History of Science in Non-Western Traditions: Africa

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Introduction

The history of the sciences in Africa is rich and diverse. In ancient northeast Africa, those regions such as Egypt, Nubia and Aksum that had evolved large, complex state systems, also supported a division of labor which allowed for the growth of science and the more practical technologies involved with the engineering of public works. In other parts of Africa, in the various city states, kingdoms, and empires that dominated the political landscape, science and technology also developed in various ways. The applied sciences of agronomy, metallurgy, engineering and textile production, as well as medicine, dominated the field of activity across Africa. So advanced was the culture of farming within West Africa, that 'New World' agricultural growth was spawned by the use of captives from these African societies that had already made enormous strides in the field of agronomy. In her work Black Rice, Judith Carnoy demonstrates the legacy of enslaved Africans to the Americas in the sphere of rice cultivation. We know also that a variety of African plants were adopted in Asia, including coffee, the oil palm, fonio or acha (digitaria exilis), African rice (oryza glabberima), and sorghum (sorghum bicolor). Plants, whether in terms of legumes, grain, vegetables, tubers, or, wild or cultivated fruits, also had medicinal implications for Africans and were used as anesthetics or pain killers, analgesics for the control of fever, antidotes to counter poisons, and anthelmints aimed at deworming. They were used also in cardiovascular, gastro-intestinal, and dermatological contexts. Some of these such as hoodia gordonii and combrettum caffrum are being integrated within contemporary pharmaceutical systems.

The African landscape is dotted with the remnants of walled enclosures of various dimensions in Southern Africa and West Africa. The irrigation terraces of Gwoza and Yil Ngas, Nigeria, and the earthworks of Benin are major testimonies to the engineering activities of ancient West Africans. The Benin earthworks have been estimated about 10,000 miles long by the archeologist Patrick Darling. The totality of all the irrigation terrace lines or contours in Gwoza, northeast Nigeria, may be on the order of 20,000 miles, according to researchers such as White and Gwimbe, who have done extensive work on this subject. Various architectural styles emerged in the region with a propensity for sun dried clay in the West African Sahelian region and East Africa. Obelisks, stelae, sphinxes, flat topped and peaked pyramids, walled enclosures called zimbabwes, sculptured temples, terraces and beehive, circular and rectangular dwellings, are among the wide variety of engineered structures of Africa.

After the 3rd century B.C.E., a process of cross-fertilization among the ancient Egyptians, Nubians, and Aksumites of Africa; their Mediterranean neighbors in Greece; and the Semitic peoples of Western Asia ushered in one of the most dynamic eras of scientific discovery the world has yet known. The Egyptian port city named after its Macedonian conqueror, Alexander the Great, became the locus of this extraordinary scientific energy. The Library of Alexandria, built apparently on an ancient Egyptian city, contained at its height well over a million books. While some European scholars of an earlier era categorized the remarkable scientific achievements emanating from Egypt during that period as essentially Greek, it is now apparent that the greatness of this epoch actually resulted from conjoining Northeast Africa's three thousand years of accumulated scientific knowledge with that of their ancient Greek conquerors.

It has been suggested that Egypt's first significant scientific document, the so-called Edwin Smith Papyrus, was initially written 2500 years before the Greek conquest of Egypt in 332 B.C.E. Hellenized Egyptians like Claudius Ptolemaeus, Heron, and the female mathematician Hypatia helped lay the foundations for what later European scholars came to label the "Greek sciences." This may be in part because the educated Egyptians of that later era wrote in Greek or a derivative language of ancient Egyptian called Coptic, which employed the Greek alphabet. The various papyri, most of which are named after non-Egyptian personalities and towns, ironically, are significant repositories of the ancient scientific knowledge of northeast Africa. The Edwin Smith papyrus remains a remarkable scientific treatise on surgery. Of the 48 cases described, 27 concern head injuries and 11 skull fractures. Some have posited that the classification of head wounds of Hippocrates, 460-377 B.C.E., derived from the Egyptian Edwin Smith papyrus. Egyptian medical papyri also include the Ebers Papyrus of 1500 B.C.E., devoted to cysts and boils—perhaps the first treatise on cardiology; and the Kahun and Carlsberg Papyri, primarily devoted to gynaecology, and dating back to 1820 B.C.E. and 1300 B.C.E., respectively. The Chester Beatty Papyrus of 1200 B.C.E. was primarily devoted to rectal ailments. In these various papyri, we have case titles, diagnoses and prescription, and presentation of data in an organized fashion. The reasoning used is largely inductive and experimental. From analyzing these documents, we know that their authors clearly recognized the effects on the lower limbs of brain injuries, attained familiarity with the nervous system, and indicated knowledge of the circulation of the blood. The ancient northeast Africans gave us the earliest known description of the brain.

