HOW WE LEARNED TO USE NUMBERS

An outline of the development of numbers and numerals from earliest times to to-day

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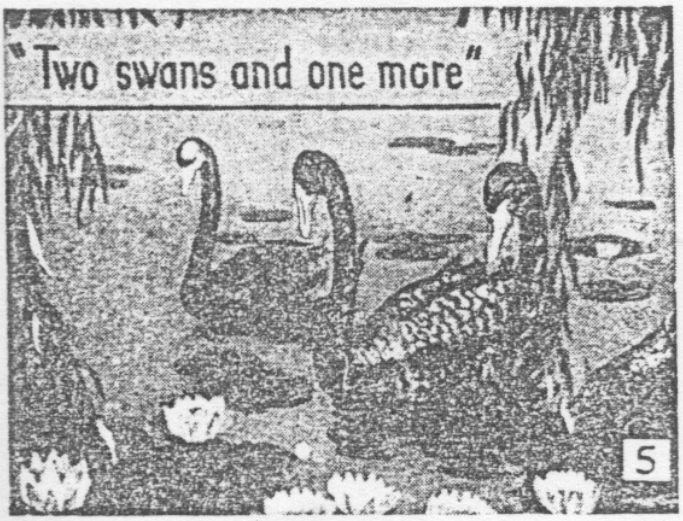
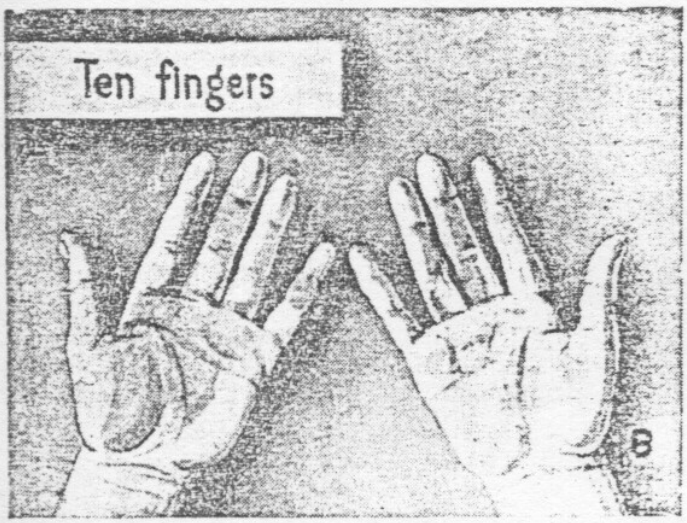
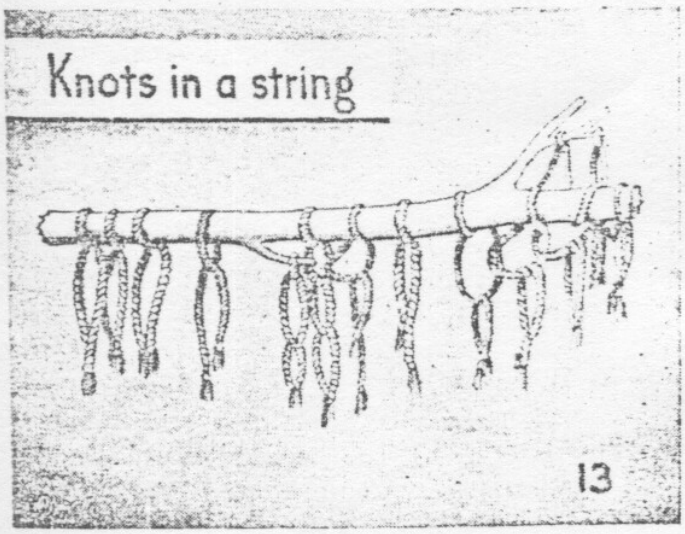
These notes were prepared by R. J. Gillings, B.Sc., M.Ed., of the Sydney Teachers' College to accompany the film strip made by the Visual Aids Section of the Education Department of South Australia







How we learned to use Numbers

Man long ago felt the need to count. To begin with he needed words to cover just a few things, " three " tortoises, for example (1). Soon the shepherd needed to count larger groups of sheep (2) and the agriculturalist of palm trees. At first they could only use the phrase " a great many " even though the number might be only 5 or 6 (3 and 4).

