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Abstract

In pre-historic times, when man first learnt to make weapons out of stones and bones of dead animals including slings, -javelins and arrows, he was responding to a genetically inherent trait for self-preservation from predators, wild beast and other humans in competition for scarce resources necessary for survival. The emergence of man as a co-habitant of the earth heralds multi-faceted challenges, physical and biological that centre on man's survival and dominance over his environment. For instance, to survive and reproduce, man has to feed and find shelter. This produces the need to dominate the environment to meet these needs. However, inhibiting the earth with other predators has its consequences: competition ensues for the scarce resources

available. On this lies the balance between survival and extinction. Thus, on one hand is man who is on perpetual struggle to survive and on the other, other co-habitants who fiercely competes with him for survival (Alkali, 2003: 134). To address this cataclysmic 'threat', means and techniques of fending off the 'enemy' and protecting himself are devised. This provides the first rudimentary elements of technological development among human societies. From the simplest and primitive means such as stones to the modern and sophisticated weaponry, they aimed at ensuring the security of man. The development of science and technology in all epochs of human development therefore reveals an interesting link of interdependence with national security and defence. Through the application of science and technology, man develops means of self-protection and even large-scale industrial production of modern age (Alkali, 2003:133). This chapter examines the link between science, technology and national security and defence. Specifically, the chapter studies in detail the general influence, which science and technology exerts on defence and security since the dawn of recorded history. The essay starts with a thematic exposition on the concepts of science, technology, defence and security and their usages as they appear in this context. A brief historic survey of human evolution, development and civilisations is imperative. This is because it provides a platform upon which examination of similar trends and related patterns in the evolution and development of defence and security system are predicated vis- à-vis science and technology. The chapter ends with an examination of the state of science and technology in Africa and how the absence of serious technological base undermines national security.

Keywords*:* Science and Technology, Defence, Weapons, Modern Technology And National Security

Conceptual Definition of Science and Technology

Most often, when talking about a scientific discovery, or a technological breakthrough, analysts omit (to provide) a clear definition of what is a science or a technology. Taking for granted the wider popularity of the terms provide a tendency of false and illogical analysis with a catastrophic and inaccurate conclusion. It is always important to offer a conceptual definition of a term and to stick by it.

According to [1], "Science is a systematic study of anything that can be examined, tested and verified". This implies that science is concerned with the material world: the world of 'organic matter' where things can be seen, touched, sensed or smelled. It is not the purview of science to investigate the non- material or the supernatural world. From a humble and early beginning,

science has today developed into the most important field of human endeavour. Different branches of science investigate almost anything that can be observed or detected, and science as a whole shapes the way man understands and interprets the universe and other living things.

Similarly, [2] observes that the word 'science' is a Latin word: 'scientia'= knowledge. The distinctive aim of science ranges from the quest to "explore, discover, explain or predict phenomena", through the rigorous application of objectivity, analyticism and empiricism. To Mbachu, science is a systematically accumulated body of knowledge, including a set of logically connected propositions concerning the phenomena under investigation". This observation means that the cardinal objective of science is to add new knowledge and skills to the existing reservoir of knowledge. It achieves this through testing and analysing hypotheses and assumptions about the physical world [3].

Scientific knowledge accumulates as time goes by, building on work performed earlier. Some aspects of this knowledge such as understanding of numbers, stretches back to the time of ancient civilisation when scientific thought first began. According to [4], organised scientific inquiry is generally traced to the Greek philosophers. Nevertheless, it is debatable whether those philosophers are the precursors of scientific methods.

[4] observes that: While science is the formulation and testing of models by the analysis of observation, technology is the observation or development of methodology for observation which is not directed towards model formulation or testing". What then is technology? Technology in general terms is the process by which human beings fashion tools and machines to increase their control and understanding of the material environment. The term 'technology' derives from the Greek word 'tekhne, which refers to an art or craft, and 'logia', which means an area of study.

Therefore, technology literally means the study or art of constructing a tool, an implement, or just about anything material [4]. With this definition, it is accepted that all human inventions, from reading lens to spinning chairs in history are an integral part of the process for control of man's physical environment.

