"Dot Patterns for Birthday Cards" excerpted from Rudy Rucker,
MIND TOOLS (Houghton Mifflin, Boston 1987). (Dover Books 2013).
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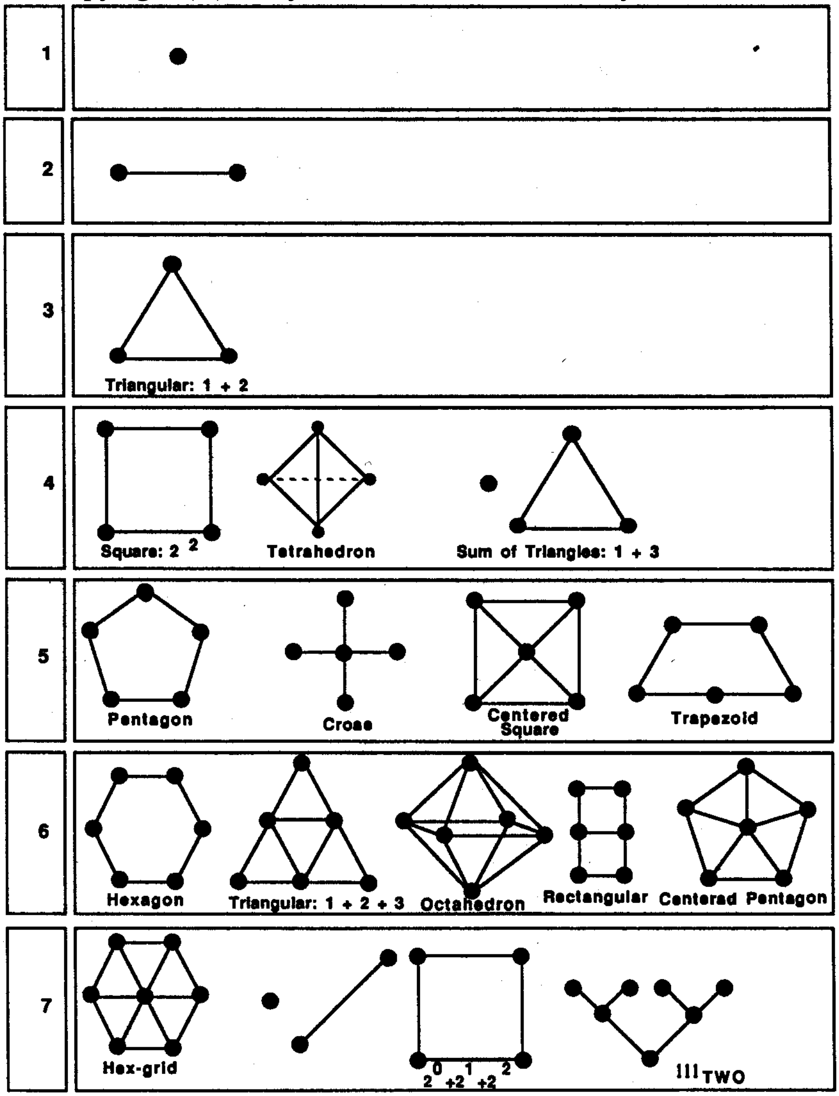


Fig. 29, No. 1.

Since 4 breaks so readily into the equal halves 2 and 2, the number 4 was thought to stand for justice. Some residue of the notion survives in the expression "a square deal." The vertical sides of the square make square (or rectangular) shapes ideal for building things. Perhaps it is this stability that has made "square" come to mean a solid (and

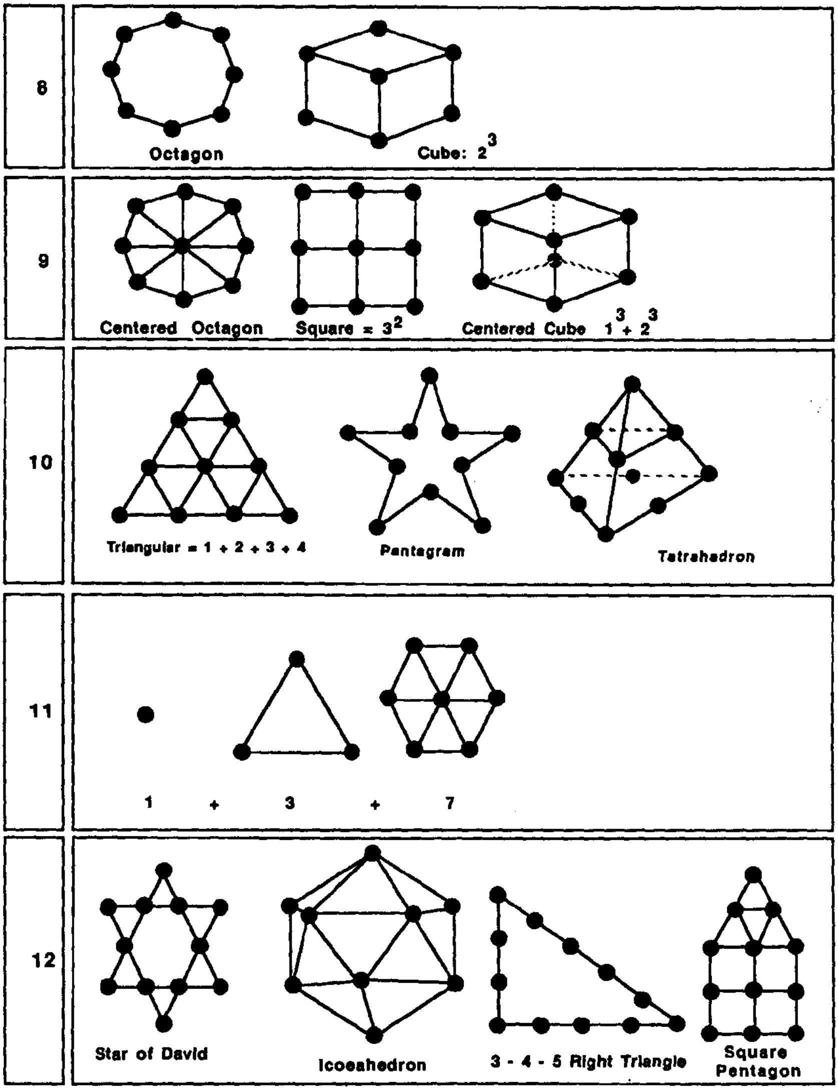


Fig. 29, No. 2.

somewhat boring) citizen. A unique feature of 4 is that not only is it 2 plus 2, it is also 2 times 2 and 2 to the 2nd power. At this low number level the distinctions between addition, multiplication, and exponentiation are not yet fully developed.