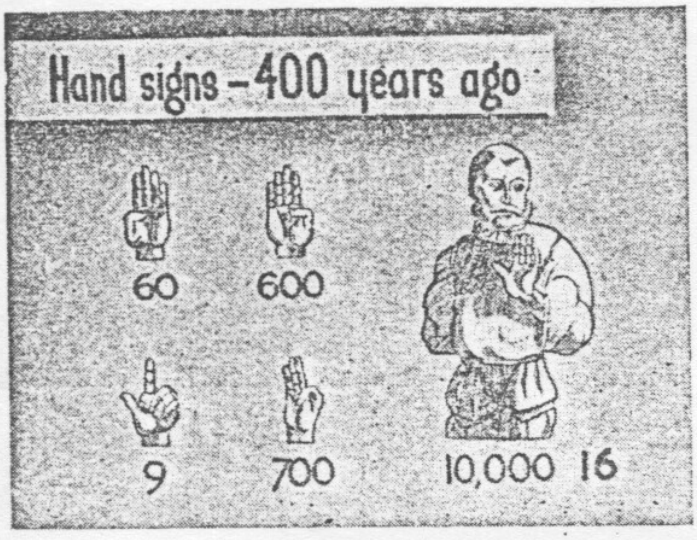
When man tried to be more specific with regard to these larger numbers (5), and having only " one ", " two " and " three " to use he could only count as follows:—

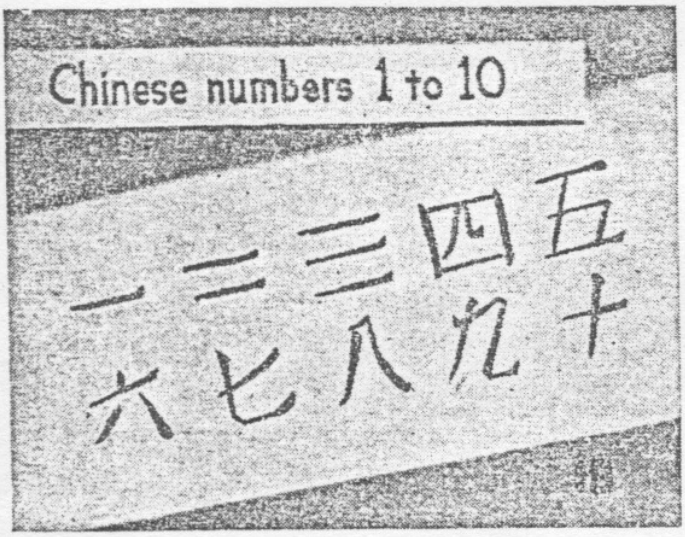
1 — one
2 — two
3 — two and one
4 — two two's
5 — two two's and one

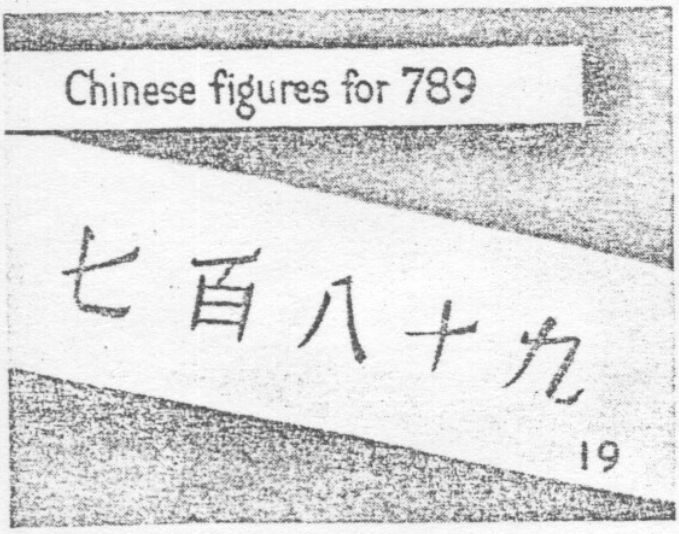
However, this method proved far from adequate when he needed to count his flock (6) until he realised that he could check off his sheep according to the fingers of one hand or both (7, 8). This was the beginning of our decimal system. (Latin " decem " = 10.) Some ancient peoples notably the Aztecs of Central America, were sensible enough to use their toes as well (9). One tribe had a word meaning, in our language, " man finished " for 20.