Providing a narrow perspective on the concept of technology, [4] mnaintains that technology is the totality of physical manmade tools intended to modify man's environment. Earlier it is pointed that the efforts man make in the direction of science and technology are a product of the desire to modify, adapt and dominate his environment. A comprehensive definition of technology includes not only the tools, but also material application of those tools. Equally, it involves the social impact of those tools. For instance, the development of A-bombs allowed for its use on innocent lives in Hiroshima and Nagasaki in Japan during the World War II. This is how science and technology collude to exert major impact on security and defence. There shall however be another cause to revisit this issue more analytically.

Suffice it here to posit that science and technology are essential to the national security and defence of any advanced, industrial cívilisation. In addition, the rate of technological change because of scientific development provides its own momentum over the last two centuries For instance. gunpowder changes how wars are waged, so is the steam engine. Technological innovations appear at a rate that increases geometrically without respect to geographical limits ot political systems These innovations transform the traditional defence and security system, frequently with unexpected social consequences [5] Even at this point, it is safe to say that technology is both 'destructive', and 'creative in defence and national security.

Science and Technology: The Linkage

The objective of science and technology does not experience remarkable shift over any extended period of time, Science in theory is less concerned with the practicability of its results; it is interested in the development of general laws In practice however, science and technology are inextricably related. The interplay of the two is in the historical development of such practitioners as chemists, engineers, physicists, astronomers, carpenters, potters and many other specialists. Through interdependence, they are able to produce different practical solutions to varying physical problems. The notion that science provides ideas for technological innovation and that research is an essential part of any significant advancement in technological development is in the least an utter myth, and at worst a fallacy. Most of the greatest technological inventions since ancient times are not achieved in laboratories. Fundamental tools and processes in the fields of mechanics. chemistry, astronomy, metallurgy and hydraulics developed before the laws governing their functions are even discovered. The steam engine, for instance, is a common place before the science of thermodynamics elucidates the physical principles underlying its operations [6].

Instructively therefore, while it is wrong to attribute development of technology to scientific progress, it may be proper or even right to observe that in modern times, technological progress is a function of scientific advancement. It may not be wrong therefore to say that the development of these two distinctive but indispensable fields is borne out of the quest of man to adapt and dominate his environment for maximum utilisation. How science and technology does thus help man in this regard? Technology provides the tools and necessary implements for dealing appropriately with the environment, while science develops, explains and provides man with the understanding of those natural laws necessary for his survival.

Defence and Security Examined

Unlike science and technology, defence and security are relative in their connotations. So what exactly do the terms connote? While there is no clear consensus on the definitions of the two concepts, it is much easier and more coherent to draw a line of demarcation between the two concepts. This problem of definition is partly due to the fact that, superficially almost the terms mean the same thing. Another reason has to do with relativity of the terms in their applicability. Yet another is partly due to the changing pattern and circumstances of man's historical development. By historical development here, we mean those cumulative processes and experiences, which are the result of a long journey from antiquity to modern times. Generations and civilisations differ on their understanding of what constitutes defence and security.

Security defined in literal term implies the state of feeling safe and protected, or the assurance that something of value will not be taken away. This simplistic definition implies absence of threat both internal and external to physical survival of an individual, community or a state. If an individual or nation is under threat from either internal or external forces, a state of insecurity exists. Defining security at the level of the state, [6], argues that, security relates not only to the desire that the state should survive, but also to the desire that it should live without serious external threat to all values that are regarded as important or vital. In essence, the point is that while it is overtly impossible for a state to get rid of all forms of threats, where it proportionately reduce them to a manageable extent, then that can state is secured.

Accepting this definition however amounts to relegating the important question here: to whom is the security more essential: to the state or the citizen? The right answer without belittling the state is to the individual. The first fundamental responsibility of any state is protection of lives and properties. A state no matter how powerful, is vulnerable if its citizenry fail to enjoy the barest minimum security of lives and properties. It is however beyond the scope of this chapter to delve

in to this debate concerning the dialectics of state and security. Suffice it to posit that security in this context means relative safety from whatever harm in whatever guise and under whatever dimensions. Security shall have the strength of guaranteeing a state and its citizens, the right of interactions with other nations without feeling in anyway threatened by their actions.

If a state without putting its sovereignty into jeopardy takes independent decisions at both the domestic and international levels within the confines of law, without any fear of retribution from another state, then that state posses a strong security base. Because of the porous nature of security, it is safe to point again that, security is not synonymous with defence. In fact, the two terms are diametrically different from each other. Defence in its generic sense implies the ability, power or strength of protection against something harmful. Defence has to do with those processes and regimes which an individual or a state put in place to serve as deterrent against harmful attack by an enemy, and repellants in case of an attack by an enemy. If for instance, an individual cannot prevent an insect bite, or a state cannot prevent an incursion into its territory by a foreign country, then definitely they are lacking in defence mechanism.

