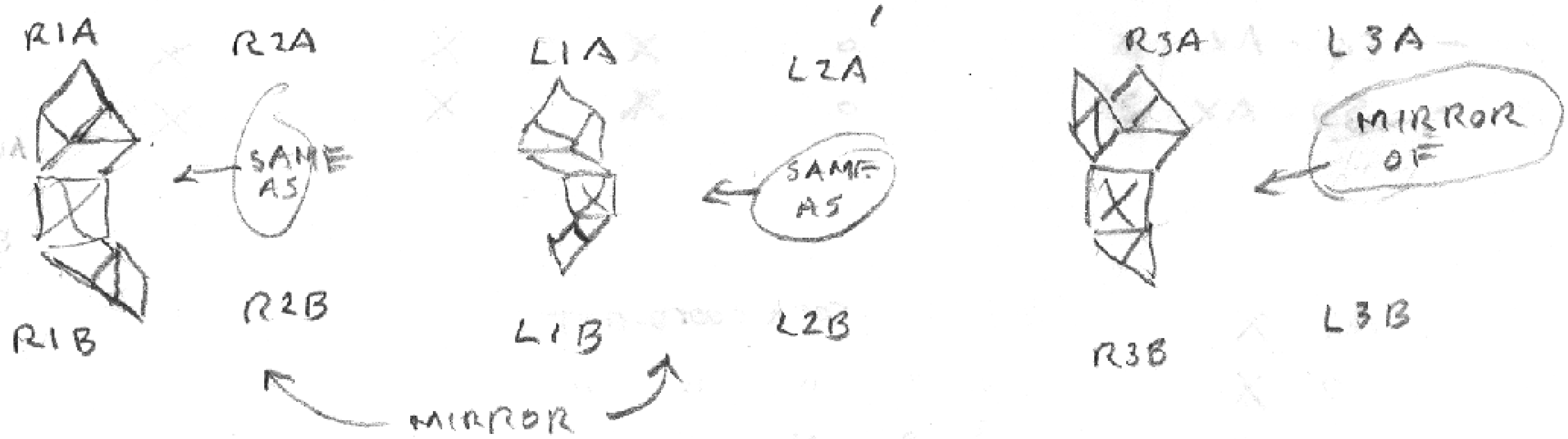
NEW HAMPSHIRES AND BARRED PLYMOUTH ROCKS

PULLORUM DISEASE FREE

BABY CHICKS -- HATCHING EGGS -- BREEDING STOCK

NEW BOSTON, N. H., ________________ 193__

95-X only one made, Jan 1996



R1A R2A R3B – BIRD

R1A R2A L3B – NON SYM.

R1A L2A R3B – NON SYM.

R1A L2A L3B – STAR

L1A R2A R3B – SPIRAL

L1A R2A L3B – SPIRAL

L1A L2A R3B – BIRD

L1A L2A L3B – NON SYM.

only one made, in teak + satinwood

95-X

already hooked L2B and R1B

95-X
10 Jan 1996

R3A + L1B + [L3A]
(L3A + R1B) + [R3A]

try hooking R3B

			deleting L3A R3B (L3B)	L1B (R1B)	L3A (R3A)	R3A (L3A)	
1	P	SP-AX	o	o	X	X	X
2	P	SP-AX	o	o	X	X	X
3	P	SP-DI	X	o	o	COORD.	ser + COORD. with rot.
4	*	ST-DI	X	o	o	o	ser + o (L3A would coord with rot.)
5	P	SP-DI	X	o	o	o	ser + o (L3A " " ")
6	*	ST-DI	X	o	o	o	ser + coord-rot. —
7	—	SQ-AX	o	o	X	X	X
8	—	SQ-AX	o	o	X	X	X

A1	X	B1	o	ser + coord-ROT		
2	X	2	o	"	"	"
3	X	3	o	"	"	"
4	X	4	o	"	"	"
5	X	5	o	"	"	"
6	X	6	o	"	"	"

95-X

L1B, L2B, R1B, R2B, R3A, L3A

3. COORD + COORD.
4. " + " + ROT.
5. " + " "
6. " + " "

CW

R1A R2A R3B BIRD
R1A R2A L3B NON ✓
R1A L2A R3B – NON ✓
R1A L2A L3B – 4 + 6
L1A R2A R3B – 3 + 5 SP
L1A R2A L3B – SP
L1A L2A R3B – BIRD
L1A L2A L3B – NON
L1A

TOO COMPLICATED! only one made – teak + satinwood

Simple version – 2 types of pieces, 3 of each

CW

RRR – can't assemble (would be spiral)
RRL – animal
RLL – non
LLL – squat

(not very good!)