Another method of counting larger numbers was made possible by using pebbles (10). If each warrior dropped a pebble on the ground, the number of pebbles was the same as the number of warriors. On their return if they picked them up, one each, the pebbles left on the ground indicated the losses in battle. The latin word for " pebble " was " calculus " (plural " calculi "), from which comes our present word, " calculate ".

As herds increased (11) another method was developed— that of cutting notches in a tally-stick (12). In 1937, a very ancient tally stick was unearthed, said to date back to paleolithic times. It is a bone from the fore-leg of a young wolf. It has 55 notches on it arranged in groups of 5. In modern times we speak of a " tally " of so many runs at cricket, and we say a batsman " notched " a certain number of runs, for in the early days of cricket, the scorer kept a " tally " of the runs by " notches " on a stick. We still have " tally-clerks " in warehouses to check the stores.







Another method of counting was by tying knots in a string (13). The Peruvians were thought to have kept their accounts with knotted cords. The Incas (of Peru) probably used a rod with several pieces of rope on it (as shown), which were knotted in different ways to represent different numbers. The first 4 cords in the picture represent 1, *i.e.*, one simple knot in the string. With no stick to hold the rope a simple knot such as one ties in a handkerchief represented " one ". For greater numbers more complex knots were tied.

Some time later signs were devised for making a record of these totals. The Egyptian carved their signs, for example, on stones (14). This is the sign for 30 though it more usually appears with the " U " shapes reversed, like " ∩ "

Not only children (15) but men, even nowadays, count by strokes as shown in the picture. The scoring boards of bowling matches often show such a method of counting with usually a stroke through each four, 1111, like this 𝍸 to mean a group of 5.

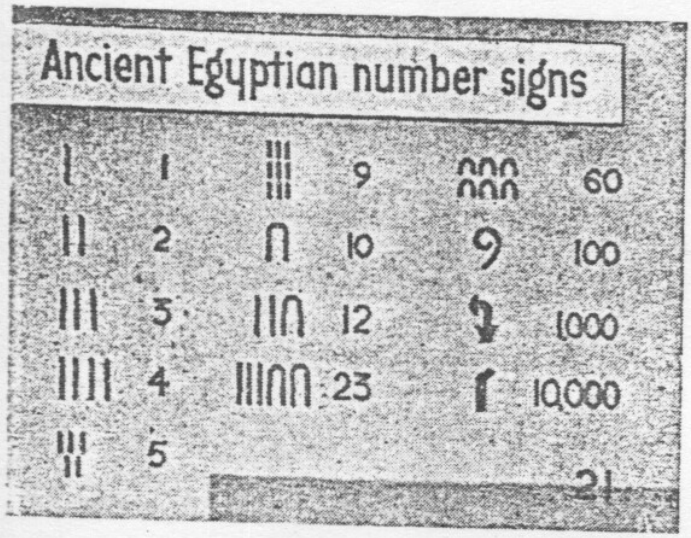
Finger counting and numbering (16) were used by various ancient peoples who may not have used quite the same signs. In a book printed over 500 years ago, pictures appear showing the hands and fingers in various positions to represent hundreds of numbers. They learnt to add and subtract using only their fingers. The sign for 10,000 in this book is a little different from the one in the picture, as the first finger or digit is there bent down. Finger counting was used as early as the 13th century.

