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Ecological Cosmological Studies Probing Concepts of "Life" and "Living Entity" in Cellular and Non-cellular Matters: Experimental and Theoretical Approaches

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ABSTRACT

Existents could be matter or antimatter, but only cellular matters are considered as having life and living entities. Critical observations indicated that cellular matter like zygote and non-cellular matter like the Universe grow to form specialized self-organized parts and systems. This research was aimed at re-investigating the concepts of "life" and "living entity" through pioneering a method of studying cellular and non-cellular matters from ecological perspective, experimentally and theoretically. Volume and mass of 45 stands of samples of *Amaranthus esculentus* (3 - 23 days old) and 60 *Clarias gariepinus* (3 - 52 weeks old) were measured; secondary data were obtained on sex, age, height and weight of 537 males and 743 females of *Homo sapiens* (0 - 80 years old). Secondary data on Universe and average length and mass of human foetus (8 - 43 weeks old) were obtained. Simulative Expansion-Growth, Generalised Einstein Mass-energy Equivalence and other Models were used to analyse the data. Quantitative and qualitative characteristics of cellular and non-cellular matters were determined: masses, volumes and densities were increasing with age; growth rates (expansion velocities), internal environment volumetric acceleration per unit mass, acceleration due to gravity, Hubble constant are decreasing with age; the qualitative characteristics indicate evolutionary structural and functional developmental stages with age through natural automation implying that the growths are governed by similar law(s) in nature**.** Findings include *Biorelativity Principle* stating that *Life is only derivable from life while living and non-living states are interchangeably latent relative to specific environmental factors*; Inherent fundamental characteristics of life are *information, mass-energy and spacetime* relative to every living entity with levels of consciousness; cellular and non-cellular matters are living entities with boundaries forming their internal environments derived from pre-existing external environments; it is postulated from evolutional perspective that every boundary-forming entity must have been derived through chains of pre-existing boundary-forming entities down to a boundless pre-existing entity which is the only non-derived life and the highest level of organisation of life termed *Omnibio*. This research is a paradigm shift from the current concepts of "life" and "living entity". Replication of this research by other scientists is recommended.

Key words: Life, Boundary–forming Entity, Biorelativity principle, *Omnibio*

INTRODUCTION

The current paradigm in science is that every existent is matter or antimatter which is characterised by mass-energy and spacetime and are classified into living and non-living. The criteria used for classifying matter into living entities were based on cellular forms of life since 1830s to date based on the discovery of Botanist Mathias J. Schleiden and Zoologist Theodore Schwann that plants and animals were made up of cells in 1838 and 1839 respectively. Several researches supported these findings culminating to cell theory (Gupta & Jangir, 2010). Conversely, this theory answers the question of what plants and animals are made up, but did not provide adequate explanation on why cellular forms of matter are considered living entities.

A single cell such as zygote grows to form several specialized and self-organized parts and systems (Tortora & Derrickso, 2012) by deriving resources from its external environment into its internal environment. Also, the universe as a whole emerges from a single finite volume in the big bang theory and has evolved to form order and specialized self-organized parts and systems. The universe is still growing, that is expanding in size for over 13.798 ± 0.037 billion years (Wilkinson Microwave Anisotropy Probe [WMAP], 2011).

Cell theory lies in the realm of biology which is a science studying nature from animate perspective while big bang theory is in the realm of cosmology and astrophysics which are fields of science studying nature from inanimate perspective. Ecology on the other hand is a science studying nature from both inanimate (abiotic) and animate (biotic) perspectives with levels of integrations, therefore, it is a discipline that could reconcile the limitations in these two theories.

All matter, whether cellular or non–cellular are made up of mass and occupy space (volume). This research seeks to develop a method of comparing the common qualitative and quantitative characteristics of both cellular and non-cellular forms of matter through the use of growth models for possibly conceptualizing a living entity from broader ecological perspective to encompass both cellular and non-cellular forms of matter. This is a basic research seeking to address the limitations of over a century old theories thus deepening the understanding of concept of life and living entity in nature. The aforementioned comparatives and findings of universe and zygote raised the curiosity to further investigate the concepts of life and living entity with the following research questions:

i. Could the mechanism of expansion of the universe as a non-cellular form of matter and relative higher level of integration be understood from growth of relative lower levels of integrations of cellular forms of matter?
ii. How could generalized characteristics of cellular and non-cellular forms of matter be deduced relative to their living and non-living states?
iii. How could the most fundamental characteristics of cellular forms of matter as living entities be applied in conceptualizing life in non-cellular forms of matter?
iv. If the concept of living entity encompasses non-cellular forms of matter, what could probably be their origin from evolutionary perspective?
v. What could be the new possible levels of integrations to be used in organizing cellular and non-cellular forms of life?

Aim and Objectives of the Research

This research is aimed at pioneering a new method of conceptualizing life and living entities from ecological perspectives through the following objectives:

i. To determine the quantitative and qualitative characteristics of cellular forms of matter using growth models for plant, animal and human beings as relative lower levels of integrations
ii. To determine the quantitative and qualitative characteristics of non-cellular form of matter using growth models for the universe as relative higher level of integration;
iii. To compare and contrast between the determined characteristics for possible extension of concept of a living entity beyond cellular forms of matter and to answer the research questions.

MATERIALS AND METHODS

Description of Sites

Laboratory works were carried out in the Department of Biological Sciences (DBS) Laboratory of Faculty of Science, Abubakar Tafawa Balewa University (Yelwa Campus). Records of human (*Homo sapiens*) biometric data were obtained from the Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi and from Primary Health Centre Federal Low Cost (PHCFLC). Samples of Plant (*Amaranthus esculentus*) were collected from a private Farm in Inkil. The animal (*Clarias gariepinus*) samples were collected from Zango Bakin Kura Modern Fish Farm; Tine Agricultural-Anderline.com Limited, Federal Low cost and Dan Adam Investment, Gwallagan Mayaka. All the institutions are in Bauchi local government area in Bauchi State of Nigeria.

Study Design

Collection and determination of biometric data of Plant Samples

A. esculentus (Hausa name of the variety is *Farin Alayyaho na gida*) were grown on a farm. Samples of varying ages (3 – 23 days old) at different developmental stages were uprooted around 6:30 am and collected into a plastic container covered and transported to the DBS laboratory. The soils attached to the roots were washed with tap water and air dried at tropical room temperature of 25^{o}C. A total of 45 stands of individuals' biometric indices (volume, mass, total height, shoot height, root height and stem diameter) of varying ages were measured and duly recorded. The volume was measured using glass 1000ml (1000cm^3) measuring cylinder (Technico BS604 made in England) and plastics 100ml (100cm^3) measuring cylinder (grandplex made in England) in water with an average density of 0.99g/cm^3. This is based on water displacement method of Archimedes' principle. The mass was measured using Top loading electronic weighing balance (Model: Scout Pro SPU4001 Max: 400g and decimal 0.1g). Other characteristics such as number of branches, number of leaves and so forth were observed and recorded.

Collection and determination of biometric data of Samples of Animal

C. gariepinus were bred and reared on Private farms. A total of 60 individual samples of different ages ranging from 3weeks to 52 weeks old were collected and their biometric indices were measured on site at the farms. The volumes were measured using calibrated Plastic container (55Litres capacity) for older fish; glass 1000ml (1000cm^3) measuring cylinder (Technico BS604 made in England) and plastics 100ml (100cm^3) measuring cylinder (grandplex made in England) for younger fish. The water used has an average density

of 0.99g/cm^3. The mass of smaller size fish were measured to the nearest 0.01g using 500g capacity Electronic Compact scale with model number: A – 110C and for bigger fish, the mass was measured to the nearest 50g using 20kg (20000g) Camry weighing pan balance. Total length (TL) and standard length (SL) of fish were measured to the nearest 0.1cm using 30cm Ruler and mounted metre rule on board. Other qualitative characteristics such as sex, types of fins developed at varying developmental stages were observed and recorded.

Collection of biometric data of *Homo sapiens*

H. sapiens records from few hours old to over 80 years old covering period from 2017 to 2019 were accessed from ATBUTH and supplementary data of infants from few hours old to 5 years old were obtained from PHCFLC within same period. The records obtained covered sex, age, height and weight for 537 males and 743 females. Sets of data on human foetus aged from 8 weeks to 43 weeks for average length and weight were obtained from baby centre (2019) retrieved from https://www.babycenter.com.

Collection of data on the Universe

Data on Universe were obtained from Wikipedia, Retrieved from https://en.wikipedia.org/w/index.php?title=Chronology_of_the_universe&oldid=925183261 and from the works of Kohut (2010).

Thought experiment

Thought experiment of a photon moving through a complete circular path was used to derive a generalised Einstein's mass-energy equivalence model with a quantised speed of light and cosmic-quantum constant.

Analysis of Data

Every matter has mass-energy and spacetime characteristics whether cellular or non-cellular. Therefore, these characteristics were used quantitatively in studying the growth models of the cellular forms of matter (plant, animal and human) and growth model of the non-cellular form of matter (the universe). Data collected were analysed using Microsoft Excel (2007 Version) with the models below:

Simulative Expansion-Growth Model (SEM) based on the expanding universe model of Friedman-Lemaitre-Robertson-Walker (FLRW) solution to Einstein Field Equations (Weinberg, 1989) was used for the comparison:

$$V_e^2 / r^2 = 8\pi GD/3 = H_o^2 \quad 01$$

Where V_e = the growth/expansion velocity; r = the volumetric radius of the growing/ expanding entity; G = Newton universal gravitational constant/acceleration of volumetric expansion per unit mass within the internal spacetime of the growing or expanding entity; D = the density of the growing/expanding entity; H_o = Hubble's constant/ inverse age constant of the growing or expanding entity;

$8\pi/3$ = Constant = 176/21

Foetal Volume was determined according to the model of Meban (1983):

$$V = 0.6056 \times L^{0.638} \times W^{0.752} \quad 02$$

Where V = Foetal Volume in cm^3; L = Foetal Length in unit of cm; W = Foetal Mass in unit of g

Human body surface area was determined according to the model of Gehan and George (1970):

$$S = 0.02350 \times H^{0.42246} \times W^{0.51456} \quad 03$$

Where S = Body surface area m^2; H = Height in cm; W = Mass in kg

Human body Volume for male and female of any age was determined according to the model of Sendroy and Collision (1966):

For male:

$V = S[57.26(W/H)^{0.494} + 0.254]$ for W/H = 0.04 to 0.1 04

$V = S[50.6\ (W/H)^{0.436}]$ for W/H = 0.1 to 0.2 05

$V = S[60.20(W/)^{0.562}]$ for W/H = 0.2 to 0.8 06

For female:

$V = S[60.36(W/H)^{0.507} + 0.254]$ for W/H = 0.04 to 0.1 07

$V = S[51.1\ (W/H)^{0.429}]$ for W/H = 0.1 to 0.2 08

$V = S[62.90(W/)^{0.578}]$ for W/H = 0.2 to 0.8 09

Where in all V = Volume in Litres; S = Body surface area in m^2; W = Mass in kg; H = Height in cm

Density = mass/volume 10

$V_m = V_s = 4\pi r^3$ 11

SEM was used by equating all volumes (V_m) of specimen to geometrical spherical volume (V_s); where 'r' is radius of the spherical volume from the origin (centre) of the sphere to the surface limit

$V_e = r_t / t$ 12

Where r_t = radius at specific age; t = specific age, that is, time taken by the expanding entity to reach distance r_t from the origin of the spherical volume; Alternatively, r_t could be determined using volume (V_t) at specific age based on the equation below:

$r_t = (3V_t / 4\pi)^{1/3}$ 13

$V_e = (2GM/r)^{1/2}$ 14

Where G = universal gravitational constant; M = mass of the entity from which another entity (which is part of the mass) is escaping from in the form of expansion; r = Spherical volumetric radius of the expanding mass from origin to the point of expansion; the expansion velocity is deemed to be escape velocity (V_e). Could be calculated using another form of equation as below:

$V_e = r_t \times H_o$ 15

Where

$H_o = 1/t$ 16

The expansion velocity (V_{et}) at specific age could be determined using the equation below:

$V_{et} = (3V_t / 4\pi)^{1/3} / t$ 17

$G_{ot} = 3/8\pi\ D_t\ t^2$ 18

Using Eq. 10: $D_t = W_t / V_t$

$G_{ot} = 3V_t / 8\pi\ W_t\ t^2$ 19

Where G_{ot} is equivalent to G (Newton Universal Gravitational Constant) DIMENSIONALLY and in UNITS (cm^3 /gs^2 or m^3 /kgs^2) but here, its takes a different interpretation which may affect the meaning of G subject to the outcome of the results of this research, however, G_{ot} means acceleration of volumetric expansion per unit mass within the internal spacetime of the expanding entity at specific age of its expansion. From another formula of escape velocity below:

$V_e = (2gr)^{1/2}$ 20

Where g = acceleration due to gravitational force of the expanding mass; r = the distance equivalent to spherical volumetric radius from the origin to the point of expansion and g was calculated as below:

$g = (r_t * H_o^{\ 2}) / 2$ 21

RESULTS

The results of the research are presented as follows.