The number 5 is significant for many reasons. A human body has five big things sticking out of it (head, two arms, two legs), and the

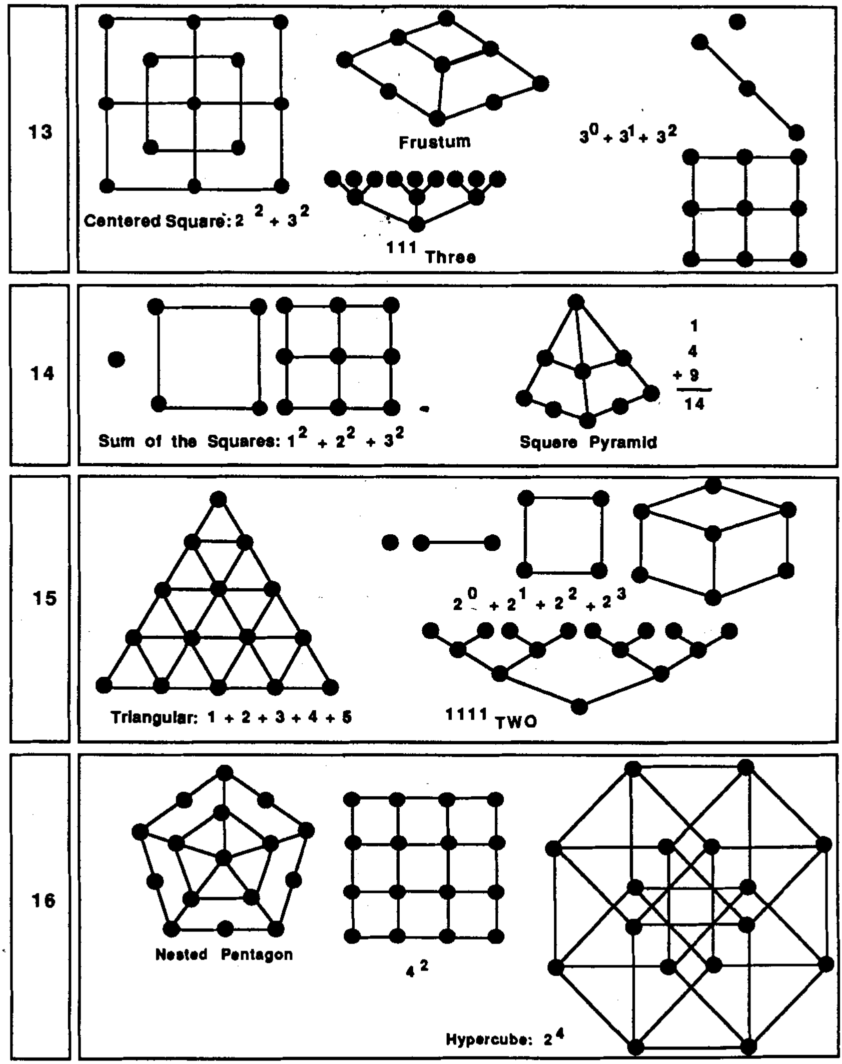


Fig. 29, No. 3.

Pythagoreans sometimes identified 5 with the body or with health. Another important human aspect of 5 is that an undamaged hand has five fingers. Followers of Pythagoras sometimes wore lucky five-pointed stars . . . just like sheriffs in a Western! Children usually draw houses as irregular pentagons.

Somehow 5 also acquired a negative significance during the Middle

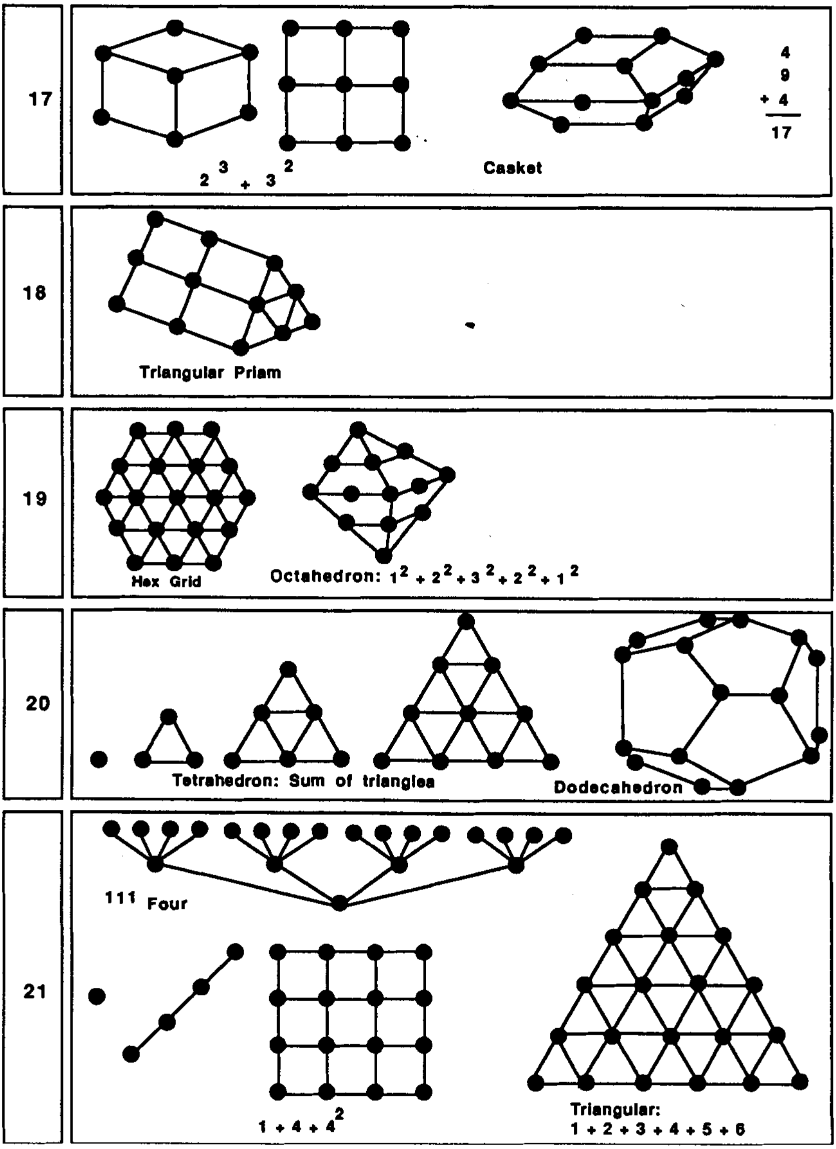


Fig. 29, No. 4.

Numbers that can be written as a series of 1s in some numeration system are called "rep-numbers." The nice thing about rep-numbers is that they can be drawn as tree patterns where each fork has the same number of branches. One other pattern that 7 embodies is that we can arrange seven dots into a hexagonal grid.

