Science & Spirituality

1. Necessary Background – Science

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I. Science and the Materialistic Spirit During the Eighteenth and Nineteenth Centuries

"Physical Science has proceeded by the soundest and most scrupulous methods and produced a mass of indisputable results which, by their magnitude and far-reaching consequences, have revolutionised the world and justly entitled the age of their development to the title of the wonderful century."[1]

"Many hard things have been said about materialism by those who have preferred to look at life from above rather than below or who claim to live in the more luminous atmosphere of the idealistic mind or ether of the spiritual existence. Materialism has been credited with the creation of great evils, viewed even as the archimage of a detestable transformation or the misleader guiding mankind to an appalling catastrophe. Those whose temperament and imagination dally lovingly with an idealised past, accuse it for the cultural, social, political changes which they abhor, regarding them as a disturbance, happily, they believe, temporary, of eternal moral values and divinely ordained hierarchies. Those, more numerous, who look beyond to the hope of a larger idealism and higher spirituality,

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proclaim in its decline and passing away a fortunate deliverance for the human spirit....Science has been declared suspect as a guide or instructor of mankind and bidden to remain parked within her proper limits, because she was for long the ally of the material view of existence, a suggester of atheism and agnosticism, a victory-bringer of materialism and scepticism, the throne of their reign or pillar of their stability. Reason has been challenged because rationalism and free-thought were appropriated as synonyms of materialistic thinking."[2]

"All this wealth of accusation may have and much of it has its truth. But most things that the human mind thus alternately trumpets and bans, are a double skein. They come to us with opposite faces, their good side and their bad, a dark aspect of error and a bright of truth; and it is as we look upon one or the other visage that we swing to our extremes of opinion or else oscillate between them. Materialism may not be quite as dead as most would declare it to be; still held by a considerable number of scientific workers, perhaps a majority, – and scientific opinion is always a force both by its power of well-ascertained truth and its continued service to humanity, – it constitutes even now the larger part of the real temper of action and life even where it is rejected as a set opinion. The strong impressions of

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the past are not so easily erased out of our human mentality. But it is a fast receding force; other ideas and standpoints are crowding in and thrust it out from its remaining points of vantage."[3]

"...this age of which materialism was the portentous offspring and in which it had figured first as petulant rebel and aggressive thinker, then as a grave and strenuous preceptor of mankind, has been by no means a period of mere error, calamity and degeneration, but rather a most powerful creative epoch of humanity. Examine impartially its results. Not only has it immensely widened and filled in the knowledge of the race and accustomed it to a great patience of research, scrupulosity, accuracy, – if it has done that only in one large sphere of inquiry, it has still prepared for the extension of the same curiosity, intellectual rectitude, power for knowledge to other and higher fields, – not only has it with an unexampled force and richness of invention brought and put into our hands, for much evil, but also for much good, discoveries, instruments, practical powers, conquests, conveniences which, however we may declare their insufficiency for our highest interests, yet few of us would care to relinquish, but it has also, paradoxical as that might at first seem, strengthened man's idealism. On the whole, it has given

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him a kindlier hope and humanised his nature. Tolerance is greater, liberty has increased, charity is more a matter of course, peace, if not yet practicable, is growing at least imaginable. Latterly the thought of the eighteenth century which promulgated secularism has been much scouted and belittled, that of the nineteenth which developed it, riddled with adverse criticism and overpassed. Still they worshipped no mean godheads. Reason, science, progress, freedom, humanity were their ideals, and which of these idols, if idols they are, would we like or ought we, if we are wise, to cast down into the mire or leave as poor unworshipped relics on the wayside? If there are other and yet greater godheads or if the visible forms adored were only clay or stone images or the rites void of the inmost knowledge, yet has their cult been for us a preliminary initiation and the long material sacrifice has prepared us for a greater religion."[4]

1. Reason

"Reason is not the supreme light, but yet is it always a necessary light-bringer and until it has been given its rights and allowed to judge and purify our first infra-rational instincts, impulses, rash fervours, crude beliefs and blind prejudgments, we are not altogether ready for the full unveiling of a greater inner luminary."[5]

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2. Science

"Science is a right knowledge, in the end only of processes, but still the knowledge of processes too is part of a total wisdom and essential to a wide and a clear approach towards the deeper Truth behind. If it has laboured mainly in the physical field, if it has limited itself and bordered or overshadowed its light with a certain cloud of wilful ignorance, still one had to begin this method somewhere and the physical field is the first, the nearest, the easiest for the kind and manner of inquiry undertaken. Ignorance of one side of Truth or the choice of a partial ignorance or ignoring for better concentration on another side is often a necessity of our imperfect mental nature. It is unfortunate if ignorance becomes dogmatic and denies what it has refused to examine, but still no permanent harm need have been done if this willed self-limitation is compelled to disappear when the occasion of its utility is exhausted. Now that we have founded rigorously our knowledge of the physical, we can go forward with a much firmer step to a more open, secure and luminous repossession of mental and psychic knowledge. Even spiritual truths are likely to gain from it, not a loftier or more penetrating, – that is with difficulty possible, – but an ampler light and fuller self-expression."[6]

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3. Progress

"Progress is the very heart of the significance of human life, for it means our evolution into greater and richer being; and these ages by insisting on it, by forcing us to recognise it as our aim and our necessity, by making impossible hereafter the attempt to subsist in the dullness or the gross beatitude of a stationary self-content, have done a priceless service to the earth-life and cleared the ways of heaven. Outward progress was the greater part of its aim and the inward is the more essential? but the inward too is not complete if the outward is left out of account. Even if the insistence of our progress fall for a time too exclusively on growth in one field, still all movement forward is helpful and must end by giving a greater force and a larger meaning to our need of growth in deeper and higher provinces of our being."[7]

4. Freedom

"Freedom is a godhead whose greatness only the narrowly limited mind, the State-worshipper or the crank of reaction can now deny. No doubt, again, the essential is an inner freedom; but if without the inner realisation the outer attempt at liberty may prove at last a vain thing, yet to pursue an inner liberty and perpetuate an

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outer slavery or to rejoice in an isolated release and leave mankind to its chains was also an anomaly that had to be exploded, a confined and too self-centred ideal."[8]

5. Humanity

"Humanity is not the highest godhead; God is more than humanity; but in humanity too we have to find and to serve him. The cult of humanity means an increasing kindliness, tolerance, charity, helpfulness, solidarity, universality, unity, fullness of individual and collective growth, and towards these things we are advancing much more rapidly than was possible in any previous age, if still with sadly stumbling footsteps and some fierce relapses. The cult of our other human selves within the cult of the Divine comes closer to us as our large ideal. To have brought even one of these things a step nearer, to have helped to settle them with whatever imperfect expression and formula in our minds, to have accelerated our movement towards them are strong achievements, noble services."[9]

6. The Old Religious Cults

"The old religious cultures were often admirable in the ensemble and always in some of their parts, but

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if they had not been defective, they could neither have been so easily breached, nor would there have been the need of a secularist age to bring out the results the religions had sown. Their faults were those of a certain narrowness and exclusive vision. Concentrated, intense in their ideal and intensive in their effect, their expansive influence on the human mind was small. They isolated too much their action in the individual, limited too narrowly the working of their ideals in the social order, tolerated for instance and even utilised for the ends of church and creed an immense amount of cruelty and barbarism which were contrary to the spirit and truth from which they had started. What they discouraged in the soul of the individual, they yet maintained in the action and the frame of society, seemed hardly to conceive of a human order delivered from these blots. The depth and fervour of their aspiration had for its shadow a want of intellectual clarity, an obscurity which confused their working and baulked the expansion of their spiritual elements. They nourished too a core of asceticism and hardly cared to believe in the definite amelioration of the earth life, despised by them as a downfall or a dolorous descent or imperfection of the human spirit, or whatever earthly hope they admitted saw itself postponed to the millennial end of things."[10]

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7. The Secularist Centuries

"The secularist centuries weighed the balance down very much in the opposite direction. They turned the mind of the race wholly earthwards and manwards, but by insisting on intellectual clarity, reason, justice, freedom, tolerance, humanity, by putting these forward and putting the progress of the race and its perfectibility as an immediate rule for the earthly life to be constantly pressed towards and not shunting off the social ideal to doomsday to be miraculously effected by some last divine intervention and judgment, they cleared the way for a collective advance. For they made these nobler possibilities of mankind more imperative to the practical intelligence. If they lost sight of heaven or missed the spiritual sense of the ideals they took over from earlier ages, yet by this rational and practical insistence on them they drove them home to the thinking mind. Even their too mechanical turn developed from a legitimate desire to find some means for making the effective working of these ideals a condition of the very structure of society. Materialism was only the extreme intellectual result of this earthward and human turn of the race mind. It was an intellectual machinery used by the Time-spirit to secure for a good space the firm fixing of that exclusive turn of thought and endeavour, a strong rivet of opinion

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to hold the mind of man to it for as long as it might be needed. Man does need to develop firmly in all his earthly parts, to fortify and perfect his body, his life, his outward-going mind, to take full possession of the earth his dwelling-place, to know and utilise physical Nature, enrich his environment and satisfy by the aid of a generalised intelligence his evolving mental, vital and physical being. That is not all his need, but it is a great and initial part of it and of human perfection. Its full meaning appears afterwards; for only in the beginning and in the appearance an impulse of his life, in the end and really it will be seen to have been a need of his soul, a preparing of fit instruments and the creating of a fit environment for a diviner life. He has been set here to serve God's ways upon earth and fulfil the Godhead in man and he must not despise earth or reject the basis given for the first powers and potentialities of the Godhead."[11]

8. Matter, the Brahman

"....the intellectual force of materialism comes from its response to a universal truth of existence. Our dominant opinions have always two forces behind them, a need of our nature and a truth of universal existence from which the need arises. We have the material and

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vital need because life in Matter is our actual basis, the earthward turn of our minds because earth is and was intended to be the foundation here for the workings of the Spirit. When indeed we scan with a scrupulous intelligence the face that universal existence presents to us or study where we are one with it or what in it all seems most universal and permanent, the first answer we get is not spiritual but material. The seers of the Upanishads saw this with their penetrating vision and when they gave this expression of our first apparently complete, eventually insufficient view of Being, "Matter is the Brahman, from Matter all things are born, by Matter they exist, to Matter they return," they fixed the formula of universal truth of which all materialistic thought and physical science are a recognition, an investigation, a filling in of its significant details, elucidations, justifying phenomena and revelatory processes, the large universal comment of Nature upon a single text."[12]

9. Why Physical Science Must Be Materialistic in the Begining

"Materialistic science had the courage to look at this universal truth with level eyes, to accept it calmly as a starting-point and to inquire whether it was not

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after all the whole formula of universal being. Physical science must necessarily to its own first view be materialistic, because so long as it deals with the physical, it has for its own truth's sake to be physical both in its standpoint and method; it must interpret the material universe first in the language and tokens of the material Brahman, because these are its primary and its general terms and all others come second, subsequently, are a special syllabary. To follow a self-indulgent course from the beginning would lead at once towards fancies and falsities. Initially, science is justified in resenting any call on it to indulge in another kind of imagination and intuition. Anything that draws it out of the circle of the phenomena of objects, as they are represented to the senses and their instrumental prolongations, and away from the dealings of the reason with them by a rigorous testing of experience and experimentation, must distract it from its task and is inadmissible. It cannot allow the bringing in of the human view of things; it has to interpret man in the terms of the cosmos, not the cosmos in the terms of man. The too facile conclusion of the idealist that since things only exist as known to consciousness, they can exist only by consciousness and must be creations of the mind, has no meaning for it; it first has to inquire

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what consciousness is, whether it is not a result rather than a cause of Matter, coming into being, as it seems to do, only in the frame of a material inconscient universe and apparently able to exist only on the condition that that has been previously established. Starting from Matter, science has to be at least hypothetically materialistic.

When the action of the material principle, the first to organise itself, has been to some extent well understood, then can this science go on to consider what claim to be quite other terms of our being, – life and mind. But first it is forced to ask itself whether both mind and life are not, as they seem to be, special consequences of the material evolution, themselves powers and movements of Matter. After and if this explanation has failed to cover and to elucidate the facts, it can be more freely investigated whether they are not quite other principles of being. Many philosophical questions arise, as, whether they have entered into Matter and whence or were always in it, and if so, whether they are for ever less and subordinate in action or are in their essential power greater, whether they are contained in it only or really contain it, whether they are subsequent and dependent on its previous appearance or only that in their apparent organisation

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here but in real being and power anterior to it and Matter itself dependent on the essential pre-existence of life and mind. A greater question comes, whether mind itself is the last term or there is something beyond, whether soul is only an apparent result and phenomenon of the interaction of mind, life and body or we have here an independent term of our being and of all being, greater, anterior, ultimate, all matter containing and contained in a secret spiritual consciousness, spirit the first, last and eternal, the Alpha and the Omega, the OM. For experiential philosophy either Matter, Mind, Life or Spirit may be the Being, but none of these higher principles can be made securely the basis of our thought against all intellectual questioning until the materialistic hypothesis has first been given a chance and tested. That may in the end turn out to have been the use of the materialistic investigation of the universe and its inquiry the greatest possible service to the finality of the spiritual explanation of existence. In any case materialistic science and philosophy have been after all a great and austere attempt to know dispassionately and to see impersonally. They have denied much that is being reaffirmed, but the denial was the condition of a severer effort of knowledge...."[13]

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10. The Future: The Extension of the Method of Science to the Exploration of Life and Mind

"Having examined and explained Matter by physical methods and in the language of the material Brahman, – it is not really explained, but let that pass, – having failed to carry that way of knowledge into other fields beyond a narrow limit, we must then at least consent to scrutinise life and mind by methods appropriate to them and explain their facts in the language and tokens of the vital and mental Brahman. We may discover then where and how these tongues of the one existence render the same truth and throw light on each other's phrases, and discover too perhaps another, high, brilliant and revealing speech which may shine out as the definitive all-explaining word. That can only be if we pursue these other sciences too in the same spirit as the physical, with a scrutiny, not only of their obvious and first actual phenomena, but of all the countless untested potentialities of mental and psychic energy, and with a free unlimited experimentation. We shall find out that their ranges of the unknown are immense. We shall perceive that until the possibilities of mind and spirit are better explored and their truths better known, we cannot yet pronounce the last all-

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ensphering formula of universal existence. Very early in this process the materialistic circle will be seen opening up on all its sides until it rapidly breaks up and disappears. Adhering still to the essential rigorous method of science, though not to its purely physical instrumentation, scrutinising, experimenting, holding nothing for established which cannot be scrupulously and universally verified, we shall still arrive at supraphysical certitudes. There are other means, there are greater approaches, but this line of access too can lead to the one universal truth.

