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THE PLACE OF AFRICAN INDIGENOUS ECOHUMANISTIC TECHNOLOGICAL WORLDVIEWS AND PRACTICE IN CONTEMPORARY SOCIETY

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Abstract

African indigenous technology is largely humanistic in its characterization. Although it may appear archaic and incompatible with the demands of contemporary techno-science, which is more ruthless and domineering in its attempt to enable humans to comprehend the secrets of nature, it nevertheless possesses the eco-humanistic potentials that can make the continent a powerhouse in modern eco-humanistic technological development. Evidence can be drawn from African indigenous metallurgical technology. This work aims to investigate elements of 'homegrown' neglected metallurgical systems, using the Yoruba and Igbo cultures in Nigeria as paradigms. A salient question in this study is: How can Africa contribute to the global circulation of eco-humanistic technological development? Focus shall be on the indigenous metallurgical achievements of the aforementioned African cultures. A critical hermeneutic and analytic method is adopted here to help understand the issues that the paper deals with. It enables us to identify indigenous metallurgy as capable, if properly harnessed, of instigating Africa's authentic drive for eco-humanistic technological development. A key finding of this study is the exposition of relatively unexplored aspects of indigenous metallurgy, and harnessing the same for the much-desired technological breakthrough in Africa. Consequently, the research recommends that genuine development in Africa must factor in the infrastructure of home-grown metallurgical systems, which can enable it to contribute to global eco-humanistic technological development.

Keywords: Africa, ecology, humanism, indigenous, technology, worldview, society.

Introduction

Technology in its modern sense cannot be discussed without mentioning science, as they have become intertwined and in a mutually progressive or beneficial relationship in the interest of humanity. Although technology predates science, its marriage with science has not only led to greater advances in human knowledge but also made life a lot easier for the generality of the human race. Science has helped to take technology to its present apogee. They have both enabled humans to conquer and dominate nature and their environment. Using technology, human beings now have dominion over the sky, the earth, and everything it contains, including the oceans. On the other hand, through the process of technology transfer, the scientific enterprise has enabled the benefits of technology to be felt and enjoyed worldwide.

Furthermore, there is no doubt that technology is a highly desirable thing for a modern nation to possess. However, it has both positive and negative effects on human society. Its positive effect is glaring in its astounding practical achievements, such as improvement in the human ability to meet the three basic needs (food, shelter, and clothing), modern

communication gadgets, improved, quicker, and comfortable transportation systems, health, and modern entertainment systems, among others. Yet, the development of destructive weapons and increasing environmental issues mark an ironic epoch in scientific and technological advancement. Rather than lead to a period of social peace and general improvement of humankind, it marks an era of unprecedented violence and human destruction (Makinde, 2011). Hence, the need for an eco-humanist approach from the perspective of an African indigenous technological development paradigm.

Significantly, indigenous scientific and technological systems in Africa is disparaged because of their inability to send humans to the moon, build airplanes, and generate practical results comparable to the technological feats which inform modern science. This work shall demonstrate that Africans are not completely bereft of such knowledge, though a case can be made that excessive secrecy and reverence and awe for the inner workings of nature hampered their quest for knowledge and its practical application. Consequently, the onus now lies on contemporary African philosophers, scientists, and technologists to make the continent a genuine contributor to the advancement in modern science, of course, especially, through the 'circulation of technology'. However, P. Houtondji (1995) has repeatedly admonished that, in the field of knowledge, Africans are faced with a two-fold task:

> First, we have to appropriate, assimilate and make entirely ours, with lucidity and critical mind, the international heritage now available including the very process of scientific and technological innovation. Secondly, after assessing, testing and updating, we need to re-appropriate our own ancestral heritage and the creativity, adaptability and ability to innovate that made our ancestors what they were.

While recognizing the limitations of homegrown scientific and technological practices, it does not follow that they are completely bereft of scientific value, or that they cannot be creatively harnessed to solve practical problems. It is our task as scholars to identify and examine indigenous African technological systems that can meet up of global circulation. A critical hermeneutic and analytic method is adopted here to help understand the issues that the paper deals with. The writer acknowledges that although there are a handful of ways to promote African indigenous technology, the focus of this paper is on indigenous metallurgy, which is drawn from the Yoruba and Igbo cultures. It is argued here that, if properly harnessed, indigenous metallurgy can enable Africa to contribute to global eco-humanistic technological development, as well as overcome some of its socio-economic challenges. At this junction, a clarification and analysis of some important concepts used in this paper is germane.

