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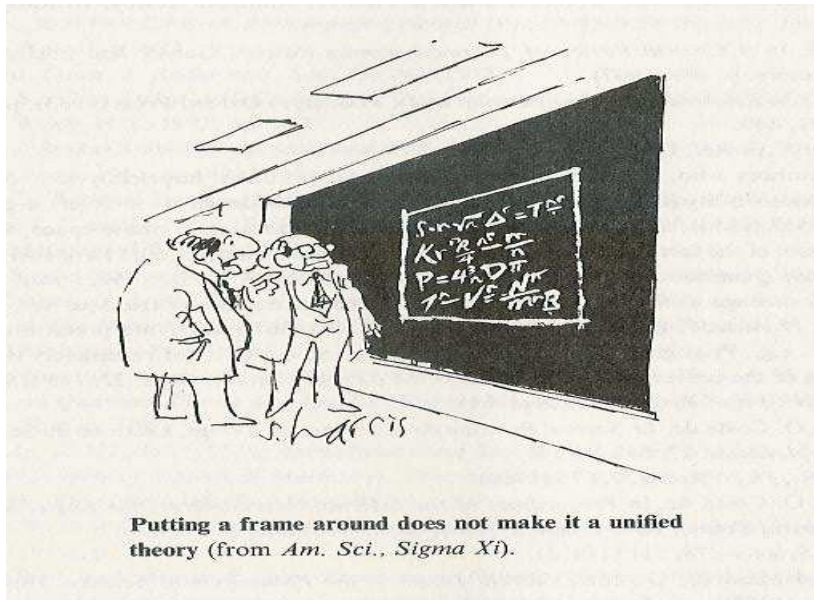
COSMOLOGY, PHYSICS and PHILOSOPHY

Benjamin Gal-Or

Volume III

A Core Curriculum Course

For reviews of Volumes I & II see book end



Pondering about Gravity Physics of Quantum Phenomena

Publisher's Logo

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Introduction

The telescope at one end of his beat,
And at the other end the microscope,
Two instruments of equal hope ...

Robert Frost

If you can look into the seeds of time,
And say which grain will grow and which will not,
Speak then to me ...

William Shakespeare

Faust:

'Tis writ: 'in the beginning was the Word!
I pause, to wonder what is here inferred?
The Word I cannot set supremely high,
A new translation I will try.
I read, if by the spirit I am taught,
This sense: 'In the beginning was the Thought'.
This opening I need to weigh again,
Or sense may suffer from a hasty pen.
Does Thought create, and work, and rule the hour?
'Twere best: 'In the beginning was the Power!
Yet, while the pen is urged with willing fingers,
A sense of doubt and hesitancy lingers.
The spirit come to guide me in my need,
I write, 'In the beginning was the Deed!'

Johann Wolfgang von Goethe

Faust I. Transl. Philip Wayne (Penguin Classics, London)

1.1 Notes to Readers, Mentors, Teachers and Professors

Until around the mid-Thirties of the previous century, Core Cultural-Curriculum Courses (*in Europe!*) were made as “scientific” as possible, and science propped up its foundations by turning to philosophy.

This attitude was in part motivated by the desire to appropriate the sciences with the great past ‘prestige’ of philosophers, and for the philosopher the new ‘status’ of science.

Hence, European professors of physics vied with one another in presenting science based on high physico-philosophical grounds, and philosophy as a ‘science among sciences’, or even as the ‘sum of the other sciences’.

A ‘*PhD*’ was then a *bona fide Philosophy Doctor*, a person of core knowledge and eloquence outside his specialism.

Western education has since withdrawn from the game. Empty specialism has since gained the highest prestige, especially in the U.S.; no longer do professors need borrow it from philosophy nor need to teach any interdisciplinary Core Curriculum Course. [CCC].

Indeed, contemporary teachers and professors vie with one another in presenting fragmented, technical lectures devoid of any interconnected content, for they can no longer hope to achieve popularity by injecting core fundamental knowledge into what has gradually become an ever narrower, disciplinary professionalism.

This turn of events has resulted in overvaluation of technical professionalism, empty academicism, absolutation of ever-narrower disciplines, and the common inclination to reject *bona fide* core knowledge from the class. A pity. For these trends only push the young into cynicism, nihilism and feelings of emptiness in education and in society at large.

Classical skepticism is usually the negation of a core, interconnected, physico-philosophical system. Not so with Einstein's methodology and skepticism.

To start with, Einstein advocated the total removal of borders between disciplines, especially between physics and philosophy.

While such attitudes add fuel to the current academic crisis, especially in the U.S., the Einsteinian methodology leads to unification of some of the most promising kernels of human knowledge, and, thus, to the potential to rejuvenate academic life by an old-new philosophy.

Einstein's failed attempts to unify [deterministic] gravity physics with [non-deterministic] quantum physics, have played a major role not only in the writing of these volumes, but have drove the need to rejuvenate a CCC approach in class, at least in physics and the 'exact sciences'.

In fact, a new physico-philosophical outlook is a matter entailing far more ambiguity than the technicalities of the derivation and application of a new theory, as explained in Volume I. But such justifications are bound up with philosophical considerations, and the latter, according to many, are not anymore *bona fide* topics for the 'exact sciences'.

Currently, our students are almost specifically trained by their teachers and professors **not to ask fundamental questions in class**, as a result of which inconsistent, or outright incorrect premises, are given a better chance of perpetuating themselves.

1.1.1 Knowledge Is One. Its Division is Human Weakness

Although most academic teaching and research must be distributed amongst various departments of a university, there is an objective need to regenerate an old tradition that cannot be associated with any specialism, because the ideas with which it deals are common to all studies, or not involved in any. Accordingly, the selection of material to be included in this book is based on a unified approach to what I consider an updated and much needed CCC book.

Interconnected teaching begins with re-assessment of "well-established" interpretations of 'accepted' theories – whether the problem is that of fragmented knowledge taught in class, or the need to re-assess the curriculum as a whole to adapt to our growing needs.

'Western academic crisis' is not subsiding. More than ever before it now demands answers and acts: How to teach mutual interactions instead of linear causality; structured complexity instead of summation

of events; asymmetric historical buildup of facts, instead of summation of isolated events.

1.1.2 How To Structure A Meaningful CCC?

Thanks to the subdivision of knowledge into fragmented ‘disciplines’, we often fail to perceive the interconnectedness between ‘self-centered’ sciences and various conflicting traditions, to judge their collective importance and to estimate their inherent structure, inner logic and ordering. In trying to overcome this problem, I begin with the problem of how to structure such a CCC.

Here I am simultaneously faced with subjectivistic and objectivistic discourses; subjectivistic, because all thought is, to some extent, ordered by personal bias; objectivistic, because all rational-empirical knowledge singles out regularity and order ranging from the *objectivistic* origins of anything in the world, to the *subjectivistic* perception of the individual ‘Here-Now’.

Should this course be directed from ‘innate’, or ‘a priori ideas’ of subjective human knowledge, to ‘external’ objective concepts?; or in a reverse order?

Should it be from updated key historical world events and their causes, origins and vindications by modern empirical knowledge in the most remote past?, or vice versa?

1.1.3 From Cosmology to Quantum Physics, or Vice Versa?

In structuring this CCC I first assert that large (cosmological, all-embracing) systems dominate smaller ones, not vice versa.

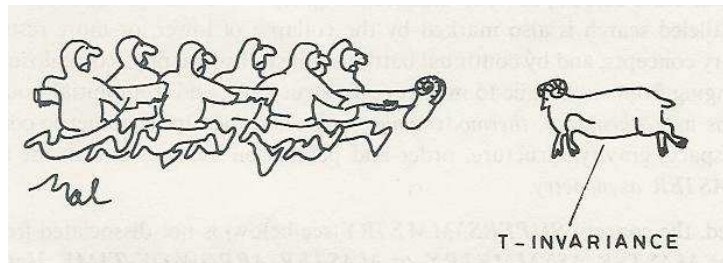
It is below where this idea is vindicated by employing recent empirical data that span a broad range of modern astronomy, astrophysics, physics, biophysics, socio-biology, history, archeology, etc. And it is there that this idea is employed to arrive at some entirely new interdisciplinary concepts about our world today.

Therefore, I shall also try to employ this structuring order in guiding a CCC based on this book.

This means that the road from *objective* knowledge to a better understanding of the origins of *subjective* knowledge must always be from *external* to *internal* worlds, namely, from the study of the most remote and earliest regions (in both space and time) of the external ‘outside’, to the most innate spheres of subjective memory, perception and brain-mind of the individual. Here the concepts ‘external’ and ‘outside’ need philosophical clarifications. This will be done later.

Consequently, this CCC starts from the cosmos and connects its dynamics, as explained in the main text, to our brain-mind perception of reality. It proceeds from the origin of time, irreversibility and the universe, to the origin of life, and from there to the origin of written language and updated modern unified knowledge.

It is only by passing these initial stages that we shall be prepared for a rational examination of old-new disputes in physics and to respond to future student’s needs in the face of inherent limitations embedded even in the best university.



Quantum physicists attack strange micro-irreversibility discovered in elementary-particles Kaonic systems [§1.7]

1.1.4 Asymmetry Vs. Symmetry Are The Key Issues Of Physics

Beyond space and time, or curved space-time, symmetry and asymmetry are the most important issues in science, especially in physics, as will be demonstrated later. Nevertheless, every item of carefully recorded information is a proper object for analysis. A drive towards novelty and discovery impels inquiry to explore all corners of the universe.

Moreover, the whole structure of unified and fundamental knowledge is not dissociated from detailed inquiries in astronomy,

astrophysics, biophysics, biology, archeology, brain-mind perception and psychology. Closely related to the unrestricted content of modern science is its unrestricted questioning of all earlier convictions.

1.1.5 Re-Assessment: A Key Scientific Principle

No belief, or even a prize-winning theory, is too sacred, or too firmly established to prevent radical evaluation of its soundness on any scale of observation. A serious scientific attitude premises willingness to admit new hypotheses, even those that seem to contradict intuitive, popular and anthropocentric theories. I shall therefore not hesitate to use these principles in leading minority attacks against the high walls of traditional majority in physics, as will become clear in the next few sections of this Introduction.

There is something provisional about all scientific theories. They have to be confirmed by fresh information from any sub-field, hence, are subject to constant revision and even replacement; -- in this, each succeeding generation takes a measurable step beyond the position of its predecessors.

Nevertheless, unlike Volume I, this one does not contain mathematics and complex definitions of physico-specialism and philosophy of science. Such a strategy does not weaken our minority attack. It may only help it, for much of the wrongs that are made today are introduced by researchers prior to writing the first mathematical equation, prior to defining the first misleading term of physics. Moreover, this strategy is adopted here to actually USE this volume as a tool, not just as a monograph aimed at a few top physicists and philosophers, as had been the case with Volume I. Instead, this volume is intended, as far as possible, to teach and draft 'CCC-soldiers' that can master the non-mathematical tools that underscore the very foundations of most 'exact' and other sciences.

1.2 Failures and Split-Physics Disputations

Einsteinian relativistic gravity physics and quantum physics constitute two different physico-philosophical world outlooks that are in constant conflict with each other.

The dispute splits physics into two unbridgeable fundamental systems of thought, each involving far-reaching implications in general science and philosophy.

Some of the key issues involved are reviewed in Vol. I, §§5.1 to 5.6, and in what is briefly discussed in §§1.2; 1.2.1 to 1.5 below.

1.2.1 Smuggling-In ‘Proofs’ in Super-String Theory, Etc.

Even in the much-acclaimed ‘*Super-String Theory*’, armies of physicists smuggle into their formulations the results of what they want to prove. In fact, they *a priori* plug into their mathematical ‘proofs’ observational facts, say, about the electron and other known values that they *a priori* know may lead to the sought-after mathematical ‘proof’ of their theory.

All such theories contain contraband-like constants, such as artificially-inserted, experimentally-known masses of ‘elementary particles’ and the strength and units of the electric charge. These are inserted into the theory for no other reason than that their formulation would provide agreement with experimental results, which are unavailable at the disputed distance: 10^{-35} meter. A self-deception?

Another, independent dispute: Despite three decades of endless attempts to provide us with experimental proof of string theories, as conducted by hundreds of physicists, there is not a single verification that the theory is correct. It claims, in short, that on sub-atomic scales, all matter and all fundamental field-forces consist of vibrating strings of energy. The speculated strings are beyond verification for their scale may be about 10^{-35} m and are vibrating at specific resonant frequencies. That assumed string size is way too small to measure by any of the current **and expected** particle physics technologies.

Moreover, there are different theories and formulations, or models. Quantum physics is satisfied for it gets away from a point-like elementary particle when such strings vibrate in 10 dimensions, or 11 or even 26. The spectrum of subatomic particles then emerges as small vibrating strings that by altering their mode of vibration they transform an electron into a neutrino, a quark, or other particles, while causing space-time to curve around them so as to give rise to Einsteinian relativistic gravity as a by-product, not as a cosmological framework that can be verified. Despite good intentions, string theories have not unified physics. Einstein’s anti-probabilistic views remain un-falsified.

Furthermore, while its various equations have survived mathematical challenges, each solution represents an entire universe. Hence, to test the theory, one must create a baby universe in a laboratory; -- an un-testable fantasy, a mathematically-based mysticism of scientists, which, when combined with the fundamental issue of *a priori* smuggling into these theories what is to be proved, makes them what they are.¹ Similarly, the much acclaimed ‘*Final Theory of Everything*’ that some have claimed that they had successfully invented, is misleading. In this context, I find it suitable to quote *Steve Weinberg*:

“I don't like the term 'theory of everything' because it suggests that there is some theory that when discovered will immediately solve all scientific problems. Clearly there isn't any such thing. I do think that we may find what I like to call a 'final theory'; that is, a single simple theory that pushes all our explanations as far as they can go.”

Nature, ‘published online’, Jan. 19, 2005

1.2.2 Further Failures of ‘Proofs’ In Other Formulations

All fundamental statistics and probabilities are precisely symmetric under time reversal. Statistical ‘*prediction*’ is precisely symmetric to statistical ‘*retrodiction*’. Hence, no distinction as to the *observed* unidirection of time can be derived from statistics and probabilities, in themselves. In other words, recourse to statistics and or to probabilities, and or to any “*averaging process over detailed molecular motions*”, *etc.* [Vol. I, §51-to 5.6], cannot, by itself, result in a proof of the origin of time-asymmetry and irreversibility in nature, as claimed by many. [§1.4]

The origin of irreversibility in nature cannot therefore be found in any formalism of quantum or classical statistical mechanics, no matter how “sophisticated” is the latter. That fundamental issue remains unresolved even when one imposes *a priori* observed and known initial and boundary conditions on any time-symmetric differential equations

¹ Super-string theories may include fermions, the building blocks of matter and incorporate supersymmetry [Vol I, §5.6.3], a conjectured -- but unobserved -- symmetry of nature. String theories are usually fragmented according to whether or not the strings are required to be closed loops, and whether or not their predicted elementary particle-spectrum includes fermions.

so as to get *integro-differential solutions* that are to be compared with *observations*. Indeed, when one selects *retarded solutions of electromagnetism*, while rejecting the time-symmetric *advanced solutions*, he simply fools himself in assuming that he has found the ‘proof’ of time asymmetry and the origin of irreversibility in electromagnetism. Other examples are provided in Volume I.

1.2.3 Rival Disputations

Special relativity reigns superb in quantum micro-physics, say, in characterizing sub-atomic particles, gauge theories, quantum field equations, quantum electrodynamics and chromodynamics. [Vol. I]

In turn, quantum physics reigns superb in small-scale physics. However, fundamentally and in practice it is scale-limited both on very small and mainly in very large cosmological scales. It is in fact scale-limited physics, aside from the famous issues of non-determinism that Einstein had raised and the other, aforementioned failures.

In contrast, Einsteinian general relativity reigns superb in astrophysics, cosmology, and, via Newtonian physics that it includes as an approximation in low gravitational fields, such as on earth, in various other macro-systems.

1.2.4 The Unresolved Issues: Type I Vs. Type II

The split in physics has remained a tantalizing, unresolved issue that is presented here from the *minority* world outlook associated with Einstein. In more general terms it constitutes a two-fold type of disputation:

TYPE I: Between Einsteinian deterministic world outlook and the probabilistic one claimed by most interpreters of quantum physics.

TYPE II: Between different interpreters, and sort of ‘clubs’, within the framework of fundamental quantum physics.

Type-II disputation is of particular interest to all scientists not only for exposing an unsubsidizing weaknesses of inherently different physico-philosophical interpretations of quantum physics, as upheld by the great *majority* of physicists, but because its various, or even conflicting, or contradicting views, demonstrate what Einstein had claimed until his

last moment half a century ago: Quantum theory formulations and its great success in exact predictions of phenomena in the small-scale world, do not mean, **by themselves**, that it is a complete theory.

Indeed, the theory remains a very useful probabilistic tool that functions superbly, perhaps in analogy to the great usefulness of entropy-steam maps in engineering designs of steam engines, refineries, etc., even though the entropy concept itself remains a ghost in fundamental science, a ghost that can be easily replaced by dissipated energy. [Vol. I] (Entropy, like information, is neither energy nor mass. Moreover, it encounters un-resolved problems in relativistic transformations.)

Quantum physics precise tools allow one to exactly predict the characteristics of physical-entities-crowds, but the picture is fundamentally different in the domain of a *bona fide* approximation of a single elementary particle as an ‘entity-in-itself’, and in cosmology.

Moreover, Type-II disputations demonstrate the fact that fundamentally, even the most updated approximations and interpretations are still far apart from each other, and provide no proof for any claim that *small-scale systems* control the large evolution of the cosmos, galaxies and stars, where general relativistic gravity reigns superb. But prior to resting my splendid minority case, I must add:

There is an independent *philosophical-linguistic issue* associated with Type-II disputations: Type II disputes often sound as personal interpretations of quantum physics world outlook; disputes that generate a sort of different cults, each with its own physico-philosophical jargon; a jargon that sometimes amounts to an incomplete physico-philosophical model, or a private one, or even a mystic one that is foreign to science.

As a matter of fact, such un-subsidying disputations inside the house quantum physics resemble a phenomenon that today, more than ever before, may be motivated by an inner desire to deny Einstein’s world outlook and refrain from admitting their surrender to his world outlook. What actually drive such ambitions I do not know.

The dispute also overflows above and beyond the superb exactness of each theory. But the ‘degree of exactness’ in formulation a theory and in its verification in small or large-scale systems has nothing to do with deep-rooted physico-philosophical meaning of each.

Additional fundamental problems emerge when physicists attempt to unify quantum physics with general relativistic gravity physics, which superbly stands as the indisputable, well-verified description of the cosmos, galaxies, stars, planets and curved space-time at any scale.

My opponents [see, e.g., §1.4] present a flat physico-philosophical denial that both statistical mechanics and quantum physics are scale-limited models that cannot fundamentally provide us with *any* proof of the origin of thermodynamics, time-asymmetry and irreversibility in nature, or that the key challenge in science remains: How to prove that irreversible change emerges from *time-reversible mathematics*; that that proof has not yet been implemented in classical, statistical or quantum physics; that in fact it is fundamentally and inherently impossible, as further explained below.

1.3 THE CENTRAL THEME OF THIS BOOK

In contrast to what is explained and concluded in §1.2 above, one may try to assign priority to relativistic gravity physics over quantum physics, to determinism over indeterminism. It is an unpopular thesis in which Einstein had been practically left alone.

To begin with, I re-visit Einstein's world outlook and try to re-assess some key parts in it in light of new discoveries, such as the 1964-discovery of the background black body radiation, gravitational lens, various new supernovae, etc. Such and many other discoveries have finally proved that the expansion of inter-galactic space from a dense-hot beginning is not a theory, as some have claimed. [§1.4]. It is a well-established observational fact. Even the proponents of the so-called '*steady-state universe*' had to accept that fact and, therefore, retract their theory to the files of the history of science.

In line with the physico-philosophical failures of fundamental quantum physics interpretations in the domains summarized in §1.2 above (see also the '*First Provocative Question*' and the '*Reply*' provided in §§1.4 and 1.5 below), both the Neo-Einsteinian world outlook and the gravity-induced, deterministic theory presented in this book, provide us with the long sought after Cause and proof of the origin of time-asymmetry and irreversibility in nature, and, as we shall see, of much more in non-relativistic, gravity-based science, biological evolution, world history and brain-mind perception and functioning.

The four integrated/inter-connected cornerstones of the new theory are grounded in the following mathematical and observational facts:

1.3.1 Einstein, Hubble, Astronomy and Astrophysics

Einstein's field equations of general relativity accept no static solutions when applied to cosmology. This is a well-known, mathematical proof in physics. [Vol. I, §§3.2; 3.2.7.2 and 3.2.7.3]

That physico-mathematical proof was first verified in the mid 20's of the last century by means of the simple astronomical methods of *Hubble*. It has since been independently re-verified by *Penzias* and *Wilson* as the 1964-discovery of the '*background black-body radiation*' [Assertion 4.1 in Chapter 2, and Vol. I, Intrd., §2.4], by radio and X-ray astronomy and by the various methods currently used on board of NASA's *Hubble Space-Telescope* and elsewhere around the globe. [Assertion 4.3 in Chapter 2].

These facts are not new.

Nevertheless, they constitute the indisputable, well-verified cornerstone of what is explained in Chapter 2 and briefly summarized in §§ 1.3.2 to 1.3.4 and §§1.4 and 1.5 next.

1.3.2 Analogy, Gamow, Un- Saturable Space, 1st Cause

ANALOGY:

My central theme may not be easy to grasp. I therefore begin this section by introducing the simplest analogy, or thought experiment, that I can imagine in teaching a CCC-class. It is, however, only an analogy. To better understand its universal meanings one may later resort to Chapter 2, or even to the physico-mathematical proofs provided in Volume 1.

Imagine filling up a highly flexible rubber bath tube at your home, but a bath tube that is so flexible that it somehow inflates and expands faster than the maximum rate that the you can fill it up with water. The level of water would then decrease and you would not be able to take a bath.

GAMOW:

Some sort of such an imagination had been probably behind the initial thinking of *George Gamow*, one of the great 20th century physicists, when he predicted, in 1948, that the left-over radiation from the first days of the cosmic expansion, would, by now, have been cooled down to a few degrees Kelvin all over the expanding inter-galactic space. Gamow's prediction was verified 16 years later, in 1964, by *Penzias* and *Wilson*, by the discovery of the background black-body radiation. We shall return to this key issue in Chapter 2.

UN-SATURABLE SPACE:

If an imaginary universe has not been expanding during the last 13.7 billion years or so, a thermal cosmic EQUILIBRIUM would have destroyed all proto-galaxies, proto-stars and other initially agglomerating structures in the early cosmos. We shall also return to this issue in our calendar of the first six days, as provided in Chapter 4.

In fact, any gravity-induced structural entity would not even begin to agglomerate in such a hot, initial equilibrium, namely, if the universe was static about 13.7 billion years ago. [Chapters 2 and 4]. Under these conditions no structure-entity can emerge in the cosmos. No irreversible process would exist anywhere in such a static cosmos, which is maintained in thermal equilibrium, past or today. But the indisputable fact is that it is not. It IS expanding, but in a particular way that is described in details in Chapter 2.