~~only~~ NONE MADE

95 – X 2

try hooked: R1B + L1B } 1+2 same
R2B L2B }

1 R1A R2A R3A spiral, axial

2 R1A R2A R3B bird

3 R1A R2A L3A animal 1

4 R1A R2A L3B non

5 R1A L2A R3A animal 2

6 R1A L2A R3B non

7 R1A L2A L3A non

8 R1A L2A L3B STAR – diag

9 L1A R2A R3A animal

10 L1A R2A R3B SPIRAL – diag

11 L1A R2A L3A non

12 L1A R2A L3B bird ✓

13. L1A L2A R3A non

14. L1A L2A R3B bird ✓

15. L1A L2A L3A SQUAT – axial

16. L1A L2A L3B non

Coord + rot [R1A + R1A + 73-A STC 1996] CW

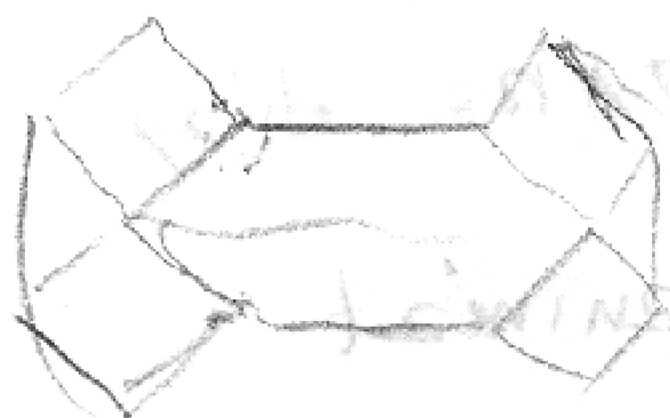
R1A + R1A + R1A CW - NO

2 should have wide bottom, one must be 4 cor RH

(all 3 at least LH bottom, for CW if slightly loose)

