Preface

I can afford to wait a century for readers ...
– Johannes Kepler

The incentive to write about Chemical Cosmology came with the realization that the natural synthesis of the chemical elements and their isotopes is hopelessly misrepresented in modern cosmology. On closer examination one finds that many other concepts, such as chirality, periodicity, chemical stability and equilibrium, understood in detail by the chemists of the world, are simply ignored by cosmologists, despite their potential relevance to cosmic models.

Apart from Svante Arrhenius and Harold Urey, very few chemists have ventured into the field of cosmology. This reluctance of chemists to contribute to the cosmological debate is no doubt due to the perception that modern cosmologies are soundly based on the concepts of general relativity, a theory not actively pursued, or even understood by most chemists. On making the effort to examine the relativistic details of cosmological theories there awaits the sobering discovery that some of the fundamental, even elementary, dictates of relativity are ignored as blatantly as the fundamentals of chemistry. In the Introduction to their excellent book on the topic, Adler et al. (1965) emphasize that:

> ″[a] reduction of gravitational theory to geodesic motion in an appropriate geometry could be carried out only in the four-dimensional continuum of relativity theory.″

We shall demonstrate that all of the currently competing models, including the standard big-bang model, fail on this score.

My dispute with big-bang cosmology is a continuation of the arguments, launched by Kepler and Riemann against medieval Aristotelean physics and Ptolemaic cosmology, best described as a hotch-potch of magic and dogma. The dogma consists of the belief in an unreachable perfect heaven and a corrupt world. Heavenly bodies are endowed with the perfect geometry of a circle and quintessential purity, compared to the polygonal nature of mundane

four-element matter. No more than a blurred image of divine knowledge, which exists in the celestial sphere, may be invoked by magical practice in the secular world. This is the basis of astrology.

Euclidean geometry is a well-known product of this dogma. Its axiomatic foundation is firm and not subject to further analysis. Alchemy is another example. Kepler had the temerity, not only to reject the dogma of circular orbits, but also to demonstrate a proportional relationship between the Platonic polyhedra and a limiting sphere. The magic is gone. Riemann broke the final schackle by showing that geometry can exist without axioms. The dogma is also gone.

Riemannian geometry produced the general theory of relativity and Kepler's golden proportion can now be shown to feature in the ordering of matter, from the sub-atomic to the cosmic scale. We contend that big-bang cosmology, which is based on the same principles as alchemy and Euclidean geometry should make place for a model based on chemistry and Riemannian geometry.

I developed an interest in the field on noticing that cosmological theories of nucleogenesis are totally out of line with reality. The important clue came from the observed periodicity of the stable nuclides, which is governed by simple concepts of number theory. Any atomic nucleus consists of integral numbers of protons and neutrons such that the ratio Z/N is always a rational fraction, which can be ordered in Farey sequences and mapped by Ford circles. This ordering predicts a unique periodic function, which is readily demonstrated to predict the correct observed cosmic abundances of the elements.

According to standard cosmology only the light elements, H and He, were formed in significant amounts during an explosion at the beginning of time. All heavy nuclides were formed later on by nuclear fusion reactions in stars. It is obvious that such a chain of reactions cannot produce heavy nuclides in the observed periodic abundances.

The validity of the general periodic function extends into the periodicity of the chemical elements under extreme conditions, showing up a cosmic periodic law that includes all elements and anti-elements. The obvious link of this function with the curvature of space-time provided a mechanism for the production of nuclides in an equilibrium process, within a black hole, that matches the observed abundances.

An important property of the extended periodic law is that its geometrical mapping requires an involuted four-dimensional space, recognized as the real projective plane. By assuming the same topology for space-time, several paradoxes of standard cosmology are immediately resolved, including redshift as an intrinsic chemical property of the electronic configuration of atoms

in strong gravitational fields. It provides a direct solution of the unsolved problem of anti-matter in the cosmos. It explains the nature of quasars, active galactic nuclei, cosmic radio sources, γ-ray bursts, the X-ray and microwave background radiation and cosmic self-similarity, as evidenced by the proposed structure of the solar system.

Despite our choice of title, this book, which aims to highlight scientific findings that should contribute to an understanding of the world, is strictly speaking not another book on cosmology.