FIRST CAUSE:

The First Cause of what I term the cosmic *un-saturable sink*, involves the well-verified EXPANSION of the universe as predicted by Einstein's relativistic cosmology and verified by Hubble *et al.* [§1.3.1] HOWEVER, THAT EXPANSION HAS BEEN CONFINED TO INTER-GALACTIC SPACE. Namely, to what I term un-saturable sink. To conclude: the observed expansion of inter-galactic space is in line with general relativistic cosmology [§1.3.1], and it involves only inter-galactic space. Its dynamics provide us with the First Cause and the origin of time-asymmetry and irreversibility in nature, as I shall explain next.

The observed dynamics of un-saturable inter-galactic space are independent of any additional sinks in the cosmos, such as those provided by localized black holes.

To Conclude:

With or without black holes, inter-galactic space, IS UNSATURABLE vis-à-vis THE GIGANTIC INFLOWING STELLAR ENERGY, OR “WINDS”, BECAUSE IT EXPANDS FASTER THAN IT IS FILLED UP WITH OUTGOING STELLAR RADIATION.

1.3.3 Temperature-Density-Pressure Gradients; 2nd Cause

The un-saturable sink is the first Cause for of all temperature-density-pressure gradients observed in all galaxies, stars and planets. This is explained by the Assertions in Chapter 2 and by Fig. 1 there, and is not to be repeated here.

1.3.4 The Long-Sought Proof

The so generated temperature-density-pressure gradients are the 2nd Cause of all irreversible processes in nature. They drive and sustain all observed energy-particles ‘winds’ pouring out from all active galactic and stellar sources in any (adiabatic) super-cluster ‘cell’ [Chapter 2].

The earth reflects back-into-space all incoming sun-energy. Namely, after about half of it is circulated in our atmosphere, all incoming solar energy reflects back into the depth of the observed dark-cold ‘night sky’, which forms an integral part of un-saturable space.

The First and Second Causes provide us with the long sought after proof of time-asymmetry and irreversibility in nature. In subsequent chapters these conclusions lead to explanations about additional, gravity-induced, everyday phenomena, ranging from entropy-free thermodynamics [Vol. I] to gravity-induced evolution and world history. [Chapter 6, TABLE II]

1.4 The First Provocative Question

It was about 40 years ago that I first realized, with a tantalizing shock, that it is not ‘scientifically sufficient’ to prove, publish and lecture on the mathematical and observational Causes, origins and foundations of this new, gravity-physics-induced theory and on a Neo-Einsteinian world outlook. One must first prove that, in this domain, the competitor theories of statistical and quantum physics fail in their physico-

philosophical and mathematical ‘proofs’; that they constitute a self-deception that borders with smuggling into their theories, without declaring the contraband, what their authors want to prove.

That shocking realization happened first at the end of my seminar at the university of Connecticut in 1968. A reputed professor of engineering’, as my host referred to him, had tried to demonstrate the alleged absurdity of my thesis by lighting up a match in the lecture hall, while adding, apparently to make the audience laugh:

Do you claim that I can light-up this match because there is a theory that the universe expands? Nothing expands in this lecture hall, as far as I can see. As to your alleged new theory, statistical and quantum mechanics have already provided us with perfect and elegant mathematical proofs of what you try in vain to re-prove. There is absolutely no need in science for another theory about the origin of irreversibility in nature.

Much of the audience, hearing that declaration from their highly reputed professor, did not even bother to stay and hear my reply. The seminar participants left the lecture hall together with the professor. I also recall that my host was highly embarrassed. Yet, a few young physicists stayed to hear my reply.

1.5 The Reply

Nothing in this lecture hall, at home, on earth, in the solar system, in our galaxy and in our cluster of galaxies co-expands with intergalactic space. But only that hard-to-define space provides us, with or without local black holes, with an UNSATURABLE SINK for all radiation-particles emerging from all galactic and stellar sources.

These well-verified observations of the first Cause: The unsaturable cosmic sink vis-à-vis the second Cause: The resulting temperature-density-pressure gradients in all active galactic sources, constitute the corner stone of my theory.

Combined with the facts that quantum physics is scale-limited and that Einstein’s field equations of general relativity accept no static (equilibrium) cosmological solutions, this un-saturable sink for all energy forms is the very Cause and origin of all irreversible processes that have led to our biosphere, amino acids, DNA, viruses and all forms

of life, and, eventually, to one's ability to set-up fire in a lecture hall by lighting-up a match.

1.5.1 On The Ability To Light-Up Matches in Lecture Halls

Instead of lighting-up matches in lecture halls, one may ask:

Why is the night sky so dark and cold?

*Why is the 1964-discovered **background black-body radiation** that fills the whole of space, being maintained at 270 degrees Celsius below zero, **despite** the gigantic energy-particles 'winds' emerging from all active stars and galaxies and flowing into it?*

Is that energy lost in violating the laws of physics? Where is it?

*Was the universe to become **static** tomorrow, and, therefore, eventually attain a state of uniform cosmic **thermal equilibrium** everywhere, would such a non-expanding inter-galactic space stop all irreversible processes anywhere?*

Attaining such thermal equilibrium would not happen at once if our universe indeed would stop expanding tomorrow. But it would, after sufficiently long cosmic time, increase the low temperature of the observed background black body radiation, i.e., the very low temperature of the dark-cold 'night sky' would gradually increase due to the gigantic quantities of energy that pours into it from all active galaxies and stars.

Gradually the 'night sky' would become as hot and bright as the sun's core temperature.

It would then stop the ability of distinguished professors to light-up matches in lecture halls. I then repeated what is explained in more details in §1.2.

Nevertheless, my theory was well accepted in 1966 at *Huntsville Space Center*; in 1968; at the Pittsburgh Conference "A *Critical Review of the Foundations of Relativistic and Classical Thermodynamics*", [Mono Books, 1969]; in 1971, by *Nature* [230, 1971]; in 1972 by *Science* as a major review paper on the origin of irreversibility in nature [176, 11-17,

1972]; in 1972 by the *New York Academy of Sciences* [Gold Medal, *Annals*, N. Y. Acad. Sci., 196 (A6), pp. 305-325, 1972; “*Entropy, Fallacy, and the Origin of irreversibility*”], and, finally, via worldwide acclaims in reputed international journals. [Some of these are reproduced in the last Chapter herein, with three quotations that would be repeated below to better explain our theory by using the words of others.]

In the meanwhile, however, *I. Prigogine* received the Nobel Prize for a counter theory that uses time-symmetric, reversible equations to ‘prove’ the origin of thermodynamics and irreversibility in nature.

1.6 Important Events Since Einstein’s Death

Much has happened since in relativistic gravity and in quantum physics since Einstein’s death. Some of these developments may affect Einstein’s original physico-philosophical heritage in which he was practically alone in his quest for deterministic physics.

The most important event is the *Weinberg-Salam unification* of the *electromagnetic and the weak fields-forces-interactions*.

Nevertheless, further unification has not yet been attained, despite the much acclaimed *super-string theory* and the discovery of many ‘elementary particles’ and new astronomical objects. [Vol. I]

Einstein’s has also stated the highly theoretical possibility of *gravitational lens* that may magnify far-away/early astronomical events. Indeed, most recently, a few such discoveries have been made. They reveal interesting data on events that took place when the ‘age’ of the universe was around 300,000 to half a million years. [Cf. Table I]

As to Einstein’s lonely quest for deterministic gravity physics that would contain quantum phenomena, one may mention *Sachs’ Quantum Mechanics and Gravity*, Springer, *The Frontiers Collection*, 2004, in which quantum mechanics emerges as a linear, flatspace approximation for the equations of inertia in general relativity.

In a supporting review, *J. Hartley*, in *Contemporary Physics*, Vol. 45 (6), 2004, writes:

“Sachs’ book is a fascinating exposition of how an approximation in general relativity brings out quantum mechanical features. Perhaps Einstein would have been greatly interested. ... I think it should be read by anyone who is interested in quantum mechanics and gravity.”

1.7 Future Unified Theories of Macro and Micro Irreversibilities

This issue had first surfaced in the Einstein-Ritz confrontation (1908-1909) over the origin of time-asymmetry in electrodynamics and entropy. Ritz argued that electrodynamic irreversibility was one of the roots of the second law of thermodynamics, while Einstein rightly defended electromagnetic time-symmetry. [See References 1 to 20].

This central issue has been re-assessed and expanded in Vol. I [§§4.11, 6.3, 6.10 and 7.8], in light of the discovery of microscopic irreversibility that apparently contradicts the [reversible] fundamentals of quantum physics at least in Kaonic systems. It is therefore termed “T-violations” in quantum physics. [Vol. I, §§4.11].

Formulations and observational verification of a more unified theory of [macro] thermodynamic and [micro] electromagnetic irreversibilities may originate in a coupled or unified theory of Einstein’s general relativity and quantum electro and chromodynamics as well as the verified *Weinberg-Salam* unified theory of electro-weak interactions. Such an ultimate theory is, perhaps, one of the most challenging fields of future research.

In the meantime, however, the ‘second law’ can be derived from the resulting time-asymmetry predicted first by Einstein’s general relativity and later verified (by independent observational methodologies) of the expansion of inter-galactic SPACE “1”, the generation of temperature-density-pressure gradients in all galactic, stellar and planetary systems observed in the cosmos and in ‘our’ solar system, as depicted and explained in Fig. 1, Chapter 2 and associated Assertions.

From Cosmology to the Foundations of Physics

It is my belief that philosophy must return to cosmology,
and to a simple theory of knowledge.
There is at least one philosophical problem
in which all thinking men are interested:
The problem of understanding the world in which we live;
and thus ourselves
(who are part of the world)
and our knowledge of it.
All science is cosmology, I believe,
and for me the interest of philosophy,
no less than of science,
lies solely in its bold attempt to add to our knowledge of the world,
and to the theory of our knowledge of the world.
Sir Karl R. Popper

2.1 Introduction

The next time that you see your mail-delivery person, please remind him or her, about the fact that your zip code is 27,000 light-years¹ away from the galactic center of our ‘spiral galaxy county’.

In fact, all of us in the ‘Solar System Community’ have acquired a ‘good-sit-in-the-middle of the Milky-Way Rotating Theater-of-Nature’². Our Milky Way galaxy is located in ‘our’ *Virgo* ‘local group’³. That zip-code reminder may be useful just in case that you want to travel deep into outer inter-galactic space and find your way back home, or if someone you meet out there would be looking for you.

¹ One **light-year** is the distance an electromagnetic wave, like light, travels in vacuum or empty space during one year. Since the speed of light in ‘empty’ space is about 300,000 km/sec, we multiply it by 60 seconds per minute, 60 minutes per hour, 24 hours per day and 365 days per year: The result is about about 9,461,000,000,000 km, or about 5,734,000,000,000 miles. Distances to our neighbors in the ‘local group’ may be referred to by using *Milky-Way’s- diameters away from each other*. Local group distances are ranging from about 1.6 to 17 Milky-Way’s- diameters. How distances to astronomical objects are measured? The various methods used are explained in *Vol. I, §1.7*. Example: The distance from earth to the nearest star beyond the sun is about 4 light-years.

To plan such a deep-space trip we provide you with a map in the form of Fig. 1. Please use it if you want to know what you are trying to accomplish beyond a mere travel to SPACE “1” Kingdom of Darkness.

What would you be looking for in SPACE “1” and why?

Einstein’s field equations of gravity physics (general relativity) accept no static solutions when applied to cosmology.

Accordingly, the cosmos must expand or contract. Namely, it cannot stay still and attain thermal equilibrium all over space and time. That is to say, over all Einsteinian general relativistic curved space-time. Indeed, as may become clear later, your mission would be to search for the hidden foundations of physics. *Bone Voyage!*

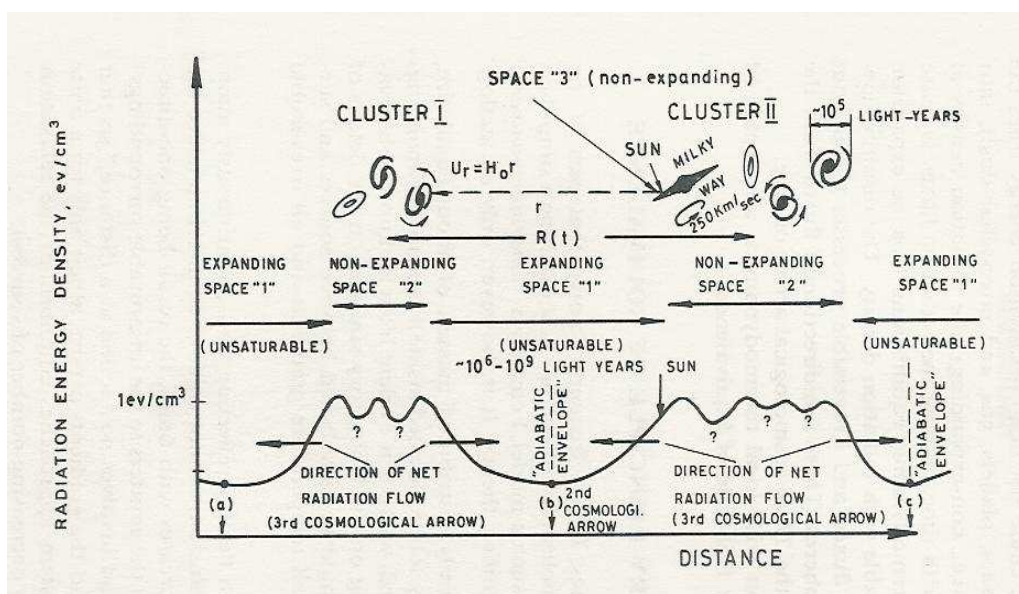


Fig. 1: A Schematic Map For The Central-Theme-Voyage

Most mortals, during all historical times, have paid much attention to the sun, moon, stars and galaxies. They simply took for granted the dark night sky as the obvious ‘background’ for these shining entities. It is, however, the other way around. The dark and cold night sky is much more important in establishing our physico-philosophical central theme than all these shining entities combined.

Indeed, from our physico-philosophical point of view, SPACE “1” [see Fig. 1] represents what we observe and feel as the cold-dark-night sky, which constitutes the most important and most interesting interconnected system in the entire universe. At one and the same time

it is far away from us, dark and cold, while it also cools us, even when we are sheltered at our secured home. So we first claim that one must pay more attention to the slightly strange dynamics of expanding SPACE “1”. But there is much more in this issue for fundamental physics than what first meets the eye. This will be explained below.

2.2 Assertions Explained

Assertion 1:

I first assert that we would not come into being in a cosmic equilibrium, for under equilibrium conditions there would be neither active galaxies and stars, nor planets, biosphere, life and books.

I next assert that only SPACE “1” has been expanding and cooling down during the last 13.7 billion years since its hot beginning.

Consequently, no irreversible process is feasible anywhere if SPACE “1” attains a long-lasting static conditions. Such conditions would lead to uniform cosmic thermal equilibrium, that, in turn, would stop all irreversible processes in galaxies, stars, planets, etc. This conclusion too would require detailed explanations, as will be done later.

It is a well-known fact that the ‘expansion of the universe’, namely, without paying much attention to the dynamics of SPACE “1”, had been predicted by Einstein’s gravity physics and has been verified by 1) Hubble’s famous observations in the 20’s, 2) The 1964-discovery of the cosmic black-body radiation, and 3) by other methods, such as the ones currently used by the Hubble Space Telescope.

To Conclude:

SPACE “1” expansion *is not just a theory*, as some still assume. It is a well-verified fact. In turn, quantum physics fails in cosmology for its fundamental lack of cosmological predictability and consequences concerning Einsteinian relativistic physics at any scale. Quantum physics is therefore a scale-limited theory.

2 **LINEAR & ROTATIONAL MOTIONS** -- Our galaxy (the Milky way) linearly moves with the ‘local group’³ in inter-galactic space while simultaneously rotating. It completes one revolution in about 250 million years. Its center moves linearly at about 600 km/sec with respect to the ‘cosmic background radiation’ that fills the whole expanding and non-expanding spaces outside planets, stars, galaxies and super-clusters of galaxies. [Fig. 1]. The earth’s net motion in space is about 400 km/sec. The direction of the earth’s net motion lies in the same plane as its orbit around the sun⁵ and at angle of 61degrees tilted upward [northward] from the plane of the disk-like milky way.⁴ As the sun’s gravitational captive, the earth travels around the sun at a speed of about 30 km/sec. Yet, this speed should not be confused with the recession speed of super-cluster galaxies from each other, as shown in Fig. 1. Taking into account all these velocities, our galaxy is deviating from the cosmological uniform expansion motion by about 600 km/sec.

Assertion 2:

I next assert that the collection of all spots (a), (b), (c), etc., wrap each super-cluster of galaxies, schematically marked as *CLUSTER I* or *II* in Fig. 1. Each super-cluster is ‘encaged’ inside an *Invisible, Expanding, Adiabatic ‘Cell’* (see below). The shapes of such ‘cells’ are not spherical, but more like long, twisted balloons, or ‘filaments’, in line with the observed shapes of super-clusters of galaxies. [see below]

Such ‘SUPER-CLUSTERS OF GALAXIES INSIDE INVISIBLE ADIABATIC CELLS’ permit no NET flow of energy from one super-cluster to another, namely, from one cosmos domain to another that contains other super-clusters of galaxies. I.e., on sufficiently large scales, the cosmos attains about the same maximum temperature at any given cosmic epoch. [see also Assertion 4.5].

Moreover, I assert that the expansion of SPACE “1”, and consequently its cooling down with cosmic time, CAUSES the generation of **all chemistry** in the cosmos, i.e., beyond hydrogen and helium. This generation takes place inside all active stars, and in *supernovae explosions* of large active stars that throw into “empty” spaces “1”, “2” and “3” **all the building blocks of life**, namely, those that would later be in our **bodies and brain**. [Assertion 4.5 and Fig. 2.]

³ Our ‘local group’ of galaxies is usually counted as containing 30 gravitationally-bounded galaxies, the largest of which are *Andromeda and our galaxy, the Milky Way*⁴. The local group is about 10,000,000 light-years in diameter. It is counted as a ‘member’ of the *Virgo Supercluster* of galaxies. It consists of *M49, M58, M59, M60, M61, M84, M86, M87, M89*, etc. X-ray studies have also revealed the presence of large amounts of intergalactic gas known as the *intra-cluster medium*, which may also emit X-rays. Notable galaxy clusters include ‘our’ *Virgo Cluster, the Hercules Cluster*, and the *Coma Cluster*.

⁴ **THE MILKY WAY GALAXY** contains billions of star-bodies like the sun⁴, each bounded together through gravity. Most stars are formed in the dilute regions of rotating interstellar SPACE “3” that is schematically depicted in Fig. 1. Our galaxy is almost 100,000 light-years in diameter, [80,000 light years in a conservative count] and is in the form of an almost flat spiral disk with an average thickness of about 1,000 light-years. *Andromeda* ‘belongs’ to ‘our’ local group and it also constitutes of a spiral structure and diameter like ours. It is located about 2,200,000 light-years away from us.

⁵ Like all stars in the universe, **the sun** is a *self-gravitating* massive sphere of sub-atomic particles in a state of a very hot *plasma* bounded together and pressed-heated by the attractive force gravity. The bigger the mass of the star, the higher are the inner pressures and temperatures and faster are the fusion processes in its interior. [See also supernova] The sun and all active stars produces energy through ‘*nuclear fusion*’ like the familiar fusion in a hydrogen bomb. Fusion transforms hydrogen into ‘**heavier elements**’ like carbon, oxygen, nitrogen, carbon, phosphore, iron, etc. Hence, the sun, and all active stars, generate the heavier elements in nature. ‘Our’ sun accounts for about 99% of the solar system's total mass⁵. Its diameter is 1.392 million km and is somewhat greater than that of an average star in the Milky Way galaxy.⁴ About 74% of the sun’s mass is hydrogen, with 25% helium, and the rest is composed of heavier elements generated by its gravity-induced thermo-nuclear reactions. Unlike a planet, a star, like the sun, generates its own energy by fusion and emits that energy as radiation and mass particles that are generally referred to as the ‘**solar wind**’⁶, which also engulfs earth. **More than two hundred planets have been discovered so far orbiting other stars.**

Assertion 3:

This book is arranged from the description of the dynamics of the largest and earliest gravity systems in the cosmos, down to smaller and later ones. The vast SPACE “1” constitutes the corner stone of our gravity-induced thesis about the origin and functioning of life, and about our knowledge of the world around and inside us, including socio-biology and the origin of natural selection and language.

I also maintain that the very act of defining a word or a concept erects a ‘fence’ around it. Anything outside that fence may, *a priori*, be wrongly rejected and lost, unless it involves the entire cosmos. Verbally precise, non-cosmic definitions, may thus be neither wise, nor practical. Yet, we use them daily in academia, science and philosophy.

According to *Plato*, everything is connected with everything else. Therefore, any verbal, non-cosmic definition, may eventually include 'the whole universe'. Consequently, whenever possible, I try to minimize the common act of 'precise verbal definition' of non-cosmic concepts, for contrary to good intent, it may introduce misunderstanding and error.

This Assertion is first used here in introducing Fig. 1 and its associated assertions. In this context, Fig. 1 is only a schematic diagram, or ‘a cosmic traveler map’ that helps to explain verified evidence vis-à-vis mythologies and disinformation in science. Fig. 1 is therefore provided here to help reject common errors in what has been considered ‘fundamental’ but is in fact distorted definitions of many sections of the world in which we live. Fig. 1 is thus not intended to teach astronomy, astrophysics, thermodynamics, space dynamics, etc. Hence, not all astronomical systems need to be explained here.

⁶ **The solar system** is comprised of our sun with its orbiting planets, moons, asteroids, comets, rocks and dust, all bounded together by the attractive gravitational field of the sun, ‘our’ galaxy and **supercluster virgo** and the rest of the universe. The sun emits radiation and sub-atomic particles as a result of a fusion process that releases energy. The gravitational field of the sun, and of its ‘*solar wind*’, extends far beyond the farthest planets, asteroids, comets, rocks and dust. Its edge is located in the space called *interstellar space*. [space “2” in Fig. 1]. Inside it, but not at its edge, there is the *Oort Cloud*, which consists of trillions of comets that orbit the sun beyond the orbit of the dwarf planet called *Pluto*.

⁷ **The solar wind** clashes with opposing ‘solar winds’ emerging from nearby stars to form a gigantic *shock wave* that we see as a glowing boundary of the solar system called the *helioshere*. The solar wind, as well as ‘similar winds’ emerging from other stars, is *dissipated in* cold SPACE “2”, a medium composed mainly of dilute concentrations of hydrogen, helium and neutrinos. The last permeate the entire cosmos.

