Rob's Puzzle Page

Interlocking Puzzles

This section covers **interlocking puzzles** - wherein multiple pieces fit together such that the puzzle does not fall apart, and presents a challenge to disassemble and re-assemble.

Here are my groupings:

- Traditional 6-Piece Burrs
  - Identifying Burr Pieces
  - The 25 Notchable Pieces Used in Solid Burrs
  - Selected Other Burr Pieces
  - Some Common 6-Piece Burr Designs
  - More 6-Piece Burr Designs
  - Burr Sets
  - Catalogue of Burrs to Try
  - Some Sources for Burr Puzzles
  - Burr Theory
- Traditional 18-piece Burrs
- The Diagonal Burr and The Diagonal Star
- 3-piece Burrs
- Boxed Burrs
- Kumiki Burrs
- Chuck and Pagoda Burrs - a large number of similar notched pieces that must be built up into a symmetric structure
- The Altekruse Puzzle and Variants
- Coordinate Motion Assemblies - the solution relies on simultaneous (coordinate) motion of groups of pieces
- Non-traditional Burrs - including 6-piece "board" burrs
  - Non-traditional Burrs in Plastic or Metal
- Interlocking Poly-cube Assemblies - individual pieces are constructed from cubes joined in specific ways (e.g. by full faces)
- Cube-and-Plank (or Plate) Assemblies
- Polyhedral Assemblies - pieces made from regular shapes other than cubes - e.g. tetrahedrons
  - Designs by Stewart Coffin
  - The 3M Hectix and The Geo-Logic Line
- Pinned Assemblies - pieces include rods or pins that hold the structure together
- Irregular Assemblies
- Keychain Puzzles
- Happy Cubes/Snafooz (Foam Assemblies)
- The Puzzle Sculptures of Miguel Berrocal

Traditional 6-Piece Burrs

Any story about interlocking puzzles has to start with the traditional **six-piece burr puzzle**.

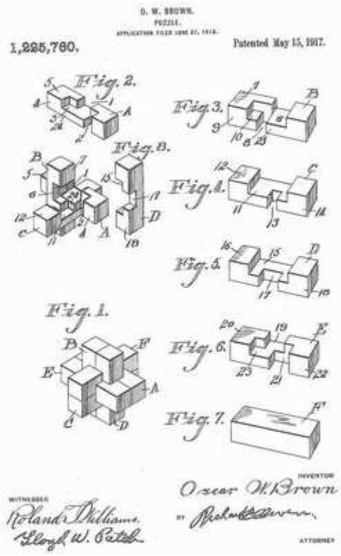
This puzzle is known by several names, including the "puzzle knot," the "Devil's Knot" (Teufelsknoten in German), the "Chinese Cross," the "Lock of Luban" (Luban Suo 鲁班鎖) or the "Lock of Kongming" (Kongming Suo 孔明鎖).

The term "burr" is thought to have been first used by Edwin Wyatt in *Puzzles in Wood* (1928), but Wyatt seems to use the term as if it was already commonly understood to apply. Supposedly whoever coined the term did so because the puzzle resembles the clinging burrs of some plants.

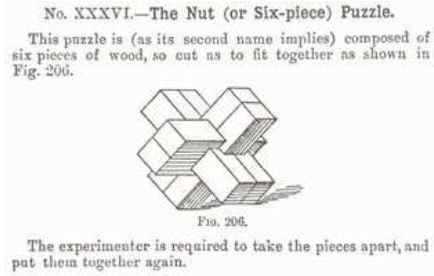
Like other well-known vintage puzzles, the burr has acquired a probably-fanciful backstory, and details of its history are lost. Some say it is a Chinese invention, along with the Patience Tanglement, the Sliding Piece Puzzle known as "The Huarong Path," and the Tangram, and date it to ancient times (see Wei Zhang's Chinese Puzzles Blog).

According to the literature, the earliest relevant U.S. Patent seems to be 1225760 - filed by O. W. Brown on June 27, 1916 and granted on May 15, 1917. But take a look at U.S. Patent 1261242 , filed by J. W. Keiser on **March 16, 1915**, and granted on April 2, 1918. Keiser seems to have filed earlier but his patent was granted later. (Keiser's pieces are the Chinese Cross set; those pieces are shown in an 1857 book so Keiser did not invent them.)

A traditional six-piece burr appears in Hoffmann's 1893 book *Puzzles Old and New* in Chapter III as No. XXXVI "The Nut (or Six-piece) Puzzle." Jerry Slocum and Dieter Gebhardt put together a compendium of puzzle advertisements found in the 1785 catalogue of the merchant *Peter Friedrich Catel*, who established a retail store in Berlin in 1780. The 1785 catalogue contains an ad for a traditional six-piece burr puzzle called "The Small Devil's Hoof" (in addition to an ad for the Large Devil's Hoof which is a 24-piece cage burr).



Brown's 1917 Patent

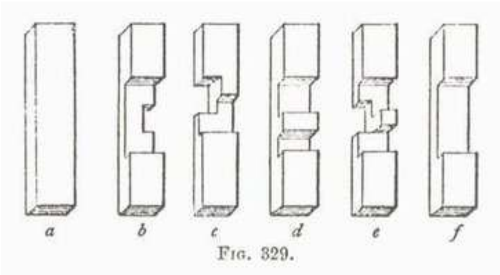


No. XXXVI.—The Nut (or Six-piece) Puzzle.

This puzzle is (as its second name implies) composed of six pieces of wood, so cut as to fit together as shown in Fig. 206.

Fig. 206.

The experimenter is required to take the pieces apart, and put them together again.



Hoffmann's "Nut" Puzzle

One early depiction of the six-piece burr puzzle and specific pieces occurs in a Spanish book, primarily on the topic of magic, from 1733 by the many-talented Pablo Minguet y Irol (b. 1700 d. ca. 1775) with a rather lengthy title that begins ***Engacos a Ojos Vistas***, which translates as "Deceptions in Plain Sight." (The text says the two other pieces are the solid key, and a copy of the piece labeled 3 in the diagram.)

ENGAÑOS
A OJOS VISTAS,
Y DIVERSION
DE TRABAJOS
MUNDANOS,
FUNDADA EN LICITOS JUEGOS
DE MANOS,
QUE CONTIENE NOVENTA Y TANTAS

AÑADIDOS LA MITAD DE ELLOS
en esta tercera impression por
SU AUTOR
PABLO MINGUET Y YROL,

CON PRIVILEGIO.
En MADRID : En la Oficina de Domingo Fernandez de Arrojo, Calle del Carmen. Año 17[illegible].

JUEGO DE ENLAZAR SEIS PALITOS, que formen un quadrado en figura de una Estrella.

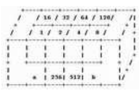
MAndaràs hacer feis palitos de madera fuerte, iguales de cuerpo, y de largo han de tener feis quadrados. El del num. 1. ha de tener dos quadrados rebaxados hafta al medio; el del num. 2. como fe vè

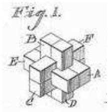
In his 2007 book *Geometric Puzzle Design*, Stewart Coffin discusses the six-piece burr in chapter 7, and reports that Jerry Slocum's *New Findings on the History of the Six Piece Burr* traces the six-piece burr back to Germany in 1698. See the 1728 *Cyclopedia* of Ephraim Chambers (online at the University of Wisconsin Digital Collection; additional commentary at www.cyclopedia.org).

You can see a six-piece burr in the lower left area of the frontispiece by John Sturt, which is a modified and left-to-right inverted copy of a 1698 engraving entitled "L'Acadйmie des Sciences et des Beaux Arts" by Sйbastien Leclerc (or Le Clerc).

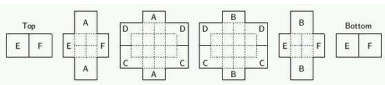
Read about this engraving at the University of Oxford. It is also noted in David Singmaster's *Sources in Recreational Mathematics*.

Stewart Coffin's book *The Puzzling World of Polyhedral Dissections* hosted on John Rausch's site contains a good introduction to this type of puzzle. Martin Gardner discusses burrs briefly (as an introduction to the puzzle sculptures of Miguel Berrocal) in his 1989 book *Penrose Tiles to Trapdoor Ciphers*, and most of the key puzzle authors mention the puzzle. There have been sporadic fits of research into the six-piece burr, including an extensive analysis by hand by the Dutch mathematician **J. H. de Boer**, and work by **Tom O'Beirne** and **Arthur Cross**, but **William (Bill) Cutler** has performed (starting in 1975) *the* definitive computer analysis, and the statistics cited below are based on his analysis.





One can visualize a burr piece as being composed of unit cubes arranged in a 2 x 2 x 2*n* prism where *n* is greater than or equal to (and usually) 3. A solid piece will contain 24 unit cubes, and other piece types will have some of the cubes removed, resulting in notches. The burrs in this section are composed of six such pieces, usually but not always distinct, selected from the overall set of possible such pieces (of a given length), and interlocked in a characteristic 2x2x2 pattern along 3 orthogonal axes. The burr shape is tricky to envision without an example in front of one, but it gets easier with practice.



In the burr shape there are **32 internal cube positions where the pieces would overlap**, but musn't in order to fit together. These 32 internal cubes must be distributed among the six pieces in some way that (a) permits every piece to remain undivided, (b) permits the six pieces to interlock together, and (c) permits the pieces to be assembled and disassembled - i.e. it is *constructible* (some groups of pieces can be fit together without overlap internally, but they interlock in such a way that they could never actually be put together from scratch that way - these are called "apparent" or "false" assemblies). These constraints mean that all pieces, except a maximum of one possible "key" piece, must be notched to remove some cubes, and that only certain sets of notchings will work together.

You can only remove up to 10 of 12 specific cubes from a 2x2x6 prism before it becomes disjoint or improperly notched for this type of puzzle (for example, showing notches on the outside where they shouldn't be visible). Overall, this results in **837 distinct physical pieces**. Cutler determined that there are **35,657,131,235** ways that six pieces drawn from the universe of 837 fit together in the requisite shape (allowing dups of pieces within a set, but discarding rotations and mirror image assemblies of sets), but of those 35 billion, "only" about **5.95 billion** (estimated) are *constructible* puzzles.

There is a distinction made between burr puzzles that contain no internal "holes" or voids - termed **solid** burrs, and those that do contain one or more - termed **holey** burrs. **There are 119,979 solid burrs**, and there are **369 piece types needed to produce them**. Of those 369, 112 are used in duplicate and 2 in triplicate, making a useful set of **485** pieces to make all the solid burrs. **The rest of those 5.95 billion puzzles are holey burrs**.

A holey burr can contain from 1 to 20 holes. The **weight of a burr** relates to the number of internal holes it has, and **can range from 32 (no internal holes), down to 12 (the maximum of 20 holes).** The **weight of a piece** refers to the number of cubies *not* removed from it, and can range from 12 (the key) down to 2 (the Y). **If the sum of the weights of six pieces exceeds 32, it is impossible to construct a valid burr from that set.**

Also, there is a distinction made among the pieces which can be produced without hard-to-manufacture blind (or internal) corners (i.e. where the sides of at least 3 cubies meet in concavity) versus those that cannot. Any piece without any such blind corner can be made using a milling machine and is **millable**, otherwise it is a **general** type piece. (In a millable piece, any cut parallel to the long axis of the piece is bounded on both ends by a cut perpendicular to the long axis.) There are **78** millable pieces. However, to produce pieces on a table saw (with a dado blade), or by hand without resorting to a chisel, one must also avoid internal edges that run parallel to the piece's long axis, and employ only cuts running perpendicular to the long axis. These pieces are called **notchable**, and there are only **59** of them (they're all millable, too). **Only 25 of those 59 pieces are useful to build solid burrs, and only 314 solid burrs can be made from that set of 25** (some dups are required, so you need a **set of 42 pieces** with dups). Overall, the 59 notchable pieces can be used to make **13,354,991** assemblies.

The **level** of a burr puzzle is the number of distinct linear moves (a shift of one or more pieces together, sometimes by one unit but usually by an arbitrary number of units, in just one direction) that must be performed to remove the first piece or pieces - there can be a concatenation of figures usually separated by dots - these are the numbers of steps to remove successive pieces.

All solid burrs are level 1 - they come apart without any preliminary shifting. Burrs with internal holes can achieve higher levels, and one goal of research has been to delimit what is possible in terms of level complexity.

Bill Cutler has done extensive analysis on both the "holey" six-piece burr and all six-piece burrs in general, and Bill offers several burrs for sale.

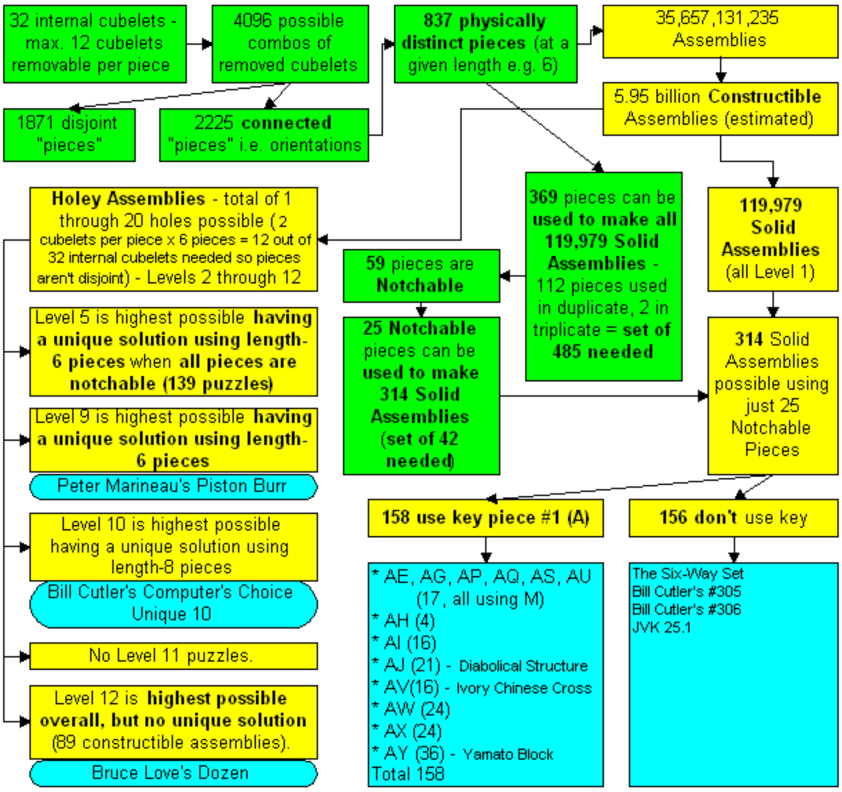
Jürg von Känel created the wonderful Burr Puzzles Site hosted at IBM Research. Jürg's site offers a **solution analyzer applet** and historical info about burrs.

Bruno Curfs' site (now defunct?) offered additional analysis. Ed Pegg wrote a good survey article about burrs. Peter Roesler's site also discusses burr puzzles, and has an interesting history of Willem van der Poel's Grandfather 6x6x6 burr. You can see some burrs at John Rausch's Puzzleworld. **You can use Andreas Röver's Burr Tools to model, solve, and design burr puzzles.**

If you're interested in collecting 6-piece burrs, I suggest you first check out Ishino's "Puzzle Will Be Played" site to get some idea of the variety available. Look under "Interlocking (6 piece burr: traditional)." Though they may be sold under different names and by different vendors, burr puzzles that use the same set of six pieces are isomorphic and have identical solutions (although using pieces longer than six units might eliminate some solutions). That site also provides a comprehensive catalogue of burr pieces.

Note that when discussing traditional burrs, ***twists or rotations* of pieces typically are not required or allowed.** It is possible, however, to design burrs that appear traditional but require such moves and frustrate the usual computer analysis - for example, see Bill Cutler's **Programmer's Nightmare** burr. For some burr designs, twisting a piece might be possible and might offer a shortcut, but isn't strictly required. It is also possible to mimic the outer appearance of a traditional burr but use different internal notchings - but such designs are outside the scope of this section (e.g. Cutler's **Explode-A-Burr**).

I admit that, early on, I didn't like burr puzzles. But as I read more about them, and tried various designs, my appreciation for them grew.
I put together the diagram below to try to summarize and organize some of the facts I learned about this category of puzzle.



Check out a nice writeup on how to go about solving 6-piece burrs, written by Guillaume Largounez, over at the Puzzle Place Wiki.

Identifying Burr Pieces

Over the years, different researchers and writers have employed different schemes to identify the pieces. Some have used rather arbitrary letters or numbers.

Some folks, however, have devised more systematic schemes, employing a mathematical calculation based on assignments of binary values to "cubies" (or "cubelets") to be removed from the unnotched basic block.

I use Jurg von Kanel's numbering system and I have adapted some of the ASCII character piece diagrams below from his documents.

To map my ID to Ishino's scheme, subtract 1 from my ID. For symmetric pieces without a mirror image, this gives Ishino's ID. For pieces that have a mirror image, the result gives Ishino's ID for the mirror image piece.

A piece ID is 1 plus the value, shown below, of each cubie removed.
The cubies behind cubies 256 and 512 can be removed, too,
and have respective values 1024 and 2048.
Such pieces appear infrequently.

```
        +----+----+----+----+----+----+
       /    / 16 / 32 / 64 / 128/    /|
      +    +----+----+----+----+    + |
     /    /  1 /  2 /  4 /  8 /    /  +
    +----+----+----+----+----+----+   |
    |    |    |    |    |    |    |   |
    |    |    |    |    |    |    |   +
    +    +----+----+----+----+    +  /
    |         |    |    |         | +
    |     a   | 256|  512|   b    |/
    +----+----+----+----+----+----+
```

When trying to identify an arbitrary piece, rotate it about its long axis
(and maybe flip it end-for-end)
until you find an orientation where the cubies marked 'a' and 'b'
and the cubies behind them are present.
Sometimes a piece could be assigned more than one number -
use the smaller number.
This entails orienting it so that cubies 1024 and 2048 are present if possible.

I created a "Burr ID Tool" in JavaScript which will display an ASCII character picture of any given burr - you just check off the particular cubies that are present in the piece.

(These character-based renderings rely on fixed-width fonts and won't display well on some devices, particularly phones - at some point I'll have to create images for the pieces.)

Open the Burr ID Tool Window

The 25 Notchable Pieces Used in Solid Burrs

Shown below is the set of 25 notchable pieces used in solid burrs. These are depicted as length-6; for longer pieces simply extend the 2x2 solid burr equally on each end.

- The first number is the **piece ID** as described above.
- The first letter, in **bold**, is the "standard" letter ID for the piece, and is used in **Pentangle's set**.
- The second letter is as assigned by Curfs and is also used in **Wayne Daniel's (i.e. the Interlocking Puzzles or "IP") set**.
- The third letter, if present, is that assigned by **Edwin Wyatt** in *Puzzles in Wood*.
- A 'p' suffix indicates the piece is included in the **Professor burr set**.
- The last number is the usual **count of this piece in a 42-piece set** that allows you to construct 314 solid burrs.

I have lately given names to some of the pieces, which I find more helpful than the letters or numbers when trying to remember sets of pieces I have seen before.

Piece #1 is the "key" piece. No more than one Key appears in any puzzle. Also, when the key #1 is used, neither #18 nor #35 can be used in the same puzzle with it. (Can you tell why?) *Piece 1024 (Y) is the "minimal" piece - no more material can be removed without the piece falling apart.*

I have located some of the pieces out of numerical sequence, to show related pieces together.

1 **A** A A [p] 1

```
 +----+----+----+----+----+----+
/                             /|
+                             + |
/                             / |
+----+----+----+----+----+----+  +
|                             |  |
|                             |  |
```

The Key					
All six positions and widths of a single slot...					
18 **B** B L [p] 2	35 **C** E 1	52 **D** P J [p] 2	103 **F** S H 1	120 **G** U 1	256 **J** X B [p2] 3
Local Mail	Out of Town Mail	The Side Tray	The Half-Tray	The Three-Quarters Tray	The Tray
Three possible dual slots...			Three symmetric pieces...		
86 **E** H 1	154 **H** K I [p] 1	188 **I** M M [p] 2	871 **M** T K 2	928 **V** L D 2	1024 **Y** Y F [p2] 3
The Mailbox	The Toaster	The (Bottle) Opener	The Barbells	The Tongue	The Y
There are six pairs of mirror image pieces...					
359 **L** F 1	615 **K** G 1	792 **R** D 2	911 **N** C G 2	824 **T** R C [p] 2	975 **O** Q E [p] 2
The Notched Half-Trays		The Walls		The Offsets	
856 **S** J 1	943 **P** I 1	888 **U** W 2	1007 **Q** V 2	960 **X** N 2	992 **W** O [p] 2
The Fingered Clubs		The Clubs		The Fingers	

Selected Other Burr Pieces

The following are only a small selection of additional pieces (or 'non-25' pieces - i.e. pieces not in the set of 25 given above), used in some of the burrs mentioned below, where they will be highlighted like this.

In this table, notchable pieces will have an **N** after the ID#, non-notchable but millable pieces will have an **M**.

Many of these pieces have internal corners and are more difficult to manufacture. Remember, there are 837 pieces in total - if you want to see them all, you'd best visit Ishino's site - though Ishino uses a different numbering scheme.

The pieces are in numerical order from top down left to right, but I show mirror image pairs together using an arbitrary color.

I have added the 20 non-25 pieces from the 27-piece **Ultimate Burr Set** - they're labeled **UBS.*n*** where *n* is the piece number as given within the set.
The UBS set includes 7 of the 25 pieces above (shown as 'UBS number = my ID'):
0=1, 25=188, 9=256, 10=928, 5=1024, 7/6=960/992

I have also included the 20 non-25 pieces from the 35-piece **Interlocking Puzzles Level-5 Set** - they're labeled **IPL5S.*n*** and again *n* is the piece number as given within the set.
The IPL5 set includes 15 of the 25 pieces above (shown as 'IPL5 number = my ID'):
46=103, 22=120, 56=154, 26=188, 00=256, 35=928, 01=1024, 30/08=824/975, 09/29=856/943, 03/02=888/1007, 28/07=960/992

20	56	60	64	72	88 **M**
Filipiak #67	Triple Slide	UBS.1	UBS.24	Interrupted Slide	Piston, Hordern, Dozen, BB31-10-40
94	109	112	124	126	
Triple Slide	BCL6000	Interrupted Slide	UBS.22	STC#36	
128	240	156	160 **M**	192 **M**	224 **M**
Hedgehog, Kaldeway, UBS.15	Avenger (pc. #4)	Triple Slide	(many)	#G, UBS.17	JVK, Millable 5.4, UBS.14
327 **N**	551 **N**	344 **N**	687 **N**	376 **N**	751 **N**
IPL5S.39	BC-L5N, IPL5S.45	IPL5S.25	IPL5S.33	IPL5S.21	IPL5S.05
410	412 **N**	670 **N**	414	416 **M**	442

UBS.2	(many), UBS.23, IPL5S.53	IPL5S.40	UBS.3	UBS.20	UBS.4
444 **N** UBS.18, IPL5S.49	734 **N** IPL5S.10	448 **M** Interrupted Slide, UBS.12	736 **M** BCL6000, #G	463 **N** Tenyo Brother, IPL5S.24	568 **N** IPL5S.34
464 Brown's	576 D. Kriz II	474 UBS.26	476 Prog. Nightmare, UBS.21	702 BC-CCU10, Mega-6	478 UBS.16
480 **N** UBS.13, IPL5S.23	704 **N** (many), IPL5S.32	495 **N** IPL5S.20	632 **N** IPL5S.06	499 BC-CC5H	757 Prog. Nightmare
506 UBS.19	508 UBS.11	511 Interrupted Slide, #D, F#73	760 Baffling, Brother	512 **N** (many), UBS.8, IPL5S.19	768 **N** (many), IPL5S.04
564 Tenyo Brother	624 BC-CCU10	800 Brown's	820 STC#36	832 Brown's, G4	976 D. Kriz II, Enigma, #G
880 Dubois/Gaby	883 BC-CCU10	896 Avenger (pc. #2)	1008 (many)	909 Tenyo Brother	922 Piston
926 BC-CC5H	927 Tenyo Brother	956 Prog. Nightmare, BC-CC4H	990 Interrupted Slide	984 Avenger (pc. #7)	996 Baffling
1015 (many)	1016 Tenyo Brother	1021 Prog. Nightmare	1933 **N** Avenger (pc. #9), IPL5S.38	2836 **N** IPL5S.44	

Some Common Six-Piece Burr Designs

I have noticed the following four designs recur over and over again in different products.

It should be fairly easy for you to find contemporary examples using these pieces, and these four burr puzzles are a reasonable introduction to the category.

The Diabolical Structure

1 **A** A [p]	256 **J** X [p2]	256 **J** X [p2]	256 **J** X [p2]	928 **V** L	928 **V** L
The Key	The Tray	The Tray	The Tray	The Tongue	The Tongue

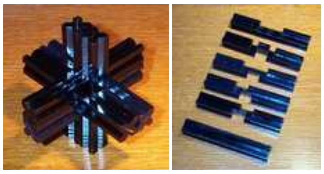
This set of pieces appeared in a French puzzle (I don't have) called "Charpente Diabolique" (the Diabolical Structure). The pieces include: 1, 3x256, and 2x928 (AJ-VV-JJ or ALLXXX). The colorful burr on the right I have from "Melissa & Doug" uses the same set. It is very easy to construct - in fact this is possibly the easiest of all 6-piece burrs.

The Chinese Cross

1 **A** A [p]	256 **J** X [p2]	824 **T** R [p]	975 **O** Q [p]	928 **V** L	1024 **Y** Y [p2]
The Key	The Tray	The	Offsets	The Tongue	The Y

This set of pieces has been used often, and has appeared in ivory. Jurg von Kaenel refers to this as "the well-known one."

This small plastic red burr is one of my older puzzles - I don't recall where I got it.



Licorice Stix - Reiss (1974)

This is a small plastic burr pendant, made in China.

[Kaiyue] Kong Ming Lock

This set also appeared as "Dohikus." (I don't have this.)

The Six-Way Set

52 **D** P [p]	792 **R** D	911 **N** C	824 **T** R [p]	975 **O** Q [p]	1024 **Y** Y [p2]
The Side Tray	The	Walls	The	Offsets	The Y

This is the only notchable, voidless set that can be put together six different ways.

I got this aluminum burr called "**Rainbow**" from Bits and Pieces - it came in a nice black drawstring pouch. It was designed by Paul Eibe.

This is **DNORTY** from Pentangle. The name derives from the bold piece letters given in my table above: 52 (D), 911 (N), 975 (O), 792 (R), 824 (T), 1024 (Y).

This is a Toyo Glass puzzle called "**Tongari Kun and Roppongi**." Not only is there a burr, but it must be assembled inside the glass container. The mouth is too small to pass the burr in fully assembled form. Remember, there are 6 different ways to construct this burr - you must find one that permits construction within the container!

This set was sold some time ago (perhaps prior to 1900) as **The ZOOZZLER**. (I don't have it.) If you look carefully at the inside of the box lid shown in the photo on the left, you'll see the Zoozzler came from the La Rose Manufacturing Company of Albany, N.Y.

In December 2008 I was contacted by Pete Brady, who discovered a Zoozzler in the back of an old desk, and after assembling it, did a Google search on it and found my website. Pete's copy is shown on the right.

Pete, who is now in his 70's (and still solving burr puzzles!) tells me that his grandfather was Anthime F. La Rose, who was born in 1842 in a small town near Montreal, and who died in 1920. Anthime was raised in French Canada and eventually emigrated to Albany, where he established his factory at 172 Broadway and made, among other things like the Zoozzler, furniture, and phone booths for Western Electric. There is no evidence of any patent, though the box does carry the words "Trade Mark" - Pete believes that Anthime produced the Zoozzler in his well-equipped factory. The box says, "Agents wanted to sell the ZOOZZLER in every town or city - liberal commission. Special inducements to boys and girls to sell in their spare time." No phone number appears on any of the packaging, so it may be that the Zoozzler was produced prior to 1900.

Pete says his grandfather was married twice. After his first wife died, Anthime married Julia, who was born in 1863 and died in 1945, and in 1899 had a daughter, Katharine, who was Pete's mother.

Thanks for the info, Pete, and for allowing me to share it! I find this kind of historical background adds a lot to my enjoyment of puzzles. It is not always easy to feel any connection to our distant ancestors, but a puzzle can be a tangible link to the past.

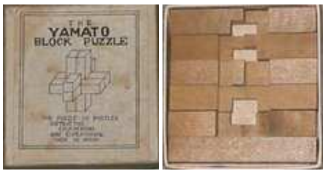
To resolve all six different solutions, I found it helpful to ask myself, "What sits in the notch of piece #52, and then which piece is opposite #52?" I found the following:

- left offset 824, right wall 911 - this *seems* like it fits together, but is in fact not constructible. This is a good illustration of what is meant by an *apparent* assembly.

1. left offset 824, right offset 975 - two 3-pc halves slide together
2. right offset 975, left offset 824 - mirror of the above
3. right wall 911, left offset 824
4. right wall 911, left wall 792
5. left wall 792, right offset 975
6. left wall 792, right wall 911

The Yamato Block

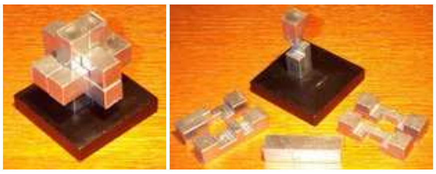
1 **A** A [p]	188 **I** M [p]	824 **T** R [p]	975 **O** Q [p]	1024 **Y** Y [p2]	1024 **Y** Y [p2]
The Key	The (Bottle) Opener	The	Offsets	The Y	The Y



The vintage Japanese **Yamato Block Puzzle**.

This is "**No. P19 Joe's Puzzle**" from **Wm. F. Drueke & Sons** of Grand Rapids Michigan. There is no date on the box but it seems fairly old.

This is a small brass burr, called the "**Ultimate Puzzle**," made for **Chadwick Miller** and dated 1969. It came with a small black case with a question mark on the front.



In this aluminum burr, piece 824 is fixed to the base. I think this came from B&P.

More Six-Piece Burrs

Love's Dozen

88	512	704	960	992	1008

This is **Bruce Love's Dozen**, (the version without the D's) purchased from Bill Cutler, and made from Maple by Jerry McFarland. This burr is special because it is **the only burr at the highest level, 12**. Unfortunately the solution is not unique - there are 89 ways to put these pieces together, and most of them *don't* achieve level 12. Note that there are no other level 12 burrs (for any length stick), and no level 11 burrs at all.

The Piston Burr

88	512	768	922	1008	1008

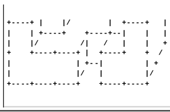
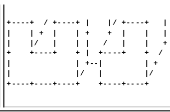
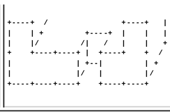
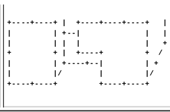
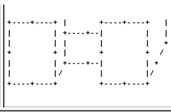
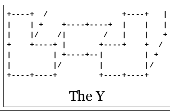
This is **Peter Marineau's "Piston" burr**, so named because of the large number of times pieces must be moved back and forth during the solution. *This* burr is special because it achieves the **highest level possible for length-6 pieces, level 9** (i.e. it requires 9 moves to release the first piece), and the solution is **unique** - it has no other solutions at lower levels.

I made an example from Lego. I also bought a version made from six exotic woods, by Thomas Moeller. It is quite large - each piece measures 1.5" x 1.5" x 4.5".

Check Bill Cutler's site for availability.

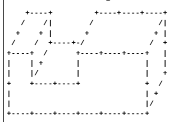
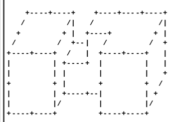
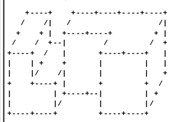
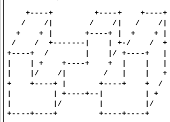
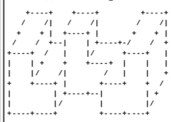
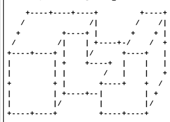
Computer's Choice Unique 10

624	702	768	883	1015	1024 **Y** Y [p2]

					
					The Y

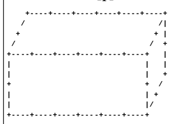
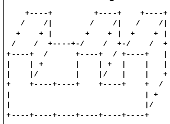
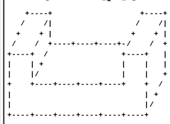
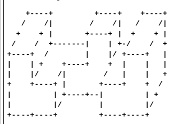
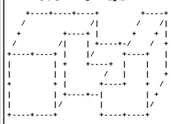
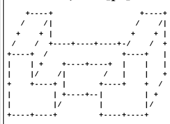
This is [Bill Cutler's] **Computer's Choice Unique 10** burr. I don't know who the craftsman is - I bought it as part of a group of hand-made puzzles. *This* burr is special because it is one of 18 burrs that have a **unique level 10 solution, the highest level achievable for six-piece burrs with unique solutions**. The pieces must be length-8, however, not length-6.