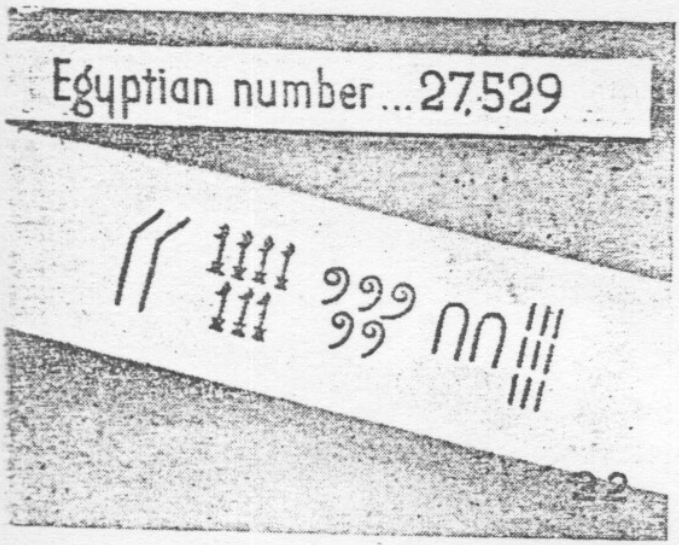
For the Indian Rock Drawing (17) no comment is necessary.

Civilized people in many parts of the world have developed their own methods of writing numerals.

The Chinese (18) wrote not with a " stylus ", a pointed stick or a pen, but with a brush, and often still do. Their writing is vertical, *i.e.*, they read from top to bottom, not left to right as we do. These numerals are here written left to right to show how they correspond to our own present day numerals. The Japanese use a system of writing and numbers not unlike that of the Chinese from whom they probably developed it.

The Chinese signs (do not use the word figures, it is deceptive to children), for 789 (19) require five signs showing (*Note.*—turn back to frame 18 a few times)





7 hundreds, 8 tens and 9 units. This is an early illustration of *place value* in numeration systems.

These (20) are called " cuneiform " numerals—wedge-shaped, which developed in Mesopotamia where they had no " papyrus " or other writing material. They used marks pressed in wet clay tablets with a sharpened stick, giving the peculiar wedge shape. These tablets were afterwards baked dry and hard, and in that climate they remained the same for years and even centuries. The system is a sexagesimal one. Note the single sign for 10. It was in a sense a " decimal system ". " Sexagesimal " means they counted in groups of 60.

The Egyptians carved their hieroglyphics in stone (21) or drew on papyrus sheets. Refer back to frame 14 where UUU is shown, and notice 𓎆 for 60 in Egyptian hieroglyphics. Sometimes in inscriptions the 𓍢 for 100 is curved differently, (𓆼), and the bend at the top of the symbol for 10,000 (𓂭), is sometimes omitted.

No comment is necessary here (22). (*Note.*—To an advanced class the symbols 𓂭𓂭 and 𓎆𓎆 might be referred to, which in our present day system are represented by the same mark, namely 2. Our 2 changes its value as it changes its place in an array of digits).

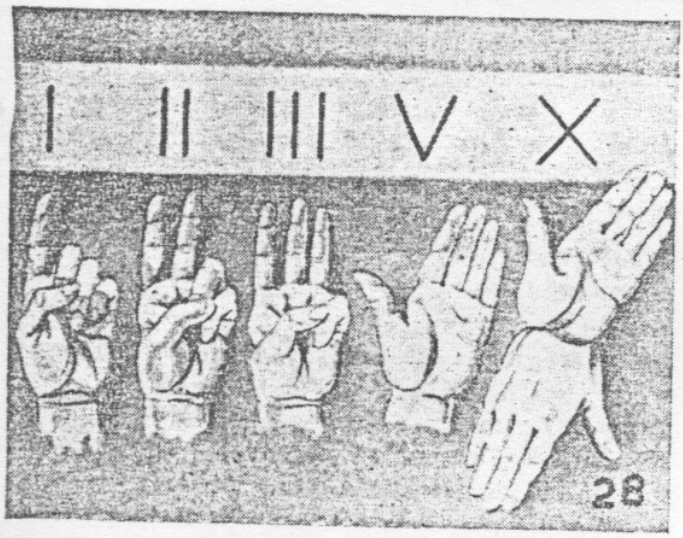
Later in history parchment was developed as a surface for writing upon (23). A parchment roll was made from the skin of a lamb or goat and polished smooth with a pumice stone. Of course it was very costly. It got its name from the town of Pergamos (or Pergamum) in Asia Minor where it was first used for this purpose.

