EGYPTIAN MATHEMATICS

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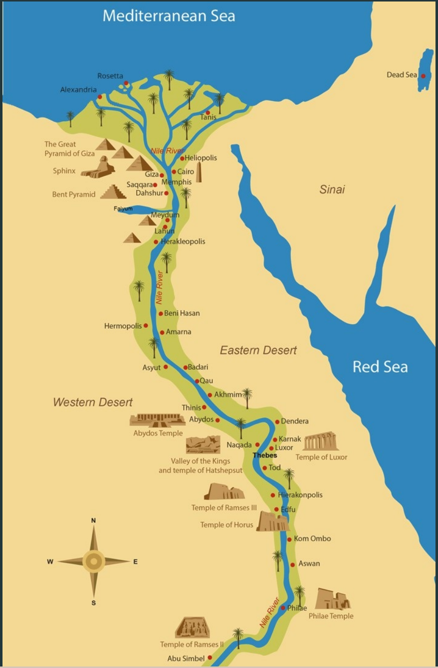
Lecture 2

OVERVIEW

1. Historical Context
2. Number Systems and Computation
3. Linear Equations and Proportional Reasoning
4. Geometry

Historical Context


Mediterranean Sea
Rosetta
Alexandria
Tanis
Dead Sea
The Great Pyramid of Giza
Nile River
Heliopolis
Sphinx
Cairo
Giza
Memphis
Saqqara
Dahshur
Bent Pyramid
Sinai
Faiyum
Meydum
Lahun
Herakleopolis
Nile River
Beni Hasan
Hermopolis
Amarna
Eastern Desert
Red Sea
Asyut
Badari
Qau
Akhmim
Western Desert
Thinis
Abydos
Dendera
Abydos Temple
Naqada
Karnak
Luxor
Thebes
Temple of Luxor
Valley of the Kings and temple of Hatshepsut
Tod
Hierakonpolis
Temple of Ramses III
Edfu
Temple of Horus
Kom Ombo
N
W
E
S
Aswan
Philae
Philae Temple
Nile River
Temple of Ramses II
Abu Simbel

TWO SYSTEMS OF WRITING

- Hieroglyphic
- Hieratic

Mathematics was primarily for *scribes*.

PAPYRI

- Dry climate
- Papyri preserved: Rhind, Moscow

Number Systems and Arithmetic

HIEROGLYPHIC NUMBERS

- 1: 𓏺
- 10: 𓎆
- 100: 𓍢
- 1000: 𓆼
- 10,000: 𓂭
- 100,000: 𓆐
- 1,000,000: 𓁨

The notation is additive. What is:

𓏺𓏺𓏺𓎆𓎆𓍢𓍢𓍢𓍢𓆼𓆼𓁨 ?

Note that the usual practice was to put smaller digits on the left.

Problem: Add

|||
∩∩∩∩
∩∩∩∩
𓍢𓍢𓍢𓍢
𓍢𓍢𓍢

and

|||||
∩∩∩∩
∩∩∩
𓍢𓍢

||||
||||
∩∩∩∩∩
∩∩∩∩∩
∩∩∩∩∩
𓍢𓍢𓍢𓍢𓍢
𓍢𓍢𓍢𓍢

Or:

||||
||||
∩∩∩
∩∩
𓆼

MULTIPLICATION

Problem: Suppose we wish to multiply 11 by 14.

	1	11
	2	22
	4	44
	8	88
Totals	14	154

Explain what is going on. Check your idea by trying 17×12.

Question: How can we divide six loaves among ten men?

Answer: each man gets one-half plus one-tenth of a loaf.

Book notation: $\overline{n} = 1/n$, $\overline{\overline{3}} = 2/3$.

Checking the answer from before:

1	$\overline{2}\ \overline{10}$
2	$1\ \overline{5}$
4	$2\ \overline{3}\ \overline{15}$
8	$4\ \overline{\overline{3}}\ \overline{10}\ \overline{30}$
10	6

Linear Equations

MOSCOW PAPYRUS PROBLEM 19

Problem: Find the number such that if it is taken 1 1/2 times and then 4 is added, the result is 10.

Solution: "Calculate the excess of this 10 over 4. The result is 6. You operate on 1 1/2 to find 1. The result is 2/3. You take 2/3 of this 6. The result is 4. Behold, 4 says it. You will find that this is correct."

FALSE POSITION

Example (Rhind Papyrus, Problem 26)
Find a quantity that when added to 1/4 of itself, the result is 15.

Solution: "Assume [the answer is] 4. Then 1 $\overline{4}$ of 4 is 5 . . . Multiply 5 so as to get 15. The answer is 3. Multiply 3 by 4. The answer is 12."

Explain.

Idea: assume a convenient (but probably wrong) solution to a linear equation and adjust it via proportionality. Used in several other examples, as well as the only extant Egyptian quadratic.

A NOTE ON GEOMETRY

- Approximated $\pi \approx 256/81 = 3.16049\ldots$
- Area of the circle $A = [(8/9)d]^2$
- No extant sources with volume of a pyramid, though several Rhind problems deal with slope (*seked*)
- Moscow Papyrus: formula for volume of a truncated pyramid