Three things will remain from the labour of the secularist centuries; truth of the physical world and its importance, the scientific method of knowledge, – which is to induce Nature and Being to reveal their own way of being and proceeding, not hastening to put upon them our own impositions of idea and imagination, *adhyāropa*, – and last, though very far from least, the truth and importance of the earth life and the human endeavour, its evolutionary meaning. They will remain, but will turn to another sense and disclose greater issues. Surer of our hope and our labour, we shall see them all transformed into light of a vaster and more intimate world-knowledge and self-knowledge."[14]

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11. Evolution of Europe: The Culminating Movement of European Civilisation

"The movement of religious freedom in Europe took its stand first on a limited, then on an absolute right of the individual experience and illumined reason to determine the true sense of inspired Scripture and the true Christian ritual and order of the Church. The vehemence of its claim was measured by the vehemence of its revolt from the usurpations, pretensions and brutalities of the ecclesiastical power which claimed to withhold the Scripture from general knowledge and impose by moral authority and physical violence its own arbitrary interpretation of Sacred Writ, if not indeed another and substituted doctrine, on the recalcitrant individual conscience. In its more tepid and moderate forms the revolt engendered such compromises as the Episcopalian Churches, at a higher degree of fervour Calvinistic Puritanism, at white heat a riot of individual religious judgment and imagination in such sects as the Anabaptist, Independent, Socinian and countless others. In the East such a movement divorced from all political or any strongly iconoclastic social significance would have produced simply a series of religious reformers, illumined saints, new bodies of belief with their appropriate cultural and social practice; in the West

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atheism and secularism were its inevitable and predestined goal. At first questioning the conventional forms of religion, the mediation of the priesthood between God and the soul and the substitution of Papal authority for the authority of the Scripture, it could not fail to go forward and question the Scripture itself and then all supernaturalism, religious belief or suprarational truth no less than outward creed and institute.

For, eventually, the evolution of Europe was determined less by the Reformation than by the Renascence; it flowered by the vigorous return of the ancient Graeco-Roman mentality of the one rather than by the Hebraic and religio-ethical temperament of the other. The Renascence gave back to Europe on one hand the free curiosity of the Greek mind, its eager search for first principles and rational laws, its delighted intellectual scrutiny of the facts of life by the force of direct observation and individual reasoning, on the other the Roman's large practicality and his sense for the ordering of life in harmony with a robust utility and the just principles of things. But both these tendencies were pursued with a passion, a seriousness, a moral and almost religious ardour which, lacking in the ancient Graeco-Roman mentality, Europe owed to her long centuries of Judaeo-Christian discipline. It was from

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these sources that the individualistic age of Western society sought ultimately for that principle of order and control which all human society needs and which more ancient times attempted to realise first by the materialisation of fixed symbols of truth, then by ethical type and discipline, finally by infallible authority or stereotyped convention.

Manifestly, the unrestrained use of individual illumination or judgment without either any outer standard or any generally recognisable source of truth is a perilous experiment for our imperfect race. It is likely to lead rather to a continual fluctuation and disorder of opinion than to a progressive unfolding of the truth of things. No less, the pursuit of social justice through the stark assertion of individual rights or class interests and desires must be a source of continual struggle and revolution and may end in an exaggerated assertion of the will in each to live his own life and to satisfy his own ideas and desires which will produce a serious malaise or a radical trouble in the social body. Therefore on every individualistic age of mankind there is imperative the search for two supreme desiderata. It must find a general standard of Truth to which the individual judgment of all will be inwardly compelled to subscribe without physical constraint or imposition of irrational

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authority. And it must reach too some principle of social order which shall be equally founded on a universally recognisable truth of things; an order is needed that will put a rein on desire and interest by providing at least some intellectual and moral test which these two powerful and dangerous forces must satisfy before they can feel justified in asserting their claims on life. Speculative and scientific reason for their means, the pursuit of a practicable social justice and sound utility for their spirit, the progressive nations of Europe set out on their search for this light and this law.

They found and held it with enthusiasm in the discoveries of physical Science. The triumphant domination, the all-shattering and irresistible victory of Science in nineteenth-century Europe is explained by the absolute perfection with which it at least seemed for a time to satisfy these great psychological wants of the Western mind. Science seemed to it to fulfil impeccably its search for the two supreme desiderata of an individualistic age. Here at last was a truth of things which depended on no doubtful Scripture or fallible human authority but which Mother Nature herself had written in her eternal book for all to read who had patience to observe and intellectual honesty to judge. Here were laws, principles, fundamental facts of the

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world and of our being which all could verify at once for themselves and which must therefore satisfy and guide the free individual judgment, delivering it equally from alien compulsion and from erratic self-will. Here were laws and truths which justified and yet controlled the claims and desires of the individual human being; here a science which provided a standard, a norm of knowledge, a rational basis for life, a clear outline and sovereign means for the progress and perfection of the individual and the race. The attempt to govern and organise human life by verifiable Science, by a law, a truth of things, an order and principles which all can observe and verify in their ground and fact and to which therefore all may freely and must rationally subscribe, is the culminating movement of European civilisation."[15]



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II. The Twentieth Century Science and the Nature of the Reality: Some Latest Models and Findings

"A Truth supreme has forced the world to be;
It has wrapped itself in Matter as in a shroud,
A shroud of Death, a shroud of Ignorance.
It compelled the suns to burn through silent Space,
Flame-signs of its uncomprehended Thought
In a wide brooding ether's formless muse:
It made of Knowledge a veiled and struggling light,
Of Being a substance nescient, dense and dumb,
Of Bliss the beauty of an insentient world."[16]

1. The Modern Myth-Makers

"In 1900 physicists were feeling pretty smug. Many of them thought they had the universe taped. The majestic clockwork wound up by Isaac Newton was running exactly as predicted. Subsequent discoveries in fields as diverse as heat, light and electricity all seemed to fit into the grand scheme of things. New telescopes were mapping the heavens and revealing that the earth and its sun were part of a huge but measurable star system, the Milky Way, that seemed to encompass the

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whole universe. Exactly what an atom was remained to be determined, and there were a few puzzling discoveries, such as cathode rays and radioactivity. But these could surely be fitted in. Basically, it was just a matter of dotting the 'i's and crossing the 't's.

A few years later, it was all over. People realised that far from knowing everything, they knew almost nothing. Two hypotheses, quantum theory and relativity, and two discoveries, the atomic nucleus and the fact that the Milky Way was not alone, but was one of a zillion similar galaxies, did not merely upset the apple cart, they scattered its contents right over the road. It has taken a century to pick the apples up and order them neatly again.

The result is impressive. Quantum theory, first proposed by Max Planck in 1900, has been elaborated into a comprehensive description of the very small. It is riddled with weirdness, mostly the result of Werner Heisenberg's famous uncertainty principle (namely, that it is impossible to be sure, at the same time, where an object is and how fast it is travelling). But it provides an accurate description of the way things are, down to the smallest objects that machines can measure. At the other end of the scale, Albert Einstein's theories of relativity (the special theory, proposed in 1905, and the general

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theory, proposed in 1916), describe the way things are up to the largest objects that machines can measure.

Using these theories and those machines, physicists have discovered many of the fundamental particles of which the universe is made, the forces that hold them together, and how those particles and forces interact to produce a bestiary of other objects – atomic nuclei and galaxies included – that were unknown in 1900. A coherent picture of sub-atomic physics, known as the Standard Model, has been painstakingly put together, and almost all the observations seem to fit into it. Similarly a coherent picture of the universe, known as the Big Bang cosmology, has emerged. Again, almost all the observations seem to fit.

This time, though, no one is feeling smug. For one thing, good as quantum theory and relativity are at explaining things, neither can be explained in terms of the other. Like parallel lines, they never meet. Nor, even in its own terms, is either of them a 'theory of everything'. At one level, both explain the universe very well indeed. At another, they explain nothing – for although they give a good description of the way things are, they are silent about why they are that way.

Moreover, there is that weasel phrase 'almost all the observations seem to fit'. As with cathode rays and

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radioactivity a century ago, some false notes are emerging. And there are a few dissenters, especially on the cosmological side, who doubt that some of the observations are actually good enough to support the theories built on them. With luck, new machines that are now coming into service, or will do so soon, will be able to address these problems. These machines will gather more and better data to quell the dissidents (or maybe prove them right) and to help to decide between the competing theories which try to embrace those observations that do not currently fit.

The next decade or so is likely to be a battleground between those theories. There are many ideas around, some extremely strange by everyday standards, and not all of them easily testable. What these ideas represent is the latest chapter in the construction of a modern creation-myth. For, unlike most branches of science, fundamental physics – the study of the very small and the very large – is not undertaken in the hope of tangible benefit. It is done to answer the question 'Why?' In some ways, therefore, it resembles a branch of theology.

Like the theologies of earlier days it demands huge temples for its worship. These temples are not cathedrals and mosques, but telescopes and particle accelerators. Their guardians – the successors of Newton, Planck,

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Einstein and myriad others, less famous in the wider world – are sometimes, jokingly, referred to as the priests of science. But the joke has a hard edge to it. In some senses they do have a priestly role. For they are the creators of the real story of creation: the modern myth-makers."[17]

2. The Big Bang Cosmology

In the Judeo-Christian mythology, the creation begins with a void – empty space. In a version of the modern theory put forward by Linde and Vilenkin, the creation begins with nothing whatsoever, not even empty space. This is a very difficult idea to grasp for our human mentality. Also, it requires the sum total of all the stuff in the universe to be nothing (zero). This result is arrived at in this model by taking gravitation as negative energy. In the famous Einstenian equation $E = mc^2$ where "E" stands for energy, the "m" for mass and the "c" for the speed of light, mass and energy are interchangeable and both are affected by gravity. Since everything is attracted to everything else by gravity, one can take it as acting as negative energy. By adding the negative gravitational energy to the positive energy (mass) in the universe one can arrive at the result zero. The observations of the amount and distribution of stuff

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in the universe are found not to contradict this assertion. In this scenario, as the universe expands, it borrows energy from the gravitational field to create more matter. Since the positive matter energy is exactly balanced by the negative gravitational energy, the net result (zero) is unaffected by it.

(a) Quantum mechanics and the Uncertainity Principle

The separation of the nothing into energy and gravity is a result of the so called "uncertainity principle", which simply stated means that the more accurately one determined a particle's position, the less accurately one could determine its speed, and vice versa. Quantum mechanics deals with the submicroscopic quantum world where, on its extremely fine scales, space-time, and thus reality itself, becomes grainy and discontinuous. Here the laws of cause and effect break down and particles jump from point A to point B without going through the space in between. In such a world one can never predict an atomic event with certainity, one can only predict the likelihood of its happening. Einstein could never accept this randomness, this unpredictable element in the basic laws and never fully accepted quantum mechanics. His feelings were expressed in his famous dictum "God does not play

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dice". Most scientists have accepted the validity of the new quantum laws because of the explanations they gave for a whole range of previously unaccounted-for phenomenon and their excellent agreement with observations. They are the basis of modern developments in chemistry, molecular biology, and electronics, and the foundation for the modern technology that transformed the world in the last half of the twentieth century.

In pre-quantum physics, an object confined by a barrier stayed confined. However, by the uncertainity principle an (subatomic) object's position is actually indeterminate. It may, therefore, sometimes find itself on the other side of the barrier, i.e., it may have tunnelled its way through the barrier. The barrier need not be material; it may be energetic – such as going from nothing to a mixture of positive and negative energy. The Linde-Vilenkin model is based on the idea that the universe simply quantum-tunnelled its way into existence.

Such quantum cosmology really is mythological, at least at the moment, since no one knows how to test it. Also, the universe that results from quantum tunnelling is small and dull, whereas the actual universe is huge and interesting. The theory that explains how it got that

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way has been tested in past few years and found reasonably fit.

(b) The inflationary universe

In the 1920s, the observations by the 100 inch telescope on Mt. Wilson revealed that universe is not static, as was earlier believed, but expanding. It was also revealed that the farther the other galaxies are from us, the faster they are moving away. The universe is expanding with the distance between any two galaxies steadily increasing with time. In the 1940s the term "big bang" was invented to describe the theory that stipulated that the universe could be traced back to a tiny beginning. It was not till the 1980s that people realised how big the 'Big Bang' may actually have been. This was when Alan Guth of the MIT came up with the idea of inflation and the calculations to estimate the speed of inflation when the universe was very very young. His calculations show that when the universe was very very young it not merely expanded but grew so fast that there are scarcely words to describe the process.