The Baffling Burr Puzzle (Bill Cutler's #305)

52 **D** P [p]	615 **K** G 1	792 **R** D 2	960 **X** N 2	992 **W** O [p] 2	975 **O** Q E [p] 2
					
The Side Tray	Left Notched Half-Tray	Left Wall	The	Fingers	Right Offset

This is called The Baffling Burr Puzzle ("Six interlocked pieces of wood that will challenge the experts") - there is no other information on the box. This has pieces numbers 52, 615, 792, 960/992, 975 and is **Bill Cutler's #305**, *not* Bill's Baffling Burr, which has pieces 103, 760, 960/992, 996, 1024.

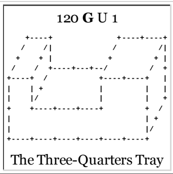
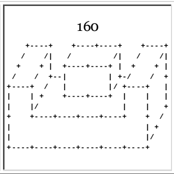
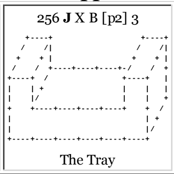
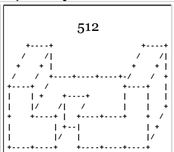
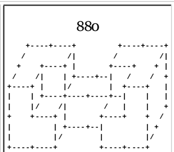
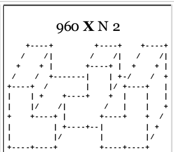
Toys From Times Past Burr Puzzle (Hoffmann Burr)

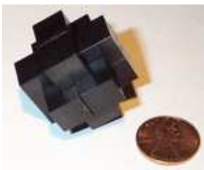
1 **A** A [p]	188 **I** M [p]	256 **J** X B [p2] 3	960 **X** N 2	975 **O** Q E [p] 2	1024 **Y** Y [p2]
					
The Key	The (Bottle) Opener	The Tray	Right Finger	Right Offset	The Y

This is the **Burr Puzzle** from [Toys From Times Past]. This has pieces 1, 188, 256, 960, 975, 1024 and is **the same design shown in Hoffmann**, except Toys From Times Past has incorporated a locking mechanism into the key piece.

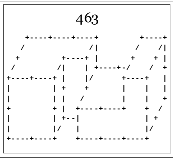
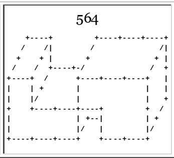
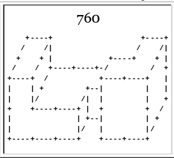
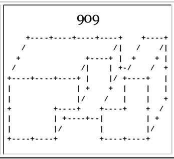
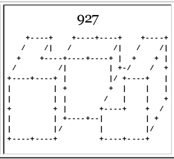
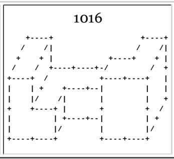
Philippe Dubois/Gaby Games

120 **G** U 1	160	256 **J** X B [p2] 3	512	880	960 **X** N 2
					
The Three-Quarters Tray		The Tray			



This small black plastic burr I found in a puzzle shop in Prague during IPP28 is a copy of the Philippe Dubois/Gaby Games burr that requires 6 (or 7, depending on how you count) moves to release the first piece. It is one of the "Fearsome Four."

Tenyo Brother

463	564	760	909	927	1016
					

I bought this plastic burr in Japan. I believe it was made by Tenyo. It is number 4 in a "Family" of burrs - this one is called "Brother." This burr uses six general pieces: 463, 564, 760, 909, 927, 1016. It has no holes, and comes apart in one move into two 3-piece halves.

This might be #72 in Filipiak's list (c.f. Anthony S. Filipiak, ***100 Puzzles - How to Make and Solve Them***, 1942, p. 86).

Kozy Kitajima's 6+6=Cube

1 **A** A [p] The Key	188 **I** M [p] The (Bottle) Opener	256 **J** X B [p2] 3 The Tray	911 **N** C G 2	1024 **Y** Y [p2] The Y	1024 **Y** Y [p2] The Y
52 **D** P [p] The Side Tray	103 **F** S H 1 The Half-Tray	120 **G** U 1 The Three-Quarters Tray	928 **V** L D 2 The Tongue	960 **X** N 2 The	992 **W** O [p] 2 Fingers

This set of twelve pieces is called the "6+6=Cube." It was designed by Kozy Kitajima. The pieces include: 1, 52, 103, 120, 188, 256, 911, 928, 992, 960, and 2x 1024. According to the instructions, there is only one way to build two burrs at once. The twelve pieces can also be combined to form a cube, with holes.

G4 or "The Cross of Marseille"

1 **A** A [p] The Key	188 **I** M [p] The (Bottle) Opener	512	832	975 **O** Q [p] Offsets	1024 **Y** Y [p2] The Y
1 **A** A [p] The Key	188 **I** M [p] The (Bottle) Opener	768	976	824 **T** R C [p] 2 Offsets	1024 **Y** Y [p2] The Y

This burr's wooden length-12 pieces are stained a dark color. The burr comes in a box with a fitted slip-out cover. At some point I saw it referred to as "G4," also as "The Cross of Marseille." The pieces used are: 1, 188, 512, 832, 975, 1024. The mirror images of the 3rd-5th can also be used: 1, 188, 768, 976, 824, 1024.

The Avenger

240	768	960 **X** N 2	984	1024 **Y** Y [p2] The Y	1933

The Avenger is offered by PuzzleMaster.ca. It includes 9 length-10 pieces, one of which (their #1) is not traditionally notched. Subsets of the pieces can be assembled into six-piece, seven-piece, eight-piece, and nine-piece burrs. The pieces are:

1	2	3	4	5	6	7	8	9
non trad.	896	928	240	1024	768	984	960	1933

For the six-piece assembly the pieces used are: 240, 768, 960, 984, 1024, 1933.

The Double-Cross Puzzle

1 **A** A [p] The Key	154 **H** K I [p] 1 The Toaster	256 **J** X B [p2] 3 The Tray	256 **J** X B [p2] 3 The Tray	1024 **Y** Y [p2] The Y	1024 **Y** Y [p2] The Y

This is **The Double-Cross Puzzle**, issued by the **General Engineering & Design Co.** of Detroit, Michigan. (No date.) Six metal pieces. A very easy design.

Miscellaneous

Here is a group of miscellaneous wooden burrs I've accumulated.

The light brown burr is perhaps the more difficult of this group, but we've seen it already - its pieces are the familiar "Six Way" set: 52, 792/911, 824/975, 1024.

The white and two (identical) dark brown burrs all employ the familiar "Chinese Cross" piece set: 1, 256, 824/975, 928, 1024.

A plastic burr from China (The Chinese Cross set - 1, 256, 824/975, 928, 1024):

Burr Sets

Obviously it would be nice to have a set of pieces all with consistent dimensions, in order to conveniently try different burr designs. In fact, there have been several sets produced, of varying completeness and quality.

I made generic burr pieces (6x #1024, each requiring 14 cubes) from LiveCube. Then, with 20 extra pieces (here in yellow), one can build any of the possible burr pieces, and any set of six to try a particular burr.

I recently (in 2008) discovered that a Chinese fellow named (I believe) Qiu Jinhua received an award and a patent for the same idea! See this Chinese website at www.eipm.com.tw for information on his "Universal Lubanga Lock." If you translate the page using Google, you'll note that the description text sounds like my introductory text to this section on traditional six-piece burrs. The LiveCube example shown even uses yellow cubes for the interior. Check out the Internet Archive "Wayback Machine" and take a look at the snapshot of my website from October of 2004 to see that I had this idea pretty early on. Hmmm. Can you say, "*prior art*?"

This is a "Professor" burr set from the Yamanaka Kumiki Works in Japan. (I've also seen it called the "Professional Puzzle" set.) Its twelve length-8 pieces can be used to assemble at least four different traditional 6-piece burrs. The set includes only notchable pieces:

1, 18, 52, 154, 188, 256 x2, 824/975, 992, 1024 x2.

This set of 13 length-8 pieces is called **Boite 13**. The pieces are assigned letters A thru M, and correspond to our codes as follows:

A	B	C	D	H/E	I/F	J/G	L/K	M
1	52	103	256	792/911	824/975	888/1007	960/992	1024

They're all notchable. You don't get 188 or 928, and you only get one each of 256 and 1024. But you do get the less commonly supplied 888/1007 pair. According to BurrTools, there are only 13 distinct subsets of 6 that form solid burrs - I have included those 13 in my catalog, and identified them as **B13S.*n*** where *n* goes from 1 to 13. These pieces can form 9104 burrs allowing internal holes. The highest level is 4. I didn't find any of the holey examples I tried particularly compelling - if I include them in the catalog, I'll label them as **B13H.*n***.

Colin Gaughran is a woodworker in Lyme, Connecticut. Colin can make *any* burr pieces, notchable, millable, or even general, using his CNC machine.
Colin has made several burr pieces for me, including 52, 359/615, 871, 911, 928, 943, 975, 960/992, 1007, and 1024. These pieces can be used to make at least four interesting burrs, including Bill Cutler's #306, CINTVY, FILTVY, and FGINOY.
You can contact Colin via his eBay sale here.
I gave him permission to use my piece ID graphic so you can clearly specify your desired pieces. (I put labels on mine so I can easily identify them.)

Wayne Daniel (Interlocking Puzzles) made this nice set of 42 of the notchable pieces which can be used to make 314 solid burrs. I believe the pieces are made of of Mahogany wood, with a Walnut box. Each piece is 0.75" square and 2.5" long, so his unit cube is 3/8 inches on an edge, and these are "length 6." The set includes a series of cards listing the six-tuples of each of the 314 burrs, and giving assembly hints by telling the adjacent pairings.

Unfortunately, I have found that certain holey burrs that are constructible from the notchable set, cannot be made to work using Daniel's set - his esthetic beveled treatment of the ends of the pieces, while fine for the 314 solid burrs, prevents certain necessary movements when trying the holey burrs. In particular, designs which use the "jutting jaw" technique as in the JVK 25.1 design, don't open far enough to allow the 3/8" cubie of a piece to pass through.

Pentangle offered a nice boxed set of the same 42 pieces. Unlike the IP set which has length 6 pieces, the Pentangle pieces are length 8.

Interlocking Puzzles also offered another nice boxed set, of 35 pieces - called the **Level 5 Set**. Another collector, Jim Storer, shows both the IP 42-piece set I have here, and the IP Level-5 35-piece set on his website.

Other burr puzzle sets:

Creative Craft House offers the **Ultimate Burr Set** that includes 27 pieces and can make over 60 puzzles. Thanks, Dave!
Ken Irvine wrote up a nice article about this set, which he has given me permission to mirror so you can download a copy.

Philos offers their set #6025, called "151er Teufel" having 20 pieces and making 159 puzzles
(I don't have this.)
Check Amazon.de; also Webwide-Spielen.de

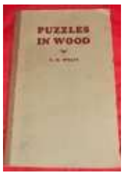
Wayne Daniel, and Pentangle, both at one point offered sets of 42, but they're not being produced any more as far as I know. Dick Wetters also offered sets, but he, too, has stopped.

Catalogue of Burrs to Try

This section gives a list of burrs to try once you have a set (or can make your own pieces, for example from LiveCube or Lego). I've included solid and holey designs. There are several sources that give the full list of all 314 solid burrs that can be produced with the set of 42 notchable pieces, including Slocum and Botermans' 1987 *Puzzles Old and New*. That list of 314 puzzles contains multiple entries for a set of six pieces when that set can go together in different ways, so there are not actually 314 unique six-piece sets. I have folded all the sets represented by those 314 puzzles into my list. I have tried to catalogue interesting puzzles I've run across and give their names or designers when I know them.

The catalgoue below is ordered by piece number - with the six pieces sorted by number, lowest first. Mirror pair pieces are listed together. I have color-coded the pieces per my guide tables above, to try to make it easier to see how the designs may be related. In addition...

- pieces highlighted in this color are from the table of additional pieces. Of these, the pieces 512/768 are used frequently and are specially highlighted. If a burr's piece list does *not* contain any pieces highlighted like this, then it (most likely) can be constructed using the set of 42 notchable pieces.
- Puzzles highlighted like this are the four common designs.
- Puzzles highlighted like this can be made with the Professor/Professional Puzzle set.
- Puzzles highlighted like this are the "Fearsome Four."
- Puzzles highlighted like this are Stewart Coffin's three designs.
- Puzzles highlighted like this are a small selection of Bill Cutler's designs. (Bill gives lists of "holey" burr designs, and other burr designs on his site.)
- Puzzles highlighted like this are mentioned on Bruno Curfs' site.
- Puzzles highlighted like this are ranked easiest by Curfs. You might use these to introduce a beginner or a child to this category. Incidentally, Curfs, Coffin, and Cutler rate Cutler's #306 as the most *difficult* of the notchable solid burrs.
- Puzzles highlighted like this are Jurg von Kanel designs.
- Puzzles highlighted like this are Peter Roesler's designs.
- Puzzles highlighted like this are David Winkler's designs.
- Puzzles highlighted like this are Keiichiro Ishino's designs. Ishino offers extensive analysis of the six-piece burr (as well as many other puzzles), giving catalogues of pieces and of designs. He lists many of the puzzles listed here, too.
- Puzzles highlighted like this are the 15 burrs described by Edwin Wyatt in his 1928 classic ***Puzzles in Wood***.
- Puzzles highlighted like this are among the oldest documented



The book ***Puzzles in Wood***, written by Edwin M. Wyatt, was published in 1928 by the Bruce Publishing Company. Wyatt includes a section on the six piece burr, shows clear plans for 13 pieces he labels A through M, and gives a list of six-piece sets for 15 puzzles.
In the list below, Wyatt's puzzles are highlighted like this.

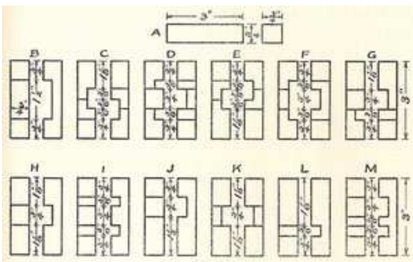


FIG. 23

Wyatt's Pieces
They correspond to:

A	B	C	D	E	F	G	H	I	J	K	L	M
1	256	824	928	975	1024	911	103	154	52	871	18	188

all of which are notchable.

Known combinations:
1. B, C, D, E, F, A.
2. E, C, F, G, F, and A.
3. J, F, M, F, F, A.
4. B, B, M, F, F, A.
5. I, B, B, F, F, A.
6. J, D, F, B, F, A.
7. I, K, F, F, F, A.
8. F, F, B, D, H, A.
9. J, H, F, F, and J, K.
10. J, G, F, B, and F, L.

With invisible hollow spaces within:

11. E, J, F, F, F, A.
12. M, B, F, B, F, A.
13. J, F, F, B, F, A.
14. M, B, E, F, F, A.
15. J, G, F, B and B and I or F (no key).

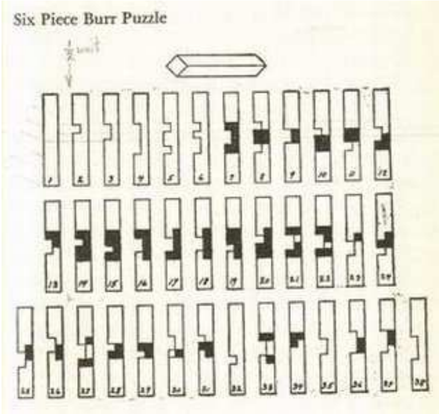
Wyatt's Puzzles

The book ***100 Puzzles - How to Make and Solve Them***, written by Anthony S. Filipiak, was published in 1942 by A. S. Barnes and Company. In his book, Filipiak includes a section on the "Six Piece Burr Puzzle," beginning on page 79. He says that though he has over a thousand mechanical and manipulative puzzles in his collection, his favorite puzzle is the six piece burr.

He gives diagrams for 38 burr pieces, and lists his "prize collection" of 73 burr puzzles using those pieces, "*collected the world over by correspondence, travel, and research into ancient books of magic, tricks, games, and puzzles.*" He admits "no doubt there are a few more to be added."

I have not reproduced all 73 designs here, but I highlight Filipiak designs like this.

Several of the designs in his list of 73 puzzles, when I checked using Jurg's applet, have no solution - maybe the wrong pieces were listed, or as noted below, the actual configuration of the pieces themselves are open to interpretation. Or, perhaps Filipiak himself hadn't bothered to actually construct all of the designs - but that seems unlikely given his enthusiasm. I cannot imagine that his editor could have checked the work, however!



Filipiak's pieces correspond to:

1	2	3	4	5	6	7	8	9	10
1	18	52	256	154	188	1024	928	871	911? (463?)
11	12	13	14	15	16	17	18	19	20
792	975	824	512	768	1016	1023	1015	760	511
21	22	23	24	25	26	27	28	29	30
992	960	564?	788	820	973	927	359	615	461?
31	32	33	34	35	36	37	38		
909	35?	920	20	103	1007	888	120		

Filipiak's notes seem to contain several errors: his pieces #2 and #32 appear to be duplicates of what I call #18, although his #32 might be my #35; his #10 as drawn equals my #463, but that interpretation results in several of Filipiak's designs having no solution - from its position in his list it might be a mistaken drawing of my #911, the complement to its neighbor #11 which is my #792.

Filipiak missed pieces #35 and #86, but there are only 3 uses of #35 among the 314 solid burrs, and few of #86. He also missed the pair 856/943, but neither of those are used often, either.

All of the pieces in his set highlighted like this are used in only 6 of his burrs! The mirror pair 512/768 is used only once, in his burr #63.

Anyway, herewith *my* list, also "collected the world over!"

(*Note that the ordinal list entry numbers will change if/when I modify the list, so you should not rely on them as identifiers for given burr puzzles. They're just there to provide a count of the number of entries in my list.*)

1. 1, 52, 188, 1024 x3 - Wyatt #3, Filipiak #4
2. 1, 52, 256, 928, 1024 x2 - Wyatt #6, Filipiak #2 ; also U.S. Patent 1425107 - Levinson 1922. May be the **earliest known** burr, depicted in a 1733 book by Pablo Minguet y Irol (b. 1700 d. ca. 1775). Appeared as the "Small Devil's Hoof" in a 1785 catalogue.
3. 1, 52, 256, 960/992, 1024 - Filipiak #3 (corrected) - substituting 824 for 992, as given in Filipiak, won't work; **B13S.1**
4. 1, 52, 256, 1024 x3 - Wyatt #13, Filipiak #1
5. 1, 52, 824, 992, 1024 x2 - Filipiak #7 - the mirror of his #6. Professional Puzzle set #3
6. 1, 52, 824, 1024 x3 - Filipiak #5 - 1 solution; compare to Wyatt #11
7. 1, 52, 888 or 1007, 928, 1024 x2 - 1 soln.
8. 1, 52, 888 or 1007, 960/992, 1024 - Filipiak #10 (use 1007), Filipiak #11 (use 888) - 2 solutions each. **B13S.2**
9. 1, 52, 960, 975, 1024 x2 - Filipiak #6 - an improvement on Wyatt #11, substituting 960 for a 1024 and thereby eliminating the single void.
10. 1, 52, 975, 1024 x3 - Wyatt #11

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11. 1, **86**, 871, 1024 x3 - the only use of piece #86 with the key #1 - requires piece #871 - easy

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12. 1, 103, 188, 1024 x3 - Filipiak #45; An "anomaly" with "inside" cubies showing
13. 1, 103, 256, 928, 1024 x2 - Wyatt #8, Filipiak #28, "Chinese Puzzle E"
14. 1, 103, 256, 960/992, 1024 - Filipiak #37 - 3 solutions; **B13S.3**
15. 1, 103, 824, 992, 1024 x2 - 3 solns.
16. 1, 103, 888 or 1007, 928, 1024 x2 - 1 soln.
17. 1, 103, 888 or 1007, 960/992, 1024 - **B13S.4** (1007)
18. 1, 103, 960, 975, 1024 x2 - Filipiak #51 - 3 solns.

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19. 1, 120, 188, 960/992, 1024 - Filipiak #47 - 1 solution
20. 1, 120, 256, 928 x2, 1024 - 1 soln. - I found this tricky for some reason.
21. 1, 120, 256, 928, 960/992 - 3 solns.
22. 1, 120, 792 or 911, 928, 1024 x2 - 1 soln.
23. 1, 120, 792 or 911, 960/992, 1024 - 2 solns.
24. 1, 120, 856, 928, 960, 1024 - 2 solns.
25. 1, 120, 856, 960 x2, 992 - 1 soln.
26. 1, 120, 871, 928, 1024 x2 - Filipiak #48 - 1 solution
27. 1, 120, 871, 960/992, 1024 - 3 solns.
28. 1, 120, 928, 943, 992, 1024 - 2 solns.
29. 1, 120, 943, 960, 992 x2 - 1 soln.
30. 1, 128, 188, 512, 960/992 - from Peter Kaldeway's site
31. 1, 128, 512, 792, 928, 1024 - Soviet Hedgehog

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32. 1, 154, 256 x2, 1024 x2 - Wyatt #5, Filipiak #12, Professional Puzzle set #1. This one is very easy (BC #2). Any burr using 2x1024 is easier than most - adding 2x256 makes it somewhat trivial. "The Puzzle of Puzzles" - made in Japan; See plans for **Betelgeuse** at www.craftsmanspace.com; **The Double-Cross Puzzle**, issued by the **General Engineering & Design Co.** of Detroit, Michigan.
33. 1, 154, 256, 888 or 1007, 1024 x2 - Filipiak #22 (corrected, use 888 not 103 as listed), Filipiak #23 (use 1007)
34. 1, 154, 871, 1024 x3 - Wyatt #7, Filipiak #42

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35. 1, 188 x2, 256, 1024 x2 - Filipiak #24
36. 1, 188, 256 x2, 928, 1024 - Filipiak #15
37. 1, 188, 256 x2, 960/992 - Filipiak #16
38. 1, 188, 256 x2, 1024 x2 - Wyatt #4 (also #12), Filipiak #14, can be made with the Professor set
39. 1, 188, 256, 792 or 911, 1024 x2 - (solid) Kitajima #1 (use 911)
40. 1, 188, 256, 824, 992, 1024 - Filipiak #27, Yamanaka Black set, can be made with the Professor set - 2 solns. - mirror of Hoffmann below
41. 1, 188, 256, 824, 1024 x2 - Filipiak #25; compare to Wyatt #14; can be made with the Professor set (1 unnecessary hole)
42. 1, 188, 256, 888 or 1007, 928, 1024 - 1 soln.
43. 1, 188, 256, 888 or 1007, 960/992 - 1 soln.
44. 1, 188, 256, 960, 975, 1024 - Filipiak #26; Described in Hoffmann's 1893 *Puzzles Old and New* Chapter III as No. XXXVI "The Nut (or Six-piece) Puzzle"; also sold as the "Burr Puzzle" by Toys From Times Past.
45. 1, 188, 256, 975, 1024 x2 - Wyatt #14, can be made with the Professor set
46. 1, 188, 512, 576, 976, 1024 - "Dreveny Kriz II"
47. 1, 188, 512, 832, 975, 1024 - Devil's Knot, G4, Tommerknude, "Chinese Puzzle B"
48. 1, 188, 768, 824, 976, 1024 - HABA Teufelsknoten; Puzzlemaster.ca Enigma; also known as "Notched Sticks." The pieces are kind of the "mirror image" of the Devil's Knot above - pic either the left or right of each of the three twins: 512/768, 832/976, and 975/824. I have seen this called "The Cross of Marseille." Also see plans for **Cassiopeia** at www.craftsmanspace.com.

49.	1, 188, 792, 888, 1024 x2	- (solid) 1 soln.
50.	1, 188, 824, 888 or 1007, 992, 1024	- (solid) 1 soln.
51.	1, 188, 824/975, 1024 x2	- The Yamato Block Puzzle, Filipiak #44, Professional Puzzle set #2. Easy. Also appeared as the "Locked Cross" from New Zealand. Also see U.S. Patent 1350039 - Senyk 1920.
52.	1, 188, 871, 928, 1024 x2	- Filipiak #43, Yamanaka Orange set
53.	1, 188, 871, 960/992, 1024	- Filipiak #46 - 3 solutions
54.	1, 188, 888 or 1007, 960, 975, 1024	- (solid) 1 soln.
55.	1, 188, 911, 1007, 1024 x2	- (solid) 1 soln.
56.	1, 208, 256, 670, 1024 x2	- Tang Yunzhou. Zhongwai xifa tu shuo: e huan huibian (Chinese and Western magic with diagrams: compilation of magic) - Shanghai, 1889
57.	1, 256 x3, 928 x2	- The Diabolical Structure - possibly the easiest (BC #1). Filipiak #13
58.	1, 256 x2, 792 or 911, 928, 1024	- Filipiak #17 (use 911) and Filipiak #18 (use 792)
59.	1, 256 x2, 792 or 911, 960/992	- Filipiak #20 (use 911) and Filipiak #21 (use 792) - compare to Filipiak #17/18 and note how the 928+1024 pair replaces the 960/992 pair.
60.	1, 256, 792 x2 or 911 x2, 1024 x2	- Filipiak #30 (use 792) and Filipiak #31 (use 911) - 1 soln.
61.	1, 256, 792 or 911, 824, 992, 1024	- **B13S.6 (use 911)** - 1 soln.
62.	[[1, 256, 792 or 911, 975, 992, 1024]]	- Filipiak #32 (911) and Filipiak #33 (792) - BOTH no soln. - compare w/ B13S.6 & 7
63.	1, 256, 792, 928, 1007, 1024	- vintage small brown wooden burr I got from England; see plans for **Andromeda** at www.craftsmanspace.com, where you can find several puzzle plans for woodworkers.
64.	1, 256, 792 or 911, 960, 975, 1024	- **B13S.7 (use 911)** - the "mirror image" of B13S.6
65.	1, 256, 792, 960/992, 1007	- 1 soln.
66.	1, 256, 820, 928, 1007, 1024	- Interlocking keychain puzzle burr from France. 1 soln.
67.	1, 256, 824 x2, 992 x2	- 1 soln.
68.	1, 256, 824/975, 928, 1024	- Ivory Chinese Cross; Wyatt #1, Filipiak #29; "Chinese Puzzle G"; Bell's Maltese Cross keychain; Russian "Admiral Makarov's Puzzle"; Misfit - advertising Phenyo-Caffein; "The Chinese Cross" in The Boy's Own Toymaker by Landells 1859, and in the 1857 *Magician's Own Book*; see U.S. Patent 1388710 - Hime 1921, for these on a string.
69.	1, 256, 824, 928, 992, 1007	- mirror of "Chinese Star"
70.	1, 256, 824/975, 960/992	- Filipiak #41 - 2 solutions; **B13S.5**
71.	1, 256, 888, 911, 928, 1024	- 1 soln.
72.	1, 256, 888, 911, 960/992	- **B13S.8**
73.	1, 256, 888, 928, 960, 975	- Saw this as the "Chinese Star."
74.	1, 256, 888/1007, 928, 1024	- Triple Cross
75.	[[1, 256, 928, 960, 975, 1007]]	- Filipiak #38; no soln for this set, but compare to the "Chinese Star"
76.	1, 256, 960 x2, 975 x2	- 1 soln.
77.	1, 359, 824, 928, 1024 x2	- 1 soln.
78.	1, 359, 824, 960/992, 1024	- 2 solns.
79.	1, 359, 888, 928, 960, 1024	- A tricky solid burr I like
80.	1, 359, 888, 960 x2, 992	- 1 soln.
81.	1, 464, 768, 800, 832, 1024	- Brown's Burr - See U.S. Patent 1225760 - Brown 1917.
82.	1, 615, 928, 975, 1024 x2	- 1 soln.
83.	1, 615, 928, 992, 1007, 1024	- mirror of the tricky solid burr I like
84.	1, 615, 960/992, 975, 1024	- 2 solns.
85.	1, 615, 960, 992 x2, 1007	- 1 soln.
86.	1, 792 x2, 1007, 1024 x2	- 1 soln.
87.	1, 792 or 911, 824/975, 1024 x2	- "Chinese Puzzle F" (use 792), Wyatt #2 (use 911), Filipiak #49, if his #10 = 911, Filipiak #50 (use 792)
88.	1, 792, 824, 992, 1007, 1024	- mirror of B13S.11 - 2 solns.
89.	1, 792, 856, 960, 1007, 1024	- 1 soln.
90.	1, 792, 888, 960, 975, 1024	- 1 soln.
91.	1, 824 x2, 975, 992, 1024	- 2 solns.
92.	1, 824, 856, 871, 1024 x2	- 1 soln.
93.	1, 824, 856, 960/992, 1007	- 1 soln.
94.	1, 824, 871, 888, 992, 1024	- 2 solns.
95.	1, 824/975, 888 or 1007, 928, 1024	- 1 soln.
96.	1, 824/975, 888 or 1007, 960/992	- **B13S.9** (use 888)
97.	1, 824, 911, 992, 1007, 1024	- **B13S.10**
98.	1, 824, 960, 975 x2, 1024	- 2 solns.
99.	1, 856, 871, 888, 960, 1024	- 1 soln.
100.	1, 871, 888 x2 or 1007 x2, 928, 1024	- 1 soln.
101.	1, 871, 888 x2 or 1007 x2, 960/992	- 1 soln.
102.	1, 871, 943, 975, 1024 x2	- 1 soln.
103.	1, 871, 943, 992, 1007, 1024	- 1 soln.
104.	1, 871, 960, 975, 1007, 1024	- 2 solns.
105.	1, 888, 911 x2, 1024 x2	- 1 soln.
106.	1, 888, 911, 943, 992, 1024	- 1 soln.
107.	1, 888, 911, 960, 975, 1024	- **B13S.11**
108.	1, 888, 943, 960/992, 975	- 1 soln.
109.	18 x2, 256 x2, 1024 x2	- The 3rd easiest burr (BC #3).
110.	18 x2, 256, 888 or 1007, 1024 x2	- compare to BC#3 - substitute either 888 or 1007 for one 256
111.	18 x2, 512/768, 1015, 1024	- Filipiak #63 - 1 solution
112.	18 x2, 871, 1024 x3	- contrast with 18,35 below - this shows how 871 can be placed with its crossbar outboard (w/ 18) or inboard (w/ 35)
113.	18 x2, 888/1007, 1024 x2	- nice symmetry
114.	18, **35**, 871, 1024 x3	- one of only 3 uses of piece #35 among the 314 solid burrs.
115.	18, 52, 103, 1024 x3	- easy
116.	18, 52, 188, 888 or 1007, 1024 x2	- use 888 or 1007
117.	18, 52, 256 x2, 928, 1024	- 4 apparent assemblies but only 1 solution. Not too tough.
118.	18, 52, 256, 792 or 911, 1024 x2	- Wyatt #10 (911), Filipiak #66, if his #10 = 911
119.	18, 52, 256, 824, 992, 1024	- Professional Puzzle set #4

