It should be evident that here Euler was in his element, operating at the height of his analytic powers. When Euler met l'Hôpital, good things happened.

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Math Bite: A Magic Eight

In many cultures, the number 8 has special significance and is even considered magical. For instance, in China the Olympic Games were scheduled to begin at exactly 8:08 PM on 8/8/08.

Those wishing to advance the cult of the number 8, even in 2009, might enjoy knowing that the sequence

$$\frac{9}{1}, \frac{98}{12}, \frac{987}{123}, \frac{9876}{1234}, \frac{98765}{12345}, \ldots$$

converges exactly to 8.

You probably have realized that the ellipses (...) need a suitable interpretation, since numbers greater than 10 and less than 0 are not normally allowed to serve as digits. Check for yourself that, with a suitable placement of the decimal point, the numerator and denominator become

$$\sum_{k=0}^{\infty} (10-(k+1)) \left(\frac{1}{10}\right)^k \quad \text{and} \quad \sum_{k=0}^{\infty} (k+1) \left(\frac{1}{10}\right)^k.$$

Summing these series gives 800/81 as the numerator and 100/81 as the denominator. And the magic quotient of these two is 8.

—Paul and Vincent Steinfeld
Darmstadt, Germany