Thought Experiments, Implications and other Derivations

The thought experiment for the derivation of quantized speed of light, C_n and its implications:

If a particle, say single photon is moving with speed C and completes a circular path as in the above diagram.

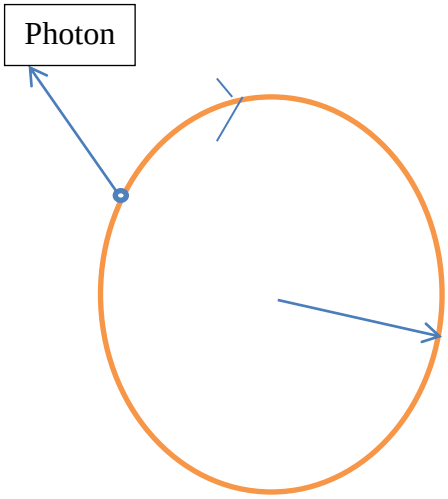


Fig. 1: Photon with mass, m navigating a circular path with velocity, C

The following relationships can be deduced:

Acceleration, $a = C^2/r$ 22

Force, $F = ma$ 23

$F = mC^2/r$ 24

Work-done, Energy, E in navigating through a complete revolution:

Work done, Energy,

$E = F \times$ distance (d) 25

$d = 2\pi r$ 26

$E = F2\pi r$ 27

$E = ma2\pi r$ 28

$E = m(C^2/r)\,2\pi r$ 29

$E = mC^2 2\pi$ 30

Implications of Equation 30: $E = 2\pi mC^2$

i. E is independent of "r" for any "m" that is whether at quantum scale or at cosmic scale.

ii. The only absolute constant is 2π; hence, E is varying with m and C^2. Furthermore, C cannot be absolute constant rather a relative constant, in $E = mC^2$.

iii. Therefore, $E = mC^2$ can be generalized to cover both quantum and cosmic scale by quantizing the speed of light to represent varying energy levels with the equation 30 below:

$E_n = mC_n^2\,2\pi$ 31

Where $C_n = C^n$ and n = 1, 2, 3. … ∞ or in general $1 \leq n \leq \infty$; n is quantum number in every energy level and is only raising the numeric value of speed of light C without affecting the dimension of C^2.

The five constants that are closely related

Speed of light C, the permeability of vacuum μ_o, permittivity of vacuum ε_o, impedance of vacuum Z_o, and Coulomb's constant, K as below:

$Z_o = (\mu_o/\varepsilon_o)^{1/2} = 377$ 0hms approximately 32

$C = (1/\mu_o\varepsilon_o)^{1/2} = 299792458$ m/s 33

$\mu_o = 4\pi 10^{-7}$ 34

$\varepsilon_o = 1/\mu_o C^2 = 1/4\pi 10^{-7} C^2$ 35

$K = 10^{-7}C^2$ 36

By quantizing the speed of light, all these related constants will be quantized as well,

hence are relative constants at different energy levels:

$$\mu_{on} = 4\pi 10^{-7n} \quad 37$$

$$\varepsilon_{on} = 1/\mu_{on} C_n^2 = 1/4\pi 10^{-7n} C_n^2 \quad 38$$

$$Z_{on} = (\mu_{on}/\varepsilon_{on})^{1/2} = 4\pi 10^{-7n} C_n \quad 39$$

$$C_n = (1/\mu_{on}\varepsilon_{on})^{1/2} = C_n = C^n = 299792458^n \text{ m/s approximately} \quad 40$$

$$K_n = 10^{-7n} C_n^2 \quad 41$$

Where n = 1. 2. 3. … ∞ for each energy level: for instance energy level 1 where $E_1 = mC_1^2\ 2\pi$; $E_2 = mC_2^2\ 2\pi$ for energy level 2; $E_3 = mC_3^2\ 2\pi$ for energy level 3 and so forth. One of the implications of the energy levels is that the quantitative value of m of similar measure varies with the energy levels, increasingly from E_1 to E_∞, hence for particles to move at a specific quantized speed C_n must be decreasingly smaller in size from E_1 to E_∞, giving rise to the prediction of photonic mass series (PMS) particles. Naturally, minute quantity of energy would be required to move such particles against the increasing impedance, Z_{on} with the increasing energy levels, E_n. However, if any particle greater than photonic mass series is to move at C_n against the increasing space impedance Z_{on} it will be very destructive due to the enormous heat that will be generated by moving against the space impedance (friction). While for any of the photonic mass series, it will harmoniously move against the impedance, hence, such particles could be called harmonious mass series (HMS) particles.

Speed within a specific energy level

Just as there are particles with speed below C_1 for E_1, similar trend could be found in every other energy level. Therefore, the concept of relativistic mass, M; space contraction and time dilation are applicable at each energy level as below:

$$M_n = m_{on} / (1 - V^2/ C_n^2)^{1/2} \quad 42$$

Where M_n is relativistic mass at n energy level, E_n; m_{on} is rest mass at n energy level, E_n; V is velocity, $V \leq C_n$; C_n is relative constant speed of light at n energy level, E_n

$$t_n = t_{on} / (1 - V^2/ C_n^2)^{1/2} \quad 43$$

Where t_n is dilated time at n energy level, E_n; t_{on} stationary time at n energy level, E_n; V is velocity ≤ C_n; C_n is relative constant speed of light at n energy level, E_n

$$L_n = L_{on} / (1 - V^2/ C_n^2)^{1/2} \quad 44$$

Where L_n is contracted length at n energy level, E_n; L_{on} is normal length at n energy level, E_n; V is velocity ≤ C_n; C_n is relative constant speed of light at n energy level, E_n

Generally, $V \leq C_n$ for E_n where n = 1, 2, 3 ... ∞ or in general $1 \leq n \leq \infty$ and C_n is as defined in Eq. 40.

The implications of $K_n = 10^{-7n} C_n^2$ on fundamental particles: atomic and subatomic particles

The relative Coulomb constant, K_n varying with the energy level has an implication on the fundamental particles. The electrical forces, will be increasing with increasing energy level, hence, there could be new set of atoms less dens than the currently known atoms at different energy level. Other fundamental particles such as electron mass, proton mass, electron radius, proton radius, electron energy, proton energy and so forth may result to new properties of some forms of new atoms for possible new chemistry that might fits into description and investigations of new entities that may be cohabiting the earth with humans or the universe or multiverse such as the aliens or even to understand some space chemistry.

Prediction of Harmonious Mass Series (HMS) particles as part of the implications of $E_n = mC_n^2 2\pi$

The photonic mass series decreases in size with increasing energy level with zero rest mass at the peak of a specific quantized speed of light where $V = C_n$ at E_n while changing to smaller quantitative value at higher energy level. For instance: $V = C_2$ at

E_2 from a lower energy level of say $V = C_1$ at E_1; that is, rest mass $m_o = m_n$ whereby n = 1, 2, 3 … ∞ such that $m_1 > m_2 > m_3 > ….. >>>> > m_\infty$. The pattern of these is demonstrated with the equations below:

$$E_n = h_n f_n \quad 45$$

Whereby $h_n = h^n$ and n = 1, 2, 3 … ∞, therefore, with $E = mC^2 2\pi$, generally,

$$m_n = E_n / 2\pi C_n^2 = h_n f_n / 2\pi C_n^2 \quad 46$$

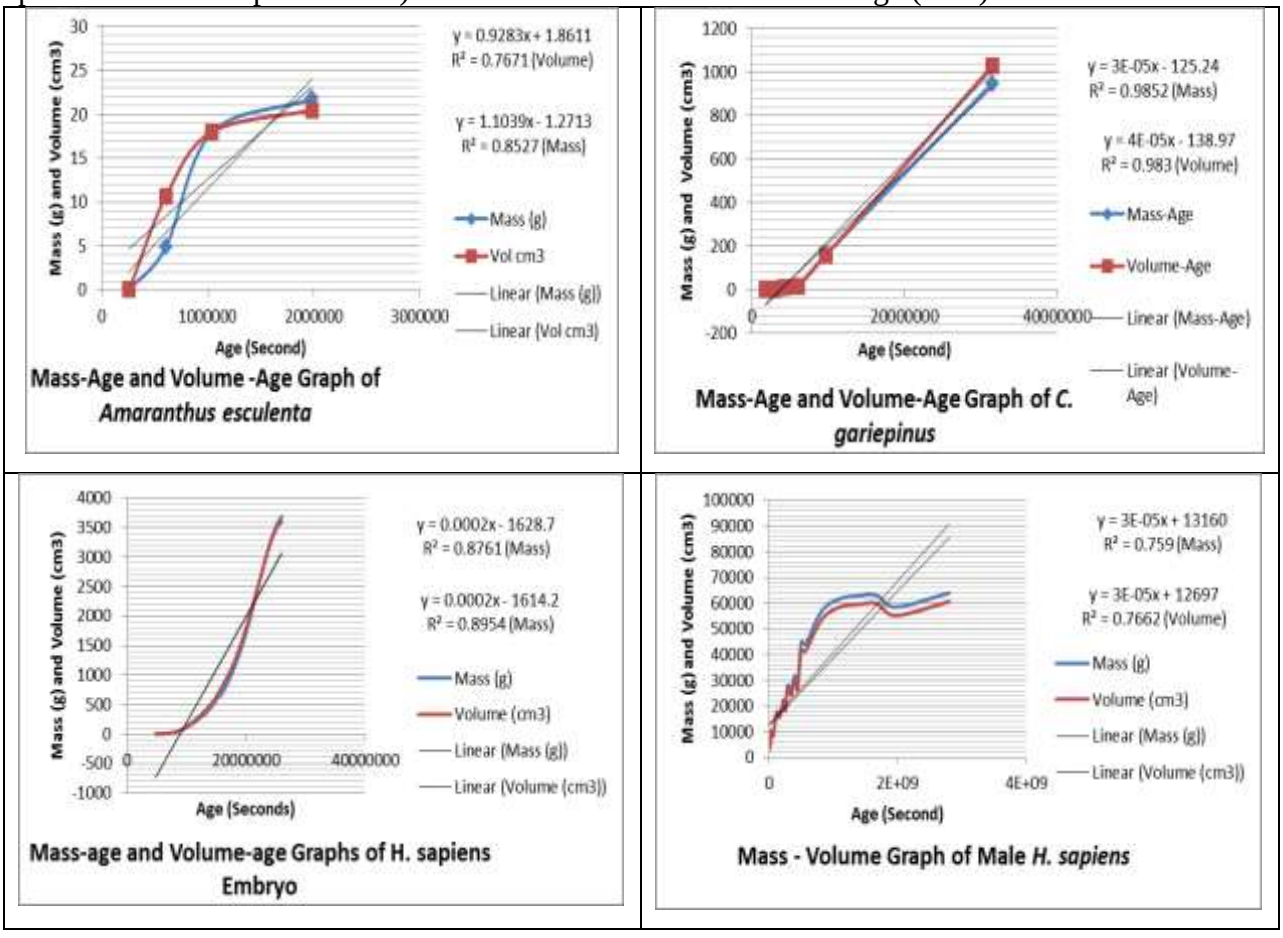
Also the De Broglie wavelength equation could be generalised as:

$$\lambda_n = h_n / mv \quad 47$$

Subsequently, the variation in the quantitative values of plank's constant, h implies that there could be unit cell spacetime smaller than the current conventionally held units (plank length, plank mass and plank time) due to their measurability by the available instruments. Inability of man not to measure a quantity in nature is not an evidence of non-existent of such quantity. Also, instruments to measure the predicted units in this research work that are far smaller than the current unit cell of spacetime could be developed in future.

The following graphs illustrate common trends of Quantitative Characteristics among cellular and non-cellular matters.

Fig.1 is mass–age and volume–age graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male *H. sapiens*, female *H. sapiens* and non-cellular matter: the universe. The trends in all the naturally growing cellular and non-cellular entities elucidated increase in mass and volume with age (time).