Assertion 4:

UNSATURABILITY of SPACE “1” is Central Theme in Physics

The expansion of the universe neither includes the reader, unless he eats too much, nor his wife or her husband, home, earth, the ‘solar system’, stars, planets, galaxies and SPACES “3” and “2”. The last ones are marked *non-Expanding* in Fig. 1 and represent the spaces between stars in a given galaxy and between galaxies in a cluster. Our galaxy, the *MILKY WAY*⁴ is the galaxy in which the sun⁵, the solar system⁶ and earth are located. *SPACE “2” (non-expanding)* represents the space between galaxies, and inside our local group³, clusters or super-clusters of galaxies. Only two, out of billions of clusters and super-clusters of galaxies that we actually observe in the cosmos, are schematically marked in Fig. 1 as *CLUSTER I* and *CLUSTER II*.

Assertion 4.1:

All expanding *SPACE “1”* mediums between clusters and super-clusters of galaxies remain interconnected as a single whole.

All *SPACE “1”* mediums of the expanding universe⁷ have been maintained at about uniform spatial temperatures at any given time during the last 13 billions years or so, yet have been cooled down with cosmic time from about 4000-3000 degrees Kelvin at the end of the first six days [Table I] to the currently observed 2.7 degrees Kelvin, namely, about 270 degrees Celsius below zero.

SPACE “1” is filled with *BLACK BODY RADIATION*, dust, other types of radiation and gas.

Non-expanding *SPACE “2”* is the space inside each cluster or super-cluster of galaxies. Clusters that stay and move more or less together with respect to *expanding SPACE “1”*⁶, are the largest gravitationally-bound structures in the universe. Such clusters may each contain from ten to thousands of galaxies.

Typical galaxies contain 10^7 to 10^{12} stars orbiting a common center of gravity. In addition to some single stars and a tenuous interstellar medium, most galaxies also contain a large number of multiple-star systems, e.g., *star-clusters* and *nebulae*. Most galaxies are several thousand to several hundred thousand light-years in diameter and are usually separated from one another by distances on the order of millions of light-years.

Non-expanding *SPACE* “3” is the space inside each galaxy, namely, between the stars. It consists of relatively dilute amounts of radiation/particles, typically 90% hydrogen and about 10% helium, and some ‘heavier’ atoms and molecules, as well as dust clouds, magnetic fields, cosmic rays, light, other electromegnetic radiations, etc.

Assertion 4.2:

During the last 13 billion years or so, *SPACE* “1” expansion⁶ means, *inter alia*:

1) A uniform increase in distances between all super-clusters of galaxies. It therefore constitutes the background against which linear motions and rotations of gravity-bounded objects are measured and counted.

2) *SPACE* “1” expansion is neither a theory nor a model, as some uninformed wrongly assume, or claim. [Cf. Vol. I, Introduction, §2.5]⁷. Its ‘local distances’ to neighboring super-clusters of galaxies are marked $R(t)$ in Fig. 1.

A consistent decrease in the lowest temperatures in *SPACE* “1”, is schematically marked as (a), (b) and (c) in Fig. 1. Its radiation energy density may also be marked by electro-volts per cubic centimeter, as schematically shown in Fig. 1.

Assertion 4.3:

The dynamics of *SPACE* “1” constitute the cornerstone of our world outlook. Its expansion and cooling is termed here: ‘*The Cosmological Arrow of Time*’, or the ‘*MASTER TIME ASYMMETRY*’, for it strictly causes and controls all other time asymmetries and arrows of time in nature, as will be elaborated on later. That control also means that the entire cosmos, at any location and cosmic epoch, is equipped with two imaginary ‘arrows’:

⁸ *SPACE* “1” expansion was first detected in the 1920’s by the American astronomer *Hubble* [Vol. I, §1.7]. It has since been verified by different methods, including those used today on the Hubble Space-Telescope. (The discovery of the ‘black-body radiation’ in 1964 [Vol. I, Introduction §2.4], is one of those independent methods by which inter-galactic cosmic expansion of *SPACE* “1” has been verified. Since then it has served as the cornerstone of astronomy and cosmology.

a) An arrow that consistently clumps and heats matter-energy together by gravitational attraction,

b) An arrow that consistently points from smaller to larger intergalactic SPACE “1” -- namely, from initial hot-dense cosmos to a cooler one that contains billions and billions of radiating, astronomical 'structures' like galaxies and stars, as well as local sinks of energy-matter in the form of black holes.

Therefore, there are two co-existing cosmic imaginary arrows - or time asymmetries, which point from past hot-chaotic cosmos to its colder-ordered future, from a denser to a dilute SPACE “1”, from a hot beginning to a possibly cold end of life anywhere in the universe, as will be elaborated on later in light of recent observations.

Assertion 4.4:

If you plan a trip beyond the edge of our galaxy, you better go in the direction of its narrow side. Namely, perpendicular to our Milky-Way ‘disk of stars’, far away from the dangerous *Galactic Center*.⁸

During your deep-space trip, you must be careful not to fall on any cool brown dwarf, like *DEN0255-4700*, which is in our ‘neighborhood’ -- just 16.2 light-years away. It is hard to detect, for it is about 100 million times fainter than the sun.

You may also encounter one-way trap-like black holes from which you can never return home, live or dead. Then, if you can imagine a *thought-traveling experiment* in which you travel close to the speed of light – a speed that is attained only by light in vacuum, but never by humans -- you would reach the side-edge of our galaxy after 500 years, give or take a decade. If you proceed further out during a much longer time, you would escape from the non-expanding *SPACE “3”* and enter into non-expanding *Space “2”*, the intra-cluster space.

Assertion 4.5:

SUPERNOVA, EARTH AND MOON – Supernova is discussed in Vol. 1, §§1.5, 8.3. It is a well observed phenomenon involving a violently

⁹ The **galactic center** of ‘our’, and of other galaxies, may contain a supermassive *black hole*, whose gravitational force is so strong that even light cannot emerge from it. Hence, the black hole itself cannot be observed. Such massive black holes may harbor a huge amount of matter [mass] in the range of hundreds of thousands to tens of billions of the mass of the entire solar system. The center of our galaxy is *Sagittarius A*, a bright and very compact source of *radio waves emissions* that originate from *gas and dust* heated to millions of degrees as they “fall” into the galactic center.

exploding star, but of particular importance to the understanding of the origin of all chemistry and life. The reason for that assertion is based on the fact that to form life like that on earth, or similar ones, one needs heavier elements like carbon, oxygen, nitrogen, phosphore, etc., which are not commonly available in the universe, for its stars and galaxies are mainly composed of hydrogen and helium, with minutes amounts of heavier elements that are generated by fusion inside their interiors. The actual situation is more complicated, for there are many types of supernovae, and we do not intend to classify them here. Some are big, say, a hundred times bigger than the sun, and like fat persons, they die first.

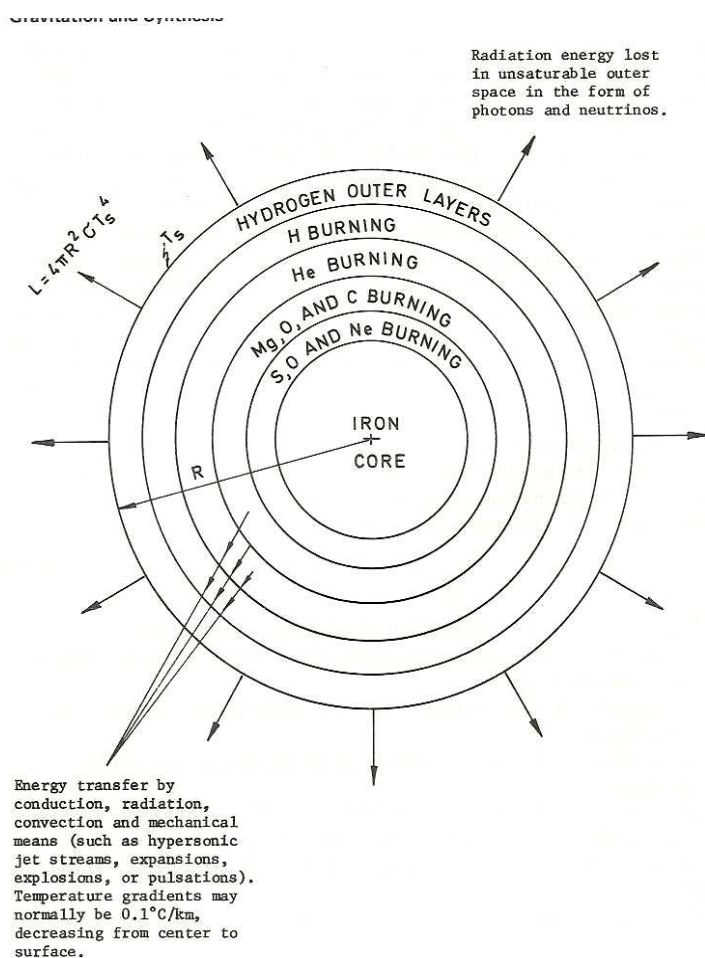


Fig. 2: Most Chemical Elements On Earth, and In Our Body, had been Generated More Than 4.9 Billions Years Ago Inside a Big Star Like The One Schematically Shown Here and Prior To It

By “dying” we mean that such big stars have already converted their available hydrogen plasma into heavier chemical elements: Carbon, oxygen, nitrogen, phosphor, iron, etc. as shown in Fig. 2. Eventually

they all run out of 'fuel'. That happens when iron is produced in sufficient quantity to reverse energy production into consumption.

At this critical stage, such big stars cannot sustain the huge force of gravity. Suddenly they collapse, i.e., they implode and may turn into 1) a black hole [if their mass is larger than a given threshold], 2) stop further implosion by forming a highly dense-compacted neutron star, or 3) implode-explode to generate what is commonly called supernova.

Supernova explosion spreads much of its inner contents of 'heavy' chemical elements into "empty" space as 'debris' of rocks, dust and gases. These debris spread out at high speeds and temperatures.

Later, in 'our motherhood-adoption case', our sun⁶ had passed near these orphan debris, 'adopting them' and forcing them to fall into it or to start orbiting it.

Gradually, such initial, self-gravitating, orbiting, proto planets, further increase in mass by collisions with in-falling moons, asteroids, comets, etc., to form the planets that we observe today in the solar system, and live on one of them, while moving and rotating with respect to SPACE "1"¹⁰, Space "2" and SPACE "3".

In the case of earth, which forms an integral part of the solar system⁸, the moon did not fall on earth and had started orbiting it about once a month.

Simultaneously, on earth, the heavy chemical element iron was gravity-attracted deepest into the earth hot interior, thereby pushing out the lighter elements, like silicon, to form the outer crust on which we would later walk, play and build homes, villages and cities.

Gases, like ammonia, had thus also been pushed and escaped from the earth interior to form what is to become later the oxygen-rich biosphere in which we live today. There is yet no life, no DNA, not even a single virus.

Assertion 5:

How do we count time prior to the formation of our familiar sun-earth clock? In fact, the earliest and only clock available throughout the history of the world is its own expansion away from hot, dense conditions to lower ones. One can therefore measure cosmic time by cosmic medium density, or temperature.

I shall use such cosmic clocks later in the composition of the first universal calender. [Table I]

In addition, one must also bear in mind that we never see the sun, a star, or a galaxy as it is “now”. In the case of the sun it takes about 8 minutes for the sun-light to reach us on earth. Therefore, what we see in telescopes, as gigantic solar events known as ‘flares’, occur there about 8 minutes prior to us seeing them.

2.3 Adiabatic Cosmic Cells: The Key Tools of Our Theory

The concept ‘*adiabatic wall*’ means a barrier to all or to a net energy flow. Such a ‘barrier’ may be a solid insulating physical wall, or an imaginary geometrical one, with no solid walls.

In physics we may employ the last concept when we consider ‘No net flow across a given geometrical boundary’ when the values of opposing flows through that border are equal. That is why we replaced the word insulating with the word ‘net flow across’.

I shall next employ this concept to generate a most important conclusion.

To reach that conclusion you must travel down the gradient leading from hot temperatures in the brightest galaxy and the brightest stars, namely from the highest radiation densities of ‘solar-wind-like’ mediums in SPACE “2” of active hot and radiating clusters or super-clusters of galaxies.

These are marked as ‘mountains crests’ in Fig. 1. From them you travel down first to deep valley (b) and enter the Dark Kingdom of cold SPACE “1”. Here you find the lowest value of energy-mass and temperatures in the cosmos at any given cosmic time. Most important, do not forget to record your findings in your travel diary.

Where in the cosmos is spot (b)?

¹⁰ Both our galaxy and Andromeda have systems of **satellite galaxies**. Our satellite galaxies consist of the *Large and Small Magellanic Clouds, Ursa Minor Dwarf, Draco Dwarf, Sculptor Dwarf, Canis Major Dwarf, Fornax Dwarf, Carina Dwarf, Sextans Dwarf, Tucana Dwarf, Leo I, Leo II, Leo A, Sag DEG, etc.* Andromeda’s system consists of *Cassiopeia Dwarf, Pegasus dSph, M32, M110, NGC 147, NGC185, AND I-V, etc.* The *Triangulum Galaxy*, the 3rd largest galaxy in ‘our’ local group, also includes the *Pisces Dwarf* as a satellite

Spot **(b)** is always located between any neighboring clusters or super-clusters of galaxies, like the deepest valley between two neighboring high mountain crests.

It is right there that the same value of energy-mass flows are is crossing point **(b)**, but from opposite directions: One flow arriving from 'CLUSTER I', the other from CLUSTER II.

Why is spot (b) so important to discover and record?

First note that there is no net energy transfer at points (a), (b) and (c). But there is much more fundamental meanings for physics at these spots than this technical conclusion.

If next you try to detect all points (b) around 'our' Cluster II, you would have to travel-search to find all spots (b) around our entire Cluster II.

To start with you may go around to reach spot (c). Then, if you proceed further, you would get back to spot (b).

Most difficult would be to complete your travel search in performing many circles in any direction [azimuth] between all neighboring clusters or super-clusters that you see around our CLUSTER II.

Well, when that job is completed and recorded, you would allocate all such spots (b) and (c), which when linked together would 'engage' our Cluster II in an 'INVISIBLE ADIABATIC CELL'.

Yes, we and our ancestors spend all our life inside such a 'cell', which is neither spherical, or square, nor solid or marked by a border police.

Most likely it has endless different forms that may resemble a very long and twisted balloon, or a twisted fat one.

The reason for that is that the super-clusters of galaxies are often shaped like long 'filaments' and to find spots (a), (b), (c), etc. in between all of them would lead to such twisted 'cell' shapes.

Assertion 6:

Cluster II, as well as all clusters and super-clusters in the cosmos, are each engaged in such an invisible [geometrical] boundary, or what we call invisible 'adiabatic cell.'

Since each cluster, or super-cluster of galaxies harbors the same maximum temperature (see below), ‘our cell’ that ‘encages’ Cluster II represents the fact that there is no net energy-mass flow from it to any one of the other adiabatic ‘cells’ in the entire cosmos. Namely, on ‘a sufficiently large scale’ the cosmos is uniform as to the maximum and minimum temperature values observed in each such ‘cell’. But, again, there is much more to it, fundamentally, as explained next:

In each Space “2” and “3” the stars convert hydrogen and helium by the well-verified thermo-nuclear fusion, as we well-know from in the dynamics of hydrogen-bomb explosion.

Thus, in each adiabatic “cell” the same fusion of hydrogen and helium takes place, but at different rates that can reach the same maximum temperature at the brightest star and the brightest galaxy.

Hence, the ‘non-expanding mountains of high temperatures’ (Spaces “2” and “3”) radiate energy-mass to the deep valleys’ (a) (b) and (c) that are maintained at lower temperatures **by the very expansion of Space “1”**, despite the huge inflowing radiation-particles from the stars and galaxies. **This energy is not lost.** It must simply fill a constantly increasing ‘cell’ size, like in the crude analogy with an expanding bath tube at home that we would employ here again.

Nothing in planets, stars, galaxies and super-clusters of galaxies participates in that cosmic expansion, as schematically depicted in Fig. 1. Hence, Space “1” is UNSATURABLE. No inflowing mass-energy from nearby and far away super-clusters of galaxies can fill-it-up, as far as the universe, namely, SPACE “1”, keeps expanding fast enough.

The simplest, but very crude analogy to this complicated situation is as follows:

Imagine a simple home-bath tube made of a highly elastic rubber that is inflated and grows in volume faster than it is filled up with water.

If one starts inflating the rubber tube from a high water-level mark, that water level would go down with the expansion-inflation of the tube. The tube cannot be filled-up.

Only in the case that the inflation of the bath-tube stops, or reverses into a contraction, the water level would start rising and the tube will be filled up.

2.4 How, At Home, We Are Directly Connected To The Expanding Universe and Its 13.7 Billion Years History

The ‘valleys’ in Fig. 1 represent the cold-*dark night sky* that we observe anywhere from earth and feel its coldness even at our home.

With so much energy pouring out of the stars and galaxies into SPACE “1”, why is the night sky not as bright and hot as the sun?

The reason is simple: SPACE “1” is dark and cold for it is expanding at a rate faster than the rate that it is filled up with energy emerging from our sun, the active stars and galaxies.

It feels quite cold at our home at night despite the fact that SPACE “1” is far away from us and expands only deep inside the vast cosmos, except in SPACES “2” and “3”. Yet, its downward generated gradients of temperatures are here, and we feel them at home.

Moreover, it has been expanding and cooling from a very hot beginning.

Therefore, every night, and in fact during the day too, we are ‘in touch’ with the entire 13.7 billion years world history and with its ongoing cosmic dynamics vis-à-vis what is happening to us, “Here-Now” at our secure home. Amazing.

2.5 Concluding Remarks

The very fact that the night sky is dark, and very cold, means that it has been expanding as an interconnected, cosmic, un-saturable SPACE “1”. It also constitutes an independent proof that it expands and cooled at a faster rate than the inflowing energy-mass from the non-expanding stellar and galactic systems can fill it up.

The invisible adiabatic ‘cell’ around each large active structure in the cosmos is the most interesting phenomenon in the world at large and at our home.

That ‘cell’ concept also means that one does not have to examine the entire cosmos in order to arrive at key physico-philosophical conclusions.

To study one typical ‘cell’ in an almost uniform cosmos is ‘scientifically sufficient’.

Our invisible adiabatic ‘cell’ is not only expanding between gravity-induced, super-cluster of galaxies, its very dynamics and interconnectedness causes energy to keep flowing from the high ‘non-expanding mountains’ (SPACES “3” and “2”) to the low ‘UNSATURABLE valleys’ (a), (b), (c), etc.

Thus, our ‘cell’ also causes the generation of heavy elements inside active stars, including supernovae. The origin of life is therefore found in the dynamics of (a), (b) and (c).

SPACE “1” and adiabatic spots (a), (b), (c), etc., constitute the origin of all chemistry, of all structures and of all supernovae explosions that throw all the chemical elements generated in their interiors into SPACE “3”.

It is there where a star like the sun can pick the ashes of such dead stars and incarnate them to orbit it form planets and life.

Life has therefore emerged from the ashes of dead stars and is feasible in many such systems in the cosmos.

In fact, more than 200 planets have already been detected at the time this book goes to print.

Consequently, we are left with no other option but to conclude that this adaptation of our brain-mind goes back in history to our cultural ancestors as far back in historical time until one reaches the roots of the first written language. How did it evolve and introduced to enslave the individual mind is discussed in Chapter 7, which is partly based on Chapter 6.

As literate persons we do not harbor this brain-mind capability, or incapability as an *a priori* innate sense in the Kantian philosophy. It had been enforced on our brain-mind by the punishable-rewarding methods of our training since childhood.

It is not a free choice of the individual.

It is determined by social needs.

But it had been enforced on our brain-mind for a good social reason: A social consensus to resort to a single common axis, a uni-directional arrow of speech and writing based on gravity-induced orientability that is mandatory to communicate with each other and record physical entities and abstract-poetic-scientific issues. It is in fact a human social selection enforced on us since the dawn of the first recognizable civilization. [Chapter 7]

Furthermore, this socially-based determinism, in all modern written languages, is strictly based on a denial of the free choice of the individual, and on enforcing an external, socially common, single universal reference that remains valid and reliable to all in any local culture; anytime, anyplace: The gravity vector. So social determinism includes not only our common, geographically determined language, but its linguistic asymmetry that is forced on the child.

3.2 Gravity-Induced Intelligent Thinking

According to *Lev Semenovich Vygotsky* (1896-1934), 'thought' and 'language' have different origins; - 'thought' in its 'pre-linguistic stage' is linked to 'biological evolution', while 'language' in its 'pre-intelligent stage' is linked to the 'social evolution' of the child. In both Vygotsky finds a clear 'link with external factors':

"Verbal thought is not an innate natural form of behavior but is determined by a historical-cultural process and has specific properties and laws that

cannot be found in the natural forms of thought and speech".

There is a moment of discovery when the child is repeatedly instructed to recognize a 'link' between a word and an 'object'. From this moment on, 'thought' becomes 'verbal' and 'speech' 'rational'.

Accordingly, 'pre-linguistic thought' has the same origin to the kind of 'primitive thought' that some animals acquire through 'biological evolution' [Chapters 5 and 6], while speech always has "an external social origin".

The origin of both is therefore 'external'. Following the methodology presented here, that origin may be traced back to gravitationally-induced processes throughout evolution. [Chapters 5 and 6]

In contrast, by a reversed speech, or writing, or 'reading', one loses the meaning of words and sentences.

The key capability of civilization: Verbal-intelligent thinking, music and order [Chapter 7] is preserved when a child associates 'objects' and 'subjects' with symbols, words and sentences. He then becomes capable of expressing intelligent thought, and can share it with others for mutual benefit. Most important, one can record numbers, equations, music, events and verbal-intelligent thinking for a later use, even when she or he is no longer able or alive to repeat such acts.

Painting, sculptures and movies are interconnected parts of human records and intelligent thinking. But they may not only express intelligent thought. They are capable of proceeding **beyond** speech, symbols, equations and words into the 'realm' of 'imagination', innovation, 'abstract imagination', movies and surrealism.

Throughout linguistic and art history, all humans have used the gravity-induced axis, the uni-directional orientation, or asymmetry in three different gravity-induced modes: left-right, right-left, up-down.

History testifies that literate humans have been forced by hard training, or what one calls 'education', to communicate with each other only by means of a single, pre-selected direction which relies on a

common reference: The vector of gravity. As we shall see next, this reliance may also be innate in certain domains of the living world.

In closing this section I stress that the brain-mind does not pay much attention to symmetrical symbols or words, but mainly to asymmetrical ones.¹

3.3 Loss of Orientability Under Zero Gravity

Much experimental evidence, in part collected in spacecraft, proves that there is a loss of orientability in growing seeds under weightlessness ['zero gravity']. Seeds lose their roots-Vs.-above-ground-growth orientability if placed under zero-gravity conditions. Hence, linguistic asymmetry is not an innate property.

The same applies to balancing in sitting, walking, jumping, swimming, floating, flying, etc. We shall return below to gravity-induced socio-biology and evolution of our skeleton, way of motility and to gravity-induced concepts in the last chapter on Homework.

