POLYGONAL, PYRAMIDAL, PRISMATIC WORDS

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INTRODUCTION

By considering the assignment of letters to points on plane figures and solids, this article provides a general classification of words which includes, among other categories, words already known as isograms and pyramid words.

Suppose we have three letters the same; it seems natural, since they are all of equal status, to arrange them at the corners of an equilateral triangle. Similarly it seems natural to place four letters at the corners of a square, five at the corners of a pentagon, and so on.

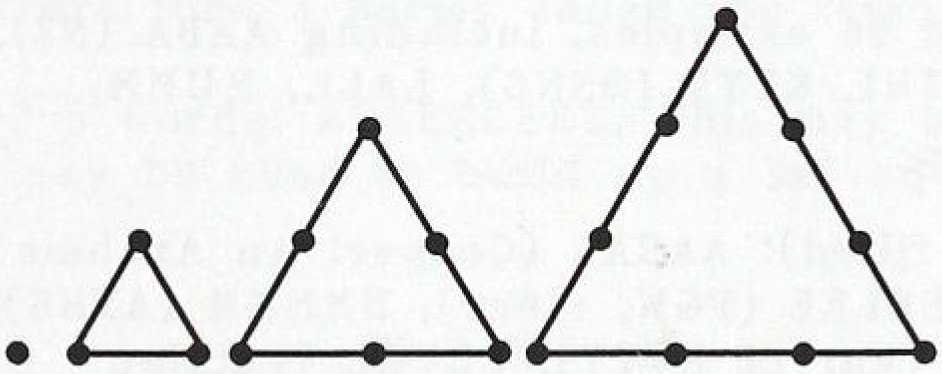
Now suppose we have another, single, letter. We could either place it at the centre of the triangle or square, so forming a triangle (square) of side zero, surrounded by one of side 1; or place it centrally above the triangle (square), so forming a tetrahedron (pyramidal square). In the case of the triangle, if we had another six letters the same (but different from before), we could build three nested triangles (or, equivalently) the tetrahedron shown on the second row of the Figure. In the case of the square, we would need another eight letters to make the figure shown in the fourth row of the Figure. The idea is that each layer in the three-dimensional objects should use a letter in place of each dot; each letter on a given layer is the same, but different from those on other layers.

The object in the second row is made by combining the first three objects in the first row, and the object in the fourth row likewise made from the first three objects in the third row.

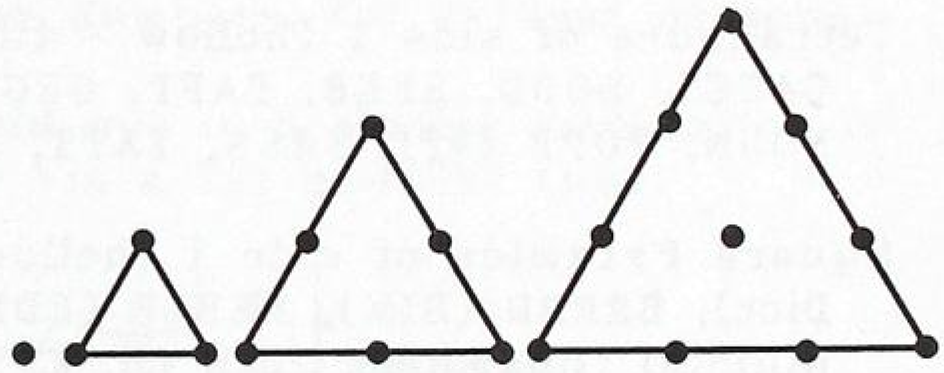
An alternative is to start with "filled" triangles or squares, in which all the grid points are present--see the rightmost objects in the first and third rows. Note that the smallest examples are the same whether filled or hollow. These filled objects can also be combined in layers to make a solid object. The filled idea works in a particular way as we progress beyond squares, as you cannot have pentagonal or heptagonal grids.

We could also combine the same object repeatedly; for example, layering the smallest triangle on itself gives the triangular prism shown last in the Figure. Readers will recognise such words as trio isograms.

I set out to find words whose letters would fit not only these shapes but also many others. The haul was disappointingly small, though I scarcely expected to find a word consisting of 15 of one letter, 10 of another, five of a third and one of a fourth, as would be needed for a pentagonal pyramid of side 3!