The mistaken belief that Cosmology is a branch of science has resulted in total stagnation of the subject. Cosmology is not part of science, but of metaphysics. Metaphysics is the intellectual pursuit that strives to identify the ultimate realities at the basis of knowing the whole world. Western metaphysics has for mellenia been conditioned by the ancient Babylonian myths, as recorded in the Hebrew Bible, starting with the phrase:

> In the beginning ...

What follows is largely immaterial – there can be no existence before the beginning of time. The logical consequence, after centuries of agonizing, is the absurdity known as standard big-bang cosmology.

Nothing demonstrates the confusion of Western thinking better than the monumental study of James Frazer (1922). All cultures and tribes are shown to recognize the cyclic nature of natural phenomena. Without this mental jump cosmology becomes meaningless. With it, all cosmological riddles and paradoxes are resolved. The necessary assumption is a closed cosmic system, and the implications are immense.

The single most important factor that argues against this assumption is the evidence of our human senses. The casual observer experiences the world as flat, allowing for a few bumps and dips. Idealized into a logical construct this concept led to the development of flat-world geometry in the hands of Euclid and others. The primary concept of a straight line suggests infinite extension in two directions, with the corollary of infinite parallel lines. The whole edifice is simplified by the definition of a metric scale that allows comparison of distances and angles and the classification of triangles. Formalized in terms of a small number of theorems, Euclidean geometry provided the tools for architects and construction engineers, with spectacular success. In essence, the practice is based on what is known universally as the theorem of Pythagoras.

It is ironic that the first instance where Euclidean geometry proved inadequate was in land surveying, the initial purpose of geometry. Later came the need of Renaissance artists to make perspective drawings. During the same era the inability of the natural number system to avoid infinity singularities

also became apparent. Whereas geometry managed to solve its problems by the introduction of fictitious ideal points at infinity, number theory remains incomplete.

The root of the problem lies in the reasonable assumption that the axioms of Euclidean geometry are equally valid on both cosmic and microscopic scales. It is now known to break down in both instances. Discovery of the electromagnetic field has shown that the familiar ideas on interaction between mass points need adjustment at both large and small separations, where they lead to singularities. Any cosmology that fails to recognize these complications must fail.

The correct starting point for a new cosmology is to accept that the universe is closed in space and time. The mathematical description of such a closed system automatically introduces the notions of periodicity and scale independent symmetries. The incorporation of scientific data into the model should be consistent with appropriate mathematics.

The mysterious similitude between science and mathematics is more than a coincidence and provides the most powerful means of theoretically exploring unknown science. This is of particular relevance in situations where experimental discovery of empirical facts are problematic – nowhere more so than in cosmology, which should embrace all of science, and hence all of mathematics. The discovery of new mathematics is driven by the requirement to eliminate exceptions. The search for generally valid subtraction led to the discovery of negative numbers and zero. General root extraction revealed the existence of both irrational and complex numbers. Division by zero remains poorly understood, with infinity an exceptional number. Although it remains algebraically elusive, it becomes a regular number in projective geometry. The distribution of prime numbers is an unsolved problem in all of mathematics.

Given the current state of knowledge the best possible cosmology must be consistent with complex algebra, projective geometry, advanced number theory, and all empirical science. As a by-product of only elementary-particle physics, the law of gravity and Euclidean geometry, standard cosmology is totally inadequate by these criteria. The current debates between big-bang cosmologists and dissidents are almost irrelevant as a guide towards a better understanding of the world, unless the fundamentally relevant principles are taken into account.

Many authors have discovered parts of the jig-saw puzzle, without recognizing the grand pattern and their findings, largely forgotten, remain dormant. Judging by the difficulties experienced by some of them to get their work accepted for publication, in the teeth of hostile peer review, countless others have probably, either published important ideas in obscure journals,

or failed to publish at all.

Empirical evidence at variance with standard cosmology is, likewise, totally ignored. Even the most fundamental of empirical observations, known as universal CPT (charge conjugation–parity–time inversion) symmetry, which dictates equal amounts of matter and antimatter in the cosmos, is dismissed out-of-hand. Less well known, but of equal importance, cosmic self-similarity, is not considered at all.