Our word "chemistry" derives from "al-kemi." The ancient Egyptians had applied this term meaning "the black land" to themselves. We should note, however, that some contemporary scholars interpret "kemit" to refer to the dark richness of the Egyptian soil, while others suggest that the term "black" refers in this instance to the skin pigmentation of these ancient peoples. In various parts of Africa, chemical principles were applied— especially in the leather tanning and cloth dyeing sectors. Indigenous distillation systems emerged in the process of the brewing of beer and other fermented beverages in various regions of Africa.

Resources

For a general introduction to Africa and the scientific traditions of Africa, see:

Molefi Asante, *The History of Africa* (NY: Routledge, 2007).

Thomas Bass, *Camping with the Prince and Other Tales of Science in Africa* (Boston: Houghton Mifflin, 1990).

Gloria Thomas-Emeagwali, (ed.), *African Systems of Science, Technology and Art* (London: Karnak, 1993).

————————*The Historical Development of Science and Technology in Nigeria* (Edwin Mellen, 1992).

———————– *Challenging Hegemonic Discourses on Africa* (Trenton, NJ: Africa World Press, 2006).

Other supplementary texts can shed light on contemporary problems and developments. Their general focus is on non-traditional science and technology, and they therefore emphasize the variables, concepts, and criteria associated with conventional and mainstream science.

Science in Africa: Achievements and Prospects (Washington, D.C.: AAAS, 1991).

Science in Africa: Women Leading from Strength to Strength (Washington D.C.: AAAS, 1993).

J.W. Forje, *Science and Technology in Africa* (London: Longman, 1989).

Science, Technology and Endogenous Development in Africa: Trends, Problems and Prospects (UNESCO, 1987).

Sal Restivo, (ed.), *Science, Technology and Society* (Oxford: OUP, 2005).

Constance Hilliard, *The Intellectual Traditions of Africa* (McGraw Hill, 1997).

Ivan Van Sertima, *Blacks in Science* (Rutgers, 1990)

H. Selin, *Encyclopedia of the History of Science and Medicine in Non-Western Science* (Kluwer, 1997)

Many books published in Africa are available from: The African Books Collective, The Jam Factory, 27 Park End St., Oxford OX1 1HU, England; Fax: 0865-793298.

Journals , Newsletters and Web Sites

Indigenous Knowledge and Development Monitor (The Hague, The Netherlands: CIRAN/Nuffic).

African Technology Forum (Cambridge, MA: MIT Press).

AMUCHMA Newsletter (Maputo, Mozambique: African Mathematical Union, Instituto Superior Pedagogico).

www.africahistory.net: African Indigenous Knowledge Systems

www.ccsu.edu/afstudy/archive.html, Africa Update, Newsletter of African Studies at Central Connecticut State University. There is a focus on indigenous chemistry, engineering and metallurgy in volume 15.

Day 1

Astronomy, Physics and Mathematics

Africa's areas of scientific investigation include the fields of astronomy, physics, and mathematics. Laird Scranton, making use of the extensive collections of Marcel Griaule, has deepened our understanding of Malian cosmological myths and their perceptions of the structure of matter and the physical world. Dogon knowledge systems have also been explored in terms of their perceptions on astronomy. Dogon propositions about Sirius B have been discussed by Charles Finch in The Star of Deep Beginnings. The solar calendar that we use today evolved from the Egyptian calendar of twelve months, calibrated according to the day on which the star Sirius rose on the horizon with the Sun.

