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THE HISTORY OF INVENTION AND INNOVATION IN AFRICA

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I. INTRODUCTION

(Pharaonic Egypt from the Fourth to the First Millennium BC)

(Ancient Egypt from 4000 to 332 BC)

> "Considering that Egypt is the far-off Mother of Western Science and Culture, most of those ideas that we call foreign are but the jumbled, inverted, modified and improved images of the creations of our ancestors"
>
> C.A. Diop. Civilization or Barbary

"The day when we shall be able to produce needles in our factories we shall then be able to say that we are developed" said an African President some thirty years ago. (1)

Indeed, that is the first impression to be gained from hasty observation of today's scientific and technological landscape in Africa. Whereas the other continents are busy exploring all aspects of matter (the macroscopic and microscopic dimensions, the physical and metaphysical dimensions), Africa would appear to be completely absent from that investigation.

Everywhere, we see desolation. The most elementary existential questions beg an answer.

It is the continent of endemic famine, mortal epidemics, material poverty, human suffering and archaic techniques. In short, it would seem to be the continent on which the Cartesian dream of science and technology, making man the "master and owner of nature", is altogether unknown.

This somber presentation of Africa's scientific and technical record that appears at first view must nevertheless be relativized when we interrogate history and when we carry out proper investigation in the field.

When digging a little into the history of the continent, we rapidly realize that, far from being the continent of atavistic and endemic intellectual incapacity, Africa has largely contributed to the emergence and development of all those sciences and technologies today considered as the best indicators of human genius.

Africa has invented and innovated in all fields. It was at the forefront of the invention or innovation of the wheel, of writing, art, music, gastronomy, mathematics, physics, chemistry, biology, medicine, architecture, masonry, astronomy, boatbuilding and military art, agriculture and animal husbandry, and so on.

Apart from that honorable pioneer participation in the achievement of the great inventions of the world, its sons have also illustrated themselves throughout history in the elaboration of knowledge and techniques that have constituted for mankind significant steps forwards towards the Cartesian dream.

They have developed the best products to fight against the worst of illnesses. They have permitted the domestication of natural energy such as rivers, wind and sun (Professor Abdou Moumouni, for instance) and so on.

Yesterday, just as today, this has happened in two different ways. Natural creative genius or specialized training institutions.

In the first case, the need to find an appropriate solution to a given problem necessarily incites men to conject, to reflect and to find original solutions to one-off problems.

The second case is more organized. Candidates for creation or innovation are admitted in their youth to specialized institutions in order to learn a trade and how to create and innovate in that field. From the forge to the institute of mechanics or electronics; from initiation to the knowledge of plants, to the biochemistry laboratory and the faculty of medicine, the concern is always the same, that is to say to methodically impart to a child knowledge which will permit him to serve in society as a guide to certain dimensions of the material world.

In both cases, numerous works have been achieved, but either they have been poorly popularized or continued use has made them everyday.

In order to take stock, it is necessary to adopt a working method, since they are spread out over time and space. They have marked the whole history of mankind and concern all parts of the continent.

Being aware of that difficulty, I have staked out my field of investigation, both in time and in space.

I shall speak in this first stage of invention and innovation in ancient Egypt of the period from the fourth to the last millennium BC

The choice of that period is justified by the fact that I wish, in the following episodes, to deal with the history of invention and innovation throughout the continent and at all times.

If I have not gone further back in time, it is because I am not only a scientific and technological historian but also an epistemologist, and a bachelardian one at that. I do not therefore intend to give much room to ideology in my approach. I wish to set out the facts in the way in which the least adulterated documents present them.

Indeed, the period that is surely the best known to mankind is the one that begins at that time and in that area of Africa. Moreover, without ignoring the highly interesting discussion on the race of the ancient Egyptians, I hold it to have no effect on their African-ness. Whether they are yellow, red, white or black, the fact is that they were Africans. That is sufficient for the topic that I am to deal with.

It is obvious that other areas also experienced a civilization rich in events (Nubia, Cush, Meroe, Ghana, etc.), but they show the same characteristics as Egypt. They are even claimed to have been founded by peoples who had left that region.

That is why I begin by dealing with invention in ancient Egypt.