From a chemical perspective the most important cosmological evidence includes the relationship between the periodicity of matter, prime numbers, Farey sequences, other aspects of number theory, cosmic abundance of the elements and nucleogenesis. These emerging periodic patterns are diametrically opposed to accepted explanations based on standard cosmology, but well in line with Veblen's projective relativity theory, Gödel's solution of the general relativistic field equations and Segal's chronometric alternative to Hubble's law.

Synthesis of these notions leads to an alternative cosmology that has little in common with the standard model. It may not have the same dogmatic appeal as the big bang, but it unifies a growing body of discordant empirical evidence, based on all the matter and energy in the universe, the Copernican principle and sound mathematics, without singularities. It has the potential directly to address the basic notions of chirality, astronomical anomalies, holistic self-similarity and other cosmological puzzles, such as Zwicky's paradox, in addition to traditional celestial mechanics. In effect, it calls for the re-examination and re-interpretation of the cosmic whole.

With so many, apparently unrelated, aspects of relevance to the argument it is necessary to understand the riddles that remain unsolved in traditional Western cosmologies. Fundamental to the resolution of these cosmological riddles and paradoxes is the structure of space and its interaction with matter. To achieve this the appropriate geometry, physics and chemistry are called for. The cosmological demands of mathematics and physics have been examined repeatedly, while chemistry has been largely ignored. At the time that modern cosmology was born an eminent science writer, (Sullivan, 1933), concluded that:

> ″. . . the atomic theory is the one fundamental contribution that chemistry has to make towards an understanding of the structure of the universe. And it is only in its simple form [...] that the atomic theory is really helpful to the chemist. For this reason we are not justified in expecting great theoretical advances from chemistry of the future. The direction of any possible theoretical advance in chemistry lies so far as we can see, through physics.″

The main purpose of the present work is to also emphasize the cosmological implications of chemistry.

The idea of the vacuum as an interface first came to me in Daresbury while staying over in a hotel, richly decorated with images and themes from Lewis Carroll's *Alice in Wonderland* and *Through the Looking-Glass*. Eventual publication (Boeyens, 1992) happened after several rejections and what kept the idea alive was the response from a number of prominent scientists. The following are verbatim extracts from private correspondence, as dated:

Olof Sundèn, 5 November 1992: You say that ′vacuum′ is an interface between different states of matter (matter and antimatter), that the universe itself is the double cover of the manifold and that its involution serves to position conjugated forms of matter and antimatter on opposite sides of the interface .... I talk about space and antispace .... Out there on the other side ′time′ changes character and appears as a conjugated antispace and even as a condensed conjugate antiparticle.

Hans-Jürgen Treder, 20 February 1993: .... you are right if you say that quantum field theory and relativistic cosmology have problems with respect to their reciprocal interpretation.

W. Kilmister, 24 February 1993: I thought that the first two sections (apart from the Intro) were extremely well done.

István Hargittai, 2 March 1993: It sounds very interesting what you wrote about...

Halton Arp, 3 March 1993: I had the rare experience, as an observer and empiricist, to be able to anticipate most of your conclusions before I came to them in your text!

Aldus Salam, 9 March 1993: I learnt a lot from it.

Peter Bussey, 7 April 1993: I did not understand a single sentence properly.

Ken Barker, 12 April 1993: .... the general thrust of the paper is most impressive.

J. Hošek, 15 June 1993: Concerning the ″vacuum″ which, apparently, is something very deep in your considerations. In ordinary sense, the vacuum is simply the ground state of a quantum system, which is both intuitively, and operationally well understood.

Peter Carruthers, 20 August 1993: I have been thinking for a long time that we need to rethink the vacuum.

Bruno Crosiguani, 2 September 1993: I have really enjoyed reading it since it is beautifully written and clear. I have found your model quite appealing and I believe it could have some connection with the work I did on the fine-structure constant....

Milo Wolff, 30 September 1993: You may find yourself in the science history books.

The subsequent discovery (Boeyens, 2003) of the grand periodicity of atomic matter put these speculations into sufficient perspective to allow definite conclusions about the projective topology of space-time and the universe. In the final analysis, all conclusions reached in this work can be reduced to the gauge principle, as summarized in Appendix B. Some readers may like to set the scene by reading this appendix before the main text.

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Pretoria
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