Since in its broad sense, defence implies protection against harmful attack by an enemy from within or without, in its narrow sense, defence implies the ability and capability by a sovereign nation not only to protect itself from harmful internal and external threats and attacks, but also to institutionalise some serious defence mechanisms as deterrents. During the Cold War, the two superpowers use nuclear warheads as deterrents against each other. Equally, different civilisations have with differing efficiencies, deployed different defensive mechanisms for self-protection in different epochs. Thus as pointed earlier, the idea of security and defence is essentially an idea of survival, and dominance. Human societies always develop and employ different means and mechanisms as a way of ensuring security. Some of those methods are crude but yet potent, others

sophisticated, depending on the epoch and the level of scientific advancement and technological development. Essentially the level of sufficiency of a particular security or defence system centre on the level and degree of advancement a state attains in science and technology. In modern time, we have the industrial nations with a sophisticated defence system in contrast to the poorly developed Third World states.

Science and technology is not restricted to military purposes only. They prove useful if not indispensable in other aspects of human development and survival [7]. From a holistic view, even those seemingly non-military applicability or uses of science and technology, are meant to serve as a form of security within the medium and long-term grand strategy of a state. 1t is therefore with this in view that this chapter shall proceed with an exposition of those aspects of science and technology that relates to the non-military application for human purposes.

Practical Application of Science and Technology: Non-Military Usages

Earlier the chapter points that the quest for survival leads to the evolution and development of science and technology as effective tools of adapting and modifying the environment. The importance of this development is not however restricted to the issue of physical defence and security alone; other aspects related to the survival of man, albeit without visible effects on military affairs are equally affected [7]. For instance, it is said that man has to eat, this means developing agricultural science and technology and to a large extent hydrology. Again, a healthy body is sine qua non to any question of survival, production and reproduction, for this, man has to develop the science of medicine, surgery, and pharmacology. In the subsequent pages, this chapter will dwells on two important aspects of human security and defence. These are agriculture and health. After

this, the chapter proceeds with an extensive analysis of the impact of science and technology on defence and security.

Agriculture

Agriculture is definitely the oldest human vocation and the longest surviving in history. Hunting and food gathering which were the earliest form of agricultural practice started as a primitive method or means of obtaining food. This is by means of simple crude tools and implements to make a kill [7]. Stones, sticks and bones from animals shaped and designed in such a form to ensure efficient result are the first available demonstration of technological innovations by man. Developments in agricultural science evolve from simple hunting and food gathering, to a period of subsistence and ultimately to the modern farming practice. The modern period witnesses various technological innovations and scientific discoveries. All these in different ways, alter agricultural practice. These scientific discoveries and technological skills and development, are essentially a function of the desire by man to harness the potentials of nature for his survival. From simple farm implements such as stones and sticks, to tractors, combine harvesters and seed planters in modern times, agricultural mechanisation replaces manual farming in most human societies.

Therefore, there is no doubt that, science and technology have the greatest credit in this development. As stated earlier, food is always the first important security requisite by any people, anywhere, any time. Thus, the entire structure of security is hinged upon what may be described as sound productive base [7]. The significance of this development and advancement in agriculture cannot be overemphasised. Aside reducing waste in man-hour, it equally aids in facilitating food sufficiency as a means of sustenance 'and economic growth. Societies tremendously benefits from this development.

Health

Health provides another demonstration of the indelible impact which science and technology exerts on humans. The history of medicine in general is indeed a history of transformation, which science and technology undergoes through the ages. From the discovery of penicillin to the modern x-ray machine and other laboratory equipments, science is at the front. During wars and other national emergencies such as disasters, flood and earthquakes, the military usually comes in to provide relief services to the victims. Their expertise and skills in the field of health care delivery is always valuable. They render services with the state of the art technology, which would ordinarily have been impossible to acquire. In saving life from wanton destruction, science and technology have indeed proved very vital.