II. PRESENTATION

Egypt corresponds to the final 1,000 kilometers of the Nile Valley, which is 6,000 kilometers long. It is situated between the thirty-first and twenty-fourth degrees of latitude north. It's true history begins in the Neolithic at about 5,000 BC with the progressive colonization of the valley by peoples fleeing the austerity of the desert surrounding the rivers, and finishes at the end of the last millennium BC with the invasion of the Kingdom by foreign peoples. Firstly the Persians in 525 BC under Darius I, Xerxes and Araxerxes and then the Greeks in 332 BC, under Alexander the Great, and the Romans in 30 BC, under Julius Caesar.

At the dawn of the historic period, Egypt was divided into several kingdoms, and then into two only (Upper and Lower Egypt), which were united towards 3,100 BC by Narmer who thus completed the work of his predecessor, King Scorpion. The son that succeeded to him, Menes, began the first dynasty (according to Manetho, an Egyptian priest of the third century BC to whom we owe a list of the Egyptian dynasties that reigned from the beginning to the end of the Egyptian civilization):

Thinite period	1st and 2nd dynasties	3110-2665
The Old Kingdom	3rd to 4th dynasties	2664-2155
First Intermediate Period	7th to 10th dynasties	2154-2052
The Middle Kingdom (Second Intermediate Period)	11th and 12th dynasties	1785-1570
The New Kingdom	13th to 20th dynasties	1570-1075
The Low Period	21st to 25th dynasties	1075-664
The Saite Period	26th dynasty	664-525
First Persian Period	27th dynasty	525-404
Last Egyptian Period	28th to 30th dynasties	404-341
Second Persian Period	31st dynasty	441 to 332
Greek Period	32nd to 33rd dynasties	332 to 30
Roman Period		30BC-324AD
Byzantine Period		324-640 AD

The history of Pharaonic Egypt resembles that of all nations that have reigned over the destiny of mankind. It is that of a people which, faced with the adversity of nature, decided to apply the tenacity of human genius in order to transform each obstacle into an inestimable asset. Such is the case of all the great powers. Europe, for example, is not the continent most favored by nature, nevertheless, through its creative genius, it has become the master of the world. The same applies to Japan and to other powers. They have cultivated a taste for adventure, they explore and exploit uninhabitable forests, austere deserts, infinite oceans, unknown lands, the cosmos, its planets and its stars. They brave the biting cold of the poles and the parching winds of the savanna, they travel under the sea and under the earth. It short, they venture forth and they succeed. In all cases with science (human genius) as their principle guide.

In such a way, ancient Egypt created the first, or at least one of the first, great civilizations of the world.

For Amara Cissé, the old adage: "Egypt is a gift of the Nile" recorded by Herodotus, is certainly a very attractive historical image, but insufficient to explain all the prowesses of Egyptian civilization. The Egyptian "miracle" essentially derives, according to him, from the rational exploitation of the strip of arable land on either side of the river.

"The history of the civilization of the African Nile (Nubia, Sudan, Egypt) may appear as part of the domestication of a river by man", he explains. (2)

The need to control the rising waters of the Nile, to provide protection against flooding obliged the inhabitants to build embankments to contain the high water and canals to drain off the water towards areas at a distance from the bed of the river.

The success of that technology led to material abundance (of food) along the whole length of the Nile basin some 3,000 years before our time. Many types of plants were grown: cereals (millet, wheat, rice, etc.), vegetables (onions, lettuce and cucumber, etc.), fruit (dates, figs, sycamore nuts, grapes, etc.). They produced oil extracted from sesame, beer, and cakes of all kinds. They invented hunting tools: traps, arrows with polished stone heads and later, around the second millennium BC, metal heads (copper to begin with and then iron). They innovated in fishing with nets, pots, lines, harpoons, and so on. As from the beginning of the Neolithic, around 5,000 years before our time, they conducted husbandry with cattle, oryx and even hyenas. The lancing papyrus tells us that the Egyptians of the Old Kingdom held in captivity and fattened in enclosures a certain number of animal species: bubais, gazelles, etc., and even cranes and hyena. However, they subsequently renounced since that type of husbandry demanded considerable manpower. The animal fats were used for making ointments.

This abundance promoted the generation of the first unified, strong kingdoms between 3000 and 2720 BC under the Thinite kings.