all 3 wide or RH tops

CW { R - R, R - L, L - L } ccw: R - R, R - L, L - L



R
R
R

3R 3R 3R cw Yes, easy

" " " ccw NO

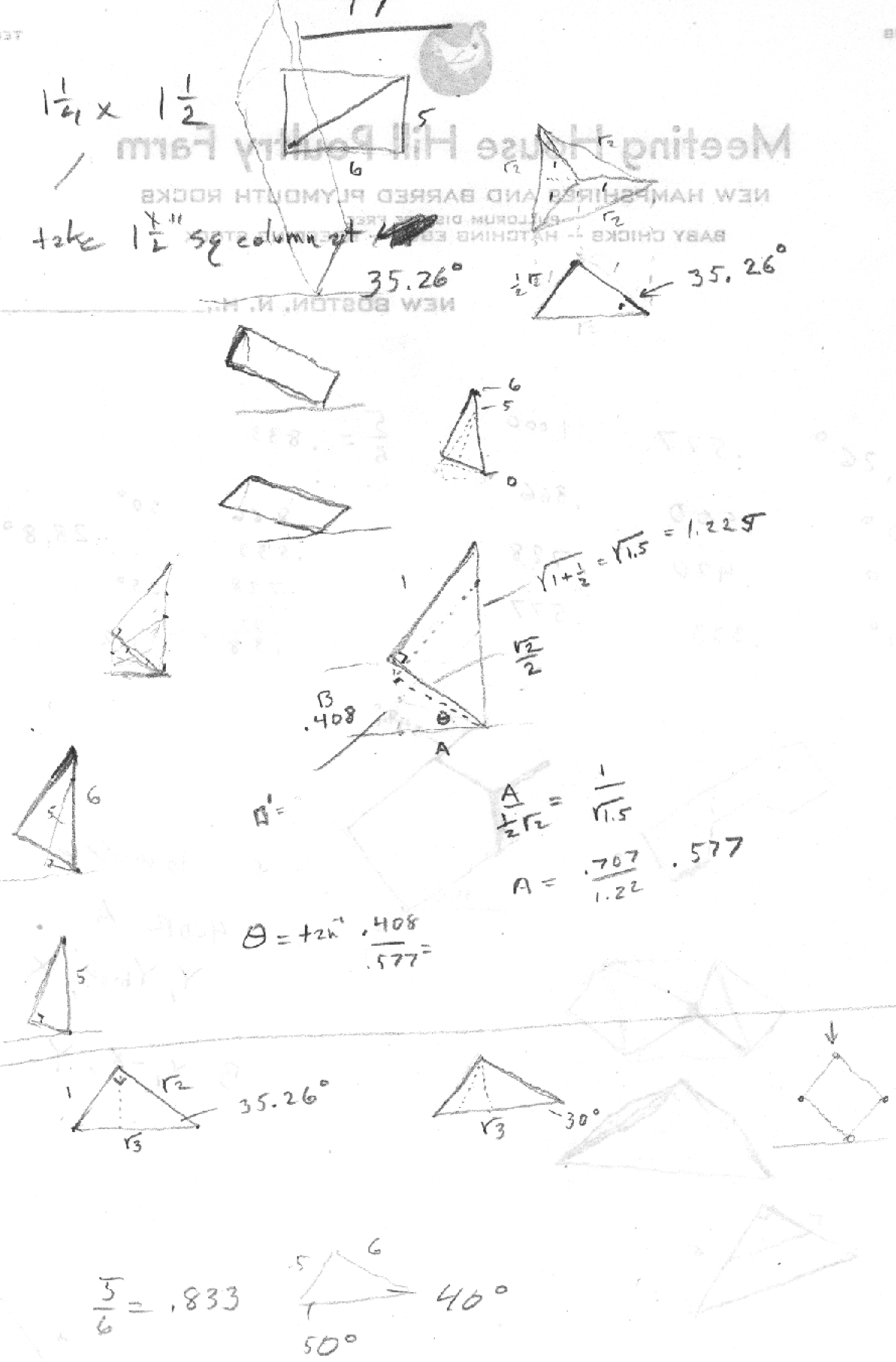
2R + 1L cw Yes, Rot - good

2R + 1L ccw NO

top 2R + 1L CW — RR, RR, RL

bottom 2R + 1L ccw — RL, RL, RL

99



α = 28.7°

(see also #92-A)