Scranton suggests major interconnections between the thought of the ancient Egyptians and that of the Malians of West Africa.

In the field of mathematics, the ancient Egyptians engaged in geometric problem solving considerably before the arrival of the Greeks. They incorporated in their mathematical activity numerous mathematical principles, including the principle of progressive doubling, the concept of square root, and quadratic equations. Egyptian and Nubian builders calculated the volumes of masonry and building materials, as well as the slopes of pyramids, for construction purposes. Bianchi points to a Nubian engraving at Meroe, in ancient Sudan, dated to the first century B.C.E., which reflects "a sophisticated understanding of mathematics." Included in the engraving were several lines, inclined at a 72-degree angle, running diagonally from the base of a pyramid. Bianchi suggests that the Nubian King Amanikhabale of the first century BCE was the owner of that pyramid. Interestingly, the Nubians of Meroe, who constructed more pyramids than the Egyptians, built steep, flat-topped pyramids.

The history of mathematics in other parts of Africa has been examined by the African Mathematical Union, based in Mozambique, and other scholars. Hundreds of sources have been listed, including 20th-century works of anthropologists such as Delafosse (1928), Almeida (1947), Armstrong (1962), and Cheik Anta Diop. There are historically very practical explanations for the development of mathematics in the continent. A complex system of trade developed across the Sahara and with Asia, based on commodities such as gold and gold dust, kola nuts, leather items such as bags, and various types of textile. For African Muslims, the calculation of inheritance and the distribution of Zakat necessitated mathematical accuracy. Some indigenous systems of calculation were decimal (based on ten), while others were vigesimal, based on twenty, such as the Yoruba system. Distinctions were made between prime numbers and multiples that contained other numbers. Various symbols evolved to represent various quantities, fractions, etc. Much of what we know about African systems of logic is manifested in games of strategy such as mancala and ayo, games of alignment, and puzzles. The major sources for studying mathematics are archaeological relics, such as the Ishango Bone of the Congo with pattern of notches etched onto it, and oral tradition in the form of riddles, proverbs, and narratives. Paulus Gerdes has done a great deal of work analyzing sand drawings, as well as basketry, to decipher some of the underlying mathematical underpinnings. Ron Eglash has pointed out that traditional African settlements as well as coiffure and hair braiding, tend to reflect fractal structures, in his words, 'circles of circles of circular dwellings, rectangular walls enclosing ever-smaller rectangles, and streets in which broad avenues branch down to tiny footpaths with striking geometric repetition.'

Student Reading

Claudia Zaslavsky, *Africa Counts: Number and Pattern in African Culture* (Brooklyn: Lawrence Hill, 1979), Chapters 1-3.

Sal Restivo, (ed.), *Science, Technology and Society* (Oxford: OUP, 2005).

Extended Reading

Paulus Gerdes, *Explorations in Ethnomathematics and Ethnoscience in Mozambique* (Mozambique: Instituto Superior Pedagogico, 1994).

Paulus Gerdes, *Sona Geometry from Angola – Mathematics of an African Tradition* (Monza, Italy: Poliometrica Scientific Publisher, 2006).

SIPATSI: Technology, Art and Geometry in Inhambane (Mozambique: Instituto Superior Pedagogico, 1994).

Richard Gillings, *Mathematics in the Time of the Pharoahs* (New York: Dover, 1982).

Gay Robins and Charles Shute, *The Rhind Mathematical Papyrus: An Ancient Egyptian Text* (New York: Dover, 1987).

Paulus Gerdes, "On Mathematics in the History of Sub-Saharan Africa." *Historia Mathematica*, 21 (1994): 345-76.

J.W. Forje, *Science and Technology in Africa* (London: Longman, 1989).

Robert Steven Bianchi, *Daily Life of the Nubians* (Westport, Connecticut, 2004).