120. 18, 52, 256, 888 or 1007, 928, 1024	- use 888 or 1007
121. 18, 52, 256, 888 or 1007, 960/992	- use 888 or 1007
122. 18, 52, 256, 960, 975, 1024	- mirror of Professional Puzzle set #4
123. 18, 52, 792, 1007, 1024 x2	- 3 solns. 18+1024, 18+1007 (2 ways)
124. 18, 52, 824/975, 1024 x2	- 18+1024 key, 2 solns.
125. 18, 52, 824, 992, 1007, 1024	- 4 solns.
126. 18, 52, 856, 960, 1007, 1024	- one of the more interesting solid assemblies featuring an 18+1024 "key" - 1 soln.
127. 18, 52, 871, 928, 1024 x2	- Yamanaka Green set
128. 18, 52, 871, 960/992, 1024	- 3 solns. - all use 18+871 key - compare w/ 18,86 below
129. 18, 52, 888, 911, 1024 x2	- 3 solns. 18+1024, 18+888 (2 ways)
130. 18, 52, 888, 943, 992, 1024	- mirror image of "interesting" one above - 1 soln.
131. 18, 52, 888, 960, 975, 1024	- 4 solns.
132. 18, **86**, 871, 960/992, 1024	- one of only two uses of piece #86 without the key #1 among the 314 solid burrs.
133. 18, 103, 120, 960/992, 1024	- 1 soln.
134. 18, 103, 824/975, 1024 x2	- 2 solns.
135. 18, 103, 824, 992, 1007, 1024	- 1 soln.
136. 18, 103, 871, 960/992, 1024	- compare w/ 18,86 above
137. 18, 103, 888, 960, 975, 1024	- 1 soln.
138. 18, 120, 188 x2, 1024 x2	- 1 soln.
139. 18, 120, 188, 824, 992, 1024	- 1 soln.
140. 18, 120, 188, 960, 975, 1024	- 1 soln.
141. 18, 188, 824/975, 888 or 1007, 1024	- 1 soln.
142. 18, 256, 792 or 911, 824/975, 1024	- 2 solns.
143. 18, 359, 824, 871, 1024 x2	- 1 soln.
144. 18, 359, 824, 911, 1024 x2	- 1 soln.
145. 18, 359, 824, 943, 992, 1024	- 1 soln.
146. 18, 615, 792, 975, 1024 x2	- 1 soln.
147. 18, 615, 856, 960, 975, 1024	- 1 soln.
148. 18, 615, 871, 975, 1024 x2	- 1 soln.
149. 18, 792, 824/975, 1007, 1024	- 2 solns.
150. 18, 824 x2, 975, 992, 1007	- 1 soln.
151. 18, 824, 871 x2, 992, 1024	- 1 soln.
152. 18, 824/975, 888, 911, 1024	- 2 solns.
153. 18, 824, 888, 960, 975 x2	- 1 soln.
154. 18, 871 x2, 960, 975, 1024	- two 871s! - 1 soln.
155. 20, 52, 824, 911, 1024 x2	- Filipiak #67 - his only use of his piece #34 / my #20.
156. 35, 52, 871, 928, 1024 x2	- the second of only 3 uses of piece #35 among the 314 solid burrs.
157. 35, 52, 871, 960/992, 1024	- the third of only 3 uses of piece #35 among the 314 solid burrs, this set goes together 3 ways.
158. 35, 359, 960/992, 975, 1024	- EFNOQY discussed by Bruno Curfs
159. 35, 975, 992 x2, 1024 x2	- EOOQYY - ***Simple Lock***
160. [[52 x2, 103, 871, 1024 x2]]	- Wyatt #9, Filipiak #64 - *NOTE - this set doesn't work* - it has too many interior cubes. Why did they both include it?
161. 52 x2, 103, 928, 1024 x2	- (solid) Burr at George Hart's house - contrast with Wyatt #9 above - this works.
162. 52 x2, 103, 960/992, 1024	- (solid) 3 solns.
163. 52 x2, 188, 888 or 1007, 928, 1024	- (solid) 1 soln.
164. 52 x2, 256 x2, 928 x2	- Another very easy burr - BC #4
165. 52 x2, 256, 792 or 911, 928, 1024	- Yamanaka Yellow set (911)
166. 52 x2, 256, 792 or 911, 960/992	- 1 soln.
167. 52 x2, 256, 824, 928, 992	- 1 soln.
168. 52 x2, 256, 928, 960, 975	- 1 soln.
169. 52 x2, 792/911, 1024 x2	- 3 solns.
170. 52 x2, 792, 928, 1007, 1024	- 1 soln.
171. 52 x2, 792, 960, 975, 1024	- 3 solns.
172. 52 x2, 792, 960/992, 1007	- 1 soln.
173. 52 x2, 824, 911, 992, 1024	- 3 solns.
174. 52 x2, 824/975, 928, 1024	- 2 solns.
175. 52 x2, 824, 928, 992, 1007	- 1 soln.
176. 52 x2, 824/975, 960/992	- symmetric halves, no holes - contrast with B13S.12, which I think is harder
177. 52 x2, 824, 928, 992, 1007	- 1 soln.
178. 52 x2, 856, 928, 960, 1007	- 1 soln.
179. 52 x2, 888, 911, 928, 1024	- 1 soln.
180. 52 x2, 888, 911, 960/992	- 1 soln.
181. 52 x2, 888, 928, 943, 992	- 1 soln.
182. 52 x2, 888, 928, 960, 975	- 1 soln.
183. 52, 56, 792, 975, 928, 1024	- "Chinese Puzzle C" (3 solns.)
184. 52, **86**, 871, 928, 960/992	- the 2nd of only two uses of piece #86 without the key #1 among the 314 solid burrs.
185. 52, 88, 768, 888, 992, 1024	- Bill Cutler's BB31-10-40 - the least un-notchable 1-hole level 3
186. 52, 103, 120, 928, 960/992	- Kitajima #2 (no holes)
187. 52, 103, 824/975, 928, 1024	- 2 solns.
188. 52, 103, 824, 928, 992, 1007	- 1 soln.
189. 52, 103, 824/975, 960/992	- **B13S.12** (no holes)
190. 52, 103, 871, 928, 960/992	- LNOPST - 3 assemblies, 1 solution; Bruno Curfs rates this 5th hardest among the solid notchables. Not too hard once you recognize it has (a) the L&P (52,928) "key," (b) typical symmetric arrangement of N&O (960/992), and (c) T 871 used in its "inside out" mode.
191. 52, 103, 888, 928, 960, 975	- 1 soln.

192. 52, 120, 188 x2, 928, 1024 - 1 soln.
193. 52, 120, 188, 824, 928, 992 - 1 soln.
194. 52, 120, 188, 928, 960, 975 - 1 soln. (mirror of above)
195. [[52, 154, 256 x2, 911, 1024]] - Filipiak #65, Wyatt #15(a) - no solution even if Filipiak's #10 is 463
196. 52, 188, 824/975, 888 or 1007, 928 - 1 soln.
197. 52, 256 x2, 911, 1024 x2 - Wyatt #15(b) - 7 solutions
198. 52, 256, 792 or 911, 824/975, 928 - 2 solns.
199. 52, 256, 888/1007, 1024 x2 - Jurg von Kanel's Burr in a Cube - assemble this inside a cubic cage.
200. 52, 359, 824, {871 or 911}, 928, 1024 - 1 soln.
201. 52, 359, 824, {871 or 911}, 960/992 - 1 soln.
202. 52, 359, 824, 928, 943, 992 - 1 soln.
203. 52, 615, 792, 871, 960/992, 975 - Gemani's Double Bill (combines Cutler's 305 and 306)
204. 52, 615, 792, 928, 975, 1024 - 1 soln.
205. 52, 615, 792, 960/992, 975 - Bill Cutler's No. 305. A nice 3x3 slide. gamesandpuzzles.co.uk has it.
206. 52, 615, 856, 928, 960, 975 - 52+928 (DV or PL) makes a 2-piece key
207. 52, 615, 871, 928, 975, 1024 - 1 soln.
208. 52, 615, 871, 960/992, 975 - Bill Cutler's No. 306. - Cutler, Coffin, and Curfs say this may be the **most difficult *notchable solid* burr**.
209. 52, 792/911, 824/975, 1024 - The 6-way (Rainbow). 8 apparent assemblies, 6 solutions. An old one sold as "The Zoozzler." Also the vintage "Mikado." **B13S.13**
210. 52, 792, 824, 960, 975 x2 - 2 solns.
211. 52, 824 x2, 911, 975, 992 - 2 solns.
212. 52, 824, 871 x2, 928, 992 - 1 soln.
213. 52, 871 x2, 928, 960, 975 - 1 soln.

214. 55, 508, $\boxed{768}$, 812, 960, 1023 - Derwin Brown's Unique Level 6
215. 56, 94, 156, 704, 1008, 1024 - Stewart Coffin's Triple Slide
216. 56, 276, 792, 832, 975, 1024 - "Chinese Puzzle D" (1 soln.)
217. 63, 480, $\boxed{512}$, 766, 896, 1012 - Curfs BC UL7000
218. 72, 112, 448, 511, 990, 1024 - Stewart Coffin's No. 40 Interrupted Slide (1979) - one of the "Fearsome Four"
219. 86, 160, 224, 992, 957, 1016 - JVK #25.2 derivation
220. 86, 256, 911, 992, 928, 1024 - JVK #25.2 - a level 3 design which uses piece #86.
221. 88, 160, $\boxed{512/768}$, 992, 1008 - Edward Hordern's modification to Peter Marineau's Piston Burr - 13 solutions, one at level 10
222. 88, $\boxed{512}$, 704, 960/992, 1008 - Bruce Love's Dozen. **The only burr at the highest level, 12.** There are 89 ways to put it together, but most of them don't achieve level 12.
223. 88, $\boxed{512/768}$, 922, 1008 x2 - Peter Marineau's Piston Burr - **The highest level, 9, with a unique solution.**

224. 103, 160, 224, 824, 928, 1024 - Ishino's Millable 5.4
225. 103, 188, 256, 928, 975, 1024 - Jurg von Kanel's jvk25.1 - Note: the notch in piece #256 (X) in my copy of the Wayne Daniel burr set is too short and prevents piece #975 (Q) from being removed, so this one cannot be constructed using the set.
226. 103, 256 x2, 824, 928, 960 - LNRSXX - unique level-5 solution, discussed by Bruno Curfs
227. 103, 256 x2, 928 x2, 960 - LLNSXX - unique level-5 solution, discussed by Bruno Curfs
228. 103, 256, 412, 824, 928, 1024 - Jurg von Kanel's favorite notchable burr
229. 103, 256, 911, 960, 1007, 1024 - **B13H.1**
230. 103, 508 x2, 824, 928, 1024 - David Winkler's favorite level 5.4 Millable burr
231. 103, 760, 960/992, 996, 1024 - Bill's Baffling Burr; Gemani's Deadlock - 5 moves to release the 1st piece. One of the "Fearsome Four."

232. 109, 188, 736, 928, 1008, 1024 - Bruno Curfs' BC L6000 - nice, 6 moves to free the 1st piece
233. 120, 154 x2, 256, 1024 x2 - Ishino's Notchable 5-Moves 2-Hole - (a set of 42 does not have 2x 154) Note: again, the problem with #256 in the Wayne Daniel set prevents this construction.
234. 120, 154, 188, 928, 1024 x2 - KLMUYY can be made with the set of 42
235. 120, 154, 256 x2, 960/992 - KNOUXX - only multiple level-5 solutions
236. 120, 160, 256, $\boxed{512}$, 880, 960 - Philippe Dubois/Gaby Games - 6 moves to release the 1st piece. One of the "Fearsome Four." Also Arjeu CT757.
237. 120, 188, 670, 928, 992, 1024 - David Winkler's favorite 5.4
238. 120, 188, 792/911, 975, 1024 - Ishino's Notchable 2-Moves 1-Hole #3
239. 120, 188, 871, 928 x2, 1024 - ***Tumult*** - try to find the level 7 solution.
240. 120, 792/911, 824/975, 992 - Bill Cutler's Notchable 1-Hole Level 2 - uses only notchable pieces and has only one void - 4 solutions, one at level 2.

241. 126, 615, 820, 856, 928, 1024 - Stewart Coffin's No. 36 Improved Burr (1979) - One of the "Fearsome Four."
242. 144, 495, 702, 975, 990, 1024 - Abad's Level 5.7 Improved Burr
243. 154, 256 x4, 1024 - U.S. Patent 1542148 - Kramariuk 1925.
244. 158, $\boxed{768}$, 824, 863, 992, 1012 - Curfs BC UL5000
245. 160, 188, 412, 751, 960, 1024 - Ishino's Millable Unique 5.4.2-Moves 4-Hole
246. 160, 499, $\boxed{512/768}$, 926, 1015 - Bill Cutler's Computer's Choice 5-Hole
247. 160, 508, 736, 742, $\boxed{768}$, 1015 - Abad's Level 9 Burr
248. 188, 256, 615, 975, 928, 1024 - GLMQXY - this one works like JVK 25.1
249. 188, 256, $\boxed{768}$, 824/975, 1024 - Old black Treen Burr seen on antiques site - level 3, 2 solns. (assuming it uses pc #256 rather than 1)
250. 188, 704, $\boxed{768 x2}$, 928, 1007 - Ishino's Notchable Unique Impossible Length 10 - 1 solution at length 8, none at length 10
251. 192, 736, $\boxed{768}$, 976, 1007, 1008 - Peter Roesler's #G

252. 256 x5, 992 - David Winkler's Level 3 - use either of the Fingers 960/992, or 928.
253. 256, 551, 960/992, 992, 928 - Bill Cutler's L5 Notchable - one of 139 designs using only notchable length-6 pieces and having a unique solution
254. 256, 792/911, 943, 960, 1024 - Curfs mentions CDINXY and rates this the third hardest (UL4 #3) of the five level-4 puzzles with unique solutions among the holey burrs constructible using the notchable pieces.
255. 256, 824, 911, 928, 943, 1024 - Curfs mentions CINRXY and rates this the second hardest (UL4 #2) of the five level-4 puzzles with unique solutions among the holey burrs constructible using the notchable pieces. This one works with the Wayne Daniel set and has nice dead-ends.
256. 256, 824, 911, 943, 960, 1024 - Curfs mentions CILRXY and rates this the fourth hardest (UL4 #4) of the five level-4 puzzles with unique solutions among the holey burrs constructible using the notchable pieces.
257. 256, 911, 943, 960, 960/992 - Curfs mentions CINNOX - this gets his "beauty prize" and rates fifth hardest (UL4 #5) of the five level-4 puzzles with unique solutions among the holey burrs constructible using the notchable pieces. Works with the Wayne Daniel set.

258. 311, $\boxed{768}$, 869, 924, 1015, 1024 - Bill Cutler's Computer's Choice 3-Hole (Level 7 unique soln) - of 2.5 billion 3-hole assemblies, 198 have level-7 solutions and of those 157 have unique solutions
259. 359/615, 928, 960, 990, 1024 - Abad's Level 4 Ambiguous Burr (maybe try using 992 instead of 990?)
260. 359/615, 943, 960/992, 1024 - Bruno Curfs' FGINOY - you can sub. 856 (J) for 943 (I) - 156 apparent, 4 level 2.2 solns

261.	359, 871, 943, 928, 1007, 1024	- Bruno Curfs' Monster FILTVY - unique level 3 soln, 36 apparent - may be the **most difficult *notchable holey* burr**
262.	412, 512, 480/704, 704, 960	- David Winkler's complex 5.4 - 1 solution but 143 apparent assemblies, the most for length-6 notchable. (All of these pieces are actually notchable.)
263.	412/670, 687, 1007, 1024x2	- XSOHO Burr - use length-8 pieces for a single level 4.6 solution
264.	416/672, 448, 848, 983,1024	- Level 5.3 "Big Burr"
265.	416, 512, 856, 960, 1013, 1015	- Peter Roesler's #C
266.	448/736, 512, 743, 880, 1015	- Curfs BC UL6000
267.	463, 564, 760, 909, 927, 1016	- Tenyo Brother; also Filipiak #72, if his #10 = 463
268.	480, 511, 512, 989, 1015, 1023	- Peter Roesler's #D
269.	509, 511, 792 x2, 788, 1023	- Filipiak #73 MODIFIED by me
270.	512, 476, 757, 956, 1021, 1024	- Bill Cutler's Programmer's Nightmare - requires a rotational move! (Use length-8 pieces.)
271.	512, 734, 871, 928x2, 1007	- Lee Krasnow's Burr - 1 soln. @ 4.6
272.	624, 702, 768, 883, 1015, 1024	- Bill Cutler's Computer's Choice Unique 10 (CCU10). Use length-8 pieces. **Maybe the hardest burr overall?**
273.	702, 768, 869, 944, 1015, 1024	- Brian Young's Mega Six - a derivative of Cutler's CCU10
274.	737, 871, 928, 956, 1000, 1024	- Bill Cutler's Computer's Choice 4-Hole (Level 8 unique soln) - of 4.7 billion 4-hole assemblies, 15 are level-8 and of those 13 have unique solutions
275.	792/911, 824/975 x2	- Filipiak #71 - 3 solutions.
276.	824, 911, 960/992, 1007, 1024	- **B13H.2**
277.	856, 871, 911, 960/992, 1024	- Bill Cutler's Bin Cross - presented by Toyo as length-8 pieces which must be assembled inside a slotted glass cage.
278.	871, 911, 943, 960, 1007, 1024	- Curfs mentions CINTVY and rates this the hardest (UL4 #1) of the five level-4 puzzles with unique solutions among the holey burrs constructible using the notchable pieces.

Sources

There are plenty of burr puzzles for sale out there - for example:

- Bill Cutler offers several.
- Mr. Puzzle Australia offers several.
- Cleverwood has carried some.
- Gemani Games carries some.
- Little Devil at PottyPuzzles
- Acesix by Michael Toulouzas
- Toys From Times Past

Theory

The recent history of discovery related to the burr puzzle seems to me like the history of world exploration - at first, the "known world" was small and encompassed some well-traveled areas, beyond which lay either the "edge of the world" (for those who thought they had seen all the burrs and only "a few" remained to be found), or a "terra incognita" that stretched off into the hazy distance.

Decades, perhaps even centuries, of exploration served to extend the frontiers of what was known, with some impressive voyages of exploration by intrepid souls using relatively primitive technology. But it was not until the computer age and Bill Cutler that a "satellite view" became available, delimiting the "globe" and showing its full extent - 35 billion assemblies.

Most of that area is "water" - assemblies that cannot be constructed. Roughly 17% is "land" - the 5.95 billion constructible burrs. The "Old World" of the solid burrs stretches across 119,979 assemblies, and features many well-known cities and well-traveled routes. Cutler's satellite view has identified several impressive peaks in the larger world beyond, and much ground remains unexplored.

Are the burr pioneers really "inventors?" Or, like the explorers of old, are they really more "discoverers?"

I don't claim to have "invented" any unique burr puzzles myself, but like others I have spent some time exploring the world that Cutler delimited.

In particular I have been interested in finding high-level (holey) burrs that can be made with the notchable set, at length 6. Bruno Curfs has utilized computer analysis performed by Keiichiro Ishino, and makes several output files available at his site. Bruno mentions and discusses several burrs already.

Here are a few holey burrs made with the notchable set, which I'd like to flag as of interest:

- The first is LLMTUY, which I like to call the "***Tumult***" burr. Its pieces have the numeric IDs: 120, 188, 871, 928 x2, 1024

  This burr does not have a unique solution, so it does not, based on what I've seen, get a lot of attention. It has six solutions, the highest at level 7, and does not have any level-1 solution. Of burrs made with the length-6 notchable set, there are only 15 assemblies that can achieve level-7, and Tumult is the one with the fewest assemblies.

  In all six of its solutions, three of the pieces retain the same orientation. The orientations of the other three pieces determine the different solutions and level.

  Tumult has an interesting sibling, LLMTVY, which substitutes the 1007 (V) piece for the 120 (U) piece. This puzzle actually messes up Jurg's applet, which reports a spurious level-9 solution.

- Another nice one is EOOQYY, which has a single level-3 solution but 26 assemblies. The mechanism reminds me of a simple lock - I really like it.

  35, 975, 992 x2, 1024 x2

- KLMUYY is similar to Ishino's Notchable 5-Moves 2-Hole, but it doesn't need two of piece 154, only one of which is supplied with the typical 42-piece set. It has one level 4.4 solution and one level 5.4 solution.

  120, 154, 188, 928, 1024 x2

- GLMQXY works like Jurg von Kanel's 25.1. It has two level-5 solutions, which differ by only the orientation of one piece.

  188, 256, 615, 975, 928, 1024

- KNOUXX has only multiple level-5 solutions.

  120, 154, 256 x2, 960/992

The core:

```
  +----+
 /  1 /|
+----+ |      +----+
|    | +----+-/  2 /|
|    |/ 4   5+----+ |
+    +       |    | +
| 3 /        |    | |
|  +----+----+    + |
+--|  6   7   8   | +
   |              |/
   +    +-|/-+----+
   |    | +  10
   |  9 |/
   +----+
```

Of the 314 solid puzzles that can be made with the 25 notachable pieces, there are 158 that use the key piece #1. If you start with 6 Y pieces and make one key piece, you use up 10 of the 20 "floating" interior cubies. The "core" shown here is then composed of the 10 interior cubies that remain to be distributed among the other 5 pieces.

Imagine that the key piece goes into the page resting on the plane formed by the core cubies labeled 4,5,6, and 7. The other 5 pieces would start as instances of the "minimal" piece #1024 (Y), and acquire some share of the 10 cubies of the core.

Note that no single piece can have all 10 - this would result in a second key piece, which some reflection should convince you doesn't work.

I have chosen an arbitray orientation for the other 5 pieces, which I'll call P1 through P5, resulting in the particular core shape shown. Other shapes are possible. Imagine P1 through P5, oriented around the core as follows.

- P1 is vertical on the left; the 2-cubie notch of P1 fits on 1 and 3, and its "arms" face right.
- P2 is vertical on the right; the 2-cubie notch of P2 fits on 2 and 8, and its "arms" face left.
- P5 is horizontal, into the page below the key piece, and fits on 9 and 10, with its arms facing up.
- P3 is horizontal across the page in front, with the notch upwards and the arms facing the rear.
- P4 is horizontal across the page in the rear, with its notch upwards and its arms facing the front.

The following chart shows how the floating pieces might be distributed, converting P1 through P5 into pieces other than Y. Note that cubies 1 and 3 must be allocated as a pair. (Why? Because if they are split up, it results in some pieces which are not notachable.) Likewise for the pairs 2 and 8, and 9 and 10.

	1 and 3	2 and 8	4	5	6	7	9 and 10
P1	●	x	●	x	●	x	●
P2	x	●	x	●	x	●	x
P3	x	●	x	x	●	●	x
P4	●	x	●	●	x	x	x
P5 (opp. key)	x	x	●	●	●	●	●

Now, consider the possibilities for building up P5...

P5 plus	(none)	5	7	(5,7)	(9,10)	(4,5,9,10) (6,7,9,10)	(4,5,6,7,9,10)
equals	Y	W	X	V	J	I	H

Note that, given the chosen orientation, P5 cannot include 4 or 6 without including 9 and 10 - they would be hanging off in space unsupported.

So, what's wrong with this analysis? It gives an incomplete list of possible pieces for P5! Missing are: **E, G, Q, U, P, and S**. Why? It is a consequence of my original arbitrary orientation of the Y pieces. P5 has access to two additional cubies on each end, provided two things happen:

- either P1 or P2 must be reversed so its notch is on the other side
- ***either P3 or P4 (but not both) must be piece M***

P5 plus	(none)	5	7	(5,7)	(9,10)	(4,5,9,10) (6,7,9,10)	(4,5,6,7,9,10)
equals	Y	W	X	V	J	I	H
plus 2 equals	Q or U	S	P	not possible	G	E	not possible

The two extras have to be taken on the same side the M piece will be placed - they cannot come one from each side since that results in internal corners again. This is only possible due to the symmetric nature of piece M, which allows its crossbar to be fitted inboard of where crossbars normally go. If you try this with my LiveCube pieces described above, some of the yellow "internal" cubies of the M piece will show on the outside due to the necessary rotation.

For puzzles using the key piece A, piece M can never appear more than once.

Here is a list of the 17 configurations employing one of E,G,Q,U,P, or S opposite A. All require an M.

1. AE-YM-YY
   (There is only one AE since E uses 6 of 10 available floating cubies, and M the other 4, demanding that all the rest be Y pieces.)
2. AG-VM-YY
3. AG-WM-YX
4. AG-XM-WY
5. AG-YM-WX
6. AQ-VM-QY
7. AQ-WM-QX
8. AQ-XM-OY
9. AQ-YM-OX
10. AU-VM-YU
11. AU-WM-YT
12. AU-XM-WU
13. AU-YM-WT
14. AP-WM-QY
15. AP-YM-OY
16. AS-XM-YU
17. AS-YM-YT

There are only 5 other configurations that use M - these do not require its rotation. All are very easy.

1. AH-YM-YY
2. AI-VM-YY

   These are three solutions for the same pieces:

3. AI-WM-YX
4. AI-XM-WY
5. AI-YM-WX

Let's look at how the remainder of the 158 configurations break out based on the choice for P5. One would assume, the more floating cubies used by P5, the fewer associated configurations.

The fewest should occur when P5 = H, using 6 of the 10. One might think the remaining 4 could be split as follows: 4/0/0/0, 3/1/0/0, 2/2/0/0, 2/1/1/0, 1/1/1/1. However, P5 as H has used 4,5,6,7,9, and 10, leaving the pairs 1/3 and 2/8 which cannot be split. This means only 4/0/0/0 and 2/2/0/0 are possible divisions. We've already seen AH-YM-YY; the M uses the remaining 4, requiring 3 Y pieces.

There are only 4 AH configurations, as follows.

1. AH-YM-YY (4/0/0/0) - both pairs part of same horizontal piece M
   (Note: making each pair part of a *different* horizontal piece P3=U and P4=U makes the burr impossible to construct!)
2. AH-YQ-JY (2/2/0/0) - one pair to a horizontal piece and one pair to a vertical piece
3. AH-YU-YJ (2/2/0/0) - mirror image of above
4. AH-YY-JJ (2/2/0/0) - both to vertical

The next smallest class should be the AI configurations. The I piece used 4 out of 10, leaving 6. 1/3 and 2/8 still must be assigned as pairs, but 4 and 5 can be independently allocated to different pieces. The possibilities: 6/0/0/0, 4/2/0/0, 4/1/1/0, 3/2/1/0, 2/2/2/0, 2/2/1/1.

There are 16 AI configurations as follows:

1. AI-QN-YY (4/2/0/0) both horizontals, 1/3 and 2/8 separated
2. AI-QO-XY (3/2/1/0)
3. AI-UR-YY mirror of QN
4. AI-UT-YW (3/2/1/0)
5. AI-VM-YY (4/2/0/0) both horizontals, 1/3 and 2/8 together in M
6. AI-VQ-JY (2/2/2/0)
7. AI-VU-YJ mirror of VQ
8. AI-WM-YX (4/1/1/0)
9. AI-WQ-JX (2/2/1/1)
10. AI-XM-WY (4/1/1/0) mirror of WM
11. AI-XU-WJ (2/2/1/1)
12. AI-YF-YY (6/0/0/0) an anomaly with inside cubies showing
13. AI-YM-WX (4/1/1/0) same pieces as WM-YX above
14. AI-YN-JY (4/2/0/0)
15. AI-YR-YJ (4/2/0/0) mirror of YN
16. AI-YV-JJ (2/2/2/0)

V uses only 2, leaving 8 - the pairs 1/3, 2/8, and 9/10, and 4 and 6.

The 16 AV configurations:

1. AV-QO-YT (3/3/2/0)
2. AV-UT-OY mirror of QO
3. AV-WK-QY (5/2/1/0)
4. AV-WP-GY (4/3/1/0)
5. AV-WT-QJ (3/2/2/1)
6. AV-XL-YU (5/2/1/0) - a little tricky
7. AV-XO-JU (3/2/2/1)
8. AV-XS-YG (4/3/1/0)
9. AV-XW-JG (4/2/1/1)
10. AV-YK-OY (5/3/0/0)
11. AV-YL-YT (5/3/0/0)
12. AV-YO-JT (3/3/2/0)
13. AV-YQ-DY (6/2/0/0)
14. AV-YT-OJ (3/3/2/0) - very common design (red, licorice stix, pendant)
15. AV-YU-YD (6/2/0/0)
16. AV-YY-JD (6/2/0/0)

Not yet shown: AJ (21), AW (24), AX (24), AY (36).

And that leaves the 156 configurations that *don't* use the key piece #1.

Traditional 18-piece Burrs

This section is about the **"Traditional" 18-piece Burr**.

This type of burr can be visualized as having a 6-piece burr shape at its core, but instead of 2x2x2 pieces crossing, it has 6x6x6. Each group of 6 pieces along an axis is arranged in a 2x3 block. The minimum length of a piece is 8 units - pieces are typically 2x2x8.

Willem van der Poel seems to have designed the first 18-piece 6x6x6 burr, in 1951-1953 - this type of burr is a much more recent development than the Traditional 6-piece Burr. In this case, "traditional" refers to the canonical 6x6x6 shape rather than hinting at any deep history. (Other shapes or arrangements of 18 pieces are possible.) Van der Poel's burr is known as the **Grandfather 6x6x6 18-piece burr**. The Grandfather burr is discussed on Pete Roesler's site, where you can read a brief history written by van der Poel. Willem made a copy by hand from Beech wood - that copy is now in Jerry Slocum's collection. Willem's design is level 3.2.4.1.1.2.

Ishino has a catalogue of length-8 **pieces** here. Ishino also has a selection of 18-piece burr designs, and a table of some designs, listed with piece codes. The burr diagrams used below are Ishino's.

As discussed in the section on Traditional 6-piece Burrs, Bill Cutler completely analyzed those. However, as of this writing in Feb. 2011, no-one has yet performed an analysis for the Traditional 18-piece Burr.

In van Delft and Botermans' *Creative Puzzles of the World*, van der Poel's puzzle is shown on page 71. In Slocum and Botermans' *Puzzles Old and New*, plans for an 18-piece burr are shown on page 71 - Ishino calls this one **Unnamed 18 Piece Burr #1**. Its pieces are length 10. (Maybe designed by Gillett as noted in this thread on the PuzzleWorld forums?)

Frans de Vreugd is a notable collector with an interest in high-level burrs - Frans has published nice articles on the topic in CFF #80 (Nov. 2009) *Recent 18-Piece Burrs*, and CFF #82 (July 2010) *More 18-Piece Burrs*, as well as an article in the book **A Lifetime of Puzzles: A Collection of Puzzles in Honor of Martin Gardner's 90th Birthday** - *Extreme Puzzles* on p.195.

At the higher levels, even disassembly is a challenge. Re-assembly without instructions becomes almost impossible.

Guillaume Largounez posted an interesting account of his attempts to construct and solve the most difficult 18 piece burrs, at the PuzzleWorld Forums. His conclusions are in this post.

Some quotes from Guillaume:

- "Most of these puzzles propose a disassembling challenge only. The puzzle is given assembled, and the goal is to find the way to take the pieces apart. In all these puzzles, the sequence of moves is not trivial. This is not 'one move allows the next one, that allows the next one etc.' There are choices to be made. A random exploration of possibilities may be enough to find the solution of the disassembling challenge, but not always."
- "I think that in order to maximize enjoyment, and [offer] an assembling challenge in addition to the disassembling one, 18-pieces burrs designs should have only one possible solution, but also one possible assembly and no more."
- "Among [the commercially available puzzles], Condor's Peeper ... gives the real enjoyable feeling of high level 18-pieces burrs. It is something similar both to labyrinths, and chess game. Like in labyrinths, you explore paths, with crossings, where you have to choose between two or more ways to go on, without knowing which is the right one. Some ways seem to bring you closer to the exit, but things are not always what they seem. You find many dead ends, and must go back in order to try another ways. Sometimes, after a long way, you realize that you are back in the position that you already were before. And sometimes, when you lost, this is like a chess game."

Goetz Schwandtner is another collector with an interest in high-level burrs - you can see his collection online at his website Extremely Puzzling. Goetz says, "Level 138 and above puzzles are very difficult even with a BurrTools solution at hand. These high-level puzzles have so many internal voids and intermediate states that tend to make moves by themselves that you can easily get lost in the solution."

Rob Chiniquy has designed a level 17 18-piece burr - you can read about it at his blog, "oddly, hippo."

In the quest for higher levels, in order to exclude lower-level configurations of a given set of pieces that have more than one solution, the pieces can be colored or marked in some other way to indicate a preferred/required solution configuration. This can also help make reassembly tractable. It should be acknowledged that some folks don't enjoy higher-level puzzles, since solving starts to seem like too much work. Also, some folks believe it is inelegant to resort to coloring or marking pieces to exclude low-level solution assemblies.

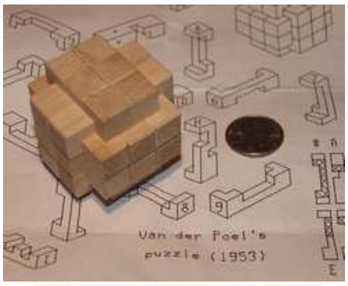
The simplest piece is arguably x00FFFF . The earliest designs (e.g. Grandfather, Lovely) are composed of a core 6-piece burr, surrounded by a "cage" of relatively simple pieces, usually x00FFFF.

