HISTORY OF TRADITIONAL SCIENCE AND TECHNOLOGY IN SUB-SAHARAN AFRICA: PROBLEMATIC AND METHODOLOGY OF APPROACH

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ABSTRACT

Sub-Saharan Africa is often at the margins of science and technology issues. Everything is presented as if Africa in the South of the Sahara has been outside of the progress of science and technology over the centuries and not accounting for the legacy of techniques and sciences. And yet the various available sources show that not only did Africa in the south of the Sahara have a history of science and technology, but they have been omnipresent throughout the centuries and have played a decisive role in the development and structuring of traditional societies. Despite the denial of science and technology to these societies by some Europeans since the first contacts with the coasts from the fifteenth century, which is expressed through their writings, written, archaeological and oral sources provide evidence of their existences and of their diversities. Concepts, epistemological aspects and approaches are at the root of this denial. However, their approaches require a methodology adapted to the cultural, social and political contexts of societies whose orality is the basis for the transmission of knowledge.

Keywords: Technology, Science, Traditional, History, Sub-Saharan.

INTRODUCTION

The history of the techniques is the study of all the technical achievements of the Man, of their context of appearance, their evolution, as of their repercussions on the society. Technical progress responds to economic, military or social necessities. Science as for it is defined in 1694 in the dictionary of the French Academy as "knowledge and obvious things by their causes. ". The time between rebirth and light has established new definitions. Over time, they become more precise. The sciences are no longer considered as a block of discipline in the making, but as a system of circulation of problems and wise practices from one field to another (Pestre, 2015: 22; 23). From the fifteenth to the eighteenth century, the history of science and the history of technology were ignored in Europe. The nineteenth century was a period of great innovations accompanying the industrial revolution, and the opportunity for a rapprochement between technology and science (Grell and Halleux, 2016: 9). Their histories over the ages are therefore closely linked to developments in the various human civilizations, including African civilizations. In the context of sub-Saharan Africa, before the introduction of Western techniques and sciences in the colonial period, these were already known and common in African societies south of the Sahara. Indeed, science and technology are ubiquitous in societies south of the Sahara. They manifest, apply in different ways and at different levels. They are manifested and lived in the socio-cultural environment. The teaching of these sciences is done in the family, in the public assemblies and initiatic and also by the games, the stories etc. The scientific spirit is seen and expressed through mathematics well known in sub-Saharan societies by arithmetic, metrology, geometry, astronomy and natural sciences. Techniques are also very present in societies south of the Sahara. They contain the techniques of acquisitions and assembly (traditional architecture, wickerwork techniques, textile techniques, agriculture and breeding), materials transformation techniques (ceramics, metalworking). , salt production, dyes and

dyeing, fat production) and technical processes (carving on different types of materials, blacksmiths, goldsmiths, leather craftsmen). These riches are denied to African societies. Indeed, these being characterized by orality, the Europeans rejected their capacity to reason and to put in place technical and scientific processes without the knowledge of writing. For many of them, science and technology in sub-Saharan Africa do not exist because the absence of the experimental method, which is the set of methods used to verify hypotheses, undermines the very idea of science and techniques in these societies. Indeed, the Europeans, always wanting to model the realities of Western societies, those of societies with orality that have other modes of operation, rejected the very idea of science and technology from the first contacts. The science and technology approach in sub-Saharan Africa is based on different paradigms. What are the problems and specificities of the approach of these traditional sciences and techniques? What methodologies are used for the study of science and technology?

Our objective in this approach is to show the existence of specific sources and their methodology of approach for the study of the sciences and techniques of African societies south of the Sahara.

To reach our goal, at the methodological level, we relied on various documentary sources, including written sources, archaeological and ethnographic documents, oral sources and scientific documents. Data processing identified problems with their studies and the sources essential to their approach and understanding.

To address this subject on science and technology in sub-Saharan Africa, we treat it in two main parts:

I- The problematic and specificities of a history of traditional techniques and sciences in sub-Saharan Africa;
II- Methodology of Science and Technology Approach in Sub-Saharan Africa
I-: THE PROBLEM OF A HISTORY OF TRADITIONAL SCIENCE AND TECHNOLOGY IN SUB-SAHARAN AFRICA

