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Ettore Simonetti (1857-1909), Rome, *The Jewel Box*.

Science never had a numeric language more versatile than the Arabic numerals for which no formula is too complex and no number too great: Eight thousand and nineteen becomes, in this system of arithmetical notation, 8019, there being no units or multiples of them in the expression of this number which correspond one thousand and one hundred in the general scale of units; is this immediate transition from ordinary numerical language to the equivalent expressions by means of arithmetical symbols and the exact correspondence between them, which constitutes the great superiority of the Arabic system of numeration above that which was known to the Greeks and Romans and other nations of antiquity.

***George Peacock* (1791-1858), *The Euclid of algebra, A Treatise on Algebra,* (1842) Vol. 1, pp. 78-79**

The Author

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A journalist since the late 1960s, he became Front Page Editor of *Al Arab* Newspaper (London), the first pan Arab Newspaper launched in Europe. In 1978, he joined Jihad Al Khazin in launching *Asharq Al Awsat Newspaper* (London) as Business and Supplements Editor. In 1980, he was appointed Central Managing Editor of the Emirates News Agency in Abu Dhabi, United Arab Emirates. In 1988, he joined Jamil Mrowa (who later re-launched the *Daily Star* in Beirut in 1996) in London for the re-launch of *Al Hayat Newspaper* and continued under the editorship of Jihad Al Khazin until he left in April 2001 to dedicate his time to historical and fictional writing.

The author co-produced a number of TV documentaries, and later produced, directed and wrote "Muslims along the Silk Road", a five part-60-minutes-each documentary tracing Muslim culture and heritage and the legacy of Muslim pioneers and merchants along the Silk Road. He hosted for TV and interviewed for the press many world leaders including Indian Prime Minister Indira Ghandi, British Prime Minister Margaret Thatcher, Afghanistan President Hafizullah Amin (shortly before his execution with members of his family at the start of the Russian invasion of his country), Austrian Chancellor Bruno Kreisky, Malaysian Prime Minister Mhatir Muhammad, Pakistan President Mohammad Zial-ul-Haq, Prime Minister Mohammad Khan Junejo, Austrian Chancellor Fred Sinowatz, Sheikh Issa Bin Salman Al Khalifa the Emir of Bahrain, Sheikh Khalifa Bin Hamad Al Thani the Emir of Qatar, Saad Al-Abdulla Al-Sabah the Prime Minister of Kuwait and many others.

As an author, his first works included several anthologies of short stories and a novella. *The Andalusian Moriscoes*: *History of the Moriscoes after the Fall of Granada* was published in Cairo in 1982. His first novel *Traces of a Tattoo* was published in 1998, his second (*Times of Death and Roses*) in 1999 and the third (*Gardens of Despair*) in 2000. *Martyrdom of the Andalusian Nation* (Part I) was released in 2001. In 2001-2002, he co-authored *A Thousand Miles in One Step* with HRH Prince Abdulla Bin Mosaad Bin Abdul Aziz Al Saud, a grandson of the founder of Saudi Arabia. *History of Injustice in the Arab World* was launched at Sharjah World Book Fair in December 2005. His most recent book, Manifest *Destiny of Imperial Decline,* came out in 2006.

The writer has published hundreds of articles and interviews in Arabic and English. He appears regularly on TV shows, and he participates in conferences and seminars on history, literature, religion, economy and current affairs.

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Chapter 1

THE STORY OF NATURAL NUMBERS

We have two stories to tell, both of which have never been told in a book before. Because they are naturally simple, they may sound outrageous. This should not be of concern, since shocking one's readership with simple facts is one reason why many authors write their books. We are confident that most of what we have discovered is probably correct, but we have no problem at all with people calling our assertions 'claims' until they can be evaluated by experts who are better suited to judging the significance of what we have found. Some of our findings will bring immense relief to millions. They may also bring immense frustration to others. We were guided in our research by a sincere desire to bring closure to a serious controversy that was sparked essentially by two orientalists hired by the East India Company two centuries ago.

Their story is the best-kept secret in the history of numbers and now is a good time to reveal our findings. For this reason we decided to provide an English version of the book that was originally prepared in Arabic, a time-consuming and laborious undertaking, and not without its faults. The temptation to rewrite large sections of the book was strong. However, the scope of our research was extended unexpectedly, and the confidentiality of our work was compromised. This book, therefore, should be viewed as a first attempt to present a complex argument in the clearest terms possible, and not to subvert established histories.

The best reward for our many months of arduous work is for this contentious issue to be settled conclusively once and for all, but we are not certain that all involved will see it this way. We are fully aware that a great deal may be at stake. The possibility that an entire historiography could be exposed as a construct founded on narrative and misunderstood concepts is unlikely to be acceptable. For this and other reasons, we expect to be criticised. This is fine with us. Before a story is told, one must be prepared to tell it. If the price for telling it is criticism, then so be it.

Our other story is much older, simpler, and therefore potentially more outrageous. If we are correct, it may be one of the oldest stories ever told about those little "things" that are so essential to human civilisation, the sudden dissipation of which could cause it to grind to a halt. Symbols that can be recognised by a computer must be special. Symbols that can be recognised by monkeys must also be special, but symbols that can be recognised by machines, apes and humans must be the only universal script invented by human beings in a time beyond the horizon of our remotest past. Speech is rightly described as one of the main discoveries that changed history, writing is the other, and both were essential tools for the creation of civilisations and the recording of history. Sadly, neither of our stories was recorded. An account claiming the non-Arabic origination of our numeric system was proven by our research to have been false. It was merely one of several other stories constructed by a number of orientalists and debunked by new research.

How old the universal numeric system we use today is, we cannot say. What can be said is that most of our numerals have an ancient Arabian origin, and they even exhibit close connections with ancient Egyptian, an old dialect of a "mother tongue" in its earliest form before it was temporarily separated from its linguistic sister tongues across the Sinai and the Red Sea. This may also sound outrageous. Like so many issues related to the Middle East, the Egyptian antiquity is controversial due mainly to biblical traditions. Attention in the 19th century shifted suddenly from how magnificent the ancient Egyptian civilisation was, to how dazed the Egyptians were by their strong sun. Out of this dichotomous argument, a new classification of Middle Eastern cultures emerged: "Afro-Asian". The eminent and independently-minded scholar Philip Hitti is in no doubt that around 3500 BC, a migration from the Arabian Peninsula forked at the Sinaitic peninsula to the fertile valley of the Nile and "planted itself on top of the earlier Hamitic population of Egypt, and the amalgamation produced the Egyptians of history. These Egyptians laid down so many of the basic elements in our civilisation. It was they who first built stone structures and developed a solar calendar." [1]

Ancient Egyptian shares with ancient Arabian or Proto-Semitic languages "triconsonantal roots, phemic-phonetic elements (such as the diversity of guttural sounds), feminine nouns and second-person verbal forms ending in *–t*, gemination (doubling) of the middle radical... similarities of the pronominal suffixes and the independent personal pronouns, performative elements (such as the S-causative and the N-reflexive), and many similarities in

[1] Philip Hitti, *History of the Arabs*, (10th Edition, 1974), p. 10.

etymology." [2] To all this must be added one of the main characteristics of languages related to the ancient mother tongue, i.e. the right-to-left writing and reading of Hieratic and Demotic and the ability to write and read hieroglyphic writing and numerals from right to left or horizontally.