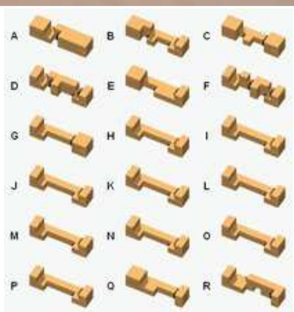
According to Ishino, in 2003 Paul Blake designed a level 4.4.3.4.2.5.3.4.2.2.1.2.1.2 using 18 of x00FFFF, called **Simply Complex**. I entered the traditional 18-piece burr shape into BurrTools, along with 18 copies of the x00FFFF piece - the run finished very quickly in only 1.4 minutes. My run gave 1960 assemblies, of which 1372 are solutions. The highest level found was 4.3.1.4.2.2.2.2 with 29 moves; the highest number of moves is 32 for a level 1.3.1.3.3.4.3.3.3 solution. My 1960/1372 statistics agree with Ishino's, but my run did not find the purported level 4.4 (39 move) solution, so there seems to be some error somewhere - or we are counting moves differently when several pieces move together, or when pieces move further than one unit in a given direction.

Designers have sought to create higher-level puzzles:

Year	Designer	Level	Name	Source
1980s	Bruce Love (by hand)	**18**.2.5.4.2.1.2	**Lovely Burr**	Bill Cutler's website
1999	Brian Young (by hand)	**19**.4.1.1.7	**Coming of Age Mark II**	Mr. Puzzle
2002	Goh Pit Khiam	**33**.7.2.1.2.3.3.1.3.1.2	**Burrloon**	
2003	Jack Krijnen	**43**.2.2.2.3.1.2	**Tipperary**	
2005	Goh Pit Khiam and Jack Krijnen	**50**.2.1.1.1.1.1.2.3	**Burrserk**	
2008	Alfons Eyckmans	**59**.2.6.1.2.3.2.2.2.1.1.1.1.1.1.2	**Condor**	
2008	Krijnen	**62**.4.21.1.2.2.1.1.1.2.2.2.1.1.1.2	**Condor's Peeper**	Mr. Puzzle
2008	Jan Naert	**65**.1.2.1.1.4.3.2.2.2.2.1.1.2.2.2	**The Monster**	
2009	Eyckmans	**113**.14.7.4.9.14.3	**Phoenix Cabracan**	
2010	Krijnen	**138**.7.5.1.1.2.1.1.2.2.2.1.1.1.1.2	**Burrly Sane for Woodworkers**	
2010	Krijnen	**148**.3.4.3.10.13.3	**Burrly Sane for Professionals**	
2010	Eyckmans	**150**.6.3.10.3.1.1.1.2.4.2.1.2	**Tiros**	
2010	Krijnen	**152**.7.9.5.11.14.4.1.1.1.1.2	**Burrly Sane for Extreme Puzzlers**	

It seems like Jack Krijnen and Alfons Eyckmans are in a duel to devise the highest-level 18-piece burr! Level 152 is the highest at the time of this writing, March 2011. The higher-level puzzles following Phoenix Cabracan are based off of it. Guillaume says, "Among the highest level burrs, Tiros (level 150), and Burrly Sane for Extreme Puzzlers (level 152) ... are very similar. The 87 first moves are exactly identical (they are both variants of the Phoenix Cabracan)."





I acquired an instance of Willem van der Poel's **The Grandfather of 6x6x6**, made by Pelikan, in an auction from Stewart Coffin's collection. Willem's exchange puzzle at IPP24. Includes a sheet with the 50-year history of the puzzle and instructions.
See it at Ishino's site.

I also have a rough handmade copy but I don't know who made it. This copy has one piece that differs from van der Poel's design - instead of piece "G" there is another "H."

According to Willem, the Arjeu CT52 was an unauthorized copy of his design. The Dalloz Urdin is the same.

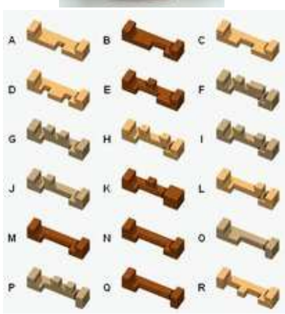
You can see solutions at Les Casse-Tete de Chantal.

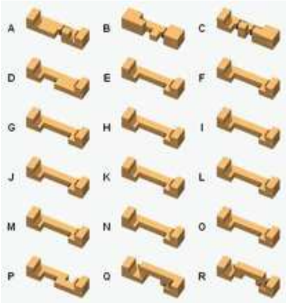
Coming of Age Mk.II - Mr. Puzzle Australia
An 18-piece 6x6x6 burr designed by Brian Young, without the use of a computer. There are multiple solutions - the highest level is 19. It was analysed using BurrTools by Andreas Roever and he found a level 14.10.3.2.5.11.10. That makes 65 moves for complete disassembly.
Here is a YouTube video of Brian assembling this burr.
Here is a YouTube video of a level 19.5.1.1.7.1.1.1.2 assembly. Here is another YouTube video, of a level 16.3.1.1.3.4.1.1.2 assembly.

Brian gives the following statistics based on Andreas' analysis:

- Highest first level is 19. There are 2 such solutions, very similar. Both take 46 moves to disassemble.
- Other high level solutions exist at level 16, level 14.10, ...
- Brian prefers 2 solutions with level 14.10.3.2.5.11.10, taking 65 moves to disassemble - more than required for Burrloon, which requires 64 moves at level 33.8...
- Analysis took 1214463 seconds = 14.06 days
- 880338023 assemblies found, 7621 solutions

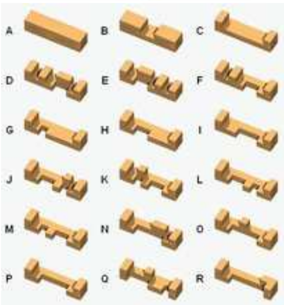


Condor's Peeper

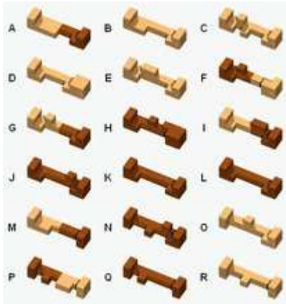


A design by Bruce Love called the **Lovely Burr**.
Level 18.
Only 1 solution.
Made by Jerry McFarland, from Walnut and Mahogany.
You might find one at [Bill Cutler's website].
Brian Pletcher [blogged about this puzzle].

designed by Jack Krijnen
made by and purchased from Mr. Puzzle Australia
Level 62
Only 1 solution, respecting the color scheme.

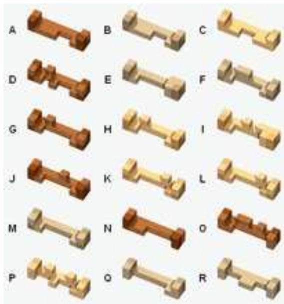


The **Dragon Burr** - a burr having 18 unique pieces. From **Creative Crafthouse**. Rated as one of their most difficult puzzles.
Level 1.1.3.2.2
This was originally designed by [Maurice Vigouroux] in 2003 and called simply "[The 18 Piece]."

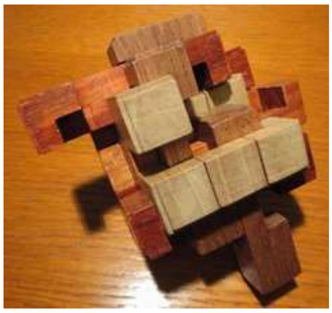


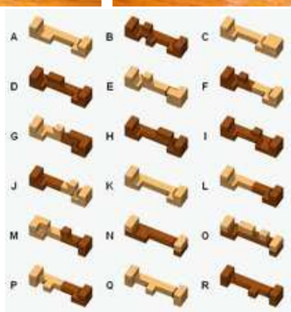
Tiros, shown here, is an 18-piece burr designed and made by **Alfons Eyckmans**. I obtained this in a trade with French puzzler **Guillaume Largounez**.
Tiros requires **150 moves** to get the first piece out!
Guillaume suggests, "If you want to turn mad someone who owns a copy of the Tiros burr, disassemble it until pieces J and K are out, swap them, and rebuild the whole puzzle without the piece G (it can't fit if J and K are swapped). If the way Burrtools gets pieces J and K out is the shortest, solving the puzzle back to its assembled configuration should take 331 moves."

[18 piece burr #3] - Not known who designed this
Level 1.2.1.2.1.1.1.1.2
Available from **Creative Crafthouse**
[Here is a YouTube video of Dave showing three 18 piece burrs offered by Creative Crafthouse].

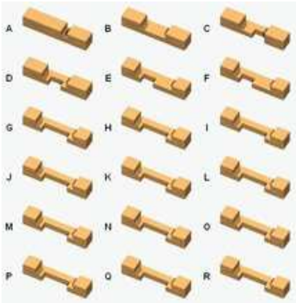


Burrly Sane for Woodworkers - designed and made by Jack Krijnen
Level **138**.7.5.1.1.2.1.1.2.2.2.1.1.1.1.2
Thanks, Jack!

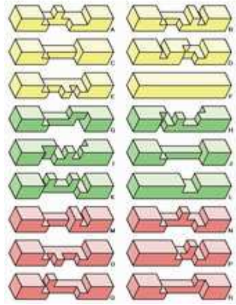




Burrly Sane for Extreme Puzzlers - designed and made by Jack Krijnen
The record holder for highest level traditional 18-piece burr, at 152.7.9.5.11.14.4.1.1.1.1.2.

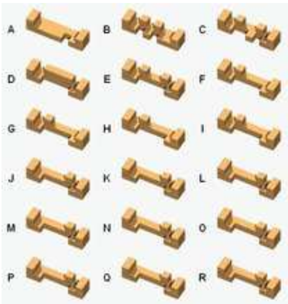


In Slocum and Botermans' *Puzzles Old and New*, plans for an 18-piece burr are shown on page 71 - Ishino calls this one **Unnamed 18 Piece Burr #1**. Its pieces are length 10. (Maybe designed by Gillett as noted in this thread on the PuzzleWorld forums?) **Creative Crafthouse** sells this one as their 18 Pc. Burr #2.

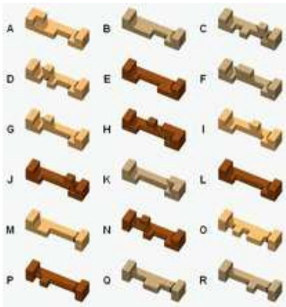


Arjeu CT666 (aka Super Croix (Cross) or Ushuaia)
Gift from Jeff Taylor
Designed by Jean-Paul Pierlot. No internal holes. Offered by Arjeu circa 1988. Pieces shown in photo.
Here is a link to the solution in a French puzzle forum.
Here is a link to a solution video on YouTube, and another in lower resolution.

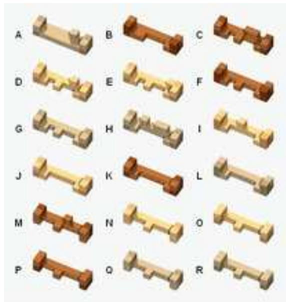
Van der Poel wrote that Pierlot designed 3 versions with no internal holes.
I read on the PuzzleWorld Forums that another is called "Tricolore."
Peter Knoppers' defunct site had the piece diagram shown above.



Burrloon pieces
(I don't have this puzzle.)



Phoenix Cabracan pieces
(I don't have this puzzle.)



Century pieces
(I don't have this puzzle.)

Bill Cutler designed the **Slider** and used it as his exchange for IPP30.
It looks innocent enough, but judging by the internals, it is *not* your typical 18-piece burr!
It is made from Walnut, by Jerry McFarland.
I obtained a copy at Eureka Puzzles.

Vertigo from Pentangle is also not quite "traditional" internally.

The Diagonal Burr and The Diagonal Star

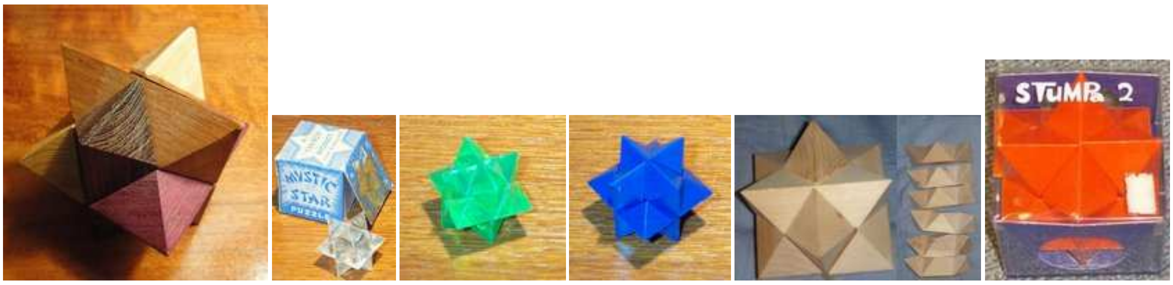
These are examples of the classic 6-piece **diagonal burr**.

The diagonal burr puzzle can be made from 6 identical pieces, each having two notches, but sometimes appears with a key piece that really isn't necessary. It can be [dis]assembled either by exploding/collapsing all the pieces simultaneously, or the pieces can be composed into two 3-piece halves that will easily slide together.

The earliest relevant U.S. patent is 393816 - Chandler 1888. Also see 779121 - Ford 1905.

From left to right: **Knobulus** by Haba, the vintage **Jane's Puzzle** by Drueke, and a vintage acrylic diagonal burr, the **Prism Puzzle**, issued in 1970 by the Pacific Game Company of N. Hollywood CA. The plastic "Lady" burr shown later on is another example.

This clever version of the diagonal burr is called **Insoma**. It has a hollow center in which a Soma Cube must be constructed simultaneously with the burr, since all but one of the Soma pieces are connected to the burr pieces! Designed and made by Mr. Puzzle Australia (Brian Young), and purchased at the NYPP 2008.



These are examples of the **Diagonal Star**. It can be derived from the diagonal burr by beveling the ends of each of the pieces. The shape is formally known as the *first stellation of the rhombic dodecahedron*. (See Steven Dutch's site for a nice explanation of stellations of polyhedra.)

After the traditional six-piece burr, I would say this is one of the best-known and most widely manufactured designs. The earliest patent seems to be Swiss - CH245402 - Iffland 1946; Iffland's design includes the unnecessary key piece. Read more about this puzzle in Chapter 7 of Stewart Coffin's *The Puzzling World of Polyhedral Dissections*. The rhombic dodecahedron also has a second and third stellation. Clever variations exist where the inside is hollow, forming a cubic cavity.

The plastic **Stumpa 2** has an un-notched key piece, with two other pieces each of which therefore has an extra notch. It was issued by Executive Games Inc. of Dorchester Mass.

This is called the "Asteroid" from Bits and Pieces. It has the same internal structure as the diagonal burr, but the pieces have been rounded off on the outside. It's not very precisely made, so it doesn't hold together very well.

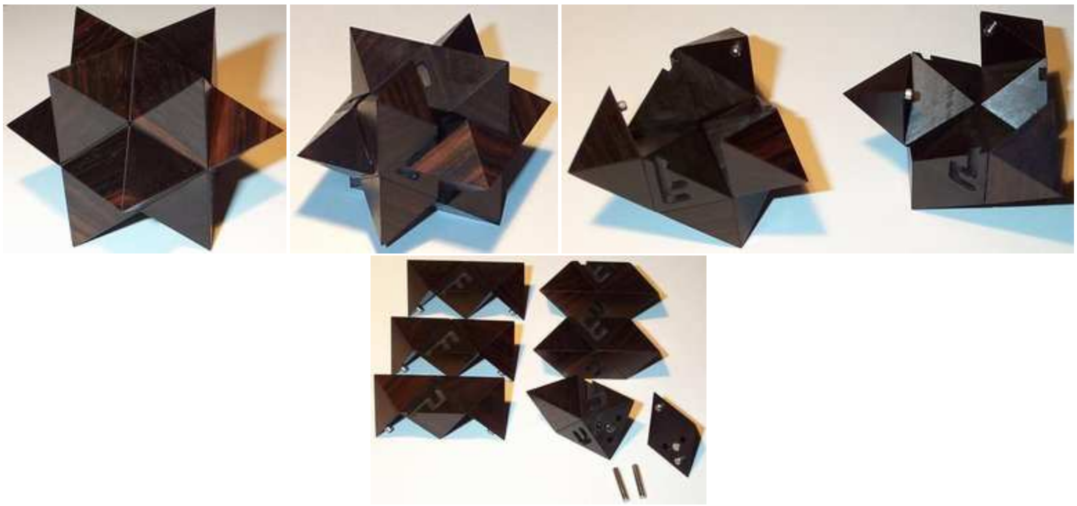
Here are true rounded versions of the diagonal burr - the pieces are cylindrical. Each of these puzzles employs an un-notched key piece. To accomodate the key piece, in each case, two of the pieces possess an extra notch at right angles to the usual two.

This is The Ball by Charles O. Perry. I got it at the MoMA shop when I used to work in Manhattan. The brass pieces are cylindrical, with curved ends. The notches are cylindrical, too. It relies on a small spring-loaded ball-bearing and a corresponding detent to hold the key piece in place. I found an acrylic version, too (the MoMA shop used to sell it).

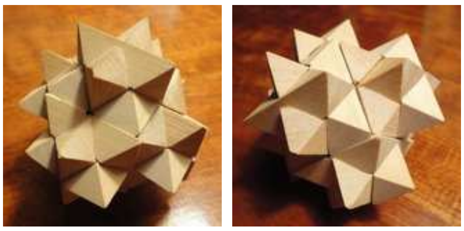
This 6-piece burr has the same internal structure as the Perry Ball (without the detent and spring/ball), but this is made of Kel-Tec bullets! Fortunately they're not live rounds. This was an advertising premium at a gun show.

Skor Mor's **Log Jam** - this is a rounded version of the diagonal burr. There was a brown plastic version, too, called **Stumpa 1**.

This is the **Sequential Star** by Lee Krasnow. I bought one from him at IPP26, where it won an Honorable Mention in the Design Competition. It is the "little brother" to his Barcode Burr. Lee has incorporated a sequential opening mechanism into the traditional diagonal star, making this a much more interesting puzzle.



Each of the six burr pieces is composed of three units - a center unit and two end units - held together by 18-8 stainless steel alignment pins and strong neodymium magnets. If undue pressure is applied to the puzzle in the wrong way, a piece can "burst" into its components - but it is easily re-assembled with no harm done. The end units are made of Macassar Ebony and are precision cut to beautifully sharp edges and points. Lee hooked up a CNC feed to his sled and the cuts were made on his table saw under computer control. The center units are made of a kitchen countertop material called Richlite - a sort of plastic-infused paper, which is climate-stable and machines nicely. Each end unit contains a peg that rides in grooves cut in the center units of adjacent pieces. The groove patterns are carefully contrived so as to dictate a particular sequence of moves through which you must navigate the six burr pieces in coordination, until the assembly finally can be slid apart into two 3-burr halves. The grooves were cut using Lee's CNC milling machine.



This is an enlarged construction related to the Diagonal Star,
called variously the **Chestnut Burr**, the **Asterisk**, the **Snowflake**, and the **Gem Cut Puzzle**.
The Chestnut Burr appears in Wyatt's 1946 *Wonders in Wood* on page 36.
My copy is fairly small, and I do not know who the craftsman is.

Three-Piece Burrs


These are examples of a common 3-piece design known as **O-C-C**, after the shapes of the three pieces. The OCC design was described by Edwin Wyatt in his 1928 book *Puzzles in Wood* (pp.24,25) - he called it the **Three-Piece Cross**; Wyatt gives no history. Hoffmann describes the OCC in his 1893 book *Puzzles Old and New* in Chapter III No. XXXV "The Cross-Keys or Three-Piece Puzzle" but gives no history. Van Delft and Botermans also describe the puzzle, as "The Wooden Knot," on page 67 of their 1978 *Creative Puzzles of the World* but again cite no history. See U.S. Patent 4198053 - Rao 1980. According to Singmaster, the Hordern collection contains an instance called "Le Noeud Mysterieux" from circa 1880-1905. It has been produced in wood, and also in plastic as the **Triple Cross** by Skor-Mor.
Here is a link to Jurgen Koeller's page showing the solution.
Someone had the idea to notch a knife, fork, and spoon so they could be assembled like the OCC burr.

Only a few other three-piece burr designs can be considered at all well-known. They are discussed on Jurg von Kaenel's site. One other common design employs two notched pieces, and a piece with a rounded shaft that allows the piece to be rotated in place. I made a copy from Lego, and posted photos on Brickshelf.


This design was also described by Wyatt in *Puzzles in Wood*, on page 26. This is also the simplest form of a Pagoda or Japanese Crystal puzzle.

Here is an example of Bill Cutler's GigaBurr design, made by Tom Lensch. (I don't have this.) During 1998-1999, Bill Cutler performed a complete computer analysis of all 3x3x3 three-piece burrs. He found 248,540,275,292 (i.e. almost 250 billion) different designs. There are 80 designs at the highest level, 8, and they come apart in two different ways. Of the 80, there are only 3 that have 9 internal voids - 2 of those come apart in one of the ways, and just one comes apart the other way. Bill named this GigaBurr. The other type is called GigaBurr II. GigaBurr was Bill's exchange puzzle at IPP19.


Here are additional examples I made from Lego: Bill Cutler's Cubie Burr #1 and Cubie Burr #2, both of which require 6 moves to open. These are based on the 3-piece GigaBurr, expanded to a 5x5x5 cube by adding edge and corner pieces. Cutler's 2000-2001 complete computer analysis of all such designs found three different disassembly sequences at the highest level, 6. Cubie Burr #1 was Bill's exchange puzzle at IPP21.


The **Three Piece Not** designed by Frans de Vreugd and made from Sapelle and Padauk by Eric Fuller. Masquerades as the innocent OCC, but it's NOT. Eight steps to remove the first piece.


This is Neptunus from Arjeu (CT1101). It is made of three notched plates.

Triple Play - designed by Jim Gooch and made by Eric Fuller, from Walnut and Redheart.
The solution requires an unconventional move, and Eric says some people thought it was an impossible object.

The **Schaekel Knot**, made of Kingwood, by Tom Lensch, and purchased from CubicDissection. It was designed by Oskar van Deventer.



R. D. Rose - #4 X-Y-Z Burr
Three identical pieces that assemble using coordinate motion. This is a nice aluminum example of the design by **Wilhelm Segerblom** of Wakefield, MA, published in the April 1899 issue of *Scientific American* magazine.


The **Slideways Burr** designed by Ray Stanton and made by Eric Fuller, from Curly Maple. The 3 identical pieces assemble with coordinate motion.

Note: this looks like the **Improved Segerblom** three-piece burr discussed on Jurg's site. The original design by Wilhelm Segerblom was published in the April 1899 Scientific American, and is described in Slocum and Botermans' *Puzzles Old and New* on page 66, as well as in the *Book of Ingenious and Diabolical Puzzles* on page 73.


Tri Again - designed by Frank Potts, and made from Walnut and Maple by Eric Fuller. This actually has six pieces, but they interlace to form the traditional three-bar shape.


This is the **Yamaosa 3 Piece Burr**, designed by Osanori Yamamoto and made by Eric Fuller from Walnut.

Magnets hold the pieces in their closed positions.

Just the Three, designed by Jack Krijnen and made by Eric Fuller, from heavily Quilted Sapelle.
A nice sequential level 7.2 assembly - according to Eric, the highest level possible for this form factor.

Three Open Windows, designed by Tom Jolly and made by Eric Fuller, from Bloodwood, Wenge, and Holly.

Invented by Nob Yoshigahara, this little burr is a *poseur* - read about it on Jurg's site. A gift from Peter Wilshire at IPP-29 in SF. Thanks, Peter!

I got this 3-piece burr, made of acrylic, at IPP 29 in SF. It's called **33E** and was designed by Frank Potts.

Several other unconventional designs using three pieces are shown on Ishino's website.

Boxed Burrs

This group usually has 4 or 6 pieces, interlocking inside a container. Some have irregular pieces.

This is a boxed burr I got from Tom Lensch. Each face of the outer box is attached to one burr piece inside the cube. Freeing the key piece requires a trick. The burr pieces used are: #1, #256, #888, #911, #928, and #1024. The box definitely makes it easier to solve, since the faces are distinctly fitted. The mahogany wood is really beautiful.

This is a 4-piece burr in a box from Arjeu, variously known as the "Secret Box" or "Pandora's Box" (I also made a copy from Lego). It employs (2x) #792, but the other two pieces have notches where Jurg's system does not allow them (beneath positions 1,4,5, or 8).

This is the "Combustion" burr from B and P. My first became hopelessly jammed; I obtained another.

According to Brian Young, both Internal Combustion and Pandora's Box are the same design, by Tadoa Muroi in the early 1990's.

"Life at 21"

Burr in a Cube

This puzzle from Bits and Pieces is called Hard Core and was designed by Frans de Vreugd.

This boxed 6-piece burr is called Quantum Entanglement. It has a unique level 48 solution.

The red puzzle is a 3-piece boxed burr called the **Swiss Cube**. There are **two versions - easy and hard** - they look the same from the outside, but their pieces are differently notched. I have both.
The red and blue puzzle in a clear cube is called the **U.S. Cube**. It has six interlocking pieces. All created by Jurg von Kaenel.

Innowoo Cube (?)

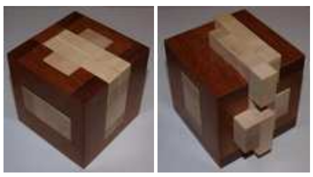
Yin Yang - Pelikan
An unusual six-piece burr inside a hollow ball. The Yin-Yang symbols are attached to the ends of the burr pieces.
Purchased from Puzzlewood.de.

Nested Burr Four
CubicDissection

Prisgon from Philos, designed by Markus Goetz
Purchased in Prague.

This is **Swirls 1**, designed by Bram Cohen. Purchased from Bernhard Schweitzer at IPP 29 in SF. Four pieces in a cage - a very difficult puzzle!

Choreographed Motion, designed by Andreas Roever
Purchased at IPP 29 in SF.
The four pieces have angular cuts, and multiple pieces must be moved at once. Clever, and not overly difficult. Nicely made from acrylic.

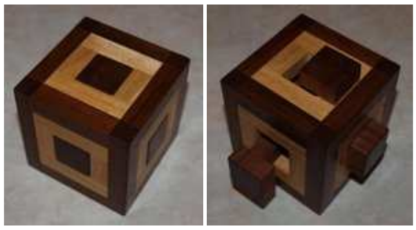


This is **Quintuplets**, designed by Franklin Gonsalves. Purchased from Bernhard Schweitzer at IPP 29 in SF.


An inexpensive "Ball Lock" - one piece seems needlessly truncated.

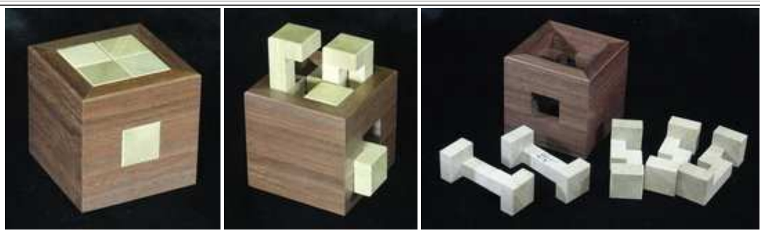

"Luban Lock Box"
from China, a boxed burr with 6 pieces.
The pieces are 2x4x8.
BurrTools says this has 98 assemblies but 18 solutions. The highest level is 10.6.1.2.2.

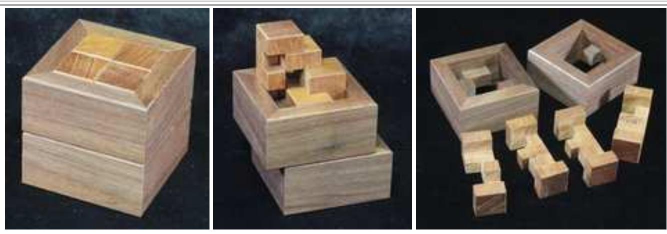

Sticks in a Cage - designed by Tom Jolly - made by Maurice Vigouroux

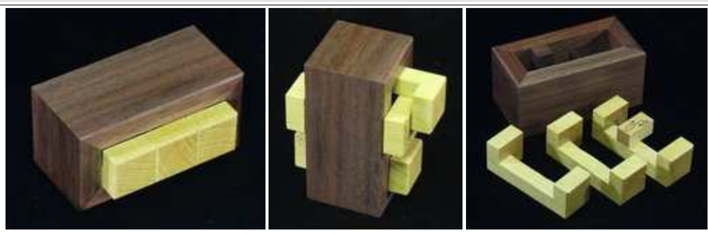

The **Sonneveld Cubed Burr** puzzle, designed by Dic Sonneveld and made by Tom Lensch
3 unusual burr pieces inside a cubic cage - rotations are required to solve.
Made from Shedua, Prima Vera, and Granadillo


Typhoon S1 by Osanori Yamamoto - made by Maurice Vigouroux

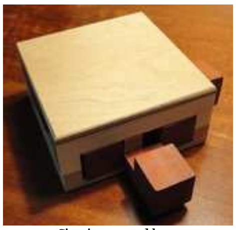

Burr in Cage, designed by Ishino
made by Maurice Vigouroux, from Padauk
from the French online puzzle shop Arteludes.com run by Jean-Baptiste Jacquin and Maurice Vigouroux


Five Sticks 28 designed by Stéphane Chomine, made by Eric Fuller,
from Walnut (frame) and Gum (burrs).
28 moves to remove the first piece.


4 in 2 designed by Stéphane Chomine, made by Eric Fuller,
from Walnut (frame) and Mahogany (burrs).
14 moves to remove the first piece, 17 for the second.

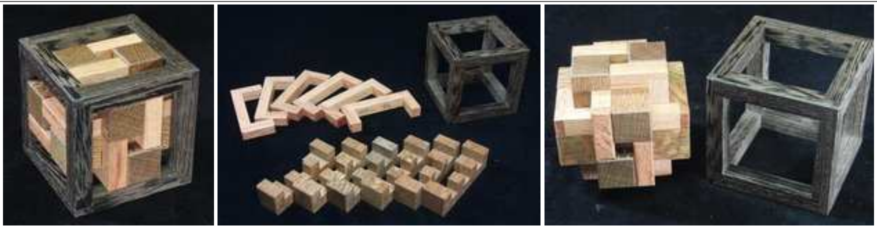

3 Sticks Trapped designed by Stéphane Chomine, made by Eric Fuller,

from Walnut (frame) and Yellowheart (burrs).
Level 12.6.8.


Six piece caged burr
Purchased at a puzzle store in Berlin during IPP31.


Six-Piece Framed Burr by miToys


Turtle's Heart - Kotani


Boards and Sticks with Frame, designed by Gregory Benedetti.
(See this design at Ishino's site.)
Made by Eric Fuller, from Wenge, Bubinga, and Leopardwood.

Kumiki Burrs

The Japanese word "Kumiki" roughly means "to join/weave/interlock wood together." Figural/representational Kumiki puzzles were invented in Japan in the 1890s by Tsunetaro Yamanaka. Japanese craftsmen have a tradition of constructing earthquake-resistant wooden shrines using interlocking pieces without metal fasteners/nails, and Kumiki puzzles may have served as practice projects. Cleverwood has a nice write-up about Kumiki puzzles. The puzzles are usually inexpensive, and made from unfinished Japanese Magnolia ("Ho") wood - but modern versions have appeared in plastic. I group into this category any puzzle with a characteristic 2-piece T-shaped key, but there are four distinct sub-categories.

- Oshi - push the key piece out
- Mawashi - twisting key piece
- Kendon - remove a piece by moving up and down or left to right
- Sayubiki - simultaneously remove two key pieces

I have several Kumiki-style puzzles, including...


Shackman Clown and Man in a Vest - part of a fairly rare set of figures. Discussed in Slocum and Botermans' "The Book of Ingenious and Diabolical Puzzles" on page 86.


A group shot of several other Kumiki burrs in my collection.