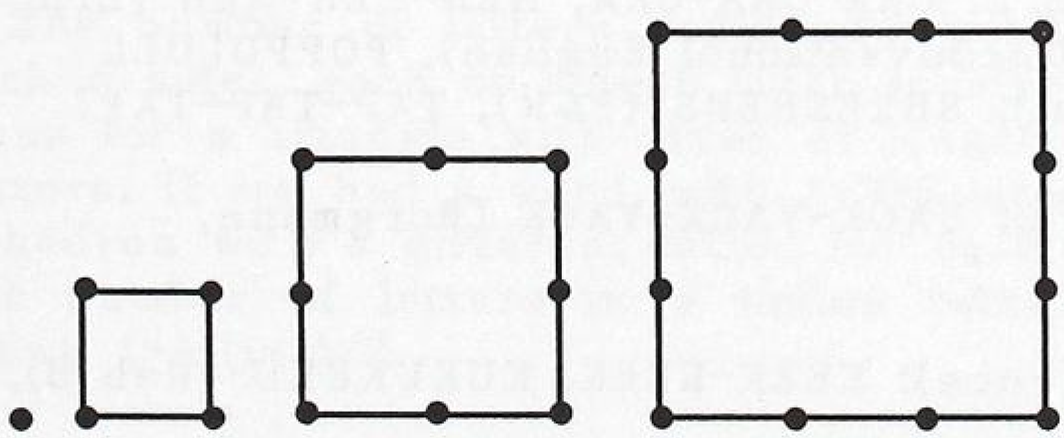


Hollow Triangles

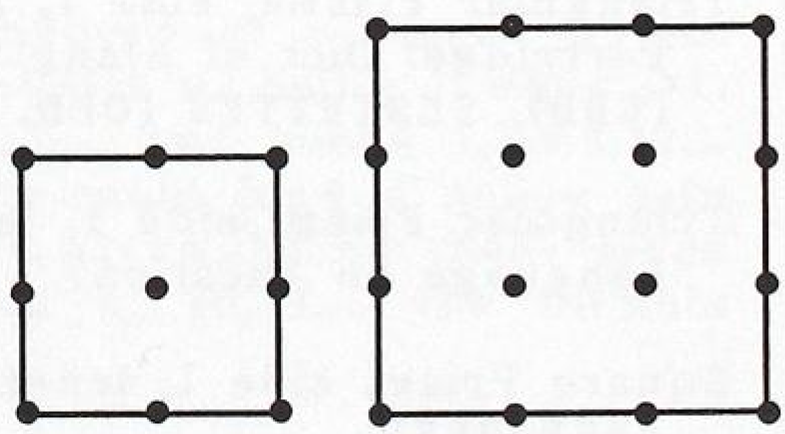


Filled Triangles

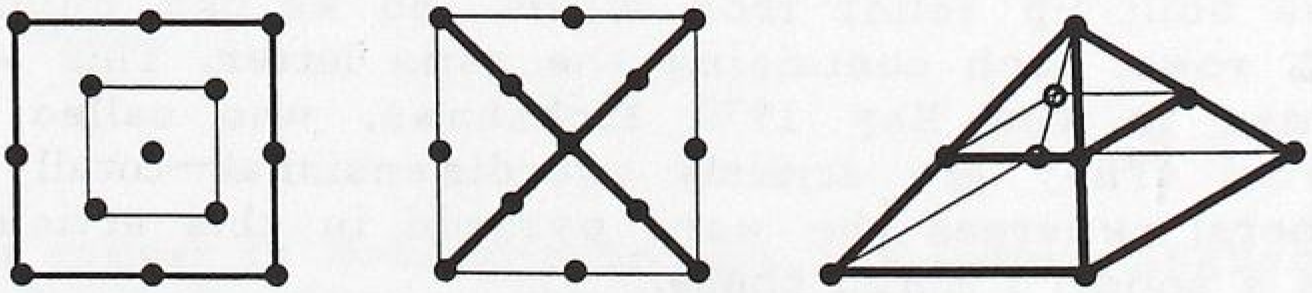
Nested Hollow Triangles, or Hollow Tetradron



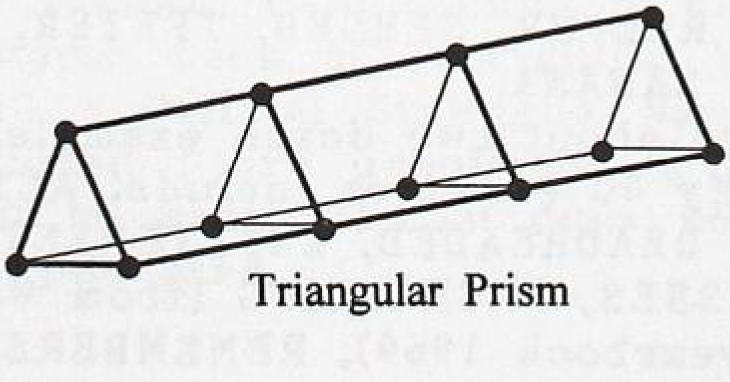
Hollow Squares



Filled Squares



Nested Hollow Squares, or Hollow Square Pyramid



Triangular Prism

RESULTS

Here is what I found. In the case of prisms, it is nicer to find words which are not tautonyms.