Animals are no exception. Each is 'conscious' of the common "up-down" surroundings, and about "weight" and acceleration. Trees are also harboring innate sensors that guide them in which direction trees grow even on a slope of a mountain.

Additional examples range from gyroscope inertial changes, or gravity-induced changes involving the fluid in the vertebrate inner ear to a crystallizing suspension of organic spheres in water, and much more.

3.4 Gravity-Induced Plant Growth and Animal Behavior

There is a direct link between gravitation and form, adaptive structure, growth rate, growth direction, adaptive behavior, navigation, and adaptive space perception in plants and animals.

A considerable empirical evidence has been accumulated on these subjects by biophysicists, biologists, plant physiologists, botanists, zoologists, neuro-physiologists, etc.

All plants and animals evolved under the influence of gravity. Their form as well as their structural development have been strongly shaped by this pointed force. In turn, they have "learned" to exploit it

and even to cope with it - learned in the evolutionary as well as in the ontogenetic sense of the development of the individual organism.

The sensing devices which plants and animals use for "gravity perception" ("gravity receptors", "g-perception", "bio-accelerometers", "gravity-induced biological clocks", etc.) are not yet well understood, even though a voluminous literature has been published on this subject. But what we already know justifies the central role we expect gravity to play in all life adaptive processes.

If a growing higher plant is displaced with respect to the "upright" position, some tens of minutes later it will adapt its growth in such a way as to restore its original orientation in coincidence with the gravity vector. (If it is displaced only briefly and then restored to its original orientation well before the growth response can set in, it still responds to that displacement.)

Gravity-induced orientation-adaptation of an organism may occur when an organism orients itself by a gravity-induced gradient of density differences or hydrostatic pressure. Small organisms (including all bacteria) may have no means for sensing gravity, but they are affected by it.

The origin of temporal behavior in animals can be traced back in time and out to external physical influences. Even "innate patterns" are frequently associated with simple orientation movement in the field of gravitation, i.e., as "up-ward-downward" righting of the biological body in reaction to gravity. Thus, gravity and geophysical periodicities emerge as prime sources of ordering.

Animals low on the evolutionary scale characteristically exhibit innate patterns that depend little on learning, and have a lesser adaptability to changes in the environment.

Consequently, their dependence on heredity-geophysical-gravitational origins is 'high' in proportion to animals that are 'high' on the evolutionary scale. While the latter show some signs of innate patterns, they harbor a greater capacity to produce a much more flexible mechanism to respond to a variety of other external changes that stimulate them. The evolutionary origin of the so-called "innate ideas" may, therefore, be external rather than internal.

Each of the billions of cells in our body contains specific organelles and nuclei, which are heavier than the rest of the cell. These are key instruments in our lives, in our orientation, balancing, walking, reading, etc.

Even ‘primitive’ plants ‘know’ to grow vertically upward when they start growing in total darkness as seeds deep inside the soil, even when they grow on a very steep mountain side, as most of the high-growing trees align their growth in conformism with the gravity vector.

Plants and animals always ‘obey’ the gravity-induced commanding-guiding force, for a reason. They try to maximize sun input and minimize shadows from other trees. We form no exception. Even with closed eyes. we always ‘feel’ and ‘obey’ the ever-present gravity force. We and all animals ‘detect it’ to orient ourselves anyplace on earth, and balance our motion.

3.5 Vertigo, Loss of Coordination-Balancing & Gravity

Vertigo is a loss of coordination, balancing and orientation vis-à-vis space and the gravity-induced horizon. I shall employ this well-known phenomenon to explain how gravity-detectors in our ear operate to help our brain² control our balancing, orientation, coordination and movement.

Our biological structures in the inner ear include semicircular canals and a fluid that moves, by gravity force, with respect to the gravity vector and activates a hair cell³ that transmits linear and rotational motions vis-à-vis the gravity vector to the vestibular nerve, which carries these signals through the brainstem to our brain **cerebellum**², which, in turn, uses them to control our balancing,

² **Cerebellum** is a brain region that integrates sensory signals, like the ones arriving from the **vestibular system** and neural pathways that connect it with the brain’s motor cortex, which sends commanding signals to the muscles, to cause specific motions, and via the *spinocerebellar tract* is provided with steady feedback signals on the position of the body in space, gravity perception, etc.

³ **Otolith organs** in our inner ear are sensitive to gravity and linear **accelerations**, which, in gravity physics is **equivalent to gravity**. When the head is in an upright position, the otolith presses on sensory hair cell receptors in the ear. This pushes the hair cell processes ‘down’ and prevents them from moving side to side. However, when the head is tilted, the gravity force shifts the hair cell, distorting the balance, and sending signals, through the brain that the head is tilted. Otoliths are small particles of calcium carbonate in a viscous fluid. The inertia of these small particles causes them to stimulate hair cells when the head moves. The hair cells send signals down the sensory nerve fibres, which are interpreted by the brain as motion. Note for Table II: Following death and decomposition of a fish, otoliths may be fossilized. Palaeontological analysis of such sediments may be used to help understand such domain in gravity-induced evolution.]

orientation, coordination and movement. The **vestibular system** in our ears comprises of two semi-circular 'canals', which are used to indicate our **rotational** movements, and **otoliths**² which indicate **linear** translations.

The vestibular system sends signals primarily to the neural structures that control our eye movements, and to the Cerebellum-muscles system² that keep us upright, and also help us to maintain clear vision.

3.6 Gravity-Induced Ecosystems

Many aspects of animals social organization and evolution can be predicted on the basis of gravity-induced environmental variables.

Since biogeochemical evolution causes key natural resources to be distributed non-uniformly in the spatial and temporal coordinates of the biosphere, resource monopolization develops in all levels of socio-biological systems.

Gravity-induced changes develop territoriality in a given spatial region or in a given assembly of individuals, especially when key resources are not sufficiently abundant and stable through long periods of historical times.

One species, or even one sex, may control a larger quantity of resources, say, scarce water ponds, than the other individuals, until a small percentage of the population monopolizes all key resources. We observe this phenomenon in both the animal and human domains of socio-biology. In humans these gravity-induced territoriality is often developed into nationality, strategy, historical events and wars.

When the limited terrestrial space must be divided into lots in a community it carries economic and social standing, or, into national "lebensraums" involving "well-defined territories", a constrain which may induce "natural selection" in some socio-biological systems; from animals' mating systems to animals' monopolies on water resources; from natural food administration to the control of key strategic ridges; from controlling fossil fuel resources to disputes over territories.

In fact, much of the currently known socio-biological evolution, and much of human history, as we shall see in TABLE II below, may be reassessed along these lines.

Other possible links between human evolution and gravity-induced changes in the environment are illuminated by empirical results that emerge from recent studies in geology and the new, DNA-based anthropology and archeology.

3.7 Gravity-Induced Law, Seconds, Minutes, days, Month, Year

Whole cultures, civilizations and religions have been constructed on gravity-induced human orientability, concepts, spirituality, art, music, home structure, village structure, wells, canals, boats, trade, transportation structures, transportation vehicles and roads, agriculture, and even law enforcement by hanging. History testifies that such gravity-induced cultural phenomena may proceed far beyond grammar and social order into the spiritual and hierarchical domains: High priest, low deck, high commissioner, highness, heaven, lofty, go to the bottom of the subject, etc. [Chapter 10]

Letter orientation, from *cuneiform writing* (Chapter 7) to later written languages includes past-present-future linguistic laws [grammar]. Such gravity-induced order dominates not only composition-order-asymmetry of everyday life, but is deeply ingrained in our brain-mind arrow of time. One cannot read or sound a sentence in reverse. One cannot enjoy music if played in reverse. Even the computer page is ordered by top-bottom/left-right orientability, including margins, footnotes, page numbers, first and last, etc. And it takes time to read them and to comprehend them, time that advances from past to future, time that I term linguistic-musical arrow of time. Similarly, gravity-rooted effects may be demonstrated in ordering documents and books in a library, or the foundations and structure of our homes.

Gravity, combined with Mitochondrial-DNA are key tools in archeology, anthropology and geology: deposition layers and trash are ordered by gravity and used in the study of evolution. [Table II, Chapter 6]

Such gravity-induced evolution is translated into gravity-rooted 'history', chronology, natural clocks, natural selection, biological clocks, etc.

3.8 Gravity-induced Perception and 'Aggregational Objects'

We train our brain-mind to appreciate only gravity-induced configuration appeals and reject chaos, confusion and disorder. In short, we reject what does not well align with gravity-induced posture, growing, walking, standing and sitting.

Our brain-mind searches for what is '*right*' via gravitationally induced symmetries and asymmetries. This applies to persons, animals, plants and the non-living structures. It immediately associates and compares the observational results with pre-trained, accepted/rejected configurations-structures. It then implements stored yardsticks associated with common concepts like young/old, slender/fat, healthy/sick, aesthetically-accepted/rejected and a priori inserted expectations to reproduce the same, or improved species.

Each picture we observe, each letter-symbol, word and sentence that we read, or hear, forms in our brain-mind a specific *aggregated, configuration-boundary*, gravity-oriented asymmetry in three-dimensional reality, or its equivalents in examining a two-dimensional page-space, or a computer display page-space. The three-dimensional configuration is than completed in our mind.

Each letter-symbol, each word and each sentence generates an *aggregated, configuration-boundary*, gravity-oriented asymmetry in our brain-mind, where it had been irreversibly recorded and compared with what was forced on our brain-mind by the previous force of our education; -- at home, school, social group, tribe, nation, religion or specific branch of civilization.

A time reversal of musical notes destroys our pleasure. I cannot enjoy it if it is played in reverse. The structure and modulation of voice and the sentences a human mind seeks to identify with are important.

Even a minor deviation from one's pre-trained language, intonation, accent, symmetry and asymmetry in face, in body, in walking, etc., destroys our gravity-induced, inner motivations for what is '*right*' and '*healthy*', and what is not.

In observing a person our mind generates a gravitationally induced structural asymmetry. In fact, any picture is gravitationally-oriented in our brain-mind: 'up/down' or 'horizontal/left/right'. Thus, inversion of a picture, or reversing the direction of lines, words and

symbols of any a meaningful text, destroys the meaning and associated verbal thinking associated with that text.

It takes us some measurable time 'to study a picture', and 'to read' a text, and even more so, to '*comprehend*' its innate/associated meaning vis-à-vis our pre-conceptions.

We term this elapsing time, and its pointed direction, the '*Pictorial Arrow of Time*', or the '*Linguistic Arrow of Time*', and maintain that each generates an irreversible '*Structural Space-Time Arrow*' in our brain-mind, in terms of '*Space-Aggregated-Asymmetric-Picture*', which points from gravity-induced form-orientation-configuration, or, 'head' and 'lower figure', to 'beginning' and 'end'.

3.9 Biological Clocks and Gravitation

The origin of temporal behavior in animals can be traced back in time and out to external physical influences. Gravity and geophysical periodicities emerge as prime sources of order and information in all non-living and living systems.

Animals low on the evolutionary scale characteristically exhibit innate patterns, depend little on learning, and have a lesser adaptability to changes in the environment. Consequently, their dependence on heredity-geophysical-gravitational origins is high in proportion to animals high on the evolutionary scale.

How, prior to and after being planted or born, biological cells inform plants, animals and our body-mind where is “up” and where is “down”? where the "head" should be? And where the ‘legs’ or ‘roots’ should be?

How new born chicken know to refrain from going down a decline the moment they open their eyes?

What is, in line of these guidelines, the Kantian a priori knowledge?

To Conclude:

Gravity generates, structures and controls all geological layers and global phenomena ranging from mountain crests, tectonic folds,

valleys, oceans and lagoons, to springs, wells, swamps, glaciers and rivers, and the bio-systems connected with them. [Chapter 10]

Many experimental data obtained from laboratory investigations have contributed to put on a firm scientific basis the assumption that life had originated from nonliving systems. These findings represent the strongest arguments for a general theory of evolution based on gravity-induced asymmetries.

Without gravity-induced orientation, order, and grammar we are lost in any given written language. Gravity-induced grammar prevents us from vertical reversals, such as floor into 'roof'. Similarly, a horizontal reversal prevents us from reversals of W into M.

There are more complicated gravity-induced grammar rules. They range from preventing reversal of past into future, and vice versa, to use gravity-induced structures as reference: A mountain crest, valley, beach line, river bed, sky, earth, ocean, etc. [Chapter 10]

Gravity-sensing cells function as detectors of the direction of gravity. The fluid-particles systems inside cells initiate inner convective currents that cease under zero gravity. Thus, the absence of gravity affects the contacts of cells via their membrane potential and their cytoskeletons.

How Did It All Start?

4.1 Introduction

The Bible answers this question in three sentences:

In the beginning God created the heavens and the earth. The earth was without form and void, and darkness was upon the face of the deep; and the spirit of God was moving over the face of the waters. And God said, "Let there be light ", and there was light. Genesis 1

Most astrophysicists, cosmologists and astronomers agree today that the biblical account of the beginning of cosmic evolution, in stressing "a beginning" and the initial roles of "void", "light" and a structure-less state, may be uncannily close to the verified evidence with which modern science has already supplied us with.

By now we have verifiable radiation-signature evidence back in cosmic time to about 99.998% of the history of the universe, namely, since its "age" had reached about 300 000 [earth-sun based] years.

What do we mean by verifiable evidence regarding the history of time and of the universe as a whole at that early stage ?

Volume I describes key measurement methods of astronomical distances as used in modern astrophysics, namely, how the detection of radiation, which had emitted from past/far-away objects is detected and used today to establish the distances to past/far-away objects. These distances are then translated into past times by the use of relativistic cosmology and astrophysics.

In the beginning, according to modern astronomy and empirical relativistic cosmology, the highly curved space-time geometry expanded as the time-reversal of a gravitational collapse into a black hole (Vol. I, §7). In simpler words, the early stages of the universe are, in many senses, analogous to a "white hole" in which radiation-dominated (structure-less) fluid had expanded away from extremely high density and temperature 'medium', to end up in the present, matter-dominated,

era in which the structure-less fluid has gradually developed into the present hierarchy of structures.

Firstly, this issue brings about non-static evolution, i.e., expansion of the universe as a whole, namely, prior to the formation of proto galaxies, stars, etc. Namely, prior to the formation of SPACE “1” as shown in Fig. 1 and discussed in Assertions 1 to 6.

Secondly, this result emerges from the fact that Einstein's field equations, as well as Newtonian gravitation, accept no plausible static (cosmological) solutions.

It is a remarkable confirmation of relativistic gravity physics, that these predictions agree with all astronomical observations.

Moreover, the growth of density perturbations - e.g., pre-galactic and pre-star structures - by uni-directional gravitational attraction, is responsible for the present existence of a hierarchy of structures, namely, from super-clusters of galaxies, galaxies, star clusters, stars, planets, and temperature-composition gradients in planetary atmospheres, down to the evolving structures of biological systems, as will be demonstrated later.

But this separation is erroneous, for, as will be shown below, both phenomena are caused and controlled by the same mechanism; i.e., the cosmic expansion, in itself, caused and controlled by the gravitational field. More details about this mechanism are to be stressed below.

However, in response to these claims, one is tempted to pose the following questions:

- 1) *How certain is this science?*
- 2) *What evidence supports it?*
- 3) *How is this cosmic history being linked to all presently observed processes on earth, “Here-Now”?*

Perhaps the most extraordinary development of all modern sciences, during the last four decades or so, has been the emergence of astrophysics, astronomy and modern cosmology as genuine empirical sciences. There are several reasons for this renaissance.

Partly it stems from the recent dramatic advances in infrared, radio, X-ray, gamma-ray and neutrino astronomy (Vol. I). And partly it

4.2 The First Six ‘Days’ of The World History

Our common second, minute, hour, ‘day’, month and ‘earth-sun year’ are neither universal nor sacrosanct. An hour composed of 60 minutes, and a minute composed of 60 seconds were invented by the first civilization, Ur, about 6000 ‘earth-sun years’ ago. [Chapter 7]. Is it time to re-assess this old time?

One can instead select any other time-scale that would make it easier to put science and religion under the same roof *without trying to fuse them together*. Hence, I introduce the first six ‘days’ of the world history using my own ‘days’.

TABLE I:

THE FIRST SIX DAYS OF WORLD HISTORY

	The First Six Days of World History	Temp Deg. K
DAY 1	<p>The laws of physics are introduced when gravity begins to control the expansion of the universe from a very hot-dense beginning and gravity attractive role begins its everlasting transformation of chaos into structures.</p> <p>These laws, and a cosmic clock, ‘day’, ‘stage’, or duration at and after Creation have been the most intriguing and most challenging issues of humanity during all historical times.</p> <p>Einstein’s General Theory of Relativity, our best verified theory of gravitation, combined with what we know today about quantum physics, the hydrogen bomb, thermonuclear reactions in the sun and in galaxies, when combined with all verifiable knowledge that we possess today, provide us with reasonable insight about what happened during the first ‘Day’ of the world history, and during the next five.</p> <p>One may also assume that all laws of physics had been</p>	$>10^{12}$ K

introduced with gravity physics at the same time, or perhaps, even 'earlier', subject to common understanding that for mortals there is neither time nor law before Creation.

Direct astronomical verification of the first six 'days' of the world history have so far been banned for the universe during these first six 'days', had been structure-less and totally opaque. Yet, it was rapidly increasing in 'size' under a state of uniform world expansion and cooling, namely, under almost perfect uniform 'Thermal Equilibrium' conditions. Neither atoms have yet existed, nor protons and neutrons. The temperature of this early totality of mass-energy has been higher than 10^{11} deg. K, namely much over 1,000,000,000,000 degrees Kelvin. [Fig. 2, below this table]

Nevertheless, recent human observations, especially by employing '*gravitational lens*', have reached 'Saturday', the seventh 'day' of Genesis, but not earlier. We only have records of the remnant micro-wave radiation that has emerged from the end of 'Day' six, and the frozen neutron-proton ratio of about 1 to 5 from Day 5, as currently verified by all observations.

To Conclude: We know today that the totality of our universe, [Nothing in four dimensions outside the universe exists according to Einstein, Vol. I.] during its first 'day' was extremely dense and hot. It was a structure-less medium much smaller than an atom. Matter, light and other types of radiation-energy were controlled by Einsteinian gravitation. Yet, all that was very rapidly cooled by the very fast expansion-explosion of the whole universe. As 'Day' 2 entered, that totality may have cooled down, but is still above 1,000,000,000,000 degrees Kelvin. [Fig. 2 below]

Did the laws of physics, which have governed the world since the beginning of this first 'Day', pre-exist?, or were introduced at the instant of Creation? **We do not know.**

	<p>All we know is that these laws have since remained invariant at any place, scale and time, as evidenced by modern astronomy, astrophysics and updated physics.</p> <p>What was prior to the moment of Creation? Or, were other universes created during the first week of the world history? Again, we do not know, and anyone who claims that he does, misleads.</p>	
DAY 2	Einsteinian gravitation and quantum particle physics rule that ‘elementary particles’ pairs be "created" out of the gravitational field. Hence this ‘Day’ is termed ‘PARTICLE CREATION’ [Fig. 2] (Theories about various ‘elementary particles’, including the building ‘blocks’ of protons [quarks] as assumed in particle physics, are elaborated on in Volume I.	$>10^{12}$ K
DAY 3	This is ‘THE DAY OF ISOTROPISATION’ that was established between strongly interacting ‘elementary particles’, such as photons, neutrinos, leptons, mesons, and nucleons, and their antiparticles. [Fig. 2, Chapter 2]	$>10^{12}$ K
DAY 4	Cosmic temperature now drops to about 100,000,000,000 degrees Kelvin. The entire universe may now contain only photons, neutrinos, anti-neutrinos, muons, anti-muons, electrons and positrons. As the temperature dropped further, the neutrinos and antineutrinos decoupled from other ‘elementary particles’: A duration termed ‘NEUTRINO DECOUPLING’. [Fig. 2]	10^{11} K
DAY 5	Electron-positron pairs began to annihilate and the cooling of the neutrinos and anti-neutrinos <i>froze the neutron-proton ratio at about 1 to 5, as currently verified by all observations:</i> This “Day”, is termed ‘HELIUM FORMATION’. [Fig. 2]. At lower temperatures photons stop disintegration of the newly formed atoms: mainly hydrogen and helium.	10^{11} K to 10^9 K
DAY 6	Neutrons fused further with protons to form the first-ever atoms in relative concentrations as we observe them today in the vast cosmos. Further nucleosynthesis, as is currently happening inside stars, including the sun, forms the nuclei of helium and other heavier elements that we	10^9 K to 1000

	observe today. [TABLE II below]: This duration is termed 'DEUTERIUM FORMATION'. On this 'Friday Night', the world temperature dropped down to around 4,000 degrees Kelvin, just when 'Saturday' enters.	4000 K
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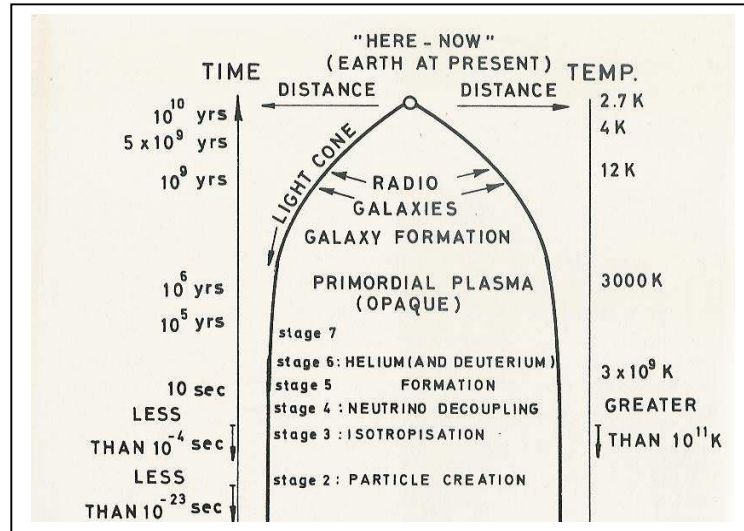


Fig. 2: The First Six 'Days' of the world history are marked here by seconds, or earth-sun years (left), temperature in degrees Kelvin (right), or as termed in Table I above

4.3 The 7th day

The presently observed abundance of hydrogen vs. a smaller concentrations of helium in the universe is a remarkable confirmation of this sequence of events. **The 1:5 frozen-in-ratio** of neutrons-to-protons that took place during 'Day 4' has also remained as the relic and record of these first six 'days' of the world history.

The duration of the 7th day itself may include all our world history. It may also be fragmented-marked into the common sun-earth events of our world history, as I do next in Table II.

Moreover, the 7th day is the first clear day in the world history.

The reasons for ‘Saturday’ to be a clear day are as follows: The cooling of the cosmic opaque medium had, for the first time in the world history, eventually allowed the photons of light and other types of radiation to get free from the agglomerating matter; free photons, neutrinos and anti-neutrinos get away from nuclei. Moreover, around 4000-3000 degrees Kelvin, the positively charged nuclei capture free electrons and at last have united to become stable, or ‘neutrals’. These ‘Saturday’ relaxation has caused the entire cosmos to become clear and transparent for the first time. The opaque period is over for good.