The Cornered Cube from Wallingford Toy Works is a very large version of the usual kumiki cube, with a beveled corner.


a wooden kumiki barrel


an octagonal "barrel"


"Hidden Passage"

The 8-Ball puzzle is one of the first puzzles I collected as a kid.
I finally found the five others in what I now know is the **Odd Ball** series issued by Norstar Toys Inc. of NY in 1970 (L to R, top to bottom):

- Baseball
- 8 Ball
- Golf Ball
- Basketball
- Football
- Bowling Ball


a plastic ball


a newer plastic ball


The "Gold Moon" I got in Japan

Terra-Toys offers a series of four "3D Puzzle" animals in their **Wildlife Conservation Collection**, made in China from woods claimed to be certified by the Forest Stewardship Council.
I picked up a Polar Bear and a Panda. Both have unusual opening tricks - not difficult, but distinct from the typical Kumiki-style animals.
There are also a Rhino and a Sea Turtle. The Rhino is very similar to the Nanook Polar Bear.

Here is a wooden Kumiki Trolley by Shackman:

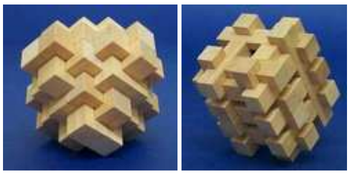
A vintage boxed set of wooden **Kumiki** puzzles,
marked "Made in Japan" but with no other provenance.
Includes: a barrel, a caged ball burr, a truncated cube,
a six-piece burr, a "crystal," a ball, a pistol,
a battleship, a dragonfly, and a small pagoda.
[10]

A very nice vintage turned wooden Kumiki Barrel, purchased from the UK. May be of German origin.

Here is a link to John Childs' extensive Kumiki collection.

Geo Australia offers the "KumiKube" puzzle.

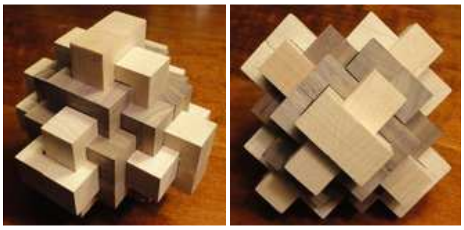
Chuck and Pagoda Burrs



The **Chuck** puzzle, according to Slocum and Botermans in *Puzzles Old and New* on page 74, was patented by Edward Nelson in 1897 (U.S. Patent 588705 - Nelson 1897). The design was improved and developed by Ron Cook at Pentangle Puzzles. Pentangle offers a series of chuck puzzles - the simplest is the Baby Chuck with 6 pieces. The Woodchuck (shown here) has 24 pieces, the Papa-chuck has 54, the Grandpapachuck has 96, and the Great Grandpapachuck has 150.

Pentangle's Lunatic puzzle, also shown, is a close relative of the Chuck family.

Richard Whiting's website offers a solution to the 24-piece Woodchuck. (The knock-off versions are called "Crystal" puzzles but that is a misnomer.)



Here is a Chuck burr made from Maple and Walnut by craftsman **Colin Gaughran**, who has a shop in Lyme, Connecticut.

The **Arjeu CT1102**, the **51-piece Pagoda** from Bits & Pieces, and the **Miyako** puzzles are examples of "**Pagoda**" or "**Japanese Crystal**" burrs. (Note that the Tower of Hanoi puzzle is sometimes called the Pagoda puzzle - but here we're talking about burrs.) You can see the pieces for several sizes of Pagoda puzzle at Ishino's Puzzle Will Be Played... website. Peter Kaldeway's website also had a nice page on pagoda burrs.

A nineteen-piece Pagoda (and a similar 15-piece puzzle) are described in Wyatt's 1928 *Puzzles in Wood* on pages 33-37. Plans for a 51-piece Japanese Crystal are given in van Delft and Botermans' 1978 *Creative Puzzles of the World* on pages 77-79. Slocum and Botermans describe The Great Pagoda puzzle in their 1986 book *Puzzles Old and New* on page 73. They state that the simplest has only three pieces. Larger versions then have 9, 19, 33, 51, 73, 99, and 129 pieces. In general, the n^{th} degree pagoda requires $2n^2+1$ pieces.

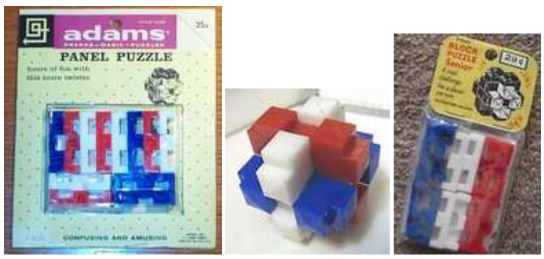
The 3-piece version requires a rotating piece. I made a Lego 3-piece version shown on Brickshelf. The tiny Miyako puzzle is a 9-piece pagoda and does not require a rotation. You can see more Lego versions at Maarten Steurbaut's website.

Last time I checked, you could buy a 129-piece pagoda from Cleverwood, where you can also find smaller sizes for sale. Creativecrafthouse.com sells 99-piece and 51-piece versions.

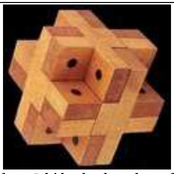
The Altekruse Puzzle and Variants

In 1890, William Altekruse patented (430502) an interlocking puzzle now known as the Altekruse Puzzle. You can read about the Altekruse puzzle in Stewart Coffin's *The Puzzling World of Polyhedral Dissections*. Many variations have been made. The Altekruse can be made with 12 or 14 pieces. Pentangle offers a 14-piece version called Hybrid, and a 12-piece version called Holey Cross. See a solution online at Casse-Tete et Solution.

The **Xeon Molecule** by Skor-Mor is a plastic, modern-looking version.
I managed to find 3 separate copies - one is all blue, one is red/white/blue, and the third is red/yellow/blue.
One of them even came with a solution sheet. On two of them, some of the pieces had broken fins, but the bits were included and I was able to glue them back together.



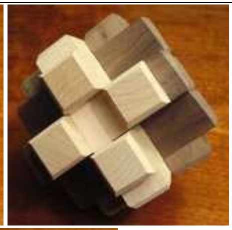
The vintage 12-piece **Panel Puzzle** by Adams is also a version of the Altekruse. This is also called the "Block Puzzle Senior." (I have a Panel Puzzle in the package, and a loose Block Puzzle Senior.)



This is **Arjeu CT679** - I purchased it from Ishi back when they offered such things. This variation of the Altekruse puzzle uses single pin/single hole pieces, six left-handed and six right-handed. [Stewart Coffin describes this variation in his book, *The Puzzling World of Polyhedral Dissections.*]

Stewart Coffin developed and licensed the pinned version of the Altekruse puzzle which was marketed by 3M and Avalon Hill and named **Frantix**. Here are the 12 pieces of the plastic version of Frantix.
[John Rausch's Frantix page]


Kerry Verne made this version of Stewart Coffin's **Giant Steps** #10 puzzle, from Sapelle. Purchased from CubicDissection. This *looks* like a pagoda burr, but notice the missing blocks in the inner corners. It is actually an Altekruse variant.


Altekruse - Colin Gaughran

Arjeu CT14 "Criss Cross"
This is an example of the 14-piece Altekruse variant.

Coordinate Motion Assemblies

In this type of puzzle, several (usually all) of the pieces must be moved in a coordinated fashion to achieve assembly or disassembly.

3-piece Heart Box - Bits and Pieces

Triple Decker - Bits and Pieces

This is called ["Iwahiro's Apparently Impossible Cube #1."] It was designed by Hirokazu Iwasawa. It was made by [Eric Fuller] from Chakte Cok wood.

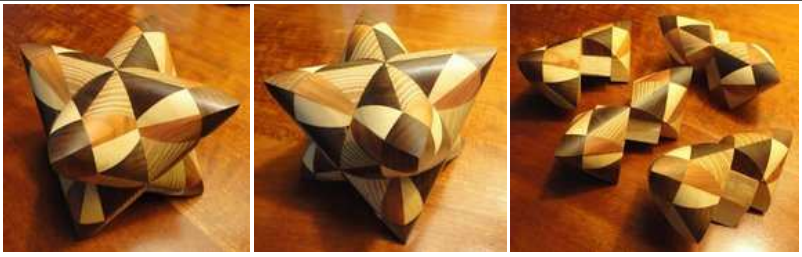
Duodeciburr
Designed and made by Vaclav Obsivac
Presented at IPP27 by Rick Eason
12 identical pieces


TriKubus by Rik Brouwer
Purchased from [Bernhard Schweitzer]


This is the **Crystal Cube**, designed by Bill Darrah. Purchased from Bernhard Schweitzer at IPP 29 in SF. I especially like this design because the pieces are not identical.



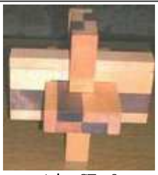
This is the **Dice Box**, designed by [George Bell] [[S]], with input from [Scott Elliott], and printed by Scott. It's not overly difficult, but I think the printed live hinges are cool.



Obtained at IPP31 in Berlin, here is a four-piece **Dual Tetrahedron** coordinate motion puzzle, beautifully crafted from Walnut, Acacia, Maple, and Plum, from Vinco.

Non-Traditional Burrs

These are from the (defunct) French company **Arjeu**, which put out an extensive line of interlocking puzzles in a wide variety of shapes...



Arjeu CT718
This looks like the "Eighteen Piece Double Cross" described by Edwin Wyatt in his 1946 book *Wonders in Wood*, on page 31.

Arjeu CT666
Here is a link to a solution video on YouTube, and another in lower resolution.

Arjeu CT16

Arjeu CT28

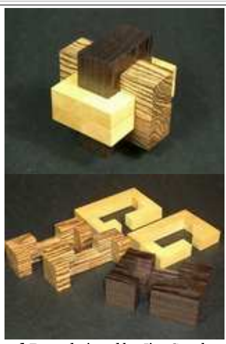
Arjeu CT752 La Lanterne
From an Ergatoudis auction

Arjeu CT14 "Criss Cross" (Altekruse)

Arjeu CT753
This is made from pieces very similar to CT752 - the slots are moved out towards the board ends.
(I don't have this - shown for reference.)

Arjeu CT456
15 2x2x12 pieces, to be arranged in a 4x5x6 structure.
Purchased from PuzzleMaster.ca.

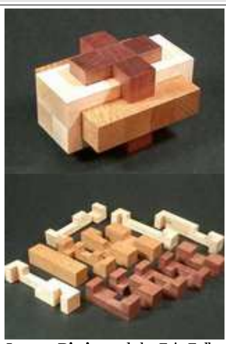
Here are some unusual burrs by various designers, from CubicDissection...



The **Switchboard Burr** designed by Jim Gooch and made by Eric Fuller mixes pieces from 3 different styles of burr, and its solution employs a move one does not often see. The woods are: Pau Amerillo (the yellow), Wenge (the dark), and Bocote (the brown striped).

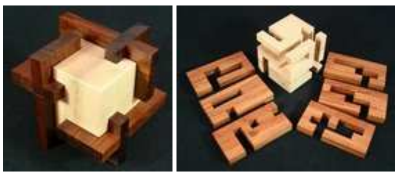
This is Stewart Coffin's **Octo-Burr** design, made by Mark McCallum and purchased from CubicDissection. See the pieces on John Rausch's site.

Die in Prison (with a central puzzle box), designed by Ronald Kint-Bruynseels and made by Eric Fuller. The six pieces are made of Bubinga, and the central cubic box is made of Yellowheart.



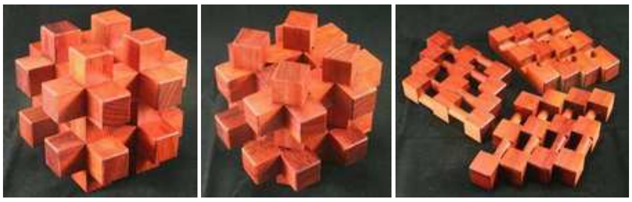
Lassen Risti - made by Eric Fuller

RD001
Designed by Ronald Kint-Bruynseels and made by Eric Fuller at CubicDissection. Gum wood and Ipe.

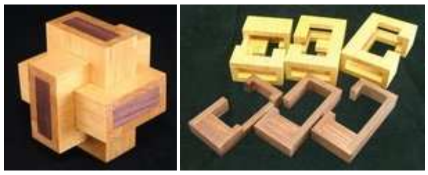


Anderson's Delusion
Designed by Ronald Kint-Bruynseels. Made by Eric Fuller from Gum wood and Rosewood, and purchased from CubicDissection.

Here is a hand-crafted puzzle from Eric Fuller at CubicDissection - the **Tornado Burr** designed in 2007 by Junichi Yananose.
My copy is made from Padauk wood.
Eric says, "This is one of the most difficult puzzles I've ever made. They are extremely time consuming to make, requiring many specialized jigs.
I doubt I'll be making these again!"
This burr, with its unusual and interesting movement, won an Honorable Mention award in the 2007 IPP Nob Yoshigahara Design Competition.

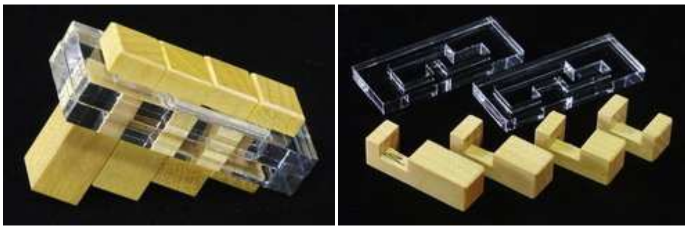


Here is the Tornado Burr partially disassembled, into two halves:



This is **Luxemburr**, designed by Matti Linkola, exchanged at IPP16 - made by Eric in Yellowheart and Walnut.

Padaung Rings, designed by Alfons Eyckmans and made from Tulipwood and Acrylic - it takes 24 moves to remove the first piece.



Zauberflote, designed by Gregory Benedetti.
(See this design at Ishino's site.)
Made by Eric Fuller, from Yellowheart and laser-cut acrylic.

The **Ribbon Puzzle**, designed by Tom Jolly, made by Eric Fuller from Chakte Cok and Zebrawood - six pieces that form the 3-piece burr shape.

These small but elegant burrs are made from a special plywood, from Pacific Puzzle Works...

Knot Mass 36, designed by Oskar van Deventer. This instance is pretty small, at 36mm. It's made from a 5-ply maple core / maple-top hardwood laminate.

Tubular Burr Box (aka Space Invaders), designed by Ronald Kint-Bruynseels. This instance is pretty small, at 36mm. It's made from a 5-ply cherry / maple-top hardwood laminate.

Oskar's Egg
A 3-piece ball inside a 2-piece egg. How does it come apart?

These are members of the "Quad Squad" family of burrs with interchangeable pieces, from Viktor Genel...

Quadrocube - Viktor Genel

QuadroPrizm - Viktor Genel

Long-Beamed Star - Viktor Genel

The burrs below are from a variety of sources...

Easy Livin' designed by Ronald Kint-Bruynseels
Purchased from Bernhard Schweitzer at NYPP 2008
This is notable because a copy sold for $11,111 in one of Nick Baxter's auctions!

William Waite's Stellar Burr

From Davan's, a Rojo


T Time - Davans


Maruca - Davans


Zinato - Davans


P24 Marian's Puzzle - Drueke
You can see a solution at Richard Whiting's site.

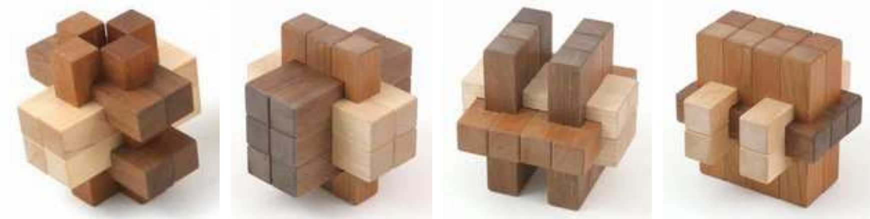

Karin's Outline Burr

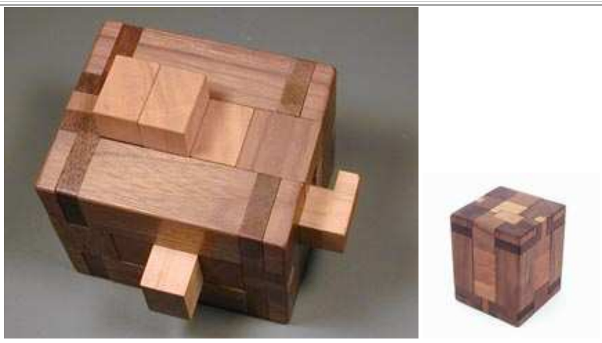

Stewart Coffin's Lock Nut


Sliced Burr - Philos

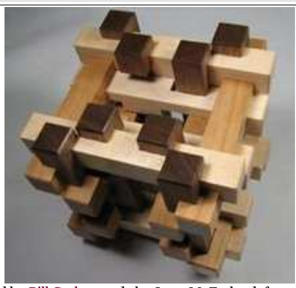

Vesa Burr Simple - Philos
- designed by Vesa Timonen for IPP21.
A gift from Bernhard - thanks!


"Numero Caro"
This is an Asian copy of Oskar van Deventer's Knot 12. Have a look at the version offered at Pacific Puzzle Works.


The four members of the **Wausau** burr series by Bill Cutler - **'81** (I don't have '81, yet.), **'82**, **'83**, and **'84**.
See Allard's blog for a nice review of the Wausau burrs.


Binary Burr - Bill Cutler


This is Bill Cutler's 66-piece Cutler Cube. It is a beauty, 100mm on a side, and difficult to disassemble/reassemble.


The **Visible Burr**, designed by Bill Cutler, made by Jerry McFarland, from Cherry, Maple, and Walnut woods.


The **Open Cube**, designed by Marc van Kreveld and Theo Geerinck, produced by PuzzleWood


The Blitz - Mr. Puzzle Australia
Seems similar to the Saturn shown at Philippe Cichon's site.


Here is "Sonneveld's Illegal Burr" - Tom Lensch made it. It's "illegal" because a rotational move is required.


The **Twisty** burr, designed by Derek Bosch and made by Tom Lensch.
Purchased from Tom at NYPP 2008.

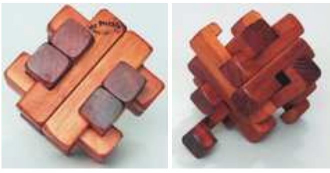

The Boston Tea Chest, from Mr. Puzzle Australia. I have one of their Craftsman Range examples in Australian Flooded Gum wood. Six pieces, with a two-step internal locking mechanism. A traditional burr-solving computer program won't help you with this one.

This puzzle from Imagin is a knock-off of von Kaenel's Coated Burr idea.
You can see a solution on Richard Whiting's site.

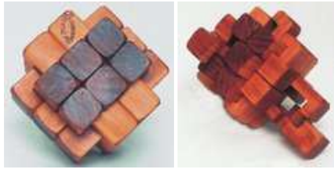

This is **Ozone** designed by Ronald Kint-Bruynseels. It is a six-board burr, with a "hook" attached to each piece. It requires 13 moves to remove the first piece, then 11 for the second. Ronald has designed several unusual burr-type puzzles, and you can see many of them at Bernhard

Schweitzer's Puzzlewood site. Richard Whiting has put together a nice page at his site where you can read about several other high-level burrs

This is Frans de Vreugd's design he used for his exchange at IPP25. Frans calls it a Plated Six-Piece Burr. Mr. Puzzle Australia called it **Around the Bend**. Frans says he developed it while working on Bent Board Burrs. It uses pieces 120, 154, 256, 412, 960, and 1024. Each has a 2x4 unit plate attached to its right end. It is the highest level burr of this type with notchable pieces. It is made from Queensland Silver Ash (the light wood) and Queensland Blackbean.



Decemburr - Mr. Puzzle Australia
A 12-piece, level 13 burr designed by Goh Pit Khiam in December 1999 without the use of a computer.

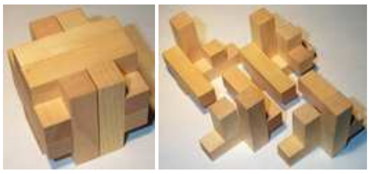


Coming of Age Mk.II - Mr. Puzzle Australia
An 18-piece 6x6x6 burr designed by Brian Young. There are multiple solutions - the highest level is 19.

Eight Piece Burr - made by Scott T. Peterson

Yananose 2x3 Type 0

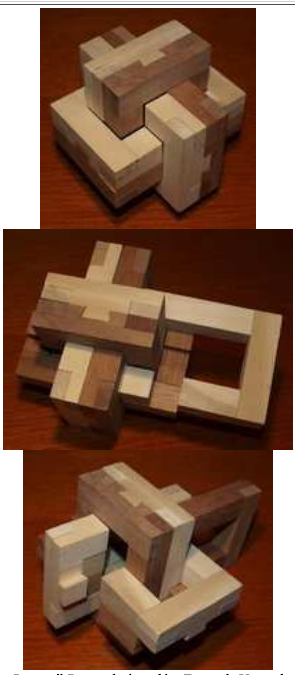
QED - Pentangle



TriRods by Serhiy Grabarchuk - from Bernhard Schweitzer

Willem van der Poel's Grandfather 6x6x6 18-pc burr (rough handmade copy - unknown craftsman)
Discussed on Pete Roesler's site, where you can read a brief history of this puzzle. You can see this on Ishino's site, too. This copy has one piece that differs from van der Poel's design - instead of piece "I" there is another "J."

Bombay Co. Angles and Edges



Dovetail Burr - designed by Frans de Vreugd
Issued by Bits & Pieces
A single solution, at level 6. Based on Yananose's 6-board burr.

Double Cross - B&P

Coming of Age - designed and made by Vaclav Obsivac
Presented at IPP27 by Laurie Brokenshire
Six pieces made from every possible combination of 3 (out of 18) 1x1x5 Walnut bars, plus 8 1x1x1 blocks. The right-hand picture shows the puzzle properly assembled.

I bought this burr in Japan. It is made by the Yamanaka Kumiki Works. It is the "Masu Model."

I bought this in a department store in Japan. It is called "The Cell" and was made in New Zealand.

Mixed Pieces Burr #2
- designed by Frans de Vreugd.
Purchased from Frans at IPP28 in Prague.

Double Kongming Lock

The **Desert Rose** micro-burr, designed by William Waite and made by Allan Boardman, who is well-known for crafting microscopic puzzles. It's only 1/2 inch across! Made from walnut and masur birch. Purchased from William at IPP 29 in SF.

This inexpensive Samanea (Monkeypod/Raintree) wood 12-piece burr was sold as the "**Mercury Star**" but it is a shrunken copy of Akio Kamei's Box and Cage design, without the box.

Flange 99A, designed by Tom Jolly.
Purchased at IPP 29 in SF.
Laser-cut. Six pieces, only two identical. 8 moves for the first piece.

Flange 77A, designed by Tom Jolly.
Purchased at IPP 29 in SF.
Laser-cut. Six pieces, all identical. 4 moves for the first piece.

I found **Linking Squares** from Philos at The Games People Play.

Linking Squares consists of 12 pieces with embedded magnets, that must be constructed into an octahedral shape composed of three interlinked rectangles. It was designed by J. Verhoeff.

I found **Sheffield Steel 6BB** from Philos at The Games People Play.

Sheffield Steel 6BB was designed by the prolific Ronald Kint-Bruynseels - it is a six-piece burr at level 17.14.5.2.3 (see the pieces at Ishino's site; Richard Whiting describes the puzzle on his site, and gives a solution).

"Knobbly Burr"
designed by Dic Sonneveld
made by Brian Menold

The **Quadlock 1** is an interlocking burr cuboid puzzle made by Jerry McFarland from Mahogany, Walnut, and Maple, and designed by him in 1992. Purchased from Jerry. It has 19 pieces and is difficult to take apart. It is beautifully finished! You can read reviews here, here, and here.

Snookstick (aka Starburst)
designed by Jean Claude Constantin
issued by Bits & Pieces, as Starburst

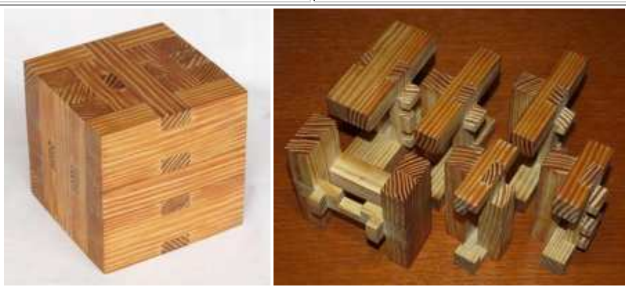
The **Ambigram Burr**, designed by Gregory Benedetti.
Available from Puzzlewood.de.
Made from Wenge, Padauk, and Robinia.
Thanks to Bernhard Schweitzer and John Devost!

An inexpensive (and imprecisely made) 6-piece board burr.
This is the same design that appeared in the French Fabbri series.

In CFF #84 March 2011, Vesa Timonen published an article "A Travelogue to My Puzzle Designs" where he describes the genesis of several designs including the 1998 6-piece Timonen's Burr.

Heart to Heart
This is similar, but not identical, to Timonen's Vesa Burr.

36 Piece Burr - designed by Jacques Frossard, made by Maurice Vigouroux
This has only eight holes inside. It has one solid key piece, but without using piece coloring constraints, even BurrTools cannot solve it!

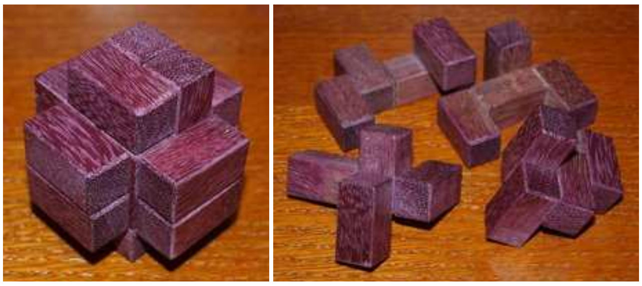


Burr Cube by unknown designer - made by Maurice Vigouroux
from Caroline (Loblolly) Pine

IPP Burr - Mr. Puzzle Australia

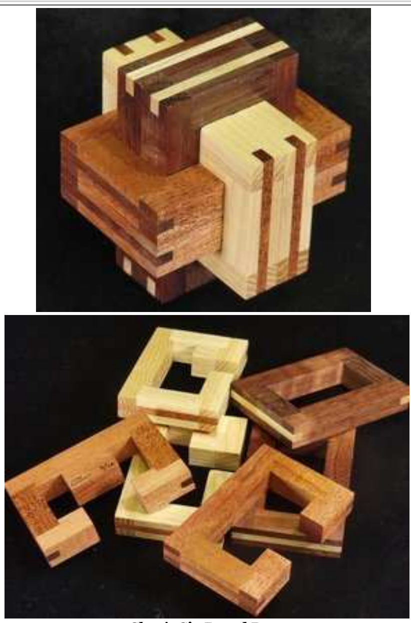
456 Burr
Almost identical to the Arjeu 456 Burr
(I don't have this - sold at NYPP2012.)

This is the **Q Burr**, designed by Jim Gooch, made by Steve Strickland, from Rosewood.
Four pieces, one of which is a cube. Purchased from Steve Strickland's new website.

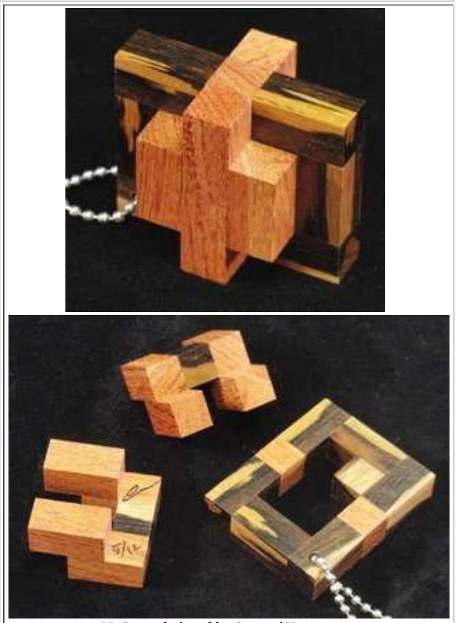


Vinco 4 Piece Burr
made by Brian Menold

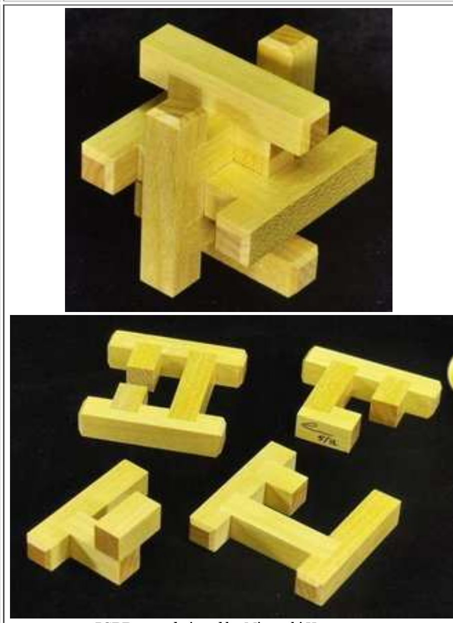
Phelan, designed by Alfons Eyckmans.
A non-traditional 18-piece burr,
made by Maurice Vigouroux, from Walnut.
Purchased from the French online puzzle shop Arteludes.com run by
Jean-Baptiste Jacquin and Maurice Vigouroux.
Ishino shows the pieces, and indicates Phelan is level
17.1.16.8.5.16.2.8.1.1.1.2.2.2



Chen's Six Board Burr
Designed by Chi-Ren Chen
Level 2.14.12
Made by Eric Fuller, in Walnut, Ash, and African Mahogany



N-One - designed by Osanori Yamamoto
Three pieces, level 15.3
Made by Eric Fuller, in Jacaranda Pardo and Bubinga



ISBR x 5 - designed by Mineyuki Uyematsu
Made by Eric Fuller, from Yellowheart

Via the Renegadepuzzlers forum, I learned about five inexpensive wooden puzzles produced under the label "Confusion Contemporary Puzzles" by The Lagoon Group. I purchased mine at Mind Games in the UK.

Trilogy
aka "Three Open Windows"
(made by Eric Fuller)
Designed by Tom Jolly

Squarrel
Designed by Ronald Kint-Bruynseels
See it on Ishino's site

Mental Block
Designed by Rick Eason
aka the Twenty Cube

Caged Knot
Designed by Tom Jolly
See it on Ishino's site

Alcatraz
Designed by Ronald Kint-Bruynseels
aka Die in Prison #2
See it on Ishino's site

See Ishino's site for a list of six-board burrs.

Here is a link to a solution video to Frans de Vreugd's Irregular Board Burr, on YouTube.

Here is a link to a stop-motion video of several of Mr. Puzzle Australia's puzzles assembling themselves, on YouTube.

See U.S. Patent 5040797 - Dykstra 1991 for an interesting burr that can be assembled in two distinct ways.

Non-Traditional Burrs in Plastic or Metal

George Miller made this version of Frans de Vreugd's "Extreme Torture" separated board burr. It takes 28 moves to free the first piece and then 21 more to free the second piece! Here is a link to the solution on George Miller's site.

Here is an article at woodcentral.com by Steve Strickland about making 6-board burrs.

Thinkfun now offers an inexpensive and colorful version of the Extreme Torture puzzle. They call it "Gordian's Knot" and it includes a step-by-step reversible solution booklet.
You can see a solution on Richard Whiting's site.

Sonneveld 9-piece Board Burr - made by George Miller.

The **Zig Zag Knot**, from Thinkfun.
This is a nice plastic mass-produced version of Ronald Kint-Bruynseels' 2003 design he called "ZeeZee ZedZed" - see it on Ishino's site.
Thanks to Tanya Thompson!

Four-piece red weave

Kaiyue Ball Burr (Kong Ming Lock 30394)

This is Junichi Yananose's **H-Burr**, made in aluminum and purchased from Torito.

The **Tubular Burr** by Derek Bosch.
Purchased from Derek at IPP 29 in SF.

The **Arch Burr** in aluminum, from Bits and Pieces. Designed by Oskar van Deventer.