The Denial of Science and Technology
When one goes through the bibliography on the history of techniques and sciences, one will be tempted to believe that sub-Saharan Africa has not known any technique or science and consequently has not been an actress of the various technological innovations. in the world. Until recently, the great syntheses of technical and scientific specialists in the Western world ignore sub-Saharan Africa. And yet, archeological, historical, and ethnographic observations of today's traditional societies demonstrate the opposite with important discoveries. Investigations on the ancient metallurgy of iron, gold, ceramics, agriculture, the approach of the kingdoms and great empires of this space are concrete examples of the role of sub-Saharan Africa in technical evolution and scientist of the world. The contribution to the technical and scientific level of sub-Saharan Africa to the technological and scientific heritage of humanity remains unknown because there is a denial and a lack of research on this theme. Indeed, to make a history of techniques and sciences, it is necessary first of all to approach typologies and their characteristics. Apart from the archaeological investigations which take into account the material culture of the different civilizations, the study of the techniques in a general way which takes into account the old cultures until recent ones is insufficient or sometimes non-existent. It is true that to make the history of techniques and sciences in Africa is a delicate and difficult approach. First, not long ago, history in its entirety was denied to sub-Saharan Africa because of the absence of writing to record the facts. Next It was necessary to fight for recognition that African societies, most of them with oral traditions, also have their history which is written according to their socio-cultural context and with specific and specific methods. It was also necessary to make accept the specific sources of this history which could in no way resemble, in every respect,

that of Western societies, nor be modeled on them, which themselves, have their own socio-cultural realities.

We believe that there is another challenge in this world of globalization, that of the history of technology and science in sub-Saharan Africa. How can we meet the challenge of Africa's development if we ignore the history of science and technology of the societies concerned. This challenge is urgent, especially as these ever-changing companies are losing important technical and scientific values in most cases without an approach and investment from researchers.

The urgency of setting up a course in history of science and technology

The history of science and technology is not just about the traditional or ancient approach to these facts. It also deals with the modern sciences and techniques which, in sub-Saharan Africa, are introduced from the colonial periods. One of the most characteristic of their impact on African societies south of the Sahara is the introduction of iron bars by sea from the first contacts. Following this, very early on, the chain of operations of the old iron metallurgy was upset. The metallurgist and the blacksmith who formed a chain at the level of techniques, sciences and worship are completely upset with its lot of consequences especially cultic, technical, scientific. There followed a regression at the societal level, technical practices and sciences, economics, political organization and especially at the cultural and cultic level. The introduction of exchange products, modern science and technology from these periods has indeed destroyed traditional societies and led to significant technical, social and economic consequences. Scientific studies are often scarce on these questions of the impact of technical colonization and science on traditional and modern societies. How can we advance, economically, societies that, from a given period, have been suddenly disrupted by technical inputs and sciences, without understanding, or measuring the impact of these changes on these societies in order to introduce new policies of techniques and sciences? At this level, African states have a duty to remedy it. Specialists exist and can help understand and correct certain economic policies. For more than 57 years of independence, for some countries south of the Sahara, they are still lagging behind sustainable development. The history of science and technology is an important economic issue that should integrate university education in sub-Saharan Africa. There is indeed a flagrant absence of a history of science and technology in Black Africa because education is not assured, it is difficult to ensure the chain of research, the transmission of knowledge and training of researchers specializing in these issues. Most researchers in this field have been trained in Europe or the United States in specialized laboratories. The consequence of all this is the rarity of this theme in the writings and major historical syntheses concerning sub-Saharan Africa. Indeed, African and Africanist intellectuals have developed for decades and still today, the general history of Africa without taking into account the history of science and technology. At the current state of knowledge, few universities in sub-Saharan Africa have a specialty and a well-marked history of the history of technology and science. Much is done on the description of technical facts and sciences, and archeology is the only scientific discipline in Sub-Saharan Africa which, based on the description of the context, the analysis and the typology of artifacts, attempts to respond to it, especially at the level of the sciences and techniques of the subject. But a history of techniques with its methodology and sources is not yet taught to students in a well-defined course. The importance of the history of science and technology is such that it appears as *« une discipline de convergence entre les sciences humaines, les sciences pures et les techniques. Elle intéresse des domaines comme la philosophie, l'histoire générale, l'histoire politique et l'histoire économique et sociale. A ce titre, elle apparaît comme l'un des aspects essentiels de l'histoire culturelle de l'humanité et son enseignement est fondamental. L'Afrique d'aujourd'hui ne peut ignorer la portée d'une telle discipline. »* (Ouattara, 1992 : 6)

There is indeed the paradox between these enormous riches in sub-Saharan Africa and the lack of scientific data on techniques, sciences and also the stories of denial of technology and science to

African societies. It is the duty of African researchers, specialists in the history of technology and science, to make known these undeniable riches. It is only here that we can break down myths and prejudices about the history of science and technology in Africa, which is considered by some to be a view of the mind because for many, the African is not not capable of technique or science. The very concepts of science and technology are, like history at the beginning, denied to Africa. Certain writings at different periods make it possible to make the observation of it. Among the authors who have influenced the course of history and played on the collective mentality that denies the techniques and sciences to Africa, there is the philosopher Hegel. For the latter, the black man cannot have known technique and science. While recognizing in the nineteenth century, the ingenuity of the ancient Egyptians he detached from Black Africa, Hegel speaks of the inculture of the rest of the continent and "the congenital inferiority of the Black". For him, because of this congenital inferiority, the Black man cannot conceive neither a history nor a science because he acts in most of the time by intuition, which is the own, according to him, of "wild societies" as opposed to the reasoning of civilized societies. Acting out of intuition, the black man can not develop a scientific and technical concept and "this condition is susceptible of no evolution and no culture and such we see today, as they always were". (Hegel, 1830: 75).