99

ALVIN P. LEWIS

TELEPHONE 242

Meeting House Hill Poultry Farm

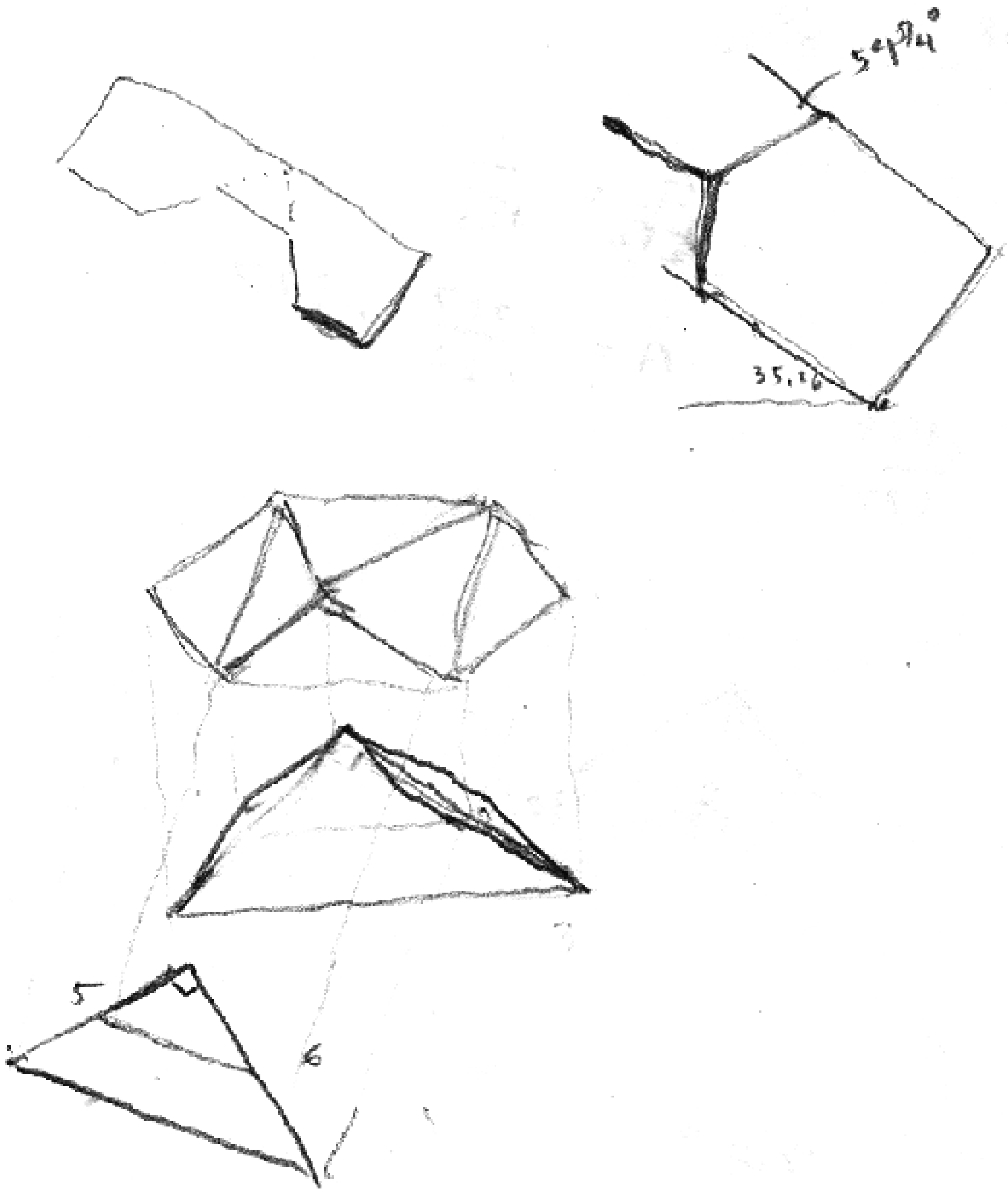
NEW BOSTON, N. H., ____________________ 193__

35.26°	.577	1.000
30°	.500	.866
25°	.420	.728
20°	.333	.577

$\frac{5}{6} = .833$

.866 30° 28.8°
.833
.728 25°

$\frac{33}{138} \times 5° = 1.2$



to make

4 COR A
Y, Yback, X

B X, -X, Y

10

100 concentrix

(# 25-V in Slocum's museum)
2489

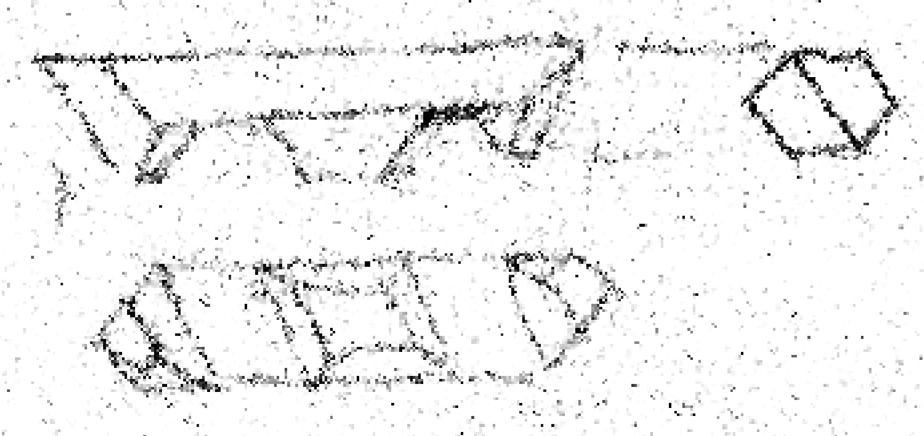
found in Slocum's museum 2 Apr 1996

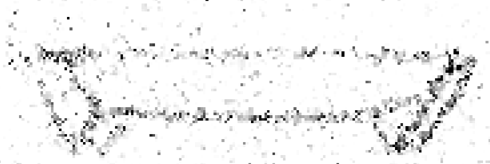
only one made, and borrowed back
made by cutting down styrene HEXTIX pieces.