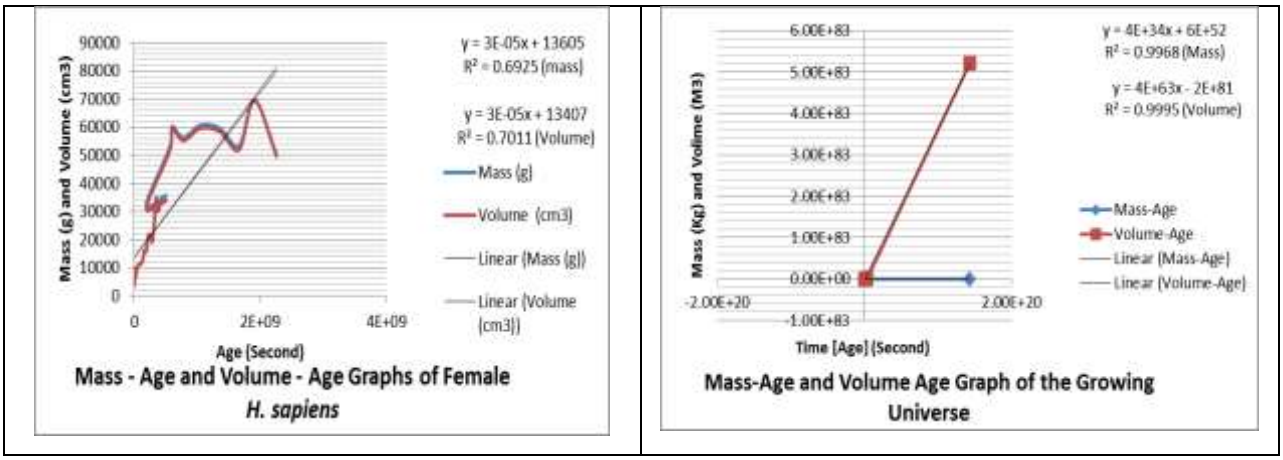
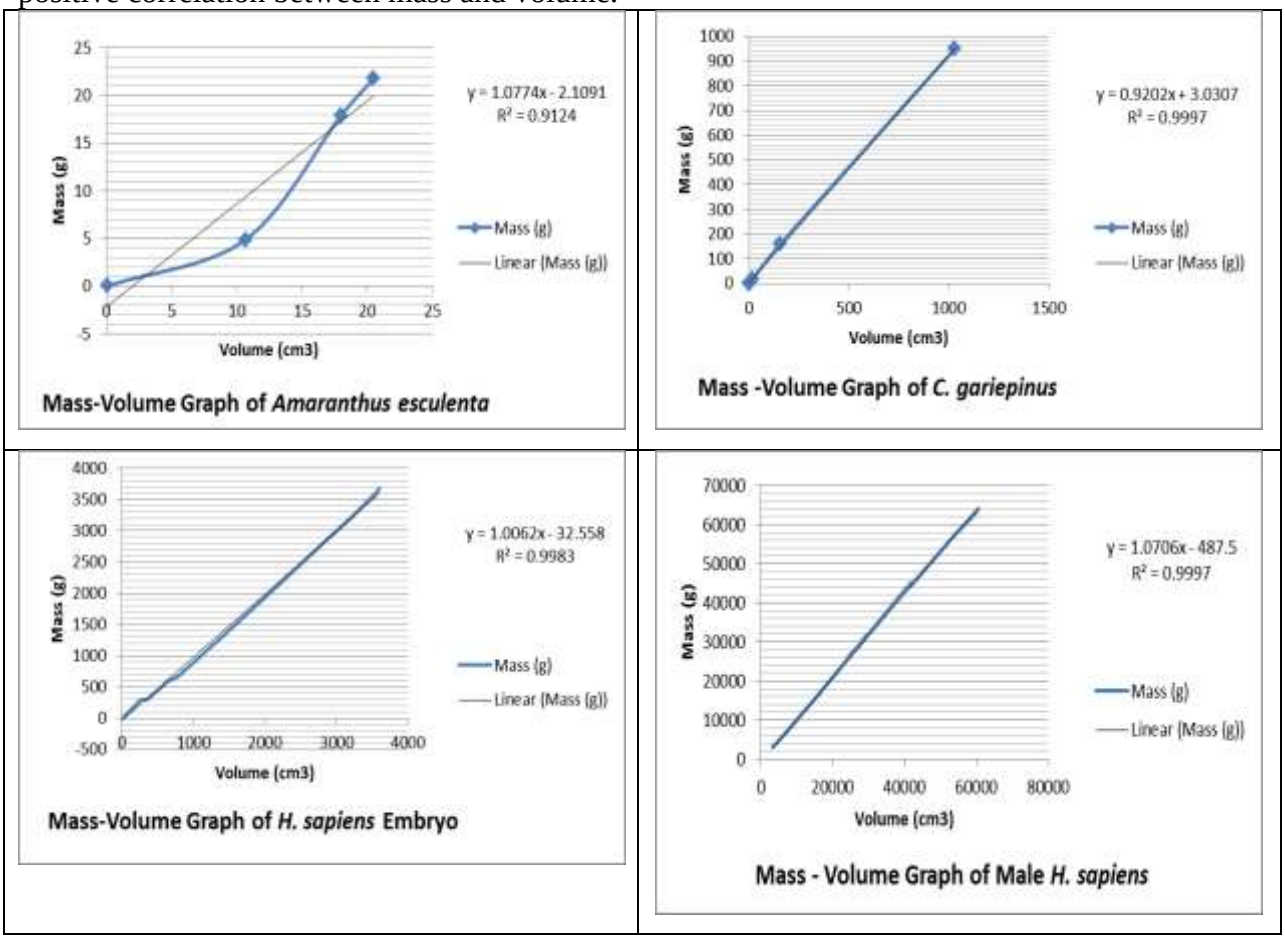


Fig.1: Comparative mass–age and volume-age characteristics of cellular and non-cellular matters as naturally growing entities.

Fig.2 is mass – volume graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male *H. sapiens*, female *H. sapiens* and non-cellular matter: the universe. The trends in all the naturally growing cellular and non-cellular entities elucidated that there is strong positive correlation between mass and volume.



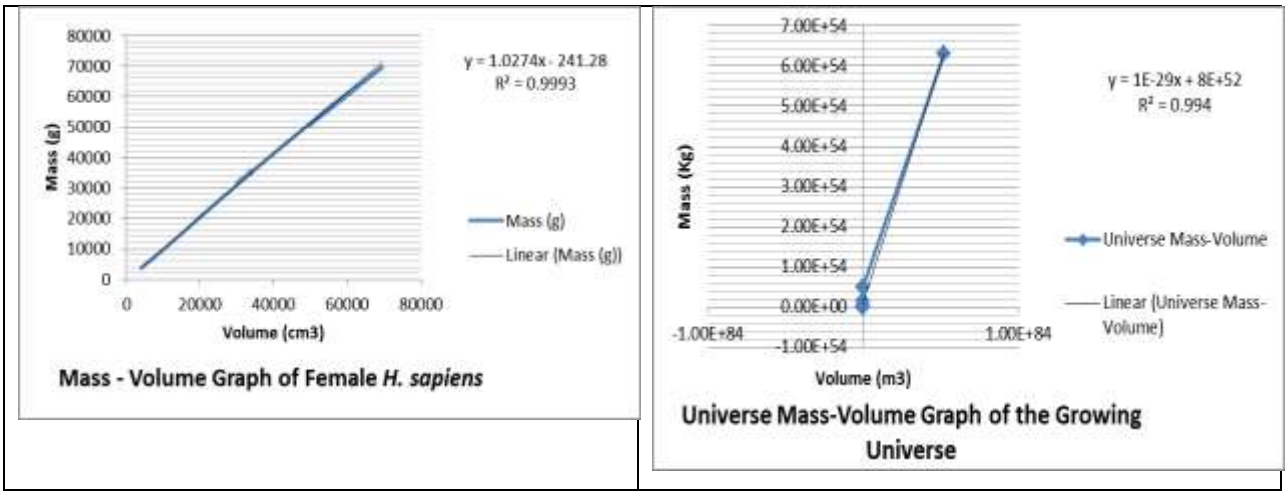
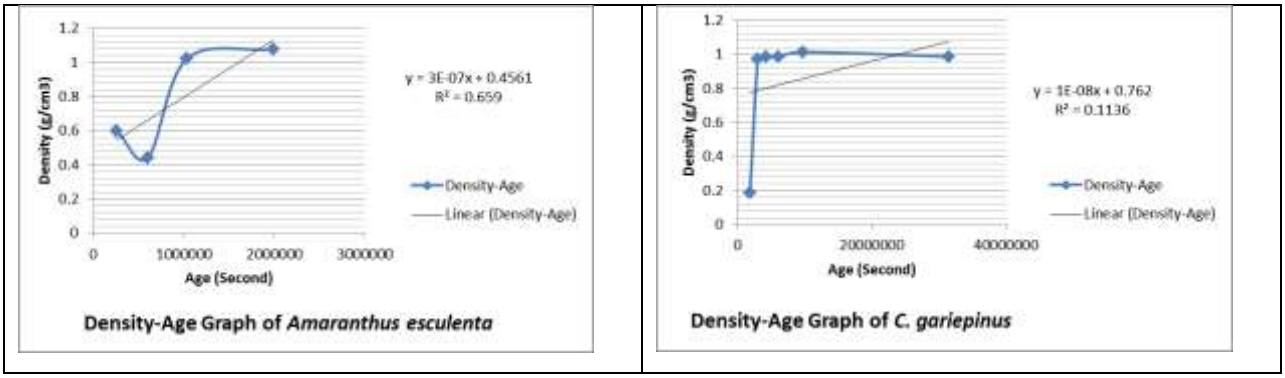


Fig.2: Comparative mass - volume characteristics of cellular and non-cellular matters as naturally growing entities.

Fig. 3 is Density – age graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male and female *H. sapiens* and non-cellular matter: the universe. The trends in all the naturally growing cellular and non-cellular entities elucidated that there is weak positive correlation between density and increasing age (time) while the densities indicated a general increase with age (time).

Fig. 4 is expansion (growth) Velocity – Distance (spherical radius) graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male and female *H. sapiens* and non-cellular matter: the universe. The trends in all the naturally growing cellular and non-cellular entities elucidated that there is weak correlation between expansion (growth) velocity and distance (spherical radius). Expansion velocity decreases with increasing distance (spherical radius) in all the entities except for embryo of *H. sapiens* where it was increasing with increasing spherical radius and with strong correlation; conversely, at a stage, it started decreasing with increasing spherical radius (distance) like others.