These unfounded comments will have a significant impact on posterity, and in particular on some researchers in so-called civilized countries, in the face of "barbaric peoples without history". We realize that the writings of serious scientists of the times after Hegel will be influenced by the ideals of the latter. One of these intellectuals who treated with contempt the history of the technique and science of African societies was the journalist and historian Pierre Gazote (1895-1982). Marked by the ideology of the extreme right, he will make remarks quite racist but based on a legacy of the philosopher and scientist Hegel. Gaxote affirmed, "*ces peuples, vous voyez de qui il s'agit... n'ont rien donné à l'humanité; et il faut bien que quelque chose en eux les est empêchés. Ils n'ont rien produit; ni Euclide, ni Aristote, ni Galilée, ni Lavoisier, ni Pasteur; leurs épopées n'ont été chantées par aucun Homère* "(Ky-Zerbo, 1978, 10). In a word, they did not know the techniques or the sciences and did not bring anything to humanity. And yet the latter is a recognized intellectual, he was a member of the French Academy, author of many books including various historical studies such as: *La Révolution française* (1928), *Le Siècle de Louis* XV (1933), Frédéric II (1938), *La France de Louis* XIV (1946), *Histoire des Français* (1951), *Histoire de l'Allemagne1* (1963) etc. He also directed for a time editions fayard, the collection "*Les Grandes Etudes Historiques*". Parallel to his studies at the Ecole Normale Supérieure, Mr. Gaxote had a degree in science. This explains his positions on science and technology studies. Going back to his intellectual work, one can imagine the impact of the latter on the mentality of his fellow citizens.

African and Africanist intellectuals have rebelled in different ways and at different times against these ideologies and the ideological alienation of not only the people of the West but also the Africans themselves who were just hearing and to integrate in their subconscious these allegations about the cultural, scientific and technical inferiority of Africans. We can cite the scholar Cheick Anta Diop and his colleagues Théophile Obenga, Asante Kete Molefe to name just a few, who are considered as the inspirers of the epistemological current of Afrocentricity, a paradigm seeking to highlight the particular identity and the contributions of African cultures to world history, including the contribution of technology and science to the history of humankind. Through controversial or non-controversial writings, they have tried to make the scientific community and the world understand the specificities and originalities of African cultures, their techniques, their sciences and the importance of a study of cultures, science and technology of African societies. Some of them have initiated a general history of Africa, on different themes that have resulted in important and essential scientific publications. However, a history of culture and science has remained largely absent from these writings. Nearly thirty years ago Theophile Obenga Egyptologist, linguist and historian claimed that « *L'Afrique a déjà toutes les histoires générales, sauf précisément une histoire*

*scientifique et culturelle. La nouvelle génération d'historiens africains doit apporter sa modeste contribution à l'écriture d'une telle histoire qui pourrait enrichir nos manuels scolaires, si réduits en matière scientifique et culturelle africaine. La jeunesse universitaire africaine qui entend sortir des sentiers battus a justement là, une excellence occasion pour manifester tout son talent; donner à l'Afrique, une histoire scientifique et culturelle, la sienne, comme apport irremplaçable à l'histoire générale». (*Obenga, 1987 :78). Even today, the same issues are topical. A history of science and technology is more than urgent because of the vulnerability of our societies to cultural shocks, globalization and the disappearance of traditionalists and artisans. The technical and scientific knowledge and know-how being transmitted by orality. We are fortunate in our African societies to have significant cultural wealth in terms of technology and science. The particularity of sub-Saharan Africa is the subsistence of these values that we can observe in vivo, describe, analyze and safeguard. The so-called developed societies have undergone a profound change for some time. However, in Africa south of the Sahara, there is a problem of lack of knowledge, of safeguarding and valuing the techniques and sciences of, most often, an inferiority complex, a lack of interest of the africans themselves and in particular, governors. Indeed, in our current societies, we are often surprised to see that techniques and sciences are still used at the level of architecture, ceramics, metallurgy, clothing, medicine, to name but a few this. To contribute to the identification, preservation and enhancement of these pathways of knowledge of traditional cultures and history, it is the responsibility of specialists to study and catalog these scientific and technical values specific to Africa. (Kiénon-Kaboré, 2004: 102).