Here is a set of burr-type plastic puzzles I bought in Japan - they are members of a "Family:"

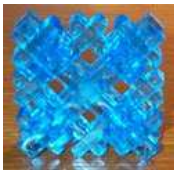
Boy

Papa

Lady

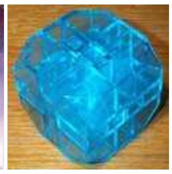
Brother

The Dollar Tree store offered several puzzles in a series called "3 Dimension" including:

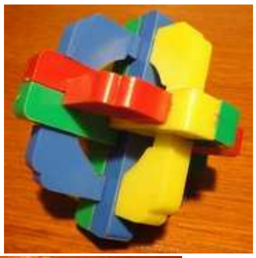


Fancy Square

Knot



"Stack Cubes" (A Kumiki Cube)



The **Chinese Ball Puzzle** from Bell of the U.K.
A vintage interlocking burr.

Interlocking Poly-cube Assemblies

Scott T. Peterson is a talented craftsman who produces high-quality limited editions of puzzles in fine woods.
See his website polyhedralpuzzles.com; and info at CubicDissection.

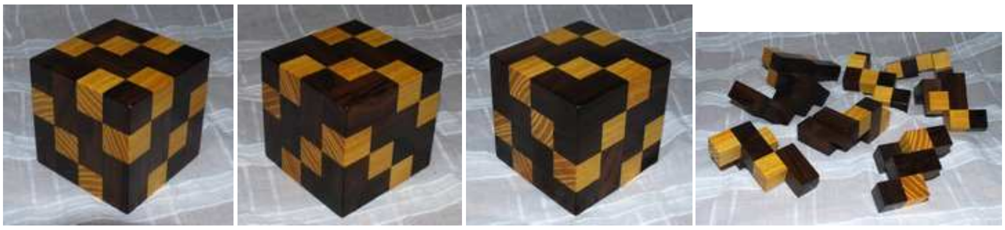
Scott made a few instances of my **2 N's Cube** design. Scott has devised an attractive coloring scheme for the cube and made me the examples shown below - the first in Bocote and Yellowheart, and the second in Kingwood and Holly. (I have since traded the Kingwood instance.)

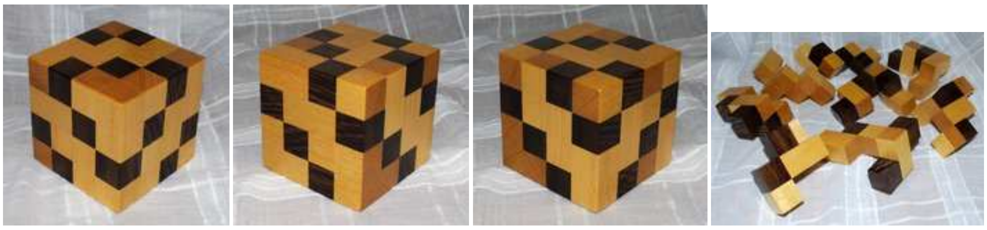
I would rate the 2 N's Cube of medium difficulty - it shouldn't take long for an experienced metagrobologist to solve it,
but I think it presents a good challenge for the casual puzzler, particularly if one starts with it disassembled and hasn't seen the assembled arrangement.
The design is the product of a search "by hand" (i.e. without a computer) for a selection of non-planar pieces formed from two n-tetrominoes each that would allow interlocking assembly into a 4x4x4 cube.
My "theme" was the frequent mis-spelling of my last name, which has two n's. I was pleased to discover an arrangement that used four pairs of pieces - thusly again doubling the double-n theme - and yet assembled in a way that was not completely symmetric.

Scott's tolerances are so accurate that when I first received the cubes, I had trouble finding the disassembling moves!
Naturally, wood tolerances vary with humidity, but Scott's pieces are very nicely made.

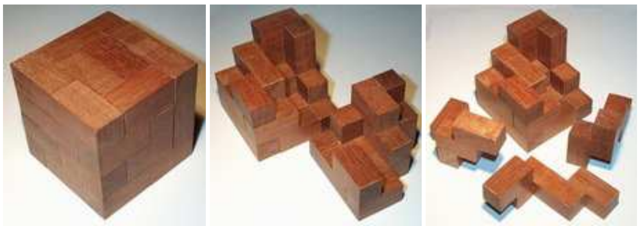
Scott has made copies of my 2N's Cube No. 5 - he designed a very nice pattern based on the "five" theme (each face has five contrasting cubes), and made these two examples - the first from Ziricote and Orange Osage, and the second from Yellowheart and Wenge. Thanks, Scott, they're beautiful!

The No. 5 design is the result of a computer-assisted search I did (using Andreas Röver's wonderful BurrTools program),
trying to find a better design than the No. 1 I designed originally by hand.
I don't think any of the designs I found by computer topped the No. 1, but of them, No. 5 is my favorite - it uses eight different pieces as opposed to the four pairs in the No. 1.
I think No. 5 is more difficult to assemble, too.





At IPP28 in Prague, Bernhard Schweitzer had a nice surprise for me - he presented me with a copy of my **2 N's Cube No. 5** that he had made - I believe the wood is Meranti. Thanks again, Bernhard!

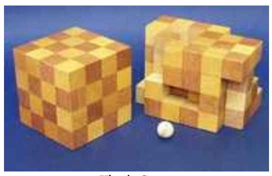


The French puzzler Guy Brette also made a copy - see a video on Guy's website.

These are from Pentangle - all very nicely made:

The Wookey Hole

Mayer's Cube
I credit (blame?) Mayer's Cube with getting me moving along on my collection.



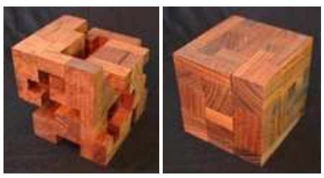
King's Court

The **Juha #6** cube by Juha Levonen
(Ishino shows other Levonen designs)

The **Noris Cube** designed by George Pfaffinger, made by Philos, purchased from Cleverwood (discontinued).

The nine-piece **Improved Mehandros Cube** by Michael Toulouzas of Greece. Purchased from Bernhard Schweitzer.

Three Trapped Sages - designed by P.F. Ramos and Rafael Abad
Purchased from Puzzlewood.de.
This was entered in the IPP 2006 Design Competition.
Maneuver the three maple pieces free of the frame.

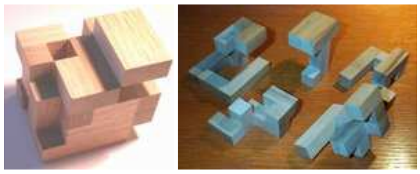


This is the Cubed Burr II designed by Tom Jolly. I bought this instance, made from English Brown Oak, from Eric Fuller. This is a 6x6x6 cube of six large pieces. The basic plan is that of a traditional six-piece burr, but the pieces have been heavily modified and augmented to form a cube. It requires ten moves to free the first piece. There is only one solution. Tom also designed a simpler version, Cubed Burr.

The Edge Corner Cube II by Markus Goetz.

This is a version of Trevor Wood's Holey Squares Cube puzzle, made by Eric Fuller. It is made from Leopardwood and Honduras Rosewood.

From William Waite, the **Literal Lateral Slide**.



Waite's Wonder
A 4x4x4 cube made of only five pieces that fit together nicely and ingeniously.

Confusio (Product No. 6170), from Philos.
Designed by Georg Pfaeffinger.
Made from Schima, Hevea, and Samena woods.
Form a 5x5x5 interlocking cube from 9 pieces.
Purchased at The Games People Play.

Barb's Cube - John Devost
A miniature 3D print from Shapeways
Thanks, Brett!

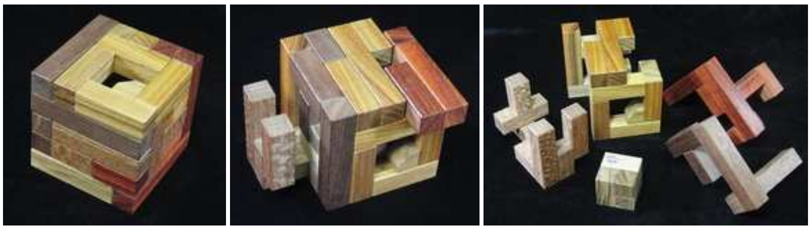
Reunification - Bram Cohen
Purchased from PuzzleWood at IPP31 in Berlin

The **Ramube Octahedron** designed by Ramu Kaminoff in 2008 and exclusive to Creative Crafthouse. Eight complex pieces and 2 balls locking things up inside. Dave says, "This is in my opinion our MOST difficult puzzle. It is difficult for me to imagine anyone solving this without use of the provided instructions."

The **Century Cube II** - a 4x4x4 cube composed of five serially interlocking pieces. A nice design that yields to logical thinking.
A copy of Juha A. Levonen's "Juha's No 2."

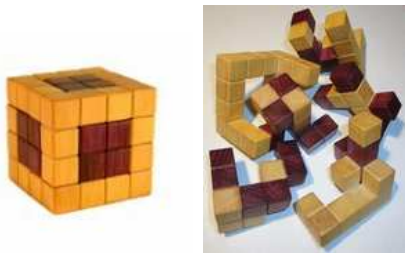
The (Count Your) **Blessings Cube** - six interlocking pieces.
The pieces occur in three mirrored pairs.

Six Pack, designed by Jim Gooch and made by Steve Strickland, from Mahogany, Red Oak, Padauk, Bubinga, Walnut, and Pecan.
Six interlocking pieces.



The **Rattle Box**, designed by Tom Jolly, made by Eric Fuller from Quilted Ambrosia Maple, Leopardwood, Padauk, Walnut, and Canarywood.
A 5x5x5 cube with a hollow interior containing a 2x2x2 cube with one unit missing.

Slow Waltz - designed by Jeff Namkung
Made by Eric Fuller, in Canarywood and Cocobolo.



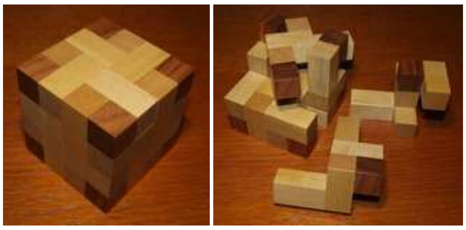
Don's Dilemma - designed by Don Kuchen, made by Brian Menold at Wood Wonders, from Yellowheart and Purpleheart

Designs by Stewart Coffin

Perhaps Setwart's best-known interlocking polycube design is his **Convolution (#30)**.
This example was made by Thomas Moeller, from Zebrawood and Bloodwood.

Stewart Coffin's Three-Piece Block (#38) - one of the few puzzles I made for myself from wood!

This is Stewart's new **Involute** design, described in his recent book *Geometric Puzzle Design*. This beautiful instance, in highly polished Padauk with Ebony corners, was made for me by Scott T. Peterson.



Stewart Coffin's **Convolution**, made by Wayne Daniels

Cube 16, a nice five-piece design by Stewart Coffin, and made from Black Palm, from Bernhard Schweitzer. Purchased at IPP31 in Berlin.

Coffin's 4 Piece Cube
made by Brian Menold

Designed and made by Don Closterman

Don Closterman lives in Rhode Island and is over 70 years old. He designs and makes a beautiful series of interlocking, sequential (dis)assembly polycube puzzles in cages.
Closterman identifies his puzzles using a code of the form T-S-N-P-M, where:

- T is the type of puzzle – C for cage
- S is an arbitrary identifier Closterman assigns to a given design with a particular solution method
- N is simply the number of cubies in the overall puzzle, which seems to include empty spaces (e.g. 6x6x6 = 216)
- P is the number of pieces including the cage
- M is the number of moves to remove the first piece, which seems to be omitted if it is only 1 move

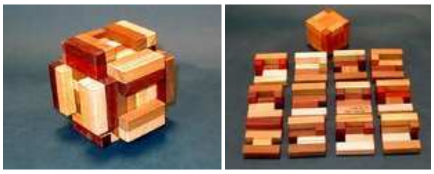
A yellowheart 4x4x4 I bought back in about March 2005, code C-2-64-7 which indeed has 7 pieces including the cage, and the first piece comes out directly – I like this one best and have solved it on my own. BurrTools confirms it has two very similar solutions.

A Lyptus 6x6x6 with Walnut plugs at the corners, code C-12-216-19-3.

A Jatoba 5x5x5 Caged Cube (type 4-125-13, from 2-99)

A Canarywood 6x6x6, code C-11-216-13-12. Made in May 07. 13 pieces and requires 12 moves for the 1st piece, including a rotation (!) which stumps BurrTools (although it can discover the single possible assembly, and also the disassembly sequence if I omit the piece that must be rotated). This one I got apart on my own but used BurrTools and the supplied instructions to re-assemble.

Designs by Hidekuni Tamura at "Atelier Tamura"



This beautiful puzzle called the **Twelve Piece Box** lies on the boundary between a non-traditional burr and a polycube assembly. The little central cube has a secret, too.

The **Six-Block Puzzle** looks like a burr, but isn't!

The Ten-Segment Puzzle

The Divide Cube.
This one was made by Eric Fuller, from Rosewood.

Designs by Leonid Mochalov

The **Russian 13** burr, designed by Leonid Mochalov and made by Mr. Puzzle Australia. Purchased in auction from the John Ergatoudis collection.

8+1 Cube
Eight corner pieces and a monolithic central frame (the "plus one").

Burr Cube - by Leonid Mochalov
I like this one - when I disassembled it, I didn't think it would take me long to re-assemble it - I was wrong, and I spent several happy hours

Each corner piece has an extension with various tabs and notches that inserts through part of the frame and mates with another corner piece - you must find a sequential assembly of the corner pieces.
Purchased from Puzzlewood.de.

trying to do it in various incorrect ways. I was surprised that these pieces had so many partial false assemblies.
Purchased from Puzzlewood.de.

Mochalov #12
Purchased from Puzzlewood.de at NYPP 2008

Mochalov Cube 2006
Purchased at GPP

Richard Gain has modeled several interesting cube designs you can buy at his Shapeways shop.
Richard's philosophy is to make them small and affordable.
See Richard's YouTube channel and his blog.
You can sometimes find dyed copies for sale at his Etsy shop.
My friend Brett has been kind enough to give me several of these as gifts. Thanks, Brett!

Roll Up! Roll Up!
designed by Richard Gain
Purchased from Richard at IPP31 in Berlin.

Angle-C
designed by Richard Gain
Purchased from Richard at IPP31 in Berlin.

Elevator
designed by Jos Bergmans
Purchased from Richard at IPP31 in Berlin.

Superstrings
designed by Richard Gain
Purchased from Richard at IPP31 in Berlin.
This won a Jury First Prize at the 2011 Nob Yoshigahara Puzzle Design Competition

Quickstep - designed by Jeff Namkung
A Level 11.5.3.3 4x4x4 cube.
Printed via Shapeways and dyed by Richard Gain

Primary Gain
designed by Richard Gain

The World's Smallest Commercially Available Cube Puzzle
7.5 mm side

Inside Out
designed by Richard Gain

Cubed Burr II
designed by Tom Jolly

Seldom Seen
designed by Richard Gain

Happiness Cube #20
designed by Sekoguchi Yukiyasu

Tertiary Gain
designed by Richard Gain

The **Steady State Cube** by Richard Gain.

Switch Cube - Richard Gain

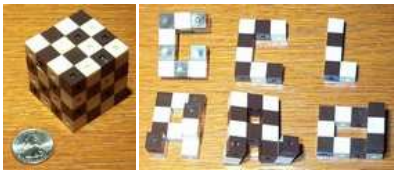

This is Richard's small instance of **Tom Jolly's *Twist the Night Away***. It is a great design that requires piece rotations to solve. I had fun solving Tom's puzzle at IPP29 in San Fransisco, but I missed out on Eric Fuller's wooden limited edition of them, so it's nice to be able to have an instance of this design, and an inexpensive one at that. It did take a *lot* of sanding of the pieces to make this one work, though.

This is ***Pivot*** by **Jos Bergmans**
Pivot took me a while to solve, and I only managed to do it after I saw an image of the solved cube and deduced the piece placement from the cuts on the faces. It's still difficult to figure out the required sequence of moves and rotations!

Modular Polycube Construction Elements

One of the coolest things is LiveCube - you can build your own polycube puzzles!
See U.S. Patent 6679780 - Sywan-Min Shih 2004.

The **Never Ever Cube** is also made from unit modules. In this case the modules are cubic frames, and there are rubber inserts designed to fit into the faces and bind to another face on an adjacent unit cube. Personally I think the LiveCube design is better, as there are fewer pieces to worry about, and the connections are more firm.



This small brown 4x4x4 cube is constructed from what seems to be a precursor to LiveCube. Some of the pieces have square sockets showing - I assume the pieces are connected via corresponding square pegs.

D Box - a puzzle construction kit, designed by the Light brothers
See www.dboxpuzzle.com

Cube-and-Plank

Triple Trouble
Purchased from Potty Puzzles.

Black and White by Kubi Games
Purchased from GPP.

Double Trouble
Purchased from Pentangle.
I really like this one - six different pieces loosely interlock. Each consists of a plank and two or more half-cubes attached in various orientations. They can be assembled using logical deduction.

Polyhedral Assemblies

I am the proud owner of Corner Cube #28 by Lee Krasnow.

It has six dissimilar pieces which assemble only one way. It is not easy to find the sliding axis to disassemble the puzzle! My instance is made from beautifully figured Tulipwood, Brazilian Kingwood, Cocobolo, and Bocote. I bought this directly from Lee in 2003.

One of my favorites is this "Ribbon Keyvos" made for me by Michael Toulouzas of Greece:

My Keyvos is made of
Bois de Rose, Wenge, and Mahogany

It's not easy to find the right slide...


There are six distinct pieces

It comes with a certificate


I have one of Michael's "Brain Attack" puzzles, too.

Designs by Stewart Coffin

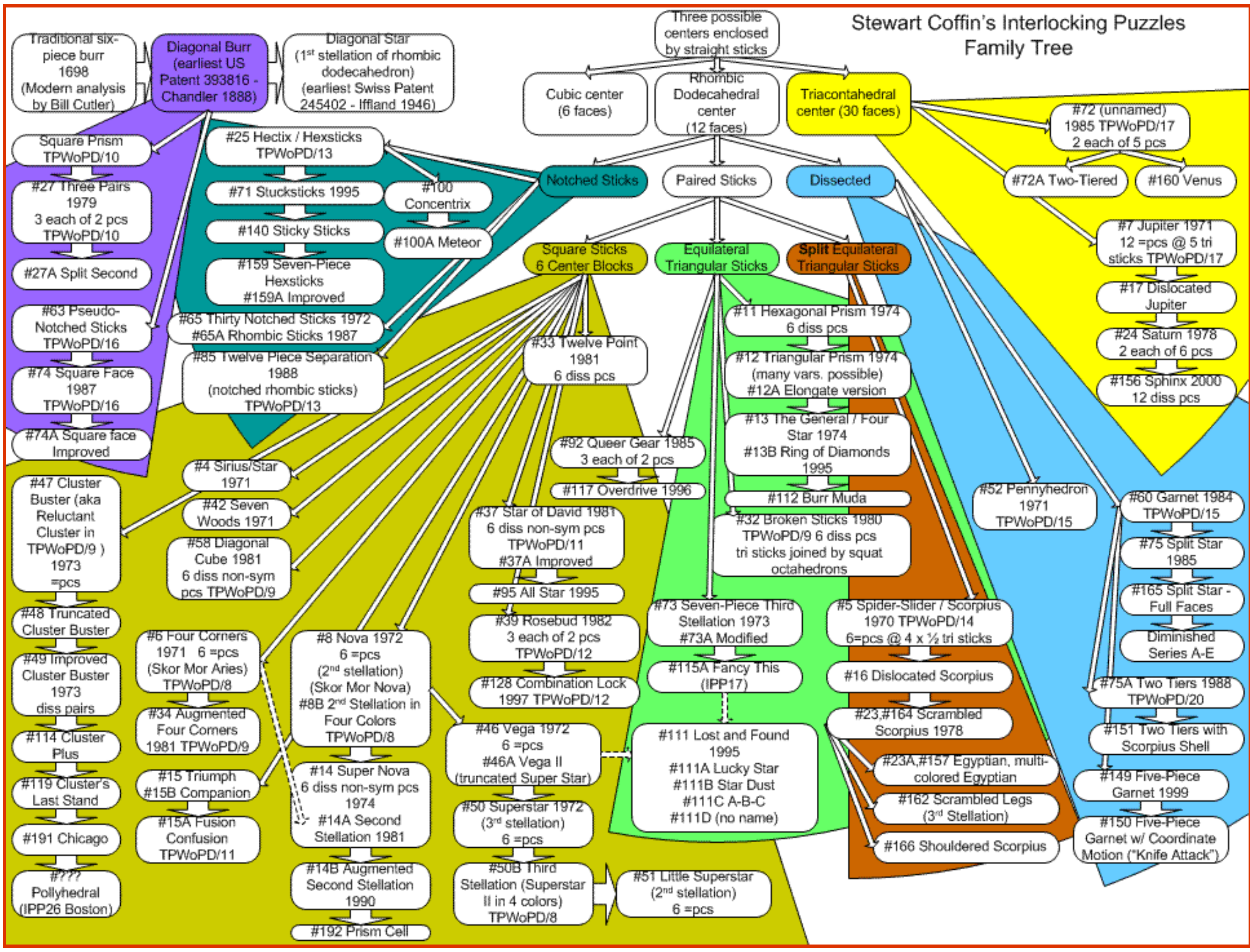
It is difficult to overstate the contributions of **Stewart Coffin** to mechanical puzzle design. In fact, it is difficult to decide where in this website to put a subsection devoted to him, since his ideas have become so widely applied across the field. Many of his primary contributions do lie in this area of interlocking polyhedral assemblies. Stewart coined the term Ap-Art to describe his "sculptures that come apart." In the 1970's through 1990's Stewart ran a puzzle club of which many of us can only wish we had been members.

With the publication of his *The Puzzling World of Polyhedral Dissections* (hosted on John Rausch's PuzzleWorld site), Stewart literally "wrote the book" on entire classes of interlocking puzzles that simply did not exist before he thought of them. Moreover, Stewart has been incredibly generous in allowing puzzle enthusiasts worldwide to utilize his designs without financial impediment. For these and other reasons, in 2006 Stewart became the first recipient of the IPP **Nob Yoshigahara Award** for "Lifetime Achievements in Design, Craftsmanship, and Popularizing Mechanical Puzzles."

Stewart has a new book out in 2007, *Geometric Puzzle Design*. Several other related books are described, offered, and/or hosted online at John Rausch's PuzzleWorld site.

I've managed to acquire a few puzzles designed by Stewart Coffin. Some are originals bearing his mark "STC" while the rest are copies of his designs made by other skilled woodworkers.

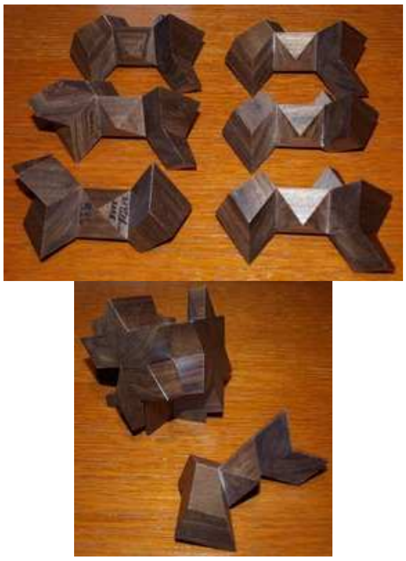
Based on the compendium called *Ap-Art*, written by Stewart and produced by John Rausch, I put together the diagram below which is my attempt at showing a "family tree" of Stewart's interlocking puzzle designs.



This is **[Jupiter]** - designed by **Stewart Coffin**, and perhaps his most iconic work. See U.S. Design Patent [232571] Coffin 1974
This instance was made by French craftsman **Maurice Vigouroux**
This Jupiter came in 60 unit pieces, 10 each of six colors. Five unit pieces assemble to make a "star" and 12 such stars go together, in two halves of six stars apiece, to form the puzzle.
The colors must be distributed such that colored pieces mate, and all pieces of a given color run parallel.

This is a **Double Triangular Prism**, based on the Triangular Prism #12. This instance was made by Pelikan - I obtained it from Bernhard Schweitzer. Shown assembled, beginning disassembly, in two halves, and in six dissimilar, asymmetric pieces.

Mark McCallum made this beautiful ***Sphinx Transformed*** for me. Thanks again, Mark! It's a rhombic triacontahedron, a relative of Stewart Coffin's Design No. 72. The woods include: Kingwood, Spotted Ebony, Bird's Eye Maple, Ziricote, Ceylon Satinwood, Chakte Viga, Narra, Tulipwood, Redheart, Macassar Ebony, Ebony, and Bocote.



Mark also made the **Ring of Diamonds** (STC #13-B) in walnut. The precision is masterful! Thanks, Mark!

Twelve Point (33) or [Augmented Second Stellation]
made by Stewart Coffin

Perhaps one of Stewart's best-known designs is the simple two-piece **Pennyhedron (52)**. I purchased this one made of Wenge from Stewart at IPP26.

Fancy This! (115-A)
made by Interlocking Puzzles

Prism Cell (192)
STC 2003
purchased from Stewart at IPP26

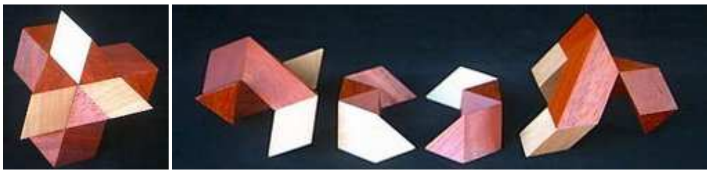
Polly-Hedral was made by Stewart in 2006 and was Jerry Slocum's exchange puzzle at IPP26.

12-piece Separation (85)
Two copies made by Thomas Moeller

Star of David - Improved (37A)
six pieces
unknown craftsman

Four Corners (6)
made by Thomas Moeller
See U.S. Patent 3885794 - Coffin 1975.

Triumph (15)
made by Thomas Moeller

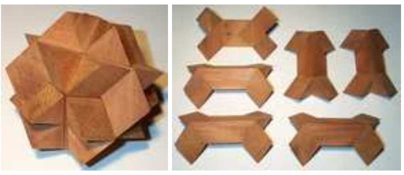


Fusion Confusion (15-A)
made by Interlocking Puzzles.

I purchased this "Multisphere" by Janod from Puzzlemaster.ca. It is Stewart's **Scorpius (5)**.

Dislocated Scorpius (16)
Purchased from Bernhard Schweitzer

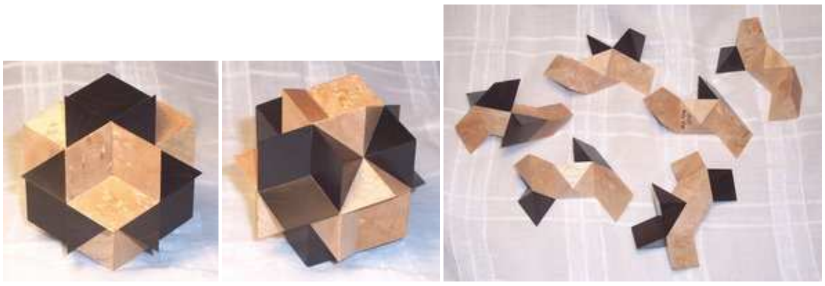
Broken Sticks (32)
Purchased from Bernhard Schweitzer



Nova (8)
six identical pieces
unknown craftsman

Vega (46)
six identical pieces
unknown craftsman

Square Prism
six identical pieces
unknown craftsman

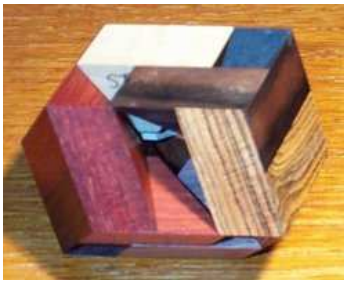


Scott T. Peterson made this **Super Nova (14)** in Bird's Eye Maple and African Blackwood.

The Hill
Introduced at IPP26 in 2006 at Boston. Unusual Coffin design, as a single piece comes out on the first move, then another piece, with the remaining four requiring coordinate motion!

This is Stewart's Split Star (75), made by Mark McCallum. It is a two-tier design, with a garnet at its heart and outer pieces of bubinga wood forming the diagonal star shape.

I bought this beautiful version of Stewart Coffin's **Garnet** (60) design, from Cubicdissection. It was made by Mark McCallum. Stewart calls it the *dissected rhombic dodecahedron*, and it is described in chapter 15 of Stewart's book. There are nine possible distinct asymmetric pieces, and this version is made from pieces A through F. Disassembly is fairly easy, but if you mix up the pieces, reassembly is challenging. My approach is to try all possible groups of three to make a half. The remaining three must form a mating half. A group of three pieces might fit together in several ways, so one must explore the possibilities carefully.

Starting in the top row, from left to right, the piece IDs and woods are:
(A) Macassar Ebony, (B) Bocote, (C) Honduras Rosewood, (D) Holly, (E) Bloodwood, (F) Brazilian Rosewood.

Pelikan's **Garnet Ball** - a spherical version of Stewart's Garnet. This puzzle uses mirror images of pieces A thru F.
Purchased from Bernhard Schweitzer

Here is a beautiful version of Stewart Coffin's Augmented Four Corners puzzle (34), made from Canarywood and Redheart by Mark McCallum, and purchased from Cubicdissection:

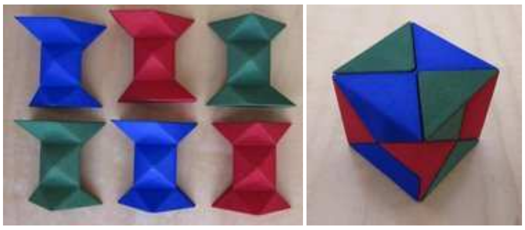
  

Scott T. Peterson has made a **Rosebud (39)** for me, from Bloodwood and Lignum Vitae, a very aromatic wood. There are six pieces - three "left-handed" and three "right-handed." They are *extremely* difficult to assemble into the Rosebud configuration. There is, however, a much easier assembly, shown in the center above.

Pieces of Eight (77)
made by Interlocking Puzzles. (Some nice photos from the old IP website.)



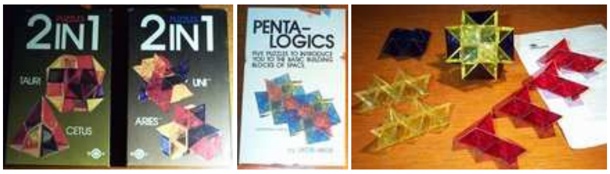
Stewart Coffin's Diagonal Cube design -
modeled by George Bell using BurrTools and printed by Shapeways -
available at George's Shapeways Shop.
(Images are George's - he dyed his pieces. Mine are white.)

I received a beautiful **Stellated Improved Square Face** puzzle (SISF for short),
designed and made by the talented **Scott T. Peterson** [W] [Y],
based on the Square Face Puzzle (74A) designed by **Stewart Coffin**.
My copy is made from Blackwood and Lacewood.

The 3M Hectix and The Geo-Logic Line

Stewart Coffin licensed several of his polyhedral designs to various companies which produced them in plastic.

Stewart Coffin and Bill Cutler both independently came up with the design of 12 interlocking notched hexagonal sticks (copied by Tenyo's "Papa" puzzle shown elsewhere).
Stewart's version was produced commercially by 3M, who called it "Hectix."
I've obtained the red/white/blue, white, and clear versions of Hectix.
See U.S. Patent 3721448 - Coffin 1973.



Some of Stewart's other designs were produced commercially in plastic as part of the Skor-Mor "Geo-Logic" and "Penta-Logics" lines. I obtained Tauri, Cetus, Aries, and Uni in 2-in-1 packs, and a Nova separately. The Penta-Logics included Spirus and another Nova. Luckily, all of the pieces are intact. Each puzzle is composed of a set of six particular identically-shaped pieces (a different piece type for each puzzle), which fit together either in two halves or using coordinate motion.
The Tauri is described in Stewart Coffin's book *The Puzzling World of Polyhedral Dissections* (see fig. 97).
The Penta-Logics set allows you to make a "Galaxy 1" (shown, with leftover pieces) and a "Galaxy 2" (not shown).