"'Very, very young' means within a trillionth of a trillionth of a trillionth of a second of the universe's coming into existence. "Scarcely words to describe this

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process" means that within that time it grew from something the size of a subatomic particle to something the size of a grapefruit. This may not sound much, but it means a million trillion trillion trillion trillion trillion trillion-fold increase in volume in that trillionth of a trillionth of a trillionth of a second.

To account for this process, Dr. Guth invokes a new force of nature. In the familiar circumstances of the modern universe, gravity acts only as an attractive force, but an unexpected consequence of the general theory of relativity is that there are circumstances when it can act as a repulsive force as well. Probably, Dr. Guth's new force is a manifestation of this idea: in its earliest existence, the universe was actually pushed apart by its own gravitational field."[18]

(c) A uniform and flat universe

The earliest period of inflation as described above has been used to solve the puzzles arising from the observations indicating a uniform and flat universe. Of course, the universe is obviously full of grit – planets, stars, galaxies, clusters and superclusters of galaxies and so on – but this grit seems to have the same sort of distribution everywhere. This suggests that the early universe was well mixed because there are places in the

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universe so far apart that light would not have had time to travel between them since the very beginning. As nothing can travel faster than light, these places could not have had any sort of contact with each other and therefore no mixing between them could account for the similarity of their appearance. Inflation solves this puzzle because the different parts of the universe were indeed once in close contact. This means that they actually separated at massively more than the speed of light. They could do so because they were not actually travelling through space, it was space itself that was expanding – and that expansion is not constrained by relativity.

The second puzzle is that the space seems flat although there seems to be no reason why it should be so. This puzzle is also solved by inflation. Regardless of the initial shape, a big enough expansion would force space to be flat or at least so close to being flat that one would not be able to measure the difference.

In the electro-magnetic spectrum, microwave radiation lies between radio waves and infra-red light. The universe is full of it. The discovery of the cosmic microwave background (CMB) in the 1960s was the second important piece of evidence in favour of the Big Bang after Hubble's finding of an expanding universe. The CMB is, in fact, radiation left over from the Big Bang

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which carries an imprint of the early universe. The CMB is actually a picture not of the bang itself, but of the universe when it was only 300,000 years old. Before this time, the radiation was traveling through gas, and this gas was resonating with sound – literally echoes from the Big Bang. It is possible to calculate the resonant frequencies, and how the changes in the density of the gas that they caused would refract the CMB. The effect would be to impose a particular pattern of sizes on the fluctuations in the radiation. If space is flat, the microwave picture of that pattern will pass through it (the space) undisturbed but the pattern will be altered in predictable ways if the space is curved. The measurements made suggest that the pattern is undisturbed. Thus this evidence also favours flatness of the space.

(d) Composition of the universe – Dark matter and darker energy

"Look into the night sky with a telescope, and points of light will fill the field. But one of the oddest things about the universe is that what you see is definitely not what you get. The stuff that is visible through telescopes (including those that see in frequencies other than visible light) amounts to only about 0.5% of the total amount of stuff out there. The rest is dark.

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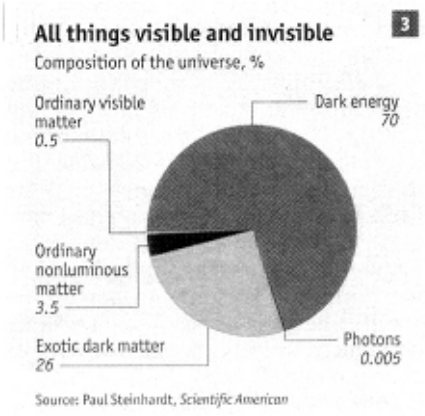

Courtesy: **The Economist, January 5–11, 2002**

That is not necessarily surprising. What is surprising is that almost all of the dark stuff is stuff that could never be visible. It is completely different from the matter that makes up atoms.

That there is something missing from the picture was first suspected by Fritz Zwicky. He was a contemporary of Hubble's who studied the rotation and clustering of galaxies. Zwicky found that galaxies rotate oddly. Instead of the central stars moving faster than the outer ones, as simple physics would predict, all move in tandem. Galactic discs, though made of widely separated objects, behave almost as if they were solid. Moreover, galactic clusters do not appear to have enough mass in them to stop themselves flying apart. Even allowing for gas and dust that do not shine, and so-called MACHOS (massive compact halo objects, a

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fancy name for stars too feeble to see), galaxies need to be a lot heavier than they look to explain this. The extra mass would form a spherical halo around the disc, holding it together gravitationally, and attracting other galaxies, holding clusters together."[19]

Another reason for the scientists believing that the universe is much heavier than it looks is cosmological. The kinetic energy (energy of motion) originating from the Big Bang causes the universe to expand. The gravitational attraction of its parts causes it to contract, tries to pull it back together again. The balance of these two opposite forces sets the expansion rate of the universe. The critical density is defined as the density in which the kinetic energy and gravitational attraction are so exactly balanced that the universe would slow its expansion over time without ever coming to a complete halt. The ratio of the actual density to this critical density is denoted by the Greek letter *omega*. If *omega* is less than 1, the universe would fly apart and if it is more than 1 it will rapidly approach zero or the original state. Of course rapidly still means a few billion years. According to present estimates, the universe is about 13.5 billion years old. This fact goes in favour of the belief that *omega* is equal to 1. Flatness of space is another factor which goes in favour of this value of

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omega. According to Einstein's general relativity theory matter and energy warp space. The kinetic energy and the gravitational attraction warp it in opposite directions. When omega = 1, they balance, and space is flat.

When all the visible and invisible atomic matter in the universe (stars, gas, MACHOS and so on) is added up, it gives value for omega of about 0.04. Something very significant is therefore missing from these calculations. British astronomer, Sir Martin Rees, suggests that we should admit that the stuff of stars, planets etc. is merely the scum of the universe. The reality is something else, and the dominant form of matter in the universe is probably made of the weakly interacting massive particles called WIMPS. The physical world is supposed to be governed by four forces, namely, gravity, electromagnetism, the strong nuclear force holding the atomic nuclei together and the weak nuclear force which is not supposed to do much but control the rates of certain sorts of radioactive decay. All matter feels the force of gravity but only quarks feel all three of the other forces.

Neutrino is one class of purely weakly interacting particles but it is too light to be included in WIMPS. Scientists have yet to find any WIMPS around. Even neutrino requires special equipment buried

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underground for identification and for any useful studies to be done. Similar equipment is being used in looking for WIMPS but the difficulty is much greater in this case since the scientists don't even know what they are looking for. Still it is hoped that they will come across such particles in near future to throw light on the dark-matter problem. Still the discovery of WIMPS will not solve the problem, it will push the value of *omega* only up to 0.3. Seventy percent of the universe will still be missing from the balance sheet.

The investigations done to arrive at a more reliable estimate of the age of the universe have revealed that the universe's expansion is speeding up. This expansion may be taken to suggest that the missing two thirds of the universe is a form of energy that, while balancing the sums and keeping space flat, actively pushes things apart. Two sorts of explanations are being floated for this dark (or darker) energy. One is that it is a pale imitation of the force that caused inflation: a form of repulsive gravity referred to as cosmological constant by Einstein. The calculations done on this line come up with estimates that are way too high.

The other explanation, which is no explanation is that this dark energy is something completely new and no one has a clue what it might be. Still a name is a

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start and to give it a novel name, Paul Steinhardt of Princeton University has dubbed it "quintessence".

3. Particle Physics – The Standard Model

"VISIBLE, invisible or just plain quintessential, the composition of matter and energy needs to be explained. The fundamental particles of which the universe is now composed are believed to have appeared very early on – within ten microseconds (millionth of a second) of the end of inflation. Before that, the mix was different. And the further you go back into those first instants, the more different it was.

The reason for these differences is that the universe in its early moments was far hotter than it is now (all its energy was concentrated into a much smaller space). As it cooled, the stuff in it changed state. Some people compare this to a gas cooling. First it becomes a liquid, then a solid. A better analogy might be the cooling of magma under the earth. It starts off as a uniform mixture of liquid rock, but as the temperature drops, minerals start to form one after another as their freezing points are reached. Each time another type of mineral crystallises, the composition of the mixture changes. Eventually, no liquid remains, and you are left with granite. The mix of subatomic particles that make up

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the modern universe is like a species of cosmic granite.

Physicists believe that if they can find out what the cosmic magma looked like, they will understand the essence of the universe. Knowing its original composition and knowing why it crystallised the way it did is to know the basic laws of physics. At the moment, physicists are some distance from such a "theory of everything" (though Stephen Hawking, a well-known cosmologist who works at Cambridge University, has a bet that it will be found within 20 years). In the meantime, they make do with an interim solution called the Standard Model."[20]

This model consists of 17 irreducible point-like particles of which 16 have been detected and the 17th is as yet undetected and is supposed to account for the important property of matter known as mass. Out of the four forces supposed to be governing physical phenomenon, this takes account of only three. It is not able to integrate the force of gravitation in its structure. However, inspite of its limitations, the Standard Model is a triumph. It is the result of collaboration between the theoreticians who use mathematical models to predict how nature should behave and the practitioners who use particle accelerators, the huge and enormously complex and expensive machines, to test these

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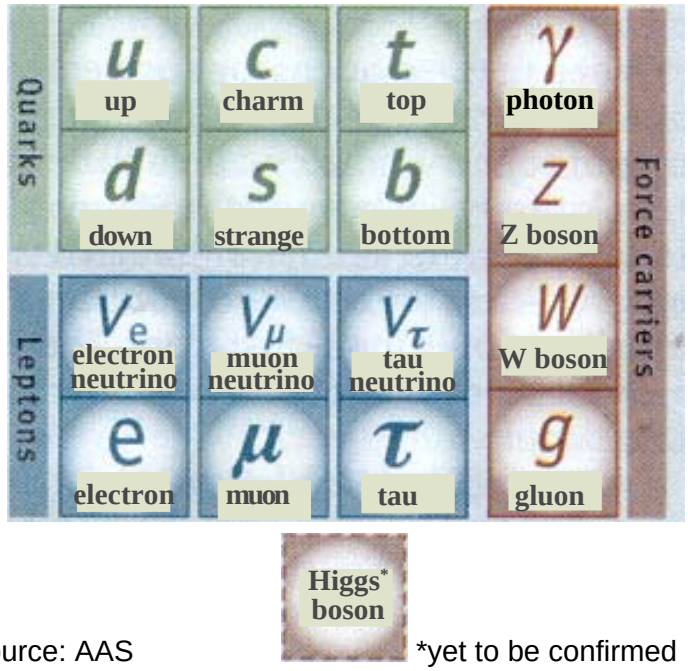
predictions. The particle accelerators use electric and magnetic fields to whip electrically charged sub-atomic particles up to speeds near that of light. As the particles travel faster, they become more massive ($E=mc^2$). When they have become massive enough, they are either slammed into stationary targets or collided head-on. The result is a shower of new particles, which give clues to the nature of the cosmic magma.

The Standard Model



Source: AAS *yet to be confirmed

Courtesy: **The Economist, January 5–11, 2002**

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Twelve particles out of a total of 17 are the ingredients of matter. These are known as Fermions which are divided into six quarks and six leptons. The six quarks interact through all the three (other than gravitation) forces while the leptons feel only the electromagnetism and the weak nuclear force.

The quarks occur in three pairs of which only the first and the least massive occur naturally at post-first-ten-microseconds (millionth of a second) temperatures. These stable quarks known as "up" and "down" combine to make protons (two ups and a down) and neutrons (two downs and an up) of the nuclei of atoms.

The leptons also come in three pairs. One member of each of these pairs is measurably heavy (though still lighter than a quark) and one is of minuscule mass. The insubstantial of these are called the neutrinos; they have no charge and just a little bit of mass – not enough to make them WIMPS. The massive members of each lepton pair are the electrically (negative) charged electron and two other particles resembling it in all other ways except that they are heavier and unstable.

The remaining five particles are called bosons after the Indian physicist Satyendra Bose who collaborated with Einstein. Four of these are the physical

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manifestations of the forces through which particles interact: photons carry the electromagnetic force, W and Z bosons carry the weak nuclear force, and glucons the strong nuclear force. It is suggested that the fifth, the Higgs boson, gives other particles their mass. The Higgs boson is the mathematical afterthought to the main body of the standard Model, and no one knows for sure if it actually exists.

4. String Theory and M-Theory

The most glaring omission of the standard Model is that it has no place for gravity, the fourth and most ubiquitious of the known forces of physical nature. String theory is a line of inquiry which tries to tackle this problem by invoking a few extra dimensions.