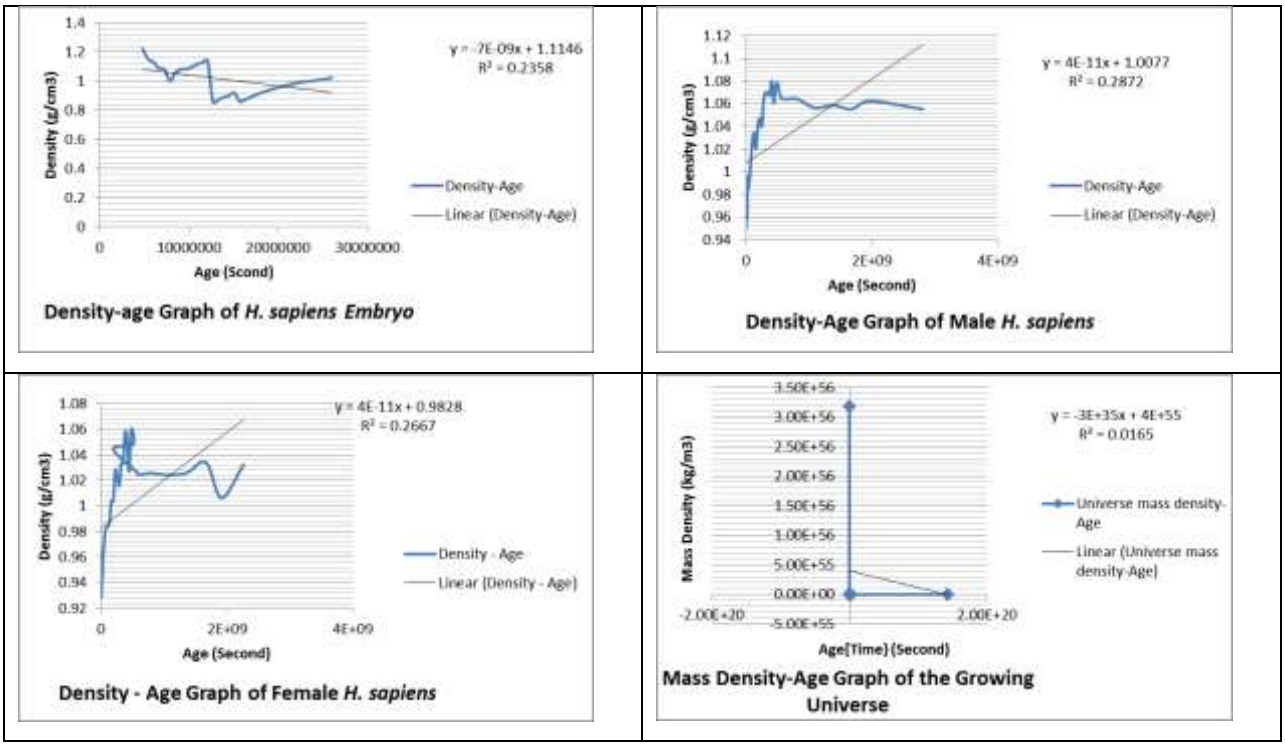
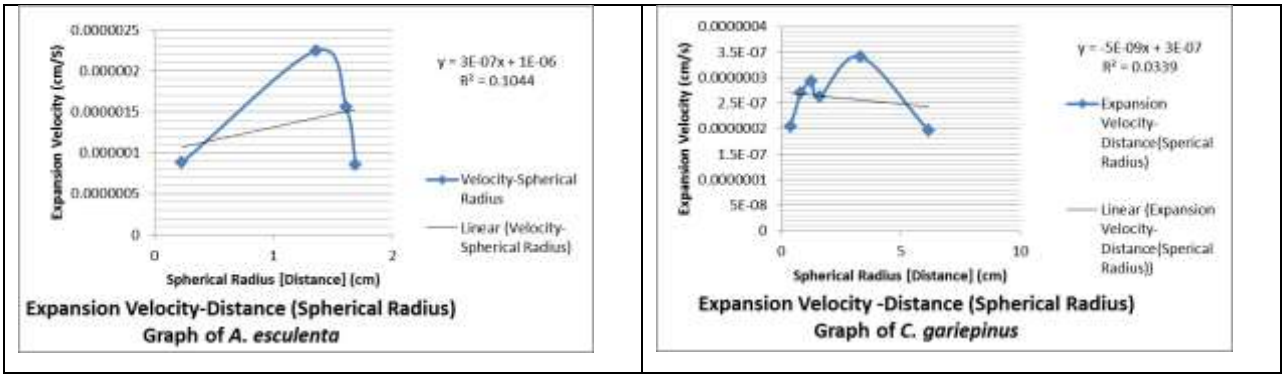


Fig.3: Comparative density – age characteristics of cellular and non-cellular matters as naturally growing entities.



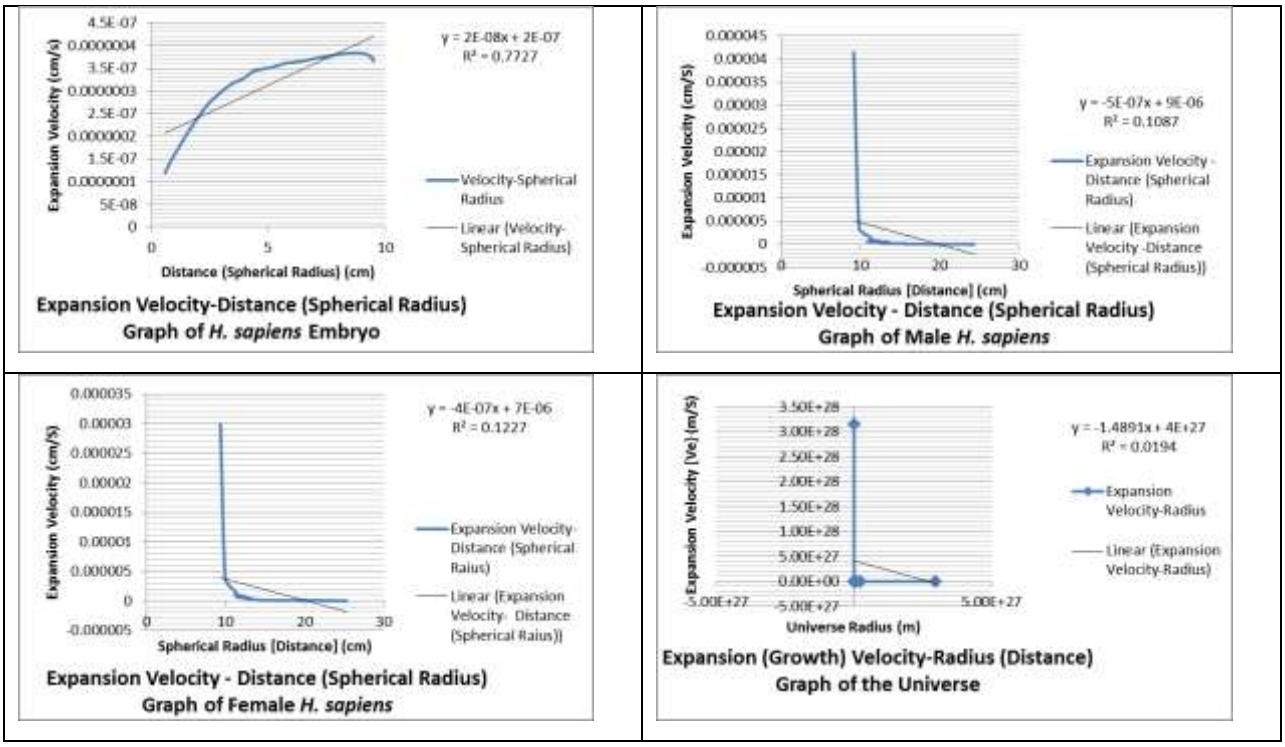


Fig. 4: Comparative expansion (growth) velocity – distance (spherical radius) characteristics of cellular and non-cellular matters as naturally growing entities.

Fig. 5 is Internal Environment Volumetric Acceleration [Bio-Newton Relative Constant] (G_o) – Age graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male and female *H. sapiens* and non-cellular matter: the universe (Fig. 30). The trends in all the naturally growing cellular and non-cellular entities elucidated that G_o is decreasing with increasing age in general.

Fig. 6 is acceleration due to Internal Environment Volumetric Acceleration [Gravity] (g) - Age graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male and female *H. sapiens* and non-cellular matter: the universe. The trends in all the naturally growing cellular and non-cellular entities elucidated that g is decreasing with increasing age in general.

Fig. 7 is Bio-Hubble Relative Constant [H_o] - Age graphs for cellular matters: *A. esculentus*, *C. gariepinus*, embryo of *H. sapiens*, male and female *H. sapiens* and Hubble Relative Constant [H_o] – Age for non-cellular matter: the universe (Fig. 42). The trends in all the naturally growing cellular and non-cellular entities elucidated that H_o is decreasing with increasing age in general.

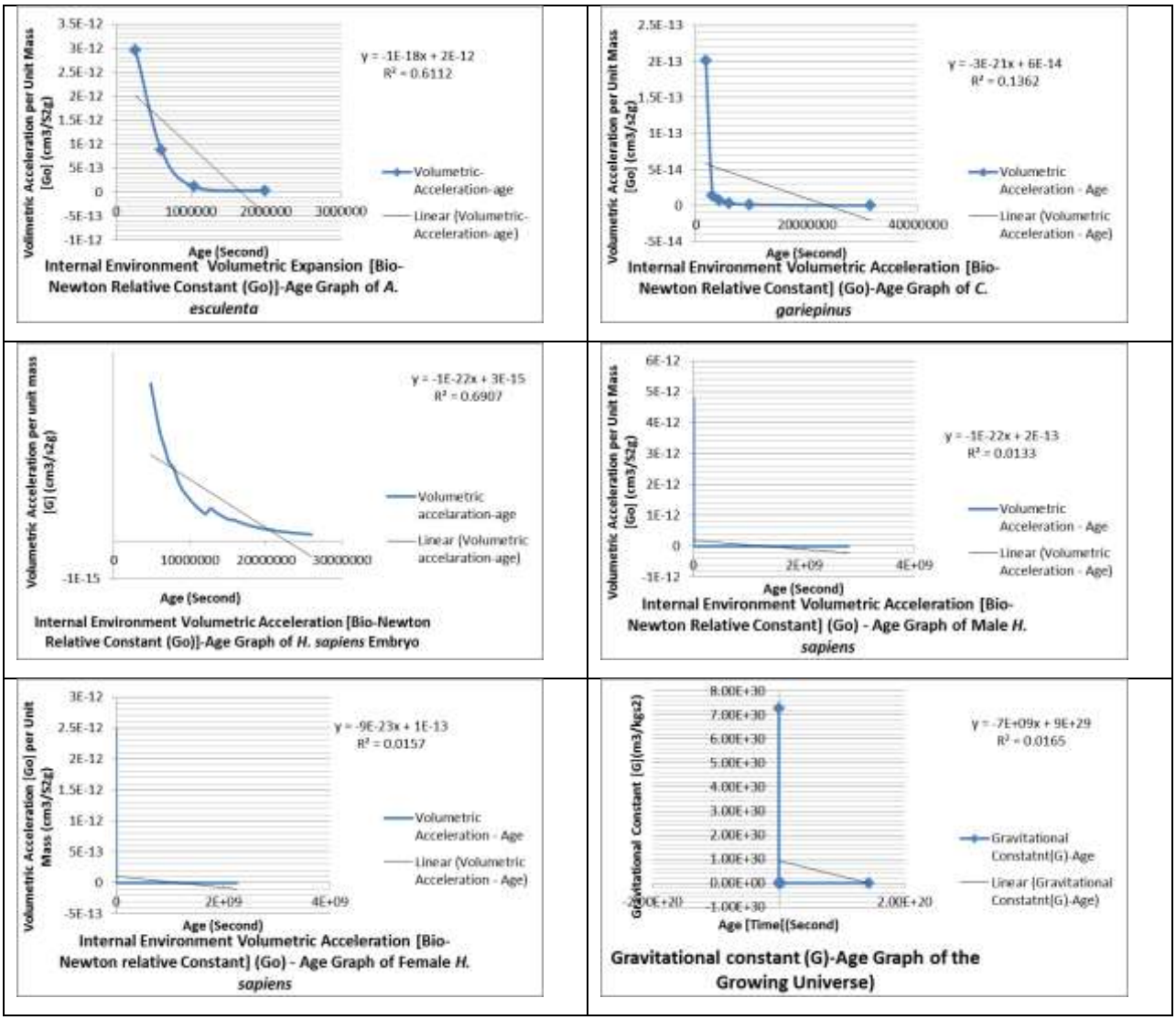
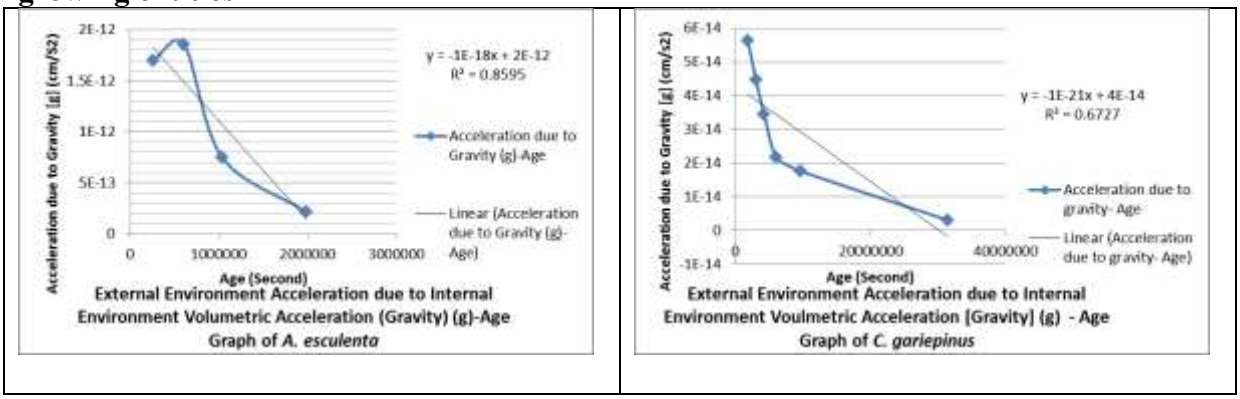


Fig.5: Comparative internal environment volumetric acceleration [bio-newton relative constant] (Go) – age characteristics of cellular and non-cellular matters as naturally growing entities