Practical Application of Science and Technology: Military Usages

It is clear to any discerning mind that, because of new achievements in science and technology, issues of defence and security are forever altered. For instance, some two thousand years ago, a journey of 500km, lasted weeks. Today because of steam and electric engines, such a distance is covered in hours. This development is pervasive practically in everything including the way resources are organised for planning strategy and grand strategy for national security. Wars are now becoming more or less a scientific-cum-technological affair. In fact, the present age is an age of smart, precision bombs and 'Electronic War' era. This is the condition whereby nations launch electronically guided precision weapons against carefully selected targets from the comforts of the territories. Electronic surveillance, eavesdropping, and satellite monitoring have replaced human means of intelligence gathering among and between nations as an integral part of their general

security strategy[8]. Nuclear and other Weapons of Mass Destruction (WMD) have strategically replaced conventional armaments as weapons of national defence and security.

In the subsequent pages, we shall attempt to examine the influence of science and technology on the question of defence and national security generally. We intend to start with an historical review of the development of science and technology since antiquity. Special emphasis is however on the modern period over which this influence is more pronounced. Because without jumping the gun we can safely say that in this age, they are progressive as well as retrogressive, creative as well as destructive. Although the scope of the discourse may seem ambitious and stretch, it is important to capture the objective of this presentation without seeming to sacrifice it on the altar of analytical precision.

Iron and the Development of Metallurgical Sciences

Iron is one of those rare gifts of nature to human kind. This is because its uses are just too numerous to mention. Sen [9] described iron as essential and strategic for any state aspiring to acquire and wield power among other nations and for effective and sustainable development. Its strategic nature directly contribute to the growth of national economies, and also guarantees and stimulates further growth of those strategic as well as non-strategic industries [9]. The discovery and development of metallurgical science radically transformed defence sciences forever.

The exact date in history during which man first discovered iron, used it, or developed the technique of smelting ore to produce usable metal was not known. Available archeological evidence indicates that, Egypt probably first used iron implements as long as 3000BC. The Greeks some 1000BC [7], had already developed advanced metallurgical sciences and foundries.

This remarkable discovery and development in metallurgy made it possible for an organised and more efficient security and defence system in different civilisations. Hitherto the nature of war was such that troops usually engaged in hand to hand battle, or by using crude weapons mainly sticks and bones of animals they killed during hunting. For the first time however, societies can organise an army with substantial arms against external threats or for defending their interest. The development of iron smithery as a vocation made it even easier to obtain weapons at a cheaper rate. Arms such as swords, axes, lances, and arrows were you designed in differing forms and shapes with specific objectives.

An Historical Survey

Grifith [7] observed that this development in iron technology was apparent in the ancient China even before 1000BC, where implements for weaponry and agriculture of uniform high quality could be produced cheaply and in quantity. Rulers established foundries and arsenals, and hence assume the prerogative of equipping the new 'standing armies'.

China was not in any way an isolated case in this regard. The importance of iron as an important tool of defence and security is supremely important and universally recognised. We have cited the examples of Egypt where the rudimentary technology of iron smelting was believed to have started some 3000BC, and in Greece, where some 1000BC, definite shape had already occurred.

By the dawn of the Christian era, defence industries have taken an advanced form. This was evident in the wars those societies waged, and the level of military strength and might of some the thriving civilisations at that time. Roman and Persian empires provide an illuminating example here. Practically the strength and dominance of those Empires was predicated on their military and

defence capabilities. The efficiency with which those civilisations mobilised their respective armies is a clear testimony to the higher level of technological attainment in their time.

Modern Age

In contemporary period, development in science and technology has increased the efficiency and capability of those states that attaches maximum premium to the utilisation of these human endeavours. It also allows for an accelerated progress in other areas of human development such as transportation, health, communication and agriculture. All these areas interestingly have a manifest forward linkage with the issue of defence and security in general [3] .

Further development in the iron and steel industries led to an important revolution in the transport services during the Industrial Revolution. This was the invention of the railroads and trains. Trains enabled manufacturers, farmers, and merchants to move goods across long distance with ease. The expanded markets, which were part of the outcome of this revolution, and the more efficient transportation sys hade bulk movement, and all sorts of inventions possible [4]. Thus development in iron and steel, which was a product of scientific and technological advancement, paved way for the introduction of modern system of transport, we all know that transportation is an important auxiliary to the military. Military units worldwide become motorised. This means more speed in troops' movement, efficiency, responsiveness, and less cumbersome.