Many of the clues to the origin of our numeral system are found in Proto-Semitic, and the original meaning of the number "one" in some of the descendent languages of that great mother tongue is "finger". How old the mother tongue of the ancient Arabians or Semites is, again we cannot say. What is commonly known and professed by experts, however, is that early written symbols were based on pictograms that appeared around 5000 BC in different parts of the world including the Arabian peninsula, Egypt and certain parts of the Mediterranean. Our numerals are often described as "symbols", "glyphs", "forms", "ideograms", and several other terms. However, they are not any of these. Except for the zero which doubles as an ideogram, every numeral in our system is a pictogram, one of the oldest forms of miniature drawings known to have been used by our ancestors several thousand years ago. The system we often describe as "modern" may turn out to be the oldest numeration system in history.

The history of the Arabic numerals, exact as the sciences employing them, is the *natural history of numbers*.

All this may sound strange, but we have much more to tell.

Our numeric system is known as *decimal* but, strictly speaking, it is not. Of all the numbering systems known to man, the "quinary" system must be one of the oldest because it originates from the five fingers we have on both hands. Not all "quinary" systems are alike. The Arabic numeral system, as we know it today, has a quinary sub-system embedded within it. This sub-system is composed of four distinctive numerals expressing the numbers 1 through 4. Numeral "five" is a pictogram in the shape of a ring formed by joining the tips of the index finger and the thumb. At a later stage, the quinary system was upgraded to a biquinary one with five additional pictograms, four of which were pictograms of various positions of the right hand with group number "10" formed by the group number "five" reduced in size. Thus, all numerals of the Arabic system are finger and hand formations, and each is a unique pictogram with variations for numerals "2" and "3" and the unique *safr* (zero), the only nil-number numeral invented as far as we know.

To appreciate how old our universal numeration system is, we have to dig deep into some of the oldest Arabic dictionaries for the meanings of numbers

[2] Geoffrey W. Bromiley, *The International Standard Bible Encyclopedia: E-J*, (1995), p. 33.

"four" and "five". Number "four" (arb'a) is derived from the tri-consonantal root *rab'a* (ربع), which means to sit cross-legged. For a horse, *raba'* is "to gallop" (on four legs, obviously). *Rab'* (ربْع) is also "a group of people", usually related and forming part of a tribe or a clan, while *rab'* and its plural *rubou'* can also refer to "land" and "lands" respectively.

According to philologist Edward Lipinski, the Proto-Semitic numeral "five" - *ḫamŝ* - signifies a hand (five fingers), and as such, it is the basic unit of any quinary system. [3] The word is retained in Arabic as *ḫamaŝa,* which means, "to scratch", as in, "*a woman scratched her face with her fingers because of a calamity*." [4] *Ḫadaŝa* is similar, but is usually used if the action is overdone or performed repeatedly. A colloquial variation is *ḫarmŝ*a, i.e. being "scratched" (usually by a cat, implying five claws). From the root of the word we also have *qamaza*, "to pick up with the fingertips", and *kamasha*, "to hold with five fingers".

Related to these words is *ḫamees*, "an army" consisting of a large number of warriors or characterised by "ferocity", probably because ferocity is the product of the hand and the weapons it can hold. In fact, this word is believed by philologists to be related etymologically to the Sabaic word *ḫas¹*, meaning "main army force", and to the ancient Egyptian noun *ḫpš*, which means "strength", originally "fist".

In certain Proto-Semitic descendent languages, expressing numbers higher than five involved adding numbers to the basic quinary unit, thus "six" would be "five" + "one", "seven" 5 + 2, etc. In several Arab countries, counting small numbers using one's fingers is still practiced by many. Having counted to five, the hand is closed and counting begins with the other set of fingers in the left hand, starting with the little finger. Each time a finger is counted, it is bent, and counting continues with the next finger. *Lisan al-Arab* indicates that counting by the fingers is an old Arab tradition: "It is said, 'the seconding with fingers starts by a certain man's name,' meaning that a particularly distinguished person is counted by fingers first followed by people who are like him." [5]

A line of poetry in the *mu'alqa* of the pre-Islamic *Imru-ul Qais* confirms what is said in the most renowned of all Arabic dictionaries. Addressing a woman, the poet said: "If the old glory of a group of people is to be counted,

[3] Edward Lipinski, *Semitic Languages: Outline of a Comparative Grammar*, (Peeters Publishers 2001), p. 295.

[4] *Lisan al-Arab* = خمش

[5] ويقال: بفلان تُثنى الخَناصِرُ أي تُبَدَأُ به إذا ذُكِرَ أشكالهُ. (خنصر).

this will be the time to count by the next finger," i.e., they will be the first to be counted by fingers because they are exceptional. [6]

It should be assumed that the quinary system lasted as long as the simple needs of the people using it were met. As life became more complicated and a need developed for the visual expression of increased quantities of items in the daily lives of ancient people, the older quinary system was enhanced by a natural progression. As in the case of other numbering systems studied over the past hundred years or more, it could have initially developed in an unsystematic fashion. For example, number "nine" may have been communicated visually by numeral "five" plus "four", while "ten" may have been a "*zuj five*" (a pair of fives), or "nine" plus" one".

We have a few examples indicating that this may have been the case in certain Semitic languages but not in standard or colloquial Arabic. The study of the Proto-Semitic tongue is in its infancy, and a clearer structure may emerge in the next ten to twenty years. Nevertheless, Arabic appears to share more characteristics with Proto-Semitic than any other descendent of the ancient Arabian tongue. Some ascribe this to the fact that unlike other peoples who migrated from the Arabian Peninsula to Egypt, Mesopotamia or Syria, Arabs remained largely confined to their Peninsula, one of very few places on Earth believed never to have been completely occupied by foreign powers, and thus never influenced by the cultures and linguistics of invading nations.

Indeed, it is in Arabic more than in any other language that we find the most extensive definitions and meanings of numeral "ten". In *Lisan al-Arab*, almost three thousand words are used for the entry. The original meaning of "ten" (*'ašra*) is likely to have been preserved in *'ašīra,* or "clan". In what may be an indication of its association with other numerals, the noun *'išra* (عِشرة) means "co-habitation" or for a man and a woman to live together (معاشرة), literally "to *ten* together".