The size of the new kingdom obliged the pharaohs to devise efficient forms of administration and communication techniques. This led to the creation of writing and the resultant prodigious development of science in all disciplines and in their technical applications.

I shall now deal with the writing, science and technology of the Egyptians.

III. WRITING

One of the most prodigious inventions of the Egyptians is writing. It is one of the oldest that mankind has known and which we are able to decipher today. The earliest written documents are claimed to date from the fourth millennium BC and the use of that writing continued to the end of the fourth century AD The last to use it were the inscriptions on the Island of Philae which date from 394 AD During the whole period in which it was used, it was progressively improved, passing from a pictograph form to the demotic form, via the hieratic form, which could almost be considered close to an alphabet.

The pictographic form means that an object is represented directly by its image.

The linking of one sign with another was mostly done for aesthetic reasons; a word had to be contained within a square in which the various sides must be harmoniously arranged. These squares are then aligned, horizontally or vertically, from left to right or from right to left, from top to bottom or from bottom to top, depending on the text, on the surface to be covered by that text, and the position taken by illustrations, etc. The direction for reading is shown by the actual drawing of the signs: reading begins on the side from which it is looked at by the animated figures (men, animals or gods). In order to represent ideas, use is made of

pictographic signs of objects having the same phonetic sound. For example, beautiful: Nfr (nefer).

In time, faced with a need to express more abstract ideas, the pictograms rapidly reached their limits. The method had therefore to be changed. Thus, instead of expressing things by means of their images, they were expressed through their sound.

Therefore the signs previously used to represent objects are now used simply as symbols that enable a name to be put together. For example, the symbol that represents a mouth "re" is now only used to provide the sound "ra". Therefore, to make the word rabbit it would suffice to write the phonemes "ra" and "bit". This is how Egyptian writing developed from the pictographic form to what is known as the hieratic form, that is to say from an expressive form to a move conventional, or even alphabetical, form. Etymologically, that in fact means having a relation to the gods, from the Greek "hiera" meaning god. The orientation of that hieratic writing was initially vertical, from top to bottom and from right to left; it subsequently adopted the horizontal, from right to left as in the case of the Arabs and the Jews today. The signs that are used represent only consonants, with the vowels being added when reading. Nfr is pronounced nefer. This is the same principle as that to be later adopted by the Jewish and Arabic writings. About 500 BC (at the Saitic, Ptolemaic and Roman periods) the hieratic writing is also improved and developed towards a more simplified version known as demotic (from "demos" the people, meaning commonly used, but in fact always used by scribes). In that way, Egyptian writing achieved a level of perfection that enabled it to record the complicated expressions of scientific disciplines to whose establishment Egypt had largely contributed.

IV. MATHEMATICS

1. Numbering

Two important papyrus from the Middle Kingdom (2000 to 1750 BC), that of Rhind and that of Moscow, provide us with exhaustive information on Egyptian mathematics.

The numbering followed the same development as writing. It passed from a pictographic form to the demotic form, via the hieratic.

It is on a ten base. In its initial form it is not positional. In the same way as the early pictographic writings were arranged randomly, the representation of figures follow the same logic.

1 10 100 1000 10 000

100 000 1 000 000

In order to make up a figure, it suffices to place one next to the other the various elements that compose it. For example 334.

However, the development of symbols in the hieratic and demotic writings was to completely change the form of numbering.

It became purely conventional and more or less positional. Indeed, the same figures will be slightly amended in order to give the Arabic figures, the ancestors of today's universal numbers. Let us look at the comparative table.

Universal	**Arabic**	**Egyptian**	
		Hieratic	Demotic
1			
2			
3			
4			
5			
6			
7			
8			
9			

Demotic writing was to significantly simplify numbering. The big numbers are represented by single symbols or by exponents above the small figures or by factors common to those figures.

101 000 = 101 x 1000
40 000 = 4 x 10 000
The arrangement of the numbers is clearly organized.

120 000 = 120 x 1000 and
1120 = 1000 + 120
The million that was previously represented by a god takes on a new form.

It is these new representations that enable all the calculations to be carried out.

