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# BOOK REVIEW

Light Miller, ***Ayurvedic Remedies for the Whole Family,*** Motilal Banarsidass Private Limited, First Indian Edition, Delhi, 2002; pp436; Rs. 350.00 (paper) ISBN: 81-208-1828-8.

This book is written with the concept that, the healing science of Ayurveda is based totally upon the knowledge of 'Prakṛti' which translates into an individual's constitution and personality. The tendency to fall sick easily could be avoided by following specific health guidelines pertaining to diet and lifestyle.

Presently, in the practices of Alternative Medicine the trend is found to include bio-type analysis, prescribing herbs and foods as per constitution. The *pañcakarma* of Ayurveda has also become the essence and part of their workshops. This book has followed the same pattern. Practically this book can be best suited to the healers, who deal with aroma and massage therapy, herbals etc. in their workshops.

Ayurveda is a vast subject. Bio-type analysis is one of the small aspects used for assessing the constitution and temperament of a person which is inherent in a person since birth which cannot be changed. This does not help to make any diagnosis. When *doṣas* become disbalanced, increased or reduced, then they only produce symptoms and signs as per their characteristics. The knowledge of herbs and diets are useful. In various normal bio-type persons advising to avoid or to take certain single herb, food or spices do not produce any significant effect. The knowledge is helpful when there is any ailment in various types of bio-type persons.

This book includes fourteen chapters and has dealt extensively with the western herbs for the maintenance of good health, which are normally not available in Ayurvedic text books. This book is an output of a hard work based on prolong experiences in the field of ayurveda, aroma therapy, massage therapy and other alternative therapeutic measures.

Briefly salient features of the fourteen chapters of the book are as follows: 1st chapter of the book, briefly deals with the three *doṣas* and various types of constitution of a person. The 2nd chapter has discussed at length the usefulness of various aromatic oils for various ailments which now a days are used as a part of the herbal therapy. The chapters 3rd to 6th have dealt with usefulness of herbs for various age groups like children, women, adult and aged etc.

In the chapters 7th and 8th, the author has discussed various causes of illness and good eating habits for maintaining good health and further in the 9th chapter, the author has elaborately discussed the usefulness of vitamins and minerals for various body-type persons. The 10th chapter further deals with herbs, herbal teas to pacify *doṣas* in various body-type persons.

In the 11th chapter, the author has discussed the use of alternative therapies like *reiki*, massage therapy, reflexology etc. for maintaining good health in addition to the foods and herbs given to various body-type persons. Further in 12th chapter for maintaining good health colour therapy, fasting, footbath, mantra, meditation, yoga have been discussed in brief.

The 13th chapter is a big one and covers nearly half of the book which has discussed in tabular form the application of various alternative measures, diet for various body type persons mentioned in Ayurveda, vitamins and minerals, essential oils, herbs etc. for various ailments and disorders.

The 14th chapter deals with **"Discovering your Ayurvedic Type"** is the best chapter in this book. I have seen many bio-type assessment charts in the market and in the internet, but all of them give faulty assessment results. The assessment procedure and chart given by Light Miller seems to be the best one to pin-point a bio-type person, and the diet chart, given along with it, will be of great help to the western masses, which undoubtedly increases the value and importance of the work.

However, a more simplified book on diet based on ailments and not simply based on *Prakṛti* (bio-type) of a person is the need of the hour.

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Tony Rothman and George Sudarshan, ***Doubt and Certainty***, Scientia, New Delhi, 1998; pp. 320; Price Rs. 295.00.

There are theories with rock-solid certainty about them that most scientists would assent without hesitation. And that is the trouble. For, if they hesitated they might, and in fact they should, feel doubts. The two-fold, entitled *Doubt and Certainty* examines this very epistemic human condition that afflicts the philosophers the most, but also disturbs the thoughtful among the physicists, chemists and the biologists in no small measure, as also, perhaps the educated non-scientists, and, of course, the oriented mystics—who only too willingly share the uneasy feeling of some serious physicists that there is an invincible ignorance of science. Certainty here refers to the known, the experimentally well tested framework theories—e.g., Einstein's Relativity (Special and General) and Quantum Mechanics. Doubt, on the other hand can refer, somewhat trivially though,to the unknown; but most importantly, it refers to the untested, and often untestable, basic assumptions, based implicitly on faith alone, that underlie the otherwise certain theories. Hence there is a deeply felt need for the philosophy of science aiming at understanding, and not merely explaining the state of affairs.