We do not exclude other possible interpretations, but ultimately we suggest that the reason why number "ten" expresses both a numeric value and an associated social concept is that we have two hands, each with five fingers, used to express an entirely different but logical and unifying concept. The logical principle underlying the construction of the Arabic numeral system should be clear. An extension of the concept of the association of a woman and a man to other members of the same family seems quite logical, and the same logic is applied to the "clan" (*'ašīra*) because it is essentially a group of

[6] فإن عُدَّ من مَجْدٍ قديمٍ لِمَعْشَر، فقَوْمي بهم تُثنى هُناك الأصابع. (ثنى)

people consisting of a number of families living together or in close proximity to each other.

We found no similar association for the number "hundred" (*mi-at* or *me-at*) which is derived from a common Proto-Semitic origin, and attested in Palaeosyrian, Old Akkadian, Assyro-Babylonian, Canaanite (Ugaritic and Phoenician), Aramaic, Old South Arabian, etc. However, *alf* (thousand) is definitely a word expressing clear association. The need for a clan to live in harmony is not just important to keep members of the clan united but essential for their very survival. It is for this reason that we suggest that the concept must have been very important, as the very first letter of the Arabic alphabet as well as of the Canaanite and other ancient Arabian dialects is "*alef*". *Alifa* (ألف), therefore, is *to be acquainted*, *to be familiar*, *habituate*, *co-habituate*, *unite*, *join*, *combine*, *put together*, *compose*, *to be attuned to each other*, *to harmonise*, *to be linked*, *to form a coalition*, *to court friendship*, plus several other similar concepts and meanings.

In both "ten" and "thousand" we have, then, two remarkable words each reflecting a specific stage of the development of the ancient Arabian tribal system. The first stage was when the mere number "10" represented a "clan". This is '*ašra*. The other word, '*alf*, expressed a much larger number. Rather than expressing only the numeric value of the word, a social value was also expressed. Because the numeric value of "thousand" is huge when compared to "ten", the possibility of dissention, acrimony, disunity, etc., among members of clans was far greater. It is not frivolous, therefore, to note that the first letter of the alphabets of many Semitic languages are not made of the single letter *alef* (ا), but of two separate symbols (أ) with a single sound: *alef,* and *hamza* (ء).

If we study the Arabic numeric system, we can easily distinguish the underlying principles upon which it was constructed. The numerals of the system can be described as "symbols", but not in the way that Roman numerals are described as numeric symbols. In addition to their numeric value, the "symbols" of the Arabic numeral system are social symbols for which fingers and hands are employed to express concepts related to tribal or familial bonds. The numerals "1", "2", etc., are not just numbers but pictographic representations of members of the tribe that symbolically exist within the confines of the hands. Numeral "five" is a symbol of the unity of the index finger and the thumb as much as *10* is a symbol of the unity of the two hands. Like the *sheikh* of a tribe, the thumb or *ibham* (إبهام), as the main finger of the

hand, holds the other fingers together. [7] That such a concept should be exhibited by Arabic numerals is not surprising, nor is it confined to Arabs whether ancient or modern. Only a few scenes could be more expressive of unity and positive association than a girl and a boy or a mother and her daughter holding hands. The image of two leaders holding their joined hands high after a significant agreement is familiar, and so is the spontaneous joining of the palms of the hands accompanied by a shake when a man or a woman finds it suitable to express satisfaction at a successful outcome.

A familiar gesture among Arabs to affirm an exceptionally close relationship between two people is to cross the two index fingers and pull tightly to indicate that they are as inseparable as a strong knot. Each Arabic numeral is as individual in its pictographic shape and its quantity value as each member of a tribe, yet group affinity is somehow "sensed" when numerals are lined up together. The numeric quantity of each numeral is assured on its own, but it changes depending on its position in a cluster of numerals. Human beings are the same. Each one is an individual with beliefs, particular skills, a personality, and a physique of his or her own, but their value changes according to their position in society.

During the 19th century, a search to find universal characters that could be understood by all humanity began. For a time, Chinese characters were thought to provide the best option, because like the Arabic cyphers, their meaning can be understood by any person, whether they stand among German, Latin, Russian, or English words, or indeed the words of just about any language. At the same time, he who understands these characters may comprehend not a single word in a German, Latin, Russian or English book in which they appear. Without suggesting an explanation, a number of writers who studied the Arabic numerals wondered what embedded qualities made them understandable by people from the tropics to the poles, yet only through translation could they determine and understand the different symbols used for letters. Maybe the answer lies in what we have just suggested. The unity of numerals is a reflection of the unity of societies. However, human beings are not the only social species. Maybe monkeys and apes can identify some of the Arabic numerals because they can identify the fingers on their hands, neither of which are exceptionally different from those of human beings.

In our research, we identified a single original family of Arabic numerals with a number of variants. One might raise the point that what we suggested

[7] وقيل للإصبَع إبْهامٌ لأنها تُبْهم الكفَ أي تُطبِقُ عليها. *لسان العرب*: بهم.

earlier can only apply to what are described as the eastern-style Arabic numerals, but not to the western-style Arabic numerals used in the Maghrib or in Europe. This assumption is wrong. The differences between the two sets are no greater than the difference between the right-to-left Canaanite alphabet first used by the Greeks, and the same alphabet after it was reversed to suit their new left-to-right script writing.

All ten numerals (the nine units and the zero) used in the eastern-style format are produced by various formations of the right hand and its fingers. Eight of the western-style numerals are either identical to their eastern counterparts or can be produced with the left hand accompanied by the appropriate positional adjustments. Thus, "0", "1" and "9" are identical in both formats. Numerals "2", "3" and "7" are produced with the equivalent left hand and finger formations rotated 90 degrees left. The position of the western-style numeral "six" in the left hand faces the eastern "9", with the thumb upwards. One of the two forms of numeral "five" is likely to have been adapted from numeral "six", minus part of the left side so as to visually indicate its smaller size and therefore its reduced numeric value (٦ ٥). The western numeral "eight" is two adjoining circles (originally two eastern "fives" (٥) positioned vertically), while "four" has two forms, one derived from eastern-style "four" (٤), and the second from rotating the form ٨ (٨٥٩٤ ٤٥٩٤).

On their own, both the eastern and western Arabic numerals are remarkable, but the Arabic numeric system is not important simply because it has this unique visually rich family of pictograms. To the impressive proportionality of the numerals must be added the seamless application of the principle of local value and the concept of the chimerical *ṣafr* in the creation of the Arabic cypher system.