The approach requires asking the fundamental questions. How are our societies organized in the field of technology and science? How to articulate the old and the new? What did we know yesterday, and what do we know today about our technical values and our sciences? What was yesterday, what is today's share of myth and reality in our knowledge of techniques and sciences? In this article, we do not answer these questions, but they allow us to understand the complexity of the subject and the interdisciplinarity of the approach of science and technology in African societies south of the Sahara.

However, we can only respond to these problems by basing ourselves on diverse sources and rigorous approaches based on the socio-cultural realities of sub-Saharan African societies. The studies on techniques in sub-Saharan Africa, have their specificities that most often require a particular approach. What are the sources of the history of science and technology? How to approach the history of science and technology in societies where oral traditions are basic sources? What can be done to derive information from intangible sources related to traditional techniques and sciences that contain much of the historical and cultural information? What is the contribution of written and material sources in the knowledge of this history?

THE SOURCES AND METHODS OF HISTORY OF SCIENCE AND TECHNOLOGY IN SUB-SAHARAN AFRICA

It is important to present sources and approaches to the history of science and technology in sub-Saharan Africa in general. The various researches have brought to light important wealth and surprised certain researchers by the specificity of sources and methods. Since the end of colonization, African and Africanist scholars, as opposed to the pre-1960s event history, have been carrying out investigations into a total history of Africa. To study this history, which deals with all parts of African civilizations, theoretical reformulation and new methods were needed. This is how some sources and methods will gain importance and refine their method. This is the oral tradition. Indeed, African societies are societies with orality, the approach demands that one investigate by this source which for some researchers had no value. The methods will be refined and eventually impose themselves. This source was the most important used for the approach of certain period of history, however, archeology and some written sources have been of great contribution to the knowledge of

the history of African societies in general and the history of science and traditional techniques in particular. The confrontation of these sources is the method most used by historians of technology and science. Written documents, archaeological and ethnographic documents and oral traditions are sources to confront so as not to leave important data that can distort the results of long periods of scientific investigation.

WRITTEN DOCUMENTS

Sub-Saharan African societies are majority societies with orals. Written documents are rare and sometimes non-existent. Despite the scarcity of written documents from companies south of the Sahara themselves, written documents outside these exist. They are descriptive writings of some observers, Arab travelers and European explorers who are often the only known written texts. For the history of science and technology, we can cite Arab writings, the best known of which are from the ninth century and those of Europeans from the fifteenth century onwards. In the last 30 years, African and African anthropologists, philosophers, historians and archaeologists have also made it possible, through their scientific productions and analyzes, to have direct or indirect data on science and technology in sub-Saharan Africa.

The Arabic writings

Most Arab writings on sub-Saharan Africa are written by Arab geographers and chroniclers, but references to black Africa are rare except for a few. In the early Islamic age (622-1050), among the many writings from the mid-ninth century to the mid-eleventh century, some authors bring serious information about Africa. One can quote, Ibn Khordādhbeh Yaʿḳūb (897), al-Masʿūdī (965), Ibn Ḥawḳal (977), al-Bīrunī. The source of Yaʿḳūb is very important. He traveled to Egypt, the Maghreb and left significant information on sub-Saharan Africa. It brings us many information on the black world such as Ethiopia, Sudan, Nubia, Bejja, Zendj. (Histoire Générale de l'Afrique TI, 1986: 73). In Sudan, he mentions the Zghâwa of Kanem and describes their habitat. One of these best-known descriptions is that of the important kingdom of Ghana and its great wealth of gold. The descriptions of this author prove that this kingdom in this first age of Islam knew gold mining techniques, the sciences that go with it and a variety of other techniques that allowed the hatching and the climax of the brilliant civilization of this part of sub-Saharan Africa. From 1050 to 1450, with the intensification of the trans-Saharan trade and the relations between North and South Africa at the second Islamic age, Black Africa will be much more cited and allow an accumulation of knowledge on this part of the world. The best known are al-Bakrī (1068), Al Idriss (1154) and al-Umarī (1342). The work of al-Umarī called Masālik al-Absār is capital for the history of Black Africa in the fourteenth century. It is indeed the main source for the study of the kingdom of Mali in its internal organization and its relations with Egypt and Islam. The main causes of the birth and emergence of this civilization known throughout the world at the time of its apogee are essentially based, apart from the control of the voices of commerce, on the metallurgical technical progress of gold. and iron. The first allowed to hoard wealth through a flourishing trans-Saharan trade, the second was important for a diversified agriculture in quality, in quantity to meet a need of a growing population and for conquests in view of the expansion of the kingdom, by the manufacture of important and sophisticated weapons in iron. Al-Umarī's work is complemented by that of Ibn Baṭṭūṭa, who was a direct observer of the Sudanese reality. They also gave information on the iron metallurgical industry. Al-Bakrī in his description of northern Africa, mentions iron specifically in West Africa. (*Histoire Générale de l'Afrique*, T.IV: 34, 35). Indeed, he points out on the road that leads from the Dra (South Moroccan River) to Ghana (Kingdom of Ghana) a mountain of iron he calls Adrar in Ouzzal. Further on about the economic and social life of the men of Silla (Senegal) he says that the inhabitants used iron harpoons to hunt hippopotamus in the Senegal River. This is proof of the existence of metallurgical iron techniques in these societies at that time. Al Idrissi in the twelfth century in his book Description of Africa and Spain speaks of an excellent iron mine in Tentano. The