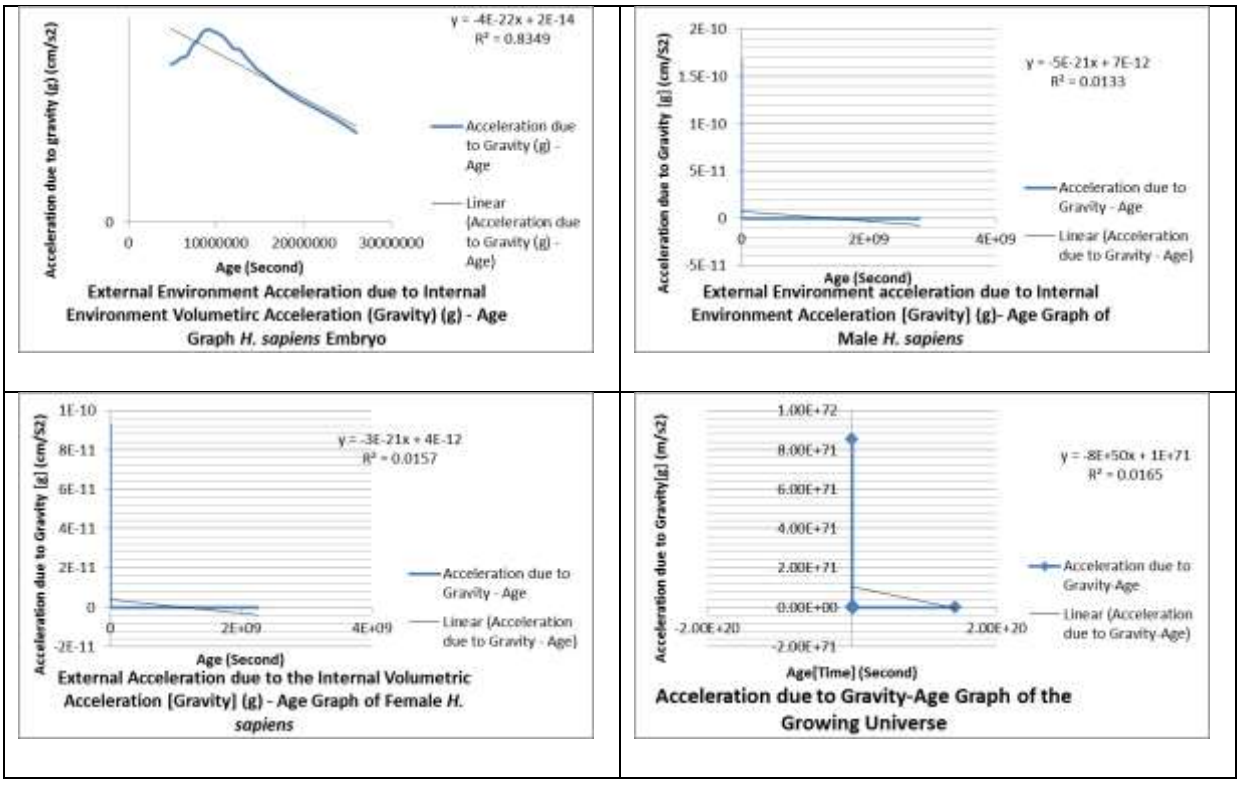
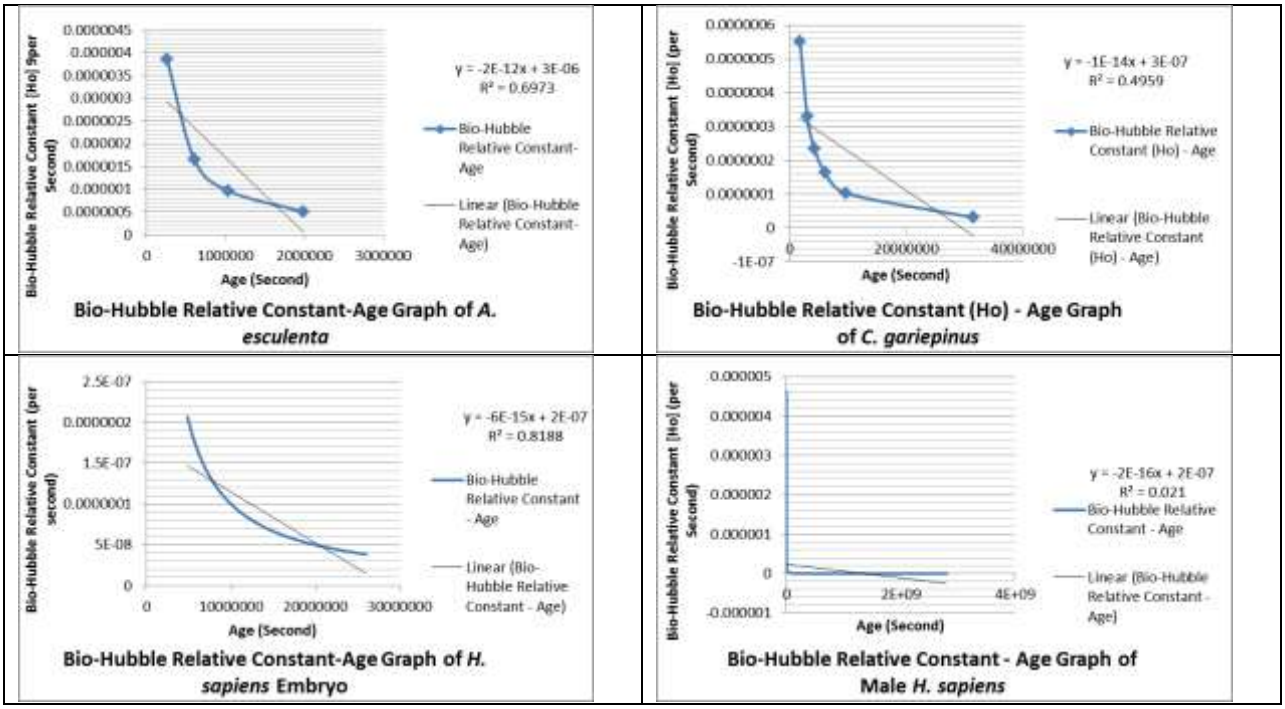


Fig.6: Comparative acceleration due to internal environment volumetric acceleration [gravity] (g) - age graph of cellular and non-cellular matters as naturally growing entities.



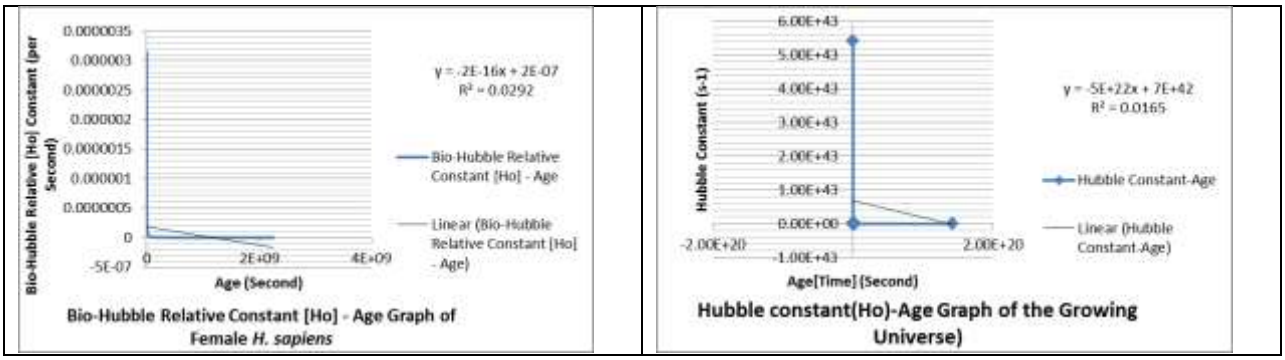


Fig.7: Comparative Bio-Hubble relative constant [H_o] - age characteristics of cellular and non-cellular matters as naturally growing entities.

Qualitative Characteristics among cellular and non-cellular matters

The entire cellular forms of matter (*A. esculentus*, *C. gariepinus*, *H. sapiens*) and the non-cellular matter (Universe) elucidated similar qualitative characteristics throughout the five developmental stages compared though at different range of time.

Table 2: Every boundary forming living entity is to exhibit at least one out of the eight generalised characteristics of a boundary living entity: "CAST DATE", that is Competability (C), Adaptability (A), Self-multiplicability (S), Transposability (T), Derivability (D), Acto-rectability (A), Transfigurability (T) and Exchangeability (E).

Table 3: The composite levels of organisation of cellular and non-cellular forms of life with the highest level being Omnibio entity in omnisphere or infinitiosphere while other six composite levels broadly in finitiosphere from cosmic entities in cosmosphere to the lowest level of organisation: infra-particles in infrosphere.

Table 4: This Unit Volumetric spherical space was modelled to demonstrate self-differentiation and integration by halving itself at every stage. The pattern elucidates that the more the partial entities are taking smaller quantitative values of unit volumes and surface areas the smaller the quantitative value of the total volume (TV) and total surface area possessed by all the partial entities compared to the whole initial volume and surface area of the unit entity. The residual volumetric space (3D) indicates that the TV is negligible at the 11^{th} stage while the residual area (2D) space indicated similar trend at 26^{th} stage.

Table 1: Comparative Descriptive (Qualitative) Characteristics of the growing Cellular and non-cellular Matters in Stages

Stage	**Amaranthus esculentus*	**Clarias gariepinus*	**Homo sapiens*	Universe**
I	**Emergence from apparent zero volume.** Embryonic development and germination in the soil and emergence (0 sec to 2 days)	**Emergence from apparent zero volume.** Formation of zygote; mitotic cell division; morphogenesis; embryonic development in the egg and hatching out (0 sec to 24 hours).	**Emergence from apparent zero volume.** Formation of zygote; mitotic cell division; morphogenesis; embryonic to foetal development in the uterus and birth (0 sec to 43 weeks or 9 months).	**Emergence from zero volume.** During this time, the energy density of massless and near-massless relativistic components such as photons and neutrinos, which move at or close to the speed of light, dominates both matter density and dark energy [From inflation ($\sim 10^{-32}$ sec) ~ 47 ka],
II	Post germination stage. Photosynthesis commenced and very few (2) leaves, stem and roots developed (3 – 6 days)	Laval and fry Stages. Absorption of yolk sac and intake of matter from the external environment into the internal environment (0 sec - <4 weeks).	Infant and childhood stages, several anatomic and psychological development (0 second to 9 years).	During this time, the energy density of matter dominates both radiation density and dark energy, resulting in a decelerated metric expansion of space (47 ka ~ 9.8 Ga).
III	Vegetative growth stage. More leaves, branching stem and longer roots and more root hairs. (7 – 24 days)	Fingerling to post fingerling stage. Development of fins (4 – 8 weeks)	Puberty stage, maturation of reproductive organs and system; psychological development and further increase in size (10 years to 19 years)	Matter density falls below dark energy density (vacuum energy), and expansion of space begins to accelerate. This time happens to correspond roughly to the time of the formation of the Solar System and the evolutionary history of cellular matter (>9.8 Ga).
IV	Reproductive growth stage. Flowering stages/ seed production. Larger leaf surface area, thicker and longer stem (24 – 28 days)	Juvenile stage. Maturation of reproductive organs sets in (9 weeks - < 6 months)	Adulthood (20 years to 40 years)	The time between the first formation of Population III stars until the cessation of star formation, leaving all stars in the form of degenerate remnants (150 Ma ~ 100 Ga).
V	Adult stage and degenerating to death stage (>28 days)	Adult stage and subsequently growing to death (> 6 months)	Old age sets in and subsequently death transforming its internal environment and boundary into the external environment (>40 years).	The Stelliferous Era will end as stars eventually die and fewer are born to replace them, leading to a darkening universe. Various theories suggest a number of subsequent possibilities. Assuming proton decay, matter may eventually evaporate into a Dark Era (heat death). Alternatively the universe may collapse in a Big Crunch. Alternative suggestions include a false vacuum catastrophe or a Big Rip as possible ends to the universe (>100 Ga).