Conceptual clarifications and analysis

Science is the world's most successful means of knowledge creation, of understanding the relationships that govern the material world. Contemporary science, by all standards, is the most vigorous force behind the development of all societies. As a form of knowledge, it deals exclusively with arguments based on empirical evidence and theories about the relationships between material objects (Chalmers, 1998; Rosenberg, 2005; Sweetman, 2010). Scientific propositions are usually testable and subject to rejection based on empirical observations. The results of science, scientists insist, must be subject to independent verification by others.

Finally, the well-tested and enduring theories of science allow scientists to make limited predictions. These properties are unique to science (Clegg, 2015).

Now, science, in its applied, practical, utilitarian, and durable manifestation, is known as technology, which itself involves the purposeful application of knowledge, experience, and resources to create processes and products that meet human needs. Interestingly, Adeoye Blessing (2011) observes that "the needs and wants of people in particular communities determine the technology that is developed and how it is applied". In this vein, M.A. Makinde (2007) aptly perceives it as 'appropriate technology'; which is a technology for development and self-reliance, and a precursor for our much vaunted 'circulation of technology'. A salient question is, can the African continent boast of appropriate kinds of technology for development and self-reliance good enough for the 'circulation of technology'? Stated differently, can Africa's indigenous technology be capable of being circulated globally?

Now, scientific and technological accomplishments of indigenous communities in Africa constitute cultural knowledge (Sefa, 2012), sometimes referred to as 'traditional' ecological knowledge (TEK), OR African indigenous knowledge systems (AIKS), or simply, indigenous knowledge (IK) (Idoko, 2012; Kaya, 2013). The word 'indigenous' refers to specific groups of people defined by ancestral territories, collective cultural configuration, and historical locations (Dei, 2002; Owuor, 2007).

In this context, indigenous knowledge is a multifaceted body of knowledge, practices, and representations that were developed and sustained by peoples with long histories of close interaction with the local natural environment. The term 'indigenous', therefore, denotes that the knowledge is typical and belongs to people from specific places with common cultural and social ties. Thus, indigenous knowledge is a process of learning and sharing skills, social life, histories, identities, economic, and political practices unique to each cultural group. It reflects the uniqueness of ways that specific societies make meaning of the world and how such forms of knowledge address local problems and solutions that are context-specific. In this work, indigenous knowledge is framed as the complex set of activities, values, beliefs, and practices that have evolved cumulatively over time and are active among communities and groups who are its practitioners. It remains so as long as the practitioners are committed to sustaining, creatively developing, and extending its potential enrichment within a specific setting. Interestingly, it is judged from the beliefs and practices of indigenous Africans, the relationship between them and nature tilts more towards humanism. Its culmination is now what scholars as M.O. Ikeke (2015), among others, referred to as African indigenous eco-humanistic technological (AIEHT) development.

Ecohumanism is a derivative of humanism, which itself requires a brief illustration to put it in proper perspective. Udo Etuk (1999) defines humanism as "a philosophy of joyous service for the greater good of all humanity in this natural world and advocating the method of reason, science, and democracy". In humanism as a doctrine, man is seen as the means and an end, the subject and the predicate of knowledge. Limitations to man are temporary, as there is no limit to what man can know or do. Humanism sees man as a creative, multi-talented, and multifaceted being, as confirmed in his exploits in science and technology. According to M. Dukor (2009), humanism is very current in the philosophical field and various thinkers and writers use it in different shades of meanings. One of such meanings is 'eco-humanism' as applied in the context of this paper to African indigenous technological development.

The term 'eco' refers to a part of the world, especially the physical or material world, in which humanity thrives. Eco-humanism is concerned with a holistic and interdependent relationship between humans and nature. Its emphasis is on 'both humanity's inherent value, including its role as a life form, along with an ethical stewardship over earth' (M.H. Javed et al, 2025). In eco-humanism, humans are considered close to nature and promote ethical

stewardship and community-based sustainability efforts. It is a response to traditional humanism as well as modern development paradigms that prioritize humans over nature. It insists that technological solutions must not bypass ethical considerations without community consultation. The point is that human-centred ethics combined with technological innovation constitute a viable way forward towards sustainable development in our contemporary society. What, thus, do we understand as contemporary society?

Following the *Cambridge Dictionary* (2025), society pertains to a mass of people who live together in an organized way, making decisions about how to do things and sharing the work that needs to be done. All the people in a country, or in several similar countries, state, or communities, can be referred to as a society. On the other hand, contemporary is concerned with 'existing or happening now, and therefore, appears modern. For instance, contemporary music such as hip hop and afro-beats. Consequently, conjoining both words, contemporary society refers to the social architectures, cultural norms, economic conditions, as well as technological advancements (such as the internet and AI) that characterize the present age. It reflects the ongoing transformations within communities, influenced by technological advancements, globalization, and changing social dynamics.