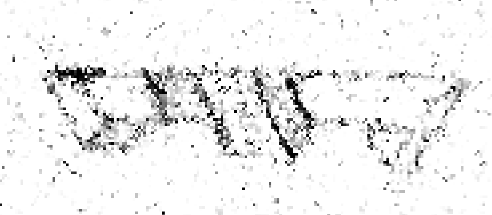
Modified Hextix

Could be described as confused stellation of two concentric R-D sized 2:3

All pieces have double bevel on both ends



3 skinny pieces have center removed 

1 odd piece has odd 3rd notch 

other eight are standard

to assemble

3rd notch

skinny (done)

1. ← wiggle last std piece in here

2. install last 2 skinny pieces fully extended

3. slide vertical skinny into place

4. slide left skinny into place

~~and 5. slide last skinny into 3rd notch~~

appears to have only this one solution, Level 4

might make a satisfactory puzzle in wood except difficult to make. especially how to make ends strong?

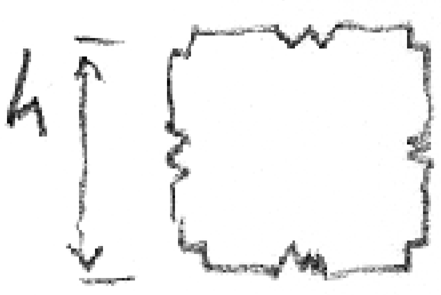
7 Apr 1996

100-A ((formerly 100 (and 104 before that)))

couple models made in pine in 1993

similar to #100 except:

1. pine model was concentric R-Ds in ratio 4:5

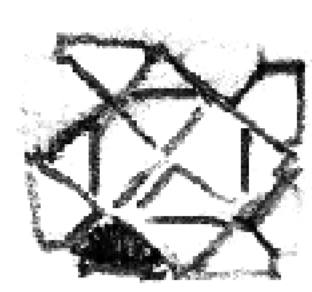
   backs approx 0.300 thick, overall 4 11/16 high 

2. Key piece slides out, away from augmented piece

3. one key, one aug., three skinny, 7 std.

has more than one solution

#100 appears to be the better puzzle

one solution: assemble 7 std + 1 aug with four spaces vacant on top: 