That 7th ‘day’, is relatively quite long, in fact, as long as one wishes, unless he or her prefer to switch back to ordinary sun-earth years and assess ‘Saturday’ as starting from about 200,000 years after creation to about 500,000 years, or even beyond that, until ‘Here-Now’.

In trying to understand what happened on ‘Saturday’ let us keep in mind that so far the entire universe has been entirely structure-less, not only opaque.

Radiation and matter have been previously intimately coupled to each other - electrons scattered photons and everything was almost in complete uniformity in space, while the cosmic expansion had continued to dilute and cool this opaque cosmological fluid [plasma].

No substantial self-gravitating systems, not even proto-galaxies or proto-stars have yet emerged as ‘Saturday’ entered.

Yet, during ‘Saturday’ some slight variations in the density of the earlier “cosmic soup”, as confirmed today by giant telescopes, have quite quickly caused massive agglomerations of matter by the attractive force of gravity.

How do we know that?

Einstein has demonstrated the possibility of what is called **magnifying gravitational lens** [the bending of light when it passes near a large gravitating star, or a through a huge cluster of galaxies].

Yet, Einstein was skeptical if one day it can be used due the rarity of such possibilities. Indeed, most recently it happened.

Magnifying gravitational lens have recently become useful in astronomy to discover very faint, far away, young galaxies that have been formed during the 7th day. [In modern astronomy this period is also termed '**dark ages**', for so far we had very little information on the period stretching from the first 200,000 to about 500,000 years of our world history.]

Such new discoveries have not only revealed the existence of unknown tiny planets circling around many stars 13.7 billion light-years away/ago [of course, less 200,000 to 500,000 years], but that these entities explain much of what happened on then, namely, when the universe had emerged from a "formless" or "structure-less" state into a growing structured hierarchy of mammoth stars, black holes and, eventually, into the great structures and large space voids that we currently observe. That 13.7 billion years delay time directly links us to the past, to 'Saturday'. It is, therefore, a key reason why I maintain that I am still on vacation on 'Saturday' of our world history. We are there and here at two different time frames that are linked together via all astronomical observations. [Recall Plato!]

Nevertheless, the only "clock", the only 'time asymmetry' that existed throughout 'Saturday' was the uni-directional cosmic expansion away from a dense-hot initial state, towards lower temperatures, densities and gravity-induced structures of proto-galaxies and mammoth stars, which eventually have generated, during about 13.7 billion sun-earth years, the living systems that are 'us'.

'Gravitational Selection' Vs. 'Natural selection'

5.1 Introduction

Except hydrogen and helium, all chemistry, namely, all the chemical elements in the cosmos and in our body, had been generated inside massive exploding stars called supernova. The supernova sin was to convert its hydrogen and helium to heavier elements, like oxygen, carbon, silicon, nickel and iron, faster than smaller stars do.

It is always gravity that plays the central role in the selection of the structures of life, from the biosphere and DNA to language and civilization.

Gravity first generates the chemical elements that lead from supernova to planet earth, then to the construction of the biosphere, then to a succession of reactions in which life means the structuring of *complex* elements from *simple ones*, i.e., from hydrogen to iron, from amino acids and DNA to the superstructures of plants, animals, humans, language and civilization.

Strong gravity pressures in the interiors of most stars build all the elements in the periodic table by successively adding small increments of mass and electric charge in hot interiors that are generated inside stars by the force of gravity, while releasing huge quantities of 'atomic energy' that would cause, with gravity-induced expansion of SPACE "1" [Fig. 1] all irreversible processes in nature.

Following the cosmological expansion and massive stars explosions, the newly formed chemical elements cool and sometimes combine to form simple molecules in deep-cold space.

The first local "*aggregates*" of matter in the solar planets already contained atoms and simple molecules, including some based on carbon, oxygen, silicon, nitrogen, etc. Again it was gravity that *stratified* these compounds in *horizontal layers* according to their *specific gravity*.

More than 4 billion [earth-sun] years ago the planets, including earth, were formed out of the ashes of a dead star: supernova, a large exploding star that throws into 'empty' space all the chemical elements observed on earth, those that would later become the building blocks of our body and brain.

Heavy elements like iron first formed the earth's interior by the gravity vector, which pushes out the gases that had formed the early hydrogen-rich earth atmosphere, that, in turn, *900 million years later*, became our present, *oxygen-rich biosphere*.

The earth's lithosphere, which includes the crust¹, is fragmented into tectonic plates that move over the upper mantle via gravity-induced *plate tectonics*.

5.2 Our Early Atmosphere Vs. the Present One

Our biosphere is relatively very thin. There is no terrestrial life below it and no life above it. It had been formed and has been retained as it is now by gravity. The biosphere includes an upper skin of the earth's land and the oceans. There is a sort of a boundary between earth and the 'earth outer space' at an altitude of 100 km, which is referred to as The *Karaman Altitude*. The biosphere protects life on earth by absorbing ultraviolet solar radiation and by reducing temperature extremes between day and night.

¹ The **crust** is the outermost layer of earth, it is part of its lithosphere. Gravity-induced planetary crusts are composed of material with lower specific gravity than the planet's deeper layers. The crust of earth is composed mainly of basalt and granite with sedimentary layers of calcium-based materials and silicon oxides. It is cooler and more rigid than the deeper layers of the earth mantle and its very hot interior. Lava emerging from volcanoes tell us the specific gravity of the earth interior. The lithosphere is in fact floating on the fluidic interior layers. Because of inner convection flows the upper mantle and the lithosphere are fragmented into gravity-induced tectonic plates that move and can generate shear, tectonic valleys and earthquakes, all of which play one role or another in the origin and evolution of life on earth. Oceanic crust is different from the continental. It is 5 to 10 km thick and is composed primarily of basalt. In turn, the continental crust is about 20-70 km deep and is composed of a variety of less dense rocks. The crust's temperature ranges from the air temperature to about 1200 degrees Kelvin near the mantle.

About 75% of the atmosphere's mass is within 11 km of earth's surface. Any person above about 80 km may be considered an astronaut. The current earth atmosphere contains about 78% nitrogen and 21% oxygen, with traces of carbon dioxide, ozone and other gases. The earth atmosphere becomes less dense as altitude is increased and gradually fades away into space. As the air density is decreased, it causes less resistance to air travel. Hence, most passenger airlines try to travel between 10 km to 11km altitude to save fuel and increase speed.

Asteroids impacts had caused significant changes to the earth's early surface and its orbit. This might be responsible for the ice ages that have covered portions of earth's surface in glacial sheets. [Table II]

The geological strata of layers of rocks composed of one material, e.g., shale or limestone, lying between rock beds of other materials, were also generated by the 'selective force of gravity'.

The gravity-induced life envelope of earth, comprising a very thin layer (surface and lower atmosphere), works from *less to more complex structures*, from *chaos to ordered sedimentation*, from structure-less shapes to ordered stratification and parallel orientation of growing high trees via the gravity vector.

It is only "gravitational selection" that puts carbon, nitrogen, oxygen, water vapor, phosphorus and lightning at one and the same layer, the biosphere, for the beginning of biological evolution. And it is the same "gravitational selection" that had protected the early products of this evolution from the fatal damages of external radiation by supplying the upper protective layer of ozone, etc.

'Natural selection' is therefore the result of continuous interaction with gravity-induced environmental-ecological systems. Hence that concept may be supplemented by 'Gravitational Selection' in many fundamental situations and even in specific cases.

5.3 Gravity-Induced Origin of Life

Life originated via gravity-induced changes in the ancient oceans, hot sources in ponds and perhaps also during geological shearing of layers of clays.

Lightning and ultra violet light from the sun were breaking apart the molecules of our early earth atmosphere, the fragments of which gradually recombined into more and more complex molecular structures, the so-called early organic molecules.

Gravity-induced processes have gradually structured the earth's core, mantle, crust, early atmosphere and energy sources for the generation of biomonomers, amino-acids, polymerization, DNA, mRNA, t-RNA, enzymes, proteins, ADP, cells, cellular organization, biological clocks, thermo-bio-organization, axons, neurons, central nervous systems, eyes, depth-perception, memory and eventually various brains in species.

5.4 Fundamental Asymmetry-Symmetry In Our DNA-Grammar

Life was created only once. One day in the distant past [Table II] four out of billions and billions of the early organic molecules on earth, had a 'date' somewhere in the biosphere. What drove that date is '*chemical affinity*'. They were attracted to each other, so as to join-together, and, yet, being able to separate to form copies of themselves, and so on, till the time one reads these lines.

All life forms, since that first 'date', are based on the same grammar, the same four letters, the same life language. Only two helical entities are attracted to each other by the forces of electro-chemistry. Each organism has since been composed of repeated, but in different sequences, of the same four letters.

DNA structure is the most fundamental symmetry-asymmetry structural code of life, the sublime beauty of all forms of life; a long, helical, huge chemical molecule, a spiral of meaningful and purposeful destination, a gravity-induced drive for preservation and reproduction.

5.5 Gravity-Induced Fertility and Skeletons

Many biological clocks associated with fertility have been gravitationally formed.

Similarly, our skeleton structure, the digestive system, body hair, and the breathing and excretion systems have been formed in response to and by gravity.

Most important, our perception of space, symmetry, asymmetry and direction in time and space are controlled by 'gravity detectors'.

Each of our trillion or so cells, contains not only the DNA, but 'gravity detectors' that are cell organelles heavier than the rest of the cell and can tell 'us' which way is the center of our planet.

Living organisms may also get such information from displacement of cell parts, or of portions of multicellular structures, and intercellular structures of their systems. Life may have also evolve under conditions that were once thought too harsh, such as an ultra-acidic river in Spain and ice-covered lakes in Antarctica.

Gravity controls the evolution of our bones, legs, skeleton, and even birds ability to fly.

The cardinal role gravity plays in the control of life, time, perception and the evolution of language and religions has been largely overlooked by physicists, biologists and philosophers, partly because the role of gravity as the universal generator of asymmetries, time, structures, clocks and organization, has not yet been taught in academia or elsewhere.

Condensed World History

TABLE II

Yrs Ago	Condensed World History
13.7 billion	The laws of physics are introduced when gravity begins to control the expansion of the universe from a very hot-dense beginning [Table I] and gravity attractive role begins its everlasting transformation of chaos into structures.
13.7 billion less 300k	<p>The atoms are formed when the radiation-dominated era of the cosmos comes to a close. [TABLE I]. It happens when the density of radiation (photons and neutrinos) drops below the (rest-mass) density of matter (mainly hydrogen and helium) and the cosmic temperature starts dropping below about 4000 degrees Kelvin.</p> <p>During the first six days of our world history [Table I], the gravity-induced proto-structures did not exist.</p> <p>As gravity-induced, proto-structures start to form about 300,000 years after Creation, the cosmos gradually becomes transparent to light and other types of radiation, and ‘measurable distances’ between self-gravitating entities in the yet relatively small cosmos start to increase with time, i.e., with the cosmic expansion, which, combined with gravity physics, constitute the gravity-induced Cause and origin of the later evolving sun, supernovae, solar system, dark-cold night sky, irreversibility, order, thermodynamics, structure and life.</p>
13.7	The earliest stars gradually emerge when the cosmic

billion less 300k to 500k	temperature drops below 4000-3000 degrees Kelvin. These early structures are about 20 to more than 100 times the mass of the sun. The increasing gravity-induced pressure and temperature inside the cores of such early stars ignites thermonuclear reactions that are later completed in relatively short cosmic times. This causes them to spread intense radiation that initially prevents the formation of other stars. Such stars are formed out of clouds of hydrogen and helium surrounding these mega stars. Later, billions of galaxies emerge, each containing 10 million to trillion stars, as verified by astronomical observations and astrophysics. [Chapter 2]
4.567 billion	The solar system is formed about 4.5 billion years ago [Chapter 2]. The sun generates light and a <i>magnetic field</i> that <i>reverses direction</i> about every eleven years. <i>Sunspots</i> on the surface of the sun, and ‘solar wind’ [plasma] affect us on earth and forms a huge shock wave at the solar system edge. [Chapter 2]
4.550 to 4.404 billion	<p>Earth and other planets are formed from <i>supernova ashes</i> floating in the vicinity of the sun -- rocks, meteorites, clouds of dust and gas. [Chapter 2] The earth gradually becomes bigger and rounded by the inner-pulling attractive force of gravity [Chapter 2]. With the other planets it starts to circle the sun as modest member of the solar system. [Chapter 2]</p> <p>Geologists, by studying lead isotopes fixed that time at 4.54 billion years ago, with a precision of 1%. Crystals of zircon from Australia provide 4.55 billion years as earth age. A compromise between astronomers and palanetologists that includes the “radiometric age dating” of meteorite material and lunar samples fix that date at 4.404 billion years ago.</p>
4.533 billion	‘Our’ moon starts to orbit the earth, causing gravity-induced tides that affect the evolution of life by adaptations to periodical cycles. [Chapter 5, biological clocks] Hot water springs were discovered in 2006 on the moon <i>Enceladus</i> -- the first time evidence of water in liquid form has been discovered. However, if Enceladus harbors life, it may be limited to microbes or other robust organisms capable of living in extreme conditions. [Chapter 5]

3.530 billion	<p>The geo-bio-chemical evolution of earth has starts. Gravity becomes the selective force for creating pre-conditions for the creation of life: First by pulling down into the earth's center the heavy elements, such as iron, thereby forcing out gases and lighter elements, like silicon-based compounds, to form the earth's crest; rocks, volcanic lava, soil. The so-ejected gases form the gravity-induced, early, hydrogen-rich earth atmosphere, which, later becomes our present biosphere. [Chapter 5] The sky gradually changes into the present, oxygen-nitrogen-rich biosphere. Gravity-induced structuring of the earth (core, mantle, crust and atmosphere), of biomonomers, amino-acids, polymerization, DNA, m-RNA, t-RNA, enzymes, proteins, ADP, cellular organization, biological clocks and reproduction. [Chapter 5]</p>
3 billion	<p>Free-living, one-celled plants join with <i>biological communes</i>, to form <i>multicellular organisms</i>. [Chapter 5]</p>
2 billion	<p>Reproduction is originated by gravity-induced phenomena. Originally reproduction of single-cell organisms and later two different organisms exchanging DNA heredity code for reproduction of a newly-born organism. [Chapter 5]</p> <p>Some of the newly-born organisms lacked the capability to participate in that exchange. As a result, they vanished from the history of life. Female and male entities have gradually evolved to reproduce by combining DNA of the two parents. The location and orientation of legs, wings, eyes, hair, digestive systems, mouth and reproductive organs have been gravity-affected.</p> <p>Some biological clocks associated with fertility are gravitationally linked to the moon gravity and tides. [Chapter 5] The head-legs super-structure-orientation of the embryo is formed by gravity-induced orientation. [Vol. I]</p>
4.5 to 0.543 billion	<p>Precambrian Era, fragmented into: Hadean [4.5 to 3.8 million YRS AGO]; Achaean [3.8 to 0.543 million YRS AGO]; further fragmented into Paleoproterozoic [2.5 to 1.6 billion YRS AGO]; Proterozoic [2.5 to 0.543 million YRS AGO];</p>

	Mesoproterozoic [1.6 to 0.9 billion YRS AGO]; Neoproterozoic [0.900 to 0.543 million YRS AGO], Vendian [0.650 to 0.543 billion YRS AGO];
650 to 543 mill.	<p>The oldest animal fossils exist from the Vendian era including trilobites and brachiopods. Fish evolved into the first creatures on land, moving on land with primitive four legs, backbones and eyes on the top of their heads rather than on the side.</p> <p>Unlike other fish, they could move their head independently of its shoulders like current land animal. They had overlapping ribs that could support the body against gravity. Evidence is based on a fossil from Canada, Ellesmere Island. A meat-eater named “<i>Tiktaalik</i>”, a 2006 find, is 4 to 9 feet long and looks like a cross between a fish and a crocodile.</p>
543 to 248 mill.	Paleozoic Era [543 to 248 million YRS AGO], fragmented into: Cambrian [543 to 490 million YRS AGO]; Ordovician [490 to 443 million YRS AGO]; Silurian [443 to 417 million YRS AGO]; Devonian [417 to 354 million YRS AGO]; Carboniferous [354 to 290 million YRS AGO]; Permian [290 to 248 million YRS AGO]
248 to 65 mill.	Mesozoic Era, fragmented into: Triassic [248 to 206 million YRS AGO]; Jurassic [206 to 144 million YRS AGO]; Cretaceous [144 to 65 million YRS AGO].
	<i>Asteroids</i> falling on earth cause global climatic catastrophes on the average <i>every 100,000 years</i> . One of them, 2004SB, about 1.3 kilometer wide, may hit earth around November 1, 2141. Yet it may be diverted away by <i>solar sails</i> .
230 to 65 mill.	Various types of dinosaurs live around the globe for about 155 million years. They became extinct by gravity-induced climatic phenomena that lead to lack of water/grass. Dino-Birds survived and have evolved into bird species.
55 mill.	Mammoths, mastodons, and elephants emerge. The first mammoths emerged in Africa. They later reached Europe and Siberia. One branch reached North America about 1,700,000 YRS AGO. It is named the American Mammoth.

50 – 45 mill.	Gravitationally-pushed glaciers advancing South, forced mammoths to what is now the state of South Dakota.
50 to 45 mill.	<p>The plate that carries the Indian subcontinent is pushed up, gradually forming the <i>Himalayas</i>.</p> <p>The new barrier to global wind changes weather patterns, altering average temperatures and ecological systems. Climates that had been tropical had turned largely temperate, jungles had thinned out, and fruits and nuts normally available year around began to appear only seasonally.</p> <p>The changing conditions for feeding, outside the forest in the resulting savanna, attracted forest-dwelling apes in search of food.</p> <p>Once out of the forest these apes began to evolve rapidly. The grasslands favored the survival of those who could stand up; for an erect position enables to see over the grass to spot and hunt their prey, and to see and escape the animals that preyed on them.</p> <p>Thus they were able to survive longer and produce more offspring who shared their characteristics. After many generations they had evolved into the <i>upright-standing-walking hominids in Eastern Africa</i>.</p> <p>Intellect henceforth is aided by fore-limbs freed from tasks of walking.</p>
65 to 1.8 mill.	Cenozoic Era [65 million YRS AGO until present], fragmented into: Paleocene [65 million to 54,800,000 YRS AGO]; Eocene [54.8 to 33.7 million YRS AGO]; Oligocene [33.7 to 23.8 million YRS AGO]; Miocene [23.8 to 5.3 million YRS AGO]; Pliocene [5.3 to 1.8 million YRS AGO].
14 to 12 mill.	<p>Once out of the forest apes began to evolve rapidly.</p> <p>The grasslands favored the survival of those who could stand up; Thus they survived longer and produced more offspring who shared their characteristics.</p> <p>Experience with gravity-induced factors, grew in these creatures into primitive but intelligent thinking. Hominids divert from Orangutans in Borneo and Sumatra in Southeast Asia</p>
8 to 6	Hominids, lived together with common ancestors, the

mill.	Chimpanzees. Several hominids may be our ancestors: <i>Sahelanthropous techadensis</i> , <i>Orrorin tugenesis</i> and <i>Ardipithecus kadabba</i> .
3.2 to 1.8 mill.	<p>Gravity-induced changes in the environment, e.g., when a volcano erupts, cause changes in feeding behavior of hominids, and with them changes in teeth, jaws, legs, backbone, etc.</p> <p><i>Skeleton structure</i> adapts to enhance motility.</p> <p>Loss of oestrus by the female hominid. This sexual rhythm differentiated them from all other animals.</p> <p>New modes of mating improve the selection of a partner lead to prolonged infant dependency, stable and more enduring family units.</p> <p>Diversion from Bonobos to Pygmy Chimps. Hominid “Lucy” lived in <i>Afar, Hadar</i>, Northern Ethiopia, about 3.2 million years ago. She had short legs. But the structure of her knee and pelvis indicates that she routinely walked upright on two legs. However, chimpanzees occasionally walk upright for short periods of time and genetic studies show that humans and chimpanzees shared a common ancestor 8,000,000 YRS AGO. Descendants split into chimps and hominids. Other sites from 2,000,000 to 1,400,000 YRS AGO include <i>Turkana, Kanapoi, Olduvai</i> and <i>Ubeidiya</i>. [see below]</p> <p>17 or 19 gravity-induced ‘ice ages’ since 3,000,000 years ago. Each lasted 50,000 to 100,000 years, each lowering the surface of the oceans, resulting in climate-induced changes in life and ecological systems, e.g., U-shaped valleys in North America and Canada. Ice melting lead to destruction of habitats of creatures which had adapted to colder climates.</p>
1.8 to 1.4 mill.	<p>First-ever human-like ‘settlement’ in the hot <i>Jordan valley</i>, near <i>lake of Galilee</i>, in <i>Ubeidiya</i>, where the <i>Jordan River</i>, meets a small river from the <i>Porria Valley</i>.</p> <p>The site consists of 'living floors' that include tools such as hand axes, picks, bifaces, pebble-core tools and flake-tools. Bones found at the site include extinct species of hippopotamus, deer, and mollusks.</p> <p>The site contains different layers of alternating floors of animal-bones vs. lake-fish-bones with no floors.</p>

	<p>The layers with floors are composed of river-rounded-stones and include the tools mentioned above. The layers correspond to repeated expansions and contractions of the ancient Lake of Galilee.</p> <p>When the lake was contracting, the animals and <i>hominids</i> who had migrated from East Africa via the Red and Dead Seas found there unique feeding site that allowed them to surpass the ‘technology’ of the Neanderthals.</p> <p>From there, our surviving ancestors gradually spread to all corners of the world. Various <i>hominids</i> migrated from the Jordan River to Europe and West Asia. Their earliest migration waves have not survived in these colder climates, but later migrations of more advanced <i>hominids</i> survived.</p>
0.5 to 0.028 mill.	<p><i>Neanderthals</i> split from Jordan Valley and Carmel Caves hominids. About 400 of their remains have been found. They made their last stand in Gibraltar. Like apes, they lacked a bony chin and their nose was more prominent than ours. Yet, they had a larger and broader face than ours. Their skull has a receding forehead and low braincase, but their brain is larger than those of our ancestors. They used fire and introduced burial sites, as did the Carmelite ancestors..</p>
500k to 40k	<p><i>Carmel Caves</i> is occupied by migrants from <i>Ubeidiya</i>. The <i>Tabun Cave</i> has the longest sequence of occupation, almost half a million years.</p> <p>The dwellers used improved hand axes of flint or limestone for killing animals (gazelle, hippopotamus, rhinoceros and wild cattle) and for digging out plant roots. Hand axes became smaller and better shaped and scrapers, made of thick flakes chipped off flint cores, were used for scraping meat off bones and for processing animal skins.</p> <p>Upper levels in the <i>Tabun Cave</i> consist mainly of clay and silt, indicating that a colder, more humid climate prevailed when glaciers formed once more; this caused the Mediterranean Sea level to drop some 100m. to its present level. It also produced a wider coastal strip, covered by dense forests and swamps. Trash in such sites reveals diet of consisting of fruit, seeds, roots and leaves with meat</p>

	supplements.
1,800k to prsnt	The Quaternary Era is fragmented into the Pleistocene [1.8 million to 10k YRS AGO] and Holocene [10k to present]
120k	Burial tradition spreads. Skeleton of a female buried inside a stone niche just outside a Carmel Cave is one of the most ancient human skeletal remains.
100k to 13k	Migrations from Ubeidiya to the rest of the world is proved by studies of complete <i>Mitochondrial DNA</i> sequence. In Ubeidiya, during 1.4 million years, hominids have 'self-educated' themselves to graduate as 'modern humans' have later survived with relatively <i>advanced technology</i> . Fourteen skeletons uncovered, including three complete ones; that define an archaic type of <i>Homo sapiens</i> , closely related to modern humans in physical appearance with delicate facial features, a protruding chin and straight forehead, has been fully developed in the Carmel Caves and the Jordan River. Carmel graves show a cult and rituals related to death and spiritual realm.
100k	Migration from <i>Ubeidiya</i> to the Indian subcontinent.
67k to 10,500	Further migration from <i>Ubeidiya</i> to China. More inventions of skills in fishing and fire making. 40k YRS AGO, further migrations from <i>Ubeidiya</i> to Europe. 35k YRS AGO, the earliest clothed body discovered in <i>Russia</i> . 30k YRS AGO: Beginning of the last North-American ice age. Mitochondrial-DNA studies provide evidence for migration from <i>Lake of Baikal</i> area in Southern Siberia, across the <i>Bering</i> land bridge, to <i>Alaska, North America and further South along the coast</i> . 27k YRS AGO, caves in <i>Africa</i> abound with paintings and carvings. 20k YRS AGO, further migration to North America via the <i>Bering</i> land bridge. 15k YRS AGO, domestication of dogs from a few ancestor wolfs starts in <i>China</i> . 13k YRS AGO, further migration from North to South America.