To understand the concept of *ṣafr* (zero), we must understand the relation between the original pictogram of the numeral "ten" and the pictogram of "zero" that replaced it. This would entail "digesting" the clear and the implied meanings of a substantial portion of the seven thousand words in *Lisan al-Arab* that define "ten", plus some 700 words for *ṣafara,* which was known by several names of which "zero" is the shortest and most popular. This search leads us to a number of images expressing more or less the same metaphor. In studying the main concepts of *ṣafr* in *Lisan al-Arab*, our attention was drawn to several definitions of physical properties that are expressed metaphorically. The first occurs in a line of poetry by the Jahiliah poet Imru-ul Qais, not to be confused with the Lakhmid king of the same name. The image the poet wants to convey is that of a soul leaving the body,

or the body emptied of blood. [8] A locust in *Lisan al-Arab* is *ṣafr* if its body is empty of eggs. A Hadith attributed to Prophet Muhammad is, "No contagion, no snake and no *ṣafr*." This Hadith appears to have been said in response to the belief that a "snake" infecting humans and cattle resided in their stomachs, causing pain whenever the parasites were hungry. Hence the term *safar* (صَفَر), which also means "hunger". It was thought that the "snake" (*ṣafr*), a parasitic worm, was contagious, but the Prophet decreed that it was neither contagious nor a snake. [9]

It is clear from these and other examples that the metaphor is that of something emptied of its contents, whether it is a body containing a soul or blood, a sac holding eggs, or a stomach full of food. All these portray what happens to the pictogram of numeral "10", the circle, when it is emptied of its numeric content. The circle is reduced in size to reflect its "shrunken" value. When numeral "one" or any other unit is placed next to it, it becomes "full-bodied" again and regains its value in a way similar to figuratively returning a soul to a body, eggs to a locust, and food to an empty stomach. If the two numerals are separated, each will revert to its original value—numeral "one" will have its known numeric quantity, and the zero will be a nil-number numeral.

The two or three hundred years of confusion in Europe regarding the "zero" is the result of a failure to explain in simple terms the metaphoric meaning related to the function of zero. Most of the confusion remains largely in place due to an entrenched 19th century orientalist-dictated historiography specific to the origination of the Arabic numeric system, according to which *safr* meant "nothing", simply because the word *safr* was incorrectly translated from *sunya,* which actually means "nothing". This is reflected in the definitions and explanations found in most contemporary English-language general references. For example, the dictionary definition of "cypher" is given as "*noun*, *attributive*, Middle English, from Medieval Latin *cifra,* from Arabic *ṣifr* empty." The large footprint of orientalist historiography is also evident in *zero*: "from It. *Zero,* from M.L. *zephirum,* from Arabic *ṣifr* "cipher," translation of Skt. *sunya-m* "empty place, desert, naught." The persistent determination to forcibly define the zero as "nothing" imposed totally alien meanings on the extraordinarily innovative concept of *ṣafr*:

[8] قال امرؤُ القيس: وأَقْلَتْهُنَّ عِلْباءٌ جَرِيضاً، ولو أَدْرَكْنَهُ صَفِرَ الوطاب. وهو مثل معناه أن جسمه خلا من رُوحه أي لو أدركته الخيل لقتلته ففزعت، وقيل: معناه أَن الخيل لو أدركته قُتل فصَفِرَت وطابُه التي كان يَقْري منها وطابُ لبَنِه، وهي جِسمه من دَمِه إذا سُفِك.

[9] وقوله في الحديث: لا عَدْوَى ولا هامَةَ ولا صَفَر؛ قال أَبو عبيد: فسر الذي روى الحديث أَن صفر دَوَابُّ البَطْن. وقال أَبو عبيد: سمعت يونس سأَل رؤبة عن الصَّفَر، فقال: هي حَيَّة تكون في البطن تصيب الماشية والناس، قال: وهي أَعدى من الجَرَب عند العرب؛ قال أَبو عبيد: فأَبطل النبي، صلى الله عليه وسلم، أَنها تعدي. قال: ويقال إنها تشتد على الإنسان وتؤذيه إذا جاع. (والصَّفْراء: الجرادة إذا خَلت من البَيْض).

some figurative, others not. An example of the first is the attested 1813 use of the zero in reference to "*a worthless person*", while the latter is exemplified in American political jargon during the Vietnam War: the strategy of "*zero tolerance*".

A popular modern Arabic expression is to be a "*ṣafr* (sifr) *on the left*", applied to describe an insignificant person, but in itself an awareness of the "positional" concept of the Arabic numeric system, as a zero to the left of any numeral does not alter its original nil-quantity value. None of the references to the "controversial" numeric zero found in English is replicated in Arabic. This may be due to the fact that the concept was well understood from the very beginning, and attention shifted quickly to the system once it was realised that the zero is a numeral like any other, except that on its own it is a nil-value numeral while other numerals have a numeric or quantity value.

Undoubtedly, significant help in understanding the system was provided by the visual concept of "*manazil*" (stations or positions), physically allocating a *manzila* (singular of manazil) to the units, tens, hundreds, thousands, etc. These are arranged from right to left in accordance with the orientation of the literary and the basic numeric Arabic script. Each *manzila* must have a number-numeral, and no single manzila is allowed to be empty. If a number-numeral is not available for a specific manzila, a zero must be introduced to avoid confusion between one manzila and the other. As all zeroes derive their numeric power from number-numerals placed to their left, it follows that the numeric value of zero is nil if it is not joined by a number-numeral. A simpler system based on the concept of *khana* (originally a room in an inn) was probably the system used almost exclusively to teach children of Arab merchants and accountants arithmetic, and it is retained in certain schools in many "eastern" Arab countries, where the Arabic system was first developed.

NUMERIC AND LITERARY SCRIPTS

It is accepted by many experts that the use of signs to represent numbers and to aid reckoning is not only older than writing, but also older than the development of numerical language. Because the decimal system involves the use of 10 symbols, it is almost certain that our ten fingers were the first real numerals used to communicate numeric quantity to other people. What applies to the decimal system should obviously apply to the quinary system in cases where it is proven that it was a sub-system of what later became a biquinary scale. The quinary system limited to the fingers of one hand is likely to have

been the first "natural" system ever invented. The next "natural" stage was to begin using the fingers of the other hand so a pair of fives was available for counting. The ten digits could thus be communicated visually with relative ease.

When the time came to represent these numbers in writing, a problem arose, because the fingers on one hand are the same as on the other. If represented as strokes, the maximum that the average person can identify quickly is four or five. It follows that while the ten fingers can be used to count and to express numbers visually, a different arrangement is needed to communicate them in writing. To accomplish this, a process of systematisation and simplification is essential to guarantee the acceptance and use of the system by the people it is supposed to serve.