Laird Scranton, *The Science of the Dogon: Decoding The African Mystery Tradition* (Rochester, Vermont, 2006).

Hellen Verran, *Science and an African Logic* (Chicago, University of Chicago Press, 2001).

Charles Finch, *The Star of Deep Beginnings* (Georgia: Khenti, 1998).

Ron Eglash, *African Fractals* (NJ: Rutgers University Press, 1999).

Ron Eglash: African Fractals in buildings and braids (in video format), 2007: www. TED.com

http://www.math.buffalo.edu/mad/Ancient-Africa/index.html

Mathematicians of Africa and the African Diaspora.

Day 2

Medicine

Some common patterns and trends in medicine emerged across the continent. These included scientifically proven methods, as well as techniques and strategies which were culturally specific and psychologically significant. Among the common principles and procedures were hydrotherapy, heat therapy, spinal manipulation, quarantine, bone-setting and surgery. Incantations and other psychotherapeutic devices sometimes accompanied other techniques. The knowledge of specific medicinal plants was quite extensive in some knigdoms, empires, and city states such as Aksum, Pharaonic Egypt (in the Northeast), and Borgu (in Hausaland). The latter continues to be well known for orthopedics (bone-setting), as is the case of Funtua in Northern Nigeria. Many traditional techniques are still utilized in some areas. Others have undergone change over time, have been revived in more recent periods, or have fallen into oblivion.

In Northeast Africa, numerous documents were written in Geez, Amharic, and hieroglyphics. These contain thousands of prescriptions for a wide range of diseases. The Edwin Smith Papyrus is useful for the Pharaonic Egyptian era, as earlier discussed. Unfortunately, scholars have been unable to decipher the Nubian Meriotic script. Oral tradition in conjunction with texts written in Arabic constitute the main sources of information on West Africa. CICIBA of Gabon has produced several works (largely in French) on medicine in the Bantu-speaking regions of Central and Southern Africa.

Student Reading

F.P.A. Oyedipe, "Science in the Metaphysical Aspects of Yoruba Traditional Medicine," in *African Systems of Science, Technology and Art*, G. Thomas-Emeagwali, (ed.) (London: Karnak, 1995), Chapter 5.

Bassey Andah, *Nigeria's Indigenous Technology* (Ibadan, Nigeria: Ibadan University Press, 1992), Chapter 3.

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Abayomi Sofowora, *Medicinal Plants and Traditional Medicine in Africa* (Ibadan, Nigeria: Spectrum/John Wiley, 1985).

Keto Mshigeni, *Traditional Medicinal Plants* (Dar Es Salaam: Dar Es Sallam University, 1991).

Z.A. Ademuwagun, *African Therapeutic Systems* (Los Angeles: Crossroads Press, 1979).

Sandra Anderson and Frants Staugard, *Traditional Midwives* (Gaborone, Botswana: Ipelegeng Press, 1986).

Cyril P. Bryan, (trans.), *Ancient Egyptian Medicine: The Papyrus Ebers* (Chicago: Ares Press, 1974).

Pascal James Imperato, *African Folk Medicine: Practices and Beliefs of the Bambara and Other Peoples* (Baltimore: York Press, 1977).

Day 3

Microbiology and Food Processing

Indigenous fermented foods in Africa have usually been derived from cassava tubers, cereal legumes, oil seeds, palm tree sap, milk, and various other local products. The scientific basis of indigenous food fermentation lies in the nature of the microorganisms involved in fermentation; the microbially induced changes of the base product; the nature of the enzymatic reactions which take place; and the specific nature of the end product in terms of nutritional and preservative qualities. A scientific process should be repeatable and open to scrutiny in such a way as to facilitate evaluation and perhaps further experimentation and research. Common to various parts of the continent are dehydrated granular food products that involve fermentation, frying, and dejuicing, or products such as sorghum, maize, or other cereals that may be fermented and made into alcoholic beverages. Food processors became aware of the significance of the various agencies by virtue of trial and error experimentation. Metallic objects have sometimes been used to hasten fermentation and in this case serve as trace elements, thus promoting the growth of the relevant microorganisms.