locality is thought to be in Tassili N'Ajjers. The direct steel industry is known to people in sub-Saharan Africa at these times.

These writings allow, through the description of some craft and industrial activities to have an idea of the wealth in techniques and sciences known at these times. It was thus possible, through these writings, to know that the kingdom of Mali knew the gold mining techniques and that it marveled certain authors by the importance of this exploitation which constituted the base of the economy and the power of the empire and its leaders. The pilgrimage of the Emperor of Mali Kankou Moussa to Mecca in 1325 made known the empire of Mali to the world by the gold he transported and the riches of his escort he distributed on his travel itinerary. This wealth led the Portuguese, Italians and Maghreb countries to take an interest in the empire of Mali and its zones of influence for the greed of gold especially.

Apart from the Arab sources of the ninth to the fourteenth century, European explorers also provide information written from the fifteenth century with the arrival of the Portuguese on the African coast. These testimonies show that the ball of the avatar of diffusionism that continues to draw sub-Saharan Africa appears as an instrument of negation of African cultures that Europe met on "his path civilizing. (Bocoum 2001: 95-103)

The European written sources

European written sources cover the period from the 15th to the 20th century. They are Portuguese, Spanish, French, English, Dutch, German, Swiss, Italian etc. The main objectives were the discovery, conquest and establishment of commercial links with the African peoples of the coast and the hinterland. The authors of these writings are of various professions as well. They are writings of explorers, cartographers, geographers, botanists, soldiers, Catholic and Methodist monks, doctors, colonial administrators and academics. Most of them are direct witnesses of the facts they tell since they came to Africa for professional reasons or out of curiosity. Some are indirect witnesses and have often used reports or stories from other travelers to synthesize. The texts and stories, even if they contain imperfections, inaccuracies have the merit to provide us with valuable information on the location, diversity and richness of science and technology. The contents of these texts prove that the claims of European intellectuals of the eighteenth century were rather ideological than scientific, based on real unfounded assertions. The data from the written sources reveal a rich culture in terms of techniques and sciences. They address different areas of the culture of African societies including the weight system, the monetary system, the system of calculation, the calendar system (lunar, ritual,), the exchange system, the sciences and techniques of the material etc. All these data show their ingenuity in different fields, so much so that Paul Erdmann Isert, a German botanist who stayed on the gold coast from 1782 to 1786, about the African monetary and weight system, who demand some knowledge technical and scientific affirmed this: *« son usage (les cauris) s'enracina rapidement dans les mœurs et il s'instaura un système de numération basé sur le cauri.(...) Un Nègre qui porte de l'or à vendre en connaît le prix jusqu'à un cheveu, et porte toujours avec lui ses poids et sa balance».* About the inhabitants of Ardres (located in the territory of the ancient kingdom of Dahomey) he says this *« Le peuple d'Ardra ignore l'art de lire et d'écrire, il emploie pour les calculs et pour aider sa mémoire, de petites cordes, avec des nœuds qui ont leur signification… Ils sont si habiles qu'il est impossible de les tromper, et quoiqu'ils n'aient pas l'usage de l'écriture, ils font pourtant si bien leurs comptes qu'il y a point de manque*». He rebels against preconceptions *« qu'on ne me parle jamais d'une race bâtarde de singes, c'est tout ce que l'on pourrait dire s'il était prouvé que les Nègres ne fussent pas doués d'intelligence, mais il ne leur manque rien à cet égard pour égaler les Européens, dès qu'on leur donnera la même culture ».* (Insert, 1989 (1792): 28; 29)

The sciences and techniques of sub-Saharan African societies related in European writings concern mathematics, arithmetic, lunar calendars, techniques of inorganic and organic materials etc. The

African societies south of the Sahara at that time knew the science and techniques of weaving, basketry, salt mining, dyeing, soap, pottery, metals and so on. For this approach, we take typical examples of the sciences and techniques of the transformation of matter such as ceramics and metals.