Another area in which development in steel and iron has greatly affected is the Defence Industries. Nowadays weapons of war can be mass produced within a short period, ranging from small caliber arms to heavy and artillery equipments such as tanks, fighter and bomber jets, frigates, submarines, and carrier ships. All these are a bye-product of advancements in metallurgical sciences, One can begin to wonder, how would defence and security be in this century, without iron?

Science and Technology in the 20th and 21st Centuries

Ideas which some hundred or so years ago would have seen not only impossible, but practically outrageous, have today been actualised. These ideas have changed the way we think, we talk, and how we even communicate with one another. Breakthroughs in Information and Communication Technology (ICT), Electrical and Electronics Engineering means that a new outlook is created in the spheres of military defence and security. Telephone, which is perhaps one of the greatest inventions of the last century, has made communication not only easier and cheaper but also quicker and sophisticated. Electric power is the classic example of an 'enabling technology also called 'general purpose' technology. By bringing power to any, point, it makes security and the economy more efficient[5].

Other specific technological inventions of the as the internal combustion engine used by the automative and trunk industries fuelled the boom of the century and breathed life into petroleum, highway construction, and military-industrial complexes. Jets like railroads dramatically increased like the telephone, the rapid speed objects travel made it easy for the sophistication and viability of defence system. Moreover, 20th Century such nations to move troops and equipments over long distance. Revolution in mass communication such as radio and television, and even the print media meant that new ideas could he developed and propagated live for a large audience. BBC and CNN provide an excellent example here. The invention of transistor (microelectronics chips) and then the integrated circuits made information easier, cheaper and faster than ever before. Computers come on the scene and ultimately the Internet [6].

It is obvious that the 20" Century was indeed one of scientific advancement and technological breakthroughs in virtually all facets of human life. Science and technology have in fact touched on

all aspects of human life to the extent that studying them will require volumes of work. The subsequent pages will deal with those aspects of the military, which are considered conventional and non-conventional.

By conventional here we mean the totality of those impacts, science and technology have on the issues of defence and security which are considered by international tradition as lawful and legitimate. Those range from the simple means of intelligence gathering via electronic satellites to modern armaments such as guns, tanks, anti-tanks, mortars, submarines, carrier ships, jet bombers and fighters. The size of an arsenal states possess is in itself a significant guaranty to external threats. It is therefore not uncommon to see intelligence reports of rival's military strength.

Non-conventional security and defence in this context should mean not only the methods a state adopts in protecting its own security, but includes the use of those weapons such as Nuclear and other Biological Agents (WMD), which in themselves are subject to various international regulatory agencies. All war is destructive, but those agents have greater destructive power than the conventional weapons. As such, not only their use but also even acquisition are frowned at and are subject to stiff sanctions. Their use is considered inhuman, immoral, cruel and barbaric. We should not loose sight of the fact that these non-conventional weapons no matter how dastardly are equally a product of scientific and technological development. For instance, just a hundred years ago, the idea of Nuclear or even Atomic Bomb would seem inconceivable. Developments in military technology have today not only made this possible, but also perfected their deployment. What about the guided chips most nuclear heads carry today, Intercontinental Ballistic Missiles (IBM) and Sea Launch Ballistic Missiles (SLBM) are good examples of what we have in mind.

Essentially defence and security is divided into the conventional and non-conventional. So is the question of its positive and negative nature. Scholars would like to quickly point out the negative and positive sides of most of those inventions. We must however be wary lest we are drawn into this debate. The primary aim is to explore the impact it has in modern age on defence and security. In a world made more dangerous by the day, more or less by the perfection and sophistication which man is able to achieve in weapons of defence and war, it is of vital interest to carefully examine this influence and see how it has been able to transform our outlook over the last century. This understanding will place us at a position to predict what this century will turn to be.

Conventional Technology in Defence and Security

Conventional defence and security include all those physical aspects of planning, strategising, mobilising, and deploying of personnel both military and para-military in safeguarding the national interest of a state. It equally includes threats to territorial integrity, core values, and even actions inimical to its sovereignty, and such other domestic threats capable of disturbing its peace.

The organisation of most modern military and para-military units in times of war and in peacetime is done in such a way that maximum level of readiness is maintained. The objective is to always put national security as a top priority. In this sense, it is pertinent to note that, the influence of science and technology is heavily brought to bear. Specific roles for science and technology are not in anyway limited to the manufacture and or production of armaments, even though that too is vital, but have cut across areas that include mapping, identification, selection, location and targeting [7].