African civilization may be associated with specific methods of preparing and even consuming food items in ways that tend to reflect some measure of uniformity throughout the continent. Fast food items ranging from couscous to "qari," or cassava granules, various types of cereal-based flour, pulverized tubers of various kinds, and a wide variety of vegetable-based soups all give African cuisine a distinct character. It must be stressed that food preparation involves hypothesis formulation, the assumption of regularity in nature, and a measure of logical and predictive capability on the part of the food processor or agent associated with food preparation.

This seems to be an under-researched issue, in need of collaborative work among historians and microbiologists, nutritionists, and sociologists. Some work in this area has been done by Richard Okagbue, formerly of the University of Zimbabwe. Sources of information for culinary trends include: excavated sites; motifs on sculpture, carvings, and textile; oral history narratives, proverbs, popular literature, poetry, and incantations; travel reports, such as that of Ibn Battuta; research in African/Carribean and African-American culinary patterns for example, revealing pervasive use of gumbo, black-eyed peas, and cowpeas- and indigenous writings in Arabic (for example, the Abuja Chronicles).

Student Reading

Richard Okagbue, "Microbiology and Traditional Methods of Food Processing," in *The Historical Development of Science and Technology in Nigeria*, G. Thomas-Emeagwali, (ed.) (Edwin Mellen, 1992).

Hamid Dirar, *The Indigenous Fermented Foods of the Sudan* (Wallingford, UK: CAB International, 1992).

Extended Reading

Bassey Andah, *Nigeria's Indigenous Technology* (Ibadan, Nigeria: Ibadan University Press, 1992).

Africa Update. Vol. X1V. Issue 4 (Fall 2007) – Nigerian Indigenous Chemistry (www.cdcsu.edu/afstudy/archive.html)

Judith Carney, *Black Rice, The African Origins of Rice Cultivation in the Americas* (Cambridge, Mass., 2001).

Day 4

Metallurgy

Various types of metal products have been used over time by Africans, ranging from gold, tin, silver, bronze, brass, and iron/steel. The Sudanic empires of West Africa emerged in the context of various commercial routes and activities involving the gold trade. In the North and East, Ethiopia and Sudan were the major suppliers of gold, with Egypt a major importer. In Southern Africa, the kingdom of Monomotapa (Munhumutapa) reigned supreme as a major gold producer. In the various spheres of metal production, specific techniques and scientific principles included: excavation and ore identification; separation of ore from non-ore bearing rock; smelting by the use of bellows and heated furnaces; and smithing and further refinement.

The use of multishaft and open-shaft systems facilitated circulation of air in intense heating processes, while the bellows principle produced strong currents of air in a chamber expanded to draw in or expel air through a valve. The various metal products served a wide range of purposes, including: armor (as in some northern Nigerian city-states), jewelry (of gold, silver, iron, copper and brass), cooking utensils, cloth dyeing, sculpture, and agricultural tools. The technical know-how and expertise of blacksmiths helped to enhance their status, although they were also often associated with supernatural and psychic powers, as well.

Student Reading

Fred Anozie, “Metal Technology in Pre-colonial Nigeria,” in *African Systems of Science, Technology and Art*, Gloria Thomas-Emeagwali, (ed.) (London: Karnak, 1993), Chapter 7.

Bala Achi, “Engineering in Pre-colonial Nigeria: The Construction of Fortifications,” in *African Systems of Science, Technology and Art*, Gloria Thomas-Emeagwali, (ed.) (London: Karnak, 1993), Chapter 9.

Extended Reading

Bassey Andah, *Nigeria’s Indigenous Technology* (Ibadan, Nigeria: Ibadan University Press, 1992).

Peter R. Schmidt, *Iron Technology in East Africa: Symbolism, Science and Archaeology* (Bloomington: Indiana University Press, 1997).