During the last three decades of his illustrious career Einstein was preoccupied by the dream of producing a unified or a complete theory, capable of explaining every element of the physical reality. In doing so he hoped to resolve the conflict between his general theory of relativity and quantum mechanics. Einstein was not able to succeed in this task, but inspired by his efforts in this direction, a new generation of physicists has taken on the challenge of creating a complete theory or what they call an Ultimate Theory of Everything (UTE). In

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Courtesy: Time Magazine, December 31, 1999, PP.86-87

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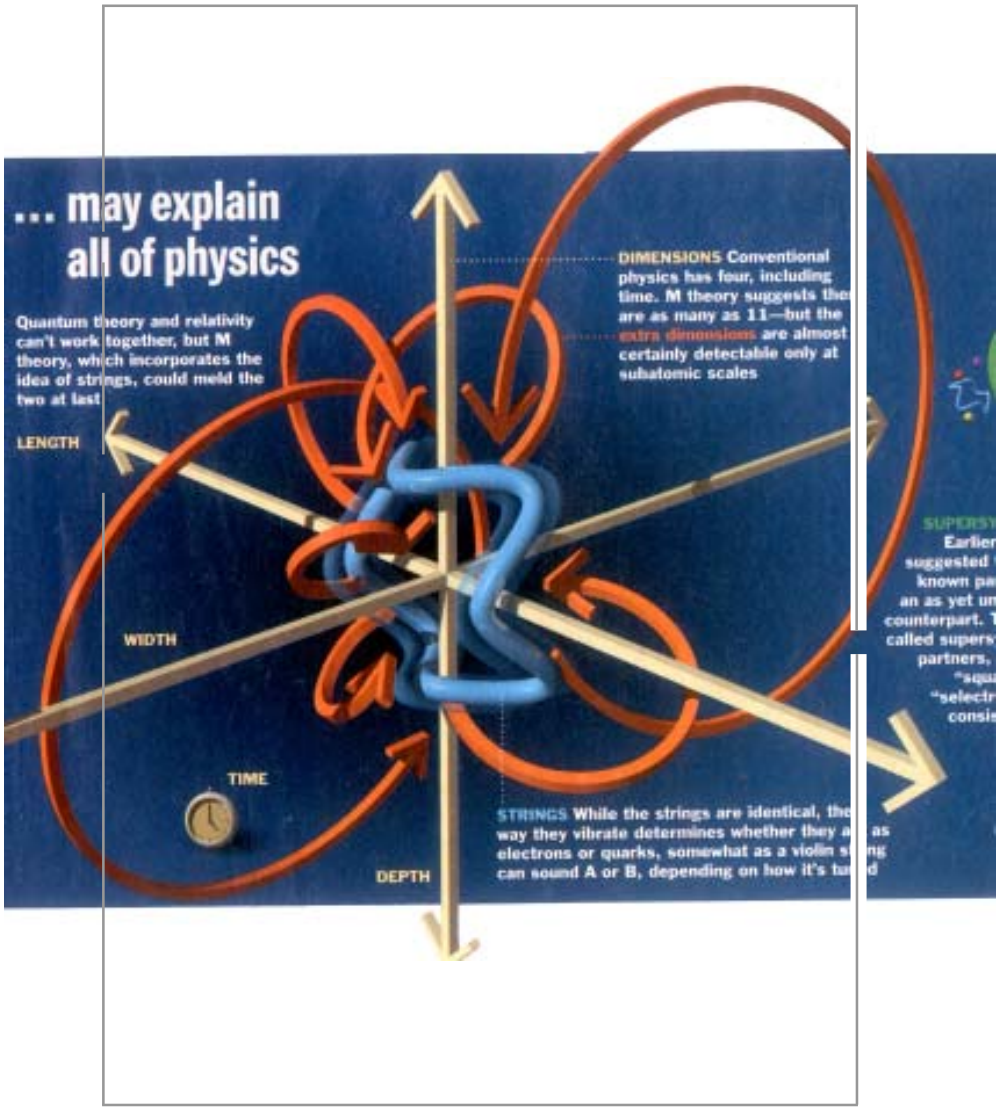

Courtesy: Time Magazine, December 31, 1999, PP.86-87

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their efforts in this direction they have succeeded in constructing a framework, called string theory, which seems to be the most comprehensive attempt at integrating gravity with the other fundamental forces of physical nature. It is called string theory because it postulates that elementary particles are not points but minute vibrating strings. These strings are believed to be like the strings on a musical instrument. Also, like musical strings, these can vibrate either at a base note or at a series of harmonics. Different harmonics are believed to correspond to different particles of the same family. To make this theory fit the perceived reality, required the scientists to introduce six extra dimensions in their mathematical equations in addition to the traditional four (three spatial ones plus time) of the General Relativity Theory. We are conscious of living only in a four dimensional physical world and these additional six dimensions have never been perceived. They are, therefore, thought of as being tightly curled up on scales too small to be measurable with any instrument that might be built in the foreseeable future.

The enthusiasm for string theory has waxed and waned over the past three decades. Working on the string theory in 1974, Schwarz and Scherk noticed that some of the vibrating strings spilling out of their

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equations didn't correspond to the particles they had expected. Initially they looked upon these as nuisances. However, on closer examination they decided that the ghosts haunting their equations must be gravitons, the still hypothetical particles that are supposed to carry the gravitational force. One of the most important attributes of the string theory is its ability to reconcile quantum theory with general relativity. And this is done by "Quantising" gravity with the help of a boson of gravity called graviton which, as we have seen above, is an inevitable consequence of the string theory.

Another consequence of the string theory is that it requires the existence of an entirely new class of subatomic particles, known as supersymmetric particles, or "sparticles". These are opposite of the particles and introduce equal and opposite infinities which cancel the original ones without any tricks. There are five string theories and none of which could be ruled out. It seemed impossible that all of them could be right but actually this has turned out to be the case.

In 1995 Edward Witten, a theorist working at Einstein's own Institute of Advanced Study, suggested that all the five string theories may be looked upon as representing different approximations of a deeper underlying theory. He called it M-theory, where M stands

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for many things including matrix, mystery and magic. Now even 'murky' has been added to the list because no one has been able to write the full set of equations that exactly describe the M-theory, for it has added still more layers of complexity to an already complex problem. Actually it may take decades before M-theory matures into a theory with real predictive power.

When Einstein developed his general theory of relativity, he dealt with a simple world that had just three spatial dimensions plus time. As a result, he could use off-the-shelf mathematics to develope and solve his equations. The M-theorists can't do so because their reality consists of 11 dimensions and for proper development and handling of such a complicated model some absolutely essential mathematical tools may be lacking and may need to be developed in future.

The 11 dimensional world of M-theory is filled with weird objects called branes. Strings, in this nomenclature, are one-dimensional branes, membranes are two dimensional branes. But there are also higher dimensional branes that no one really knows how to deal with, for the branes can fold and curl into any number of bewildering shapes. These branes are supposed to float around in an 11th dimension. And it is here that gravity enters the picture.

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The force of gravity is relatively very weak. This was noticed by the physicists even before the discovery of the strong and weak nuclear forces. The ratio of the strengths of the electrical repulsion between the two protons and their mutual gravitational attraction is represented by the letter N. Its value is about a trillion trillion trillion to one.

According to M-Theory, the force of gravity is very weak because it spends most of its time in the 11th dimension and only rarely visits the dimensions of the branes. The 11th dimension of M-theory is small, but unlike the curled-up dimensions of basic string theory, it may not be undetectable. Some versions of the theory suggest that it may intrude into 3D space over distances of a tenth of a millimetre or less. The scientists who have set up experiments to test this have so far not found any evidence in its favour.

One of the reasons for the popularity of string theory is that in mathematical terms it is completely internally consistent. Here there is no need for arbitrary assumptions and there are no loose ends except that besides the solution that seems to describe the symmetries of the universe, there appears to be an indefinite number of other solutions each with its own, private set of symmetries, that do not. The indefinite

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number of solutions in string theory is taken by a number of scientists to mean that our universe may not be unique, but just one of a possibly infinite number of "universes".

5. The Multiple Universes

The idea of multiple universes has proved to be surprisingly attractive to the scientists. Two important problems that would seem to be resolved by this are: (i) the true nature of the uncertainty principle and (ii) the "anthropic principle" – the coincidence that the universe seems to be set up with precisely the right conditions – the right values of six fundamental physical numbers – for human-like life to evolve within it. The anthropic problem is resolved because there is an indefinite number of universes, each governed by different solutions to string theory, some of the universes must have the right conditions for carbon based life. And because life will arise only in such universes, the observers will only ever see this set of conditions.

The uncertainty principle was developed as a part of an approach to the quantum theory known as the Copenhagen approach. An alternative approach that researchers found even harder to swallow than the Copenhagen approach was developed by Hugh Everett

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in 1957. According to Everett, the universe does actually behave in the deterministic way that 19th-century physicists thought it did; it just looks uncertainly probabilistic because each event that takes place spawns an infinite number of parallel universes, and, taken together, the various versions of the event in question take place with the probability dictated by the uncertainty principle.

Dr. David Deutsch of Oxford who has taken up this approach of Everett not only believes in parallel universes but, in a way, even admits the possibility of collaborating with them. The universe-straddling machines he has in mind are called quantum computers. Instead of "bits", (0 or 1) of data, a quantum computer manipulates "qubits". In the Copenhagen approach, their values are indeterminate until an observer attempts to examine them and in that case the uncertainty "collapses" and he is left with an ordinary, non-quantum bit.

What does all this mean? It means that lots of calculations can be performed in parallel, as long as their intermediate steps remain unexamined. The quantum computers proposed by Everett are much much more powerful than an ordinary computer and its power increases exponentially. In fact, it will not take

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a particularly large quantum computer to perform more parallel calculations than there are elementary particles in the visible part of the universe!

Computing is not an abstract process, the information being manipulated has to be associated with something physical. According to Dr. Deutsch, the computation cannot, therefore, be happening in a single universe. In his view, the only possible explanation is that the separate, parallel calculations are being done in separate, parallel universes.

6. The "How" of the Multiple Universes and the Ultimate Theory of Everything (UTE)

Although only at a more or less purely speculative level, there have come up a number of approaches or explanations for the coming into being of multiple universes. One approach is to extend the popular "inflation" theory into what has been dubbed – "eternal inflation". In this theory the difference between speeds of the inflationary force-field's expansion and collapse is believed to account for the appearance of a universe expanding at a normal, Hubble-type rate. The calculations done in this context suggest that the inflationary force-field outpaces its own tendency to

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collapse. The result is a continuously growing set of local collapses – in other words, a growing set of universes – i.e. a multiuniverse. This multiuniverse would still require a definite beginning (a quantum tunneling event, or something similar) but once it got going, it would spawn new universes indefinitely with possibly different laws of physics in each of the universes.

Another approach to the creation of multiuniverse has been developed by Lee Smolin of Waterloo, Ontario. In this approach newly formed black holes – things of such density that not even light can escape their gravitational fields – are the seeds of new universes. These then expand outwards in their own, private dimensions independent of those in which the hole formed. In effect, each universe gives birth to another every time a black hole forms within it.

There is yet another approach to multiuniverse theory that requires only two universes. This approach, in which two branes (in effect two parallel universes) collide every so often, disposes the theory of inflation. According to the calculations done by Dr. Steinhardt of Princeton and Dr. Turok of Cambridge, such collisions of the branes would produce almost the same results as inflation. This theory has different implications for CMB than the theory of inflation and may therefore be

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tested in the near future. In the nature of things no test can prove the validity of any theory. It can only show us that the observations done (so far!) are not apparently inconsistent with the theory.

The apostles of string theory tend to believe that there really is an ultimate explanation of things and that the physicists are probably not very far from finding it. However, the past experience in physics has been of unsuspected deeper explanations and unexpected results. "So perhaps the last word should go to J.B.S. Haldane, a British scientific polymath of the early 20th century, who once said, 'My own suspicion is that the universe is not only queerer than we suppose, but queerer than we can suppose.' The modern myth-makers, like their religious forebears, may be chasing shadows after all."[21]

7. A Positivist Physicist on the Future Possibilities of Science

Here are some interesting excerpts from Stephen Hawking's latest book, "The Universe in a Nutshell."

"In 1988, when *A Brief History of Time* was first published, the ultimate Theory of Everything seemed to be just over the horizon. How has the situation changed since then? Are we any closer to our goal? As will be described in this book, we have advanced a

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long way since then. But it is an ongoing journey still and the end is not yet in sight. According to the old saying, it is better to travel hopefully than to arrive. Our quest for discovery fuels our creativity in all fields, not just science. If we reached the end of the line, the human spirit would shrivel and die. But I don't think we will ever stand still: we shall increase in complexity, if not in depth, and shall always be the center of an expanding horizon of possibilities."[22]

(a) Nature of a scientific theory – the positivist approach

"Any sound scientific theory, whether of time or of any other concept, should in my opinion be based on the most workable philosophy of science: the positivist approach put forward by Karl Popper and others. According to this way of thinking, a scientific theory is a mathematical model that describes and codifies the observations we make. A good theory will describe a large range of phenomena on the basis of a few simple postulates and will make definite predictions that can be tested. If the predictions agree with the observations, the theory survives that test, though it can never be proved to be correct. On the other hand, if the observations disagree with the predictions, one has to discard or modify the theory. (At least, that is what is

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supposed to happen. In practice, people often question the accuracy of the observations and the reliability and moral character of those making the observations.) If one takes the positivist position, as I do, one cannot say what time actually is. All one can do is to describe what has been found to be a very good mathematical model for time and say what predictions it makes."[23]

(b) Limitations to scientific knowledge: Godel's theorem

"In 1931 the mathematician Kurt Godel proved his famous incompleteness theorem about the nature of mathematics. The theorem states that within any formal system of axioms, such as present-day mathematics, questions always persist that can neither be proved nor disproved on the basis of the axioms that define the system. In other words, Godel showed that there are problems that cannot be solved by any set of rules or procedures.