The authors have examined, critically and in fairly plain English a number of fundamental issues through a series of ten nested incisive debates. They are clearly not afraid of being misunderstood! Each one of the Debates opens with a question, which is followed by an exposition giving the necessary background to the question and leading on to the Debate proper, that then closes with a summary. There are commentaries at the book-end that explain, if somewhat tersely, the technical points arising from the Debates. The format of presentation of *Doubt and Certainty* is most unusual—not the discursive exposition familiar from the New Age books on science and spirituality that now abound. The Debates here are conducted imaginatively—set in the Celebrated Academy, in its central palazoo, and joined in by the celebrated Academicians—Pythagoras, Plato, Aristotle, Śaṅkara, Descartes, Newton, Leibnitz, Laplace, Poincaré, Boltzmann, Planck, Niels Bohr, Schrödinger, Heisenberg, Weyl, Einstein, Prigogine, Dyson, David Bohm, Anderson, Peierls, Penrose, Wittenand Hawking and many others, some making cameo appearance. The Debates are live and interactive—with the committed followers and the crowd of spectators (tourists and visitors) including the reader, while the authors guide, interpret, and generally moderate the Debates. The proceedings are rife with bits, wits, passion and humour, at times frankly hilarious, what with the doubting 'Foxes' and the reductionist sonic *'hedgehogs'*, the uncertain Knowledge Marker and the fluctuating World Idea Exchange, and the Oblivion File!

The First Debates (Is the Universe Describable ?, Laws, Principles, Theories and Models), the second (Is Nature Unreasonably Mathematical ? Mathematics, Theories and Reality), and the Tenth Debates (What Do You Mean ?, Metaphors, Analogies, Culture Wars) address some of the deepest philosophical questions, a recurring theme being the epistemological status of the soft-stated but non-testable principles—of reduction from Nature-to-physics-to-mathematics due to Laplace; of compelling simplicity and beauty of the fundamental physical laws due to Dirac, Heisenberg and Einstein; and of the *'unreasonable effectiveness of mathematics in natural sciences'* due to Wigner (and before him held true by Pythagoras and Plato). Can one dismiss as mere numerological accident the fact that the spiral shells of the chambered nautilus and the spiral florets of the sunflower of the real world are patterned after the abstract Fibonacci sequence ? Mathematical truths perhaps exist *'out there'*, and the scientists merely uncover more and more of the pre-existing mathematics—the Platonic view of the relationship between the physical and the mathematical worlds. But then, the authors point out the compromising fact of degeneracy of mathematics—namely, e.g., that the same mathematical equation describes equally well the Planckian oscillators, the Debye oscillators and the Hertzian-dipole oscillators. Also, Mathematics is under-determinate—the truth of the conclusions does not imply the truth of the starting premises. Indeed, a mathematical (logical) truth preserving chain of reasoning in and of itself has no ontological implication. Mathematics has to be anchored to an existing reality at one end—an experimentally tested truth. And then there is the Gödel incompleteness theorem that finally limits the almighty mathematics. Some, like Jean-Pierre Changeux, hold that mathematics is merely some derivative of the human language. Authors, however, disagree with this extreme view.

The other seven Debates engage the more specific scientific questions of modern science, and of physics in particular. Thus, in the Third Debates one asks if Nature demands symmetry, and if the world is in fact symmetrical—Symmetry not merely of geometrical shapes, but also of the abstract laws (equations) governing Nature. The question is clearly related to that of physical truth following from the beauty and the simplicity of mathematical truths. Symmetry is clearly a powerful principle that continues to help scientists classify particles, discover new particles and unify apparently diverse natural laws and forces—the electro-magnetic and the electro-weak unifications, the unification of all weak interaction, the prediction of the antiparticles by Dirac, and of the particle $\Omega$ by Gell-Mann are the celebrated cases in point. (The authors are, however,not quite happy about the claimed beauty and simplicity of the symmetry based electro-weak unification, it being more of a splicing.) There is a discussion of the powerful idea of spontaneously broken symmetry through which the One becomes Many. The power of continuous space-time symmetries manifests in its connection with the conservation laws—e.g., of energy, momentum, etc. Indeed, the symmetry of the Maxwell equations led Einstein to create the Special Theory of Relativity. Symmetry does seem to imply Beauty. But, there are asymmetries in Nature—the excess of matter over antimatter, the absence of magnetic charges (monopoles), and that gravity is only attractive. Even in Art, beauty often lies in the strangeness of proportion—the Golden Ratio, say. Then, of course, the initial conditions are not symmetry dictated. *"Is symmetry or asymmetry prior"*—they ask. Authors go on to suggest that the mental state of *Kaivalya* (or shall we say that of *Nirguṇa Brahma*)is the most symmetric state of all.