*Embryonic developmental stages were inclusive in the description; ** Wikipedia (2019) from https://en.wikipedia.org/w/index.php?title=Chronology_of_the_universe&oldid=925183261

Table 2: Generalized Characteristics of a Boundary Forming Living entity (To exhibit at least one of the "CAST DATE" Characteristics)

Generalized criteria for both Cellular and non-cellular matter	Explanation	Equivalent Criteria for Cellular Matter
Competability	Any resource within the internal environment of a boundary forming living entity is a denial to its external environment. The competition among the boundary forming entities is based on the principle of opportunity cost.	Competition
Adaptability	This is the ability of the entity to maintain equilibrium of the internal environment with the external environment in order to continuously sustain its living state.	Adaptation, homeostasis
Self-multiplicability	This is natural automatic quantitative and qualitative increment with time in its internal environment, structurally and functionally. It includes self-organisation and differentiation.	Growth, development
Transposability	This is the ability to change position wholly or partially in form of vibration, rotational, translational, randomly or relatively.	Movement
Derivability	This is the ability to Selfless-multiply resulting to another form derived from self (internal environment) and/or to be derivable from another self (external environment).	Reproduction
Acto-reactability	This is the ability to act and be reacted upon or to react due to being acted upon.	Irritability
Transfigurability	This is the ability of the entity to change partly or wholly losing its internal environment to the external environment.	Death
Exchangeability	This is an interactive ability of the internal environment of the boundary forming entities with the external environment in the form of absorption, conduction, contraction, excretion and so forth	Nutrition, Respiration, Excretion

Table 3: Levels of Integration to organize Cellular and Non-cellular Forms of Life to include Boundless and Boundary Forming Entities

Levels of integration of organisation of Life in descending composite order	**Explanation**	**Spheres**
Omnibio Entity	The highest level of organisation of life. The boundless environment with no distinct internal and external environment; characterized by **information, mass-energy** and **spacetime** in its singularity from which the inherent characteristics of **life** in boundary forming cellular and non-cellular forms of matter were derived through simultaneous self- differentiation and self-integration abilities resulting in the continuous formations of any boundary forming entity.	Infinitiosphere or omnisphere
Cosmic entities	This include, in descending order: multiverse, universe, galaxies, solar systems.	Cosmosphere
Ecosystemic Entities	Planetary bodies like satellites, planets and stars; community and population entities.	Ecosphere
Organismic Entities	System-organ entities, organ entities and Tissue entities	Organosphere
Multi-particulate Entities	Nuclear, atomic, elemental, molecular, organelic and unicellular entities	Polosphere
Particulate Entities	Electronic, protonic and neutronic entities	monosphere
Infra-particulate Entities	Charges, neutrino, quark, higgs boson, photon, gravitons and photonic mass series (generally including all fermions and bosons)	Infrosphere

Table 4: The Unit Volumetric Spherical Space Model to demonstrate simultaneous Self-differentiation and Self-integration

Energy Quantum Number (a)	Length (spherical radius, r_o) [$2^{\wedge}$ -a (r_o)]	Unit Volume (UV) [$2^{\wedge}$ -3a (r_o $^{\wedge}3$)]	Unit Surface Area (USA) [3 x $2^{\wedge}$ -(2a-1)]	No. of Entities[(Rv$^{\wedge}$2)]	Total Volume (TV) [$2^{\wedge}3a$]	Total Surface Area (TSA) [$2^{\wedge}$ -3a (r_o $^{\wedge}3$)]	Three Dimensional Space Residual (3DSR) [1 – TV]	Two Dimensional space Residual (2DSR) [4.836624600868 54 –TSA]
0	**0.620267**	**1**	**4.836625**	**1**	**1**	**4.836625**	**0**	**0**
1	0.310134	0.125	1.209156	2	0.25	2.418312	0.75	2.418312
2	0.155067	0.015625	0.302289	4	0.0625	1.209156	0.9375	3.627468
3	0.077533	0.001953	0.075572	8	0.015625	0.604578	0.984375	4.232047
4	0.038767	0.000244	0.018893	16	0.003906	0.302289	0.996094	4.534336
5	0.019383	3.05E-05	0.004723	32	0.000977	0.151145	0.999023	4.68548
6	0.009692	3.81E-06	0.001181	64	0.000244	0.075572	0.999756	4.761052
7	0.004846	4.77E-07	0.000295	128	6.1E-05	0.037786	0.999939	4.798838
8	0.002423	5.96E-08	7.38E-05	256	1.53E-05	0.018893	0.999985	4.817732
9	0.001211	7.45E-09	1.85E-05	512	3.81E-06	0.009447	0.999996	4.827178
10	0.000606	9.31E-10	4.61E-06	1024	9.54E-07	0.004723	0.999999	4.831901
11	**0.000303**	**1.16E-10**	**1.15E-06**	**2048**	**2.38E-07**	**0.002362**	**1**	**4.834263**
12	0.000151	1.46E-11	2.88E-07	4096	5.96E-08	0.001181	1	4.835444
13	7.57E-05	1.82E-12	7.21E-08	8192	1.49E-08	0.00059	1	4.836034
14	3.79E-05	2.27E-13	1.8E-08	16384	3.73E-09	0.000295	1	4.836329
15	1.89E-05	2.84E-14	4.5E-09	32768	9.31E-10	0.000148	1	4.836477
16	9.46E-06	3.55E-15	1.13E-09	65536	2.33E-10	7.38E-05	1	4.836551
17	4.73E-06	4.44E-16	2.82E-10	131072	5.82E-11	3.69E-05	1	4.836588
18	2.37E-06	5.55E-17	7.04E-11	262144	1.46E-11	1.85E-05	1	4.836606
19	1.18E-06	6.94E-18	1.76E-11	524288	3.64E-12	9.23E-06	1	4.836615
20	**5.92E-07**	**8.67E-19**	**4.4E-12**	**1048576**	**9.09E-13**	**4.61E-06**	**1**	**4.83662**
21	2.96E-07	1.08E-19	1.1E-12	2097152	2.27E-13	2.31E-06	1	4.836622
22	1.48E-07	1.36E-20	2.75E-13	4194304	5.68E-14	1.15E-06	1	4.836623
23	7.39E-08	1.69E-21	6.87E-14	8388608	1.42E-14	5.77E-07	1	4.836624
24	3.7E-08	2.12E-22	1.72E-14	16777216	3.55E-15	2.88E-07	1	4.836624
25	1.85E-08	2.65E-23	4.3E-15	33554432	8.88E-16	1.44E-07	1	4.836624
26	**9.24E-09**	**3.31E-24**	**1.07E-15**	**67108864**	**2.22E-16**	**7.21E-08**	**1**	**4.836625**

DISCUSSIONS

Research question 1: Could the mechanism of expansion of the universe as a non-cellular form of matter and relative higher level of integration be understood from growth of relative lower levels of integrations of cellular forms of matter?

According to Krebs (1978), the mechanisms of higher level of integration could be better understood by studying the lower levels of integrations constituting it. Cellular growth of plant, animal and human and non-cellular growth (expansion) of the universe are physically an increase in size (space) of an entity relative to time. The whole universe could not be observed wholly as a single entity, however, some entities within the universe such as the *A. esculentus* (plant), *C. gariepinus* (animal) and *H. sapiens* (Human beings) could be observed wholly. Some common physical characteristics and mechanism or processes between the wholly observable entity (WOE) and partially observable entity (POE) could be generalized.

Volume and Mass have time dependent increment for Cellular and non-cellular Matters (Figs 1 – 7). This is evidence that there is regular inflow of material/energy

from the external environments of the entities into their respective internal environments. By applying the general principle of equilibrium; it implies that, there is inflow (such as nutrition in cellular matter) and outflow (such as excretion or energy dispensation in doing some work/ metabolism in cellular matter) but the rate of inflow is greater than the outflow, making the balance to favour the increase (growth) with time. An equivalent mechanism such as inflow through probably a white hole and outflow through probably a black hole should definitely exist in the non-cellular matter (Universe) for it to be increasing in size (growing) as well. The cumulative increase in the masses and volumes of the cellular and non-cellular entities through varying mechanisms has led to observable structural formations and self-organizing systems in both cellular and non-cellular forms of maters.

Trends in other quantitative characteristics (Figs 1 – 7): Turing (1952) applied cosmological model in studying chemical basis (mechanism) of morphogenesis in human embryo. However, the application of growth models in this study is for comparative study. The quantitative characteristics like Rates of growth, that is, the expansion velocities, internal environment volumetric acceleration per unit mass (G_o), acceleration due to gravity (g), bio-Hubble and Hubble constant (H_o) all were decreasing with increasing time (ages) of the cellular and non-cellular matters.

The emergence of cellular and non-cellular matters from zero volume as part of their qualitative characteristics as elucidated in Table 1 whereby, it could be observed that *A. esculentus* developed from dormant embryo in its seed; *C. gariepinus* and *H. sapiens* developed from zygote formed from fertilization of eggs by spermatozoa; hence, none of the cellular entities emerged from Absolute Zero Volume. This implied that the cellular matters which are wholly observable entities (WOE) developed from pre-existing environment before developing their respective boundaries giving them distinct entity characteristics by separating their respective internal environments from their external environments. Therefore, the zero volume in the universe as a partially observable entity (POE) could be understood in similar trend. This simply means that the existence of what cause the universe was in a pre-existing environment prior to formation of the boundary of the internal environment of the universe as non-cellular matter (POE).

Generalized implication of zero (0) in physical Mathematical models could be understood as a change of state of an entity which the model is describing rather than depicting absolute nothingness. For instance, the zero volume/mass relative to the time just before the birth of *H. sapiens;* The zero volume/masse relative to the time just before hatching of *C. gariepinus*; the zero volume/mass relative to the time just before the germination of *A. amaranthus*. All of these apparent zero volumes/masses relative to time simply mean that they were in a different state (environment) relative to the new environment they are (change), hence, their respective apparent zero volumes/masses are not nothingness. These phenomena are extended as a general principle applicable to the universe, thus, "*all the constituents of the universe and beyond the universe, that is, multiverse inclusive, emerged from external environment; hence, there is no entity without mass-energy and spacetime characteristics.*"

Based on the generalized principle afore mentioned that all matter whether cellular or non-cellular entities are characterized by mass-energy and spacetime without absolute zero mass or volume in conjunction with the De Broglie principle of generalized wave-

particle characteristics to every matter (λ = h/mv) (De Broglie, 1923a, 1923b, 1923c, 1929 in Aspect and Villian, 2017), the energy-mass equivalence model of Einstein was derived and modified from a thought experiment for a circular moving photon (Fig. 1) with all its implications.

The mass-energy, spacetime and information are constant intrinsic characteristics in every entity and are related by the formulae below:

$2\pi = L_c/r = S_A/2r^2 = 3S_v/2\ r^3 = w/f = E/\ mC^2 = Ik_B ln2T/mC^2 = 2\pi$ = constant 48

Where L_c is circular space path (circumference), that is one dimensional space curvature (1D) in metre (m); r is linear space path (radius), also one dimensional linear space in m (1D); S_A is spherical surface area, that is two dimensional space curvature in m^2 (2D); r^2 is linear area of space (square of radius), also, two dimensional linear space in m^2 (2D); S_v is spherical volume, that is, three dimensional space curvature in m^3; r^3 is linear cubic space (cube of radius), also, three dimensional linear cubic space in m^3 (3D); w = is inverse circular time in per second, that is, angular frequency in Hz; f is inverse linear time in per second, that is linear frequency in Hz; E is energy in J; m is mass in kg; C is speed of light in m/s; I is bits of information; T is temperature in K; k_B = Boltzmann constant in J/K; ln2 is numerical constant, the natural log of 2 based 'e' which is a common organic growth constant and 2π is a universal constant linking quantum scale to cosmic scale.

The Eq. 48 is linking spacetime, mass-energy and information together right from quantum scale to cosmic scale. The progressive pattern of interactions between space curvature and linear space from 1D through 2D to 3D depicts a strong relationship between angularity and linearity. This relationship is not only spatial; it extends to time in terms of angular frequency (w) and linear frequency (f). While there are formulae to express spatial angularity and linearity from 1D to 3D, there is only one formula to express relationship between angularity and linearity of time in 1D. There is need for formula to express angular and linear frequencies in 2D and 3D as well. The choice of spherical volume encompassing cubic volume may be deduced as the natural tendency of foams giving rise to spherical volumes in units but could adapt to other shapes in multiples. It could be reasoned that nature has natural tendency to make entity into spherical shapes but adaptation by interacting with its external environment may lead to other observable shapes. That might be why cosmic bodies are usually spherical but adaptation may change it. Also, quantum entities are presumably spherical conversely, adaptation might change it too. Macro bodies such as most cellular organisms being symmetrically cylindrical-like might be due to adaptation too.