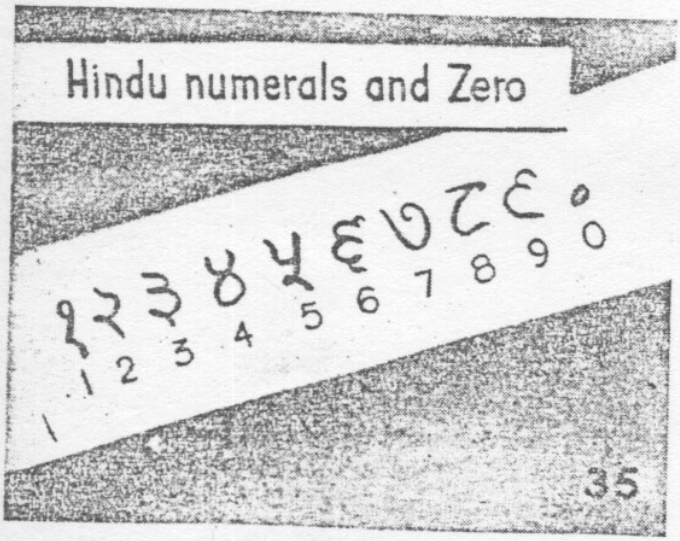
Much Greek writing was done on parchment. The Greeks (24) had no numbers as we have, like, 1, 2, 3, etc. They used the letters of their alphabet, as—

α	alpha	=	1
β	beta	=	2
γ	gamma	=	3

etc., etc.

So as to distinguish between letters and numbers the Greeks wrote the numbers with a small dash near them as, α′. β′. γ′. This is usual in Attic Greek. However, there were several kinds (*e.g.*, Hellenic Greek), and sometimes their capital letters were used. In frame 25





the letters are called Herodianic Greek numerals, and the 5 is represented by a capital (gamma), *i.e.*, Γ , the 10 by a capital δ (delta), *i.e.*, Δ , the 100 by a capital η (eta), *i.e.*, H and the 1,000 by a capital χ (chi), *i.e.*, X . In this system, the letters are the first letters of the words for 5, 10, 100, 1,000, etc., thus—

penta	=	5	Π or Γ =	p
deka	=	10	Δ =	d
hekto	=	100	H =	h
kilo or chilo.	=	1,000	X =	ch

Thus the Greek number 2977 is shown (25) as—

X X =	2,000	X =	1,000			
Γ =	500	Γ =	5	H =	100	
H H H H =	400	H =	100			
Γ =	50	Γ =	5	Δ =	10	
Δ Δ =	20					
Γ II =	7	Γ =	5	II =	2	
Adding number	2,977					

This way of writing numbers is, as you can see, nearly as cumbersome as the Roman method. How much should we admire Archimedes and the other Greeks, for the work they did in mathematics, with such awkward tools for working out problems involving numbers !

The later Greeks (26) (as was mentioned in frame 24) used the first 10 letters of their alphabet for the first 10 numbers, usually with a dash near them. The letters in the picture are the *capitals* and read as follows:—

A	α	alpha	1
B	β	beta	2
Γ	γ	gamma	3
Δ	δ	delta	4
E	ε	epsilon	5
F	ϝ	digamma	6 (pronounced like our v but not always used).
Z	ζ	zeta	7
H	η	eta	8
Θ	θ	theta	9
I	ι	iota	10

The Hebrews (27), like the Greeks, used the letters of their alphabet to represent numbers. But Hebrew writing reads from right to left instead of from left to right as ours does. Their numbers read as follows:—

a	aleph	1
b	beth	2
g	gimel	3
d	daleth	4
h	he	5
v	vau	6
z	zain	7
ch	cheth	8
t	teth	9
j	jod	10

If you would like to see these Hebrew letters printed, you will find them in the old testament of the bible in Psalm 119.