2. Calculation

Addition and subtraction, as we might expect, did not lead to any problems. It was sufficient for the Egyptians to use physical objects or gnomons (abacuses). However, despite the high level of knowledge, it has to be noted that it was still empirical. No operation was made without recourse to everyday activities. The King wished to know the quantities of production, the rhythm of consumption in order to make better estimates. In order to share out land after each flood, it was necessary to be able to divide and calculate the surface of the various geometric figures that the land could assume. Construction of granaries, of pyramids and of royal palaces required the ability to calculate volumes. It was those concerns that obliged the Egyptians to become forerunners in all fields of mathematical science.

They carried out multiplications by means of successive multiplications by two. The number is multiplied by two and the two figures added, and so on until the final result is obtained.

8 x 6 = (8 + 8) + (8+8) + (8+8)
16 + 16 + 16
32 + 16
48

The calculation is simplified if one of the terms is greater than or equal to ten. The Egyptians did not have a zero, but they knew how to multiply by 10, 100, 1000 and so on in the same way that we do it, that is to say by adding one, two, or three zeroes to the multiplier, as required.

Division is done in the reverse way, it is attempted to reconstitute the dividend by successive additions of the divisor:
25/5 = the number of parts of five in twenty-five that is equal to (5+5) = (5+5) + 5, i.e. five parts of five.

Where division is not made with whole numbers, recourse is had to fractions. Egyptians knew how to deal with fractions where the numerator was equal to one and more rarely 2/3, 3/4. Where any operation required division, they split up the number into fractions with a numerator equal to one and subsequently reduced them to the same denominator.

The Rhind papyrus contains both fractions with the numerator one and fractions of 2/3 or 3/4.

Mastery of such operations enabled them to devise formulae for calculating the surface of a rectangle, of a sphere, of a triangle, of a trapezium, of the volume of a cube, of a pyramid, of a cylinder, and so on.

They were the originators of the Thalesian axiom and of the theorem of the right-angled triangle attributed to Pythagorus, 2000 years earlier. They solved simple and quadratic equations 2000 years before our time. The Berlin and Rhind papyrus clearly set out such problems.

The measurement of surfaces, of volumes and distances required the development of units of measure in order to compare sizes.

3. Units of Measure

- Units of Length:

- one cubit (meh), this varies depending on the period and on the nature of the work = 45 cm
  = 6 hands (shesep)
  = 24 fingers (djeba)

- one royal cubit = 52.3 cms
  = 7 hands

- one rod (khet = wood) = 100 cubits

- one iteru (river) = 20,000 royal cubits
= 10.5 kms

- Units of area:

- 1 setat (arura) = 1 square rod = 2735m^2

- 1 kha = 10 setats

There exist various fractions of a setat, the smallest of which is a cubit which is equal to 1/000 setat (the name cubit (elbow) comes from the fact that it corresponds to a strip of land that is one forearm wide and one rod — i.e. 100 cubits — long).

- Units of volume:

- 1 heqat (bushel) = 4.54 liters (or 4.785 l)
= 10 hin (1 hin = 0.5 l)
= 320 ro

A heqat is also subdivided in accordance with the composition of the eye of Horus (1/2, 1/4, 1/6, 1/8, 1/16, 1/32, 164).

- Units of weight:

- 1 deben = 91 grams
= 1 kite

The Egyptian units of measure are not perfect but they at least open the way to the search for more harmonious and more balanced units. And even if the units are not so accurate in the field of spatial measure, in respect of the stars they elaborated ingenious methods for measuring the movements. Thus they were able to devise the most accurate calendar of antiquity, that was then slightly amended to produce the present calendar in 238 BC by the Pharaoh Ptolemy.

V. THE EGYPTIAN CALENDAR

The Egyptian calendar probably dates from the fifth millennium BC, or to be more exact from 4236 BC It comprises 365 days, or 12 months of 30 days plus five additional days devoted to the major Gods (Osiris, Horus, Seth, Isis, Nephthys) known as the epagomenal days by the Greeks. They knew with accuracy that the earth completed its annual revolution in 365 and a quarter days. But they only corrected the difference once every 1,460 years, that is to say when sunrise coincided with that of the star Sirius, that they called Sothis. In 238 BC, the Pharaoh, Ptolemy Euergetes decided to add one day every four years, but the Egyptians refused that change, which would not be imposed until 29 BC by the Emperor Augustus.