Another important pattern in Eq. 48 is speed of light C. Speed generally relates differential relationship between space and time. There are separate formulae for angular speed relating differential relationships between spatial and time angularities and linear speed relating same for spatial and time linearity but in 1D; could there be for 2D and 3D? Mass is understood as condensed form of energy or equivalent to energy; could it also, be understood as folding of space, hence, spatial constituent. For instance, *H. sapiens* with just 1.6m tall might have veins of several kilometres when the whole body vein networks are joined end to end together but all are folded within said height thereby constituting the mass of the entity. Mass occupies space and space occupies mass. Both are intrinsic characteristics, hence, there is mass in 1D, 2D and 3D spaces both linearly and angularly. There is angular and linear momentum but in 1D. If liner space is

related to angular space by 2π as $L_c = 2\pi r$; same constant relates angular time and linear time in terms of frequencies ($w = 2\pi f$) in 1D. Liner momentum of photon $p = mC$; and its energy $E = mC^2$. Is C^2 not relating linearity of spacetime in 2D? May be E could be regarded as 2D linear momentum. The relationship between the linear $E = mC^2$ and angular E was independently derived in this work as $E = mC^2 2\pi$. Probably $p = mC$ may be regarded as E in 1D. Could linear energy E in 3D be $E = mC^3$ while is related to its angular energy E by $E = mC^3 2\pi$? This may be called energy momentum such that $mC^3 = EC$ compared to mass momentum in $p = mC$.

By following the above pattern of thoughts, there might be need for definitions of new quantities with infinite dimensions in nature. Also, the pattern would continue infinitely as nature's numerical quantitative values can hardly be exhausted. However, the numeric values of interest to scientific inquiries, explanations and application can still be attained without going into newer dimensions as a measure of nature. In order to maintain same energy concept while still exploring the possible numeric values of interest, $E_n = mC_n^2 2\pi$ with energy levels of $1 \leq n \leq \infty$ where $C_n = C^n$; this equation was derived and is considered as the general form of $E = mC^2$. For main energy levels, n = 1, 2, 3, … ∞, that is, natural numbers while for any intermediate energy levels n could take any real number. For instance n = 1.5 as an intermediate energy level between 1 and 2. This will result in the possible 3D energy quantitative value without changing the current energy concept or taking up any new dimension: $E_{1.5} = mC_{1.5}^2 2\pi$; $C_{1.5} = C^{1.5}$ hence, $E_{1.5} = m\ C^{1.5(2)}\ 2\pi$ where power 2 determines the dimension for dimensional analysis of C but 1.5 only increase the numerical value of C therefore, the equation take the form $E_{1.5} = mC^3 2\pi$ and the numerical quantities and implications of possible 3D energy concept ($E = mC^3 2\pi$) could be explored but as an intermediate energy level.

Furthermore, the angular time or curvature time T_w is related to linear time T_f by 2π thus, $T_f = 2\pi\ T_w$ that is 1 second at the linear time is $1/2\pi$ seconds, that is angular time clicks faster at the space curvature than linear time at the linear space. $T_f / T_w = L_c / r = 2\pi$ = constant and numerically $2\pi = 44/7$. Unlike time, the curvature space is longer than the linear space for 1m in linear space equals 2π m in angular space. The constant 2π shows that the variables' relationship holds at cosmic scale as they tend to infinity equally as the relationship is true at quantum scale as the variables tend to zero. If 1m of r is covered in 1 second of T_f, the linear spacetime speed r is 1m/s; equally, 2π m of L_c will be covered in $1/2\pi$ of a second, hence, the spacetime curvature speed C_s is $4\pi^2$ m/s, therefore, $C_s = 4\pi^2 L_s$. Similarly, $C_s / L_s = 4\pi^2 = (2\pi)^2$ = constant. This might be counter intuitive, but might be the way nature works at the very fundamental level, particularly, for the fact that our clocks click to measure linear time. Conversely, observations have shown that the universe is expanding faster than the speed of light C outside the boundary, supposedly, spacetime curvature of the universe.

If C is linear spacetime speed of light in vacuum, then, the curvature spacetime speed of light would be $4\pi^2 C$ m/s (1.1835331E10 m/s). Its equivalent value of $C_n = C^n$ can be obtained where $n = \ln 4\pi^2 C / \ln C$; Substituting C = 299792458; n = ln1.1835331E10 / ln299792458 = 1.1883. This speed is within E_2 energy level with $1 < n \leq 2$, hence, $4\pi^2 C = C_{1.19}^{1.1883205699}$. Therefore, $E_n = mC_n^2 2\pi$ is a generalised form of $E = mC^2$ and it is an instrument that can be used to probe and understand nature right from quantum scale to cosmic scale as a standardised reference scale.

As for $Ik_B ln2T/mC^2 = 2\pi$ which could be rewritten as $Ik_B ln2T = 2\pi\ mC^2$; from the observed trends, the thermodynamic information $Ik_B ln2$ is independent of temperature T whether high or low as derived in the work of Yusuf (2023) and seems to be on the spacetime curvature from the mathematical model, that is angularity not linearity. The obtained bits of information are 4 bits per particle. This might depict more philosophical implications such as the four bases paring (Adenine pairs with Thymine as A-T or T-A while Cytosine pairs with Guanine as C-G or G-C) in DNA (Deoxyribonucleic Acid) sequence codes in cellular matters; the four fundamental positional reference planes of north-south and east-west in space or the vertical references of up-down and horizontal reference of left and right symmetry are all in four pairs of information codes. The ratio of 3D area of a curvature space (surface area of a sphere = $4\pi r^2$) to 2D area of a curvature space (area of a circle = πr^2) is $4 = 4\pi r^2/ \pi r^2$ = constant. Conversely, ratio of 3D volume (Volume of a sphere = $4\pi r^3/3$) to 2D area of a curvature is $4r/3= 4\pi r^3/3\ \pi r^2$ = variable NOT constant. This varies with the linear space r by a constant of 4/3. Bekenstein (2003) found that the quantity of information or entropy is dependent and bounded by the area of an entity; the findings of this research are consistent with it. Conversely, while the quantity of bits of information per unit time that an entity could receive and transmit is bounded by the surface area of such entity, the speed of transmitting and receiving such information could make a difference among entities of same quantity of surface areas.

The quantity of bits of information an entity could store varies with the volume which varies directly with the linear space 'r' and the unit size of entities carrying the information to be stored. Bekenstein (2003) further advocated that the universe may be hologram of 2D. Actually, contrary to his view, it could be 3D universe and this is supported from the perspective of information storage. But in conformity to the holographic view: information are received and transmitted in 2D, particularly the light energy that gives the visual impression to entities.

Research question2: How could generalized characteristics of cellular and non-cellular forms of matter be deduced relative to their living and non-living states?

Prior to the formation of the respective boundaries separating the internal environments of cellular and non-cellular forms of matter from their respective pre-existing environments, they were in their non-living states but with inherent potential living characteristics while relative to the boundary formations giving them distinct entity, they are in their living states. Conversely, the pre-existing external environments from which the cellular matters were derived (in this case, the parents) were in their living states. Therefore, life is only derivable from life while living and non-living states are interchangeably latent relative to specific environmental factors. This generalization is extrapolated to include the non-cellular matter such as the universe. This implies that the environment from which the universe is derived is also in its living state while the universe as a non-cellular entity was though in its non-living state then but with inherent potential life, prior to its formation of boundary that gave it a distinct internal environment from its external environment; conversely, is now in its living state after its boundary is formed similar to the cellular entities (plant, animal and human) that were in their respective non-living states prior to their formation of boundaries that gave each its distinct

internal environment from a living parent which is the external environment from which each was derived before been in their respective living states after the formation of their respective boundaries.

The current paradigm in science is based on criteria for classifying matter into living entities is restrictive to cellular forms of matters as a physicochemical self-organising system with specific characteristics which are movement, reproduction, nutrition, irritability, growth, excretion, respiration, death, competition and adaptation. Whereas, fundamental observations revealed that cell functions and structures depend on the genetic information carried by the genes on the chromosomes (Vasudevan *et al.*, 2011) and traits, though inherent, are expressed based on genetic (internal environment) and epigenetic (external environment) factors. The ability of the DNA to store, replicate and transmit information (Abercrombie *et al.,* 1990) is what makes cellular forms of matter exhibit their set of characteristics for them to be considered as living entities peculiar to a specific external environment.

Every measurement of quantity is made relative to a unit of measurement; conversely, any measure of a quantity relative to itself is unit. A homogenous unit spherical spacetime with unit energy density model (Table 4) was used to demonstrate the simultaneous self-differentiation and self-integration of wholesome entity which is the pre-existing environment from which all other existing entities were derived. From Table 4, why the total volume (TV) at a lower stage is very low compared to the total volume (TV) at a higher stage? The plausible reason will be to naturally give the partial entities (the derivatives from the wholesome entities) at the non-holistic unit stage but in lower stages to interact with their external environments for possible increase (growth and reproduction) of their respective internal environments (measurable as either unit volume – UV or total volume – TV), that is, to be increasing in sizes and subsequently to form structural and functional systems at different levels.

For instance, the TV at 5^{th} stage (Table 4) is just 25.0128% of the TV at 4^{th} stage. This implies that for entities at 4^{th} stage to occupy the space occupied by entities at 5^{th} stage it has to grow 4 times, that is, 400% of their 5^{th} stage. However, 26^{th} stage (TV = 2.22E-16) to grow to 2^{nd} stage (TV = 0.25), the entities have to grow 1.1261261E15 times of their current sizes. A very important trend of the homogenous unit spherical spacetime with unit energy density model is the fact that as the derivatives of the unit volume is tremendously increasing in number, their collective total volumes compared to the residual volume of the self-differentiating wholesome entity is increasingly becoming as though the total volumes of all the derivatives are negligible: 11^{th} stage (Table 4). The natural model of the observable universe concurred to this model whereby there is large space than particles occupying the space and such space are continually increasing. This model harmonises between the steady state model of the universe by considering the wholesome entity as being in a steady state (constantly, simultaneously and instantaneously self-differentiating and self-integrating) while the universe and all other things are the partial entities that could be expanding or growing.

During the simultaneous and instantaneous self-differentiation and integration, the most fundamental and universal characteristic passed from wholesome entity to other partial entities is information in concrete and abstract symmetric forms of spacetime (space is concrete and time is abstract) and mass-energy (mass is concrete and energy is abstract). The universal registerable bits of information in every entity with spacetime, mass-energy at any scale: quantum or cosmic depends on its energy level and

number of unit particles that constitute the entity. These bits and accompanying accessible states enhance interactions among all entities and in forming different kinds of partial entities varying with temperature and other environmental factors. These interactions with spacetime and mass-energy makes the partial entities to exhibit at least one or all partial entity's characteristics summarized as "CAST DATE" (Table 2). Therefore, the criteria for classifying matter into a living entity may be broadened and generalized to include cellular and non-cellular matter as Competability (C), Adaptability (A), Self-multiplicability (S), Transposability (T), Derivability (D), Acto-rectability (A), Transfigurability (T) and Exchangeability (E). Every entity in finitiosphere or infinitiosphere (Table 3) at cosmic or quantum scale has registerable bits of information. This concurred to the Landauer's principle which states that every physical system by merely existing registers information (Landauer, 1988).

Research question3: How could the most fundamental characteristics of cellular forms of matter as living entities be applied in conceptualizing life in non-cellular forms of matter?

The most fundamental characteristic of the cellular or non-cellular matter as a derived life prior to its living state is the information inherent in it mass-energy which enables it to form its internal environment as a distinct entity by interacting (communicating) with the external environment intelligibly to express its quantitative and qualitative characteristics (traits). With mass-energy equivalence principle ($E = mc^2$) according to Einstein (1905) and generalised in this work as $E_n = mC_n^2 2\pi$, the mass is a condensed energy peculiar to the spacetime dimension of the entity, therefore, *Information, mass-energy* and *spacetime* are the three inherent fundamental characteristics of life in cellular and non-cellular forms of matter. It is the energy that gives the boundary forming living entity the ability to exhibit any of the generalized characteristics (Table 2). The energy in wholesome boundless entity gives it the ability to self-differentiate and self-integrate simultaneously and instantaneously thereby, creating and evolving other partial entities. The mass-energy; space-time and information are constant intrinsic characteristics in every entity.

The fundamental characteristics of every living entity (information, mass-energy and spacetime) confer consciousness to it, therefore, making it an intelligent and subjective being to certain degree – every entity has potential consciousness. Consciousness is the state of knowing or being aware of, that is being informed of oneself (internal environment) and/or other entities (external environment). Information is carried in and by energy that can be transmitted and decoded visually (light energy)/in audio form (sound energy)/ as feelings in form of impulses (electrical/heat/chemical energy). All these forms of energy are characterised by speeds, waves and frequencies within spacetime with mass-energy. The intrinsic nature of these characteristics generates quantifiable ranges of values which are specific to the sensitivity (protocols) of each entity to communicate (transmit - encode and/or receive - decode) in order for an entity to be aware of the constituent information. Information is potential intelligence. Also, intelligence is function of memory (accumulated information with time) in form of records of past experiences through spacetime dynamics and the retrieval mechanism of part or whole of the record which is partly an exhibition of acto-reactability broadened characteristics of a living entity.