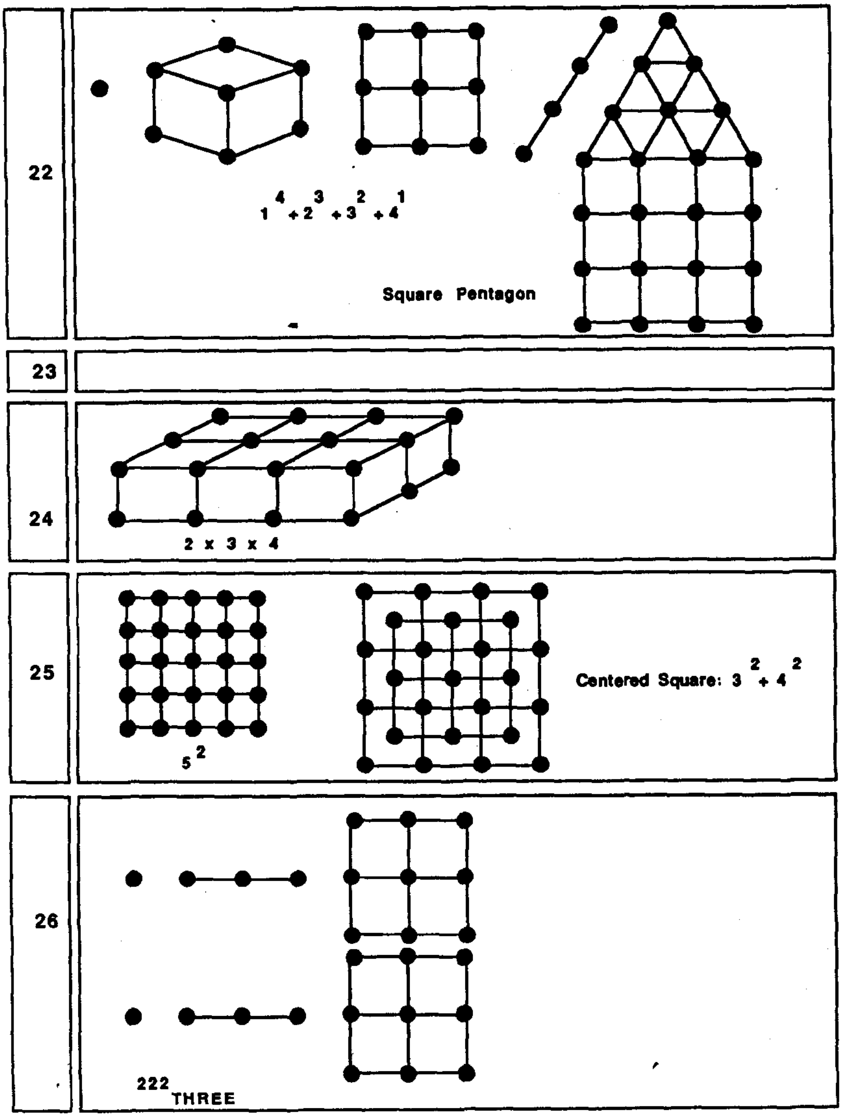


Fig. 29, No. 5.

Eight is an interesting number, since it is the first number that is a perfect cube — that is, $8 = 2 \times 2 \times 2$. Eight is, so to say, even with a *vengeance,* and its smooth curves make it really an even more feminine number than 2. A curious thing about our symbol for 8 is that, if we push this symbol onto its side, we get the common symbol for infinity. Perhaps it is 8's ability to be halved, rehalved, and halved again that suggests the notion of endlessness.

Nine is the first really typical square number. If we think of it as "thrice three," it sounds quite grand. An interesting thing about the transition from 8 to 9 is that one is going from two cubed to three squared! It is quite hard to think of nine dots without arranging them into a 3-by-3 grid; at 9 the human imagination is worn out, and we stop inventing new number symbols. One other way of thinking about

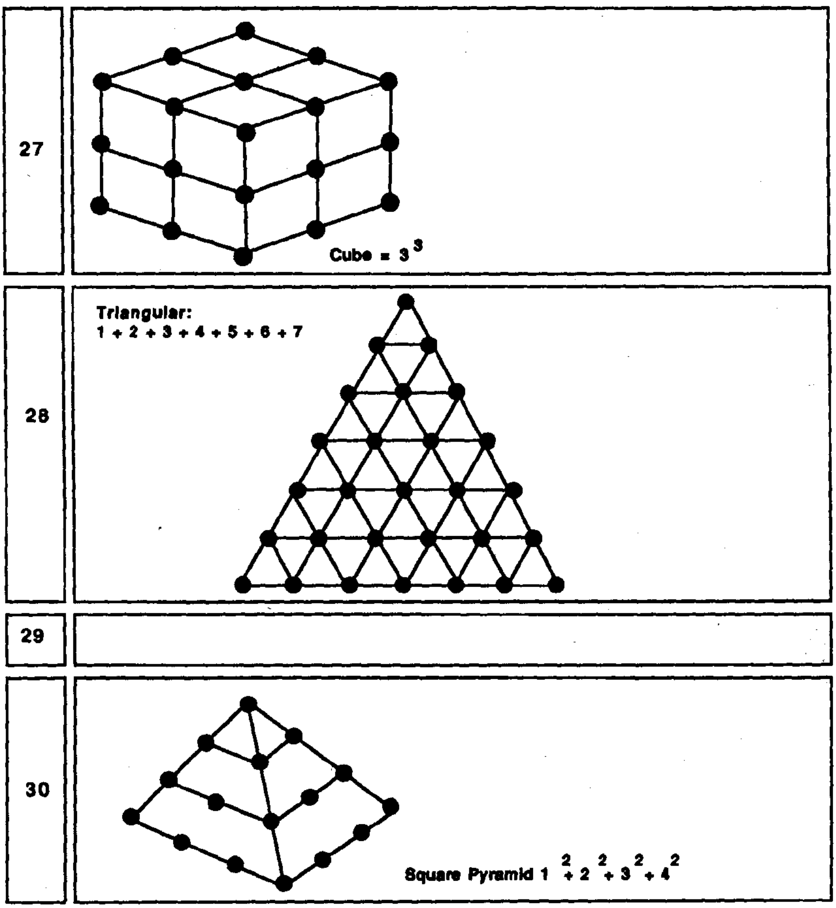


Fig. 29, No. 6.

nine is to imagine placing an extra dot in the center of a 2 × 2 × 2 cube to get a "centered cube."

Ten is where we begin using our positional decimal notation. Like 3 and 6, 10 is a triangular number: 10 = 1 + 2 + 3 + 4. (In general, any number is called triangular if it is the sum of a consecutive number sequence starting with 1.) This fact is, of course, the basis for the game of tenpins, or bowling. The Pythagoreans valued 10 highly, as 1, 2, 3, and 4 seemed so fundamental to them.