For the Egyptians, the day as a unit of time was composed of 24 hours, 12 for daytime and 12 for night. Those hours were determined during the day by means of sundials and shadow clocks. Even where the position of the shadows was not the same at all periods of the

year and they were extremely long in the morning or the evening, the Egyptians nevertheless had techniques to remedy those drawbacks. In the former case, they used latitude; and in the second, they sloped the graduated scales (gnomons) in order to shorten the shadows. They invited the clepsydra (or water clock) to improve the counting of time both day and night.

At night time they also used star clocks that enabled them to know the time as a function of the position of the stars. The system was ingenious and proved that they were capable astrologists. The stars change position in accordance with the seasons. The Egyptians found how to identify each period of the year with a series of stars that appeared successively in darkness at regular intervals and for a period of ten days (a decan).

It was that precise knowledge of the stars that enabled their descendants, the Dogons, to inform scientists of the existence of stars that were invisible to the naked eye (white dwarfs) having a millenary revolution. The companion of Sirius (Sothigi), that was unknown to modern scientists until 1965, was known to them although it appears only every 1,460 years and is invisible to the naked eye.

Ingenuity was also remarkable in the field of medicine.

VI. MEDECINE

In the field of medicine, ancient Egypt accomplished many miracles. Doctors correctly diagnosed patients, proposed a variety of treatments depending on the illness identified. Surgery, sudation, purging, potions, unctions, suppositories, massage, ointments, and so on were effectively practised as from the first dynasty, around 2900 BC

The Smith papyrus, a copy of an original compiled under the Old Kingdom, between 2600 and 2400 BC, is a veritable treatise on bone surgery. 48 cases are examined systematically. Each time the author of the treatise begins with a general statement: “instructions concerning such or such illness” then there follows a clinical description: “if you note such and such a symptom … you will say to the patient … this is a case I can deal with or it is a case where I can do nothing.” If the surgeon is able to treat, the cure is given with precision: “You will wrap it with meat on the first day, then you will place bandages of textile in such a manner that the edges of the wounds are touching.” It may be noted that this treatment is still used in modern surgery. This is to the honor of our ancestors. The cases studied in the Smith papyrus concern superficial wounds to the face, injury of the skull, lesions of bones or joints. Mummies have been found with the traces of healed openings of the skull, teeth filled with gold wire, cheek wounds healed by surgery, etc., dating back as far as great antiquity.

The cure is always effective. The Egyptians also used magic in order to determine the origin of illnesses or to cure them. In the papyrus of Ebers, of Berlin and of Edwin Smith, the medical treatments proposed used both natural substances (plants, minerals, plant extracts, animal products of all kinds (milk, meat, blood, urine, droppings, honey, etc.)); but also incantations in order to stimulate those products.

The illnesses that were frequently treated were: gastric problems, swollen stomachs, skin cancers, head colds, laryngitis, angina pectoralis, diabetes, constipation, ailments of the rectum, bronchitis, retention and incontinence of urine, bilharziosis, opthalmia, etc.

The effectiveness of Egyptian therapeutists was such that they were deified, even beyond the frontiers of Egypt, for instance, Imhotep, vizier, architect and physician to King Djezer of the third dynasty, was deified by the Egyptians under the name of Imutes and was held by the Greeks to be the supreme God of medicine (Asclepios).

There effectiveness is also to be noted in the mummification of the dead, a technique that they were the only ones to master.

To enable physical bodies to subsist beyond the tomb (as a result of their philosophy of being) they removed the innards and the brain, and immersed them in natron for 70 days to prevent them from putrefying. The body was then packed with sheets impregnated with (conifer) resin, anointed with ointments and resin, and then wrapped up in strips of cloth that were also impregnated with resin. Today, 4000 years later, the mummy of Tutmes II is still intact in the Cairo museum after having been subjected to that treatment.

VII. ARCHITECTURE

One of the fields in which the Egyptians were unbeatable pioneers was certainly that of building. They put up buildings whose construction secrets remain a mystery to this day. The cutting of the enormous blocks of stone, their transport and their ingenious positioning still remain secrets that no researcher has really discovered. It is thought that they may have used some equipment or other, some principle of mechanics or other principle. However, when looking closer at the comments none of those hypotheses would seem adequate to solve the enigma. For example, the idea that blocks of stone weighing several tons could be mounted by using levers is difficult to accept when we consider the height to be lifted and the weight of the blocks.