I. Van Sertima, *Blacks in Science* (NJ, Transaction Books, 1992).

Video

Tree of Iron — shows steel making by the Bahaya of Tanzania.

Day 5

Textile Manufacturing

Skill and expertise developed in various parts of the continent in terms of the making of yarn, weaving pit or pot dyeing and various activities associated with cloth-making. Over time evolved vertical and horizontal looms, vertical frames on which the beams were tied, supportive items for the cross-pieces or beaters and shedsticks, shuttles and other technical devices, and vegetable dyes of various colors. Women played a major role in this area of material culture, as in food processing. In textile production, product design and the invention of innovative techniques largely derived from females. In more recent times, with the introduction of capital intensive technology, women have been pushed aside, from some activities that they once dominated. Generally, the raw materials used in textile included camel hair, wool, flax, raffia palm, and cotton. Flax was commonly used in Egypt, while cotton from indigenous species and raffia palm were common to various parts of West, Central, and Southern Africa. Silk cloth was produced in Western and Central Nigeria, as well as other places, though less extensively. Some city-states and empires became famous for particular types of cloth and product design. Akwete, Ilorin, and Okenne, for example, gave their names to the cloth produced in their regions. Textile technology has not been static, and over time interacted with the prevailing value systems to facilitate communication. Ideas, emotions, attitudes, beliefs, and political philosophy were symbolized in specific ways by the use of a diverse range of motifs. Sotiba (Senegal), Kente (Ghana), Adinkra (Ivory Coast and Ghana), Sanyan, a silk based fabric made in western Nigeria, Adire (starch resist fabric) and Aso Olona, title cloths of the Ijebu, are some of the various types of indigenous African cloth. Knowledge about textiles spread from travel reports, for example, Mungo Park in Ivory Coast, Cadamosta in Senegambia, Bailie in Nigeria and much earlier, Herodotus in Egypt. Missionary reports, autobiographies such as that of Equiano of Nigeria, archaeological sites such as Igbo-Ukwu, Nigeria or the 11th-century Bandiagara Cliffs in Mali, and oral tradition have been useful repositories of information on African textiles.

Student Reading

African Technology Forum, Vol. 7, No. 2 (1994).

Extended Reading

T. Picton and J. Mack, *African Textiles* (London: British Museum, 1991).

J. Gillow, *African Textiles* (London, 2003).

Olayemi Akinwumi, et al. *African Indigeneous Science and Knowledge Systems: Triumphs and Tribulations, Essays in Honor of Gloria Thomas Emeagwali* (Nigeria, *Abuja*: Roots Books and Journals, 2007).

Day 6

Engineering and Building Technology

In various parts of ancient, medieval, and contemporary Africa, building constructions of various dimensions, shapes, and types emerged, reflecting various concepts, techniques, raw material preferences, and decorative principles. Builders integrated the concepts of the arch, the dome, and columns and aisles in their constructions. The underground vaults and passages, as well as the rock-hewn churches, of Axum are matched in Nubia and Egypt with pyramids of various dimensions. In the Sahelian region, adobe, or dried clay, was preferred in the context of moulded contours, at times integrated with overall moulded sculpture. Permanent scaffolding made of protruding planks characterized the Malian region. The principle of evaporative cooling was integrated into building design. Mats were used as part of the decor and also to be saturated repeatedly in order to cool the room.

Derelict ruins from walled cities—such as Kano, Zazzau, and other city-states of Hausaland in the central Sudanic region of West Africa—complement structures such as the rock-hewn and moulded churches of Lalibela in Ethiopia or the Zimbabwe enclosures. The structures of ancient Nubia, as well as those of Egypt, are parallel structures in the northeast. It is possible to see these ruins through various video productions now available. One may also find eyewitness accounts and sketches, such as those by Rene Caille and Henrich Barth.

Student Reading

Bassey Andah, *Nigeria's Indigenous Technology* (Ibadan, Nigeria: Ibadan University Press, 1992).

P.J Darling, *Archaeology and History in Southern Nigeria: The Ancient Linear Earthworks of Benin and Ishan* (Cambridge Monographs, 1990).