In terms of metallurgical techniques, the authors identify the objects or metallurgical techniques of gold, silver, copper and iron. From the texts of the fifteenth to the twentieth century, these techniques are reported in different African societies. We can quote the writings of the Portuguese Alvise de Ca Da Mosto (1455-1457). He says that in Senegal iron is brought from the kingdom of the blacks who are further south and that with this iron they made weapons. (Schefer, 1895: 84) What could this kingdom be further south? Mali at the time of its decline or the Songhai amount? Valentin Fernandes, who did not go to Africa himself, was able to collect travel stories in the 16th century, giving descriptions of the regions visited in West Africa, from Senegal to Cape Monté (Sierra Leone) from 1505 to 1510. Speaking of the iron industry he mentions many iron objects: arrows and spears, harpoons and pertuisanes, axes and daggers. (Fernandes, 1951: 77). In the 17th century, Olfert Dapper, a Dutch national, spoke of the specialization and diversity of certain regions in the production of ferrous metals. He says that all the trades they know consist of blushing iron, beating it and putting it on an anvil. (Dapper, 1989 (1668): 323). Nicolas Villault De Bellefond traveled on the shores of Africa in the 17th century. Sent by the company of the Indies of France to raise the possibilities of trade on the African coasts, it speaks of the ability of the African craftsmen. For him they surpass much of the best workmen in Europe, and have finer files than theirs, and the cast as delicate as watermark works. (Villault De Bellefond, 1669: 393). It also gives information on gold that is used extensively in the weight and exchange system all over the gold coast. This means that the inhabitants have experienced an industry and techniques of gold mining and goldsmithery. William Bosman, who lived on the coast and was in charge of the Dutch traders in El Mina in the 18th century, points out the gold weights that were made of copper or bronze. (Bosman, 1705: 86). The furnaces of direct reduction of the iron of the hinterland peoples were pointed out in the eighteenth and nineteenth centuries in several localities by some explorers like Mongo Park, Binger and Réné Caillé, respectively in the regions of Ségou, in the smiths Malinké and in Timbuktu . The last city claims to have seen furnaces for the reduction of iron ore found in abundance in the mountains (Caillé, 1965 (1830): T1, 270). L. G. Binger observed metallurgists and ore reduction furnaces. According to him, metallurgists use large clay furnaces in places where ore is abundant. (Binger, 1980, T1 (1892): 204). Mongo Park in the eighteenth century speaks of the city of Segou which he describes as a brilliant civilization which he did not expect to see in these countries. Among the elements of this culture is the metallurgical industry characterized by large furnaces which produce large quantities of iron according to him. (Mungo Park, 1982 (1875): 281).

The sciences and techniques related to ceramics are also known by the peoples of sub-Saharan Africa and have been cited at different times. The diversity of techniques and the ingenuity of craftsmen are also described in the texts of the European authors. Valentin Fernandes, speaking about coastal peoples in Senegal, says that compared to the production of 15th century ceramics, they say that they are all potters and make pots both men and women. (Fernandes, 1951 (1506-1510): 29). The popularization of these techniques at this time on the African coast is well illustrated by the words of Father Loyer in the eighteenth century. Not only did he notice the presence of many trades, but note that artisans such as weavers, ornaments and potters are the most common. (Rent, 1714: 64). At that time, the potters made special, original objects, such as the terracotta lamps that served as lighting lanterns. (Ramseyer, 1974 (1876): 177). The ceramics used during this period were not rare but common and diversified. The craftsmen had gained experience that allowed them to be very effective. At the level of the peoples of the interior, the explorers who traveled the hinterland were also amazed by the ceramic techniques. Binger in 1886, is entrusted by the government an important mission in Africa. It was the geographical recognition of the Niger Loop and the study of the possibilities of linking the French establishments of the interior to those of the Gulf of Guinea.

Captain Binger in his journey and speaking of Senoufo artisans said that the pottery seemed to him more sophisticated than elsewhere and reported urns of various models and sizes, bowls and dishes of all sizes and very regular terracotta pipes . (Binger, 1980 T1 (1892): 79).

The conclusion we make after this wealth of written data on traditional science and technology is that the absence of writing is not synonymous with the absence of civilizations or culture and does not confer a negative value on these last. On the contrary, oral peoples have developed ingenious systems of knowledge, learning, transmission and memorization, based on the specificities of their societies, which compensate for the lack of writing in these societies. They think, conceive, experiment in their societal and cultural specificities which should be taken into account by specialists in these topics.