Emphatically, technology derives from the Greek word *techne,* meaning "art", "craft", while logos means "the study of". Thus, technology means the study of the actual tools and artifacts which men use in daily activities to manipulate nature and their environment for their needs, wants, and pleasures. Technology transfer has been seen as the process by which commercial technology is disseminated (UNCTAD, 2005). This takes the form of a technology transfer transaction, which may or may not be covered by a legally binding contract (Blakeney, 1989, p.136), especially among countries within the international community. Thus, international technology transfers or diffusion refers to the process by which a firm in one country gains access to and employs technology developed in another country. N. Foster (2012) admits that some transfers occur between willing partners in voluntary transactions, but much comes through non-market transactions or spillovers. Technology flows across borders through several formal and informal channels. One of such is trade in goods and services, with imports having the potential to transfer knowledge through reverse engineering, but also through the cross-border learning of production methods, product design to mention a few. This process is also known a technology diffusion.

Furthermore, technology transfer is the movement of technical and organizational skills, knowledge, and methods from one individual or organization to another for economic purposes (Klimczuk and Kochanska, 2015). This process usually involves a group that possesses specialized technical skills and technology that transfers it to a target group of receptors who do not possess those skills and who cannot create that technology themselves. Klimzcuk and Kochanska (2015) also identified several types of technology transfer (which for space and time constraints, we shall not dwell on here).

In the context of this work, technology transfer is simply about the relationship between a giver and a receiver of techno-scientific ideas. The giver refers to the advanced techno-scientific nations who wish to transfer such knowledge. On the other hand, the receiver refers to countries especially in the African continent interested in receiving techno-scientific knowledge from the advanced countries. Now, while the receiver desires technology for the sake of material progress, modernity, and prosperity, the donors (receivers) are not interested in such improvement in fortunes for fear of competition be it in economy or in techno-scientific development. The fact is that, the givers might lose markets for the finished technological products if the receivers are allowed access into the industry. For instance, it is obvious that some developed countries are not interested in Nigeria having its steel mills, to make the country a dumping ground for imported steel products. Moreover, also diabolic is the fact that

some myopic and corrupt African rulers are not interested in the scientific and technological growth of the country. It's even worse with talks of 'circulation of technology', which can help resuscitate the local and indigenous metallurgy.

Importantly, also, the technology that suits one environment may not suit the other. There can even be differences between environments within a country, and the different ways that people respond to it. Hence, it is necessary to compare and identify the systems vis-à-vis the environment, to make sure the technology is appropriate to both the people and that its environmentally compliant. It is against this background that Makinde (2007) has suggested that rather than opt for 'transfer of technology', Africa should talk of 'circulation of technology'. The latter grants the existence of the hope that Africa 'someday may use borrowed ideas from the advanced countries to develop their own techno-scientific capabilities to meet her needs as well as contribute to innovative ideas that will advance the growth of technology, as successfully done among the Asian tigers.

Now, granted that most technologies in Africa are imported, and only a small fraction is produced locally. Can such locally produced products, which are sometimes the product of indigenous technological systems, be recognized and accepted globally for the sake of durability and efficiency? In other words, how would the circulation of technology be beneficial to Africans?

Concerning the foregoing question, it should be noted that the idea of the circulation of technology, as argued thus far, recognizes the flow of technology from one nation to another, like the dissemination of technology. This is aptly seen with, for instance, the flow of technology from America to Japan and China, which may later flow back to America with an innovation provided by the Japanese and Chinese through their native scientific intelligence, or what we here referred to as indigenous technological knowledge. Following the Japanese and Chinese examples of the past decades, it's plain to see that it has led to further scientific and technological innovations. It is therefore not a case of dumping technology as a finished product on a nation without the receiver contributing its quota and sending it back in an advanced form. Hopefully, in a similar manner, the circulation of technology would be beneficial to Africans as it would encourage further growth of science and technology and, eventually, competition, which in turn enhances further growth or advancement in both areas. What is therefore needed is for Africans themselves to go beyond mere importation of technology by using their indigenous scientific and technological intelligence as Japan and China did, to acquire particular kinds of technology relevant to their needs and not in conflict with their eco-humanist orientations.

In the foregoing connection, M. P. Soma (1999) avers that:

> Technologies in the indigenous world…include the world of spirit…indigenous technology is accomplished…by a dynamic interplay among the mind, emotion, spirit, and senses of the human body on the one hand, and the natural world on the other. Indigenous technology concerns not only the material world but extends to and grows out of our interaction with spirit; it is the embodiment of our relationship with spirit.