Godel's theorem set fundamental limits on mathematics. It came as a great shock to the scientific community, since it overthrew the widespread belief that mathematics was a coherent and complete system based on a single logical foundation. Godel's theorem, Heisenberg's uncertainty principle, and the practical

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impossibility of following the evolution of even a deterministic system that becomes chaotic, form a core set of limitations to scientific knowledge that only came to be appreciated during the twentieth century."[24]

(c) The M-theory and its future

"How will our journey of discovery proceed in the future? Will we succeed in our quest for a complete unified theory that will govern the universe and everything that it contains? In fact,.... we may have already identified the Theory of Everything (ToE) as M-theory. This theory doesn't have a single formulation, at least as far as we know. Instead we have discovered a network of apparently different theories that all seem to be approximations to the same underlying fundamental theory in different limits, just as Newton's Theory of Gravity is an approximation to Einstein's General Theory of Relativity in the limit that the gravitational field is weak. M-theory is like a jigsaw: it is easiest to identify and fit together the pieces round the edges of the jigsaw, the limits of M-theory where some quantity or other is small. We now have a fairly good idea of these edges but there is still a gaping hole at the center of the M-theory jigsaw where we don't know what is going on.... We can't really claim to have found the

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Theory of Everything until we have filled that hole.

What is in the center of M-theory? Will we discover dragons (or something equally strange) like on old maps of unexplored lands? Our experience in the past suggests we are likely to find unexpected new phenomena whenever we extend the range of our observations to smaller scales. At the begining of the twentieth century, we understood the workings of nature on the scales of classical physics, which is good from interstellar distances down to about a hundredth of a millimeter. Classical physics assumes that matter is a continuous medium with properties like elasticity and viscosity, but evidence began to emerge that matter is not smooth but grainy: it is made of tiny building blocks called atoms. The word atom comes from Greek and means indivisible, but it was soon found that atoms consisted of electrons orbiting a nucleus made up of protons and neutrons.

The work on atomic physics in the first thirty years of the century took our understanding down to lengths of a millionth of a millimeter. Then we discovered that protons and neutrons are made of even smaller particles called quarks.

Our recent research on nuclear and high-energy physics has taken us to length scales that are smaller by

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a further factor of a billion. It might seem that we could go on forever, discovering structures on smaller and smaller length scales. However, there is a limit to this series, as there is to the series of Russian dolls within Russian dolls.

Eventually, one gets down to a smallest doll, which can't be taken apart any more. In physics, the smallest doll is called the Planck length. To probe to shorter distances would require particles of such high energy that they would be inside black holes. We don't know exactly what the fundamental Planck length is in M-theory, but it might be as small as a millimeter divided by a hundred thousand billion billion billion. We are not about to build particle accelerators that can probe to distances that small. They would have to be larger than the solar system...."[25]

However, there has been an exciting new development that means we might discover at least some of the dragons of M-theory more easily (and cheaply). In the M-theory network of mathematical models, spacetime has ten or eleven dimensions. Up to recently it was thought that the six or seven extra dimensions would all be curled up very small. "If all the additional dimensions were very small, it would be very difficult to observe them. However, there has recently

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been the suggestion that one or more of the extra dimensions might be comparitively large or even infinite. This idea has the great advantage (at least to a positivist like me) that it may be testable by the next generation of particle accelerators or by sensitive short-range measurements of the gravitational force. Such observations could either falsify the theory or experimentally confirm the presence of other dimensions.

Large extra dimensions are an exciting new development in our search for the ultimate model or theory. They would imply that we lived in a brane world, a four-dimensional surface or brane in a higher-dimensional spacetime."[26]

(d) Multiple universes and histories – Histories in imaginary times

"Even if the boundary condition of the universe is that it has no boundary, it won't have just a single history. It will have multiple histories, as suggested by Feynman. There will be a history in imaginary time corresponding to every possible closed surface, and each history in imaginary time will determine a history in real time. Thus we have a superabundance of possibilities for the universe. What picks out the particular universe that

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we live in from the set of all possible universes? One point we can notice is that many of the possible histories of the universe won't go through the sequence of forming galaxies and stars that was essential to our own development. While it may be that intelligent beings can evolve without galaxies and stars, this seems unlikely. Thus, the very fact that we exist as beings who can ask the question "Why is the universe the way it is?" is a restriction on the history we live in. It implies it is one of the minority of histories that have galaxies and stars. This is an example of what is called the anthropic principle. The anthropic principle says that the universe has to be more or less as we see it, because if it were different, there wouldn't be anyone here to observe it."[27]

(e) The likely state of science and technology in future

"I want to.... ask if we will ever reach a final steady state in science and technology. At no time in the ten thousand years or so since the last ice age has the human race been in a state of constant knowledge and fixed technology.... Life seems to have originated in the primordial oceans that covered the Earth four billion years ago. How this happened we don't know. It may

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be that random collisions between atoms built up macromolecules that could reproduce themselves and assemble themselves into more complicated structures. What we do know is that by three and a half billion years ago, the highly complicated DNA molecule had emerged.

DNA is the basis for all life on Earth. It has a double helix structure, like a spiral staircase, which was discovered by Francis Crick and James Watson in the Cavendish lab at Cambridge in 1953. The two strands of the double helix are linked by pairs of bases, like the treads in a spiral staircase. There are four bases in DNA: adenine, guanine, thymine, and cytosine. The order in which they occur along the spiral staircase carries the genetic information that enables the DNA to assemble an organism around it and reproduce itself. As it makes copies of itself, there are occasional errors in the proportion or order of the bases along the spiral. In most cases, the mistakes in copying make the DNA either unable or less likely to reproduce itself, meaning that such genetic errors, or mutations, as they are called, will die out. But in a few cases, the error or mutation will increase the chances of the DNA surviving and reproducing. Such changes in the genetic code will be favoured. This is how the information contained in the

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sequence of DNA gradually evolves and increases in complexity."[28]

"Because biological evolution is basically a random walk in the space of all genetic possibilities, it has been very slow. The complexity, or number of bits of information, that is coded in DNA is roughly the number of bases in the molecule. For the first two billion years or so, the rate of increase in complexity must have been of the order of one bit of information every hundred years. The rate of increase of DNA complexity gradually rose to about one bit a year over the last few million years. But then, about six or eight thousand years ago, a major new development occurred. We developed written language. This meant that information could be passed from one generation to the next without having to wait for the very slow process of random mutations and natural selection to code it into the DNA sequence. The amount of complexity increased enormously. A single paperback romance could hold as much information as the difference in DNA between apes and humans, and a thirty-volume encyclopedia could describe the entire sequence of human DNA."[29]

"Even more important, the information in books can be updated rapidly. The current rate at which human DNA is being updated by biological evolution

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is about one bit a year. But there are two hundred thousand new books published each year, a new-information rate of over a million bits a second. Of course, most of this information is garbage, but even if only one bit in a million is useful, that is still a hundred thousand times faster than biological evolution.

This transmission of data through external, nonbiological means has led the human race to dominate the world and to have an exponentially increasing population. But now we are at the beginning of a new era, in which we will be able to increase the complexity of our internal record, the DNA, without having to wait for the slow process of biological evolution. There has been no significant change in human DNA in the last ten thousand years, but it is likely that we will be able to completely redesign it in the next thousand. Of course, many people will say that genetic engineering of humans should be banned, but it is doubtful we will be able to prevent it.... I think the human race, and its DNA, will increase its complexity quite rapidly. We should recognize that this is likely to happen and consider how we will deal with it.

In a way, the human race needs to improve its mental and physical qualities if it is to deal with the increasingly complex world around it and meet new

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challenges such as space travel. Humans also need to increase their complexity if biological systems are to keep ahead of electronic ones. At the moment, computers have the advantage of speed, but they show no sign of intelligence. This is not surprising, because our present computers are less complex than the brain of an earthworm, a species not noted for its intellectual powers.

But computers obey what is known as Moore's law: their speed and complexity double every eighteen months. It is one of those exponential growths that clearly cannot continue indefinitely. However, it will probably continue until computers have a complexity similar to that of the human brain. Some people say that computers can never show true intelligence, whatever that may be. But it seems to me that if very complicated chemical molecules can operate in humans to make them intelligent, then equally complicated electronic circuits can also make computers act in an intelligent way. And if they are intelligent, they can presumably design computers that have even greater complexity and intelligence.

Will this increase of biological and electronic complexity go on forever, or is there a natural limit? On the biological side, the limit on human intelligence

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up to now has been set by the size of the brain that will pass through the birth canal. Having watched my three children being born, I know how difficult it is for the head to get out. But within the next hundred years, I expect we will be able to grow babies outside the human body, so this limitation will be removed. Ultimately, however, increases in the size of the human brain through genetic engineering will come up against the problem that the body's chemical messengers responsible for our mental activity are relatively slow-moving. This means that further increases in the complexity of the brain will be at the expense of speed. We can be quick-witted or very intelligent, but not both."[30]

8. The Tao of Physics

"The fairest thing we can experience is the mysterious. It is the fundamental emotion which stands at the cradle of the true science. He who knows it not and can no longer wonder, no longer feel amazement, is as good as dead."[31]

— Albert Einstein

Fritjof Capra is one of an increasing number of scientists who are deeply interested in the philosophical implications of the discoveries of modern physics and

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are trying, in their own way, to understand the nature of the reality in the light of these discoveries. Here is a selection of some important excerpts and a discussion of some of the issues raised in Capra's writings entitled "The Tao of Physics" and "The Turning Point".

(a) The world of subatomic particles and the new physics

"The exploration of the atomic and subatomic world brought scientists in contact with a strange and unexpected reality that shattered the foundations of their world view and forced them to think in entirely new ways. Nothing like that had ever happened before in science."[32]

The experimental investigations of atoms at the begining of the twentieth century yielded sensational and totally unexpected results. Instead of being the hard, solid particles (basic building blocks of matter) of the earlier theory, atoms turned out to be consisting of relatively vast regions of space in which extremely small particles called electrons moved around a nucleus consisting of protons and neutrons. All matter consists of these three particles, only the difference in number and arrangement accounts for the existence of over one hundred varying elements found in nature. It was hoped

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that these particles will be explained in terms of still more primary or simpler particles and science will be able to arrive at the root of all material creation. A few years later quantum theory made it clear that these subatomic particles were nothing like the old solid objects of classical physics. These were constituted by still smaller subatomic particles which are very abstract entities and which have a dual aspect. Depending on how one looked at them, they appeared or behaved sometimes as particles and sometimes as waves. It was discovered that light also exhibited this dual aspect, it took the form of electromagnetic waves or particles. The particles of light – first termed 'quanta' (the origin of the term quantum theory) by Einstein – are known as photons. With the help of particle accelerators it was discovered that there existed a veritable zoo of (over 200) subatomic particles – existing for a millionth, billionth, trillionth or even far less of a second – that were constantly merging and separating from each other in an eternally unstable dance of creation and destruction. In recent years it has been hoped that this particle zoo can be shown to be made of a much smaller number of particles called "quarks", "leptons" and "bosons".

In quantum physics there is no such thing as a "stable" subatomic particle. A subatomic particle, even

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when held alone, is constantly interacting with itself and breaking itself into other particles before joining into its original form. Thus each particle is always in the process of reconstituting itself. This dance of particles is eternal. In fact, if we consider that each particle has an antiparticle which travels backward in time, one can say that the particles are independent of time – they are not bound by any sense of the direction of time.

At the subatomic level, the solid material objects of classical physics dissolve into wave-like pattern of probabilities. All the laws of atomic physics are expressed in terms of these probabilities. One can never predict an atomic event with certainty; one can only predict the likelihood of its happening. "At the subatomic level matter does not exist with certainty at definite places, but rather shows tendencies to occur."[33]

Observations in atomic physics have shown that isolated subatomic particles are abstractions, their properties are definable and observable only through their interaction with other systems. Subatomic particles are not "things" but interconnections between "things". And these, in turn, are interconnections with other "things" and so on. In quantum theory one always deals with interconnections. All this reveals the basic oneness of the universe and the sense of "infinite unity" of the

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subatomic particles.