Let us however start with a review of those aspects of defence and security, which interestingly defies our dichotomy of conventional and non-conventional defence and security.

Communications is one of them. It cut across the two elements. The importance of communication to security and defence is perhaps only equaled by the significance attached to it by the security organisations, military inclusive. Enormous resources have always been allocated to the development of this sector. Almost all military and other security organisations have Signals and Communications departments or Corps.

The reason for this is not far fetched; communications is the life- wire of defence and security. Sending and receiving messages and other relevant information depends entirely on an effective means of communications. In October 1969, for instance, researchers at the University of California were ready for a critical experiment, which if sailed through, would have the enviable credit of forever transforming the communications technology in the world. Initially conceived as a secured, reliable, and speedy means of transmitting information by the Pentagon, this experiment turned to be the birth of the Internet. Communication nodes via the application of computer networking, through which a secured line of communication can be established without enemy interference was, invented [8]. Little did those researchers or even their Pentagon sponsors at the time realised the tremendous power or consequences of their experiment. Internet is the most amazing and interesting manifestation of the power of science and technology on virtually all aspects of human life in general, and military communications in particular. To date scientists have consistently maintained that, the entire depth and mystery of the internet is yet to be fully comprehended or explored. Advances in communications technology are not however limited to the Internet. Satellites are another fascinating development. Earlier we had talk of the precision missiles, elaborate system of target identification, Global Positioning System [GPS], and mapping, all these are only possible because of the satellites. It is the satellite that transmits live data across

the globe while in orbit, not in the least failing to record what it is programmed to record. Satellites project world events in words and pictures[9].

According to Helena Toumi and Raimo Vayrynen [10] security matters and military technology have in modern times reached an extremely sophisticated position such that physical combat is increasingly becoming obsolete. Developments in weapons system such as supersonic combat aircrafts, long- range aircraft with the ability to carry hundreds of thousands of cargo across the ocean, Intercontinental Ballistic Missiles (IBMs), Sea-Launched Ballistic Missiles (SLBMs) means dislocation of the existing ideas. Nuclear-powered submarines, space crafts to aid in navigation, observation and communications, guided weapons for all purposes, the new computers, are all inventions of the modern age that has radically changed security and defence systems [11].

Although World War II is no doubt to date the most bloody, tragic and catastrophic conflict in human history, the deadly precision with which more recent conflicts were decided, far superceded the World War II, in terms of accuracy, sophistication of weapon systems, excellent communications line and amount of intelligence gathered. Gulf War I & II, Afghanistan, and to a lesser degree, Yugoslavia all provided an ample if, somewhat disturbing testimony to what science and technology could do to security and defence. We are not in anyway re-echoing the moralists' debate, which consistently point to the dangers of applying modern science and technology in defence and security. We are merely expressing the obvious. The level of destruction, carnage, ugliness and breathtaking accuracy and efficiency of the weapons used in those wars was simply astonishing and indeed alarming. War could be a dangerous business, but in this century,-they are downright crazy.

Non-Conventional Technology in Defence and Security: Weapons of Mass Destruction (WMD)

If we could conclude, after reviewing the conventional aspect of defence and security, that war is a crazy affair in this century, then how or where does one begin to talk of the non- conventional weapons? The deadly efficacy of the conventional weapons is terrifying, then how about that which by every standard is considered ugly. hence viewed with suspicion, apprehension and awe.

In this section, we are going to look into those non-conventional agents of defence and security, which are a product of the technological and scientific development. Primarily we will concern ourselves with Nuclear, Biological, and Chemical Weapons. Let us start with an observation by Michael Dockrill, a cold war expert; this is to underscore the seriousness of what we are talking about. According to him [12], the cold war remained 'cold' because the development of nuclear weapons had made resort to war suicidal enterprise." This was in reference to the bitter ideological rivalry between the US and the USSR, which created a serious state of tension verging on an all-out war between them. The development of nuclear science and Technology introduced the concept of 'deterrence' in the international arena. Deterrence from any act of aggression, which may in a given situation or circumstance lead to an all-out war.

Nuclear, Chemical, and Biological Weapons are described in modern parlance as "Weapons of Mass of Destruction' (WMD). They have the extreme capacity for wanton destruction and mass annihilation multiple times over. U S and the Russia are estimated to have the largest number of operational warheads; 7,088, and 7,958 respectively.