But then, one may wish to know if at all, Africa has anything to offer to the current pool of global technological advancement. The answer we believe is in the affirmative. D.I.O. Anele (2002) has asserted that "every culture, every race, has contributed something to the corpus of scientific knowledge as we have it today". Humanity is bestowed with the capability to thirst for knowledge as well as the physical and mental equipment for its acquisition and transmission to future generations. Moreover, there are pieces of evidence that Africans in the traditional setting provided serviceable answers to the questions of ethics, religion, politics, art, philosophy, science, and technology from diverse perspectives. Although questions may be

raised as to whether the result of such activities can be classified as science in the modern sense. Once again, it is reiterated here that it is the task of concerned African scholars to identify, examine, and extrapolate from the available indigenous resources, which can help contribute to their goal of the circulation of technology.

Nevertheless, African indigenous technological systems cannot be exempted from the historical, philosophical, and anthropological evolution of science. What may be lacking, however, is 'Scientific consciousness', which is that cognitive state that equips Africans with the capability of constantly evaluating and assessing their capability to improve their material and immaterial living conditions on earth. Thus, it is contended here that what is referred to as indigenous science must pass the requirements of sound explanation, deductive connections, and predictive power for it to graduate to 'Science' proper. It is by so doing that an atmosphere for the circulation of technology can take place.

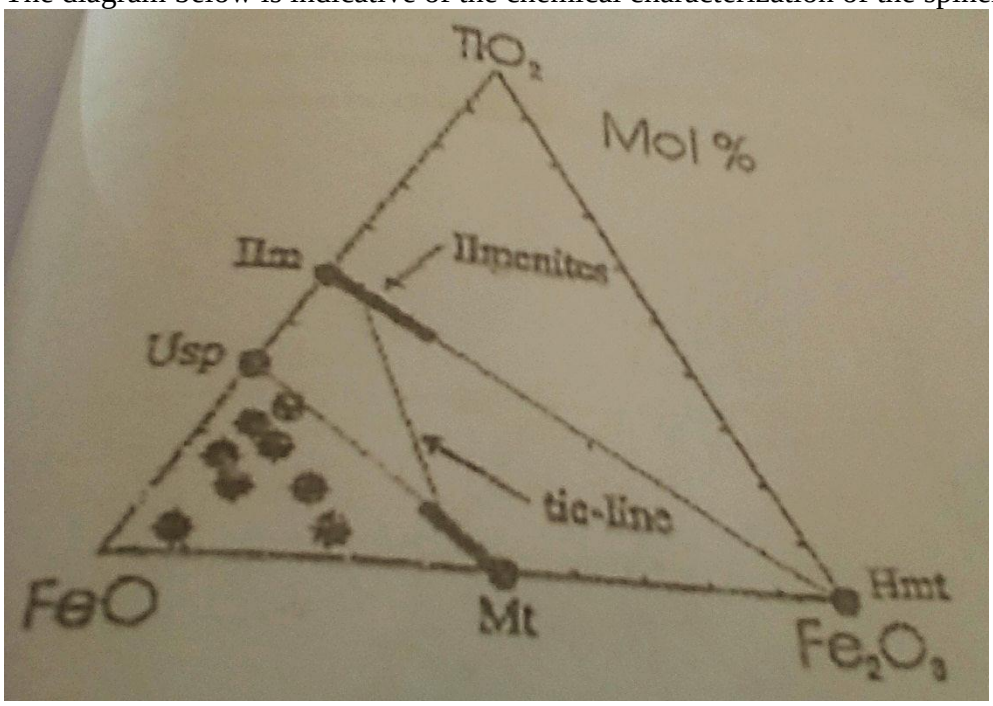
Using indigenous metallurgy to promote African indigenous ecohumanistic technology

Science and technology are convivial in the development of human civilization, although the latter is older than the former by thousands of years. Advancement in human civilization really began with the discovery of fire; it was given a tremendous boost by the invention of metallurgy, which itself is simply concerned with the multiple processes involved in extracting metals from their ores and refining them for utilitarian purposes. Such scientific and technological processes were not particularly absent in indigenous Africa. Thus, it is apropos to briefly peruse the technology of iron and bronze metal working of the ancient Yoruba and Igbo cultures.