Einstein had devised a thought experiment that became known as the Einstein-Podolsky-Rosen (EPR) experiment. The EPR, which has been confirmed now, posits that two particles (electrons) that are part of a "system" are in some way always connected. If one of them is affected in some way, the other also changes instantaneously and in such a way that the overall system remains unaffected. So a change in one particle will instantaneously cause a change in the other even if it were at the other end of the physical universe. "In other words the Cartesian view of reality cannot be applied to the two electrons. Even though they are far apart in space, they are nevertheless linked by instantaneous, nonlocal connections. These connections are not signals in the Einsteinian sense; they transcend our conventional notions of information transfer. Bell's theorem supports Bohr's interpretation of the two particles as an indivisible whole and proves rigorously that Einstein's Cartesian view is incompatible with the laws of quantum theory. As Stapp sums up the situation, 'The theorem of Bell proves, in effect, the profound truth that the world is either fundamentally lawless or fundamentally inseparable."[34]

"In quantum theory individual events do not always

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have a well-defined cause. For example, the jump of an electron from one atomic orbit to another, or the disintegration of a subatomic particle, may occur spontaneously without any single event causing it. We can never predict when and how such a phenomenon is going to happen; we can only predict its probability. This does not mean that atomic events occur in completely arbitrary fashion; it means only that they are not brought about by local causes. The behavior of any part is determined by its nonlocal connections to the whole, and since we do not know these connections precisely, we have to replace the narrow classical notion of cause and effect by the wider concept of statistical causality. The laws of atomic physics are statistical laws, according to which the probabilities for atomic events are determined by the dynamics of the whole system. Whereas in classical mechanics the properties and behavior of the parts determine those of the whole, the situation is reversed in quantum mechanics: it is the whole that determines the behavior of the parts."[35]

"Whenever a subatomic particle is confined to a small region of space, it reacts to this confinement by moving around. The smaller the region of confinement, the faster the particle will 'jiggle' around in it. This

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behavior is a typical 'quantum effect', a feature of the subatomic world which has no analogy in macroscopic physics: the more a particle is confined, the faster it will move around. This tendency of particles to react to confinement with motion implies a fundamental 'restlessness' of matter which is characteristic of the subatomic world. In this world most of the material particles are confined; they are bound to the molecular, atomic, and nuclear structures, and therefore are not at rest but have an inherent tendency to move about. According to quantum theory, matter is always restless, never quiescent. To the extent that things can be pictured to be made of smaller constituents – molecules, atoms, and particles – these constituents are in a state of continual motion. Macroscopically, the material objects around us may seem passive and inert, but when we magnify such a 'dead' piece of stone or metal, we see that it is full of activity. The closer we look at it, the more alive it appears. All the material objects in our environment are made of atoms that link up with each other in various ways to form an enormous variety of molecular structures which are not rigid and motionless but vibrate according to their temperature and in harmony with the thermal vibrations of their environment. Inside the vibrating atoms the electrons are bound to the atomic nuclei by electric forces that try

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to keep them as close as possible, and they respond to this confinement by whirling around extremely fast. In the nuclei, finally, protons and neutrons are pressed into a minute volume by the strong nuclear forces, and consequently race about at unimaginable velocities."[36]

"Both force and matter.... have their common origin in the dynamic patterns that we call particles. These energy patterns of the subatomic world form the stable nuclear, atomic, and molecular structures which build up matter and give it its macroscopic solid aspect, thus making us believe that it is made of some material substance. At the macroscopic level this notion of substance is a useful approximation, but at the atomic level it no longer makes sense. Atoms consist of particles, and these particles are not made of any material stuff. When we observe them we never see any substance; what we observe are dynamic patterns continually changing into one another – the continuous dance of energy.... At the subatomic level the interrelations and interactions between the parts of the whole are more fundamental than the parts themselves. There is motion but there are, ultimately, no moving objects; there is activity but there are no actors; there are no dancers, there is only the dance."[37]

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(b) The new physics and the nature of the Reality

"Out of the revolutionary changes in our concepts of reality that were brought about by modern physics, a consistent world view is now emerging. This view is not shared by the entire physics community, but is being discussed and elaborated by many leading physicists whose interest in their science goes beyond the technical aspects of their research. These scientists are deeply interested in the philosophical implications of modern physics and are trying in an open-minded way to improve their understanding of the nature of reality.

In contrast to the mechanistic Cartesian view of the world, the world view emerging from modern physics can be characterized by words like organic, holistic, and ecological. It might also be called a systems view, in the sense of general systems theory. The universe is no longer seen as a machine, made up of a multitude of objects, but has to be pictured as one indivisible, dynamic whole whose parts are essentially interrelated and can be understood only as patterns of a cosmic process."[38]

"According to.... bootstrap philosophy, nature cannot be reduced to fundamental entities, like

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fundamental building blocks of matter, but has to be understood entirely through self-consistency.... In the framework of S-matrix theory, the bootstrap approach attempts to derive all properties of particles and their interactions uniquely from the requirement of self-consistency. The only 'fundamental' laws accepted are a few very general principles that are required by the methods of observation and are essential parts of the scientific framework. All other aspects of particle physics are expected to emerge as a necessary consequence of self-consistency. If this approach can be carried out successfully, the philosophical implications will be very profound. The fact that all properties of particles are determined by principles closely related to the methods of observation would mean that the basic structures of the material world are determined, ultimately, by the way we look at this world; that the observed patterns of matter are reflections of patterns of mind."[39]

"Increased use of the bootstrap approach opens up the unprecedented possibility of being forced to include the study of human consciousness explicitly in future theories of matter. The question of consciousness has already arisen in quantum theory in connection with the problem of observation and measurement, but the pragmatic formulation of the theory scientists use in their

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research does not refer to consciousness explicitly. Some physicists argue that consciousness may be an essential aspect of the universe, and that we may be blocked from further understanding of natural phenomena if we insist on excluding it.

At present there are two approaches in physics that come very close to dealing with consciousness explicitly. One is the notion of order in Chew's S-matrix theory; the other is a theory developed by David Bohm, who follows a much more general and more ambitious approach. Bohm's starting point is the notion of 'unbroken wholeness,' and his aim is to explore the order he believes to be inherent in the cosmic web of relations at a deeper, 'nonmanifest' level. He calls this order 'implicate,' or 'enfolded,' and describes it with the analogy of a hologram, in which each part, in some sense, contains the whole. If any part of a hologram is illuminated, the entire image will be reconstructed, although it will show less detail than the image obtained from the complete hologram. In Bohm's view the real world is structured according to the same general principles, with the whole enfolded in each of its parts."[40]

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(c) The parallels between Western science and Eastern mysticism

"Science at its limits, even physical science, is compelled to perceive in the end the infinite, the universal, the spirit."[41]

The ways of the modern physicist and the Eastern mystic, which seem at first sight totally unrelated, have in fact, much in common. "Both emerge when man enquires into the essential nature of things – into the deeper realms of matter in physics; into the deeper realms of consciousness in mysticism – when he discovers a different reality behind the superficial mechanistic appearance of everyday life."[42]

"The parallels between the views of physicists and mystics become even more plausible when we recall the other similarities which exist in spite of their different approaches. To begin with, their method is thoroughly empirical. Physicists derive their knowledge from experiments; mystics from meditative insights. Both are observations, and in both fields these observations are acknowledged as the only source of knowledge. The object of observation is of course very different in the two cases. The mystic looks within and explores his or her consciousness at its various levels.... In contrast to

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the mystic, the physicist begins his enquiry into the essential nature of things by studying the material world. Penetrating into ever deeper realms of matter, he has become aware of the essential unity of all things and events. More than that, he has also learnt that he himself and his consciousness are an integral part of this unity. Thus the mystic and the physicist arrive at the same conclusion; one starting from the inner realm, the other from the outer world."[43]

"A further similarity between the ways of the physicist and mystic is the fact that their observations take place in realms which are inaccessible to the ordinary senses. In modern physics, these are the realms of the atomic and subatomic world; in mysticism they are non-ordinary states of consciousness in which the sense world is transcended. Mystics often talk about experiencing higher dimensions in which impressions of different centres of consciousness are integrated into a harmonious whole. A similar situation exists in modern physics where a four-dimensional 'space-time' formalism has been developed which unifies concepts and observations belonging to different categories in the ordinary three-dimensional world. In both fields, the multi-dimensional experiences transcend the sensory world and are therefore almost impossible to

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express in ordinary language."[44]

"After tracing the parallels between western science and Eastern mysticism in his famous book "The Tao of Physics", Fritjof Capra raises the question of the possible implications of these parallels and asks, "Is modern science, with all its sophisticated machinery, merely rediscovering ancient wisdom, known to the Eastern sages for thousands of years? Should physicists, therefore, abandon the scientific method and begin to meditate? Or can there be a mutual influence between science and mysticism; perhaps even a synthesis?

I think all these questions have to be answered in the negative. I see science and mysticism as two complementary manifestations of the human mind; of its rational and intuitive faculties. The modern physicist experiences the world through an extreme specialization of the rational mind; the mystic through an extreme specialization of the intuitive mind. The two approaches are entirely different and involve far more than a certain view of the physical world. However, they are complementary, as we have learned to say in physics. Neither is comprehended in the other, nor can either of them be reduced to the other, but both of them are necessary, supplementing one another for a fuller understanding of the world. To paraphrase an old

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Chinese saying, mystics understand the roots of the Tao but not its branches; scientists understand its branches but not its roots. Science does not need mysticism and mysticism does not need science; but man needs both. Mystical experience is necessary to understand the deepest nature of things, and science is essential for modern life. What we need, therefore, is not a synthesis but a dynamic interplay between mystical intuition and scientific analysis."[45]

"The Eastern religious philosophies are concerned with timeless mystical knowledge which lies beyond reasoning and cannot be adequately expressed in words. The relation of this knowledge to modern physics is but one of its many aspects and, like all the others, it cannot be demonstrated conclusively but has to be experienced in a direct intuitive way. What I hope to have achieved, to some extent, therefore, is not a rigorous demonstration, but rather to have given the reader an opportunity to relive, every now and then, an experience which has become for me a source of continuing joy and inspiration; that the principal theories and models of modern physics lead to a view of the world which is internally consistent and in perfect harmony with the views of Eastern mysticism.

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For those who have experienced this harmony, the significance of the parallels between the world views of physicists and mystics is beyond any doubt. The interesting question, then, is not whether these parallels exist, but why; and, furthermore, what their existence implies."[46]

Note: There is a significant element of subjectivity in these parallels. They exist for one who has an element of catholic synthesism and harmonisation in his mind. Those scientists who lack this – Stephen Hawking, for example – do not feel much of any such harmony and parallelism and continue to believe in the self-sufficiency of their (scientific) approach and the possibility of it leading them to the Ultimate Theory of Everything (UTE).

Moreover, this apparent harmony cannot be expected to survive as greater and greater heights and depths are sounded as a result of man's unending quest for discovery. New notes of discrepancy (disharmony) would likely be discovered in time. Of course these may also, in turn, permit one to arrive at a greater harmonisation and this process may well continue indefinitely – for we are dealing with the unthinkable and ineffable Absolute.

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It is conceivable that, before too long, the scientists will reach a point in their discoveries that it will begin to dawn on them (or at least on some of them) that the ultimate reality is beyond their reach and altogether escapes their grasp and that this not only is, but, as long as they are limited to their approach (and perhaps even otherwise), always will be.



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III. Reason, Science and Religion

"What men call knowledge is the reasoned acceptance of false appearances. Wisdom looks behind the veil and sees.

Reason divides, fixes details and contrasts them;

Wisdom unifies, marries contrasts in a single harmony."[47]

1. What is Reason?

Reason may be defined as the power of the mind to think, understand, and form judgements by a process of logic. It is undoubtedly the highest developed faculty of man at the present point of his evolution, for it is the governing and self-governing faculty in the complexities of human existence. Reason uses the intelligent will for the ordering of the inner and the outer life of man. The rest of terrestrial existence, lacking in reason, is helplessly enslaved and tyrannised by its nature. The instinct of man, when he finds his manhood, is to be master of his nature and free. What is at work at the present juncture in terrestrial evolution is a self-conscious soul in mind, mental being, struggling to arrive at some intelligent ordering of its self and life and some indefinite, perhaps some infinite development of the powers and

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potentialities of the human instrument.

"The intellectual reason is not man's only means of knowledge. All action, all perception, all aesthesis and sensation, all impulse and will, all imagination and creation imply a universal, many-sided force of knowledge at work and each form or power of this knowledge has its own distinct nature and law, its own principle of order and arrangement, its logic proper to itself.... But the intellect has this advantage over the others that it can disengage itself from the work, stand back from it to study and understand it disinterestedly, analyse its processes, disengage its principles. None of the other powers and faculties of the living being can do this: for each exists for its own action, is confined by the work it is doing, is unable to see beyond it, around it, into it as the reason can; the principle of knowledge inherent within each force is involved and carried along in the action of the force, helps to shape it, but is also itself limited by its own formulations. It exists for the fulfilment of the action, not for knowledge, or for knowledge only as part of the action."[48]

"Reason, on the other hand, exists for the sake of knowledge, can prevent itself from being carried away by the action, can stand back from it, intelligently study, accept, refuse, modify, alter, improve, combine and

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recombine the workings and capacities of the forces in operation, can repress here, indulge there, strive towards an intelligent, intelligible, willed and organised perfection. Reason is science, it is conscious art, it is invention. It is observation and can seize and arrange truth of facts; it is speculation and can extricate and forecast truth of potentiality. It is the idea and its fulfilment, the ideal and its bringing to fruition. It can look through the immediate appearance and unveil the hidden truths behind it. It is the servant and yet the master of all utilities; and it can, putting away all utilities, seek disinterestedly Truth for its own sake and by finding it reveal a whole world of new possible utilities. Therefore it is the sovereign power by which man has become possessed of himself, student and master of his own forces, the godhead on which the other godheads in him have leaned for help in their ascent; it has been the Prometheus of the mythical parable, the helper, instructor, elevating friend, civiliser of mankind."[49]

The disinterested seeking after true knowledge is the highest power of reason. This power has been the basis of all scientific and philosophical seeking after knowledge in the West, for "The dharma of science, thought and philosophy is to seek for truth by the

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intellect dispassionately, without prepossession and prejudgment, with no other first propositions than the law of thought and observation itself imposes."[50]

2. Reason – the Mediator Between the Infrarational and the Suprarational

"The spiritual or suprarational is always turned at its heights towards the Absolute; in its extension, living in the luminous infinite, its special power is to realise the infinite in the finite, the eternal unity in all divisions and differences. Our spiritual evolution ascends therefore through the relative to the absolute, through the finite to the infinite, through all divisions to oneness. Man in his spiritual realisation begins to find and seize hold on the satisfying intensities of the absolute in the relative, feels the large and serene presence of the infinite in the finite, discovers the reconciling law of a perfect unity in all divisions and differences. The spiritual will in his outer as in his inner life and formulation must be to effect a great reconciliation between the secret and eternal reality and the finite appearances of a world which seeks to express and in expressing seems to deny it. Our highest faculties then will be those which make this possible because they have in them the intimate light and power and joy by which these things can be

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grasped in direct knowledge and experience, realised and made normally and permanently effective in will, communicated to our whole nature. The infrarational, on the other hand, has its origin and basis in the obscure infinite of the Inconscient; it wells up in instincts and impulses, which are really the crude and more or less haphazard intuitions of a subconscient physical, vital, emotional and sensational mind and will in us. Its struggle is towards definition, towards self-creation, towards finding some finite order of its obscure knowledge and tendencies. But it has also the instinct and force of the infinite from which it proceeds; it contains obscure, limited and violent velleities that move it to grasp at the intensities of the absolute and pull them down or some touch of them into its finite action: but because it proceeds by ignorance and not by knowledge, it cannot truly succeed in this more vehement endeavour. The life of the reason and intelligent will stands between that upper and this nether power. On one side it takes up and enlightens the life of the instincts and impulses and helps it to find on a higher plane the finite order for which it gropes. On the other side it looks up towards the absolute, looks out towards the infinite, looks in towards the One, but without being able to grasp and hold their realities; for it is able only

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to consider them with a sort of derivative and remote understanding, because it moves in the relative and, itself limited and definite, it can act only by definition, division and limitation. These three powers of being, the suprarational, rational and infrarational are present, but with an infinitely varying prominence in all our activities."[51]

3. What is Science?

"Mind dealing with the facts and relations of Matter and Energy as they are arranged to the senses in experience and continuative experiment and are analysed by the reason, would be a sufficient definition of physical science."[52] Or in other words, Science is concerned with the systematic study of the physical and natural world through observation and experiment based on the power of human reason.