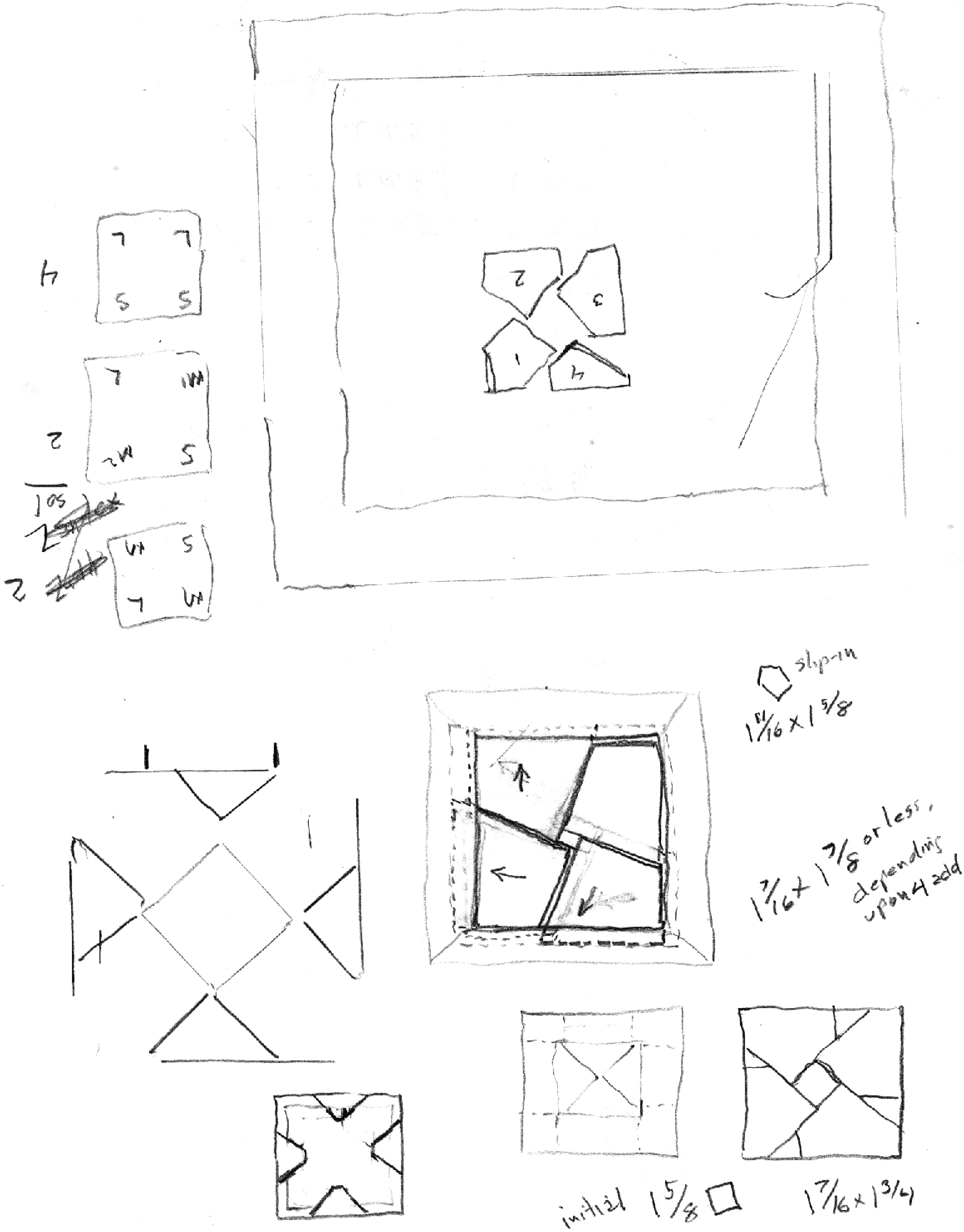
100-A

133

1	A B C D ★		A B C D ★	
2	A B D' C X			
3	A B' C D	S 0.8	S 0.4	S 0.2!
4	A C D B'	L 0.3, S 0.4	S 0.5	S 0.5
5	A C D B	L 1.0	L 1.0	L 0.6
	A C' X			
6	A D B' C	S 0.9	L 0.3	S 0.2!
7	A D C B'	L 1.2	L 0.3	L 0.3
8	A D' C B	L 1.2	L + S	L + S
9	A D' C B'	L 1.2	L 0.5	L 0.2!
	A' B X			
	A' B' X			
	A' C X			
10	A' C' B' D'	S 0.5 L 0.5	S 1.0	S 0.2!
11	A' D B' C	S 1.1	S + L	
	A' D' X			