Frank Willet, according to Abosede Emmanuel (2000) writes that "the phase of transition from a stone-using to an iron-using economy is one of the most interesting periods in Nigerian pre-history". For the Yoruba, the use of iron was discovered between the years 300 BC to 500 BC. This Iron Age compares favourably with some technologies in ancient India and China. Ifaology (a term coined by Makinde about the study of Ifa the philosophy and science of indigenous Yoruba spirituality) has it that Orunmila, the founder of Ifa divination system as it is known today, had this message from Olodumare (a greater deity). " Just as an iron crashes on earth, reverberating with ominous sound. So, you will discover the importance of this matter. When it ends, not when it begins…"

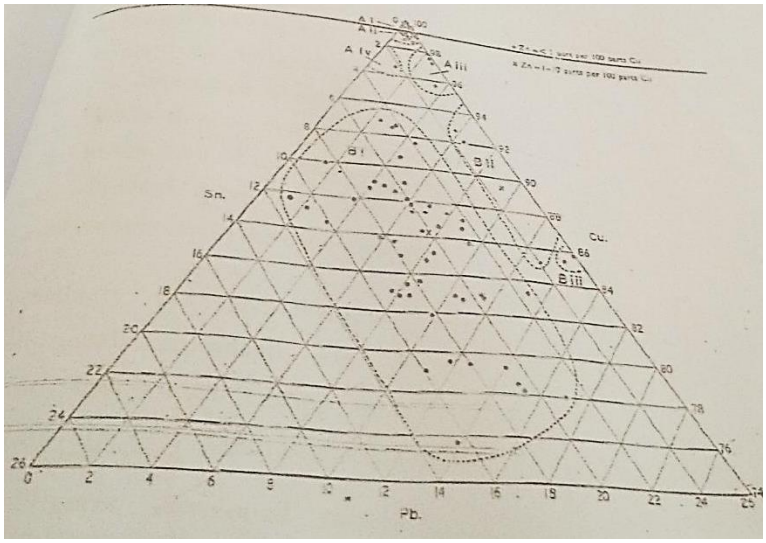
The import of this message to us is first, the early appreciation of iron in Yoruba history, and secondly, its appreciation and importance to their everyday life. Lastly, it is a pointer that metallurgy and by extension, technology was not alien to Yoruba history. Excavations at several locations in Yoruba land have revealed what may be one of the oldest known iron smelting sites in the world.

The diagram below is indicative of the chemical characterization of the spinel in slags
DIAGRAM 1
The diagram below is indicative of the chemical characterization of the spinel in slags



Source: O. A. Ige (2003)
Key
Fe-Iron
FeO- Iron-Oxide
TiO-Titanium-oxide

From the diagram above, mineralogical and chemical analysis of slags and ores from such ancient smelting sites show that the slags consist essentially of olivine and spinel in a glass matrix (Ige, 2003). Chemical analysis shows that most of the iron has been extracted, a sign of high efficiency of the furnace used (Fe2O3 about 55%). Radivojevic (2010) asserts that the extraction of iron from its ore into workable metal is much more difficult than for copper or tin. Experts in materials and metallurgical engineering (Apley, 2001; Radivojevic, 2010) also agree that the furnaces were used for iron smelting, and the remains cover most of the technical steps one would find in that process. According to Ige, the absence of wusite as a mineral phase in the slags is an indication of high efficiency of the furnace used. This, in other words, is comparable to what obtains even in science and technologically advanced Western countries. A case can therefore be made for the reactivation and modernization of small smelting operation as a tool for the rapid industrialization of Nigeria.
Diagram 2



Thurston Shaw (1970)

Key
Zn = Zinc
Pb = Lead
Cu = Tin
Zn =< 1 part per 100 parts Cu
Zn= 1=10 parts per 100 parts Cu

Igbo-Ukwu is a town in Anambra State of Nigeria, in the Southeastern part of the country. The town is renowned for three archeological sites, where Thurston Shaw, a famous scholar and archeologist between 1959 and 1964, excavated bronze artifacts from a highly sophisticated bronze-metal working culture believed to date back to the ninth century. Its castings of bronze or leaded bronze are believed to be among the most inventive and technically accomplished bronzes ever made. According to Shaw (1970);

> …the Igbo-Ukwu sites must surely represent something exceptional rather than something typical…. Archeological sites of this nature, while exciting and spectacular, are often harder to interpret and evaluate than a culture's more humble, more everyday productions. This is simply because the former tend to produce unique objects and constructions with which it is difficult to find parallels, whereas comparisons with large series of everyday objects are easier to find.

