THE RHIND PAPYRUS AND THE ST. IVES PUZZLE

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The effects of time have destroyed many great works of historical significance, but a few Egyptian papyri have managed to survive over three millennia. The most extensive papyrus of a mathematical nature is the ***Rhind Mathematical Papyrus*** (ca 1850 B.C.). Purchased in 1858 by Egyptologist **Henry Rhind**, hence its name, it was later willed to the British Museum, where it now rests. (Because it was copied from an earlier work by a scribe named **Ahmes**, it is sometimes called the ***Ahmes Papyrus***.) About 1 foot high and 18 feet long, the papyrus contains 85 problems written in hieratic form.*

The *Rhind Mathematical Papyrus* provides us with much information about ancient Egyptian mathematics, particularly in the areas of counting and measuring. Additionally, its use of ciphers represents an important contribution to the development of numerical notation. Because Egyptian arithmetic operations didn't include fractions that contained nonunit numerators, the *Rhind Papyrus* contains a table that allows the reader to represent fractions as a sum of unit fractions (fractions with a numerator of 1). For instance, $\frac{2}{97} = \frac{1}{56} + \frac{1}{679} + \frac{1}{776}$.

Most of the problems in the *Rhind Papyrus* have been deciphered and interpreted, with the exception of Problem 79, which contains a curious set of data.

Houses	7
Cats	49
Mice	343
Heads of wheat	2401
Hekat measures	16807
	19607

Each number is a power of 7, but because the problem in the *Rhind Papyrus* was never accurately interpreted, we don't know what the numbers represent. In 1907, historian Moritz Cantor recognized a possible connection between this data and a problem posed by thirteenth-century mathematician Fibonacci in his *Liber abacci* (*Book of calculation*). A familiar version of Fibonacci's problem is represented in this old English children's rhyme.

As I was going to St. Ives I met a man with seven wives;
Every wife had seven sacks; every sack had seven cats; every cat had seven kits.
Kits, cats, sacks, and wives, how many were going to St. Ives?

This verse, called the St. Ives Puzzle, is part of the world's puzzle lore. One possible answer to the St. Ives Puzzle is 1. As the puzzle states, the speaker was going to St. Ives. If he (or she!) met the man and his wives on a road, they could have been *coming* from St. Ives. ★

Rhind Mathematical Papyrus, Problem 62

- Example of figuring the contents of the bag of various precious metals

  A bag containing equal weights of gold, silver, and lead has been bought for 84 *sha'ty* [unit of value]. What is the amount in the bag of each precious metal if a *deben* [unit of weight] of gold costs 12 *sha'ty*, a *deben* of silver costs 6 *sha'ty*, and a *deben* of lead costs 3 *sha'ty*?
- Solution

  Add what it costs for a *deben* of each precious metal. The result is 21 *sha'ty*. Multiply 21 by 4 to get 84 (the 84 *sha'ty* it cost to buy the bag). Thus 4 is the number of *deben* of each precious metal.
- Find the value of each metal in this way:

  Multiply 12 by 4, getting 48 *sha'ty* for the gold in the bag.
  Multiply 6 by 4, getting 24 *sha'ty* for the silver in the bag.
  Multiply 3 by 4, getting 12 *sha'ty* for the lead in the bag.
  Multiply 21 by 4, getting 84 *sha'ty* altogether.
- **What are some other ways to approach this problem?**

*Ancient Egyptian priests kept their records in the hieratic form, a type of writing consisting of abridged forms of hieroglyphics. Egyptian hieroglyphic writing was a pictographic script whose symbols were often conventionalized pictures of the things they represented.

ACTIVITIES

1. In the *Rhind Mathematical Papyrus,* the area of a circle is described as being equal to the area of a square with a side that is $\frac{8}{9}$ of the diameter. What does this yield as a value for π?

2. Interpret this explanation from the *Rhind Papyrus:* "If you are asked, what is $\frac{2}{3}$ of $\frac{1}{5}$, take the double and the sixfold; that is, $\frac{2}{3}$ of it. One must proceed likewise for any other fraction."

3. Show that $\frac{a}{bc} = \frac{1}{br} + \frac{1}{cr}$, where $r = \frac{(b+c)}{a}$. Use what you discover to represent, in two different ways, $\frac{2}{63}$ as the sum of two unit fractions.

4. The Egyptians invented the paperlike writing material called papyrus. How is papyrus made?

5. The problems in the *Rhind Papyrus* are written in the hieratic form and have been transcribed into hieroglyphics for translation. A hieroglyphic symbol that looks like legs walking to the left indicates addition; legs walking to the right indicates subtraction. What do other hieroglyphic symbols look like? What do they mean?

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