ORAL TRADITION AND HISTORY OF TECHNIQUES

The oral tradition is defined as the oral testimonies handed down from generation to generation. Approaches to oral traditions continue to reveal the specificity of sources and methods of approaching oral sources that must take into account the social context and the mental representation of civilizations in order to understand the societies they approach. This means that each studied society is differentiated by its intrinsic values and its worldview which play fundamentally on the oral testimonies transmitted to the generations. In other words, the researcher must understand the intrinsic reality of each society before moving on to collecting data on the history of technology. The technical thinking and the world view of the whole of society have a real influence on the information that it transmits orally and the understanding of it. The lack of knowledge of sub-Saharan African societies by Europeans has led to contempt for them. At the time when Europe approached the African coast, it was already structured for centuries by the culture of writing and had in their collective memory a negative vision of societies without writing. For them, writing was the key to all civilization. African and Africanist scholars who have penetrated the "soul" of African societies have realized the values and importance of oral traditions in oral societies. Everything that is transmitted orally is an intrinsic value of these societies, just like societies that know writing and freeze important values and information in writing. Every society, whatever its mode of transmission of knowledge and knowledge of its civilization, develops methods based on its specificities. African societies with orality have developed internal systems of transmission of their civilization which is not always easy to decipher if one does not know its internal functioning. The information given by the oral traditions must be studied and understood because one can not study a society with orality with the same methods as for a society that knows writing. The writing is static but the oral tradition is alive. We understand then the first European anthropologists who to study African societies in the early twentieth century, were one with them by sharing their experiences and remained for a while to observe, seeking to understand before any other analysis.

Oral traditions play a fundamental role in the knowledge of science and technology. Their approach showed the specificity of their content and their typology according to the period concerned by the study.

Organic Tradition: Basic Source for the Science and Technology Approach

The importance of oral tradition in the knowledge of science and technology in sub-Saharan Africa depends on the periods studied.

For periods older than the fifteenth century, the oral tradition is impotent in the history of technology because the collective and individual memories rarely go back to the level of knowledge of certain parts of the history of civilizations which include sciences and techniques. This indeed constitutes a serious handicap for the description of the operating chains and the evolutions of the sciences and the techniques of these old times. However, they contribute to the location of archaeological sites, the majority of which are related to ancient sciences and techniques (ceramics, metallurgy, architecture,

etc.), and their relative dating by the testimony of the inhabitants of places that are often foreign to the remains.

His role in studies of the periods after the fifteenth century is particularly remarkable. Without the contribution of oral tradition, an important part of our traditions in science and technology would be unknown and lost to posterity. Indeed, since writing is absent in the majority of societies, it is only through oral traditions, sometimes analyzed with archaeological data that we can make the typology, go up the operating chains, study, analyze and safeguard these important heritages that most often constitute the "soul" of oral civilizations. The oral tradition has allowed researchers and especially archaeologists, from the twentieth century, to go up the operating chains of some traditional techniques such as ceramics, metallurgy and know the important steps in obtaining finished products. The raw materials used, the methods of research and exploitation thereof, the methods of obtaining, the stages of obtaining the finished products, the evolutions over time, are known thanks to the methods employed by the researchers for understand oral traditions and extract reliable information. Thanks to the oral tradition, a large number of traditional techniques have been listed on metallurgy, ceramics, inorganic materials techniques, architecture, goldsmiths and so on to name only these.

Oral tradition and intangible sources

From the collection of oral traditions, we have realized the importance of certain types of traditions that contain information crucial to the knowledge of these specific heritages. Oral traditions that convey and convey various information most often require a deeper analysis for comprehension, which most often transcends the first meaning given by traditionalists and the content of the message itself. In sub-Saharan Africa, science and technology are often linked to religious, mythical and didactic facts with the rites and symbols that accompany them. These studies of socio-cultural aspects related to science and technology are for the historian real sources of information, especially at the level of the research of the origins of the craftsmen, the local diffusion of the techniques and the knowledge of the technical thoughts.

The methods of approach depend on the different research issues and the periods concerned. With regard to the most recent periods, socio-cultural aspects in the intangible aspects can be very useful. These are real history vehicles that must be detected. The libations, the rites contain some historical information. During the various stages, craftsmen always observe a certain number of rituals, gestures and attitudes that contain information that is difficult to detect on board. It is in this that the technical thinking of societies is important to detect (Kiénon-Kaboré, 2012: 35). AF Garçon in his book *L'imaginaire et la pensée technique* organizes operational thinking into three main regimes: the regime of oral practice, on which all technical cultures in sub-Saharan Africa depend, the regime of technology and the regime of technology both related to the written word. All are technical and are based primarily on the efficiency and transmission of knowledge. However each regime has its own processes to operate and transmit the technical facts. (Garçon, 2012: 149). In sub-Saharan Africa oral tradition is the basis of technical processes, the support of the imaginary to translate the dream into reality. And in this, the technique in these oral societies finds ways and means to realize what is abstract and also to transmit it. Thus, the imagination will be based on oral culture. The approach of the regime of practice has its realities and methods on which research must be made to penetrate and understand the reality of ancient sciences and techniques and their history in sub-Saharan Africa.