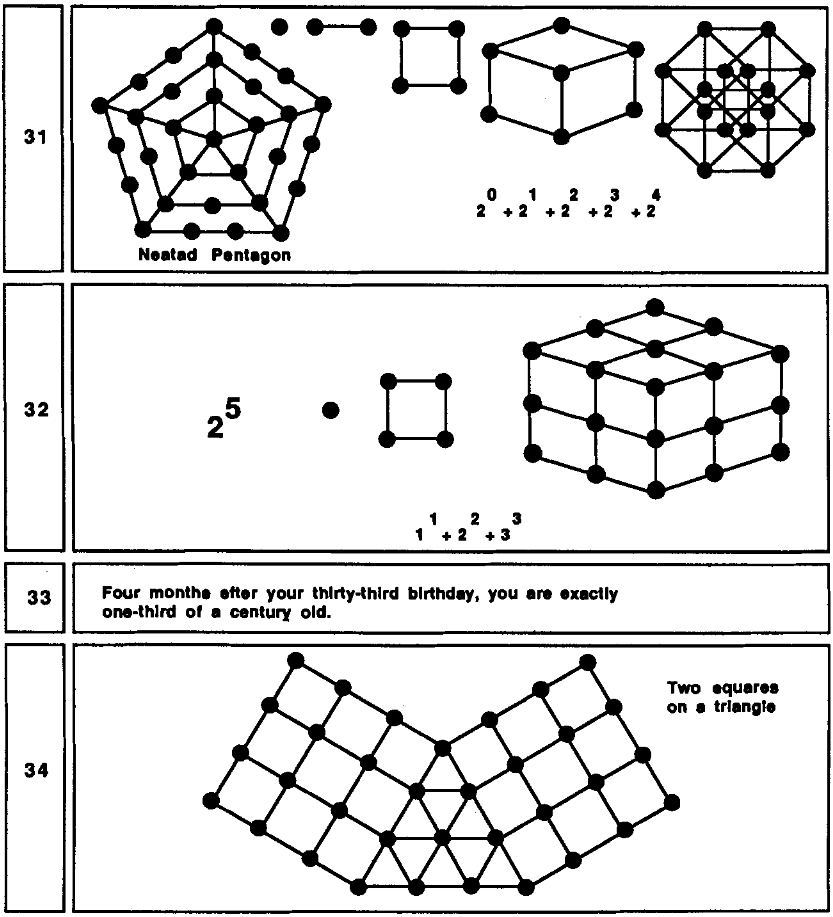


Fig. 29, No. 7.

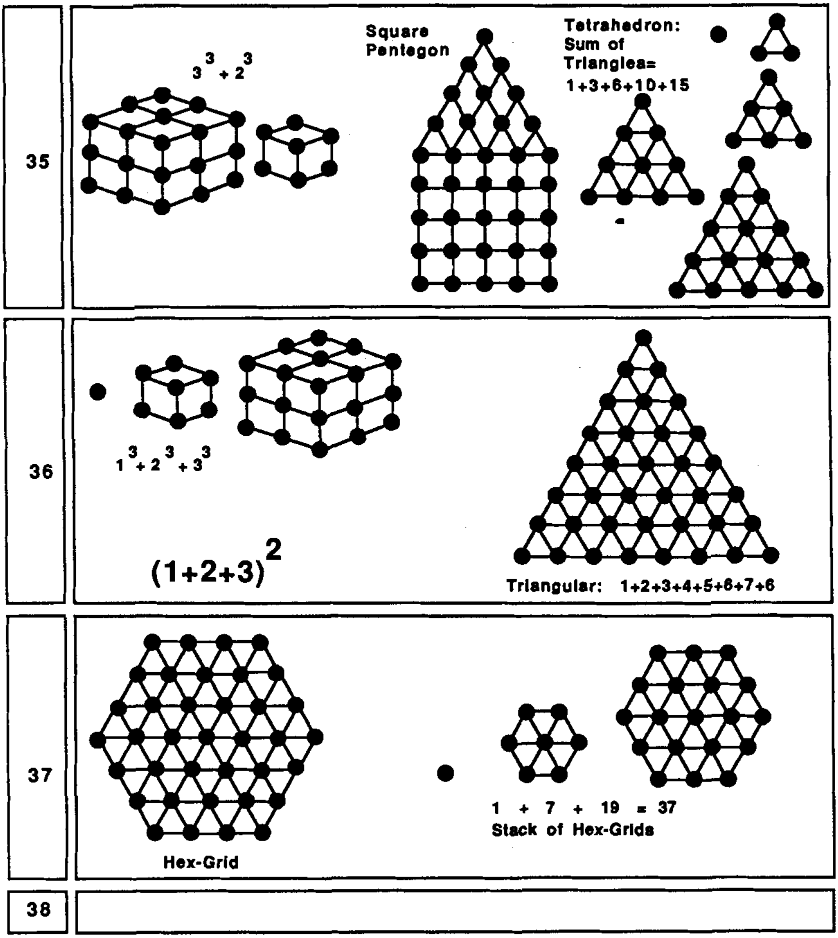


Fig. 29, No. 8.

Eleven is often thought of as a lucky number. This could be because, in our number system, 11 represents a new beginning, a fresh run through the basic sequence 1 to 9. As such, 11 makes one think of rebirth and increase. Another pleasant feature of 11 is the fact that its two digits are the same. This suggests notions of duplication and plenitude. It is also interesting that 11 is the sum of the three most magical earlier numbers: 1, 3 and 7.

Twelve is a number with very many associations. There were twelve apostles; eggs are sold in dozens; a clock shows twelve hours; a year

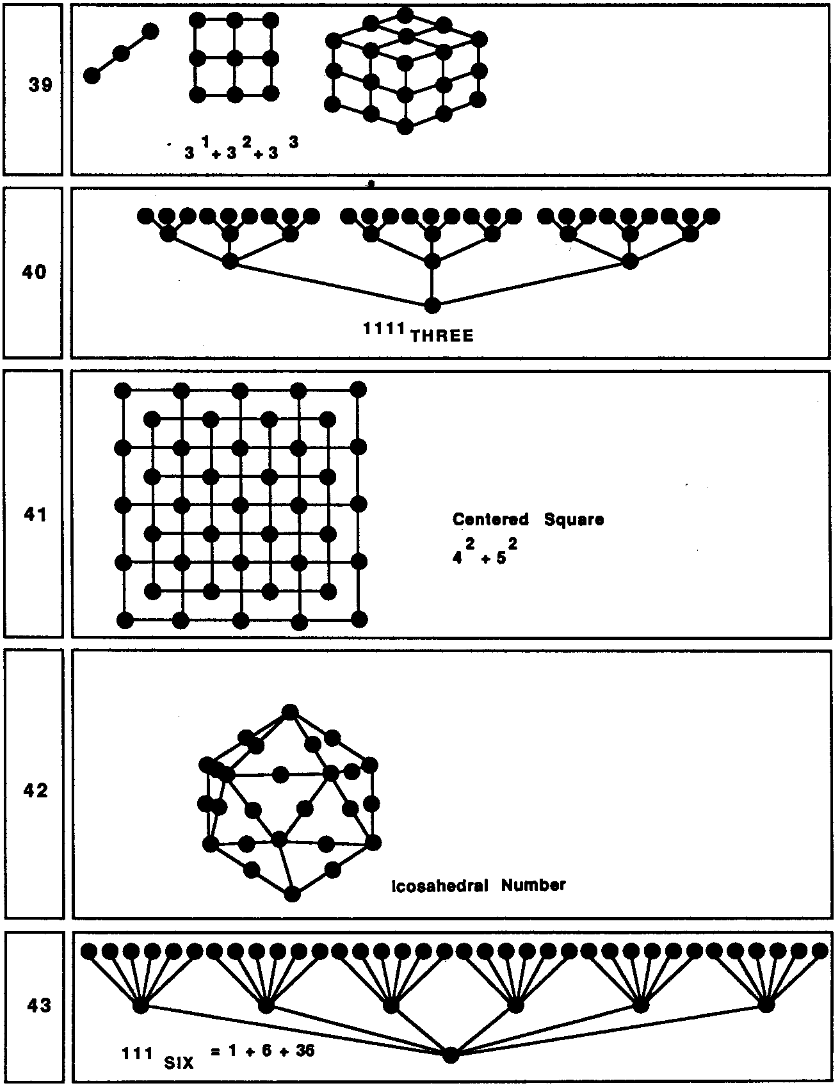


Fig. 29, No. 9.