One of the consequences of $E_n = mC_n^2 2\pi$ for $C_n = C^n$ where $1 \leq n \leq \infty$ has led to a

proposed physical concept of soul as a cosmic record of every distinct boundary forming entity with natural automation. The cosmic record of every distinct entity at energy level E_∞ with the information carried by the least harmonious mass particle m_∞ is very stable and does not decay. The non-decaying nature of m_∞ made it stable and hence, preserves all information and is considered as the fundamental *informon*. The implication of this is that any boundary forming entity without natural automation though has life in it but do not have natural soul. However, boundary forming entities that have artificial automation could have ARTIFICIAL SOULS an example is the Subscriber Identification Module (SIM) in a cell phone. The formulated *Dual energy relativistic principle* which states that every lower energy level is relative exoenergy to any higher energy level which is relatively an esoenergy to it; this principle made it possible to have both natural and artificial souls just as there are natural and artificial intelligence.

According to Siefe (2000), the existing information pathways in the universe are yet to be completely discovered but the impact of quantum entanglement behind material processes spreads at least 10^7 times faster than speed of light C in a vacuum. This statement is corroborating the proposed soul concept in this research. These fundamental informons pervade all spheres as Unit Density Universal Fluid (UDUF). The complex interactions of these particles m_∞ within all spheres: infinitiosphere and finitiosphere (Table 3) forms a cosmic matrix (cosmotrix). At this energy level, E_∞, there is singularity of spacetime and mass-energy as information is accessible, transmittable and receivable at the highest possible speed C_∞ in all spheres from quantum to cosmic scales instantaneously. The capability of what soul could do is limited by the complexity of the design in the body's structures and functions it is cohabiting; therefore, every boundary forming living entity has soul as a cosmic record, recordable and accessible within the omnisphere by the *Omnibio* at E_∞ energy level.

To appreciate the singularity of spacetime at C_∞ to all spheres, an example of astronomical distance of Sun-Earth is considered. A light year or lightyear (symbol is ly) is a unit of measurement of length as the distance light travels in a vacuum in one Julian year, that is 365.25 days (31.5576 million seconds) as defined by International Astronomical Union (IAU), it is 9,460,730,472,580.8 km (9.4607E15m) (Seidelmann, 1992 in IAU, 2020). It takes 8.3 minutes for light to travel from sun to earth which is a distances of 1.58E-5 ly (about 150 million km). Now, at speed of light C (C_1 = 299792458 m/s), the photons we received on earth informs us of the condition of the sun 8.3 minutes ago and to communicate back to the sun from earth it will take another 8.3 minutes. Simply put, coming from the sun to earth was our past and it took 8.3 minutes and going back to sun from earth would be our future and it will equally take 8.3 minutes while our present is instantaneous relative to our position on earth. In a nutshell, a distance of about 300 million km to and fro between sun and earth is covered in 16.6 minutes at the speed of light C; hence, we are conscious of our past and future to occur through our present in 16.6 minutes. At higher speed of light C_n ($C_{1.3539}$ = 3E11 m/s) the whole of the events of the past and future of 16.6 minutes can occur instantaneously as our present in a second. Therefore, this leads to the formulation of a *Biorelativistic principle of consciousness* which states that ***the consciousness as a barrier of time relative to the past, present and future events at a lower speed of lower energy level is an instantaneous event at certain higher speed***

of higher energy level while at C_∞ in omnisphere, Omnibio is constantly in an instantaneous consciousness of every event in all spheres.

Research question 4: If the concept of living entity encompasses non-cellular forms of matter, what could probably be their origin from evolutionary perspective?

All the cellular matters (*A. esculentus, C. gariepinus, H. sapiens*) and non-cellular matter (the Universe) exhibit similar trends in their quantitative characteristics whereby Mass, volume and density are generally increasing with increasing time (age) except for human foetus and Universe that tend to decrease in density with increasing age; Rates of growth, that is, the expansion velocities are decreasing with increasing age; Internal Environment Volumetric Acceleration per unit mass [gravity] (G_o), Acceleration due to gravity (g), Hubble constant (H_o), all decrease with increasing age; similarly, the qualitative characteristics are showing developmental structural and functional stages with increasing age through natural automation (Table 1). All these implied that the growths and mechanisms of cellular and non-cellular matters are governed by similar law(s) in nature. Could these characteristics be generalized whereby, all would be considered as living entities of different forms?

The cellular and non-cellular matters are living entities with boundaries forming their internal environments derived from pre-existing external environments. if traced back through time, every boundary-forming entity must have been derived through chains of pre-existing boundary-forming entities down to a boundless pre-existing environment, that is, such boundless entity would only be the non-derived life with no distinct external or internal environment but characterized by the three fundamental characteristics of life: information, mass-energy and spacetime in its singularity from which the inherent characteristics of life in boundary forming cellular and non-cellular forms of matter were derived from.

Johannsen (2005) asserts that organisms (cellular forms of matter) first appear with information, that is, information has been in existence since the beginning of evolution which is linked to meaning. Therefore, meaning is produced by evolution as part of the organisms (cellular forms of matter) that are created in the process of evolution partly relative to the internal environment and partly by allowing external information to enter the organisms from the external environment for further processing. The organisms depend on the information that comes from the external environment but with varying senses which began from evolution with life as biological biggest mystery. However, it could be argued that the evolution of information as an intrinsic property of life for both cellular and non-cellular forms of matter started from the boundless entity and not from the cellular forms of matter. Johannsen (2005) considered catching of information as the first and Loevenstein (2003) argued that the most fundamental level of life is photosynthesis. On the contrary, this might be restrictive to cellular forms of matter but the fundamental level of life could be more generalised to consider the non-cellular entity that initially self-differentiate and subsequently self-integrating at various levels – aggregating progressively – and through evolution to cellular forms of matter.

Conversely, the boundless entity cannot exhibit all the generalised characteristics of the boundary forming entities (Table 2) rather part of its inherent fundamental characteristics which is energy and the most composite of all gave it the ability of simultaneous and instantaneous self-

differentiability and self-integratability bringing about changes in the equilibrium of energy flow (creating gradients) within the omnisphere resulting in the continuous formations of any boundary forming entity. Therefore, the boundless entity with no distinct internal and external environment is a living non-cellular entity and the origin from which all life forms (cellular and non-cellular) evolved.

Research question 5: What could be the new possible levels of integrations to be used in organising cellular and non-cellular forms of life?

The composite levels of integration to organise cellular and non-cellular forms of life including boundless and boundary forming entities is suggested in Table 3. There are two major spheres in organisation of life: infinitiosphere or omnisphere and finitiosphere or partiosphere.

The infinitiosphere or omnisphere is infinite relative to the partial being in finitiosphere or partiosphere of every partial entity but is finite relative to the wholesomeness of *Omnibio* entity itself. The infinitiosphere or omnisphere is the sphere of *Omnibio* entity. Every partial entity is dependent on an external environment to be derived from and grows and develops through interaction between its internal environment and external environment. On the other hand, the wholesome entity is self-dependent on its environment which is non-derivative from any environment. According to the fundamental law of kinematics which states that object will continue to be in motion or state of rest unless acted upon by internal or external force. As for the boundless entity (Omnibio) without distinct internal or external environment, what informed it of its first motion? The inherent fundamental characteristics of life (information, spacetime and mass-energy) confer intelligence to it with consciousness and subjectivity. The multiple laws of nature and its applicability to certain domain leading to various mechanisms functionally and structurally are evidences for the subjectivity of *Omnibio* as an entity while the orderliness that evolved in processes among the partial entities in the universe and multiverse sustainably is evidence of the intelligence of the *Omnibio*.

The word Nature is coined from the Latin word: *naturalis* which means "process", the *Omnibio* being the highest level of organisation of life and non-cellular living entity is ultimately the originator and evolver of all the processes and intrinsically the process, hence Nature. Therefore, all partial entities in finitiosphere evolved and are progressively sustained by ultimately a subjective process (Nature). There is life in every entity. As discussed earlier *that Life is only derivable from life while living and non-living states are interchangeably latent relative to specific environmental factors.* This may be considered as *Biorelativity principle*. Also, considering that the most fundamental characteristic of the cellular or non-cellular matter as a derived life prior to its living state is the information inherent in it mass-energy which enables it to form its internal environment as a distinct entity by interacting (communicating) with the external environment intelligibly to express its quantitative and qualitative characteristics (traits). *Omnibio* is a boundless entity without distinct internal and external environment, therefore, it is constantly in its living states, hence cannot exhibit transfigurability. Its boundless characteristics will never make it exhibit holistic transposability as other boundary-forming entities could; conversely, it may exhibit transposability relative to all its derivative partial entities.

As for the finitiosphere or partiosphere of partial entities, they are also in levels. The highest among the partial entities but second

in the levels of organisation of life is the cosmosphere comprising cosmic entities. These include, in descending order: multiverse, universe, galaxies and solar systems.

The third level of organisation of life is ecosystemic entities in ecosphere. These include planetary bodies like satellites, planets and stars; community and population entities. The fourth in hierarchy of organisation of life are the Organismic entities in Organosphere comprising System-organ entities, organ entities and Tissue entities. Many multicellular entities like *H. sapiens* are in this level of organisation of life. The fifth level of organisation of life is multi-particulate entities in polosphere such as nuclear entities, atomic entities, elemental entities, molecular entities, organelic entities and unicellular entities. The sixth level of organisation of life is particulate entities in monosphere which include Electronic entities, protonic entities and neutronic entities. The lowest level of organisation of life is the infra-particulate entities in infrosphere. These include charges, neutrino, quark, photon, higgs boson and photonic mass series.

CONCLUSIONS

Based on the findings of this research; the following conclusions could be made:

i. All the cellular matters (*A. esculenta, C. gariepinus, H. sapiens*) and non-cellular matter (the Universe) exhibit similar trends in their quantitative characteristics whereby Mass, volume and density are generally increasing with increasing time (age) except for human foetus and Universe that tend to decrease in density with increasing age; Rates of growth, that is, the expansion velocities are decreasing with increasing age; Internal Environment Volumetric Acceleration per unit mass (Go), External Environment Acceleration due to gravity (g), Hubble constant (Ho) all decrease with increasing age;

ii. Similarly the qualitative characteristics are showing evolutionary and developmental structural and functional stages with increasing age through natural automation.

iii. Life is only derivable from life while living and non-living states are interchangeably latent with inherent fundamental characteristics of life being information, mass-energy and spacetime relative to every living entity.

iv. The cellular and non-cellular matters are living entities with boundaries forming their internal environments derived from pre-existing external environments.

v. From evolutionary perspective, every boundary-forming entity must have been derived through chains of pre-existing boundary-forming entities down to a boundless pre-existing environment, that is, such entity would only be the non-derived life with no distinct external or internal environment.

vi. There should be a mechanism such as inflow through probably white hole and outflow through probably black hole that exist in the non-cellular matter (Universe) for it to be increasing in size (growing).

vii. Also the cumulative increase in the mass and volume alongside with other mechanisms are leading to structural formations and functional self-organizing systems in both cellular and non-cellular forms of maters (order and disorder in non-cellular matter are equivalent to

anabolism and catabolism in the cellular matter).

viii. The most fundamental characteristic of the cellular or non-cellular matter as a derived life prior to its living state is the information inherent in it mass-energy which enables it to form its internal environment as a distinct entity by interacting (communicating) with the external environment intelligibly to express its quantitative and qualitative characteristics (traits).

ix. One of the consequences of $E_n = mC_n^2 2\pi$ for $C_n = C^n$ where $1 \leq n \leq \infty$ has led to a proposed physical concept of soul as a cosmic record of every distinct boundary forming entity with natural automation. The cosmic record of every distinct entity at energy level E_∞ with the information carried by the least harmonious mass particle m_∞ is very stable and does not decay.

x. *Omnibio* is the proposed scientific name of the highest level of organisation of life that is the boundless entity with no distinct internal and external environment characterized by information, mass-energy and space-time to its singularity from which the inherent characteristics of life in boundary forming cellular and non-cellular forms of matter were derived through simultaneous and instantaneous self- differentiation and self-integration ability resulting in the continuous formations of any boundary forming entity.

RECOMMENDATIONS

i. The research findings should be re-examined by other scientists and the methods should be replicated for constructive criticism.

ii. This research is a potential shift in current paradigm in respect to the concepts of life and living entity, hence, laid the foundation for a new theory which could complement the theory of everything.

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