Aries

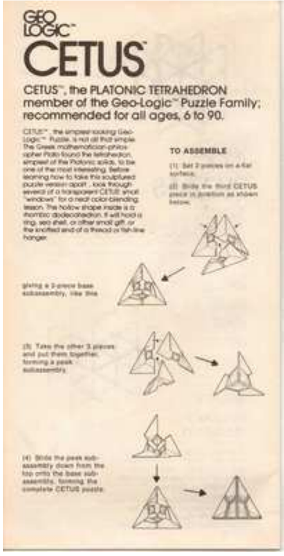

Cetus


Nova

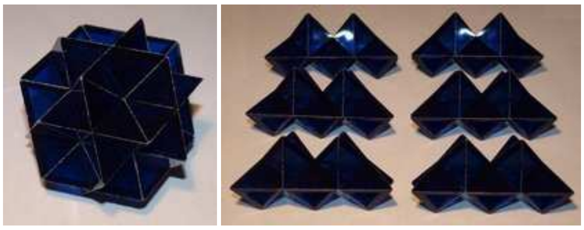

Tauri


Spirus

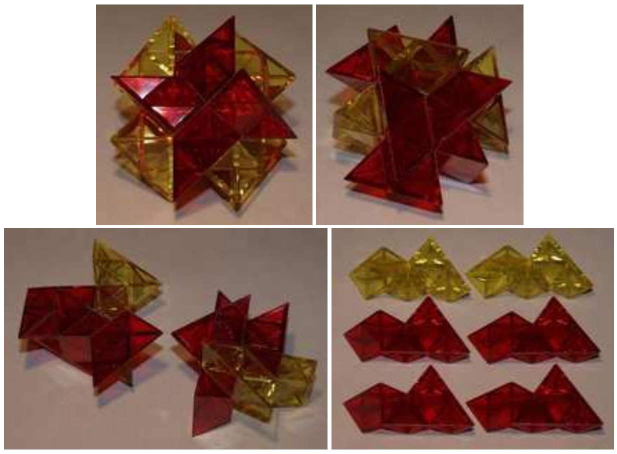

Uni (A real pain to assemble!)



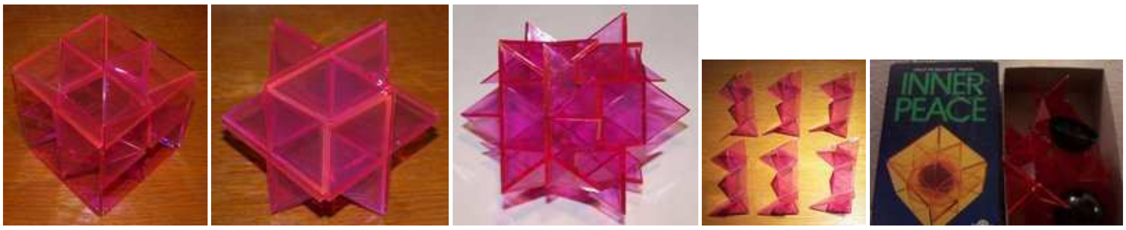
Cetus instructions and six identically shaped pieces.



Nova



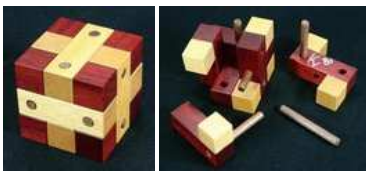
Spirus



The Geo-Logic line also included an "exploding cube" called "Inner Peace." It has six identical pieces.
I obtained one but with no box - I did not know what it was until I found a box shot on the web.
The six pieces can be built into a cube or a stellated rhombic dodecahedron. The latter is a very tight fit.

Pinned Assemblies

This is a puzzle called "**Rube's Cubic**" purchased from IQ Puzzles. It is also described in Coffin's book, as the **Pin-hole Puzzle.** As Stewart says, it is fairly easy to assemble.



This is Coffin's **Corner Block** puzzle, made by Kerry Verne from Yellowheart, Bloodwood, and Walnut (pins). Purchased from CubicDissection. Stewart describes this type of puzzle in his book, showing a set of possible pieces. Coffin's Corner Block uses pieces numbers 1, 2, 3, 7, 8, and 12, and one pin. Stewart says he has been unable to find a selection of pieces that can be assembled one way only. This set has two solutions.

This is the "**Ancient Key**" puzzle, from the Mandalay Box Company. This is a variant of the Corner Block. The Ancient Key uses pieces numbers 1, 2, 3, 7, 11, and 12, and one pin.

Arjeu CT442 (Colorado)
purchased from Ishi
Also known as Electrons, by Janod.

Arjeu CT210
purchased from Ishi

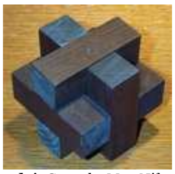
Arjeu CT795 (Cactus)
gift from Jeff Taylor

This is Arjeu's Quadro (CT755), purchased from Ishi. It is a simple version of Coffin's **Locked Nest** puzzle and is described in Coffin's book in Chapter 13 (see figure 130b).

Tetralott by Markus Goetz (Philos)

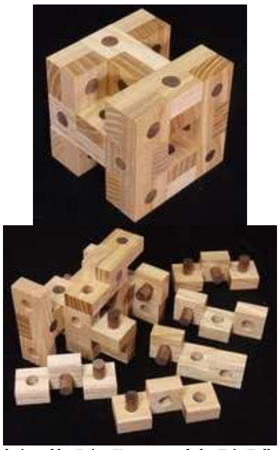
Arjeu CT5152
aka **Achille**

Tipi - Bits and Pieces



Woodn't Cross by Mag-Nif 1974

Charles O. Perry's **The Double** (my favorite).



Alchemy, designed by Brian Young, made by Eric Fuller, from Ash wood.

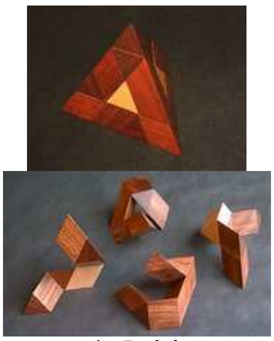
The Aqube, purchased from Puzzlemaster.
(I got the Psychodelic version - blue pieces shown for example.)

Irregular Assemblies

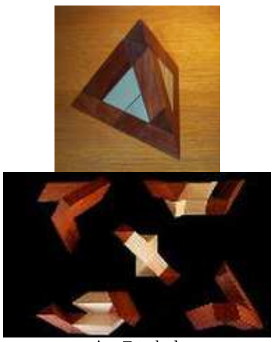
This is my catch-all group for interlocking puzzles made of pieces and/or forming shapes that aren't geometrically easily described. Some are figural representations of various animals or objects, while many are abstract geometric fantasies. Sometimes the pieces of the puzzle are similar, sometimes dissimilar. They can be made from wood, or plastic, or metal.

I'll start with a beautiful spherical puzzle called the **O. S. M. Ball**, designed by Jakub Dvorak of the Czech Republic. I purchased this from Bernhard Schweitzer at IPP28 in Prague. Eight pieces. The first and second moves are tricky to discover. Made from beautiful hardwoods.

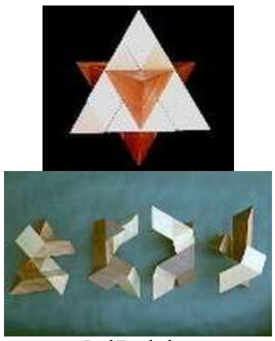
These are from **Interlocking Puzzles**. Some were designed and/or made by Wayne Daniel. All of these puzzles are very well made and attractive.



4-piece Tetrahedron

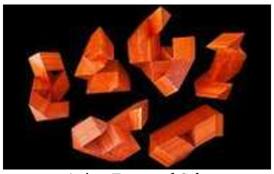


5-piece Tetrahedron
Padauk and Beech



Dual Tetrahedron

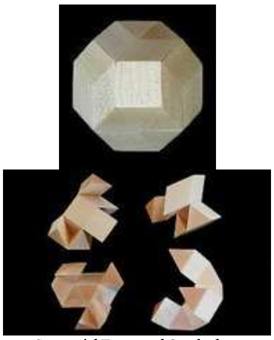
5-piece Truncated Cube
The Truncated Cube is surprisingly hefty, and very nicely finished.
Very unusual piece shapes.
Brazilian Cherry (Jatoba)



6-piece Truncated Cube
Padauk

7-piece Truncated Cube
Jarrah
For me this has been the most difficult of the three truncated cubes.

Rhombic Crystal



Sequential Truncated Octahedron
Maple

[Vaclav Obsivac](#) (aka "Vinco"), makes wonderful wooden puzzles.

I have acquired several, some purchased from [puzzlemaster.ca](#), others from Cleverwood or directly from Vaclav.

[Cross in Ball](#)

[Prismastar](#)

Twister 1

UFO

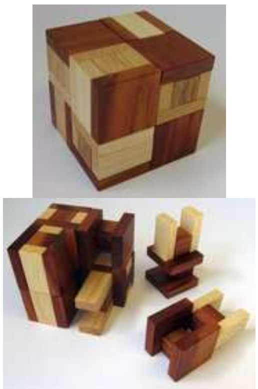
The **Hedgehog**
purchased from Cleverwood

The **Trick Box** is also a coordinate motion puzzle - darned hard to assemble.

This small 4-piece ["Cube Vinco"](#) was a gift from Vaclav at IPP26.

Cubetresor

This is the Button Prison from B & P.



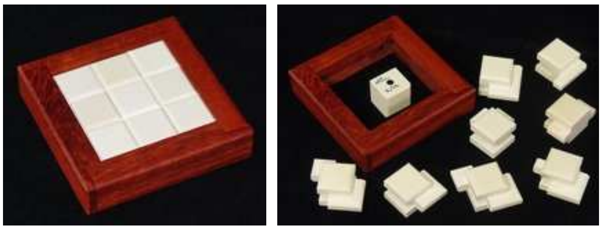
This is **Two U**. It is described on [Vinco's website](#). In addition, there is a nice [chart of various types of "half-cube" puzzles](#). This puzzle reminds me of Coffin's Pieces of Eight. Purchased from Vaclav at IPP28 in Prague.

This is Vinco's **Vidly Half-Cubes**. Although technically this isn't an Interlocking puzzle, I show it here since it is another of Vinco's series of half-cube designs. A gift from Vaclav at IPP28 in Prague. Thanks!

IPP 31 - octahedron - Vinco

Xcruci8 - designed and made by Vaclav Obsivac
Exchanged at IPP28 by Laurie Brokenshire
Purchased from Laurie at NYPP2011

Additional interesting interlocking designs...

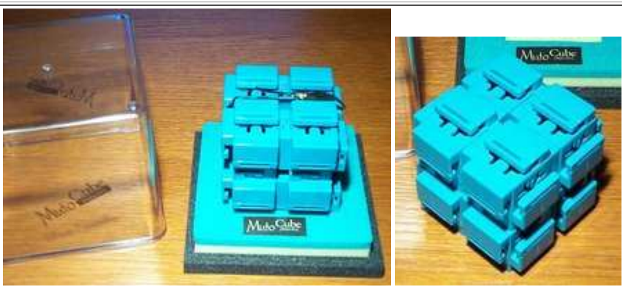


Tom's Square Dance, designed by Tom Jolly, made by Eric Fuller, from Padauk and Holly woods. This design is difficult to classify - the objective is to remove the nine pieces from the frame, then re-assemble the puzzle. The pieces interlock with each other and the frame via tabs and grooves. It seems like a sliding-piece puzzle but it really isn't, though its solution does depend on finding a sequence of correct movements of the pieces.

This is George Hart's "Screw Cube" - a two-piece interlocking puzzle George invented and 3D printed with white nylon. I got **prototype number 1** from him at one of Brett's Manhattan puzzle dinners.

It's not too difficult, but everyone who plays with it likes it and is a little stumped at first. I think it's a classic. Thanks again, George!

This puzzle is called **Pulsar**. It is based on a design by Victor Genel, modified by Benji and Ginda Fisher, and served as the Fishers' exchange puzzle at IPP 20. It was made by Wayne Daniel. In the modified design, two pieces are fused to two others, and the cubic central cavity is occupied by a bisected cube.



These are **Oskar's Matchboxes**.
The first set I got from gemanigames.com. They're not really matchboxes - the "interior" pieces are solid, not hollow boxes. Also, not all interiors fit easily into all containers and the ends have obvious saw marks with overall finish being mediocre. Still, I am happy to have them and the puzzle is fairly challenging. The solution configuration does fit together nicely. I have wanted this puzzle since first reading about it on page 81 of Slocum and Boterman's *Puzzles Old and New* way back when, and I was glad to find a vendor selling it.

This is a **Muto Cube** from Japan. I've seen it on only one other collector's (Martin Watson's) site.

Eric Fuller made the second set, from Madrone and Aformosa woods. These are beautiful - the boxes actually have walls and interiors and the fit is great.

These are **Oskar's Cubes**.
The large wooden version is from Tom Lensch.
The small aluminum version is from B and P.
You can see the pieces at Ishino's site.

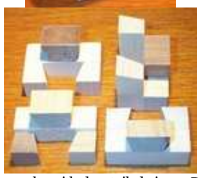
 

The **Devil's Half Dove-n** and the **Devil's Other Half Dove-n**.
Designed by Pavel Curtis.
From Puzzlecraft, gifts from LuAnn.

This puzzle is called **Six Tabbed Planks**.
It is made from acrylic. I really like it - the proper configuration can be logically deduced with a little effort, and the assembly is sequential.
Unknown designer. Purchased from Pavel Curtis.
Pieces shown here.

Six-piece ball
(aka Faberge Knot)
Made by Lee Krasnow - mechanism is identical to the Six Tabbed Planks from Pavel Curtis.

Caged Spheres (in purpleheart wood)
Also purchased from Puzzlecraft.



A 4-piece cube with dovetailed pieces. Designer unknown to me.

This is Arjeu's **CT87**.
This was designed by Oskar van Deventer. Evidently Arjeu never compensated Oskar! Tom Lensch is selling a really nice version.

Myopic Doves by Rick Eason.

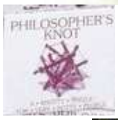
The **Dragon Cube**, designed by Doug Engel. Issued by Philos. Purchased in Montreal.

The **Tease** puzzle cube designed by Sam Cornwell and made from Quilted Sapelle, Wenge, and Carolina White Ash by Eric Fuller. Five pieces, and five moves to get the first piece out.

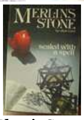
 

This is **Oskar's Patchwork Box**, designed by Oskar van Deventer and made by Tom Lensch. Purchased from Tom at IPP 29 in SF.

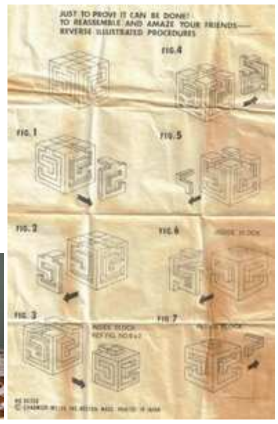
This cube was included in an auction lot. I didn't recognize it at the time, but after I received the lot I realized this was a copy of the **Frankfort Cube** I had wanted after I saw it on Casse-Tete et Solution (scroll down to item #33).





Plato's Secret
See U.S. Patent 3695617 - Mogilner and Johnson 1972. See also D0224974 - Mogilner 1972.
A puzzle based on tensegrity - "tensional integrity" - a balance between tension and compression. (For another example, see Bathsheba Grossman's "Moon Pi.")
A number of sticks with slots at each end, a cord, and a ball for the center. The first challenge is to remove the orb without disconnecting anything. The second challenge is to (re)build the structure - lash the sticks together in the proper pattern to create a polyhedron around the ball. The patent describes a structure with 12 sticks, and mentions 9 and 15-stick versions, claiming that tensegrity structures can be made from any number of sticks. The puzzle has appeared with 10 sticks, forming a dodecahedron (12 pentagonal faces, 20 vertices).
I've also seen this called the "Philosopher's Knot" (1975 by whom?), "Plato's Plight" (Mag-Nif 1971), "Cobweb" (Reiss), "Knit Wit" (Romany 1974), and "Merlin's Stone" (Skor-mor). Supposedly it has also been called the "Philosopher's Stone" though I have not seen that version.
Richard Whiting has a solution to a version he calls Whiting's Woe on his website.



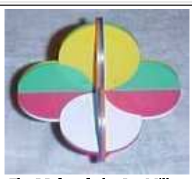
A vintage **Think** puzzle by Chadwick Miller of Massachussetts. Made in Japan. Copyright 1968.

The **Kuball**,
a 3-piece puzzle designed by Viktor Genel. Made by Tom Lensch. See the pieces at John Rausch's PuzzeWorld.


This is **Trickstix**, by Harris. See U.S. Patent 2473369 - Harris 1947.
The similar cage with rotating sticks and a ball inside is a common design.


I have had this small plastic red, white, and blue puzzle cage since I was a kid, and I think it was from Adams - it may be either the Locked Blocks or the Oriental Puzzle (also pictured for reference) - I no longer have the packaging. Its pieces are more decorated than the Trickstix.

Adam's **Block Puzzle Senior** and **Locked Blocks**
I finally obtained instances of these two in their original packaging.



The **Molecule** by Joe Miller.
See U.S. Patent 5762336 - Miller 1998.
Entered in the IPP 2001 Design Competition.

Here are several offered by Bits & Pieces at various times...

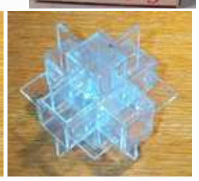





Meiji Cheese Curls, and the "Light" version.





Several classic puzzles by Mag-Nif and Reiss that I have had since I was a kid. From Mag-Nif: Four Square, Third Dimension, and the Curious Cross in smokey plastic and blue plastic. Some 1974 Reiss puzzles: Equilibrium, Star, and Reiss' version of Curious Cross, which they call Torment.


A 12 Sticks puzzle by George Hart, 3-D printed on his Makerbot. This is the 1st of his series of stick puzzles!

Stephen Chin of Australia is a skilled woodworker and woodturner. He created a beautiful apple-shaped wooden interlocking / coordinate motion puzzle he calls **1 Pinko Ringo**, inspired by Wayne Daniel's 10-piece icosahedron. Stephen's puzzle was among the top 10 vote-getters in the 2010 IPP Design Competition. A similar puzzle by Stephen called the Bomb won the first Rochester Puzzle Picnic Puzzle Competition. Stephen has also created his own version of the icosahedron, known as the "Spinico." Brian Pletcher blogged about it. **George Bell** did some CAD modeling and after several prototypes to get the angles just right, offers spherical versions of Stephen's design in two sizes at his Shapeways shop. He calls this the **Exploding Ball**. The puzzle comprises 10 identical very interesting pieces. The dissection using 10 identical pieces was at first thought to be impossible to assemble, but it can be managed. Disassembly can be challenging if you cannot think of a convenient method. I bought the larger version.




More, in wood:




These two sets of "Brain Benders" from Cardinal (blue box and red box, 3 puzzles each) include a six-piece Diagonal Star, a Chuck similar to Pentangle's Woodchuck, above, a traditional 6-piece burr, a wooden version of an 18-piece puzzle similar to Mag-Nif's Third Dimension, a rods-and-pins "Nest" puzzle similar to the Arjeu Quadro, and another 12-piece chuck called "Double Cross." They are cheaply made from softer wood, and I've seen them at toy stores for $3.99 a box. Similar sets are branded by Pavillion.



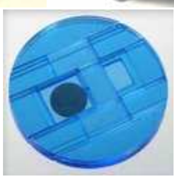

More, in plastic:













This is the TenGeo Great Circle Challenge.

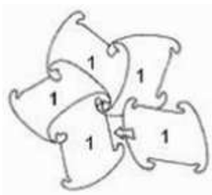
This is a selection of "Mighty Midget" puzzles from Mag-Nif:

I got this lot of 3 of the same "Chinese Burr" in different colors, from a French auction. I gave away two and kept the green one. Normally the #1 mechanical puzzle rule is "No Force Required!" but this puzzle really requires some force for the first and later moves.

These 4 "Travel Puzzles" are from Game Kingdom: ball in cage, 6x6x6 sticks, star burr, depth charge:

Ms. Leone, a teacher at the local elementary school, uses puzzles in her classroom.
Last year I loaned a bunch of puzzles to her for her students to try,
and she was very kind to send me a **Cyclone** puzzle as a thank-you. Much appreciated!

The Cyclone is offered by The Lagoon Group.

Interestingly, this design seems to have first appeared as a lamp!
The product IQ Light won the 2001 Danish Design Award for its packaging.
IQ Light was designed by Holger Strøm of Denmark in 1973.
It is based on a single piece or tile, various numbers of copies of which
can be interlocked to form more than 21 different shapes.
30 tiles form a triacontahedron.
In the assembly, there are 12 vertices where 5 tiles hook together, and 20 vertices where 3 tiles hook together.

You can find a template for the piece at www.craftster.org.
William Chow has a website explaining the geometry of what he calls the **Celtic Tile**.

Puzzle friend and renowned sculptor and mathematician **George Hart** has been creating beautifully symmetric, complex, and puzzling geometric assemblies for some time.
Large versions of many of George's sculptures have been installed at universities, parks, and various other public and private spaces. George has recently joined the team at the **Museum of Mathematics**, scheduled to open in New York City in late 2012.

You can now own a copy of one of George's beautiful designs - it's called **Frabjous** and is available from the folks at Artifacture in Dallas, who sent me this 6" x 6" x 6" **Special Edition Frabjous**, laser cut from Acrylite Radiant Acrylic. Thanks, Michael!

This type of acrylic material reflects light in different colors from different angles and provides a fascinating display of varying hues as you move around the sculpture. The puzzle sculpture comes unassembled, in a package that includes instructions, 31 S-shaped pre-notched interlocking pieces (one extra piece is thoughtfully provided), and even a pair of cotton gloves to wear during assembly, so that you can avoid getting fingerprints in hard-to-clean places! Artifacture sells direct through various online outlets (see links on their product page), including their Etsy shop. Artifacture has produced Frabjous for MoMath (the MoMath logo, and George Hart's name, are engraved on one piece) and Frabjous is also available at the MoMath online shop. (A less expensive version is available in blue.)

It took me about an hour to assemble Frabjous. I had to recover from a false start when I realized I had been careless while interweaving some of the pieces. I disassembled what I had so far and started over, being much more deliberate. The pieces lock together by friction/pressure fit using simple rectangular tabs and notches at apexes where three pieces meet - the hold is secure, but it is possible to work the pieces apart again without too much trouble. One thing I was pleased about is that though acrylic in general seems to have an unfortunate tendency to crack at angular cut-outs, I experienced no faults in any of the Frabjous pieces even after I had attached and detached them multiple times.

During my second try at putting Frabjous together I actually found that if I ignored the included instructions and instead concentrated on the five-fold symmetry of the structure, adding five pieces at a time in symmetry around the growing assembly, I could much better ensure the correct relative placement of the pieces. Something to note is that you cannot simply create a bunch of "tripods" and then expect to link them together - it is too difficult to properly interweave such sub-structures. I took photos along the way - I think you'll agree that Frabjous is a beautiful object! I can also attest that Frabjous is a puzzling challenge to assemble, and you will enjoy a nice sense of satisfaction on completing it. My wife even let me put this one on display in the family room!


MOMATH
MUSEUM OF MATHEMATICS
SPECIAL EDITION
FRABJOUS
PUZZLE/SCULPTURE

Use the included cotton gloves during assembly to avoid fingerprints in hard-to-reach places.

MO MATH










Here are some interlocking irregular geometric designs made in metal.

This is a **Glingle Ball**
Copyright 1984 R. E. Sanson
I've had it a looong time, and NEVER took it apart!

Charles O. Perry's **Zen**

The **Buffalo Nickel** is clever - it is a two-piece (plus "case") interlocking. It made by George Miller, based on a design by Oskar van Deventer. Bits and Pieces marketed this nice metal version. See this article by Oskar on Planar Burrs (PDF file).

Impossicube - Markus Goetz (B & P)

The **Lucky Clover** from B and P was designed by Oskar van Deventer. It has only 4 pieces but requires many steps to assemble properly.

Gravity Well - Bits and Pieces

Double Monad (Yin-Yang) - Bits and Pieces

Butterfly - Bits & Pieces

The **Ego Sculptural Puzzle** is a 6-piece version of the Third Dimension style above. It was offered in a "Good Design" box by Austin Enterprises and Something Else Inc. of Akron Ohio and Ossining NY.

From Bits & Pieces, a Curly Cube, designed by Vladimir Krasnoukhov.

This is a sculpture puzzle called "**Moon Pi**" made by the artist Bathsheba Grossman, using a direct-metal 3-D printing process driven by a CAD design. I learned about it via James Dalgety's Hordern-Dalgety Puzzle Museum site.

The **Peppermint Twist** puzzle was introduced at IPP17 by John Ergatoudis. It consists of five twisted metal rods that, surprisingly, interlock. If one rod is slid out of the bundle, it collapses, and is a challenge to reconstruct.

Entangled Fish - B & P

Great Collision, designed by Doug Engel. Purchased at IPP 29 in SF.

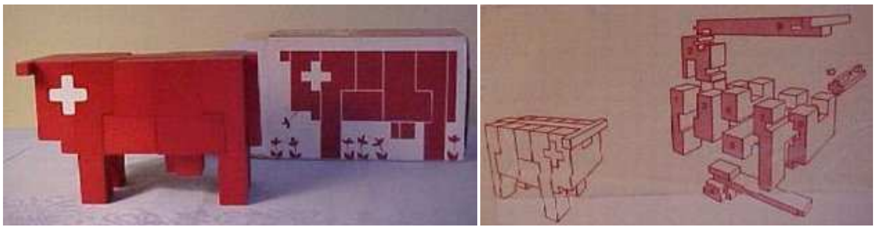
While most of the Irregular Assemblies are geometric shapes, some are in the form of various figures.

This is **Mr. Puzzle** from Bits and Pieces, which contains several different kinds of puzzles including interlocking (his feet).

A **Hartley's Humpty Dumpty Egg** puzzle U.S. Patent D160283 - Irving Hartley Steinhardt 1950.

This is **Nanook the Polar Bear**.

This is **Naef's Swiss Cow** or **Vache Rouge**. It was designed by Gerard Petremand in 1978. This version has six pieces.



This version of **Vache Rouge** has more pieces.

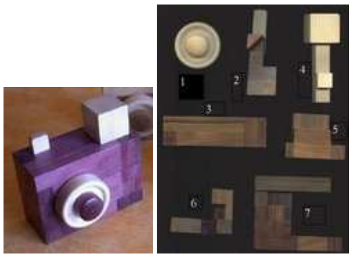
A hand-carved wood **Dragon** puzzle from Thailand or Mongolia, I'm not sure.

The **Sphinx** (or Turtle). Getting it apart was somewhat of an ordeal, as some pieces were fused by the sloppy shellac on them - but fortunately I separated them without damaging anything.

A vintage locomotive puzzle by Reiss.

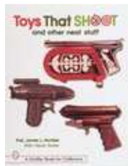
The **R. B. Rice Sausage Company Pig puzzle** (Lee's Summit, MO). Virtually the same pieces as Nanook, but smaller and less dense.

Cicada by Kathy Bass
Available from Mr. Puzzle Australia (Brian Young). Obtained at NYPP 2008.



From William Waite, the **Camera Conundrum**.

Keychain Puzzles



There are many **keychain** puzzles. They include interlocking, twisty, sliding piece, dexterity, and other types. Even if they don't actually have a keychain attached, they're characterized by being diminutive. Often there is a hole or a loop where a chain *could* be attached. In this section, I have focused on the interlocking variety of keychain puzzles.

The 1998 book *Toys That Shoot and Other Neat Stuff* by James Dundas has a section on keychain puzzles on pages 70 through 80. Dundas shows about 70 puzzles and suggests rarity and dollar values for them. The auction website eBay started in Sept. 1995 and the evaluations given by Dundas should now be considered in the light of how eBay has affected the market.

In 2011, Jerry Slocum and William Waite issued their **Compendium of Keychain Puzzles**, which gives details for 465 puzzles.

William Waite has an extensive collection of keychain puzzles. You can see a variety of interlocking keychain puzzles at Waite's website.

I haven't organized the keychain puzzles below, but you'll see examples from several categories: Animals & Riders; Vehicles, Planes, & Rockets; Tools & Other Equipment; People, Robots, & Other Whimsical Figures; and Geometric Cubes, Spheres, & Miscellaneous Shapes.

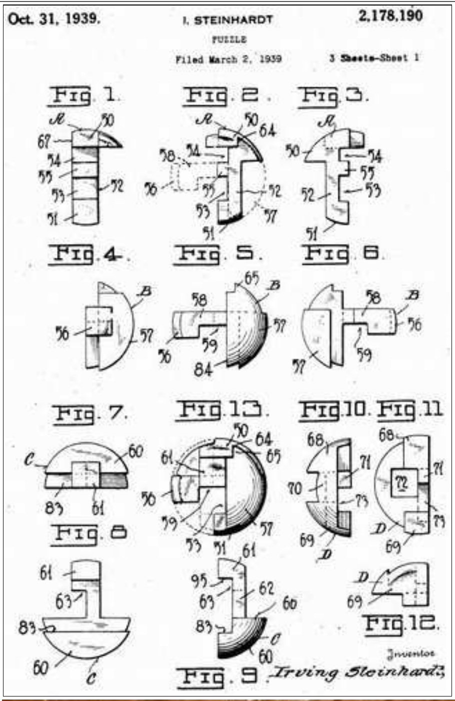
"In 1935, at the height of the Depression, a group of New York businessmen decided that what the city and the nation needed to lift itself out of the difficulties of the times was an international exposition. That same year they formed the New York World's Fair Corporation and established an office on one of the higher floors of the new Empire State Building, electing Grover Whalen the President of the organization." The 1939 New York

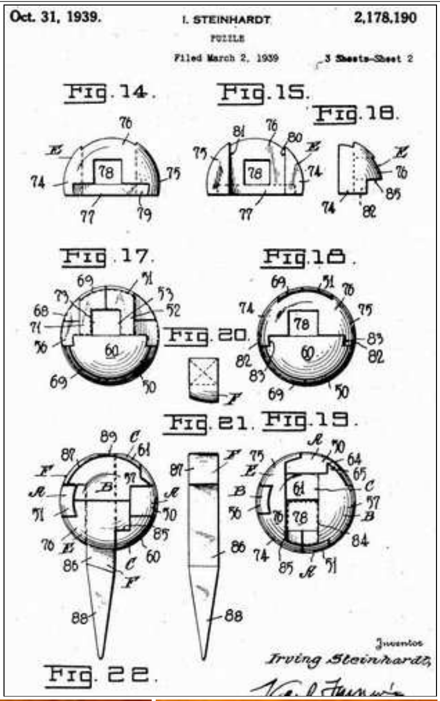
World's Fair opened on April 30, 1939, closed for the winter on October 31 1939, reopened on May 11 1940, and closed down on October 27, 1940, having drawn about 45 million admissions.

This is a **Trylon Perisphere** puzzle souvenir from the fair. It is very small, and I have read that **this is the puzzle that gave birth to keychain puzzles** (even though it has no chain).

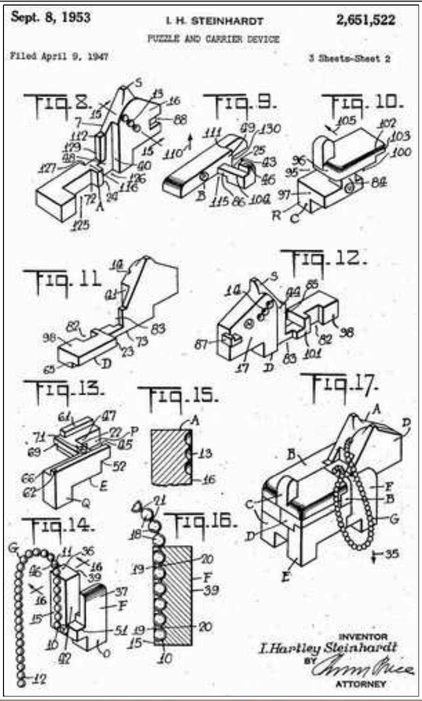
Irving Steinhardt received patent 2178190 in March 1939 for a six-piece interlocking puzzle. The patent depicts a spherical puzzle with an obelisk through it, but notes that the outside shape can vary. The drawings also include a bottle shape. The sphere pieces shown in the patent match the pieces of this puzzle. Steinhardt's design patent D112470 of Dec. 1938 clearly shows the Trylon Perisphere design, and is cited on the puzzle box. Steinhardt also received design patent D118253 in Dec. 1939 for an egg-shaped interlocking puzzle.