The point is that the Igbo-Ukwu metallurgy is in line with modern materials and metallurgical requirements. Shaw also alludes to the quality of raw materials used for the Igbo-Ukwu castings as suggestive of 'a stupendous knowledge of metallurgy'. S. Bunney buttresses the point further that '…scholars had previously looked to the Mediterranean region for the source of the metals and the casting technology, and their design, which is exceptionally sophisticated is not known from anywhere else'. The assertion "not known from anywhere else", leads one to recent studies where quantum theoretical analysis discovered that the main principle of alloy, exist in the molecular and sub-atomic level (Ritter, 2008). Physicists have also managed to make homogenous cylindrical objects completely invisible in the microwave (Rybin 1986). Thus, supporting the view that, 'there exist phenomena in nature which cannot be explained or understood with the current methods of science'. This, as well as current advances in Artificial intelligence (AI) appears to be a corroboration of Soma's earlier

mentioned position that indigenous technology is the outcome of a dynamic interplay among the mind, emotion, spirit, and senses of the human body on the one hand, and the natural world on the other.

As mentioned earlier, an analysis of the foregoing metal works is indicative of some important scientific characteristics. They include: precision, measurement, mathematics, and consistency, to mention a few. Although such salient features may fall short of modern scientific standards, they are no doubt instances of the evolutionary stages that usually occur in the advancement of scientific knowledge. A case can, therefore, be made that Africa possesses the potential and ingredients required for scientific and technological pursuit, which in the long run can instigate the process of the circulation of technology.

O.A. Ige (2003:343-351) has been able to show that indigenous metallurgy and technology can be modernized and the production subsidized so as to survive the intense competition by imported iron. He relied on locally sourced materials such as iron ore, fluxes, nickel, chromium, including fuel obtained from coal briquettes, for the production of iron and other metals. Such local raw materials, according to him, also contributed to the durability, strength, and beauty of the finished product. However, he noted that;

> The former method of visual prospecting was not always successful, as seen by the abandonment of many unproductive mines. In response, there is crucial need to reactivate the machineries of provenance studies, especially those frequently employed in geology and geochemistry: petrography, chemical and stable isotope analyses, experimental methods that ensure efficiency, reliability and economy, and the development of comparative databases for both sources and materials (Ige, 2003:350-351).

Citing metallurgy in Igboland as a corroboration of the foregoing, S.U. Osuala (2012) has it that;

> The beginning of blacksmithing in Nkwerre-land, was hazardously disorganized. With the advent of time, the art expanded and underwent changes for the better…Since there was no knowledge of coal at the time, it was not strange that the smiths used *icheku* (charcoal derived from African oil bee) to generate heat. Armed with all these tools and knowledge, Nkwerre smiths were able to practice their craft skillfully.

This, by implication, means that indigenous technology can be adapted to modern science and technology if and only if, the prerequisites are properly handled. In fact, the analyses of Ige's works were said to have been carried out at the Institute of Archeology, University College London by reputable scholars and experts in metallurgy and archeology.

The analysis of the metal works in diagram 1 and diagram 2 is indicative of some important scientific characteristics. They include: precision, measurement, mathematic, and consistency, to name a few. Although such scientific features may fall short of modern scientific standards, they are no doubt instances of the evolutionary stages that usually occur in the advancement of scientific knowledge. Ige (2003) buttresses the point when he held that the absence of wusite as a mineral phase in the slags is an indication of high efficiency of the furnace used. This, in other words, is comparable to similar processes in science and technologically advanced Western countries. A case can, therefore, be made for the reactivation and modernization of such small smelting operations as a tool for the rapid industrialization of Nigeria.

Similarly, the previously indicated analysis of the major constituents of the Igbo-Ukwu bronze speaks volumes to the potential for adaptability inherent in indigenous technology. For one, it dispels the myths as well as erroneous thoughts that Africans are incapable of second-order thought, and deficient in generating novel and consistent ideas (Makinde, 2007:275). It shows that the indigenous Africans were not oblivious of such scientific characteristics as precision, consistency, measurement, and mathematics. Scholars and experts attest to the fact that the metallic composition of the Igbo-Ukwu metallurgy is in line with modern materials and metallurgical requirements (Shaw, 1970; Bunney, 1989). The same can be said of the Yoruba iron smelting technique, whose analysis was done in a reputable university in London. Although we must confess that such technology is an instance of the evolutionary stage in the advancement of scientific knowledge. Adaptability is therefore required to make it compliant with current trends in contemporary science and technological practice. Importantly, too, its respect for ecological concerns cannot be overstated.

The role and importance of African indigenous Eco-humanistic technology

In our effort to further propagate an African-centered circulation of technology, a discussion of how technology and science were initially perceived in the West is apropos here. There is no doubt that the Western form of technology is more associated with Western science, which ultimately ended up promoting a mechanized, materialistic society and environment. This is a world in which progress and development were assumed to consist mainly of physical attributes that eventually orchestrated the industrialization phenomenon; the precursor of contemporary widespread pollution. It is taken for granted among historians and philosophers of science that before the shift in consciousness, before the industrial era, technology was not associated with Western science. In such an era, humans perceived everything as mystic and related to nature with dignity and respect. For example, agriculture and animal husbandry were co-operative human interferers with non-human nature because their actions were not coercive. However, with the application of science leading to increased production of goods and services, a great need arose to milk nature of all its nutrients. Consequently, a human-interest policy emerged which culminated in the abuse, plunder and pillaging of the environment and its resources.