The Romans developed their system of numerals from hand signs (28). From the finger positions shown come these numerals (29), with which we are still familiar from the chapter headings of books, and from the face of an ordinary clock, from 1 up to 12. Of course they are not all shown here, but everyone is familiar with Roman numerals at least up to 12. You should note that later Romans wrote IV for four, rather than IIII, and the latter form is always (or nearly always) used on clock faces to-day. There are two clock faces on the tower of St. Philip's Church, Sydney, near the approaches to the Harbour Bridge. They are, I should think, the only big clocks in Australia, which have IV for four, on their faces. The arrow (↧) for 50 is old Roman, the later symbol for 50 was L, C for 100, D for 500 and M for 1,000, as you will see in the next picture. These are (30) the later Roman numerals, more familiar to all of us, although the double D or ∞ sign for 1,000 was most commonly replaced by M.

It is almost certain that our modern numbers, after years of change, variation and alteration, had their very beginnings among the Hindus of India (31). The cross for four was sometimes written like X as our sign for multiplication is made. Before the invention of paper, people had to improvise whatever was available in their country for materials to write on. Thus there were used " papyrus " from a plant growing in the Nile, flat clay tablets which were afterwards dried by baking, wax tablets, slates, sand trays, etc., etc. Frame 32 is a picture of dried palm leaves cut into strips on which much early Indian writing was done. These numerals (33) are later Hindu numbers probably of Brahmin origin and are about 2,000 or more years old. Notice that there is no zero shown, and the cross for four is somewhat different from that of frame 31. The development of a positional system for numbers with place values using a zero as a " place holder ", does not appear until some 500 years later. The zero may have been used, as a small circle or a small dot, but it meant only " nothing ", " a void " and was not used as in 305, 3 hundreds, no tens and 5 units as it is to-day. It was this special use of 0 as a place holder that made our present number system so great an advance on the older systems. The Hindu word for a " void " was " sunya ", and in Arabic the corresponding word was " cifra " from which come our modern words " cipher " and " zero " other names for " nought "

Although our present numerals are called " Arabic " (34), they have never been used by the Arabs. The Arabs apparently translated some Hindu works into their own language and merchants and traders brought these Arabic works across to Europe. This was about the 10th or 11th centuries, long before the invention of printing. These books were hand written and so you can see that when learned men (scribes) copied them out, their handwriting varied from the originals, and thus many slight differences in form arose. The Arabs did then and still do now, use the symbols as shown here for their numbers. But the numbers in modern use are still called " Hindu-Arabic " numbers, because although they had their origin among the Hindus, they were made known to the European world through the medium of the Arabs. Observe the Arabic 5 is like the present day zero, and the Arabic zero is a dot. The Persians (Iran) used a very similar form of these Arabic numerals.

In frame 35 is a third (and later) stage of the development of the Hindu numerals which probably reached Bagdad (Iraq) about the 10th or 11th centuries, per medium of the Arabs. These in being re-written and copied (remember printing was not invented), changed in form quite a lot. Thus a later form of these received a special name of " Gobar " or " Dust " numerals, from

the custom of writing them on a smooth flat tray covered with (blue) sand. Observe the changes which occurred, by looking at the numbers in the next picture.

These European numerals (36) are about a thousand years old and represent a further stage past the " Gobar " numerals, though some clear similarities can be seen if you turn the frame back, notably with 2 and 5. These numbers here read from right to left *which they never did originally*. Perhaps they are written like this because they were taken from a book (" Numbers and Numerals " —Smith and Ginsburg), where they are so printed. There they are stated to have come from a Spanish manuscrip (*i.e.*, hand-written), in the year 976 A.D., and they ma have been written backwards in that manuscrip Otherwise I cannot say why these Early European numera are shown the way they are.

The last frame (37) needs little comment, except perhaps to say that these *printed* numerals even to-day vary from our own handwritten numbers. For example how many of us looking at this picture at this moment would, if asked to write the numbers 1 to 10, write the as shown, or the 4 or even the 8 or 9 ?

Related Film Material

The 16 mm. films:

The Story of Money

and

Ancient Mesopotamia

will provide related information though neither film is devoted fully to the topic treated in this strip.

Related Reading Material

Your Arithmetic Book	I. TURNER	(Primary)
Number Stories of Long Ago	D. E. SMITH	(Primary)
How Much and How Many	J. BENDICK	(Primary and Secondary)
Numbers and Numerals	SMITH AND GINSBURG	(Secondary)

List of Frames

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