The Fourth Debates (Why Do Things Happen ? Causality, Synchronicity and All That) discusses the Laplacian idea of reductionism and determinism (closest to Aristotle's efficient cause) and the axiomatic idea of causality vis-a-vis the somewhat strange idea of acausal synchronicity (due to Carl Jung), and that of teleology (the Aristotelian idea of the final cause). Newtonian mechanics with all its forces and mechanisms is ultimately reductionist and admits of no teleology. Newton's laws can, however, be re-formulated in terms of demanding minimization of a certain action integral, a global quantity rather than a local force, introduced by Maupertuis, that suggests teleology, as advocated by Leibnitz and Euler. The idea of a field replacing action-at-a-distance was introduced to propagate effects at a finite speed, but the advanced solutions of the field equations had to be rejected so as to conform to the conventional idea of causality. The authors, however, argued that in a stricly deterministic world, the temporal ordering of cause and effect is not quite meaningful. One really ought to speak of correlations. But the notion of synchronicity—a massive parallelism to explain coincidences as proposed by Carl Jung, in misplaced sympathy with the idea of *adṛṣṭa* from the Indian Vaiśeṣika system, was not admissible as it implied superluminal signalling.

The Fifth Debates (Does Time Go Forward ?) discusses the question of past and future—of the arrow of time. Of the seven arrows of time compiled by Roger Penrose, the thermodynamic arrow of time, based on the famous Second Law of Thermodynamics (pointing to ever increasing entropy in a closed system and irreversibility) takes centre-stage. After all, eggs do not unscramble and we all age—facts of daily experience. But, can macroscopic irreversibility emerge from the microscopic laws, known to be time-symmetric ? — one of the greatest unresolved paradoxes perhaps, and hence the unending debate. Boltzmann's *'derivation'* of irreversibility (thermodynamic entropy) and the second law of thermodynamics from the Newtonian mechanics was viciously attacked by Zermelo and Loschmidt—Boltzmann had ignored the correlations introduced by collisions, introducing thereby a distinction between before (past) and after (future). The subjective coarse-graining (not averaging) implicit in the derivation and the assumption of a special initial (boundary) condition of low-entropy state (an early use of the Anthropic Principle) were brought out. Finally, the astronomically long recurrence time of Poincare' relieves Boltzmann. Several other proposals were made, some to introduce irreversibility at the microscopic level itself, some invoking cosmological considerations, while some others (Ilya Prigogine and his Brussels group) brought in the Chaos theory (undermining Laplacian determinism) and held thermodynamics as primary. Finally, the debate turns to *'time'* in Eastern mysticism. The *'sacred'* reversible time of the meditative state of super-consciousness experienced by the enlightened ones, as distinct from the *'profane'* irreversible (physical) time of the daily life, has to be properly examined.