Biological weapons are an educating example catastrophic a scientific knowledge could turn to be. Simply put biological weapons are termed 'public health in reverse' because of the deliberate use of disease and poison to incapacitate people. Pathogens are employed as a weapon. Four kinds of biological warfare agents are presently known, these are Bacteria, Viruses, Fungi, and Rickettsiae[12]. With an excellent delivery system, biological agents have the horrifying multiplier effect of sudden death without property loss or destruction.

Chemical weapons are inert agents that come in four categories of horror. According to [13] , they are choking, blister, blood and nerve. In modern history, Germans were believed to have first used chemical agents with the introduction of 'Chlorine Gas' in the second battle of Ypres on 22, April 1915, during the World War I.

Weapons of mass destruction are important only as an effective deterrent to an all-out war as pointed by Dockrill. Equally Gray [14] pointed that the utility of WMD can be political, strategic, tactical or operational. We must however bear in mind that, WMD are to date the greatest known horrific legacy of science and technology. Horrific because as Gray observed (2005:278), they are deadly accurate and horrendous in their effect. Today's balance of power is a strategic reflection of the power and status WMD confers on those nations that have either the operational war heads or the necessary know-how of developing them. Nuclear science and technology is the most sought in this era. This is because as pointed earlier, its mere acquisition is synonymous with power and prestige in the international system.

Because of the danger inherent in it, nuclear technology is now a restricted business. International watchdogs like International Atomic Energy Agency (IAEA), under the auspices of the United Nations, closely monitor its acquisition and use by nations. Treaties are all over the place, seeking

mostly to restrict its acquisition. For instance, according [15] the Non-Proliferation Treaty is meant to fundamentally stop those nations that have not acquired the technology from acquiring, and to commit those nations that have either the knowledge of developing it or have operational war heads to a frame work of forbidding them from using it. It is therefore an essential contribution to global peace and security.

Science and Technology in the Third World: The African Experience

Like other necessary ingredients of development, the story of science and technology in the Third World is not particularly a happy one. Indeed, in Africa it is a sad tale. Some countries that are inadvertently described as the Third World or developing, like most of the Asian and Latin American countries, are today the leading nations in science and technology. Countries like India, Malaysia, Brazil and China are today leading the pace in technological and scientific development. The same cannot be said of the African countries however.

According to a survey by the Africa Recovery Magazine (December 1999), Africa currently has the least developed communications network in the world. Sub-Saharan Africa leads in this respect, with almost 12 percent of the world's population; the region has only 0.5 percent of all telephone lines. Compounding the shortage of lines, few people can afford to own a telephone. Africa has some 14mn telephone lines, or fewer than 2 per 100 people. Excluding South Africa. Sub-Saharan Africa has fewer than 0.52 lines per 100 people.

On internet. again the report has bleak tale for Africa for instance, of Africa's roughly l million internet users, 90 percent are in South Africa alone. There are a fewer than three computers per 1,000 people; one person in 1,500 has access to the internet: the world average however is about

1 in 40. Equally, Africa generates some 0.4 percent of the World Wide Web contents and only 0.02 percent when South Africa is excluded [16].

Other areas of human endeavour, which if taken holistically, are also significant part of the concept of national defence and security, such as agriculture, education, health, and sustainable production, are all grossly underdeveloped. The most important and dependable component of national defence and security is not science and technology, but human resource development. This is especially applicable to the African societies in particular and the Third World in general. The reason for this assertion is not farfetched, clearly these societies do not have the capacity to attain higher level of scientific and technological development as an integrated aspect of their national defence and security. Competing with US for instance in terms of resource allocation for national defence is like engaging in delusion.

The function, which as thus ought to be given priority in the Third World especially Africa, is not only on how to develop Science and technology for national defence and security, but on how to develop and empower the most salient component of the national defence: the citizenry. This is the sine qua non of any national defence policy in almost all the developed world. They are able to develop and empower their populace in excellent skills and technological knowhow as an insurance against depending on an external source.

Nevertheless, African nations are entirely, pathetically and shamefully dependent on external source for their means of livelihood and existence. Without knowing it, they have already mortgaged their national sovereignty. At present their existence and development is entirely dependent on whims and caprices of their external suppliers, who at their discretion may decide to play god with Africa. Africa is in a precarious and desperate situation. The urgency of the situation

can be illustrated in the understanding that, although it continued to be a popular cache phrase among the policy makers: the territorial integrity has already been breached. Nigeria for instance is to date, the only country in Africa and among the god's own few chosen ones in the whole world with the capacity for independent development, but she is still teetering on the doorsteps of the Western nations begging for Foreign Direct Investment (FDI), and aid.