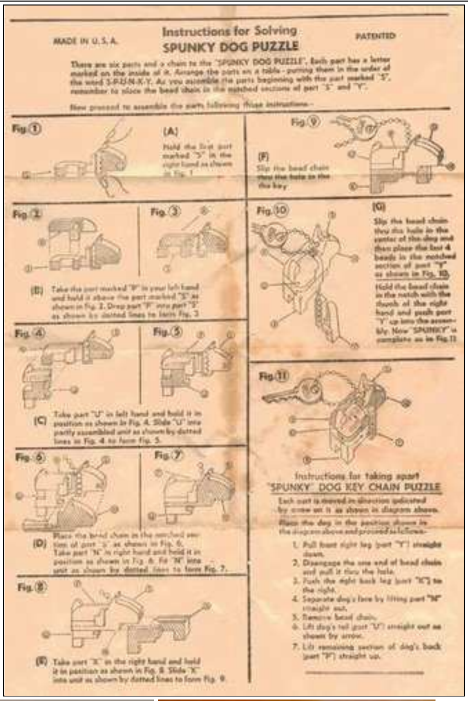
Steinhardt has many puzzle patents.





This interlocking keychain puzzle ball was patented by Irving Hartley Steinhardt in 1939 (2178190).
This patent number is embossed on the hollow inside of the green key piece of the example with the chain.
The six letters W-H-A-L-E-N are embossed, one in each of the six pieces. Grover Whalen was president of the New York World Fair Corporation, and helped run the 1939 fair - for which Steinhardt's Trylon Perisphere puzzle was issued.
This puzzle ball contains virtually the same pieces as the Trylon Perisphere, except the Trylon key piece has been truncated and become part of the ball.
According to Slocum and Waite, this is the **first keychain puzzle**, issued by the Helenhart Novelty Company of New York City.
Steinhardt also patented the horseshoe-shaped clip, in 1942 (D132116), and another type of retension device having a cord, in 1944 (2361069).





MADE IN U.S.A.

Instructions for Solving
SPUNKY DOG PUZZLE

PATENTED

There are six parts and a chain to the "SPUNKY DOG PUZZLE". Each part has a letter marked on the inside of it. Arrange the parts on a table - putting them in the order of the word S-P-U-N-K-Y. As you assemble the parts beginning with the part marked "S", remember to place the bead chain in the notched sections of part "S" and "Y".

Now proceed to assemble the parts following these instructions:-

Fig. 1

(A) Hold the first part marked "S" in the right hand as shown in Fig. 1

Fig. 2 Fig. 3

(B) Take the part marked "P" in your left hand and hold it above the part marked "S" as shown in Fig. 2. Drop part "P" into part "S" as shown by dotted lines to form Fig. 3

Fig. 4 Fig. 5

(C) Take part "U" in left hand and hold it in position as shown in Fig. 4. Slide "U" into partly assembled unit as shown by dotted lines in Fig. 4 to form Fig. 5.

Fig. 6 Fig. 7

(D) Place the bead chain in the notched section of part "S" as shown in Fig. 6. Take part "N" in right hand and hold it in position as shown in Fig. 6. Fit "N" into unit as shown by dotted lines to form Fig. 7.

Fig. 8

(E) Take part "K" in the right hand and hold it in position as shown in Fig. 8. Slide "K" into unit as shown by dotted lines to form Fig. 9.

Fig. 9

(F) Slip the bead chain thru the hole in the the key

Fig. 10

(G) Slip the bead chain thru the hole in the center of the dog and then place the last 4 beads in the notched section of part "Y" as shown in Fig. 10. Hold the bead chain in the notch with the thumb of the right hand and push part "Y" up into the assembly. Now "SPUNKY" is complete as in Fig. 11

Fig. 11

Instructions for taking apart
"SPUNKY" DOG KEY CHAIN PUZZLE

Each part is moved in direction indicated by arrow on it as shown in diagram above.

Place the dog in the position shown in the diagram above and proceed as follows-

1. Pull front right leg (part "Y") straight down.
2. Disengage the one end of bead chain and pull it thru the hole.
3. Push the right back leg (part "K") to the right.
4. Separate dog's face by lifting part "N" straight out.
5. Remove bead chain.
6. Lift dog's tail (part "U") straight out as shown by arrow.
7. Lift remaining section of dog's back (part "P") straight up.



This interlocking keychain puzzle is **Spunky the Dog**, patented by Irving Hartley Steinhardt in 1953 (2651522).
According to Jerry Slocum, Spunky was Steinhardt's pet dog.
The six letters in S-P-U-N-K-Y are embossed, one in each of the six pieces.
Spunky, and other dogs, have appeared in several forms, including one having asymmetric-sized ears (2nd from left).

As a kid, I had a **Bibendum** (Michelin Man) keychain puzzle I got at a car show at the NY Coliseum. It disappeared long ago, but after searching for some time, I finally found another one.
This puzzle is the last of four "Lost Puzzles of My Childhood" (Drive Ya Nuts, Phony Baloney, Screw Loose, and Bibendum) that originally motivated me to start following auctions!



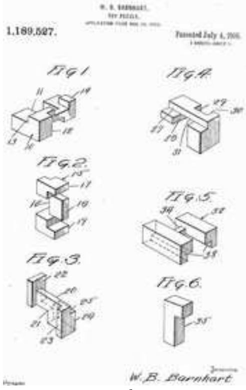
A pair of keychain interlocking puzzle Robots. The black and white one came from Russia.



A Howdy Doody keychain puzzle, and another in its package.

Small Cube keychain puzzle





A cube.

William Barnhart received patent 1189527 in July 1916 for a cube design. The pieces are similar to but not the same as the cube shown here.



A soft plastic cube. Different pieces than the previous cube. The same design as the larger Frankfort Cube shown elsewhere on this page.



Keychain Cube
I know this as the "Frankfort Cube" - this instance is in hard plastic.

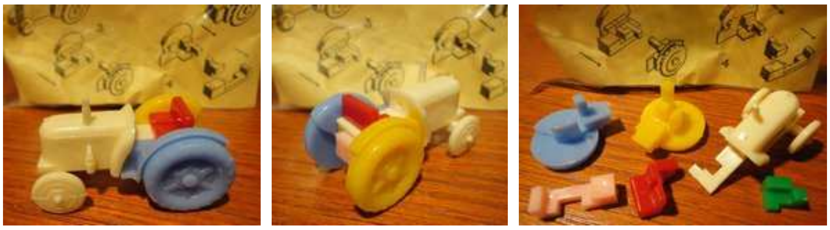
Keychain Coffee Grinder (French)
The pieces are similar to those of the first cube shown above.


A ball, burr, and Kumiki barrel.

These are from Mefferts.


Keychain Jeeps
(The windshield frame is damaged on the white example.)


Soft plastic Tractor keychain



Two hard plastic Tractor keychains, with packages

I've had these two since I was a kid.

mini Rubik's Snake

Each keychain puzzle typically contains six pieces. Here is a photo of a bunch of pieces mixed together. Can you figure out which pieces go with which puzzle?

This bowling ball and pin came in a set of puzzles by Kawada, from Japan. They're small enough to be keychain puzzles, but do not have chains attached.

Bowling Pin keychain puzzle
Same mechanism as previous, but a bit larger, and thinner plastic.

Bowling Pin keychain puzzle
This one has a bowling ball inside!

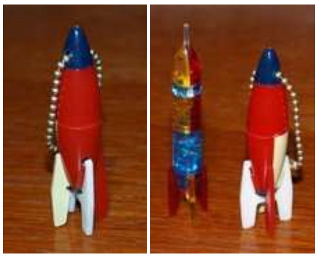
Interlocking keychain puzzle Tanks

William Waite was kind enough to provide some info on what I thought was called the "Contortionist" keychain puzzle. It turns out this model is actually known as the **Wha Hoppen** or Wrestler puzzle. The hapless wrestler has been tied into a pretzel by his opponent. I found an image of the card, shown. William says this was marketed by the Harrison Co. of Long Island City NY in the 1950s.

Additional Wrestlers
I think the proper assembly is with the feet directly behind the head and in front of the tab on the back piece. This requires you to remove the head before you can free the legs.

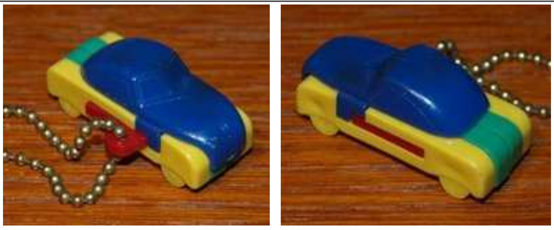
Burro and Rider puzzles

A really nice rocket ship.



Rocket keychain
at the Launch Pad...

Space Ship keychain puzzle



Car keychain

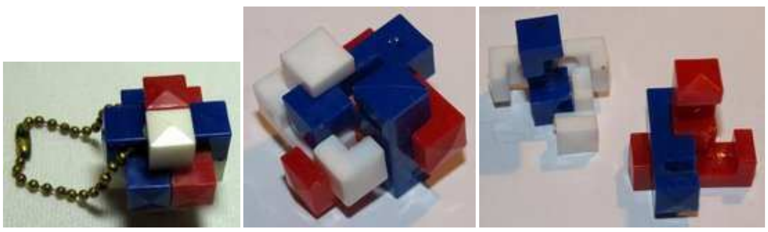
Airplane keychain

A trio of Sedan keychain puzzles

A pair of Airplane keychain puzzles.

A different type of Airplane, compared to the previous type.

Keychain F-104 - Japan

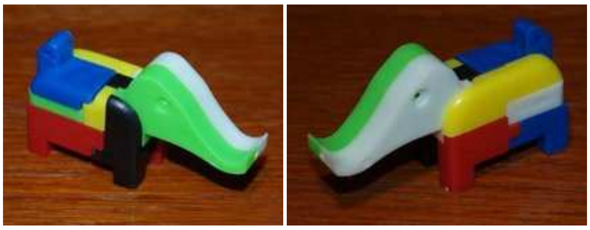


Six-piece burr keychain puzzle

Football keychain puzzle

Pig keychain puzzle
(Same base assembly body as elephant above.)

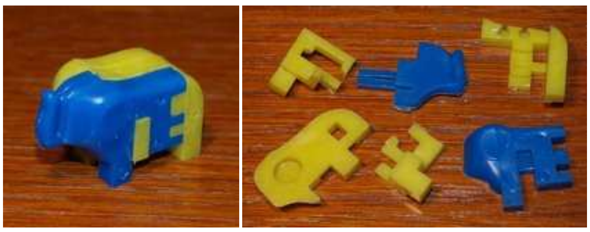
Two examples of an Elephant keychain
This type has a separate ears piece.



Elephant keychain
In 1953, Irving Steinhardt received patent [2651522](2651522) for this type of keychain puzzle (the patent depicts the dog head).

Two examples of an Elephant with Clown rider keychain

Two examples of an Elephant keychain
The head is a single piece - note the tab at the top of the back of the neck.
William Waite discusses variants of this Elephant.



soft plastic Elephant keychain
Pieces are similar to but different from the elephant above right.
Here, the head is three pieces.

Elephant keychain
Another variant - note the absence of the tab at the top of the back of the neck.

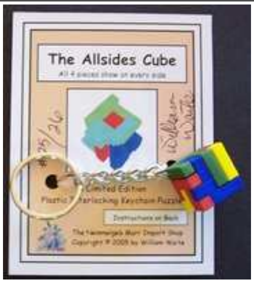
Two examples of a German Elephant keychain

Giraffe keychain

Camel Rider keychain puzzle

Keychain Camel Rider (green)

Keychain Elephant - Mechanical Servants




Allsides Cube keychain puzzle - designed by [William Waite](#)
Mine is #16, from a limited edition of 26 puzzles. Includes a signed card reminiscent of the way keychain puzzles were sold in the 50s.
Each of the four pieces touches all sides of the cube, hence the name. Four moves to remove the first piece. "One of the most difficult keychain puzzles ever produced."


Conestoga Wagon keychain puzzle


Conestoga Wagon - hard plastic - 8 pc.

soft plastic covered wagon keychain
This one has eight pieces - the canopy and wagon are split lengthwise.

Wagon (blue) keychain puzzle

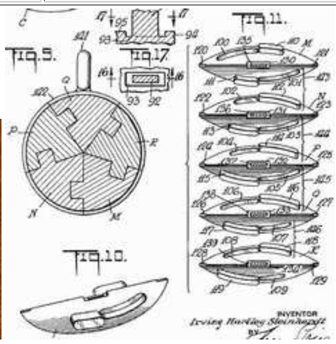
Keychain Wagon (8 part)

Keychain Covered Wagon

Stagecoach keychain puzzle

Another eye test - can you tell which pieces comprise which puzzle?

Keychain Covered Wagon, in package

Five-segment Football keychain puzzle
In 1955, Irving Steinhardt received patent [2712447](#) for this type of football keychain puzzle, called the "sector puzzle construction."


Donkey (red) keychain puzzle

Donkey (orange) keychain puzzle


Jericho Car keychain puzzle


Fire Truck keychain puzzles


Keychain Puzzle Pieces Jumble #3



Jericho Car keychain puzzle


Indian on horseback keychain puzzle


Jockey keychain puzzle


Jockey keychain puzzle (green)


Bronco keychain puzzle


Keychain Cowboy (blue)


Keychain Cowboy on horseback, with rifle - in package

Lional Indian Raid







An orange and a white Scout on Horseback (no gun)
Compared with Cowboys on Horseback, with pistol and rifle


Dog keychain puzzle


Scotty Dog keychain puzzle


Scotty Dog keychain puzzle - older type


Donkey (German) keychain puzzle


Hot Rod keychain puzzle


Keychain puzzle pieces jumble #4


Race Car keychain puzzle






Several (5) examples of the Motorcycle Cop keychain puzzle.


soft plastic car keychain


Keychain Car - Mechanical Servants
This one has a neat mechanism I like.


Keychain Car - Mechanical Servants - green


Keychain car (yellow, green, and white, with black loop)


Keychain Piece Jumble #5



Six-shooter keychain puzzles




Revolver



This interlocking keychain puzzle revolver came from Israel.
As you can see from the photo of its parts, it is distinct from the two other revolver puzzles I have.


Here is a comparison of two kinds of keychain interlocking puzzle revolvers. (Note that I managed to find the missing pieces to the second example.)

Raygun keychain

Here is a **Schmoo**, from the old comic strip Li'l Abner.


A couple of Duck keychain puzzles

Duck in Tophat

Keychain interlocking puzzle Duck w/ Seaman's cap

Locomotive

A pair of Locomotives (the blue cab is damaged)

Keychain puzzle parts Jumble #6







Keychain Locomotive (small)


Machine Gun keychain puzzle


Cruise Ship keychain puzzle


Happo - The Jolly Clown Puzzle
Ad in 1951 Johnson Smith Catalog


A keychain clock


Airplane keychain puzzle


Owl keychain puzzle


Keychain Fish


Keychain Dino in package


Keychain Slipper


Keychain Showboat (orange)


Keychain Showboat


Keychain Cat

Canon keychain puzzle

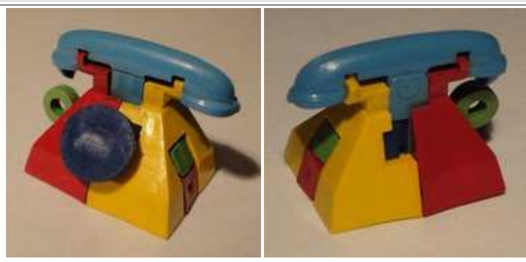

Drop keychain puzzle


Movie Camera keychain puzzle


Keychain puzzle parts jumble no. 7

Drill (Peugeot France)
The pieces of this puzzle can sometimes get wedged very tightly together. I found an image of instructions - don't break yours trying to pry it apart! The bit/chuck comes out first, then the handle, then the top front cowl slides forward.

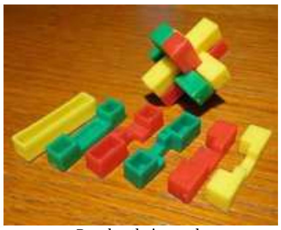

Die keychain puzzle



Keychain Truck group

This Old-style Telephone Interlocking Keychain Puzzle was designed by John Flower in 1952
and issued by the UK company Bell.
It has six pieces and assembly requires several pieces to be moved back and forth in sequence,
which is not typical for keychain puzzle mechanisms.
I like this one a lot!

Bomber keychain puzzle
Soft plastic.



Burr keychain puzzle
The "Chinese Cross" piece set.

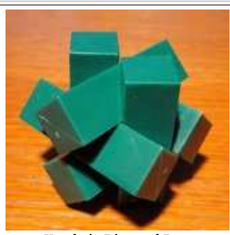
Teapot keychain puzzle
This one has an actual screw thread.

Good Luck Horseshoe keychain puzzles

Keychain Good Luck - Clover version

A vintage **Crown** interlocking keychain puzzle, issued by Bell.
With its original card!

Keychain VW Beetle

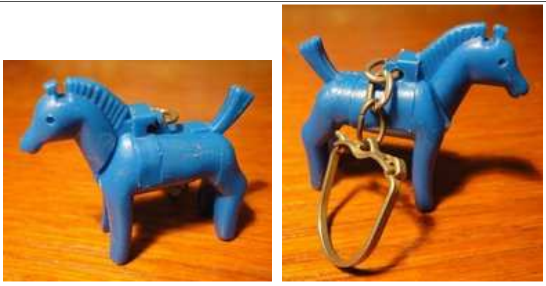


Keychain Diagonal Burr

Here is a plastic interlocking keychain puzzle Knight.

Keychain Space Blaster Guns

Bartissol Man



Blue Horse (Dutch, vinyl)

BP Longlife Oil

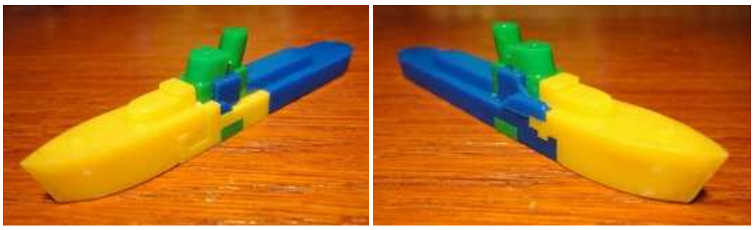
Keychain interlocking puzzle Oil Can

Kodacolor (France)

The Oil Cans and the Kodak Box puzzles employ similar mechanisms.

Legal Coffee Bean

The Legal Coffee Bean and Cube puzzles employ similar mechanisms.



Keychain interlocking puzzle Battleship
(Looks like a destroyer to me.)

Keychain Battleships, in bags

Keychain interlocking puzzle car (Germany)

Keychain interlocking puzzle Circuit Breaker (France)

Spray Bottle (France)

Keychain interlocking puzzle Hedgehog (Germany)

Slocum and Waite identify this Japanese interlocking keychain puzzle as a Diver, but it reminds me of Gigantor.


Two Dragonfly keychain puzzles
(both soft plastic)

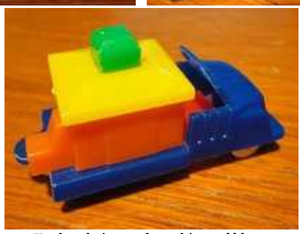


Keychain Tow Truck




Keychain Open Car - green and blue examples





Kottage Kar keychain puzzle - white and blue examples

Apollo Command Module and Lunar Lander set (Japan)

Bell (German) keychain puzzle

Keychain Batter

Heart and Arrow keychain puzzle

Keychain Heart


Keychain Helicopter - Lido


Keychain Helicopter
The Lido design, but in soft plastic.

Keychain Trophy - Japan

A keyhain Dump Truck, in its package

Keychain Covered Truck

Mechanical Servants keychain Covered Truck, with package.

Two Beetle keychains (in packages)

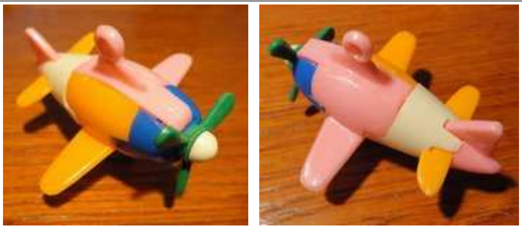
A keychain Stag Beetle with horns

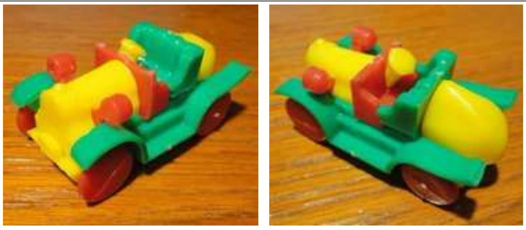
Two examples of a Lantern keychain puzzle

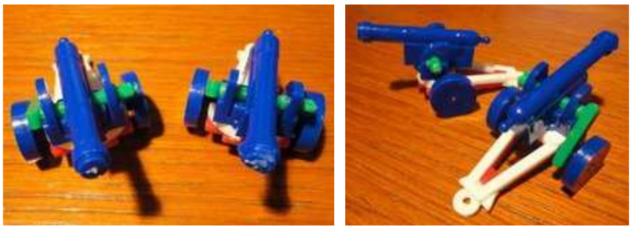
A keychain Woman - thanks, Erhan!


A flatbed truck interlocking keychain puzzle.
This design was issued by Merit.
This copy is made from soft plastic.

A Dump Truck interlocking keychain puzzle with a tipping bed.


Keychain Airplane


Keychain Touring Car

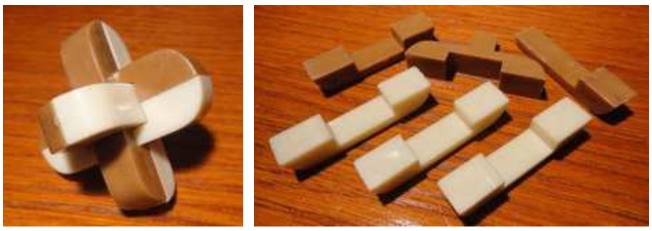

A pair of interlocking keychain puzzle cannons.

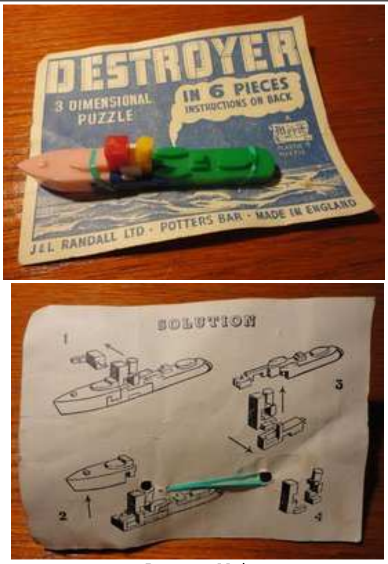

Keychain parts jumble.


Keychain Burr - France

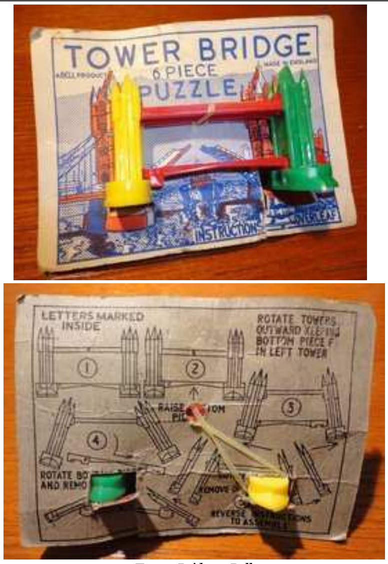

Keychain Sphere - France


Keychain Sailboat - soft plastic

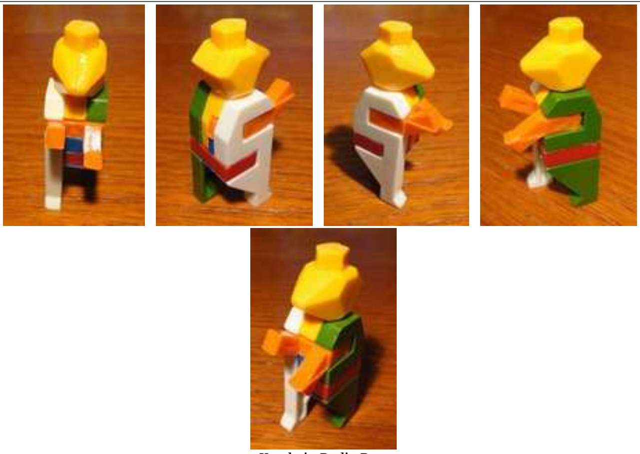

Keychain Burr - Brown & White



Destroyer - Merit



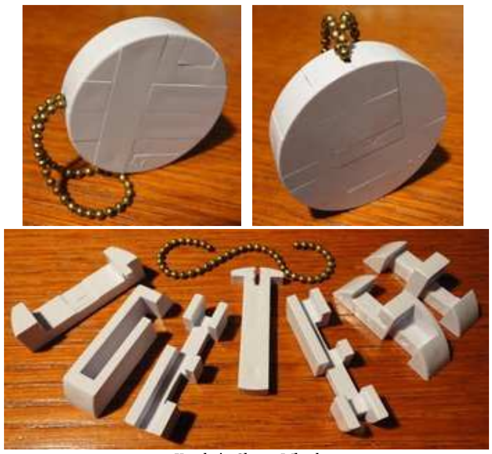
Tower Bridge - Bell



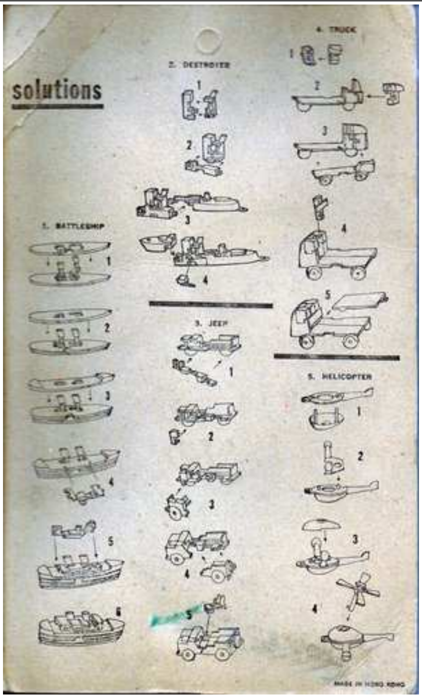
Keychain Berlin Bear

Keychain Lucky Charm

Keychain Mack Bulldog (red and yellow examples)
Minimally interlocking (only two pieces) and minimally a puzzle - but still nice.



Keychain Cheese Wheel



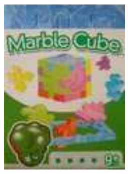
Keychain puzzle 5-pack
I am very pleased to have found this -
not only does it include a Helicopter, Flatbed Truck, and Destroyer
(nice puzzles of which I already have copies),
it also includes a Jeep with an unusual assembly,
and the rare **Battleship**.

[237]

Happy Cubes/Snafooz (Foam Assemblies)

At the Jan. 2005 NYPP, I got these from Norman Sandfield, not knowing what they were. There were originally 4 blue and 4 yellow cubes, but I gave away 2 of each to various folks who wanted them. All the blues and yellows are each made of the same set of six different pieces.

Since receiving a copy of the CFF newsletter issue 50 (Oct. 1999, Part 4/6), I have determined that they are all equivalent to the "Tokyo" version of the Wirrel Warrel, also known as "Happy Cubes."



Inexpensive puzzle pieces can be cut from dense foam mats. Several varieties of puzzles in the "Wirrel Warrel"/"Happy Cubes"/Snafooz family have been implemented using this material.

Happy Cubes were invented by Dirk Laureyssens - read more at the Cricro site. Cricro provides a pair of pentagonal faces.

Happy Cubes are being marketed by Happy n.v.

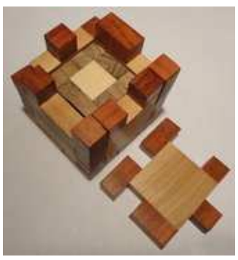

Inspired by reading about Happy Cubes in the CFF newsletter and following information on Jurgen Koeller's Happy Cubes page, I made my own set of generic pieces from LiveCube. I used 8 cubes each for the 6 centers (in black) and an additional total of 44 yellow cubes to be distributed about the edges, as required by the various piece configurations.

Snafooz makes 6-piece cube puzzles where the pieces are cut from foam slabs. They are similar to Happy Cubes, but the Happy Cubes are based on a 5x5 square face, while the Snafooz are based on a 6x6 square. Snafooz are often issued as corporate promotional give-aways, and I have accumulated several from various trade shows. I also have a promotional puzzle based on a 7x7 square.

This is "Mystery Shapes" designed by Oscar van Deventer, issued in 1993 by Binary Arts. Four cubical puzzles made of six foam pieces each, but with extra confusing ridges running around the faces.

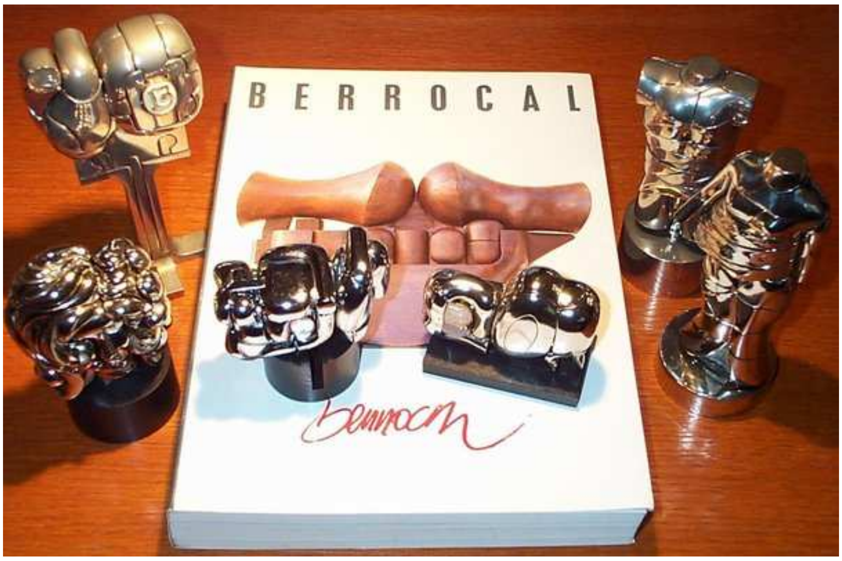


The "Eraser Cube" is made from eraser-type rubber material, and is based on a 4x4 square side.


Take Me Apart - designed by Bruce Viney, made by Brian Menold at Wood Wonders, from Padauk and Cherry
A side-5 cube with a smaller nesting side-4 cube inside.

The Puzzle Sculptures of Miguel Berrocal



The Spanish sculptor **Miguel Berrocal** has produced many wonderful artworks, including puzzle sculptures coveted by collectors.
Berrocal was born in Malaga, Spain, in 1933, and died in 2006. He was married to Princess Cristina, the grand-daughter of the last King of Portugal. He presided over a 200-employee foundry in Negrar and referred to himself jokingly as the "boss of the sculptor's Mafia."

Probably the first time I heard of the puzzle sculptures of Miguel Berrocal was upon reading about them in one of Martin Gardner's columns in Scientific American. (Gardner discusses them in Chapter 18 of his book *Penrose Tiles to Trapdoor Ciphers*.) In college I had occasion to visit a friend - she was a foreign exchange student staying with an American family (hi Fariba!). The family owned a Berrocal Mini-David and that was my first opportunity to try one of the puzzle sculptures of Miguel Berrocal.

Berrocal made six sculptures in his "Mini" series, and offered them as limited edition "multiples." They include:

- Mini-David
- Mini-Maria
- Mini-Cariatide
- Portrait de Michele
- Mini-Zoraida
- Mini-Cristina

I have seen a variety of costs - the set of six has been offered for anywhere from $5K to $10K. Mini-David is the most popular and runs anywhere from $1K to $2.5K.
The others run from $350 to $1800 depending on where you look and how lucky you get. Asking prices are on the rise. John Rausch and James Dalgety are two dealers. Read about Berrocal on Dalgety's site.

James Strayer has quite a collection of Berrocals, as does John Rausch.

Portrait de Michele
(My favorite...)

Mini-Zoraida


Mini-Maria


Mini-David


Mini-Cristina

Mini-Cariatide

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