Africa Update. Vol. XV. Issue 2 (Spring 2008) – African Engineering: Terraces and Earthworks

(www.ccsu.edu/afstudy/archive.html)

Extended Reading

Graham Connah, *African Civilisations* (Cambridge: Cambridge University Press, 2001).

Webber Ndoro, "The Great Zimbabwe," *Scientific American*, 277 (Nov., 1997): 94-99.

Peter Garlake, *Early Art and Architecture of Africa* (Clarendon: Oxford University Press, 2002).

Video: Tubali: Hausa Architecture of Northern Nigeria (Ogbuide Corporation).

Possible Topics for Student Research

1. Agronomic techniques and new crops taken by West Africans to the Americas.

2. African crops such as the oil palm, coffee and sorghum and their impact on Asia.

3. Herbal medicines selected for treatment of illnesses in various African regions.

4. The holistic African model of illness and disease.

5. Traditional surgical procedures and techniques in various parts of Africa.

6. Engineering and architectural skills in the building of the Egyptian and Nubian pyramids.

7. Ethiopian sculptured temples such as the Lalibela Churches of the 13th century.

8. Regions of ancient West Africa which developed indigenous suspension bridges .

9. Comparison of the ancient architectural styles of West Africa with that of Southern Africa.

10. African irrigation terraces in any two regions of West Africa.

11. Elements of modern calendar derived from the Egyptian calendar.

12. African cosmological thought permeating the culture and religion of

various city states, kingdoms and empires.

13. The naming of constellations by the Ancient Malians.

14. Techniques of counting and calculation in African societies.

15 The vigesimal system in Yoruba mathematics.

16. Indigenous metallurgy with respect to iron and steel in East Africa..

17. Role of women in the production of West African textiles such as adire, sanyan, adinkra and kente.

18. Food processing techniques and indigenous fermented beverages

19. Perceptions of time and space in various parts of Africa.

20. Five scientific works authored by 19th century scientists.

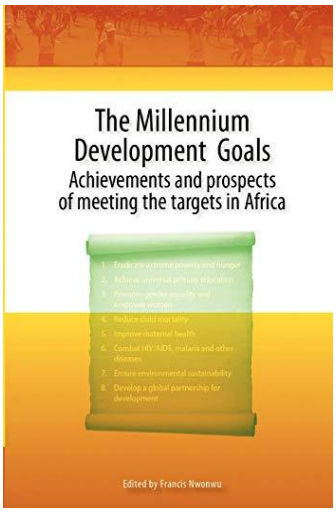
21. Interconnections between religion and science in West Africa.

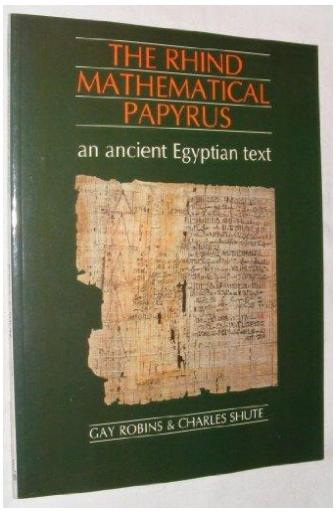
22. Biographical notes on Nigerian scientists such as the mathematician Chike Obi.

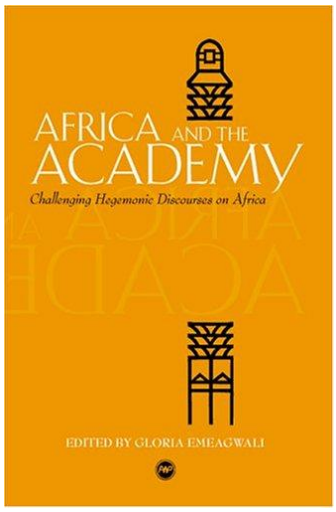
23. Comparing the aggregate mileage in ancient West African terraces and earthworks.