	<p>12,500 to 10,500 YRS AGO, Natufian culture on Mount Carmel emerges. Plant-gathering and animal-hunting is transformed to plant-growing and animal-domestication. The level of the Mediterranean Sea rose again, as the glacial period came to an end, and the coastline stabilized to roughly its present contours. The Coastal Plain became narrower. Carmel settlements become permanent, consisting of a few families living together in a kind of a village that serves as a base for hunting expeditions and food gathering. Improved Natufian flint tools are used primarily as scrapers of animal skins.</p> <p>Decorative beads, blades for cutting meat and sawing bone and sickle blades (secured in wooden or bone scythes) emerge for harvesting grain (which left a characteristic gloss on the edge of the blades).</p> <p>Microliths of a lunatic shape are used as arrowheads, harpoons and fish hooks. Grinding tools, mortars and pestles made of stone are used for food processing.</p>
12,000 to 11,200	<p>Further migrations from Asia across the <i>Bering</i> land bridge to the Americas. Migrants' artifacts in <i>Clovis, N.M., North America</i>.</p>
10,000	<p>Main racial groups are frozen in territories that they dominate. Cultivation of primitive forms of <i>rice</i> in <i>South-East Asia</i> emerges.</p> <p>Pottery is produced in <i>Japan</i> 9,818 YRS AGO.</p> <p>Human remains in '<i>On Your Knees</i>' cave in <i>Alaska</i>.</p> <p>9,500 YRS AGO, evidence of harvesting of wild grasses in <i>Asia Minor</i>.</p> <p>9,400 YRS AGO, human remains in <i>Kennewick</i>, on the Western Coast of <i>North America</i>.</p> <p>8,640 YRS AGO, human remains in <i>Palli Aike</i>, at the Southern end of <i>Chile</i>.</p>
9200	<p>Village and perhaps a shrine in <i>Jericho</i>, the <i>Jordan Valley</i>. <i>Jericho</i> is considered by some scholars as the birthplace of civilization, but see <i>Ur</i> below.</p>



8,100	End of the last 'Ice Age'. Ocean water level rising. New ecosystems start to emerge.
7,000 to 5,500	<p>The first recognizable civilization: The Ubaid Culture, Ur, is established on the fertile soil formed between the <i>Tigris</i> and <i>Euphrates</i> rivers, in an area close to where they flow into what is today <i>Iraq</i>, near the <i>Persian</i> or <i>Arabic Gulf</i>. It is also called <i>Sumer</i>. Yet, other call it the '<i>the land between the two rivers</i>', '<i>the Ur Civilization</i>', '<i>Ki-engir</i>', '<i>Acadi</i>' as the Bible refers to it sometimes via other names, including Ur.</p> <p>Its first settlers are called <i>Ubaidians</i>. Their name is derived from <i>Tel al'Ubaid</i>, near the city of Ur. [Chapter 7]</p> <p>6600 YRS AGO, the Ubaidians living in villages develop systems to drain marshes and irrigate their crops by digging ditches to river waters. As in the Carmel culture, they learned to keep farm animals and develop weaving, leather work and copper and bronze metallurgy. They are involved in trade with other societies. [Chapter 7]</p> <p>6100 YRS AGO, the Ubaidians develop large ovens for baking bread. In <i>Tell Hamoukar</i>, a protective city wall is erected Primitive hieroglyphics is developed, mainly for record keeping of trade transactions. It has evolved into the first written language. [Chapter 7]</p> <p>Villages had local religious cult centers, each with its particular god. One of these, <i>Eridu</i>, is traced back to about 7000 YRS AGO. It later had a temple with monumental architecture that goes back to around 6500 YRS AGO.</p> <p>Semites have worked their way from the Carmel Caves into the fertile Ur area, either peacefully or by force.</p> <p>An <i>U'baid</i> site at <i>Yarim Tepe</i> yielded several hundred grindstones and grinders in a single room.</p> <p>A simple machine is devised to make pottery easier to manufacture and paint. Pottery emerges as <i>Ubaid Style of Art</i>, with its monochrome black painting. The earliest historical division of labor and professionalism evolves. Stamp seals are used at various Ubaid-culture sites as precursors to writing. Earlier flint sickles are replaced by clay sickles.</p> <p>A religious temple dedicated to <i>Nin-Khursag (Ninhursag)</i> was uncovered at al'Ubaid, with a dedication inscription from <i>A-anni-padda</i>, king of Ur and son of <i>Mes-anni-padda</i>, king of Ur. Uncovered "<i>Sumerian King List</i>" show that they are</p>

	<p>from the First Dynasty of Ur. [Chapter 7] The <i>Ubaidians</i> were then invaded by the <i>Sumerians</i> and a new era starts to evolve. As with the Ubaidians, the origin of the Sumerians is not clear. Their language, which has survived through writing, bears some resemblance to the <i>Ural-Altai</i> languages. [Chapter 7]</p>
5.9k	<p>Sumerians replace Ubaidians and construct improved canals for irrigating crops and for transporting crops by boat to village centers. They also improve the roads over which their donkeys trod, some of their donkeys pulling <i>wheeled carts</i>. As the UR/Sumerian population increased, the key element in creating a civilization - a word derived from an ancient word for <i>city</i> - had emerged. At least fifteen cities were emerge: <i>Ur, Uruk, Kish, Lagash, Eridu, Sipper, Nippur, Adab, Umma, Larsa, Eshnunna, Shaduppum, Isin, and Shurupak</i>. Ur, for example, has increased to a city of about 24,000 people and Uruk to around 45,000. [Chapter 7] Around each city were fields of grain, orchards of date palms, and land for herding. Besides planting and harvesting crops, the Sumerians hunted, fished, or raised livestock. [Chapter 7] Sufficient food is produced to support population that has further developed professions: Priesthood, pottery making, weaving, carpentry, early metallurgy and trading. The Sumerians has developed trade by sea and designed and constructed seaworthy boats and even ships. They imported key commodities made from wood, stone, tin and copper.</p>

Gravity-Induced Emergence of The First Civilization

7.1 Introduction

The first recognizable civilization, where the first written language was invented, among other first-timers in the world history, had emerged about 7000 years ago on the fertile soil formed by repeated flooding, sedimentation and deposition of rich clay-like soil, between the Tigris and Euphrates rivers, in an area (currently Southern Iraq) close to where they down-flow into what is called today the Persian-Arabic Gulf.

Its original name, however, as had been used by its the founders, is not clear and was probably not a single uniform name.

I shall henceforth use both *Ur* and *Sumer*, or *Shumer* to refer to this important civilization in the history of the world. It should be stressed, however, that some refer to it as the ‘the land between the two rivers’, *Ki-engir*, *Acadian*, *Akkadian*, etc. The Bible refers to it with other names, including *Ur*.

Once a complete writing language has evolved there, its surviving records -- on time-invariant clay tablets -- have provided us with details of incredibly rich culture that had flourished mainly from about 6500 to 4700 years ago and has been later adopted, almost in its entirety, by Babylonian civilization, and in some parts of it, like the use of seconds, minutes, an hour and numerology, has been adopted by all other subsequent civilizations until today.

Poems, anecdotes, prose, huge decorated temples, pantheon of gods, diversified theology, cosmology, political system, government, organized armies, numerology, etc., had all first originated there. No such parallels in Egypt and India emerged that early. Hence, *Ur/Sumer* is widely recognized as the first civilization on earth.

A minor portion of these great epics have also survived via the Bible, say, in the story of Gilgamesh, the flood, Noah, the ark and Ur, the birthplace of Abraham, the biblical founder of monotheism.

Gilgamesh ruled *Uruk* and was probably *the first world poet and author of great epics*.

One of his epics relates to the coming of a great flood, which obliterates mankind except for a single righteous family that has survived the flood by constructing an ark. It is from this single family that an improved race has emerged and inherited the earth.

There are also original Ur/Sumerian epics resembling the later written Biblical Eden, Creation of the world and man.

In fact, Ur/Sumerian literature, cosmogony, theology and rituals, have strongly influenced the next civilizations to such an extent that even today one can observe their various echoes in the Judeo-Christian and Islamic traditions.

- *Where and when did it flourish?*
- *What was its original name?*
- *Who were its founders?*
- *Where they came from?*
- *How did they develop the first-ever complete system of a writing language? And how it looks and reads?*

7.2 The Founders of The First Proto-Civilization: The Ubaidians

About 7,000 to 5500 years ago, the first settlers are called Ubaidians. Their name is derived from *Tel al'Ubaid*, near the city of *Ur*.

There is no evidence to back-link them with *Ubeidiya*, more than a million years earlier. Nevertheless, as recent DNA-based studies link humans around the world to *Ubeidiya*, it is a plausible assumption.

About 6600 years ago, the Ubaidians living in villages developed systems to drain marshes and irrigate their crops by digging ditches to river waters. As in the earlier *Carmel culture* [Table II], they learned to

keep farm animals and probably developed weaving, leather work and even copper and bronze metallurgy. They were also involved in trade with other societies: West, east, North and South of their unique land.

At about 6100 years ago the Ubaidians developed large ovens for baking bread. In *Tell Hamoukar*, a protective *city wall* had been erected. *Primitive hieroglyphics* were first developed, mainly for record-keeping of trade transactions. Gradually these primitive hieroglyphics have evolved into the first written language. (see below)

Villages had local religious cult centers, each with its locally particular god. One of these, *Eridu*, is traced back to about 7000 years ago. It later had a temple with monumental architecture that goes back to around 6500 years ago.

Some scholars consider them ‘Semites’ and assume that wave after wave of semi-nomadic Semites have worked their way from the Carmel Caves into the fertile Ur/Sumerian area, either peacefully or by force.

It was during the Ubaid period that a simple machine was devised to make pottery easier to manufacture and paint. Pottery gradually became more uniform, conforming to an Ubaid Style of Art, with its monochrome black painting. The invention of the more advanced potters' wheel came at the end of the Ubaid era.

Other scholars assume that within this period the early historical division of labor and professionalism had started to evolve.

Stamp seals have been found at various Ubaid-culture sites, perhaps as precursors to writing (see below). Earlier flint sickles had been gradually replaced by clay sickles.

A great temple was uncovered at *al'Ubaid*, with a dedication inscription from *A-anni-padda, king of Ur* and son of *Mes-anni-padda, also a king of Ur*. According to the “*Sumerian King List*” that has survived, they are from the *First Dynasty of Ur*.

7.3 Ubaid Invaded By Sumerians

The Ubaidians were then invaded by the Sumerians and a new era starts to evolve.

As with the Ubaidians, the origin of the Sumerians is not clear. Their language, which has survived through writing, bears some resemblance to the *Ural-Altai* languages.

About 5900 years ago the Sumerians have replaced Ubaidians and constructed improved canals for irrigating crops and for transporting crops by boat to village centers. They also improved the roads over which their donkeys trod, some of their donkeys pulling wheeled carts.

As the UR/Sumerian population increased, the key element in creating a civilization - a word derived from an ancient word for city – had emerged.

At least fifteen cities were well-maintained, *including Ur, Uruk, Kish, Lagash, Eridu, Sipper, Nippur, Adab, Umma, Larsa, Eshnunna, Shaduppum, Isin, and Shurupak.*

Ur, for example, has increased to a city of about 24,000 people and Uruk probably had a population of around 45,000. Around each city were fields of grain, orchards of date palms, and land for herding. Besides planting and harvesting crops, the Sumerians hunted, fished, or raised livestock. Sufficient food has been produced to support a growing population that further developed specific professions: Priesthood, pottery making, weaving, carpentry, early metallurgy and trading.

The Sumerians further developed the trade by sea. They designed and constructed seaworthy boats and even ships, and had imported key commodities made from wood, stone, tin and copper.

7.4 Socio-Biology, Armies, Organized Religion and Education

Disciplined infantry in a phalanx with overlapping shields and leveled spears appear on monuments from Ur. They have also introduced a new key weapon: A bow composed of interlocked wood and horn strips, which has provided their arrows with a longer range.

The Sumerians had also introduced the foundations of mathematics, establishing the technique of expressing numbers by position and sign, the sixty-based system in our circle of 360 degrees and the hour of sixty minutes. A later Babylonian cosmogony is based on the Sumerian one, with creation of the world from structural watery waste and the eventual generation of mankind.

As a well-functioning civilization, Ur/Sumer lasted about 1,300 years, roughly from 5300 to 4000 common years ago. Then the *Elamites* invaded and sacked Ur.

Hammurabi of Babylon defeated *Rim-Sin* of *Larsa* (about 3823-3763) and became the sole ruler of Ur/Sumer/Akkad. This date probably marks the end of the Sumerian empire. Sumerian civilization, was then adopted almost in its entirety by Babylonia.

And the name of the third river is Hidde-kel [Tigris];
which flows toward the east of Ashur.
And the fourth river is Euphrates.
Genesis 2:14

Hidde-kel and *Euphrates* are amongst four rivers identified in the original Bible as leading to Eden, the garden of Eden and the river of Eden. *Hidde-kel* was later shortened to *Diklat*. The Persians pronounced it, *Tigra*, from whence the Greek name *Tigris*. In Arabic it is, *Dijla*, *Idikna*, *Idikla*, or *Idiklat*.

Ur is located at *Tell el-Mukayyar* which in ancient texts was named *Uriwa* or *Urima* and later *Uru*.

Shinar is a broad designation applied to Mesopotamia: the 'land between the two rivers'. It is mentioned eight times in the original Hebrew Bible in reference to a later civilization: Babylonia. *Shinar* may have also included *Erech*, or *Ur/Shumer*. The Euphrates is also called

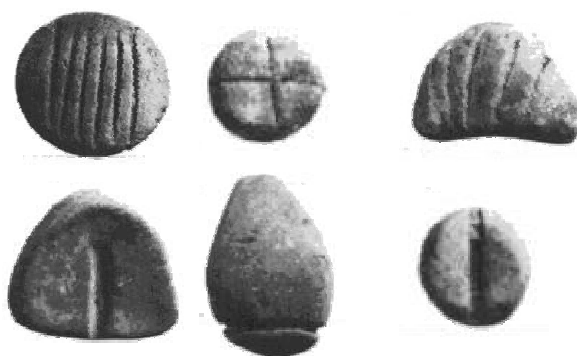
Puranum [meaning, Great water] or *Pura*, or *Purat*, or *Ufratu*. In Greek it is *Euphrates* and in Arabic *Furat*.

7.5 How The First Writing Language Was Invented?

The invention of a full-fledged writing language in human history is attributed to both the Ubaidians and the Sumerians. That great historical progress coincides with the gradual transition from hunting-gathering families, groups, and tribes, to permanent agrarian communities, villages and cities, incorporating principal sites and private property.

The pressing needs to mark and count private property, such as parcels of land, animals or measures of grain, or evidence of trade in transferring private property to another, or contribute it to the cult center to please the local priest/god, were probably the main driving forces for the invention of a writing language. Then, as ‘by-products’, rich literature, list of kings and a mythology have emerged and survived on clay tablets.

The first evidence of recording of property was discovered as "counting tokens", such as those depicted here. These “tokens” were probably introduced by the Ubaidians to the Sumerians and they evidence early recorded numerical calculations for trade, or to keep records of supplies and goods exchanged, or provided to the temple priest/god.



At about 6100-5800 these “Counting Tokens” become symbols that could be impressed or inscribed into a wet clay – prior to drying it - - to represent a record of land, grain or cattle. Thus, “property tokens” are the origin of a written language.



Head



Foot

Sun
"day"

Hand



woman

Pictographs have also served as precursors of a written language. They were gradually stylized, rotated with respect to the common up-down vector of gravity, and then impressed on a soft clay with a wedge shaped stylus to become the script known as *Cuneiform writing*.

Excavations of the ancient city of *Ugarit*, has produced texts in a cuneiform script that was also **consonantal**. In the order of the **Alef-Beyt**:



The Sumerian writing is the oldest full-fledged writing known. Many Sumerian words do not appear to be of Sumerian origin, not even

the Sumerian words for Tigris and Eurphates -- *idiglat* and *buranun*, respectively. Some Sumerian city names also do not appear to be Sumerian.

The Sumerians also wrote **arithmetic based on units of ten** - the number of fingers on both hands. They wrote by pressing picture representations into a wet clay with a 'pen', then dried the clay to form tablets commonly made and then read when their up-down and left-right orientation was agreed upon by the priest or king and enforced by education.

These tokens and pictographs were thus enforced by hard and punishable training into the minds of 'educated' Sumerians to teach them how to associate symbols with things and animals. Gradually, when combined and added together via an enforced order of symbols and a gravity-induced orientation to represent the spoken sounds - phonetic letters - forming what is now called the cuneiform writing, has emerged and have stayed with us, as described earlier.

7.6 The Emergence of National-Religious Order

The invention of writing was immediately exploited as a tool to tighten control of the priestly castes and government over the illiterate population. Beyond record of private property it was widely enforced by rulers and priests of cult centers. Such cult centers gradually evolved into bigger cities, like Ur and *Uruk*.

One of the earliest historical uses of seals is also linked with such control of power, for seals were used to certify the amount of crops at their receipt in the temple or king residence.

It is in Ur/Summer that a close relationship between religion and government had greatly evolved. In fact, no other ancient culture has provided religion with such a central status and had allocated so much physical resources to religious government.

7.7 The Origin of Our Seconds, Minutes Hours and Numerology

Concerned about their cosmological-star-gods, the Sumerians needed to map the fixed and moving stars. That prompted them to divide the sky circle into units of sixty, each 6 degrees, from which they also invented the 60 seconds in a minute and 60 minutes in an hour. So when we use that in everyday life, we are using part of the Sumerian culture.

7.8 Organized Education, Judicial Laws and Women's Equality

The first-ever organized system of education was also introduced in Ur/Sumer. It was based mainly on memorizing and copying in the cuneiform script.

Nevertheless, the legal idea of justice, with or without clear division between secular and religious authority, played a basic role in Ur/Sumer, the seed of all great civilizations that are to arrive later on the stage of history.

Monogamous families were established, all based on the Sumerian Law, which gave women important rights.



Sumerian Lyre

Divorce was conducted by law which provided equitable treatment of divorced wives.

Survived Sumerian pictorial art portrays women in skirts, clean-shaved men and uniformly dressed soldiers, as well as a picture of a drinking party; a group of men sitting in armchairs with cups in their hands while musicians play for them.

Some scholars assume that the first musical instrument in the ancient world is the depicted Sumerian Lyre. Some at first assumed that all Mesopotamian cuneiform inscriptions were in the Acadian language. It was later discovered that some were in a non-Semitic language.

7.9 Survival of Names in Later Cultures

Most Sumerian excavations were conducted at *Kish*, *Adab*, *Erech*, *Eridu*, *Eshnunna*, *Jemdet Nasr*, *Shuruppak*, *Tell al-Ubaid*, *Tutub*, and *Ur*. The canalled city of *Kish*, is known to have been one of the most important cities of Ur/Sumer.

Te'rah begat Abram, Nahor, and Ha'ran;
and Ha'ran begat Lot.
And Ha'ran died before his father Te'rah,
in the land of his nativity,
in Ur Kasdim [of the Chal'dees].
Genesis, 11; 27, 28

Ur Kasdim is identified with *Urfa*.

The Turkish name *Urfa* is derived from *Orhāy* and the Greek *Oppa*, *Orrha*.

UR is identified with Uruk, or the Biblical *Erech*. The Talmud (Yoma 10a) also identifies *Ur Kasdim* with *Erech* in a place called *Urichus*.

According to Islamic tradition Abram, or Abraham, lived in *Edessa Sanli Urfa*, a site of a mosque called the Mosque of Abraham.

The Talmud and some Arabic writers regard *Erech*, or *Orek*, as the birthplace of Abraham. The cuneiform writing refers to this city as *Urki*. *Ur* is also identified with the current Iraqi city *Mugheir*, or *Mughayyar*, also called *Urumma*, or *Urima*, and later *Uru* in a district called *Chaldea*, or *Kaldu*.¹



Bull-headed Lyre



7.10 The Origin of Monotheism

Ur is a well-investigated archeological site. Its castle-temple is depicted here. Its link with the early Bible is as the hometown of the first Hebrew and the most pious father of Monotheism, *Abraham*. Those who are considered descendants of Abraham are known as '*Hebrews*', '*Ishmaels*' and *Druzes*.

The Hebrews are the first to collectively arrive at and obey the abstract notion of a single, Almighty God, The Creator, and later, to forbid, via the Ten Commandments, God's representation by any image, statue, painting or icon. No people has produced a greater historical impact from the idea of Monotheism.¹

¹ Ur was constantly at war with other states. It was attacked by raiders from *Akkad*. Ur then entered a stage comparable to the *Dark Ages*. It remained that way until a new king came to power. His name was *Ur-Nammu*. Under his rule a government was established which enforced its laws and rules strictly. Temples were re-built, including the biggest and most beautiful: The Ziggurat, depicted here. This period ended when northern tribes attacked and Ur was occupied by Babylonians. The ruins of Ur were found and first excavated by the British consul J.E. Taylor, who partly uncovered the ziggurat of *Nanna*. The British Museum began excavations there in 1919 and was joined later by the University Museum of the University of Pennsylvania. The expedition completely excavated the ziggurat, the entire temple area at Ur, and parts of the residential and commercial quarters of the city. The most spectacular discovery was the Royal Cemetery. It contained art treasures of gold, silver, bronze, and precious stones. (see an example depicted here.)