What is expected of all numeration systems is that they develop incrementally, in response to the need for more numerals to express larger quantities of items. Indeed, research seems to confirm that throughout most of history this was largely the case. Simple strokes expressing small numbers were used in Egypt 5400 years ago, in Mesopotamia 3000 years ago, and in China and Crete 3600 to 3200 years ago respectively. Strokes are the easiest shapes to make, remember and reproduce. The need for higher numbers led to the creation of groups of various shapes to satisfy an almost endless demand, until the numerals became too many to remember and numeric systems too complex to understand.

In addition to the quinary and decimal systems, the vigesimal (base 20) scale is also considered a "natural" system because it involved the additional use of the ten toes. However, it is recognised that the decimal system has been the favourite scale for many nations. Ten different numerals are a reasonable number of forms to remember, but because of their numeric relation to fingers, there appears to be a permanent visualisation of the numeral forms in the mind. Some suggest this is the case not just for adults but also for young children, but the same is not so for the vigesimal scale.

Many nations used all their numeric symbols and supplemented them with letters "borrowed" from their alphabets that were given specific numeric values, while others made use of the entire alphabet. The Greeks used letters to represent numbers in a system that operated on an additive principle, so a total would be the combined numeric value of all the letters used in a given number. More familiar to Europeans is the use of letters as numerals in the Roman system. Arabs used a system known as *huruf al-Jumal* (letters of association [with the numbers assigned to them]). Each of the 28 letters of the extended Arabic alphabet is given a numeric value starting with units,

then tens, then hundreds, while the last letter is assigned the number "1000". A base-60 version of this system was used by astronomers.

The evidence that letters were assigned numeric values by the Greeks, the Romans, the Arabs and many other nations was never challenged and should be admitted as incontestable. However, the probability that numerals were used as letters has not been sufficiently studied. If the assumption that the use of visible signs to represent numbers and aid reckoning is older than writing, we may assume that some numerals at least existed before letters. As such, they may be among the first readily available symbols to be considered as possible phonograms irrespective of their original numeric value or their pictograms. As an illustration, the pictogram of the Arabic numeral "nine" (٩) may be assigned the sound "w" (و) in the Nabataean script, or the numeral "three" (٣) may be assigned the sound "ṣ" (ص) in the Canaanite (Phoenician) script. If the pictogram "٩" is reversed, we have a new shape: "p". If "p" is reversed, we have "q", and if "q" is flipped vertically, we have "d". If the same principle is applied to the numeral "three" (٣), we would theoretically have at least three additional shapes, each of which can be assigned a different sound and therefore a different letter of the alphabet, for example, *m*, *ŝ* and *t*:

Fig. 1 Phoenician

Is it possible that some of the Arabic numerals were derived from Canaanite letters? Unlikely, because the pictograms of the Arabic numerals are constant and identical to hand and finger formations. What may be useful to remember is that, as both letters and numerals are essentially characters, the possibility of altering their original role should not be ruled out. The association of letters with sounds and numerals with numbers is a learning process. For example, when a child or a monkey (and some may consider them both as one species) identifies the numeric value of numeral "١", he or she may as well be identifying the letter "ا". Because we do not expect to find numerals in a word, or a letter in a number cluster, the "characters" used in both cases are identified according to a known mapping process where letters and numerals are not mixed. In reality, this does not happen, and conditioning is largely responsible for the outcome. For example, because we were focused on looking for numerals in all available documents regardless of their con-

tent, numerals in a variety of shapes were quickly identified. When we asked some friends to study the same documents without telling them what to look for, most of them found only letters.

A remarkable example is the 17th century Maldivian Thaana alphabet (**Fig. 2**). We suspect that not all Maldivians are aware their 24-letter script includes the nine Arabic numerals and a few more created by slightly altering the original shapes. In the chart from *Omniglot.com*, the first nine letters in the top row (from right to left) have been assigned nine different sounds. The fourth letter (top, right to left) is a variant of the eastern-style "four" (٤) and the future form of one of the two shapes in the western-style set for numeral "four" (**4**). Meanwhile, the original eastern "four" (٤) was used as the letter "d" (bottom row, sixth from right), and a tail was added to numeral "five" to become the shape for the letter "t". For numerals, the Maldivians use the western-style set.

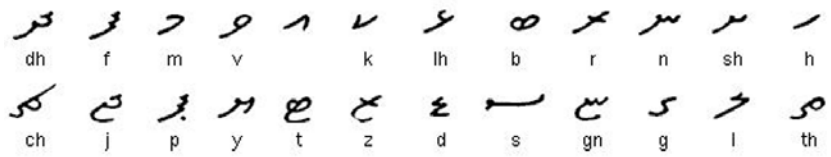


Fig. 2

Almost nothing comes free, and there is a price for using numerals as letters. Most of the numeral-letters are in italics, but numerals are not cursive like letters. Technically, because the numerals are treated like letters, nothing obvious should stand in the way of joining them with other letters. However, this is something that is not done, and there is more to this "natural" inhibition than mere tradition. The same may apply to capital letters.

The natural progression of scripts is to become gradually cursive, because longhand writing is essential to attain speed. Yet, if we were to study the Phoenician alphabet, we would find that it never became as cursive as Aramaic, Nabataean or Arabic, and most languages that used the original Phoenician script became either fully or partially cursive at one point in their evolvement. This occurred when paper or other soft surfaces began to be used for writing, but before the scripts became cursive a new set of "small" letters was necessary. The "small" letters are so familiar that only a few seemed to have stopped to wonder who developed them, when, and what all the original shapes were. The Maldivians are "casual" about using numerals

for letters, and most foreigners who are aware of their use were alerted by the Maldivians themselves. However, we know very little about the evolvement of their scripts and letters. No doubt, this is a story that may be never told.

As far as the Canaanite/Phoenician alphabet is concerned, we are not suggesting at this stage that some of the familiar letterforms of that famous alphabet may have originally been pictogramic numerals, but some logical explanation must be found for the presence of so many numeral look-alike letters, as well as the possibly manipulated letterforms that were derived from original numeric shapes. Any attempt at finding some answers should be guided by a well-known principle in the development of scripts. Aside from occupying a large space, pictograms are more difficult and time-consuming to draw than characters. Therefore, the need arises to reduce pictogramic content until some pictograms cease to resemble their original shapes. If the result is unsatisfactory, simpler and more elegant forms are borrowed instead. It is also possible that such simpler "stock" forms are familiar in another function, which may facilitate their inclusion into a reformed script (**Fig. 3**).

Fig. 3 From top: Detail of Punic inscriptions from Carthage; the famous 8th century BC *Bar-Rakib* silver ingot in early Aramaic (British Museum); detail from the Arabic epitaph of King Imru-ul Qais in Nabataean script and a chart of eastern and western-style numerals for visual comparison.