The Sixth Debates (Why is There Left and Right ? Chirality, Complexity and Emergent Properties) begins with the observation that handedness, or chiral asymmetry, is quite common in Nature—the conch shells are predominantly right-handed; the DNA molecules have right-handed sugars, and the protein molecules have left-handed amino-acids (the same amino-acid handedness is also detected in the carbonaceous meteorites, and, therefore, presumably of extra-terrestrial origin); at the elementary level of the sub-atomic particles, neutrino (anti neutrino) is left-(right-) handed, making the weak interaction, responsible for the radio-active decay parity violating (parity violation was demonstrated experimentally by Madame Wu as an excess of left-handed antineutrinos over the right-handed ones, emitted in the decay of $^{60}Co$ as suggested by T.D. Lee and C.N. Yang. A unified theory of all such weak interactions was first given by Sudarshan and Marshak); at a higher level of complexity, the human brain shows a left-hemispherical dominance while people are predominantly right-handed (primates and monkeys are, however, achiral). Handedness, or chirality, means that the object (e.g., a molecule or a process) can not be superposed on its mirror image—violation of the discrete bilateral symmetry. (In three dimensions, this mirror symmetry is the same as parity—invariances with respect to inversion through the origin). Chiral molecules are optically active—thus the solutions of the Left-handed (L) sugar and of the right-handed (D) sugar rotate the plane of polarization of the plane polarized light in the opposite sense. Chirality in molecules was discovered by Louis Pasteur who considered it crucial to life. The authors explained why. The highly specific enzymatic biomolecular reactions demand a hand-in glove fit which in turn requires a chiral compatibility between the enzyme and the substrate. Same for the relative chirality of the DNA D-sugars and the protein L-amino acids. And similarly for the homochirality of the DNA—all sugars are of the same handedness. A finer point was raised. The biochemistry and, therefore, biology should work equally well if reflected in a mirror, i.e., if all sugars are made Left-handed and all amino-acids right-handed (ignoring, of course, the parity-violating weak interaction which is abysmally weak compared to electromagnetism that dominates all chemistry). The debate then turns to the central issue of provenance: The origin of chirality at the biomolecular level. Actually, the question resolves into three distinct questions—origin of homochirality, of the sign of homochirality, and of the relative chirality. A plausible solution of this chirality conundrum was provided by Dilip Kondepudi and George Nelson—homochirality emerged by spontaneous symmetry breaking (as indeed was proposed earlier by Charles Frank for auto-catalytic set of chemical reactions), while the sign of chirality was fixed by the amplification of the weak chiral bias, provided by the Weak force, through bifurcation. A spectacular finding was reported by Kondepudi, namely, that crystals of sodium chlorate, an achiral molecule, precipitated out gradually from a well stirred solution were all of the same chirality, though the sign varied from beaker to beaker (unstirred solution with quick crystallization, however, gives a racemic mixture—containing both the Left and the Right in equal proportions). As for the bias provided by the Weak force, calculations by Stephen Mason and George Trantor indeed showed that the L-amino acids are energetically favoured by the Weak force, though ever so slightly! Other mechanisms making use of polarized lights for biasing biochemical reactions were also briefly discussed. As the emergence of biomolecular chirality and the life seem to involve spontaneous symmetry breaking, the discussion turned to Emrgent Properties of Complex Systems. Emergent properties of complex systems are, of course, consistent with the microscopic laws of physics, but one may not even begin to deduce them from the latter—limiting thus the power of reductionisms, at least in practice. Instead, one uses intermediate concepts appopriate to the level of complexity. There was an interesting aside on chirality—one could use the parity-violating weak decay (of $^{60}Co$, say) to tell the distant aliens what *'left'* means in absolute terms (assuming, of course, that their world like ours is made up of matter, and not antimatter!).

The Seventh Debates (Is the Universe Weird ?) deals with Quantum Mechanics—that framework theory which is now believed to correctly describe our universe (with no exceptions known so far), and agreeing quantitatively with the laboratory experiments with unprecedented accuracy; and yet the one which totally defies comprehension by our, admittedly, classically imprinted mind. The debate, which is, therefore, mostly about the interpretation of Quantum Mechanics, begins with a most lucid account of the logic of the photoelectric effect that had led Einstein to the quantum nature of the photon, and eventually to the quantum nature of all matter and fields, much against his own deeper conviction. The strangeness of Quantum Mechanics is then revealed—the principle of superposition of states and interference of alternatives (Young's double-slit experiment); the deterministic wave equation determining, however, only the probabilities intrinsically (quite different from the classical probabilities that measure our ignorance); the instantaneous collapse of the wave function to actuality on measurement (as proposed by Homo Copenhagensis, Niels Bohr), the collapse itself not being described by Quantum Mechanics; and the problem of measurement involving the classical apparatus and the observer, ultimately his subjective consciousness. There is a heated debate on local *'hidden variable'* theories that attempt to re-instate classical physics by introducing unseen statistical agents that give rise to classical probabilities, only to be ruled out by Bell's inequalities. There is a fascinating discussion of the EPR (Einstein-Podolsky-Rosen) non-locality paradox involving *'correlation'* between space-like separated measurements, as demonstrated experimentally by Alain Aspect. A logical treatment of the non-locality, using the negative probability, was also proposed by the authors. Next, going beyond re-interpretation, mechanisms for the collapse are discussed—based on decoherence by environment (after Zurek) and now widely approved, and the alternative many-world reformulation of quantum mechanics (after Everett), where the world splits at each measurement. There is an interesting, but short, discussion of Quantum Zeno Effect, and of Weak Measurement (that can protect the wave function against the measurement induced collapse). I wish the discussion was a bit longer. Similarly, there was a discussion of the Delayed-Choice experiment (proposed by John Wheeler) that brought out the full surprise of the Double-Slit experiment. The debate ended inconclusively, with an even deeper question of how quantum mechanics can possibly describe the primary experience of consciousness and the quiet meditative experience of Eastern mystics.