has twelve months; and the zodiac has twelve signs. Twelve is "more divisible" than any larger number — that is, no number after 12 is divisible by so great a proportion of the numbers less than itself.

Twelve also has the property that, if we set a triangular pattern of

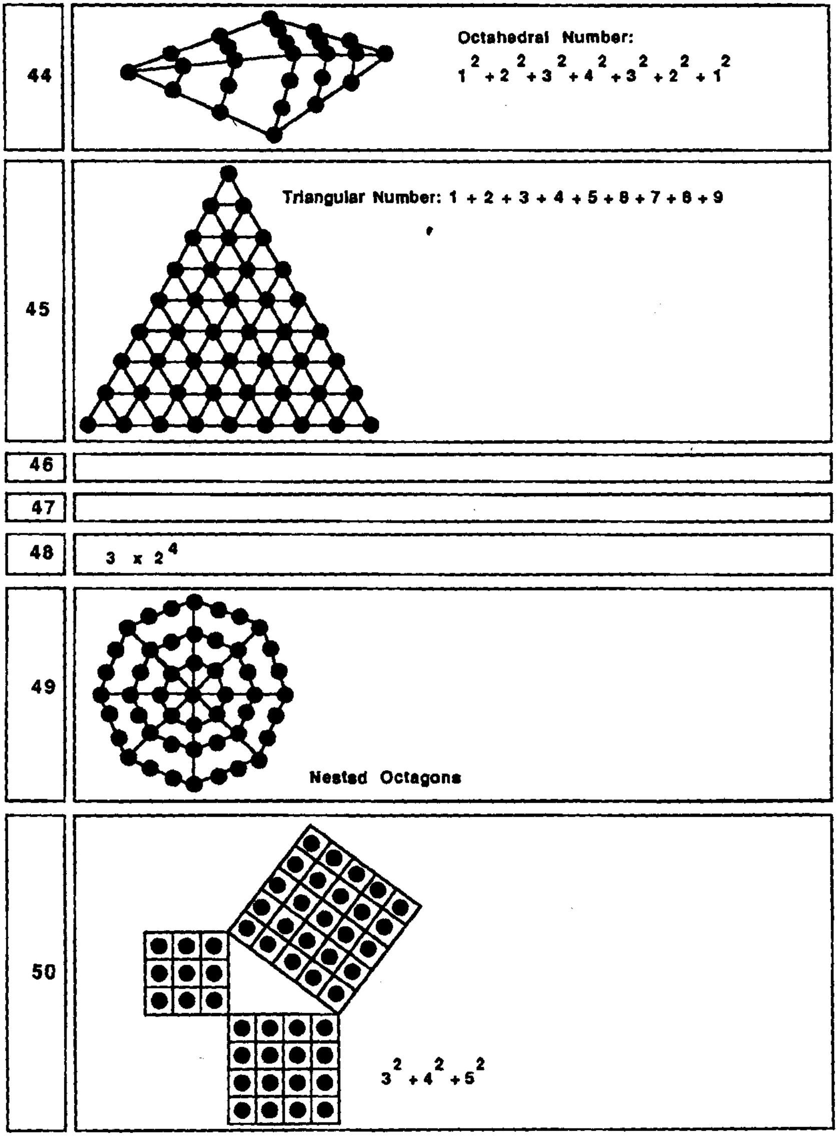


Fig. 29, No. 10.

cornered pattern that represents a 2 × 2 × 2 × 2 hypercube. Sixteen can also be represented by a pattern of nested pentagons. In our society 16 is important as the age when a person can get a driver's license,

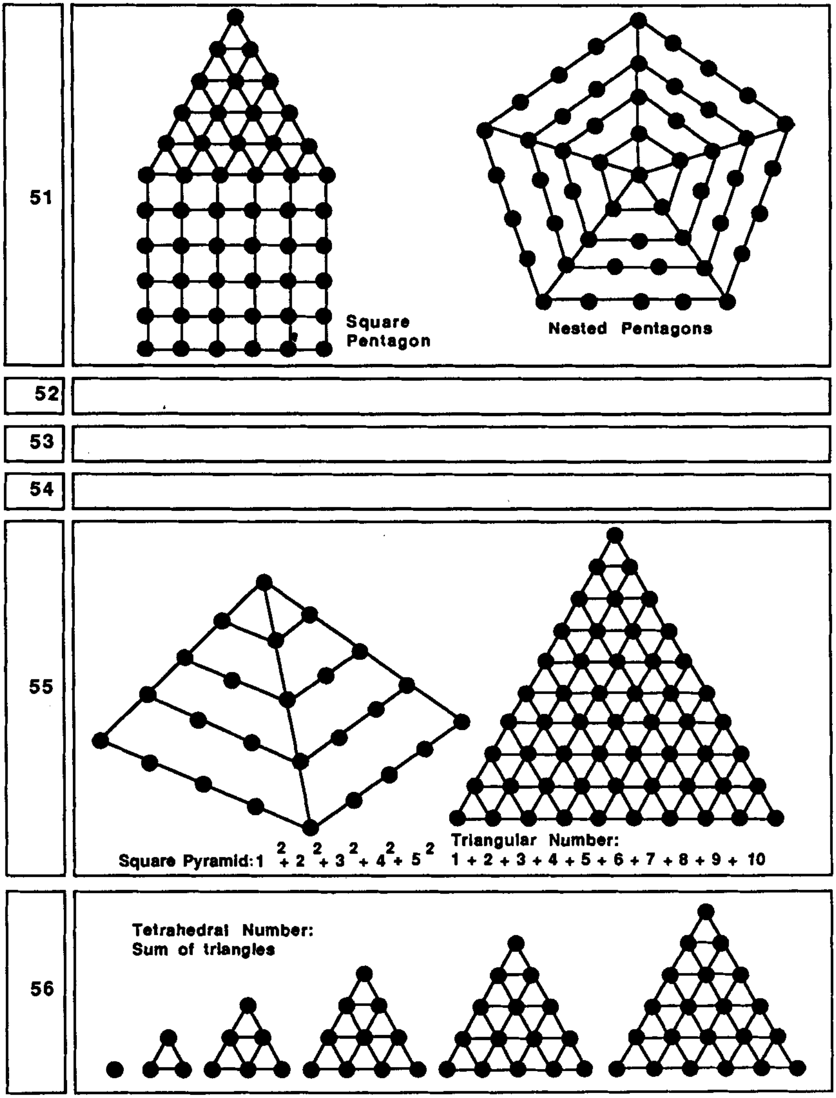


Fig. 29, No. 11.

and "Sweet Sixteen" is often thought of as the age when a girl reaches womanhood.