Almost every eastern alphabet contains a number of numeral-like shapes, but the most unusual concentration of these shapes is in the Demotic section of the Rosetta stone. Aside from what we think is the entire set of the eastern-style Arabic numerals, several of the western-style numerals can be clearly identified in the same text. From different parts of the inscription tens of clusters can be collected, some several numerals long. The "feel" and look of the text is eerily Arabic, and a few distinctly "Arabic" words can be identified, such as "لا" and "كل" (**Figs. 4, 5** are at the end of this section).

THE EGG AND THE GOLF BALL

If we are confronted with a newly discovered cuneiform tablet from occupied Iraq with a description of an egg as a "golf ball" we would naturally be surprised, but describing a golf ball as an egg would be probably rational to most people, save golf players. The discovery that our numerals were originally miniature pictures of real fingers should not be surprising now that we know it. Indeed, the resemblance is so obvious and the idea so natural that very few people contemplated the possibility, otherwise we would have been spared writing this book. The literature on finger counting, particularly Arabic accounts is extensive, and a few writers have pointed out that some of the Arabic numerals are representations of finger signs. However, no contemporary researcher, as far as we know, has suggested that they are not simply representations but the actual drawings of finger and hand signs and formations.

Of all writers, the German numerologist Karl Menninger [10] should have seen the obvious, but his grand tour through the cavernous halls of numerical history unfortunately sought to confirm an established historiography, not to discover the truth. This historiography stipulates that Arabic numerals are derived from Brahmi (Indian) numerals, so almost every writer was inspecting written forms for Brahmi clues rather than searching for evidence in real life. A glaringly obvious clue in Al-Beiruni's *India* was "mistranslated" to fit into this historiography, and a unique chance to confirm the origin of the Arabic numeric system in the late 19th century was lost. On the other hand, even if the truth were discovered, many would have kept mum about it because contradicting the powerful orientalist lobby of the 19th century would have been fatal for the career of any independently minded scholar. The last

[10] Karl Menninger, *Number Words and Number Symbols*, 1992.

scholar to contradict the historiography of the numerals was G. R. Kaye (1907), and many in scholarship wish that his research had been buried with him. Unlike many others in his time, Kaye both read the books and studied the natural manifestations. On grounds of the orientation of the numeral script alone, he decided that Arabic numeric language could have been invented only by people with a right to left script.

Very few ideas are original, including ours. The fact that we may not be aware of what others have expressed before is irrelevant. A clever writer, James Gilchrist, told his readership in the early 19th century that if they are intelligent, they should be prepared to consider the alphabet as consisting of real *signs*, and to reduce all its letters to their original forms. "Several, if not all the letters of the alphabet, are evidently varieties of the same forms or figures, and therefore our shortest method in treating of them, is first to resolve all the varieties or derivatives into their primary forms." [11]

Gilchrist listed a number of "principles" that should apply in analysing alphabets, some of which need updating. The other principles applicable to the evolvement of letterforms are interesting, but not for their obvious relevance. "Those forms of letters most speedily and most easily written, or rather graved, (for graving on leaves of trees, on stone, wood, lead, brass, etc., was the first mode of writing and printing,) are to be considered as derivatives, varieties, or corruptions of those forms graved most slowly and difficultly, but not *vice versa*... In this view, the hardest letter in the alphabet is O, and the easiest I" (ibid., pp. 25-26).

The line of thought as far as the development of the numerals is concerned is that it all started with objects like pebbles, beads, shells, pieces of bone, and the items Gilchrist listed. However, what happens if such objects are not available or plentiful? No writing?

The ancient Arabians needed to express numbers visually because this ability was vital to claim the right of ownership of camels, sheep, dwellings, etc. Had they been living on the fringe of a jungle, their numeral alphabet may have followed the historical pattern of most other alphabets in their creation, with collections of pebbles and beads translated into shapes to be recorded on leaves, wood, etc. The Arabian Peninsula contains some of the largest oases in the world (al-Hasa, for example), but it is mostly so arid that swarms of hungry locusts must have hated to fly over it. Instead of finding crops and foliage to nibble at, they were confronted with hungry Bedouins who used to catch, roast, and eat them, preferably full of eggs. Most nations

[11] James Gilchrist, *Philosophic Etymology, or Rational Grammar*, (1816), pp. 24-25.

viewed locusts a catastrophe, except the Arabs, who believed they were a gift from Allah. Ancient Arabians were mostly nomads whose livelihood depended on their camels, sheep and other cattle, so keeping numeric records of the only wealth they had was vital. It remains so today. Ancient Arabians, like everybody else, used their fingers for reckoning. However, unlike most other people, there was no need to scribble their numerals onto surfaces because a permanent presence is preserved on their hands and fingers, and this continued for many more millennia.

The question we were asked by experts better placed than us in judging anthropological trends is what answer we would have for those who will rightly enquire why no inscriptions of Arabic numerals were ever found in antiquity. We have two answers: the first is cited above– there was no need to inscribe them. The second is that thousands of inscriptions of Arabic numerals *are* available: the problem is not that we cannot see them, but that we do not *want* to see them, because the mind decided long ago that numerals are different from letters. Like hands and legs, they do not mix, and each type is processed mentally in a different way.

Hieroglyphs were not the first stage in the creation of the alphabet, but the second and third. The first must have consisted of *real signs*, and been reproduced in pictograms. The Canaanite alphabet consists of far too many numeral shapes for one to describe their presence as circumstantial. If ten unique shapes (the numeral pictograms) were available to them, why would they use ideograms? Writing can be done by anybody who knows the alphabet, but granite inscriptions must be done by professional scribes, because mistakes were very costly, especially if they were made in honour of kings and gods. It does not take an expert to observe that every letter in the Canaanite alphabet is either a numeral shape or can be developed from a numeral shape almost effortlessly.

If we keep in mind that the pictograms of the Arabic numerals must be sufficiently individual to be identified quickly by most members of a tribe, the maximum number of pictograms that can be made by the various formations of the right hand and fingers are ten. The last one, the shape of the English small letter “d”, runs contrary to the normal right to left script and is hardly used. In fact, the hand gesture made by Arabs with the thumb pointed upwards () is always accompanied by repeatedly pointing away from the body to indicate something that happened in the past, i.e., the opposite direction to the present.

The Arabic numerals in use today are not “golf balls”, but “eggs”. They have been on the hands of nomads and their descendents since the earliest

times. Readily available, expressive, and beautifully shaped, they are the ultimate "natural" creations. Flexibility is another valued characteristic of the Arabic numerals. Unlike basic shapes such as a circle, a slash, or a vertical stroke, most of the numerals can be easily manipulated to produce new forms in addition to those available with the left hand and finger formations. The varieties that can be made of both the original pictograms and the manipulated shapes are almost infinite.