The Eighth Debates (Is There An Answer ? Theories of Everything) is about the ongoing attempts at unification of the four fundamental forces of Nature—the Electromagnetic force (involved in atomic and molecular binding), the Weak force (involved in radioactive decay), the Strong force (involved in nuclear binding), and the Gravity (the universal attraction between masses). The forces are carried by fields whose quanta are *Bosons* (e.g., photons), while those of the matter field are *Fermions* (e.g., electrons). The authors clarify the idea of unification of forces based on the merger of the constituent symmetry groups into a larger symmetry group, that naturally generates new *Bosons* (this is not a mere splicing of the two symmetries). Thus, we have the unification of the Electric and the Magnetic felds due to Maxwell, the Electroweak unification (due to Weinberg, Salam and Glashow) that ultimately led to the Standard Model of high energy physics unifying the Electroweak and the Strong forces (though this unification was more like splicing together of the constituent symmetries involved—a unification without unification). A true unification, called the Grand Unification Theory (GUT) for the three forces was proposed by Georgi and Glashow, but was abandoned for lack of agreement with experiments. Supersymmetry (SUSY) that unifies *Fermions* and *Bosons* was also briefly discussed—it, however, predicted a plethora or particles never seen, and hence remains in doubt. Gravity, the weakest of all forces, however, remained isolated. At this stage, the String Theory claimed as Theory of Everything (TOE) by its chief exponent, Edward Witten caught attention. Authors explained that in String Theory, the point-particles are replaced by tiny strings under tension (a 1-dimensional, or p-dimensional D-brains, open or closed), whose modes of vibration (like the violin overtones) correspond to different particles. The String Theory, because of its extended rather than a point-like structure gets rid of the worrisome infinities of earlier theories (it is intrinsically a finite theory). Besides, it contains graviton, the Boson that carries gravity, and supersymmetry—indeed, String Theory demands Einstein's gravity for its consistency. It unifies the two framework theories—Quantum Mechanics with Einstein's General Theory of Relativity—it is perhaps the much sought after Quantum

Gravity. The Standard Model of particle physics appears to fall out of it at low energies. The String Theory is consistently formulated in 10 (9 space + 1 time) dimensions, with the 6 space dimensions curled up and hence not explored at low energies—the idea of such extra dimensions, and their compactification (curling up) goes back to the earlier Kaluza-Klein idea who tried to unify Electromagnetism with Gravity by invoking a fifth dimension. Another plus point is that it predicts remarkably exactly the Black Hole entropy (and radiation) as calculated earlier by Hawking semi-classically—by counting correctly the string configurations. Finally, there are in fact five String Theories. However, uniqueness seems restored by the fact of duality that relates them as being different versions of one hitherto unexplored theory—the M-theory. On the flip side, of course, the String Theory is as far removed from the terrestrial physics as imaginable. It may describe the high-energy physics of the early universe, the hot Big Bang. None of the predicted particles have been seen around.

Question was posed—what's the point ? Herman Bondi thought there is no unification without verification. After all, science is only possible because one can say something without knowing everything. P.W. Anderson finds TOE's futile and sterile. Edward Witten's answer is that *"good wrong ideas are extremely scarce"*.