In trying to comprehend the origin of Monotheism I shall briefly stop at the pantheon of gods in Ur/Sumer. The *Akkadian* top god was *Marduk*. All land belonged ultimately to the gods, while the king-priest was their vicar.

The various gods were eventually organized to play special roles.² There were gods of the air and water as well as the goddess of love and procreation and war named *Ishtar*, as was later mentioned in the Bible. One may therefore label the Sumerian religious government as the beginning of a systematic and organized theology.³

² There were also important **political** aspects to the Sumerian religion. The gods ANU, ENLIL and ENKI were on top of other gods. ANU was the father of the other gods. ENLIL was the one without whom nothing happens.* ENKI was the god of wisdom, the teacher, the life-giver and the keeper of order as well as the god of sweet waters that meant life to the Sumerians.

³ The Sumerians invoked the idea of the creation of man from several models or designs that had been created from clay, prior to the **final selection of man**. They also introduced the faith in life after death, and the idea of *Sheol [hell]*. Through the invention of the *cuneiform writings*, we can read today UR/Sumerian hymns, myths, lamentations, incantations and the structure of their religious world.

The *priesthood* initially held this role, and even after secular kings ascended to power, the *clergy* still held great authority through the interpretation of omens and dreams. Many of the *secular* kings claimed *divine* right.

The temples included many rooms for priests and priestesses and were decorated with human and animal figures. Some have evolved into towering ziggurats in which priests, priestesses, musicians, singers, castrates and hierodules performed.

Various public rituals, food sacrifices, and libations took place there on a daily basis as well as monthly feasts and new-year celebrations.

Lamentations reveal that people could plead, lament and wail, confessing their sins and failings.

From verses scattered throughout hymns and myths, one can compile a picture of the *universe's (anki) creation* according to the Sumerians. The primeval sea (abzu) existed before anything else and within that, *the heaven (an) and the earth (ki) were formed*. The boundary between heaven and earth was a solid vault, and the earth was a flat disk. Within the vault lay the *gas-like 'lil', or atmosphere*, the brighter portions therein formed the *stars, planets, sun, and moon*. *An*, god of heaven, is the main god of the pantheon, *Ki* is likely to be the original name of the earth goddess *Ninhursag* (queen of the mountains), *Ninmah* (the exalted lady), or *Nintu* (the lady who gives birth). *Enki*, during the *first days*, needed things that were *created*. *First Heaven and Earth were separated*. *An* took Heaven, *Enlil* took the earth.

Nammu is the Goddess of the watery abyss, the *primeval sea*. She may be the earliest of deities within *Sumerian cosmology* as she gave birth to heaven and earth. She is elsewhere described both as the mother of all the gods and as the wife of *An*, *Enki's* mother. *Anunnaki's* temple was in *Erech*. He and *Enlil* give various gods, goddesses and kings their earthly regions of influence and their laws.

Nammu and *Ninmah* help create man from clay. *Enki* drinks overmuch at a feast when she shapes six flawed versions of man from clay. *Enki* also creates a flawed man which is unable to eat.

Get yourself out of your country,
 And from your kindred,
 And from your father's house,
 To the land that I will show you.
Genesis 12:1

Abraham [*Ibrahim* in Arabic, and initially *Abram*) was 75 years old when he left his Ur/Sumer. He was probably forced to leave because of his radical belief in Monotheism and his total rejection of the pantheon of gods. This was probably the beginning of Monotheism. His son, Itzhaak [Isaac] defined early monotheism simply as: "The God of my father, the God of Abraham" [Genesis 31:42].

All *Abrahamic religions* are deduced from Abraham's early idea of only ONE GOD. Unlike his children Isaac and Jacob, Abraham tried *to spread* Monotheism through people who had not been 'blood-related'.

Christianity had first spread to Greece, Rome and Egypt, and then to most of Europe, Asia, the Americas and other parts of the world. It was later divided into various churches and *denominations*: On the 5th century between *Western Catholicism* and the *Oriental Church* (later divided into *Greek Orthodox*, *Russian Orthodox*, etc) and on the 16th century into the *Protestant Reformation* and *hundreds of Protestant denominations*.

Islam had originated in the 7th century in *Mecca* and *Medina* and is a continuation of Abrahamic Monotheism. Through the son of Abraham, *Ishmael*, conceived through Abraham's servant *Hagar*, Muslims believe to be also related to Abraham.

Abraham had 8 sons: *Ishmael* by his wife's servant *Hagar*, Isaac by his wife *Sarah*, and six by another wife, *Keturah*.

The Druzes also believe in the Abrahmic faith through their ancestor *Yitro* [Jethro], the father-in-law of *Moshe* [Moses]. The *Noachide faith*, is based upon the faith of Abraham through the children of Abraham.

Moses, Jesus, Muhammad and Bahauallah are all claimed to be descendants of Abraham through one of these sons and relatives. The *Bahai religion* reconizes them all as precrusers of their universal faith.

The contents of *Genesis*, and later of the *first five books of the Bible [Torah, Pentateuch]* had existed when a written language was available at least in Ur. There is little doubt, that since the aforementioned *Summerian and Akkadian literature* is so rich with epics, proverbs and wisdom anecdotes, that part of *Genesis* had inspired some parts of the early Hebrew text concerning, say, the story of the great *flood [Gilgamesh]* and the *implementation of the law*. Yet, there is no surviving written evidence of any of the early texts prior to the famous 2nd century *Dead Sea Scrolls* discovered only about two generations ago.

One may therefore assume that the earliest written texts were *consonantal [no vowels]* and that only much later, after the first exile, the Hebrew consonantal text had started to include vowels, especially when the early translators from Hebrew to *Aramaic* had to fix the proper pronunciation and understanding of the text. These early editing processes have generated *the first textual variants*, a process that have ended up with thousands of variants of the Old and New Testaments of the Bible as we know them today. Indeed, both the Old and New Testaments have evolved over long periods of editorial process: For instance, Psalms, Proverbs and Job reached their final form in the 4th century.

Eleazar, the high priest of Jerusalem, sent to *PtolmeyPhiladelphus* in Alexandrai, Egypt, at about 250 BCE, the Hebrew manuscripts of the Pentateuch to be translated into Greek -- the famous *Septuagint* -- about 400 years prior to the Hebrew 2nd century *Dead Sea Scrolls*.

• In fact, *there are at least 5,250 different manuscripts of New Testament*.⁺ Each translator and copier had to first master the Hebrew grammer, pronounciation and meaning, a hard task Many have therefore turned to the *Septuagint* and later to *Latin versions*.

⁺ Andrew D. Benson, *The True Origins of Christianity And The Bible*, Prudential Publishing Company, Clovis, Ca, 1997. Mr. Benson has assembeled a massive amount of evidence and thoroughly documented it with over 2000 footnotes and references. It may also be pointed out that prior to the first exile the Hebrews *did not believe that there is life after death*. A significant minority of Christians and Christian denominations, as well as other major monotheistic religions, stress that to replace Abrahamic Monotheism with the idea of the *[indivisible] Trinity Diety contradicts Monotheism* and may be traced back to *Roman religious culture*.

The Skeptic Outlook

8.1 Civilization is Precarious

Scientists who claim that they operate without reliance on philosophical principles are self-deluded. Scientific theories always advance, stagnate or decline under the domination of a philosophy, whether declared or undeclared. To undertake a scientific approach to the whole of nature one must consciously evolve a universal philosophy of science and not pretend to avoid it.

Intellect is given to us to speculate, to observe, to compare, and to speculate again; this is scientific-philosophical progress; almost all the rest is technocracy or chimera. In this process we are guided by two principles: One, empirical, according to which the conclusions drawn from a theory must be confirmed by *experience*, the other, semi-logical and semi-aesthetic, according to which the fundamental laws should be *as few and as unified* as possible and compatible with logic.

Bold and adventuresome philosophical speculation is at best self-indulgence, a passing culture occurring when philosophers speak a language that is neither accessible to nor intended for empirical verification, mathematical exactitude and the unity of science and philosophy. For synthetic, empirical and speculative methodologies must seek to comprehend nature, by putting it all together in the service of repeatable verification, exactitude and the unity of human thought (see below). In seeking to comprehend nature we must bear in mind, on one hand, that the greatest snare for creative thought is uncritical acceptance of traditional assumptions, and, on the other, that new philosophies are not necessarily more advanced than old ones.

It is meaningless to ask:

What is the world made of? What are things-in-themselves?

Materialism, idealism, positivism and the like are isolated oversimplifications in a pluralistic science and philosophy.

Actual scientific and philosophical works require the simultaneous use of several concepts and methods. This methodological pluralism explains why a given scientific theory can be considered “valid” and yet relative rather than absolute. Both teach us the inter-connections between different descriptions of one and the same reality. In fact, nothing in both is but shadows of reality, painted with words and symbols.

Science and philosophy are relative and vary with historical times, in other words, verifiable knowledge grows with historical time, as is illustrated by our widespread success in applying it in practice.

8.2 The Dangers of Mind-Stagnation

One never wakes up twice the same person. In the arts, sciences, industry, politics, hospitals, farm-fields and the military, or even in any armed-chair professionalism, life circumstances change daily, making a mind stagnation impossible.

Inner civilization strength to withstand external and internal dangers is mostly the outcome of moral and inner conviction of a few that work for the good and safety of all. No single culture, single temple of knowledge, science, or book can supply such multiple attributes.

In any civilization, past and present, such attributes are frequently acquired, sadly, in the battlefield. Emerging out of it, survivors are often the mature leaders that no university, school or book can teach. Such strong, physically and mentally adaptable survivors, may bring home more responsible culture and leadership, or whatever one calls it, than any arm-chaired professional.

Both culture and civilization are precarious. Their survival depends on education, adaptation and innovation a creative minority generates and maintains with incalculable effects these have had upon everyday thinking. Since these are the basis on which we survive and

progress, it is pertinent to understand how, where and when they occur or are subdued.

The origin of this problem is intimately linked to the *separate* roles played in Western academe by scientists, technologists, business, management and law “experts” vs. humanists and religious mentors.

Most Western humanists are ignorant of modern advances in the exact sciences, of their inner conflicts and various formulations, of their experimental and observational verification or refutation. They are likely to resort to an *a priori*, or superficial answers to complex problems whose detailed implications are beyond them.

Consequently, many withdraw to empty professionalism and “easy-and-fun pragmatism”. On the other hand, the contemporary scientist, a stranger to cultural-historical-philosophical knowledge, can only deal with problems by applying those disciplinary methods that are familiar to him or her through the non-cultural-philosophical (and sometimes even anti-intellectual) methods of education in our universities.

The resulting vicious cycle opens unbridgeable gaps between all professionals, and, gradually, *isolates*, each discipline. It is this *separatism* that causes declining standards, deterioration, empty academicism and the crisis in education.

8.3 The Dangers Introduced By A Declining Education

Most students today participate in fragmented courses of disciplinary professionalism that leave them with a feeling of *inner cultural emptiness in academia*. In fact, what they find in the temples of knowledge is overwhelming bureaucracy, inertia, nihilism, careerism, populism and irresponsibility of the faculty to provide them with what would make them *bona fide* cultured persons. Wondering about their lost dream in the temples of knowledge, they ask:

Has the Time for the Grand Cultured Mentors in Academia Passed?

A bright and ambitious student, who commences his/her studies in the firm belief that much of the fundamental-core knowledge of our civilization is comprehended by at least most of his/her professors, is extremely perplexed to discover, sooner or later, that the professors are uncertain about the fundamental, interconnected meanings of what they teach in class.

Other, who seek explanations about the world at large in which they live or about the worlds at small that compose the world at large, realize that it entails sub-terrainian links between an undeclared philosophy of fragmented education adhered to by most of their professors.

Whether declared or not, that current mundane philosophy of education any professor is bound to face in confronting intellectually starving students.

But he or she frequently remains unresponsive, for she/he is just following the curriculum approved by *accreditation committees*.

So here is the main source of what went wrong.

Here is the starting point for reassessing our crisis.

What is is their education?

Where are their eyes, brains and minds?

Sensing that attitude some intellectually-starving students often give up, or blame themselves unnecessarily for their inability to grasp what their mentors dismiss as trivial. A splendid minority of bright students dare to continue, by themselves, the interminable search, which calls for questioning, re-examination, screening, and at times radical rejection of 'accepted', or 'established doctrines' that fail to justify themselves through their own logic, consistency, universality and testability.

8.4 The Current Confusion In Western Academia

Nowadays most ‘humanists’ are ignorant of modern advances in the ‘exact sciences’, of their mathematical formulations, experimental, observational and verification methods. They are likely to resort to a priori, or superficial answers to complex problems whose detailed implications are beyond them. [Vol. II]

On the other hand, the contemporary scientist, a stranger to philosophical knowledge, can only deal with problems by applying those narrow disciplinary methods that are familiar to him or her through the non-philosophical (and sometimes anti-intellectual) methods of education practiced today in so many of our universities.

The resulting vicious cycle opens unbridgeable gaps between various ‘professionals’, and, gradually, isolates each discipline. It is this separatism that causes declining standards, deterioration and empty academicism of accreditation committees.

Most of us are aware of mankind's inherited hostility to change. This dogged obstinacy in clinging to habits, this suspicion of the unfamiliar, is exactly what might be expected given the history of humanity.

The verified result today is a spectrum of fragmented educational studies that mass produce empty professionalism and the largest-ever armies of PhDs -- Philosophy Doctors -- who know close to nothing about philosophy.

Our world is a sad little affair,
 unless it has in it something,
 for every age to investigate.
 Philosophy would ravish all mortals with love for her;
 we should abandon all those things which,
 in our ignorance of what is great,
 we believe to be great.
Seneca

Our globe has already been transferred into a ‘small’ global village. It is now electronically linked by what might be expected to bridge old gaps

that separate humanity. Yet, so far, the results are mixed, as we all know. Deep divisions keep deepening. Narrow specialism and physico-philosophical deserts spread out today more than ever before.

8.5 A CCC-Type of Education requires a world afresh outlook

The history of civilizations testifies that advancing and preserving a civilization is not a discipline. More than ever before, there is a proportional lack of mentors who can provide a *bona fide* CCC-Type of education, for such a task requires a world-afresh outlook.

Moreover, the greatest advances in all human endeavors are made when scientific and governmental thinkers maintain a close dialogue; when multi-disciplinary thinking is a two-way street.

The constant search for such attributes is not merely a necessity to stem the tide of CCC-Type of decline. It stems from the remarkable failure of most mentors to eliminate serious fragmentations, inconsistencies and incoherencies that exist today at the core of our educational system. Bright students sense these issues immediately. They remain, however, helpless.

Such failures are behind the common reluctance of mentors to adopt a new world outlook and the tenacious hold to fragmented disciplines, paid positions and tenure. It may also be linked to the roles sacredness plays in any field of life. It is certainly behind the solid walls of cultivated prejudice that most innovations are faced with in the sciences, the industry and the arts.

Beyond Present Knowledge

We are only just embarking on a universal quest for knowledge
and are still like children playing with pebbles on the seashore,
while the great ocean of truth rolls,
unexplored, beyond our reach.

Isaac Newton

It is better to debate a question without settling it,
Than to settle a question without debating it.

Joseph Joubert

Our race has not succeeded in solving any large part of its most difficult
problems in the first millionth part of its existence.
Perhaps life would be a duller affair if it had,
for to many it is not knowledge,
but the quest for knowledge,
that gives the greatest interest to thought
– to travel hopefully is better than to arrive.

James Jeans

Mind, Cosmos, Clock: Which of them generate time?



Readers and mentors who had the perseverance to reach the end of this short book may have concluded that it is essentially a CCC course without an ending; a sightseeing/mind-seeking guide to a land of interconnected complexity; a land for which I can only serve as a 'tourist guide' to those who search for the most interesting and promising domains of human thought and practice.

I have only tried to indicate those knowledge crossroads that, to my mind, one may cross before arriving at the fields of promising future core knowledge of cultured persons.

Yet, it should be pointed out at this point, that some of these fundamental, CCC-Type issues do not lie in the course of the future. To reach them, one must occasionally go back to the greatest thinkers of the past.

Inflicted damages may initially remain undetected. It takes time to understand the damages to the individual and to society at large. Eventually, the current practices may become so embarrassing, that there is no alternative but to break, or modify them.

All reality is one in substance,
One in cause,
One in origin
Attributed to Giordano Bruno

Theoretical physics is actual philosophy.

Max Born

9.1 How All Life Would End?

The end of the world has haunted humans since the beginning of all intelligent thinking. As for science today, the question may have been partially answered in 2004 by the *Hubble Space Telescope* via observations of the luminosity of a very early supernova: The 1997ff, and by comparing the result with that of 'close-by' ones.

Unlike the common belief, there would be no 'end' to the physical universe, only to life.

We may be living in an ever-expanding universe, which would not end with a contracting 'hot end crunch', namely, when spots/boundaries (a), (b), (c), etc. in Chapter 2 would attain the highest temperatures depicted in Fig. 2 there, and the direction of energy flow would reverse, namely, from spots/boundaries (a), (b), (c), etc., to the galaxies and stars that are inside clusters and super-clusters.

But in a cold end of all life in the cosmos, the expected cosmic dynamics are different: The sun and all active stars would gradually, over a period of billions of years, consume all their fuel, and, like campfires on a cold mountain, would become as cold as the surrounding, inter-galactic, dark-cold background radiation, and even colder, and SPACE "1" at spots/boundaries (a), (b), (c), etc. [Fig. 1] would attain temperatures close the zero absolute temperature.

Nevertheless, the gravitational force of the freezing planets and stars would forever function; - causing some to flare up for a longer time than the other.

Yet, eventually, they would all 'die' holding hands with each other via the gravitational force, which penetrates all and is at one with all planets, stars and galaxies.

The only time, the only physical clock left in such a frozen cosmos would be the quiet increase of SPACE "1" size, $R(t)$ in Fig. 1.

The whole cosmos, including our remains, would exist forever; would just grow very cold; forever merciless.

CCC Homework

Who attends the school of wisdom now?
 Who has regard for philosophy or any liberal pursuit,
 except when a rainy day comes round to interrupt the games,
 and it may be wasted without loss?
 And so,
 the many sects of philosophers are all dying out for lack of successors.
 The Academy,
 both old and new,
 has left no disciple.
Seneca

A participant in this CCC may begin by reading the first five subsections of the Introduction. [*Introduction, §§1.1; 1.1.1 to 1.1.5*].

But when it comes to meaningful homework one may begin by reading about themes that deal with philosophy, cosmology, gravity physics, quantum physics, time, bio-physics, archeology, anthropology, linguistics, intelligent thinking, the origin of life, world history and other important branches science and human knowledge that have emerged since the dawn of civilization. [Chapter 7]

Nevertheless, prior to selecting a specific homework theme, it may be important to read a few notes about the fundamental general nature of ‘Mathematics’ and ‘Theories’. These themes are briefly reviewed below, without introducing a single mathematical equation.

10.1 Mathematics

Many of our theories are fundamentally based only on a very few basic concepts: Space-time, symmetry-asymmetry, scalars, vectors and Tensors. Some add probabilities and their interpretations. [Introduction, §1.2] From these one can derive a world outlook that can be compared

with observations. Space-time, symmetry-asymmetry, statistics and probabilities have been dealt with briefly in the main text.

Scalars are numbers, ‘constants’, or measurable quantities that one can count. They harbor no direction in space, time or space-time. *Algebra and calculus* belong to this domain, and both constitute boring subjects to most students, and to me. An example is speed.

Vectors are scalars and other entities that harbor *direction* in space, time, or space time. These are frequently used as the ‘first derivatives’ of entities, physical or imaginative, in space, time, space-time or higher dimensions. An example is velocity.

Tensors are perhaps some of the few most important themes in physics and in any reliable science and philosophy of science. They are subject to certain ‘grammatical laws’, but in essence they relate to you and to any other observer in the universe: Rotating, standing still, moving linearly at constant speed, accelerating, standing on tiny, small, big or huge entity, like a planet or a star, or just ‘floating’, imaginarily, in ‘empty’ space, or in ‘pure’ vacuum.

Most important, tensors are your safegurads. They protect you from making errors. They are usually the second derivatives in space, time, space-time or in additional dimensions. They may also be the first derivatives of vectors, and they are the most reliable translators that can always tell you if what you observe, scale, measure, or read in other theories, is agreeable with you and with any and all other observers.

Tensors therefore allow you to reliably communicate with any other observer in the entire universe, real or imaginative, verified or not. They are also, to use other words, the precise translators from one set of coordinates, say, the set used by a rotating observer, to any other set used, say, by an observer ‘falling’ or fast accelerating into a black hole, or ‘standing’ on the Planet Jupiter.

Thus, tensors can express a theory in physics by resorting to a **single universal language**, for they, via their mathematical derivatives, tell any observer that these or these scalars, vectors or other physico-mathematical entities, when all arranged on one side of a tensorially-expressed equation are all zero for any and all observers. We

may judge that result as an '**invariance**' for all. No court of appeal can change this verdict

We may also state that mathematics is the science of multi-dimensional pattern that seeks out patterns whether found in scalars [numbers], vectors, space, time, physics, science, computers, or in any imaginary abstraction.

In short:

Mathematics constitutes a special kind of 'intelligent thinking plus grammar', a sort of thinking which has been partially developed to safeguard our minds from prejudices and inconsistencies.

Mathematics is one of our reliable ways to communicate globally, at all times and with all cultures, while precisely expressing or transferring and preserving 'analytical thought' about 'ideas', phenomena, events, etc.

For instance, once a scientist begins working with [reversible] time-symmetric equations, the consistency of mathematics forces any of his results to remain time-symmetric, irrespective of one's wishes or one's mathematical funambulism.

Once [irreversible] time-asymmetry is forced by man on [reversible] symmetric equations, mathematical consistency dictates, at any stage of the analysis, that that man is making a fundamental, not practical, mistake.

For instance, reversible differential equations cannot be compared, as such, with events, with observations in the 'real' world.

It is in the unique domain of mathematics that time-symmetry, reversibility and symmetrical laws serve us as tools of *analytical research*; and it is only by combining (conceptual, reversible, analytic) time-symmetry with (factual, aggregated, observational) time-asymmetry, or by combining reversible equations with *a priori* known, factual, initial and boundary conditions, that one may, mathematically, arrive at a world outlook in agreement with observations.

While symbols and analytical concepts may be symmetric and meaningful, words and sentences (in order, syntax, phoneme, form, sound modulation or other modes), or ‘useful’ physico-mathematical equations, *are basically asymmetric*.

Mathematics, gravitation, symmetry-asymmetry, aggregation, time and meaningful sentences are coupled. While some minor reservations are justifiable, there is an overwhelming "word of evidence", derived from physics, the languages and the studies of linguistics, cybernetics, information and mathematics, that fortifies this contention.