There is really very little to say about 17. It is 8 plus 9, which is somewhat interesting, I suppose. Alternatively, one might represent

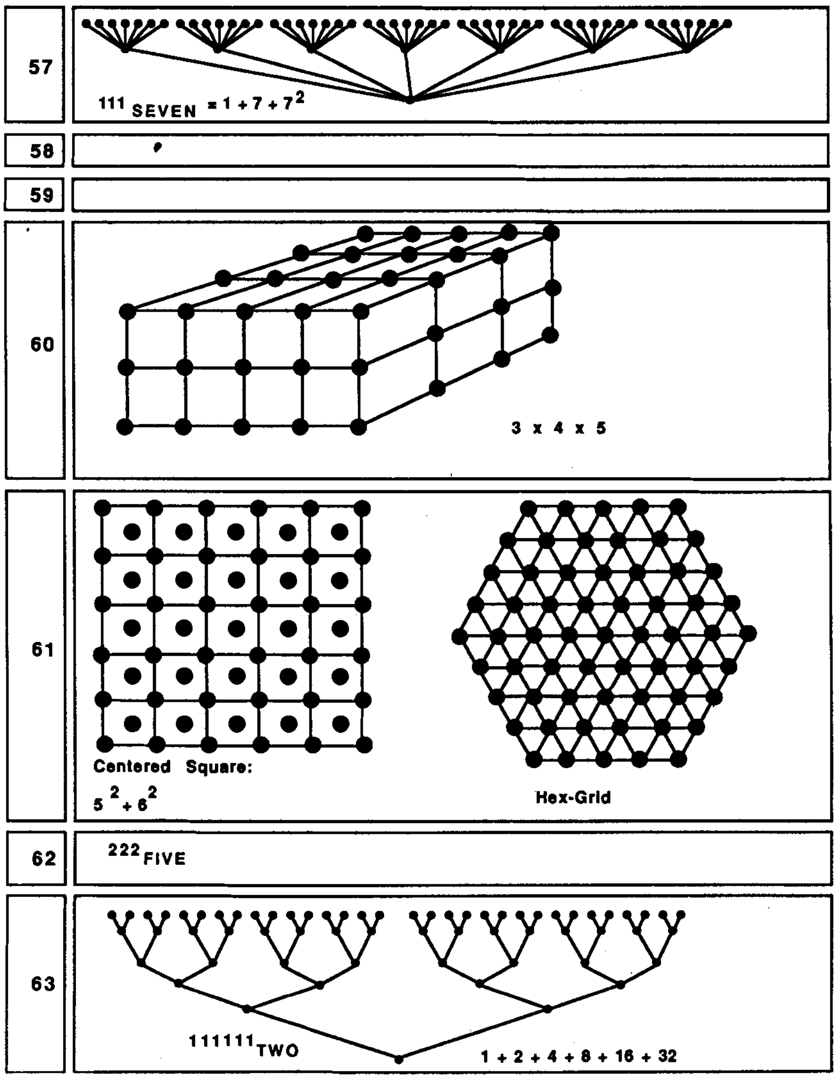


Fig. 29, No. 12.

17 as a "casket" pattern: two 2 × 2 squares on either side of a 3 × 3 square.

Eighteen also provides slim pickings, but 19 is interesting in two ways. First, 19 dots fit into a nice hexagonal grid pattern; second, 19 dots can be arranged into an octahedral pattern.

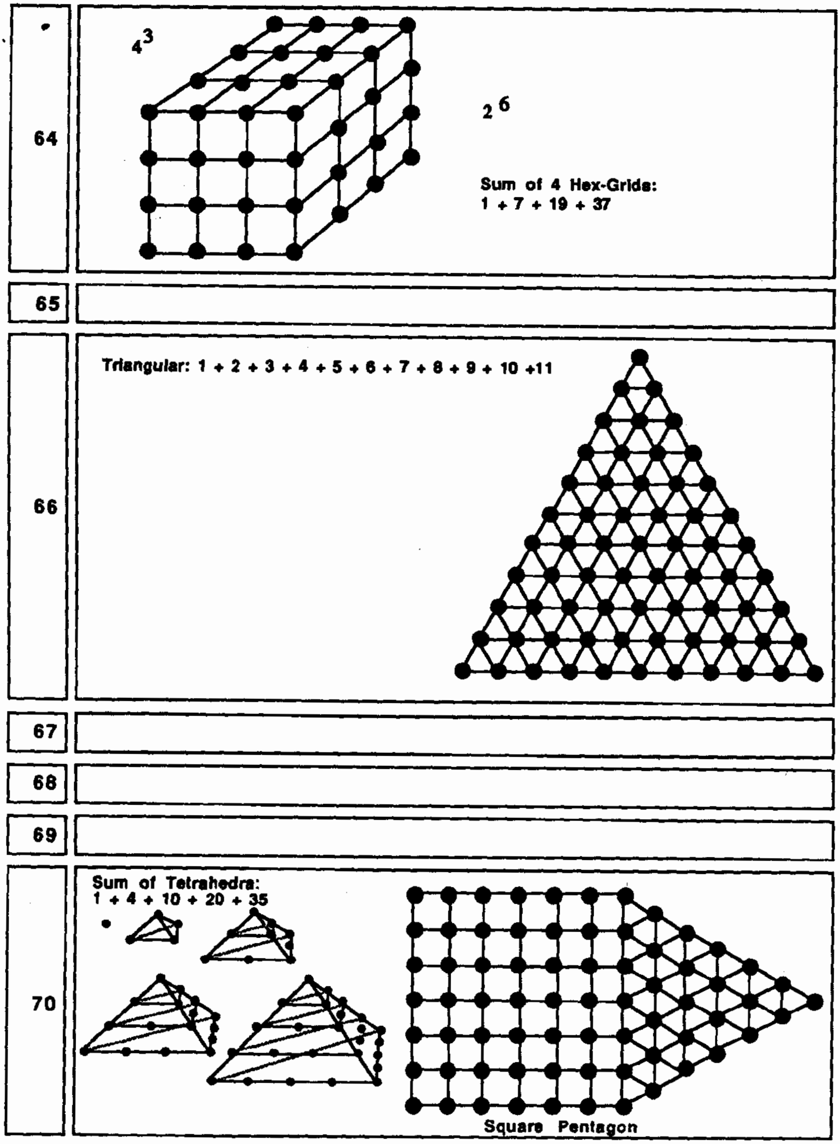


Fig. 29, No. 13.