Without meaning to sound ominous, we are compelled to point that African states have confused the meaning of national defence and security, and as such with all certainty, would continue to live and wallow in this confusion and delusion. Physical protection of territorial integrity is not in any way equated with national defence and security. Granted this is even so, what capacity has Africa generated for this physical protection of its territorial boundaries against for example, a US invasion.

National defence and security is much more broad and encompassing than the narrowness of their mind would allow them to conceive. It includes all the structures put in place by a nation for advancing the well-being of its citizens, protecting and if possible projecting and advancing its national interest amidst competing interest in the globe. Those countries we often referred to as having an excellent national defence and security policy have all achieved this with varying degree of success.

National defence and security is development, because it was Dudiey Seers[17],who said that the question to ask about a country's development are what has been happening to unemployment, what has been happening to poverty, what has been happening to inequality", if all these three have declined then beyond doubt that is a period of development for the country concerned. Africa is

clearly not within those nations. Walter Rodney (1976) is of the opinion that development is increased skills and capacity, greater freedom, and creativity. Africa has none of these indices.

Science and technology are only important so long as they are subjected to human development not the other way round. Africa needs to re-evaluate its grand strategic calculations and give them proper articulation. Designing new national defence and security is imperative. It should have the power of integrating science and technology for national development, which we have already seen is the greatest guaranty to national defence and security. If properly applied in all aspect of human development, be it in the military or non-military aspects, science and technology would exert a serious positive impact on the national defence and security of African countries.

Conclusion

During the pre-historical and early periods of man evolution, rudimentary knowledge of technology was restricted to the designing and shaping of stones, sticks, and animal bones for hunting purposes as well as for physical defence against harmful attacks. Man was yet to develop into a more intelligent creature with an instinct for private property accumulation. Thus at this early stage, the primary goal was survival at all cost in an extremely hostile environment. This was a condition, which Thomas Hobbes described as the 'state of nature' where, might, is right, man was involved in a war of all against all, basically for sustenance (Alkali, 2003:6). In this difficult situation, man was in a struggle to harness all the resources made available by nature. The life span was dependent on how man was able to ward of threats both internal and external. Gradually with the passage of time, man discovered ways of subjecting nature to his purpose. This actually could be described as a first serious attempt towards the evolution of technology as an integral part of defence and security. The discovery of iron and the subsequent development in metallurgical science practically implies man could move into a more secured phase in life where the art of survival was a bit cheapened down. Iron and steel as we have seen means a lot on the issue of defence and security. As against war of survival using crude tools such as stones and bones, man can now afford to maintain a professional body of guards (army) over his vast interests, equip them with effective, cheap and easily affordable means of defence (weapons).

Further developments in science and technology, especially since the early 20" Century. However, entirely transformed the structure and character of security, defence and war. Life changing inventions such as the internal combustion engine, electricity, communication technology, and electronics are some of the developments with far reaching implication for the military and other

security agencies. Defence and security system are now more elaborate, comprehensive, sophisticated and potent.

There is no doubting the impact of science and technology on national defence and security. What is however, the subject of debate was whether this impact is profoundly positive or negative. This question is best left to the experts and pundits, more so we will be going out of our scope. Since the dawn of the last century, opportunities have at different times avail themselves to test most of the modern security and defence systems. From the WWI where Germany first used the chlorine gas, to the World War II where motorised and mechanised war strategies were tested, to the fighter jets and latest submarines, we all see the impact of science and technology.

These expositions boiled to one point, science and technology have had great influence on defence and security since early man. This influence is both conspicuous as well as breathtaking. These notwithstanding, African countries and other Third World countries need to evolve a serious framework of action that will be geared towards harnessing their natural and human resources for sustainable development. This is the only alternative strategy of national defence and security for them. When they have developed enough capacity for empowering their people using the latest benefits science and technology can provide, then definitely they would be marching with confidence into this crazy world where might is right, and gun boat diplomacy is the norm. For societies like Africa, science and technology can be progressive, creative, and very helpful in providing them with all the necessary ingredients of security, national development and defence.

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