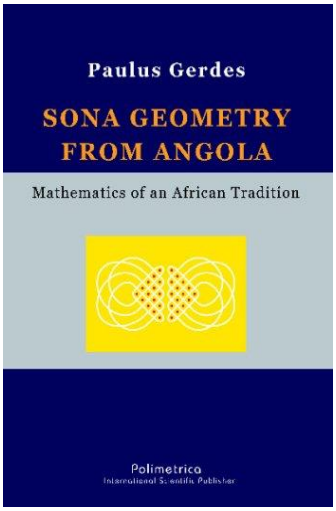
24. Intellectual property rights and African indigenous practitioners.

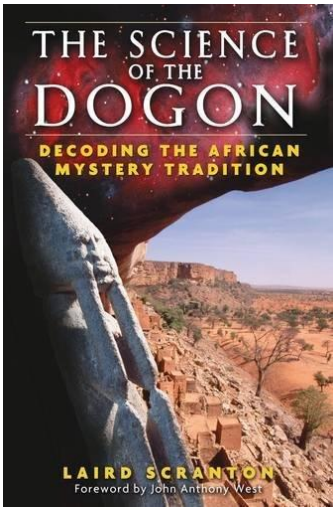
Some Titles Mentioned Above

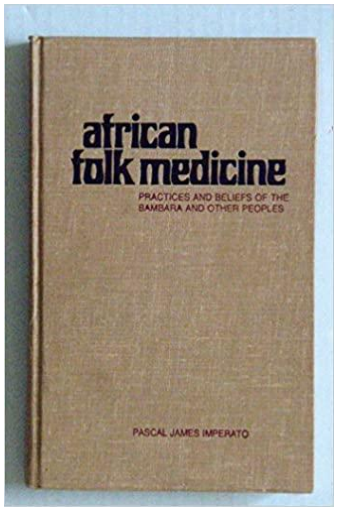


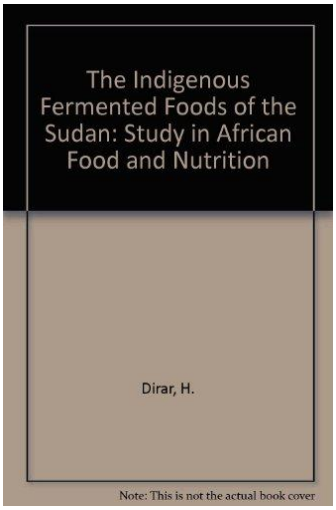


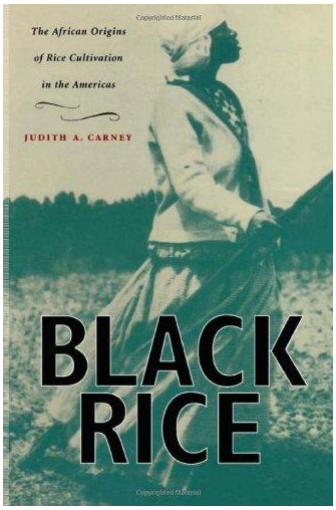


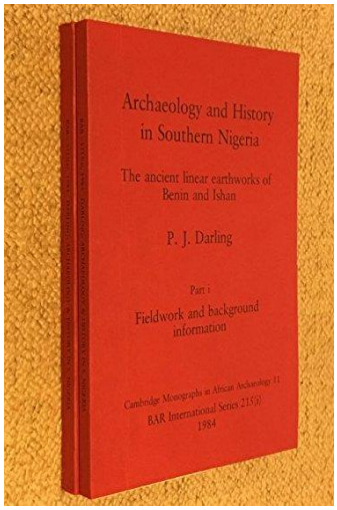







The Indigenous Fermented Foods of the Sudan: Study in African Food and Nutrition
Dirar, H.
Note: This is not the actual book cover


The African Origins of Rice Cultivation in the Americas
JUDITH A. CARNEY
BLACK RICE


Archaeology and History in Southern Nigeria
The ancient linear earthworks of Benin and Ishan
P. J. Darling
Part i
Fieldwork and background information
BAR International Series 215(i)
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