They used all possible materials for their constructions. They began to use heavy granite as of the third millennium BC for the floor of certain tombs of the first dynasty at Abydos. During the second dynasty, limestone was used in building the walls and the tombs.

A new architectural phase began during the third dynasty. That was a capital event in the history of Egypt since it concerned the construction of the first building entirely of stone. The step pyramid at Saqqarah which formed part of the mighty funerary monument of King Djoser.

The step pyramid, in which for the first time we find hewn stone, was again the work of Imhotep (2580 BC). It is still of small dimensions. It is the first architecture of hewn stones of regular shape. They also invited the column. Both the inserted column and the free-standing column. They were built in the image of local flora. Thus, the head of the columns were represented by a lotus, papyrus or other plants. They likewise invented the vault, which was first a brick-made vault around 2100 BC and then of stone during the sixth dynasty. The Great Pyramid of Giza was one of the seven wonders of the ancient world. It has enormous and amazingly regular proportions.

VII. BOATBUILDING

The needs of everyday life along the Nile Valley also caused the Egyptians to make inventions in the field of river transport. Boats thus occupy a privileged place in the earliest of works of art of the prehistoric era. They were present throughout the life of Egyptians and even after their death. Boats were buried in the necropolis to enable the dead to sail on

beyond the tomb. At Haluan in a necropolis from the first two dynasties and at Dahshur, close to the Pyramid of Sesostris III, a more recent and more extraordinary discovery has been made. In 1954 was discovered, along the southern side of the great pyramid, two pits cut into the rock and covered with enormous slabs of limestone. In those pits had been deposited, in a disassembled state, complete boats with oars, cabins, rudders, that had served Kheops. One of those boats has been removed from the pit and reassembled. The other one is awaiting still that it be taken out of its "tomb".

The Kheops boat, which now occupies a special museum, has been reassembled. It is composed of 1,224 pieces of wood that had been partly disassembled and placed in 13 layers one over the other in the channel. It measures 43.4 meters long, 5.9 meters broad and had a tonnage of some 40 tons. The planking is between 13 and 14 cms thick. It is flat bottomed and does not have a keel. The most remarkable thing is that it was assembled without nails, simply using mortise and tenon joints.

The achievement of such works was the direct consequence of the prodigious developments in carpentry, metalworking and weaving.

IX. WOODWORKING

The skill and creative genius of the Egyptians also manifested itself in the making of everyday articles (household stencils, decorative objects, working tools, funerary equipment, etc.). Coffins of wood, combs with ivory handles, various types of pottery, articles of glass, ceramics, gold, copper, bronze or brass in the Old and Middle Kingdoms, and of iron towards the end of last millennium BC have been discovered in large quantities during archeological digs. Enameling and glassmaking techniques had indeed been mastered already in the pre-dynastic period (3500 BC). Pearls were known but glass was only invented in 2500 BC during the fifth dynasty. Transparent glass appeared in the reign of Tutankhamen around 1300 BC Towards 700 BC, Egyptian polychrome glass vases of the shape known as "alabaster" were to be found throughout the Mediterranean and were imitated by the Phoenicians, who made them one of their preferred industries.

In Lower Egypt, hieroglyphic signs molded in colored glass are inserted in wood or stone or in the form of inscriptions. Later, during the Greek period, Alexandria became the largest center of glassmaking.

For agriculture, they manufactured highly developed stone tools and then in copper or alloys. However, stone (flint) was used for a long time even after the discovery of metals, for religious reasons. For carpentry, they manufactured, saws, pliers, hammers and chisels.

The mastery of toolmaking also permitted another great achievement of the ancient Egyptians: papyrus.

X. PAPYRUS

Papyrus is produced from a plant of the same name whose fibers are used to caulk boats, to make wicks for oil lamps, mats, baskets, ropes for attaching boats, etc.

It was also used to make the celebrated paper that has permitted the conservation of information that has enabled us to obtain many details on the history of that people and of many others of antiquity, up to the Middle Ages.

Papyrus is manufactured by crossing successive thicknesses in layers of fine strips drawn from the stalk of the plant which, after being pressed and dried, enable a large sheet to be made. Twenty sheets joined together when they were still freshly made constituted a scroll whose length could vary between three to six meters. Those scrolls were the Egyptian books. They were held in the left hand and unrolled as reading progressed. They were in use as from the first dynasty, around 3000 BC.