The Ninth Debates (How Did We Get Here ? Cosmology) takes us away from the familiar reproducible conditions, and addresses the ultimate uniqueness of the system under observation, namely the universe itself—inclusive of the Academicians, the reader, the authors, the observers and all else—and its origin. The authors clarify that probabilities in the context of such unique events make little sense *per se*, but one can sensibly appeal to the Anthropic Principle, that, in its weakest form, merely states that the properties of the universe must be consistent with the known fact of existence of life, or we would'nt be present to observe it. The force of such a principle is still in question. It was generally accepted, despite some (Henri Poincare and Steven Weinberg among them) arguing otherwise, that Einstein's General Theory of Relativity, together with his Cosmological Principlé, namely, that the universe is perfectly uniform everywhere, is the correct theorëtical framework to describe the large scale space-time structure of the universe, where curvature replaces the force of Newtonian gravity. This led to the Standard Model of cosmology due to Friedmann-Lemaitre-Robertson-Walker (FLRW) of the universe, consistent with the universal expansion as observed by Hubble through the cosmological red-shifts. The expansion, when extrapolated backwards, points to a singularity suggesting a dense hot Big Bang some 15 billion years ago. The authors caution against the naive picture of the expansion (as that of a balloon) and the BIG BANG (as that of an explosion)—there was no *'outside'* space-time into which the explosion and the expansion had taken place; the space-time appeared concomitantly with the BIG BANG. It was argued that the *'relic'* 2.7 Kelvin Cosmic Microwave Background Radiation (CMBR) observed by the radio astronomers Arno Penzias and Robert Wilson confirms the hot BIG BANG, and it was reconfirmed by the COBE (Cosmic Background Explorer) satellite. The hot BIG BANG was also consistent with the observed light-nuclear abundance—from the early nucleosynthesis. Next, the debate turned to the curious coincidences (the Dicke Coincidences) actually observed: Why is the universe so nearly flat (the flatness problem) ?, and Why is the universe so uniform in temperature (the Horizon problem) ? All this would demand an unimaginably fine turning of the density parameter of the BIG BANG model. These problems appear to have a neat solution in the idea of Inflation due to Alan Guth, that involves phase transition and spontaneous symmetry breaking in the very early phase of the universe as it cooled and supercooled. This inflationary scenario, and variations on it, are still being debated. The debate then turned to the most prior question of all—the origin of the universe itself and that of the initial (boundary) condition. Alexander Vilenkin, and Jim Hartle and Stephen Hawking invoked the idea of quantum tunneling (out of nothing into existence) along with an imaginary time, and then Hartle and Hawking introduced the *'No Boundary'* boundary condition. The imaginary time revmoves the singularity at the origin. The classicalization and irreversibility of the early reversible quantum state was achieved through decoherence—from within the decohering system ? This Quantum model of the early universe—with its superposition of geometries—seems consistent with the observed fine-scale temperature anisotropy of the measured CMBR—God's Fingerprints, some claim ! Finally, the Question of Who chose the Boundary Condition, however, remains, and re-opens the age-old theological question.

Finally, was there a compelling reason for *Doubt and Certainty* to have been written, and having been written, who can, and should, read it—one may ask. As authors have themselves very correctly noted there is a sensible discontent growing among the public that *"All that is human, all that is of concern to us lies outside of natural sciences"* (as voiced by Alan Bloom). This is re-orienting the public, including the educated non-scientist, towards Eastern mysticism and away from the natural science of the fraternity of *'dead white European males'*. This trend is clearly evidenced by the growing number of books, in the New Age section of book-stores with titles containing, e.g., *the Quantum and the Consciousness,* and claiming to unify Western science with Eastern mysticism, verbally—through the use of merely the terminology of modern physics. But these books are actually confused and confusing and signify really nothing—a caveat emptor ! (The situation is much worsened by the exaggerated claims made by some well-known scientists themselves). This millennium muddle must be cleared, and the mountebanks chased out. This is what *Doubt and Certainty* is aiming at. As to who can, and should read it, the authors state that the book is addressed to non-specialists (though, I think, the specialists/scientists too should, they obviously can read it—for enjoyment, of course,but also for experiencing the meaning of it all. I would strongly recommend the book to the educated non-scientists among the public, but I suggest that they read it twice—first time for the sheer joy of reading it, its disarming wit and humour. And, the second time round, to closely follow and *'participate'* in the Debates ! I am of the view that *Doubt and Certainty* ought to be acted out on the stage, and that the stage-play be sponsored by a learned body—an Academy, perhaps ?

Borrowing a phrase from E.M. Forster, I can verily say of *Doubt and Certainty* that it *'stands at an angle to the universe'*.

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