Alan R. Drengson (2005) reminds us that the prevailing increasing problems are overpopulation, pollution, and resource depletion that are all excretes of the techno-scientific attitude and consciousness. Although technology is credited with increasing human comfort and enjoyment while triggering the development of human skills on an unimaginable scale, it has nonetheless become a Frankenstein monster with destructive tendencies to persons, properties, and nature. It is now a paradigm incorporating a philosophy and a psychology of worldview and activity. This unfortunate paradigm he referred to as the 'technocrat model' that is traceable to the Cartesian encouragement for analysis and atomization. Consequently, he argues that the technocratic mindset strives to create the perfect machine process at all levels of society. However, the machine metaphors for the body, for nature, for the solar system, and social systems have been illuminating in limited ways. Thus, in Drengson's own words, "the earth comes to be seen as a machine, devoid of consciousness but for the humans, and even in humans, the methods of empiricist science pass consciousness by or attempt to technologize it".

The foregoing unveils the fact that human culture needs a paradigm shift. In this case, it is about the organic-person-planetary paradigm in which respect and dignity is accorded to all levels of life. By so doing, the symmetry between our bodies and the body of the planet is understood. Eventually, our world must be thought of as intersecting fields

of processes rather than as separate individuals. We cannot isolate our actions from the rest of society, nor from the rest of the ecosystem. In contrast to the machine, the organism is a complex interrelated whole of processes equipped with both internal and external principles of organization. The ecosystem is thus like a living body. In a similar tone, Toynbee asserts that, after Western man gained the upper hand over nature through the systematic application of science to technology, his belief that he was licensed to exploit nature provided the impetus to crave for more, while encouraged by the successes brought about by an advancing and more efficient technological capabilities.

The foregoing views are different from the African techno-scientific society, which is grounded in humanism where nature and man are in a symbiotic relationship, culminating in a qualitative and sustained development. M. P. Soma (1999) explains that the concept of technology in Africa is not an aggressive manipulation or exploitation of nature but a humbling, judicious adaptation with nature. Following the awesome awareness of nature as a teacher, indigenous technology adopts a radically different form than in the West. This is because its sole aim is not to disturb the natural world. Rather, indigenous people are familiar with the sorts of technology that do not assault nature, do not compete with the natural order, nor assume a superior status. Technology in this context is perceived as the vehicle for going home, because once a person lays their hands on such technologies, one is reminded of true home, which is out there somewhere. Consequently, African technological consciousness is nature-friendly and aims at linking the physical and the divine, as well as the spiritual and the material worlds.

The foregoing position is further affirmed by C. Glendinning (1990) with her reference to the humanities' disconnect with nature as a "mental pathology for the millions". She writes that among several lost psychic qualities was that of the sense of belonging originally built into our psychic reality by a full personal and cultural relationship with nature. This begins in infancy with the physical contact that the hunter-gatherer life had afforded, a loss of intimacy with the natural world that is conjoined with a loss of intimacy with one's parents and specifically, one's mother. What happens is that civilization increased the separation between the individual and the natural world, as it did the child from the mother. There is, therefore, a growing sense of childhood abandonment, which produces more insecure adults whose unconsciously driven *d'etre* leads to acting out their unmet needs.

The indigenous Americans, also known as 'American Indians' are believed to display a similar attitude to the earth just like the indigenous Africans. Such an attitude, according to C. J. Ekwealo (2012), is an earth-based spiritualism wherein respect for nature and for all life is demanded. In this case, it is stressed that man's request from nature to release its nutrients should be done with respect and dignity.

Significantly, the emotive analysis of the American Indians is the same as the African attitude, where land and nature are treated with respect and dignity. As mentioned earlier, Western technology allied with Western science created a materialist culture and consciousness. This accounted for the abuse and plunder of the environment in the same fashion as was done in the human world, as argued by environmentalists. Interestingly, it explains why Soma asserted that the purpose of technology is to help human beings increase their awareness and consciousness. In the same manner, pre-colonial indigenous cultures, even within their unrefined technologies, were heavily involved in an evolutionary process. In the interest of their evolution, it was essential to maintain cohesion within the culture, as people have to stick together to evolve together.