Mathematics is therefore very consistent and reliable special language. It stays aloof of human emotions and ambitions, for instance, when one fools himself or herself, like in the example provided in the Introduction [§1.2]. Mathematics, as stressed before, protects one from himself or herself and from mistakes made by others.

One may add that via the the use of ‘logic’, ‘logical reasoning’ and abstraction mathematics, it has evolved from counting-recording and calculus as had probably been first invented in the first recognizable civilization, UR [Chapter 7] and from the studies of configurations and shapes in any dimension, including time.

Moreover, mathematics can ‘discover’ what the human mind ‘intuitively’ cannot. For example, a key mathematical conclusion was hidden even from Einstein when he concluded the [tensorially based] field equations of general relativity, our best and most universally verified theory of acceleration and gravity.

The greatest living philosopher of science in the last century, *Karl Popper*, has elaborated much about falsification of a mathematical theory, about conjectures and about the ability of mankind to establish what might be ‘true’ within the domain of a given theory, or a set of ‘facts’, axioms or definitions.

A general approach to nature is provided in §2.1, *Assertion 3*, *Plato*, about the great dangers associated with ‘precise, local, word definitions’.

Mathematics may also lead one to development of entirely new disciplines. Moreover, ‘**pure mathematics**’, is often developed for its own sake, without *a priori* harboring applications, although they may be ‘un-covered’ later.

In concluding these introductory remarks, and prior to selecting a homework theme, I stress again that it would be beneficial to start from the beginning, namely, from the first five sections provided in the Introduction. [*Introduction, §§1.1; 1.1.1 to 1.1.5*]

10.2 Theories

According to Einstein, when we predict the behavior of a specific or confined set of natural phenomena, we usually mean that we have found a ‘constructive theory’ covering this set.

When we find that other sets of phenomena are incompatible with that theory, we tend to either generalize or modify it, or failing that, seek an alternative one.

To this ‘constructive’ category Einstein opposes the so-called “theories of principles” (exemplified, according to Einstein, by thermodynamics and his general theory of relativity), whose point of departure and foundation are not hypothetical constituent, but empirically observed general properties from which mathematical formulae are deduced so as to apply to every case of observation which presents itself.

Thus, according to Einstein, the merit of constructive theories lies in their comprehensiveness, adaptability, and clarity for a given set of phenomena; that of the “theories of principles” -- in their logical ‘perfection’ and universality and in the vast observational spectrum of their formulation at any scale and time.

Yet, Einstein did not trust some key, semi-hidden aspects of his own general theory of relativity. Two such events are described next:

The failure of statistical mechanics (both classical and quantum) to deduce and explain the origin of irreversibility, time-asymmetries, cosmic and local structuring, generation of order and what is called

“entropy growth” -- as well as its philosophical and applicative limitations and its lack of large-scale universality -- has been explained in this book and in Vol. I.

Yet, Einstein had not suspected that his general theory of relativity also incorporates another ‘theory of principle’: The second law of thermodynamic. Namely, that, thermodynamics is NOT a separate, or independent theory; it is NOT fragmented from the rest of science. It is an integral part of gravity-induced unified human knowledge.

During the well-known 1919-1924 events associated with the Einstein-Friedmann-Hubble discovery of the expansion of the universe, Einstein simply could not believe the mathematical predictions of his own general relativity, namely, that the universe is ‘unstable’, that the cosmos MUST expand [or contract]; that it cannot stay still.

To prevent that ‘instability’, Einstein artificially and emotionally forced on his general relativistic field equations a simple, unjustified, constant (a number) aimed only at stopping that ‘unwanted’ expansion [or contraction].

Was Einstein contemplating more about the cause behind the observed dark-cold night sky, he may have reached an earlier conclusion, namely, that the dark-cold night sky is the simplest and direct proof that the cosmological predictions of his general relativity are right; that there is no need to add a number to stop the expansion of the cosmos, which at that time was not yet known.

Einstein did that regrettable act in 1922 -- after *A. Friedmann* from Russia had proved that Einstein’s general relativity accepts no static cosmological solutions.

Einstein would not have to wait (in peace of mind) a few more years until the American Hubble proved, in 1924-1929, by precise astronomical observations, that, indeed, the universe is expanding.

When Einstein was informed about Hubble’s great discovery, he admitted that by forcing on his general relativity a constant aimed only at stopping the ‘unwanted’ expansion, he had made ‘the worst blunder

of my life.’ He did not believe that his theory harbors much more than he saw in it.

Einstein’s general relativity, our best theory of gravity [gravitation], incorporates, according to the central theme of this book, the origins of time-asymmetries in nature, the origin of irreversibility and the second law of thermodynamics, apparently without Einstein suspecting that. That may be similar to the conclusion of the historical event described above.

10.3 A List of Potential, Inter-Connected Homework Topics

A spectrum of inter-connected topics for a potential homework are listed below.

Grading should be based only on a self-composed thesis that is based on themes dealt with in the main text, or selected from the list of the inter-connected topics, or just words and concepts, listed below.

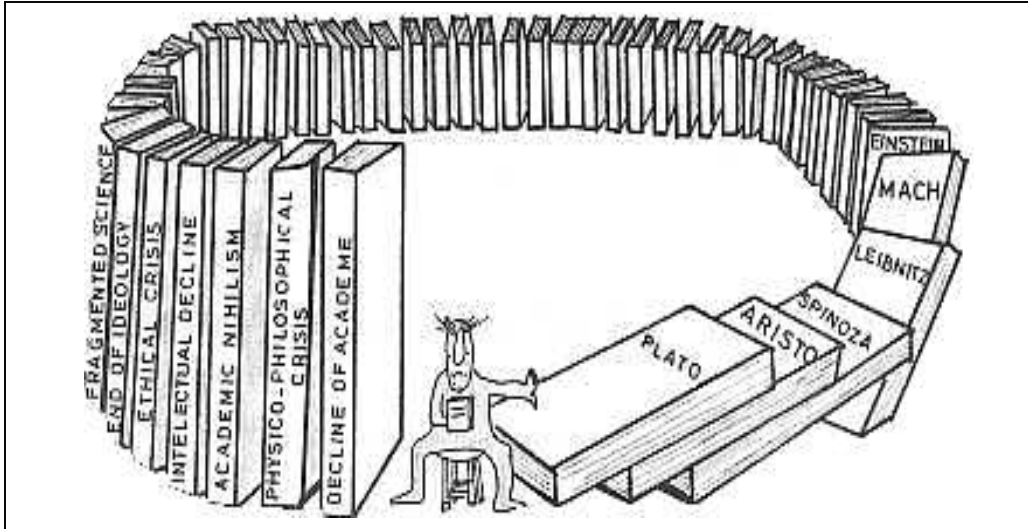
Some of these inter-connected topics, etc. may be combined in a single homework.

It is for this reason that I refrain from labeling the following ‘subsections’ and from any strict definition of, or their division. The list should thus be considered as a single undividable whole. Yet, for the purpose of homework, one may focus on a few of topics of choice that, more than others, are meaningfully inter-connected.

- Otolith organs, cerebellum, motor cortex, spinocerebellar tract, vertigo, gravity-sensors, gravity-detectors, biological detectors of sound modulations; bio-accelerometers. biological evolution, gravity perception, gravity receptors, bio-accelerometers, brainstem, balancing, coordination, orientation, movement, vestibular system, cell structure vis-à-vis gravity, etc.
- Intelligent thinking, verbal thinking, speech, music, linguistic asymmetries, linguistic symmetries, symbols, words, sentences,

- grammar, linguistic arrow of time, gravity axis, social determinism, social communication, mathematics as a special language, mathematical proof, etc.
- Sky, atmosphere, biosphere, rain, clouds, ozone layer, head, legs, chair, table, bed, rugs, walls, curtains, tapestries, chandeliers, candle flame, roof, stairs, stage, dome, arc, shelves, balcony, porch, piers, drainage, dams, doors, ladder, lift, elevator, columns, tides, sea level, beach, rivers, river bank, river flow, river stones, waterfalls, birds, snakes, seeds, plants, grass, roots, grass roots, molls, trees, etc.
 - Sit, rise, hang, plowing, mowing, dive, float, fly, walk, balance, jump, ski, takeoff, land, pour water to, fall, rise, decline, stand-up, break down, far down, upright, withstand, overcome, tear down, downgrade, precipitate, settle, settle down, settle up, settle upon, showdown, uphold, bring down, upbringing, upgrade, upheaval, ascend, upkeep, uplift, high, low, heavy, light, heavenliness, heaven-ward, lightness, buoyancy, floating, etc.
 - Second, minute, hour, day, year, Ur/Sumer, Ubaid, flooding, canals, temples, clay tokens, numerology, night, seasonal changes, seasonal rituals, calendar,
 - Geological layers, crust, mantle, lithosphere, mountain crests, tectonic folds, earthquakes, volcanoes, valleys, oceans, lagoons, ponds, springs, wells, swamps, glaciers, rivers, and the bio-systems connected with them,
 - Moon-planet-stars rounded shape, asteroids, meteors, meteorites, comets, the solar system, 'our galaxy and local group', formation of stars, supernovae, 'heavy elements', 'light elements', thermo-nuclear reaction, fusion, the building blocks of life, etc.
 - Tsunami, hurricane, tornado, flooding, draught, fog, lightning, thunder, caves, canals, village structure, road systems, city and village structures, transportation structure, bridges, overpasses,

- tunnels, ships, light houses, boats, docks, anchors, cable cars, airfields, aircraft, spacecraft, space exploration, etc.
- Climatology, weather, desert, islands, beach, snow-caps, glaciers, ice-age, paleontology, sediments, biogeochemistry, fractional crystallization, geophysical periodicities, fossil fuels, solar wind, solar energy, solar system, background black radiation, dark-cold night sky, time, time asymmetry, cosmological arrow of time, the origin of time, cosmic time, etc.
 - Unified field theories, string theories, quantum physics, particle physics, particles as points, gravity physics, curved space-time, geodesics, photon trajectories, principle of equivalence, gravitational attraction, gravitational collapse, neutron stars, X-ray sources, supernovae, black holes, proto-galaxies, galaxies, gravitational lens, dwarf planet, dwarf star, dwarf galaxies, quasars, galactic centers, star formation, intergalactic space, interstellar space, planetary system, biosphere, DNA, RNA, Mitochondrial-DNA, DNA-based archeology, tectonic folds, thermodynamics, entropy, information, etc.
 - Structural stability, aggregation, symmetry-asymmetry, irreversibility, boundary conditions, observations, memory, etc.
 - Origin of life, socio-environmental interactions, point of view, maps, clays, pottery, machines that exploit the force of gravity, ocean waves, wind, wind-generators, geothermal energy, etc.
 - Marc Chagall vs. mankind dreams of flying, Salvador Dalli vs. gravity-induced, down-flowing clocks, gravity-induced modern art, surrealism, dadaism, realism, naturalism, hanging gardens, landscape gardening, landscape architecture, environmentalism vs. preservation of gravity-induced structures, ‘anti-gravity’ leitmotifs vs. related stories, anecdotes, movies, , etc.
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The box the man holds contains Western educational funding

- Facts, meanings, metaphors and educational conclusions associated with the caricature depicted above vs. the organized system of education, past and present.
- Roots, branches. flower or wheat morphology; apical dominance position of a shoot, form (habit) of a plant depends on the orientation of its parts in relation to gravity, production of ethylene by physical stress imposed on the tissue, etc.
- Structural changes in legs, hands, fingers, knees, neck, throat, intestine, rectum, skeletons, nervous system, skull, hair, eyebrows, eyelids, location of nose nostrils, mouth, reproduction organs, inability to eat upside down; shoes, socks, underwear, pants, shirt, coat, necktie, hat, crown, etc.
- One of my CCC-students has “nominated” in line with the great *American Indian tradition 'Ship Rock'* near the Arizona/New-Mexico border as the “*Church of Gravity*”. Low Churchman, High Churchman, high table, high altar, high priest, fallen angels, heavenly, heavenliness, upper regions vs. lowest grounds, High Church, High Mass, lofty, elevated, spiritually elevated, sublime, hell, heaven, upper domains in faith, towering cathedrals, sky

scrapers, religious rituals on high mountains, highest justice, Lower Tribunal, Supreme Court, etc.

- Highness, upper class, upper court, higher judge, top commander, top rated, top list, top quality, top schools, top universities; highlight, highborn, high commissioner, high-hat, high-minded, high-powered, high rise, lowborn, lowbred, lowbrow, low-down, lower class, lower deck, lower house, low life, lowly, lowliness, uppity, uproot, up-rush, upstanding, upstart, upswing, uptight, sink, go to the bottom, bottomless; atop, deep, earthy, dust, earthly, earthiness, etc.



Reviews of Volumes I & II

A master piece .. any good library must have a copy of this classical work .. The well-known author bases his philosophy on a very sound knowledge of present-day scientific theories.

Indian Journal of Physics

Professor Benjamin Gal-Or is a man with a message. (The Book) is audacious, ambitious and provocative, it will appeal to scientists of all disciplines who are prepared to open their minds. It shines a welcome light in some dark corners of science. Sir Karl Popper, in a foreword, correctly describes it “a great book”.

New Scientist

Benjamin Gal-Or's remarkable book is an attempt to see and seize the world whole. He emphasizes that all scientists operate under some set of philosophical prejudices, and that failure to acknowledge this is self-delusion. Furthermore, he argues that a failure to attend to the philosophical base of physics leads to an empty scientism.

Gal-Or's work is challenging on many levels, constituting a review 'with derivations' of general relativity 'as applied to cosmology', thermodynamics, the current state of theoretical particle physics, astrophysics, as well as a summary history of western philosophy, 'especially the philosophies of time and mind' and critiques of western society, the intelligentsia and the relationship between academic science and government.

One 'and perhaps the central' theme explored, is that of the interplay between symmetry and asymmetry.

His primary interest is not in the recent progress in the unification of forces in gauge theory, although he finds support in it for his

Einsteinian outlook, but is rather time, time's arrow, and the asymmetry between past and future.

Around time are accumulated discussions, both mathematical and philosophical, of thermodynamic reversibility, time reversibility, the nature of causality, and the use of advanced and retarded solutions to wave equations.

The second major theme is that of gravity and its overwhelming domination of the actual form of the universe, at all scales.

The combination of these themes is not accidental; they are point and counterpoint to his thesis that the time asymmetries are connectable to and perhaps even determined by the master asymmetry given by the gravity of general relativity: the remorseless cosmological expansion.

He argues that only the expansion can provide the unification of time asymmetries.

The expansion provides, among other things, an UNSATURABLE SINK for radiation, which, in turn, permits the establishment of gradients in temperature and density, which provide the basis for the physical process that leads to life.

He also criticizes the sloppy and improper use of the concepts of entropy 'and the related notions in information theory' and quantum indeterminism, especially as covers for an inadequate understanding of temporal asymmetries.

Taking an Einsteinian position on the interpretation of quantum mechanics, he looks forward to revitalization of Einstein's quest for a deterministic interpretation of quantum events.

The value of this book lies in the challenging combination of ideas which Gal-Or presents, which goes far beyond what can be sensibly described in a review.

[His] work may be too large to digest as a text in these days of the decline of academic institutions "as Gal-Or describes them", but that will be the loss of both the faculty and the students.

American Journal of Physics

The works of scientists like Gal-Or, Bohm, and [Noble Prize-Winner] Prigogine provide important resources. Prigogine's formalisms do not really tell us how irreversible change emerges from reversible [mathematics]. (in this Gal-Or is superior). Gal-Or assigns priority

instead to general relativity and to the gravitational processes which it describes.

It is gravity which drives cosmic expansion and galaxy and star formation, and thus nucleosynthesis, and the emergence of chemistry, life, and intelligence.

Philosophy of Science, Foundations of Social Progress

This book evokes a person heart! Following its publication, the book has generated a large number of responses from physicists and philosophers around the world.

All respected journals in physics had published special reviews authored by highly noted physicists and philosophers.

While maintaining that this book is of the highest professional level, some even declare it has turned them into 'Gal-Orians'.

In philosophical circles the book has also pioneered new and unique views of Spinoza and Kant, and has generated an unsubsidying argumentation in the West.

Since the thought presented by this book is so rich and its contents cover so many disciplines, physicists, philosophers and translators of our country should recommend this book with all their intellectual power.

Chinese Academy of Sciences

This is a great book, and an exciting book; readable, worth reading and enlightening; with a most fascinating cosmological story of time, expansion, and gravitation. ***Sir Karl Popper, in Foreword I to Vol. I***

Book recommended by ***Encyclopedia Britannica,***
"Nature, Philosophy of"

'We are all Gal-Orians' ***Foundations of Physics (Journal Editor)***

richness of ideas and structures

Physikalische Blatter

inescapably fascinating

Stern und Weltraum

Interesting to read, .. integrating much of scientific material, .. good introduction to relativity theory, quantum mechanics and theoretical cosmology for readers interested in natural sciences in general.

Deutsche Literaturzeitung

An interesting and original book, ..easy to read, interesting and fascinating.

Nouvo Cimento

Physics cosmology and the Universe by Benjamin Gal-Or is one of the most beautiful books that I have read. It beautifully combines and explores physics cosmology and Philosophy.

Outstanding Books List

One of the best books on the totality of the sciences & the universe is the book called 'Cosmology, Physics and philosophy' by Benjamin Gal-Or. It was one of the favorite books of Sir Karl Popper. It looks at physics and the universe as a totality of the mathematical philosophical understanding. It also combines the physical concept of time with human psychological perception and brain understanding of languages.

Robin (forumhub.com/expr/@ 202.54.92.222), Nov 24, 2000

A comprehensive explication of a large area of Physical science which the reader may study in many subjects, such as astrophysics, fluid mechanics, and general relativity. All tied into philosophy. Highly recommended to the philosopher of science.

Contemporary Philosophy

This is a tome for the reader. Volume two is very much concerned with sociology and philosophy. It introduces such topics as a consideration of whether universities are adequate or otherwise, the assessment of priorities, development of philosophical thought and problems of decision making, etc. ... it is a book for those with time to stop and

think. In stimulating such ideas, this book will do much to open great vistas in contemporary thought for large numbers of its readers.

Space Education

The red thread that runs through everything is the conception of the author that present-day research (and education) in physics, like our view about men and society, is harmed because it is not enough guided by philosophy, where he sees it as the task of philosophy to construct a coherent and comprehensive vision of the world, starting from the results of diverse scientific specialism.

Nederlands Tijdschrift voor Natuurkunde

It is a most excellent and thoughtful essay on one aspect of the foundations of modern thought in physics. Gal-Or may well launch a new spirit of inquiry by his excellent and thought provoking writings. I would recommend awarding a prize and would hope that this would serve to focus attention on a most important subject.

T. Gold, Cornell University

Gal-Or's book is really a tour de force, which I have no doubt will be widely read and appreciated by physicists and philosophers all round the world. A magnificent and sustained piece of work !

Sir Alan Cottrell, Cambridge University Chancellor, in Foreword II

I do not know a better modern expression of science, philosophy and classical humanism than that of Gal-Or's book.

Book Reviews, Haáretz Daily

Once gravity driven phenomena are taken into account, it becomes clear that the direction of evolution is not towards chaos, but rather towards even higher degrees of organization, understood as complexity (an increased diversity of elements) coupled with "centreity"- i.e., the closing of these elements in on themselves.

The doctrine of Benjamin Gal-Or is rather more promising. He brings a "dialectical" understanding of the process of unification, as "a process of criticism wherein lies the path to the principle of all inquiries" (Aristotle in Gal-Or 1987: 47).

This dialectic leads Gal-Or to the conclusion that it is necessary to unify theories of reversible and irreversible change first (i.e., dynamics and thermodynamics), before attempting to unify relativity and quantum mechanics.

He rejects, furthermore, attempts at unification which give a leading role to quantum mechanics and to an information-theoretical understanding of organization.

[According to Gal-Or] all of chemistry, beyond hydrogen and helium, and, therefore, all of life, has been formed by stellar evolution. In other words, with the exception of hydrogen, "everything in our bodies and brains has been produced in the thermonuclear reactions within stars which later exploded in galactic space." (Gal-Or, 1987: 352ff)

Gal-Or re-theorizes thermodynamics in a way which is free of the "subjectivist" concept of entropy, so that science terminates in a recognition of the ultimate unity and organization of all things.

Philosophy of Science, Foundations of Social Progress

One noted scientist [B. Gal-Or], even affirms that the stress placed by Genesis, Chapter one, on 'beginning' and the initial roles of 'void', 'light' and a "structure-less" state, "may be uncannily close to the verified evidence with which modern science has already supplied us."

Christian Apologetics, Journal, Vol. 2, No.1, Spring 1999

Einstein's time-symmetric tensor was elevated by [Gal-Or's] "*New Astronomical School of Unified Thermodynamics*" ... to the status of the source of "master asymmetry" controlling not only irreversible thermodynamics, but all physical and biological phenomena!

Gal-Or calls "GRAVITISM" [his philosophy] that gravitation is the prime cause of structures, irreversibility, time, geo-chemical and biological evolution -- that the expansion of the universe is the cause of the second law of thermodynamics -- that microscopic physics, and thermodynamics in particular, cannot be understood without reference to cosmology.

Gal-Or ties "irreversibility" to the "expansion of space itself", i.e. as far as space is expanding, the contribution of all kinds of radiation in space is weakened "irreversibly" due to the expansion phenomenon itself.

Such loss, or "degradation" of energy in the depth of intergalactic expanding space, may then be considered as a universal sink for all the radiation flowing out of the material bodies in the expanding universe.

*Soc. for the Advancement of Physics,
APEIRON, Vol. 3, #3-4, 1996, Germany*

The lack of teachers who can see the alluring beauty of mathematics and perceive its profound philosophical implications is quite understandable with respect to the observations of Professor Benjamin Gal-Or:

"Today, especially in the United States, professors in natural sciences vie with one another in presenting technical lectures devoid of any philosophical content, for they can no longer hope to achieve popularity by injecting philosophical inquiry into science.

This turn of events has resulted in overvaluation of technical science, empty scientism, absolutism of specific interpretations in physics, and the common inclination to reject any philosophy of science from physics. A pity. For these trends can only push physics into stagnation."

*H. & E Monteith, "Experiencing the Awesome Beauty
and Wonder of Matematics"*

"*The Judeo-Christian tradition*", via V.F. Weisskopf in *Scientific American*, is in accord with Gal-Or's conclusions published in his

Cosmology, Physics and Philosophy, and from which Weisskopf quotes:

"Most astrophysicists, cosmologists and astronomers agree that the biblical account of cosmic evolution, in stressing 'a beginning' and the initial roles of 'void,' 'light' and a 'structureless' state, may be uncannily close to the verified evidence with which modern science has already supplied us"

For the historian of science, Benjamin Gal-Or's "beauty" has always been the object of science, which, he lyrically observes as "a most fundamental aesthetic frame of mind, a longing for the run-away horizons of truth and symmetry that we always try to reach."

*Order Amidst Chaos:
Enlightenment Aesthetics after Post-Modernity. M. Wickman*

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