Twenty is significant as the number of corners on a dodecahedron; another thing about 20 is that it is a "tetrahedral" number. We say that a number is tetrahedral if it is the sum of successive triangular

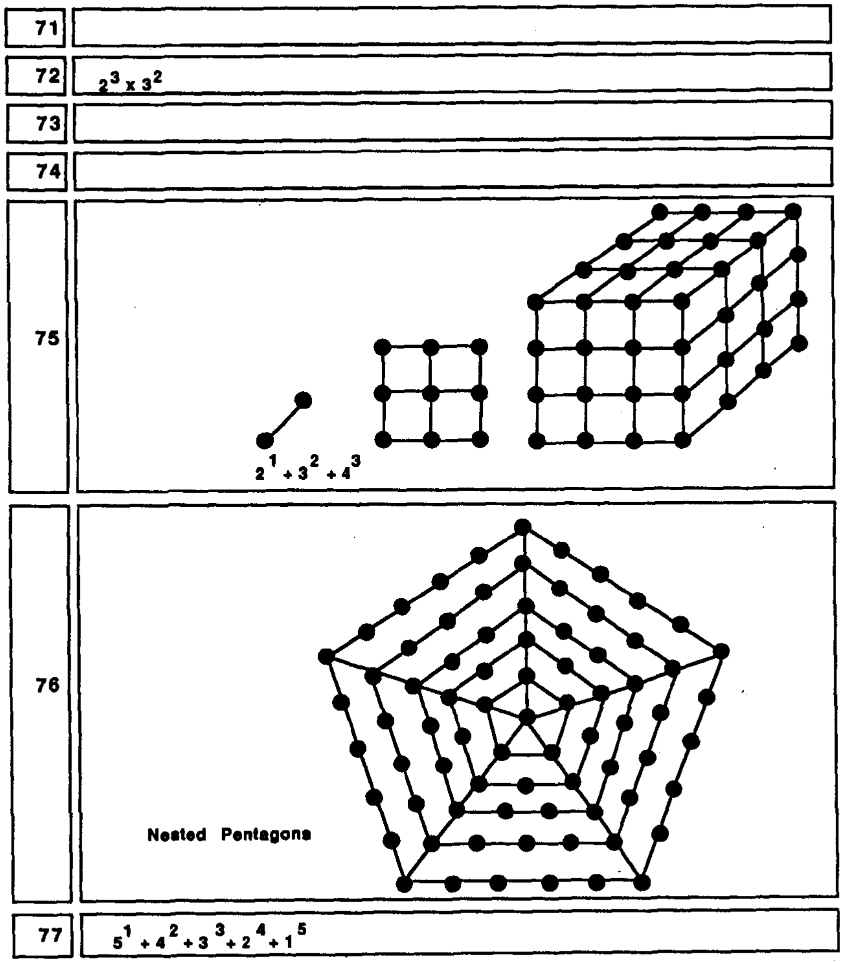


Fig. 29, No. 14.

numbers. Twenty spheres (try tennis balls or oranges) can be stacked in a tetrahedral pattern.

As we move further down our list of pictures, we find numbers that embody no simple pattern at all. The first really hard case is 23. For some reason 91 is one of the most exciting numbers of all!

It is interesting, even mesmerizing, to see how many patterns and connections are hidden in our first 100 numbers. I've thought about

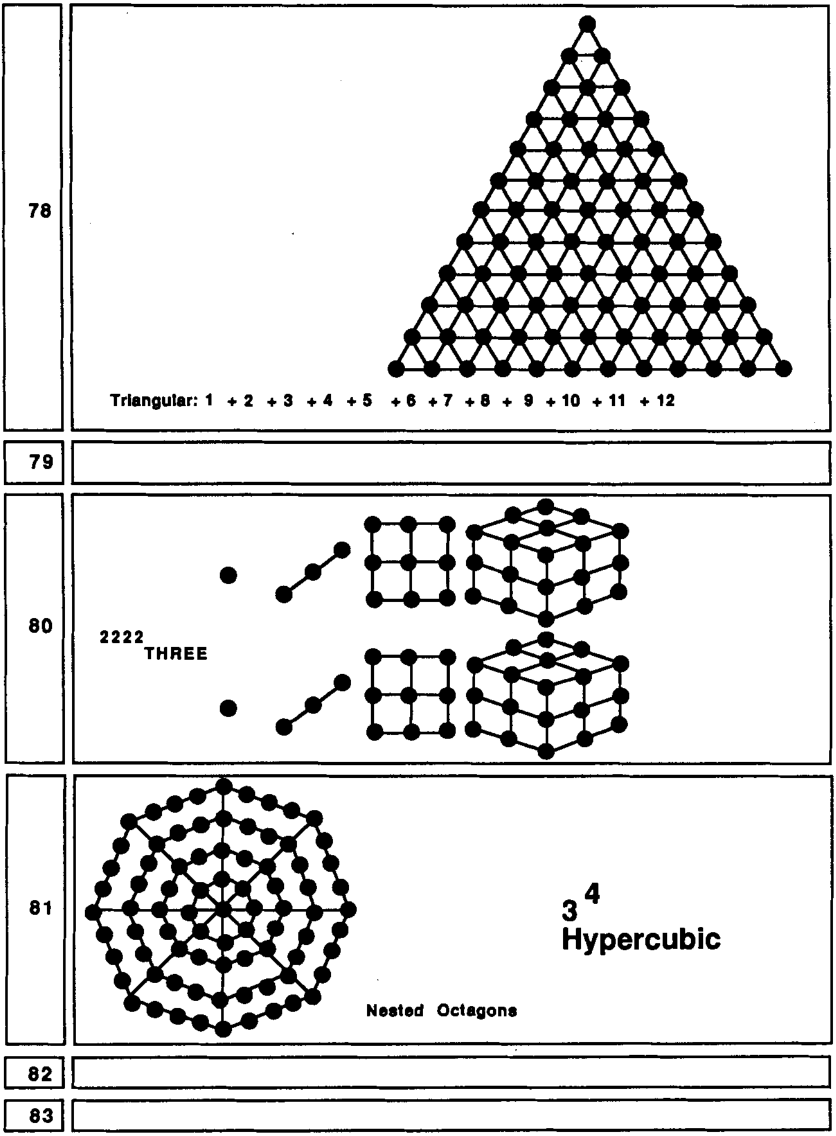


Fig. 29, No. 15.

nothing else for a couple of weeks now, and I'd like to stop. Last night I got so bothered about 11's lack of a good pattern that I got up out of bed to check that a tetrahedron of four billiard balls fits nicely on top of a hexagonal grid of seven billiard balls, which is something, I suppose.

But what good is all this? A good, if superficial, use for these patterns is in decorating birthday and anniversary cards. People enjoy knowing that their age (or number of years married) embodies some interesting geometrical form.

