The temptations of numerology

Too much innocent energy is being spent on the search for numerical coincidences with physical quantities. Would that this Pythagorean energy were spent more profitably.

EVER since the Pythagoreans sought an explanation of their puzzling world in terms of simple numerical relationships, there has been a small but ingenious industry given over to the search for numerical relationships between supposedly fundamental quantities that specify the Universe. And the numerologists do have a few successes to their credit. Prout's hypothesis, early in the nineteenth century, that the masses of atoms relative to hydrogen would turn out to be integers when accurate measurements were carried out was for a long time discredited when accurate measurements of chlorine, for example, seemed to make such a simple rule untenable. But as things have turned out, atomic masses are indeed multiples of the nucleon mass with an appropriate allowance for what was called the "packing fraction" half a century ago. Much the same may be true of what is known as Bode's law, the rule that the distance in astronomical units from the Sun to the Solar System planets is given by a simple arithmetical series, at least as far as Neptune and if it is supposed that the asteroid belt takes the place of the planet between Mars and Jupiter supposed to be "missing". For although none of the attempts so far to account for Bode's law by the condensation of material from the solar nebula is wholly convincing, there is always a chance something may turn up.

These are not, however, the fields in which the numerology industry concentrates its efforts. With the proliferation of different particles of matter in the past several years, most of the practitioners have turned their attention to the discovery of numerical relationships between particle masses. Some have been impelled in that direction by the recognition that the reciprocal of the fine structure constant, a dimensionless quantity, is almost (but, significantly, not quite) the integer 137. More than a score of papers in this genre turn up in the *Nature* office each year, and then make their way back to their authors. The accompanying argument, from Mr Peter Stanbury, a factory worker from Tunbridge Wells in Kent, is a comparatively elegant piece of numerology which the author fears may be kept from the public by a stuffy establishment.

There are three kinds of reasons why numerology usually gets and more often deserves scant attention. First, if indeed there is some underlying numerical ideal, why are the relationships never exact? How can Pythagoreans be so tolerant of departures from their golden rules, in this case by several parts in a thousand? Second, sheer coincidence is by no means as unlikely as the numerologists like to think. Indeed, given that simple algebraic combinations of numbers such as π are literally infinite, the chance of being able to match an arbitrary set of numbers to within a fraction of a per cent must be high, tedious though the task may be. Third, there is the sceptical riposte "So what?". In spite of the hard work lavished on these numerical comparisons, nobody is any wiser about the way that matter is constituted even when they are successful. The pity is that such devotion is spent on such fruitless pursuits.

John Maddox

The alleged ubiquity of π

IT has long been known that the proton to electron mass ratio is very nearly $6\pi^5$—that is to say that $m_p/m_e = 1{,}836.15152$ compared with $6\pi^5 = 1{,}836.118$. What I have done is to look for and find a more general relationship between the value of π and the masses of the sub-atomic particles.

The particles of the basic octet are π^0, π^+, π^-, κ^+, κ^-, κ^0, $\bar{\kappa}^0$ and η. The sum of their masses is 3.14006 m_p. It can hardly escape one's attention that the multiplier of m_p is very nearly π or 3.1415926. When I first discovered this, my natural reaction was to see if anything similar occurred for baryon masses. The basic baryon octet contains the particles p, n, Λ, ε^+, ε^-, ε^0, Ξ^0, Ξ^- and the sum of their masses is 9.812 m_p, where the multiplier is significantly close to π^2 or 9.869604. Can one really say that both these results are coincidence?

Having observed that $m_p/m_e = 6\pi^5$, let us do away with man-made electron volt units for mass and instead use a system in which $m_p = \pi^6$ so that $m_e = \pi/6$. In these units, the masses of the particles become

$$m_p = 961.389\ (=\pi^6)$$

$$m_\mu = 108.26$$

$$m_{\pi^0} = 138.28$$

$$m_{\pi^\pm} = 143.006$$

$$m_{\kappa^\pm} = 505.827$$

$$m_\eta = 562.3$$

$$m_e = 0.5235987\ (\pi/6)$$

I note that

$$m_\mu/\pi^4 = 1.111434 \qquad (1)$$

$$m_\eta/m_{\kappa^\pm} = 1.11167 \qquad (2)$$

$$(m_\eta + m_{\kappa^\pm})/m_p = 1.1102 \qquad (3)$$

Relations (2) and (3) are both independent of the choice of units. Note also that $1+\pi^{-2}+\pi^{-4} = 1.111587$.

Now we come to the really interesting part of my work. The fine-structure constant is a dimensionless quantity whose reciprocal is equal to 137.03604 and is very nearly equal to $4\pi^3+\pi^2+\pi$ or 137.03630. Considering that this represents the ratio of the strength of the strong nuclear force (for which π^0 is the main carrier) to the electromagnetic force, it must surely be of some significance that the value of m_{π^0} is $\pi^4+\pi^3+\pi^2$ or 138.286.

How does all this fit together? For a long time I could see no really simplified pattern until I found the following:

	x	y	z
A	π^4	π^2	1
B	π^4	π^3	π^2
C	π^4	π^4	π^4

The values in row B (column y) add up to the value of m_{π^0} already quoted. The values in row A (column z) add up to 108.276, which is close to the value 108.2618 for m_{π^0}. The values in row C (column x) do not add up to a particle mass, but the sum of rows B + C (columns $x+y$) is the same as the expression I have previously derived for $\pi\alpha^{-1}$. Although row C does not produce a mass value, $m_\mu + m_{\pi^0} + m_{\pi^\pm} = 4\pi^4$.

Bearing this in mind, we note that

$$m_{\pi^\pm}/m_{\pi^0} = 1.03441 \qquad (A)$$

$$(m_{\pi^\pm - \pi^3})/m_\mu = 1.0345 \qquad (B)$$

$$m_{\pi^0}/(m_{\pi^\pm - \pi^3}) = 1.1111^2 \qquad (C)$$

The two values 1.0345 and 1.1115 turn up in so many of our results that I would state categorically that coincidence is ruled out. Indeed, there are many more of them, of which the following are two examples

$$\pi^{11}/m_\eta \cdot m_{\kappa^\pm} = 1.0343$$

$$[(m_\mu/m_\pi) - m_{\pi^3}]/m_{\pi^\pm} = 1.0346$$

Peter Stanbury

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