Arabic letters in Naskhi script may be considered the ultimate development of letter shapes. The "natural" evolvement of the magisterial but austere-looking Kufic script can be observed in transverse lines and angular shapes resolved in modular designs, from complex to simple and from large to small. This, Gilchrist observed, can be a universal principle (ibid., p. 26). As far as Arabic is concerned, the smoothing and rounding of letterforms allowed, at last, the preservation of the ten Arabic numerals to express their original function as numeric pictograms. Identifying the original numeral-shaped letters in the new 28 letter Arabic alphabet may not be as easy as identifying them in the Nabataean script, but they can be detected nevertheless. The Nabataean "٩" standing for the letter "w" is the Arabic "و", and several Arabic letters such as ع, ٥, and ا, may have originally been the numerals ٤, ٥, and ١.

Contrary to the general assumption, Phoenician did not become extinct after the destruction of Carthage by the Romans, for it is proven that it was a tongue spoken in Libya until the eleventh century AD and in the eastern Mediterranean later than the fifth or the sixth century AD. Demotic survived until the fifth century AD, and Aramaic is still used, albeit in a very limited way. In a region that is more like a sea in which water continuously churns and mixes than a range of mountains that are forever separate and individual, it is doubtful that indigenous languages ever became "extinct". Most of them were originally dialects of the ancient Arabian tongue (Proto-Semitic) anyway. Many of their sounds and letterforms are not unfamiliar to the speakers of other dialects, and the unique vocabularies and letterforms of aging languages can be absorbed easily into younger tongues to enter mainstream communication. This is one reason why it is difficult to determine the origin of a large number of words of the eastern languages. Arabic, for example, is one of a few major languages lacking a comprehensive etymology dictionary. Many words in its vocabulary are Proto-Semitic and may never be attested epigraphically, and the origin of thousands of other words is unknown.

In trying to explain why the Demotic script on the Rosetta stone looks like a page in Uqlidisi's al *Fusul*, we must be prepared with answers to several important questions. We know that Demotic, as opposed to hieratic, was the popular script of Egypt. We are told that deciphering Demotic was the key to unlocking the mystery of the hieroglyphic script, but many aspects of Demotic are still either vague or unknown. Aside from Greeks and Byzantines living mainly in Alexandria, what were the ethnic backgrounds of the great majority of the original Egyptians?

The features and complexions of the majority of Egyptians are distinctively Arab and Mediterranean, yet only about 10,000 Arabs, and probably less, were involved in the conquest of Egypt in the seventh century. The millions of Egyptians that exist today could not be the offspring of such a small number. A possible explanation is that throughout Egypt's history, permanent contingents of ancient Arabians were stationed at Egypt's eastern border—the Sinai, waiting to be admitted to sell their camels, buy henna, earn a living as builders of monumental structures or traders, till the fields along the banks of the Nile for food, settle, and become Egyptians.

Some of those people would have been speakers and writers of Aramaic, Nabataean, and many of the other dialects in southern and northern Arabia. If the case was as we suggested, we should assume that they influenced Demotic, a strictly right to left script written mostly in ink on papyrus. Another possibility is that Demotic, as the language of most people, would have to cater for most of the sounds uttered by the common people.

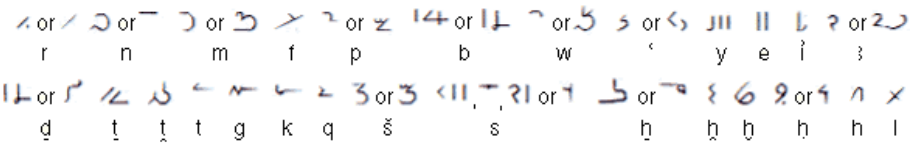


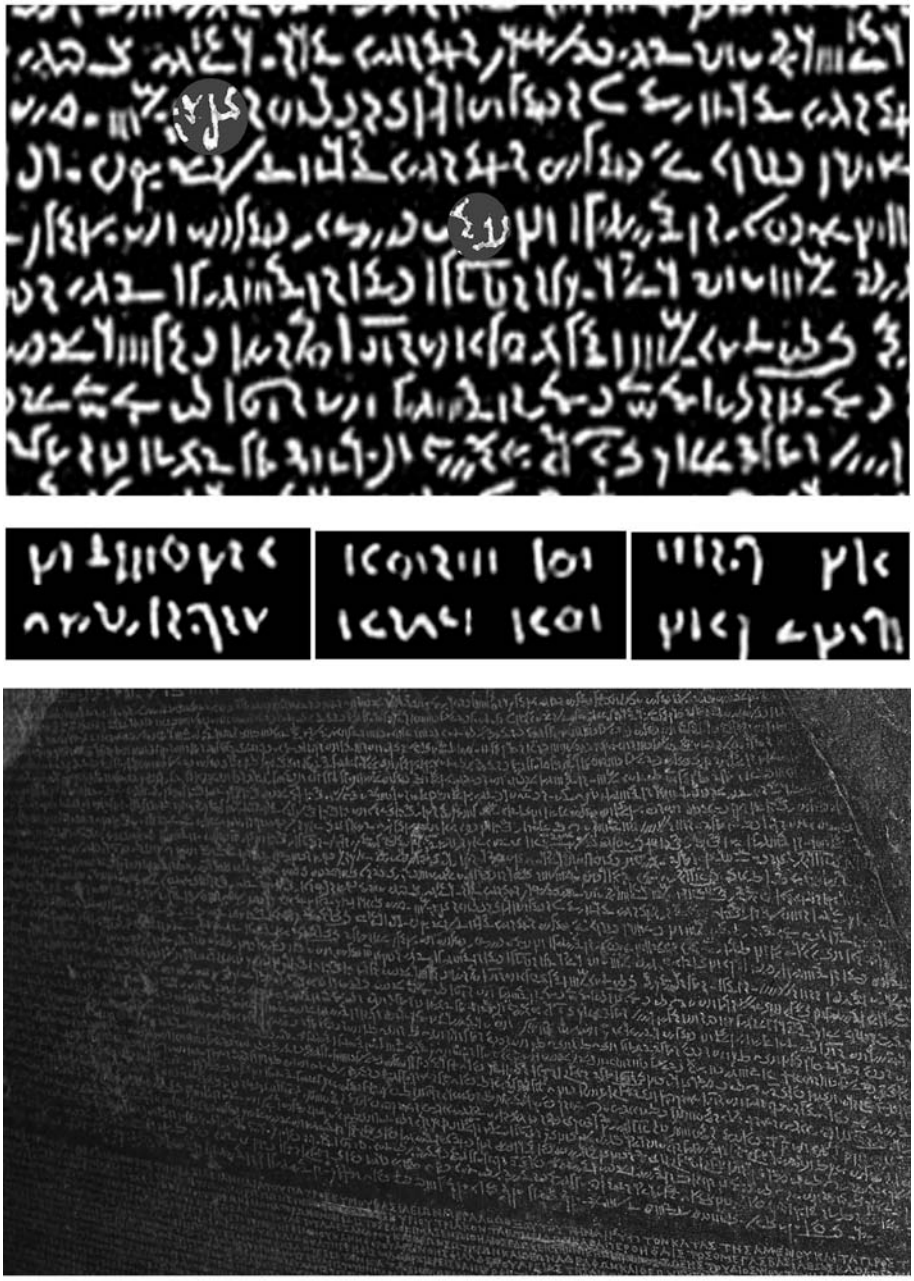
Fig. 6 The Demotic alphabet from *Omniglot.com*

This may explain the un-Semitic features of the Demotic alphabet as far as the numbers of letters are concerned (more than forty, with variant forms for several letters, some of which are western-style numeral look-alikes). Additional letterforms would have been needed, and these would have been made available either by Arabians or by people in contact with them via Arabic numeral pictograms that were used as phonograms.