At a deeper level, this exercise gives one a much better insight into

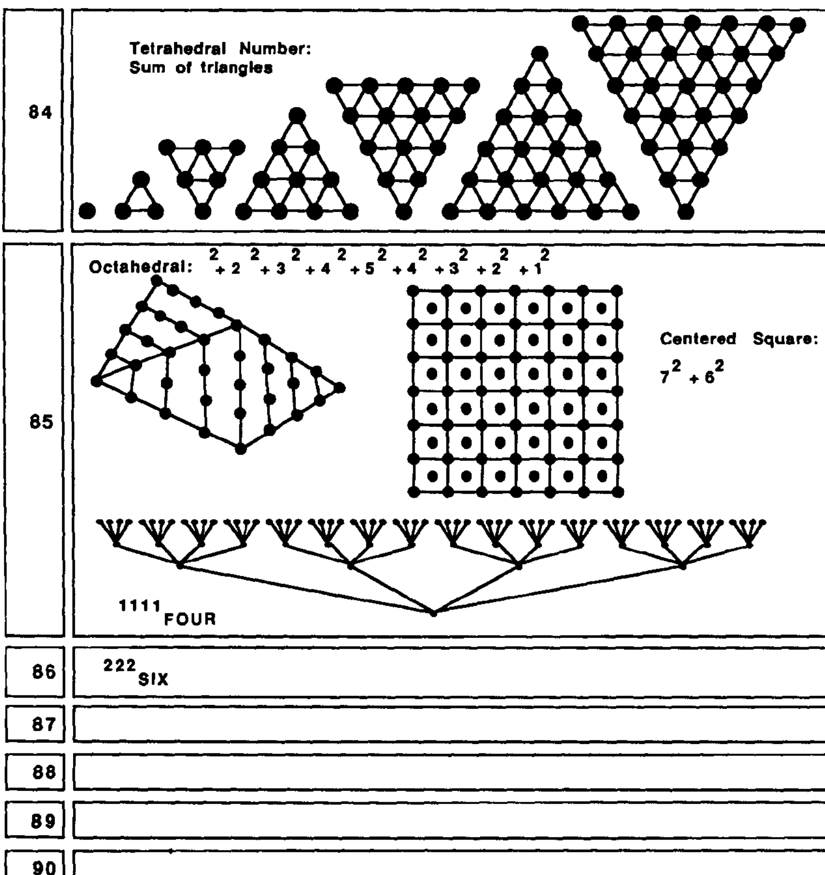


Fig. 29, No. 16.

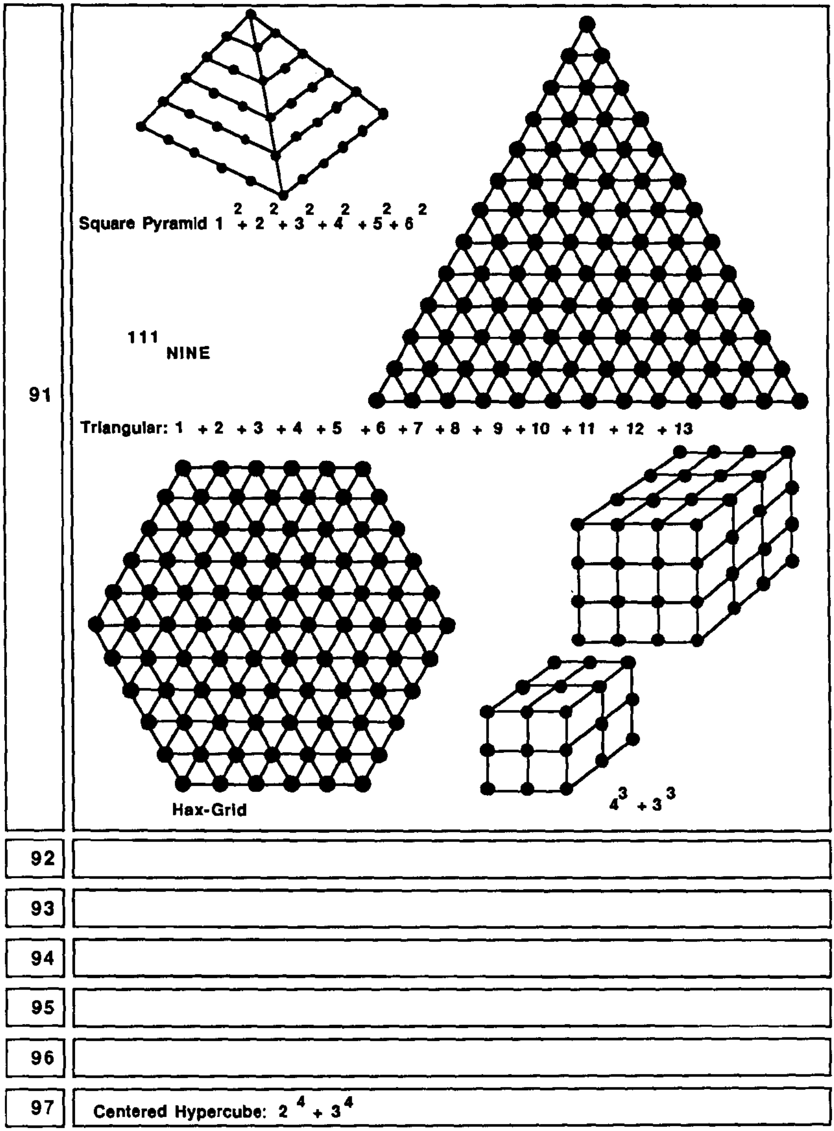


Fig. 29, No. 17.

the nature of numbers. All the patterns I drew are based on combinations of small numbers. Small numbers are added, multiplied, squared, and cubed. These simple combinations yield many more patterns

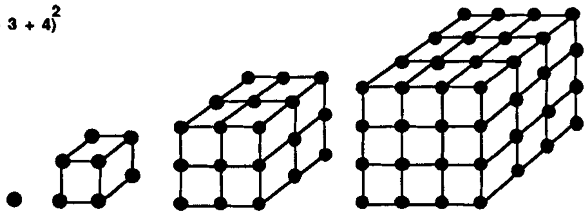
98	$1^4 + 2^4 + 3^4$
99	
100	$(1 + 2 + 3 + 4)^2$  $1^3 + 2^3 + 3^3 + 4^3$

Fig. 29, No. 18.

than one might have imagined. The endless list of numbers contains unexpected regularities, and some genuine surprises, like the rich structures of 91 and 100.

For all this, there are some numbers, like 23 or 59, that do not come out of simpler numbers in any obvious way. This suggests that the world of number is, in the final analysis, endlessly rich. As we go out through the numbers, strange and wholly new patterns keep appearing — patterns that cannot be described in terms of smaller numbers.

Numerology, Numberskulls, and Crowds

Numbers have a definite existence as patterns underlying the thoughts and objects that surround us. Depending on the complexity of the pattern from which they are drawn, numbers fall into four rough size ranges: small, medium, large, and inconceivable. *Small numbers* — the numbers, let us say, from 1 through 1000 — code up simple, universal archetypes. These numbers have the solidity and definiteness of naturally occurring crystals. *Medium numbers* — the numbers from