"Science is in her own way a great seer and magician; she has both the microscopic and the macroscopic, the closely gazing and the telescopic view, a dissolving power of searching analytic resolution, a creative power of revealing synthetic effectuation. She has hunted to their lair many of the intermediate secret processes of the great creatrix, and even she has been able, by the inventive faculty given to us, to go and do

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one better. Man, this midget in infinity, locomotive yet nailed to the contiguity of a petty crust of soil by the force of gravitation, has certainly scored by her a goodly number of points against the mother of the universe. But all this has been done in some perfection only in the limits of her lowest obtrusive physical field.

Face to face with psychic and spiritual secrecies, as in the open elementary world even of mind, Science has still the uninformed gaze and the groping hands of the infant. In that sphere she, so precise, illuminative, compelling in the physical, sees only the big blazing buzzing confusion which James tells us, with a possibly inaccurate vividness of alliterative phrase, is the newborn baby's view of the sensible world into which he has dropped down the mysterious stairs of birth. Science, faced with what are still to her the wonderful random accords and unexplained miracles of consciousness, protects herself from the errors of the imagination, – but stumbling incidentally by that very fact into plenty of the errors of an inadequate induction, – behind an opaque shield of cautious scepticism. She clings with the grasping firmness of the half-drowned to planks of security she thinks she has got in a few well-tested correspondences, – so-styled, though the word as used explains nothing, – between mental action

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and its accompaniment of suggestive or instrumental physical functionings. She is determined, if she can, to explain every supraphysical phenomenon by some physical fact; psychological process of mind must not exist except as result or rendering of physiological process of body. This set resolution, apparently rational and cautious of ascertainable and firmly tangible truth, but really heroic in its paradoxical temerity, shuts up her chance of rapid discovery, for the present at least, in a fairly narrow circle. It taints too her extensions of physical truth into the psychological field with a pursuing sense of inadequacy."[53]

Science, based on human reason, moving as it does from a starting-point of ignorance (and in a great environing circle of ignorance) must proceed by hypothesis, assumption and theory subject to verification of some kind convincing to our reason and experience. Being based on reason, it is also subjected to the difficulties of human reason. "The system of science seems to be itself only another feasible and fruitful construction of the reason giving a serviceable account to itself of the physical world and our relations to it, and it seems to be nothing more. And its knowledge is fatally bound by the limitation of its data and its outlook. Science too creates only a partial image of Truth

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stamped with a character of much uncertainty and still more clearly imprinted with the perverse hallmark of insufficiency."[54]

4. The Office and Limitations of the Reason

(a) Double working

The intellect of man has a double working. "The one is a disinterested pursuit of truth for the sake of Truth and of knowledge for the sake of Knowledge without any ulterior motive, with every consideration put away except the rule of keeping the eye on the object, on the fact under enquiry and finding out its truth, its process, its law. The other is coloured by the passion for practice, the desire to govern life by the truth discovered or the fascination of an idea which we labour to establish as the sovereign law of our life and action. We have seen indeed that this is the superiority of reason over the other faculties of man that it is not confined to a separate absorbed action of its own, but plays upon all the others, discovers their law and truth, makes its discoveries serviceable to them and even in pursuing its own bent and end serves also their ends and arrives at a catholic utility. Man in fact does not live for knowledge alone; life in its widest sense is his principal preoccupation and he seeks knowledge for its

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utility to life much more than for the pure pleasure of acquiring knowledge. But it is precisely in this putting of knowledge at the service of life that the human intellect falls into that confusion and imperfection which pursues all human action. So long as we pursue knowledge for its own sake, there is nothing to be said: the reason is performing its natural function; it is exercising securely its highest right. In the work of the philosopher, the scientist, the savant labouring to add something to the stock of our ascertainable knowledge, there is as perfect a purity and satisfaction as in that of the poet and artist creating forms of beauty for the aesthetic delight of the race. Whatever individual error and limitation there may be, does not matter; for the collective and progressive knowledge of the race has gained the truth that has been discovered and may be trusted in time to get rid of the error. It is when it tries to apply ideas to life that the human intellect stumbles and finds itself at fault."[55]

(b) Reason and life

As soon as the reason, sure of its findings, tries to govern human life by its light or even concerns itself with action, it stumbles and at once becomes partial and passionate and makes itself (in its ignorance) the

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servant of something other than pure truth. In fact, even if the reason keeps itself as impartial and disinterested as possible for human intellect, still the truths it discovers or the ideas it promulgates become, the moment they are applied to life, the plaything of forces over which the reason has little control. "Science pursuing its cold and even way has made discoveries which have served on one side a practical humanitarianism, on the other supplied monstrous weapons to egoism and mutual destruction; it has made possible a gigantic efficiency of organisation which has been used on one side for the economic and social amelioration of the nations and on the other for turning each into a colossal battering-ram of aggression, ruin and slaughter. It has given rise on the one side to a large rationalistic and altruistic humanitarianism, on the other it has justified a godless egoism, vitalism, vulgar will to power and success. It has drawn mankind together and given it a new hope and at the same time crushed it with the burden of a monstrous commercialism. Nor is this due, as is so often asserted, to its divorce from religion or to any lack of idealism. Idealistic philosophy has been equally at the service of the powers of good and evil and provided an intellectual conviction both for reaction and for progress. Organised religion itself has often

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enough in the past hounded men to crime and massacre and justified obscurantism and oppression."[56]

(c) The relativity of reason – equally serving opposing ideas, principles and theories

Reason can be used and has always been used "to justify any idea, theory of life, system of society or government, ideal of individual or collective action to which the will of man attaches itself for the moment or through the centuries. In philosophy it gives equally good reasons for monism and pluralism or for any halting-place between them, for the belief in Being or for the belief in Becoming, for optimism and pessimism, for activism and quietism. It can justify the most mystic religionism and the most positive atheism, get rid of God or see nothing else. In aesthetics it supplies the basis equally for classicism and romanticism, for an idealistic, religious or mystic theory of art or for the most earthy realism. It can with equal power base austerely a strict and narrow moralism or prove triumphantly the thesis of the antinomian. It has been the sufficient and convincing prophet of every kind of autocracy or oligarchy and of every species of democracy; it supplies excellent and satisfying reasons for competitive individualism and equally excellent and satisfying reasons for communism or against communism and

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for State socialism or for one variety of socialism against another. It can place itself with equal effectivity at the service of utilitarianism, economism, hedonism, aestheticism, sensualism, ethicism, idealism or any other essential need or activity of man and build around it a philosophy, a political and social system, a theory of conduct and life. Ask it not to lean to one idea alone, but to make an eclectic combination or a synthetic harmony and it will satisfy you; only, there being any number of possible combinations or harmonies, it will equally well justify the one or the other and set up or throw down any one of them according as the spirit in man is attracted to or withdraws from it. For it is really that which decides and the reason is only a brilliant servant and minister of this veiled and secret sovereign."[57]

(d) The role of reason in life and society – the two articles of faith of a rationalist

The truth of the relative nature of reason is hidden from a rationalist because he is supported by two constant articles of faith, first that his own reason is right and the reason of others who differ from him is wrong. Secondly that the collective human reason, whatever may be the present deficiencies of the human intellect, will eventually arrive at purity and be able to found

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human thought and life on a clear rational basis entirely satisfying to the intelligence.

The first article of faith of the rationalist is no doubt "the common expression of our egoism and arrogant fallibility, but it is also something more; it expresses this truth that it is the legitimate function of the reason to justify to man his action and his hope and the faith that is in him and to give him that idea and knowledge, however restricted, and that dynamic conviction, however narrow and intolerant, which he needs in order that he may live, act and grow in the highest light available to him. The reason cannot grasp all truth in its embrace because truth is too infinite for it; but still it does grasp the something of it which we immediately need, and its insufficiency does not detract from the value of its work, but is rather the measure of its value. For man is not intended to grasp the whole truth of his being at once, but to move towards it through a succession of experiences and a constant, though not by any means a perfectly continuous self-enlargement. The first business of reason then is to justify and enlighten to him his various experiences and to give him faith and conviction in holding on to his self-enlargings. It justifies to him now this, now that, the experience of the moment, the receding light of the past,

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the half-seen vision of the future. Its inconstancy, its divisibility against itself, its power of sustaining opposite views are the whole secret of its value. It would not do indeed for it to support too conflicting views in the same individual, except at moments of awakening and transition, but in the collective body of men and in the successions of Time that is its whole business. For so man moves towards the infinity of the Truth by the experience of its variety; so his reason helps him to build, change, destroy what he has built and prepare a new construction, in a word, to progress, grow, enlarge himself in his self-knowledge and world-knowledge and their works."[58]

"The second article of faith of the believer in reason is also an error and yet contains a truth. The reason cannot arrive at any final truth because it can neither get to the root of things nor embrace the totality of their secrets; it deals with the finite, the separate, the limited aggregate, and has no measure for the all and the infinite. Nor can reason found a perfect life for man or a perfect society. A purely rational human life would be a life baulked and deprived of its most powerful dynamic sources; it would be a substitution of the minister for the sovereign. A purely rational society could not come into being and, if it could be born, either could not live

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or would sterilise and petrify human existence. The root powers of human life, its intimate causes are below, irrational, and they are above, suprarational. But this is true that by constant enlargement, purification, openness the reason of man is bound to arrive at an intelligent sense even of that which is hidden from it, a power of passive, yet sympathetic reflection of the Light that surpasses it. Its limit is reached, its function is finished when it can say to man, "There is a Soul, a Self, a God in the world and in man who works concealed and all is his self-concealing and gradual self-unfolding. His minister I have been, slowly to unseal your eyes, remove the thick integuments of your vision until there is only my own luminous veil between you and him. Remove that and make the soul of man one in fact and nature with this Divine; then you will know yourself, discover the highest and widest law of your being, become the possessors or at least the receivers and instruments of a higher will and knowledge than mine and lay hold at last on the true secret and the whole sense of a human and yet divine living."[59]

(e) The root of the difficulty

"The root of the difficulty is this that at the very basis of all our life and existence, internal and external,

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there is something on which the intellect can never lay a controlling hold, the Absolute, the Infinite. Behind everything in life there is an Absolute, which that thing is seeking after in its own way; everything finite is striving to express an infinite which it feels to be its real truth. Moreover, it is not only each class, each type, each tendency in Nature that is thus impelled to strive after its own secret truth in its own way, but each individual brings in his own variations. Thus there is not only an Absolute, an Infinite in itself which governs its own expression in many forms and tendencies, but there is also a principle of infinite potentiality and variation quite baffling to the reasoning intelligence; for the reason deals successfully only with the settled and the finite. In man this difficulty reaches its acme. For not only is mankind unlimited in potentiality; not only is each of its powers and tendencies seeking after its own absolute in its own way and therefore naturally restless under any rigid control by the reason; but in each man their degrees, methods, combinations vary, each man belongs not only to the common humanity, but to the Infinite in himself and is therefore unique. It is because this is the reality of our existence that the intellectual reason and the intelligent will cannot deal with life as its sovereign, even though they may be at present our supreme

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instruments and may have been in our evolution supremely important and helpful. The reason can govern, but only as a minister, imperfectly, or as a general arbiter and giver of suggestions which are not really supreme commands, or as one channel of the sovereign authority, because that hidden Power acts at present not directly but through many agents and messengers. The real sovereign is another than the reasoning intelligence. Man's impulse to be free, master of Nature in himself and his environment cannot be really fulfilled until his self-consciousness has grown beyond the rational mentality, become aware of the true sovereign and either identified itself with him or entered into constant communion with his supreme will and knowledge."[60]

(f) The higher action of the intelligence

The action of the intelligence is not only turned downward and outward upon our subjective and external life but it has also an upward and inward eye and accepts divinations from hidden eternities. In this movement it opens to a Truth above from which it derives, however imperfectly, an indirect knowledge of universal principles of our existence and its possibilities. It receives and turns what it can seize of them into