Tetrahedra of side 1 (hollow = filled): 56 examples, including AABA (NZ), CACC?, DODD, EPEE, FAFF, GEGG, IIWI, KYYY (OSNG), LALL, MUMM, NONN, POPP (vf), SASS, TATT, ZAZZ

Square Pyramids of side 1 (hollow = filled): AASAA (Cooper: An Archaic Dict), BRRRR (BIW), EEECE (EDD), EELEE (F&W, river), HMMMM (ATHS), HOO-OO (Chambers 20th C), KYYYY (var of KYYY), LLULL (Catalan writer), MOOOO?, OOLOO (F&W), OOPOO (Nobbs, Dict of Norfolk Words & Usages), OOROO (Thurber invention), SSESS (EDD)

Pentagonal Pyramid of side 1 (hollow = filled): EEEEVE (Word Ways 1981, p 157)

Triangular Prisms, side 1, length 1: AIAIAI, DEEDED, ESSEES, FEFFEE (Word Ways 1982, p 138), GEGGEE, LILLII (World of Mammalian Species) SHSHSH

Triangular Prisms, side 1, length 2: CHA-CHA-CHA, MEH-MEH-MEH (Eric Partridge: Dict of Slang and Unconventional English), POPPOLOLL (EDD), SESTETTES (OED, plural), SHEESHEHS (F&W), TAP-TAP-TAP?

Triangular Prism, side 1, length 3: YACK-YACK-YACK (Borgmann, Language on Vacation)

Square Prism, side 1, length 1 (cube): KEEK-KEEK, KUKUKUKU (Web 3), PEEP-PEEP

Heptagonal Prism, side 1, length 1: BUBUBUBUBUBUBU (DJE)

Just as we built up solids from layers, so we can build up a filled triangle from rows, each containing the same letter. This was noted by Dave Silverman in the May 1970 Kickshaws, who called such words pyramid words. (They are strictly two-dimensional--totally useless for burial chambers!--whereas the word pyramid in this article, and generally, implies a solid.) I noted these:

1-2-3 words: the 330 examples include ACACIA, BANANA, COCOON, DOODAD, EFFETE, FALLAL, GOOGOL, HUBBUB, INNING, JEERER, KABAKA, LESSEE, MAMMAL, NAGANA, OTOTOI, PAOAYA, REEFER, SEEDED, TEETER, UNLULL, VENENE, WEDDED, YESSES, ZANANA

1-2-3-4 words: Robert Cass Keller gave about two dozen examples of these in the May 1982 Word Ways. My 40 examples include: ACTAEACEAE, BEERBIBBER, CHACHALACA, DEADHEADED, ENTETEMENT, HOOTSTOOTS?, ISOOSMOSIS, KEENNESSES, NAGNAGGING (from Web 3 NAGNAG), PEPPERETTE (Britannica yearbook 1969), REMEMBERER, SERENENESS, TENTRETENE, WELL-DEEDED.

For example, SERENENESS can be arranged as shown at the right. No one seems to have found any 1-2-3-4-5 words. The total number of letters form a series called the triangular numbers, for evident reasons.

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            R
        N       N
    S       S       S
E       E       E       E
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1-3-5 words: ASSESSEES. This may be laid out in a similar fashion, or it may be used to build up a 3x3 square via a 1x1 and 2x2 thus:

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        A                   A   E   S
    E   E   E               E   E   S
S   S   S   S   S           S   S   S
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I have not fully investigated such possibilities, nor have I looked at other ways of "coloring" nested cubes, etc. (for example, assigning one letter to internal points, and another to external ones). I leave this to any reader who is interested. With the advice to keep to simple, small shapes, here is how to find some of the numbers when you are tired of drawing objects and counting.

FORMULAS

The number of letters required on the periphery of a planar object with n sides, each of length (i-1), is n(i-1), subject to being 1 when i=1. Thus for a triangle with sides of length 0,1,2,3..., one needs 1,3,6,9,12... letters. If we had a word with 1+3+6 letters we could form a hollow tetrahedron with a different letter for each layer. Accumulating these gives the number of letters in a hollow tetrahedron: 1,4,10,19..., the formula being 1+ni(i-1)/2.

For a filled planar object, the formula is i(ni-2i-n+4)/2. For example, for a triangle this reduces to i(i+1)/2, giving the well-known triangular numbers 1,3,6,10,15... Accumulating these to make a filled solid gives the pyramidal numbers i(i+1)(ni-2i-n+5)/6: for n=3 this becomes i(i+1)(i+2)/6, giving 1,4,10,20...

SOURCES

Most words appear in Webster's Second, the Oxford English Dictionary, the Official Scrabble Players Dictionary, Pulliam and Carruth's The Complete Word Game Dictionary, or Stedman's Medical Dictionary. Others are labeled ATHS = American Thesaurus of Slang, DJE = Dictionary of Jamaican English, F&W = Funk & Wagnalls, Web 3 = Webster's Third, BIW = Wordsworth Book of Intriguing Words, EDD = English Dialect Dictionary, OSNG = Official Standard Names Gazetteer (USSR), or Word Ways. Words labeled ? are unsourced. I have inserted hyphens where I know they must be present; that does not mean that some other words should not be hyphenated.