133

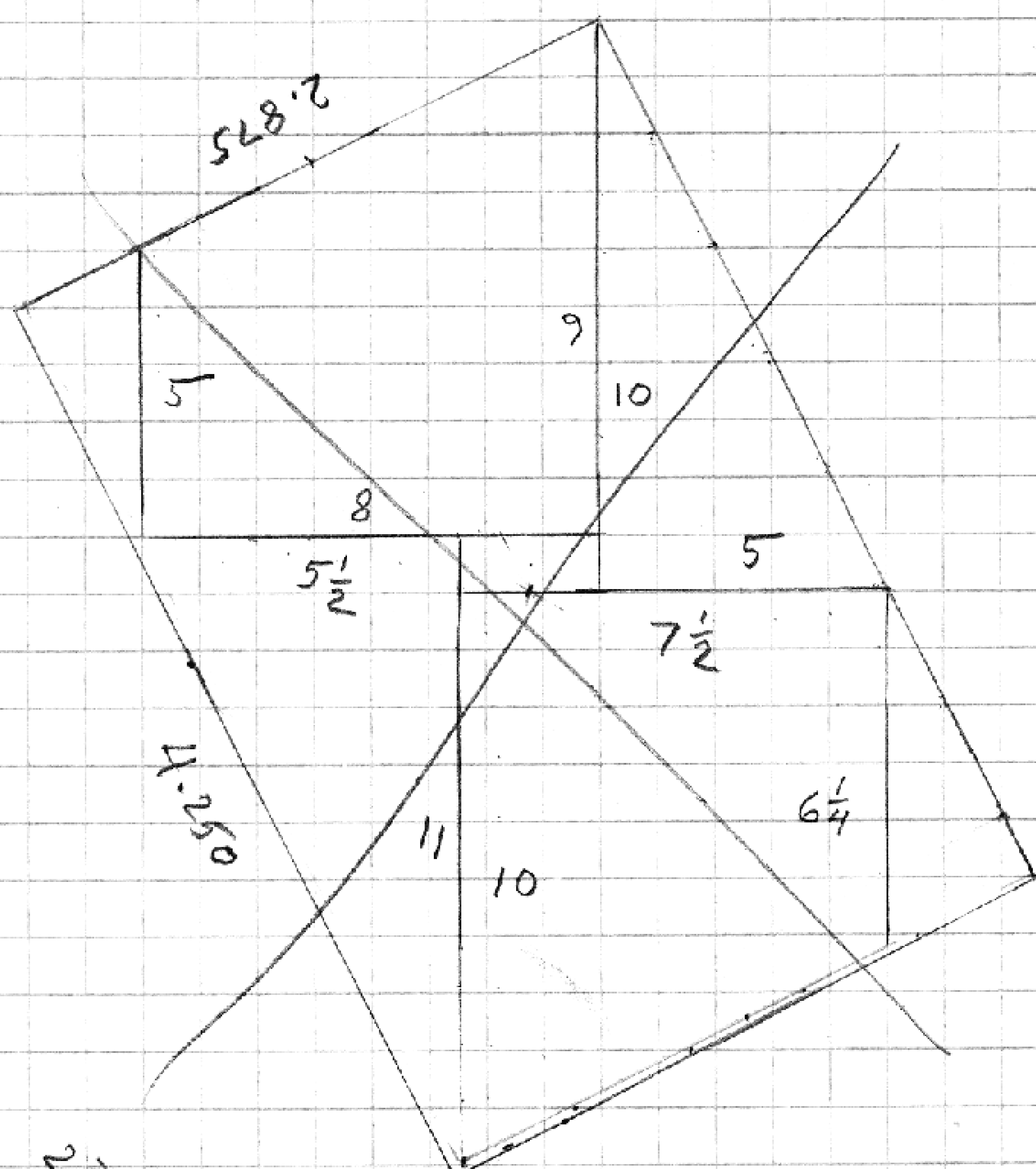
				C→A 0.2
A B' C D	S 0.2	S 0.3	S 0.5	ok
A C D B'	S 0.4	S 0.3	S 0.6	ok
A C D B	L 0.7	L 0.8	L 0.8	ok
A D B' C	S 0.2	S 0.5	S 0.9	ok
A D C B'	L 0.3	L 0.6	L ~~0.6~~ 0.4	ok
A D' C B	L + S	L 1.0	L + S L 0.4	ok
A D' C B'	L 0.5	L 0.8	L 0.4 ←	ok
A' C' B' D'	S 1.0	S + L	L + S	ok
A' D B' C	S 0.6	S 0.8	S 1.0	
A B' D C			S 0.2! ←	better



slip-in
1 11/16 x 1 5/8
1 7/16 x 1 7/8 or less, depending upon 4 add
initial 1 5/8 □
1 7/16 x 1 3/4

#167

Revised



#167
#167

round all corners approx 1/32

samples sent to Tom + Walter Mar. 24, 2000