

Épreuve de section européenne

Two bees or not two bees

Dan Brown's *The Da Vinci Code* has become a publishing phenomenon, not least because of its controversial recasting of early Christian history. We can allow fiction authors creative freedom to change history to get a good story, but why do they mangle science? Especially when getting it right would have been even more interesting! Dan Brown puts silly words into the mouths of his "expert" characters. Soon after a murder in the Paris Louvre, the Harvard Professor Langdon is daydreaming about a lecture he gave on the divine proportion, which he calls PHI.

In fact, it is more commonly known as the Golden Ratio, an irrational number φ , written with the Greek letter of that name, and whose value is approximately 1.618.

Let's pick up the story directly from the book, where Langdon talks about bees :

Plants, animals and even human beings all possessed dimensional properties that adhered with eerie exactitude to the ratio of PHI to 1... So the ancients assumed PHI must have been preordained by the Creator...

Langdon grinned. "Ever study the relationship between females and males in a honeybee community?"

"Sure. The female bees always outnumber the male bees"

"And did you know that if you divide the number of female bees by the number of male bees in any beehive in the world, you always get the same number?"

"You do?"

"Yup. PHP"

The girl gaped. "No way!"

This couldn't be more wrong, especially the so-called eerie exactitude! Approximately 95% of the bees living in a beehive are workers, and the workers are female, so that leaves 5% males. If you divide 95 by 5 you get 19, which is nothing like "the ratio of PHI to 1", 1.618. Hardly an eerie exactitude! And in a severe winter, all the male bees die off, so then the ratio is infinite! So the facts seem to make Dan Brown completely wrong. But did he somehow hear something interesting about bees and the Golden Ratio but lost it in the retelling?

From "B-" for *The Da Vinci Code*

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Questions

1. Explain why scientists complain about Dan Brown's book.
2. All the females are produced when the queen bee has mated with a male; so, female bees have two parents, a male and a female, whereas male bees have just a single parent, the Queen. Make a family tree for a male bee, who we'll call Rob, up to the 5th generation (Rob is counted as generation 0).
3. Let M_n and F_n be respectively the number of male and female ancestors of the n -th generation; make a table presenting the values of M_n and F_n for n ranging from 1 to 5.
4. Justify the following identities given for any natural number n : $M_{n+1} = F_n$ and $F_{n+1} = M_n + F_n$
5. Prove that for any natural number n , $F_{n+2} = F_{n+1} + F_n$. Deduce that

$$\frac{F_{n+2}}{M_{n+2}} = \frac{F_{n+2}}{F_{n+1}} = 1 + \frac{F_n}{F_{n+1}}.$$

6. Assuming that approaches $\frac{F_{n+1}}{F_n}$ a real x as n approaches $+\infty$, prove that x is a solution of the equation : $x^2 - x - 1 = 0$.
7. Solve the previous equation for x and explain Dan Brown's mistake.