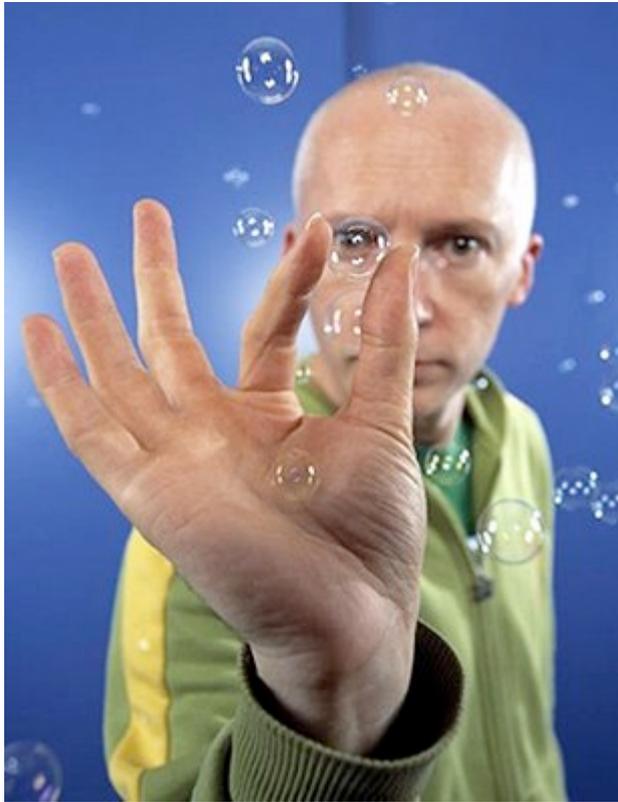


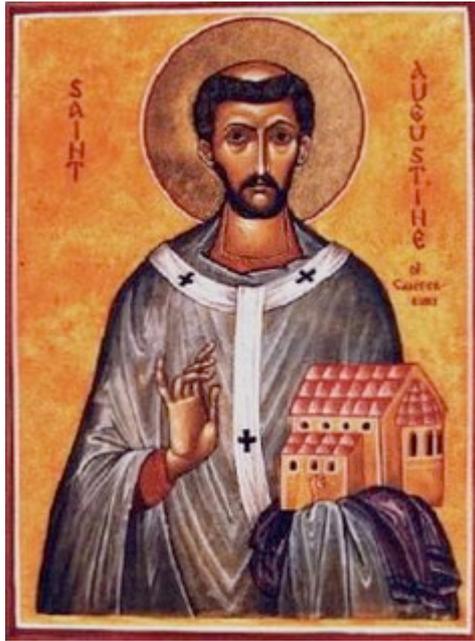
**Friday, 17 July 2009**

**[Marcus du Sautoy: Pefect Numbers \(The Times, July 1 2009\)](#)**



(...) As a mathematician I was beginning to feel a bit left out. We've got Pi Day, which we celebrate on March 14, but how about adding a World Maths Day to the June calendar? On Sunday, when I looked at the date, it suddenly dawned on me why 28/6 would be the perfect day to celebrate **World Maths Day** - literally the perfect day because 28 and 6 are what mathematicians call perfect numbers.

A number is called perfect if, when you take all the smaller whole numbers that can be used to divide the number and you add them together, you get the original number. For example **6** is divisible by 1, 2 and 3. Add these together and you get 6. Similarly, **28** is divisible by 1, 2, 4, 7 and 14, which add up to 28. These are the first two perfect numbers. The next is **496**.



Perfect numbers have been studied since ancient times and were regarded as having mystical significance. The 4th-century philosopher **Saint Augustine** believed that God created all things in six days precisely because the number **6** is a perfect number. In **Jewish mysticism**, it was because **28** was a perfect number that the mystics believed that God Chose it as the number of days that it takes the Moon to travel round the Earth, so defining the length of the Jewish month.