Other sources are fundamental in studies of the history of science and technology in sub-Saharan Africa. These are archaeological and ethnographic documents. Their approach makes it possible to answer important questions.

ARCHEOLOGICAL AND ETHONOGRAPHIC DOCUMENTS

The existence or not of ancient textual sources made it possible to establish a chronological division of the archaeological specialties in three great periods: the archeology of the prehistory (absence of textual sources), the archeology of the protohistory (peoples not having textual sources but cited in those of contemporary peoples) and the archeology of historical periods (existence of textual and / or oral sources). There are also archaeological specializations made according to the type of artefacts studied (ceramics, built metals, textiles, etc.), or from the raw material of the artifacts studied (stone, raw earth, glass, bone, leather, plants, etc. .). This gives a diversity of specialty of the archaeological discipline according to the studied period and artifact. At all times, men have been interested in their past. However, archeology was only formed as a science in the nineteenth century. Since then, she has continued to perfect her techniques, her methods of analysis and to enlarge her fields of study by relying on the exact sciences and the human sciences, in a global approach of the societies of the past. This approach takes into account the technical and social aspects of civilizations. Archeology is a scientific discipline whose objective is to study man from prehistory to contemporary times through his technical creations thanks to all the material remains that have survived, thus becoming an important source in the world answer to certain societal or civilizational historical issues. Indeed, the study of archeology technique is one of the fundamental bases of his approach. The material culture, the artifact is studied through its technique and its context which make it possible to establish the typologies, the cultures and the civilizations to which these techniques belong. So we can follow the evolution of techniques in their archaeological context. Taking into account the theory of modern and contemporary archeology, the study of techniques without being buried is an archaeological study by the approach of the technical object resulting from the creativity of man. It thus enlarges the field of study of archeology. For African societies where writing has been absent to freeze information, the buried archaeological remains and the survival of our ancient techniques not buried allows to study a history of techniques long ignored and denied. The observation of the technical facts in vivo through the objects and ethnographic facts, makes discover by the gestures, the words, the silence, the symbols, the anthropomorphization and the metaphors of the names of objects and structures, unsuspected information on the history of techniques and sciences.

Sub-Saharan Africa is full of important archaeological sites that have made it possible since the beginning of the 20th century to address important issues including the history of science and technology. Archeology is for the history and civilizations of ancient and contemporary Africa an important and essential source for the study of our societies, mostly oral. Much of the civilization of our African societies is buried under our soil and left to looting and illicit trafficking. Examples are Nok terracotta; Ife bronze statuettes, Esie stone statues in Nigeria, terracotta, bronzes and pottery of the Niger Valley in Mali, terracotta, bronzes and stone statuettes of the Bura system in Niger and Burkina-Faso, the terracotta of North Ghana and Côte d'Ivoire etc. The approach of these sites allowed largely to answer questions on the controversy of the origin of iron metallurgy, to reveal the existence of great brilliant civilizations through the approach of certain techniques, such as the gold, ceramics, iron metallurgy. We can mention the empires of Ghana, Mali etc. revealed through the approach of archaeological and historical remains. The artifacts discovered have provided very old dates that confirm the age of iron metallurgical technique in sub-Saharan Africa. Nowadays, one of the oldest dates comes from Nigeria in Taruga, 2500 BP (Aremu, 2002: 147). This archaeological research, through the approach of certain techniques, has made it possible to rehabilitate Africa's contribution to the world's technical heritage and thus to allow a better visibility of the contribution of certain African peoples to the universal scientific and technical heritage.

The archaeological and ethnographic documents thus constitute essential sources for the study of African civilizations in general and African traditional sciences and techniques in particular.

CONCLUSION

The history of science and technology of societies south of the Sahara is unknown because denied and obscured for a long time. The negation of fundamentals (science and technology) for the economic, political and social well-being of members of the same society has had real consequences for the development of science and technology in sub-Saharan Africa today. This denial has indeed led to disinterest, the lack of research and approaches to these issues. The different oral, written, archaeological and ethnographic sources nevertheless make it possible to address these themes. At the level of sciences, mathematics, geometry, astronomy etc. are known and most often govern the lives of members of society at the social and cultural level. It is time for traditional sciences and techniques to be approached and studied in order to safeguard what remains of these specific heritages, given the disappearance of traditionalists who are depositories of their knowledge, most often with their knowledge.

The approach of these questions must be done taking into account the conception of sciences and techniques in African societies. This will help to understand the specific nature of these. Sacredness and secrecy characterize science and technology in sub-Saharan Africa. Indeed, to penetrate his knowledge, initiation is often the gateway for learning, training and education, marked by a good deal of religion. The latter is omnipresent, opens and often closes the stages of science, of techniques at the level of the operating chains. The omnipresence of the sacred shows the complexity of these approaches.

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