1. Clothmaking

The Egyptian genius also showed itself in clothmaking as from very early antiquity, well before the end of the Neolithic, around 5000 BC

Linen was used and women were the principal artisans. Those women were extremely skilful we are told since they often manipulated two spindles at once. One of the features of the spinning technique was the great distance between the raw tow placed in recipients on the ground and the spindle that transformed it into a yarn. In order to increase that distance, the spinners sat upon stools. Spinning frames, that were horizontal to begin with and then vertical as from the Middle Kingdom, enabled them to fabricate cloth of great length that was demanded both for the ample daily clothing of the Pharaohs and for the funerary rights: cloth strips, shrouds for mummies.

XI. CONCLUSION

This overview of the repertory of inventions and innovations in Ancient Egypt teaches us two things. It enables us to understand that the greatness of Egypt was above all based on its science and technology. Also that the African continent is the receptacle for all that civilization and is therefore not a continent that is anhistorical, completely absent from the history of human civilization.

The dissemination of that science and technology within the continent also permitted the emergence of new empires that were as dynamic and as ingenious as that of Egyptians. However, our purpose for the moment is limited to that first part of African history.

Africans must realize that the poverty that stifles them is in no way a fatality. Everywhere where men have deployed their genius, they have been capable of satisfactorily responding to their needs. The most unimaginable dreams may become reality when one devotes oneself to them. All the tools at the disposal of mankind, before they were created, were utopian, or even an idle dream for those not committed. Unfortunately, the habit of utilization removes sooner or later the trace of genius and the initial difficulties involved in making an article. That is why the steam engine, the radio, television, the airplane, rockets, computers and other “surrealistic” achievements of other centuries are now but everyday gadgets for contemporary man. However, many great scientists have been executed for simply imagining the possibility of far less complicated objects. Socrates was forced to drink hemlock for the simple idea that there was but one God, Aristotle was exiled for the same reason, William Servet and Marcelo Malpighi were burnt alive by the Inquisition for having maintained that the heart is a pump that causes blood to circulate in the body, through the vessels (veins and capillaries). Gallileo’s astronomical telescope led to panic within the clergy and the microscope was qualified as satanic.

Nevertheless, these objects are quite everyday for contemporary man. The same can be said of the science and technology of our Egyptian ancestors. At the time they were elaborating certain knowledge or carrying out certain technologies, the majority of peoples were hardly any different from animals. They lived in caves, ate raw meat, walked bare foot and defended themselves from the many aggressions of nature simply by instinctive or bestial gestures (flight, screaming, throwing stones or sticks, etc.).

Africa may be proud of the prowess of its earliest inhabitants and at last convince itself that it has the necessary genius to take charge instead of pathetically entrusting its destiny to other continents.

This genius indeed shows itself everyday in the achievements of independent researchers or of specialized institutes. This is witnessed by the diversity and quality of achievements presented in the various creative competitions held locally or at continental level.

We have people like Alpha Diarra, who explores space on board NASA's vehicles, like Abdou Moumouni, who transforms the rays of the sun into a source of thermal and electric energy, like C. Anta Diop, who uses nuclear physics and molecular biology to show us the true nature of man in the past and of ancient beings, and like Mohamed Bodé from Togo, who developed the best system for conserving electrical energy.

In addition to these great figures of invention in contemporary Africa, there are thousands of researchers in the field of health, preservation of the environment, exploitation of natural resources, in foodstuffs, in art and literature, singing and music, etc.; however, their popularization constitutes a problem.

The reason for this is that African leaders rarely show confidence in the creative genius of their compatriots with the result that, whatever the value of their achievements, they can only promote them outside the continent.

This makes it appear that Africa is a *terra incognita* for inventions. That is the most important challenge for African inventors: to devise a strategy that will cause the leaders of their countries to take them seriously. No true development can be initiated in a country if it is not initiated and conducted by its own children.

In the United States of America, in the Soviet Union, as in China, Germany and Japan, we see the same philosophy: wherever human genius has been able to develop and to serve mankind it has been promoted and stimulated by leaders who are ambitious and concerned for the wellbeing of their peoples.

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Notes

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