On the other hand, in the development of Western technologies, as Africans, we cannot allow some among us to evolve while others are left behind, as that is not a

community. Community is the common handling of the journey. Thus, attention to community and to the spirit in indigenous technologies implies that the evolution of indigenous cultures takes place quietly without the explosive and destructive angle of Western technology. When our ties with the spirit are strong enough, our evolution has less visibility. There is no gainsaying the fact that a good portion of modern technology is extremely destructive, probably because of the lesser presence of the spirit within it. Soma's emphasis is that, the larger the presence of the spirit, the subtler and less polluting technological evolution will be. One could then understand why most indigenous societies, according to Denis Goulet (1977), 'presuppose some kind of harmonious contact with nature and its forces and seek to minimize the damage done to life'. It is in the forgoing sense that not only is indigenous technology made suitable for circulation of technology, but also its steep eco-humanistic features can act as a balance to the Western 'Baconian' sense of science and technology, where the ability to control and dominate nature and his environment to human's selfish advantage is primary.

Challenges and factors affecting African Indigenous technological development

There is no gainsaying the fact that, at a time when technology is seen as a highly desirable thing for a modern nation to possess, its development in the African continent is currently and sadly in a stultified state. In fact, there is hardly any recognizable industrial production of technological innovations going on in Africa, such that the countries completely depend on Asia and the West to purchase almost all their technological needs and products. Makinde (2007) sees it as a dilemma that many African leaders cannot do without the advanced or developed countries. They rely mainly on their scientific and technological achievements for their own (Africa's) political survival, such that most technologies in Africa are imported, and only a small fraction is produced locally. Again, it raises the question, can such locally produced products that are sometimes the product of indigenous eco-humanistic technological systems, be recognized and accepted globally for the sake of durability and efficiency? The answer is in the affirmative.

Significantly, indigenous scientific and technological systems in Africa is disparaged because of its inability to send humans to the moon, built airplanes, and generate practical results comparable to the technological feats which inform modern science. However, recent studies have shown that Africans are not completely bereft of such knowledge, though a case can be made that excessive secrecy and reverence and awe for the inner workings of nature hampered their quest for knowledge and its practical application (Horton, 1967; Rodney, 1976; Onyewuenyi, 1994; Makinde, 2007). Consequently, the onus now lies on contemporary African philosophers, scientists, and technologists to make the continent a genuine contributor to the advancement in modern science, of course, especially, through the 'circulation of technology'. However, P. Houtondji (1995) has repeatedly admonished that, in the field of knowledge, Africans are faced with a two-fold task:

> First, we have to appropriate, assimilate and make entirely ours, with lucidity and critical mind, the international heritage now available including the very process of scientific and technological innovation. Secondly, after assessing, testing and updating, we need to re-appropriate our own ancestral heritage and the creativity, adaptability and ability to innovate that made our ancestors what they were.

While recognizing the limitations of homegrown scientific and technological practices, it does not follow that they are completely bereft of scientific value, or that they cannot be creatively harnessed to solve practical problems. It is our task as scholars to identify and examine indigenous African technological systems that can meet up for global circulation.

Conclusion

This work has been able to identify and examine indigenous metallurgy as a potential for African indigenous eco-humanistic development. It has been argued that genuine development in Africa, we reiterate, must factor in a philosophical/eco-humanist understanding of the ecology of African indigenous peoples. Fashioning a science-centered advancement strategy should consider the ontology of indigenous beliefs and knowledge systems. An awareness and appreciation of indigenous science and technology through the educational curriculum can trigger the scientific consciousness necessary for Africans to improve their living conditions on earth. There exists an inseparable relationship among the material, the spiritual, as well as religious worlds of indigenous Africans. Accordingly, techno-scientific development in Africa must be informed by an understanding of the complexities that make up the philosophical ontology of the indigenous world. Africans should be the leading players in the making of their techno-scientific development and socio-economic advancement. What is needed, therefore, is for Africans to go beyond mere importation of technology by using their native scientific intelligence, as Japan, China, and the Asian tigers did, to acquire particular kinds of technology relevant to their needs and not in conflict with their ontological systems. This grants the opportunity to provide innovative ideas that may lead to further growth of technology.

Consequently, the benefits of the circulation of technology for Africa will help to reduce dependence on foreign technology, open up opportunities for innovative ideas, foster economic development, and of course, political stability, encourage further growth of technology, as well as sustainability of the human ecological environment. However, merely regurgitating foreign finished products will only continue to render Africans dependent on such technology. We concur with the affirmation of a certain scholar that any attempt to divorce science from culture is unsustainable. On the other hand, it is a travesty of justice for potential learners if science is divorced from culture. African cultures in the traditional setting provided answers to the questions of science and technology from diverse perspectives. One of which has been shown in this work is indigenous metallurgical systems.

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