But it was the great Greek mathematician **Euclid** who discovered the exciting **connection between perfect numbers and another important sort of number: the primes**. By adding up powers of 2 he found that whenever the answer was a prime number then there was a way to use that prime number to get a perfect number. For example,  $1 + 2 + 4 = 7$ , which is a prime number. If you multiply that prime by the last power of 2 in the sequence you get a perfect number. In this case  $7 \times 4 = 28$ . The next time you get a prime by adding up powers of 2 is  $1 + 2 + 4 + 8 + 16 = 31$ . Multiply 31 by 16

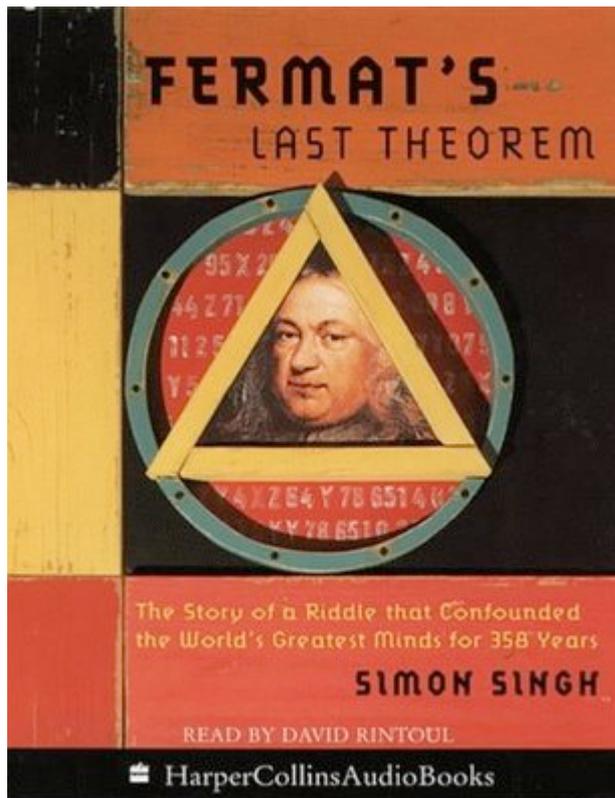
and you get 496, the third perfect number.



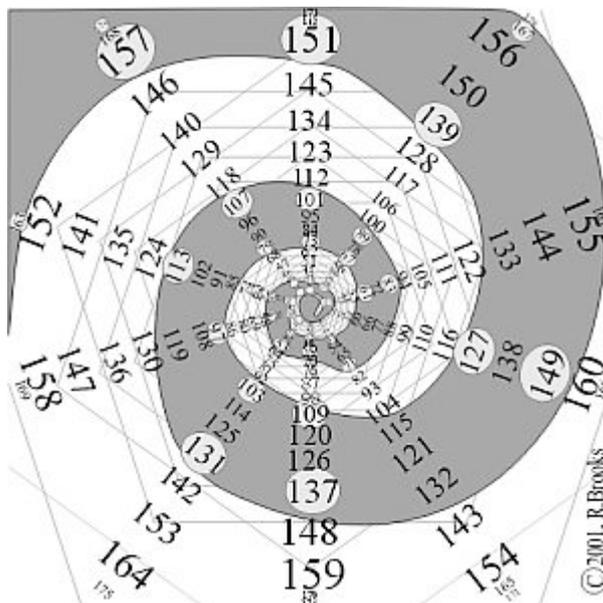
Euclid was able to prove that this always worked. Whenever the powers of 2 add up to a prime, you get a perfect number by multiplying the prime by the last power of 2 you added. But was every perfect number discovered this way? It wasn't until nearly 2,000 years later that mathematicians were able to give a partial answer to this. Both **Descartes** and **Fermat** wrote to the French monk **Mersenne** with their discovery that **every perfect number must come from the primes that are sums of powers of 2.**



**Mersenne** acted as something of a medieval internet hub, broadcasting discoveries across Europe, and it is his name that is now given to the primes that are got by adding powers of 2. Whenever a new Mersenne prime is discovered it leads to the discovery of a new perfect number. So far we have discovered **47 perfect numbers**, the largest of which has nearly 26 million digits.



But there are still many mysteries that surround these perfect numbers. **Are there infinitely many of them?** Or is the 47th perfect number the last one? Thanks to Descartes and Fermat, we know how to get even perfect numbers. But it is still unknown how to get an odd perfect number. Indeed most mathematicians believe there is none.



So when June comes round again next year, and it's time to give thanks for the badgers and the oceans, why not celebrate a bit of mathematics on the perfect day: June 28.