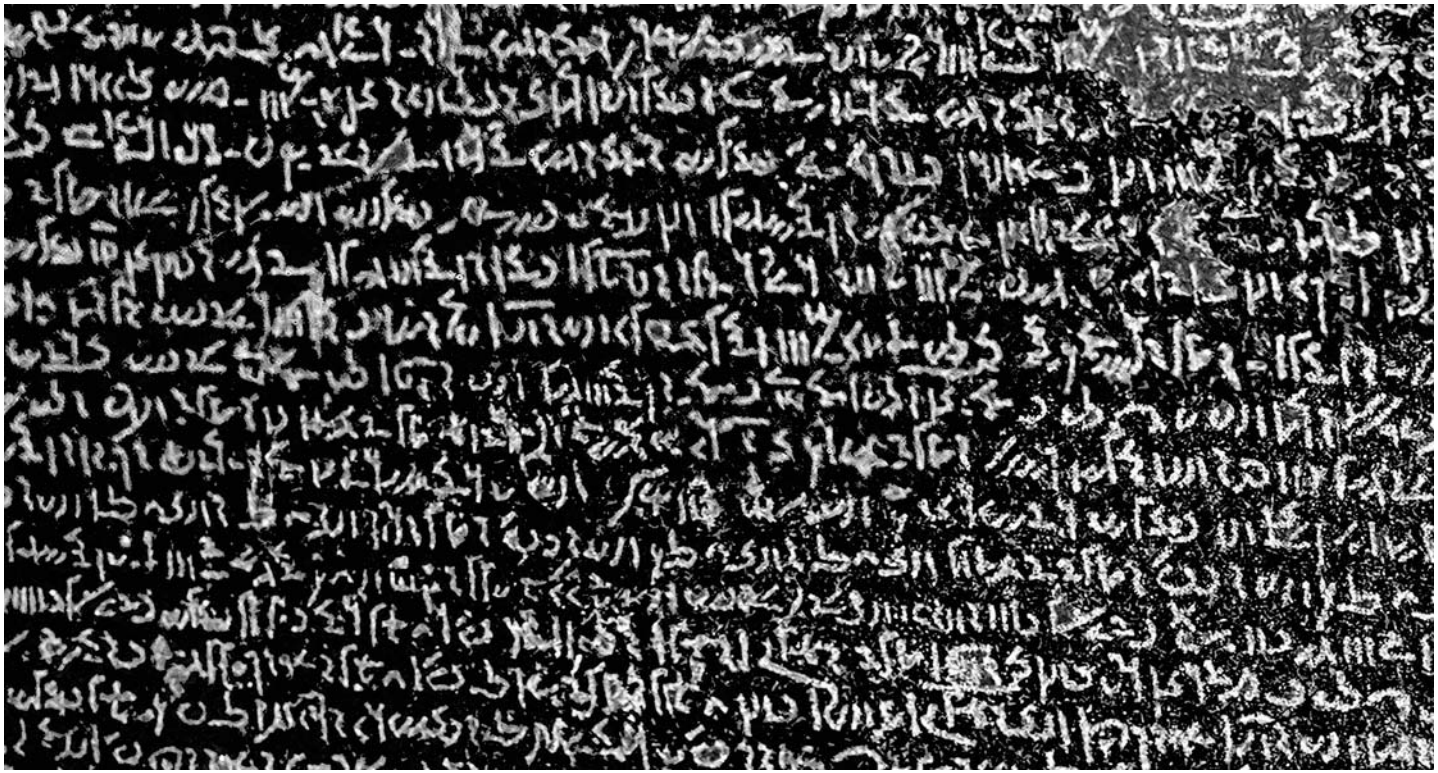
Like the Canaanites who knew themselves by no other name, “Demotic” to the Egyptians was an alien name of the popular language they identified as “sekh shat” (writing for documents). Most of these documents were concerned with trade and business in addition to the other fields for which languages are normally used. Literature, science, religion, etc., are all important topics that seek expression, but in the Middle East, the creation of literary and numeric scripts seems to go hand in hand with the creation of wealth derived mainly from trade. This was the case with the Phonecians, South Arabians, Nabataeans, Palmyrenes, and Arabs. It is for these reasons that we thought it appropriate to include in this book a chapter about trade. Indeed, the Arabic numeric system is the creation of the marketplace in the same way that the system was taken to Europe by traders, not by scholars and scientists.

The last two comments in this chapter are as follows: If the Arabic numerals are ancient Arabian or Proto-Semitic as claimed, can we still call them “Arabic”? The answer is not difficult. Of all other dialects, Arabic is the most loyal daughter to a great mother tongue that we can only identify by matching its features on the faces of its daughters. Compared to Canaanite, Aramaic, Arabic, etc., very few Arabic numeral shapes are used in ancient Southern Arabian. This may suggest that the Arabic numerals were used mostly in the northern part of the Arabian Peninsula where they were picked up and reused by Nabataeans and later by Arabs, whether via older Phoenician and Aramaic scripts, or by going straight for the pictographic source available on the fingers and hands of tribal Arabs.

The numeral pictograms are a marvel on their own, but the Arabic numeric system is primarily a cypher and positional system, and the concept of *safr* is as Arabic as you can get. The fact that Arabs described locusts empty of eggs as *safr* is not a reflection of their knowledge of biology, but of their want for sustenance, because they used to supplement their meagre diet with locusts. We presume they valued the eggs because without them, locusts were mere exoskeletons unworthy of a meal. Locusts are still collected but sold mostly as animal fodder, or so it is said.



Figs. 4 Top: Detail from the Demotic section of the Rosetta Stone with colour contrasted. Middle: Some numeral-like character clusters. Last is the Demotic section of the Rosetta stone. *British Museum, London*.



Figs. 5 Detail from the Demotic section of the Rosetta Stone with the background cleaned slightly. The approximate area of the detail is represented in the box to the left. *British Museum, London.*