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intellectual forms and these provide us with large governing ideas by which our efforts can be shaped and around which they can be concentrated. It defines the ideals which we seek to accomplish. "It provides us with the great ideas that are forces (idées forces), ideas which in their own strength impose themselves upon our life and compel it into their moulds. Only the forms we give these ideas are intellectual; they themselves descend from a plane of truth of being where knowledge and force are one, the idea and the power of self-fulfilment in the idea are inseparable. Unfortunately, when translated into the forms of our intelligence which acts only by a separating and combining analysis and synthesis and into the effort of our life which advances by a sort of experimental and empirical seeking, these powers become disparate and conflicting ideals which we have all the difficulty in the world to bring into any kind of satisfactory harmony. Such are the primary principles of liberty and order, good, beauty and truth, the ideal of power and the ideal of love, individualism and collectivism, self-denial and self-fulfilment and a hundred others. In each sphere of human life, in each part of our being and our action the intellect presents us with the opposition of a number of such master ideas and such conflicting principles. It finds each to be a

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truth to which something essential in our being responds, – in our higher nature a law, in our lower nature an instinct. It seeks to fulfil each in turn, builds a system of action round it and goes from one to the other and back again to what it has left. Or it tries to combine them but is contented with none of the combinations it has made because none brings about their perfect reconciliation or their satisfied oneness. That indeed belongs to a larger and higher consciousness, not yet attained by mankind, where these opposites are ever harmonised and even unified because in their origin they are eternally one. But still every enlarged attempt of the intelligence thus dealing with our inner and outer life increases the width and wealth of our nature, opens it to larger possibilities of self-knowledge and self-realisation and brings us nearer to our awakening into that greater consciousness. The individual and social progress of man has been thus a double movement of self-illumination and self-harmonising with the intelligence and the intelligent will as the intermediaries between his soul and its works."[61]

5. Reason and Religion

The limitations of reason and of science and scientific mentality based on it become very strikingly,

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very markedly apparent when it is confronted with the religious being and life of man. "Here is a realm at which the intellectual reason gazes with the bewildered mind of a foreigner who hears a language of which the words and the spirit are unintelligible to him and sees everywhere forms of life and principles of thought and action which are absolutely strange to his experience. He may try to learn this speech and understand this strange and alien life; but it is with pain and difficulty, and he cannot succeed unless he has, so to speak, unlearned himself and become one in spirit and nature with the natives of this celestial empire. Till then his efforts to understand and interpret them in his own language and according to his own notions end at the worst in a gross misunderstanding and deformation. The attempts of the positive critical reason to dissect the phenomena of the religious life sound to men of spiritual experience like the prattle of a child who is trying to shape into the mould of his own habitual notions the life of adults or the blunders of an ignorant mind which thinks fit to criticise patronisingly or adversely the labours of a profound thinker or a great scientist. At the best even this futile labour can extract, can account for only the externals of the things it attempts to explain; the spirit is missed, the inner matter

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is left out, and as a result of that capital omission even the account of the externals is left without real truth and has only an apparent correctness.

The unaided intellectual reason faced with the phenomena of the religious life is naturally apt to adopt one of two attitudes, both of them shallow in the extreme, hastily presumptuous and erroneous. Either it views the whole thing as a mass of superstition, a mystical nonsense, a farrago of ignorant barbaric survivals, – that was the extreme spirit of the rationalist now happily, though not dead, yet much weakened and almost moribund, – or it patronises religion, tries to explain its origins, to get rid of it by the process of explaining it away; or it labours gently or forcefully to reject or correct its superstitions, crudities, absurdities, to purify it into an abstract nothingness or persuade it to purify itself in the light of the reasoning intelligence; or it allows it a role, leaves it perhaps for the edification of the ignorant, admits its value as a moralising influence or its utility to the State for keeping the lower classes in order, even perhaps tries to invent that strange chimera, a rational religion."[62]

The mistake of the intellectual reason is like that of a foreigner "who thinks everything in an alien country absurd and inferior because these things are not his

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own ways of acting and thinking and cannot be cut out by his own measures or suited to his own standards. So the thoroughgoing rationalist asks the religious spirit, if it is to stand, to satisfy the material reason and even to give physical proof of its truths, while the very essence of religion is the discovery of the immaterial Spirit and the play of a supraphysical consciousness. So too he tries to judge religion by his idea of its externalities, just as an ignorant and obstreperous foreigner might try to judge a civilisation by the dress, outward colour of life and some of the most external peculiarities in the social manners of the inhabitants. That in this he errs in company with certain of the so-called religious themselves, may be his excuse, but cannot be the justification of his ignorance. The more moderate attitude of the rational mind has also played its part in the history of human thought. Its attempts to explain religion have resulted in the compilation of an immense mass of amazingly ingenious perversions, such as certain pseudo-scientific attempts to form a comparative Science of Religion. It has built up in the approved modern style immense façades of theory with stray bricks of misunderstood facts for their material. Its mild condonations of religion have led to superficial phases of thought which have passed quickly away and left no

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trace behind them. Its efforts at the creation of a rational religion, perfectly well-intentioned, but helpless and unconvincing, have had no appreciable effect and have failed like a dispersing cloud, *chinnābhram iva naśyati.*

The deepest heart, the inmost essence of religion, apart from its outward machinery of creed, cult, ceremony and symbol, is the search for God and the finding of God. Its aspiration is to discover the Infinite, the Absolute, the One, the Divine, who is all these things and yet no abstraction but a Being. Its work is a sincere living out of the true and intimate relations between man and God, relations of unity, relations of difference, relations of an illuminated knowledge, an ecstatic love and delight, an absolute surrender and service, a casting of every part of our existence out of its normal status into an uprush of man towards the Divine and a descent of the Divine into man. All this has nothing to do with the realm of reason or its normal activities; its aim, its sphere, its process is suprarational. The knowledge of God is not to be gained by weighing the feeble arguments of reason for or against his existence: it is to be gained only by a self-transcending and absolute consecration, aspiration and experience. Nor does that experience proceed by anything like rational scientific experiment or rational philosophic thinking. Even in

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those parts of religious discipline which seem most to resemble scientific experiment the method is a verification of things which exceed the reason and its timid scope. Even in those parts of religious knowledge which seem most to resemble intellectual operations, the illuminating faculties are not imagination, logic and rational judgment, but revelations, inspirations, intuitions, intuitive discernments that leap down to us from a plane of suprarational light. The love of God is an infinite and absolute feeling which does not admit of any rational limitation and does not use a language of rational worship and adoration; the delight in God is that peace and bliss which passes all understanding. The surrender to God is the surrender of the whole being to a suprarational light, will, power and love and his service takes no account of the compromises with life which the practical reason of man uses as the best part of its method in the ordinary conduct of mundane existence. Wherever religion really finds itself, wherever it opens itself to its own spirit, – there is plenty of that sort of religious practice which is halting, imperfect, half-sincere, only half-sure of itself and in which reason can get in a word, – its way is absolute and its fruits are ineffable.

Reason has indeed a part to play in relation to this

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highest field of our religious being and experience, but that part is quite secondary and subordinate. It cannot lay down the law for the religious life, it cannot determine in its own right the system of divine knowledge; it cannot school and lesson the divine love and delight; it cannot set bounds to spiritual experience or lay its yoke upon the action of the spiritual man. Its sole legitimate sphere is to explain as best it can, in its own language and to the rational and intellectual parts of man, the truths, the experiences, the laws of our suprarational and spiritual existence. That has been the work of spiritual philosophy in the East and – much more crudely and imperfectly done – of theology in the West, a work of great importance at moments like the present when the intellect of mankind after a long wandering is again turning towards the search for the Divine. Here there must inevitably enter a part of those operations proper to the intellect, logical reasoning, inferences from the data given by rational experience, analogies drawn from our knowledge of the apparent facts of existence, appeals even to the physical truths of science, all the apparatus of the intelligent mind in its ordinary workings. But this is the weakest part of spiritual philosophy. It convinces the rational mind only where the intellect is already predisposed to belief, and even if

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it convinces, it cannot give the true knowledge. Reason is safest when it is content to take the profound truths and experiences of the spiritual being and the spiritual life, just as they are given to it, and throw them into such form, order and language as will make them the most intelligible or the least unintelligible to the reasoning mind. Even then it is not quite safe, for it is apt to harden the order into an intellectual system and to present the form as if it were the essence. And, at best, it has to use a language which is not the very tongue of the suprarational truth but its inadequate translation and, since it is not the ordinary tongue either of the rational intelligence, it is open to non-understanding or misunderstanding by the ordinary reason of mankind. It is well-known to the experience of the spiritual seeker that even the highest philosophising cannot give a true inner knowledge, is not the spiritual light, does not open the gates of experience. All it can do is to address the consciousness of man through his intellect and, when it has done, to say, "I have tried to give you the truth in a form and system which will make it intelligible and possible to you; if you are intellectually convinced or attracted, you can now seek the real knowledge, but you must seek it by other means which are beyond my province."[63]

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6. The Utility and the Limitations of the Pursuit of Knowledge Through Philosophy, Science and other Disciplines

"All pursuit of knowledge, if not vitiated by a too earthward tendency, tends to refine, to subtilise, to purify the being. In proportion as we become more mental, we attain to a subtler action of our whole nature which becomes more apt to reflect and receive higher thoughts, a purer will, a less physical truth, more inward influences. The power of ethical knowledge and the ethical habit of thought and will to purify is obvious. Philosophy not only purifies the reason and predisposes it to the contact of the universal and the infinite, but tends to stabilise the nature and create the tranquillity of the sage; and tranquillity is a sign of increasing self-mastery and purity. The preoccupation with universal beauty even in its aesthetic forms has an intense power for refining and subtilising the nature, and at its highest it is a great force for purification. Even the scientific habit of mind and the disinterested preoccupation with cosmic law and truth not only refine the reasoning and observing faculty, but have, when not counteracted by other tendencies, a steadying, elevating and purifying influence on the mind and moral nature which has not been sufficiently noticed.

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The concentration of the mind and the training of the will towards the reception of the truth and living in the truth is also an evident result, a perpetual necessity of these pursuits; and at the end or in their highest intensities they may and do lead first to an intellectual, then to a reflective perception of the divine Reality which may culminate in a sort of preliminary identification with it. But all this cannot go beyond a certain point."[64] An integral reflection and taking in of the divine reality requires a systematic purification of the whole being. One cannot have even one's reason act in anything like its native purity till one achieves at least some emancipation from desires and from the hold of the separative ego. Only the special methods of Yoga can provide one the essential freedom from desires and the ego's domination. The absolute concentration brought about by Yoga has to take the place of the dispersed concentrations of these disciplines. Also the vague and ineffective identification, which is all that these approaches to lower knowledge can bring, has to be replaced by the complete, imperative and living union with the Divine Reality which Yoga brings.

7. To Follow After Truth – Essential to Man

"Man is so constituted that he must follow after

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truth whether it is attained or not; something in him secret, masterful, essential to his existence, forbids him to be satisfied with a falsehood; the moment it is perceived or even believed to be a falsehood, he rejects it and the thing begins to crumble. If he persists in his rejection, it cannot last. Yesterday it was, today we see it tottering, tomorrow we shall look for it and find that it is no longer. It has passed back into Prakriti; it has dissolved into that of which it was made. For sraddha is the condition of all existence in consciousness and that to which sraddha is denied, ceases to have existence whether here or elsewhere, *na caivāmutra no iha*. It is not, neither in this world nor in another. We may not unreasonably infer from this importance and this imperative necessity that Truth does really exist and everything is not illusion. If then Truth is always escaping our hold and leaving us to disillusionment and derision, it may be because we have neither formed any clear conception of what Truth itself is nor taken hold of the right means by which it can be grasped."[65]

8. The Fundamental Truth – Two Approaches and the Right Means of Discovery

In the Vedantic beginings, OM TAT SAT, That (Brahman) is the thing that Is, and all this, everything

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of which we are aware (and all of which we are not aware) is Brahman. That being known, all is known is the popular Vedantic formula. The Vedic seers perceived this truth of the fundamental unity of knowledge and sought to know Sat (Brahman) first, confident that That being known, the different elements, laws, aspects and particulars of Brahman would more readily yield their secret. This was the approach at the root of the knowledge of the ancients relating disciplines like astrology and Ayurveda. It was not primarily through observation, experiment and the use of intellectual reason – though there need not have been an entire absence of such methods – that such knowledge was acquired. Only a part of that ancient knowledge is recoverable at present and even that is very much superior to the knowledge laboriously acquired by the modern specialists in these and other related fields of endeavour.

The methods of Vedantic knowledge were based on knowledge by identity – the one and the only true way of really knowing. The moderns follow another method which – although has a truth and place of its own in the scheme of integral knowledge – is indirect and lower as it approaches the fundamental truth from outside, from separation. The thought behind this

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approach is that since the being is one, the knowledge of the particulars must lead to the knowledge of the fundamental unity and they begin therefore at the bottom and climb upwards – the essence of the modern scientific approach. The important question here is whether, without knowing the Brahman, we can really know anything – know it, and not merely its name and form or all the details of its name and form. "Rupa we can know and analyse by the aid of science, Name by the aid of philosophy; but Swarupa? It would seem that some third instrument is needed for that consumation of knowledge. The senses and reason, even though aided by microscopes and telescopes, cannot show it to us.... the form of that stands not in the ken of sight. Mind and speech are not permitted to lead us to it.... All these various disabilities are due to one compelling cause; they are, because Sat, the truth of existence, Brahman, the reality of things which fills and supports their idea and form, is beyond the recognisable and analysable elements of idea and form.... It is subtler even than elemental subtlety and therefore not to be deduced, induced, inferred or discovered by a reasoning which proceeds from a consideration of the elements of name and form and makes that its standard. This is a truth which even the greatest philosophers, Vedantic

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or un-Vedantic are apt to forget; but the Sruti insists on it always."[66] Such error is natural and inevitable to the human consciousness fallen into the darkness of matter. It is not surprising therefore that mankind has been attempting for some thousands of years, obstinately and with passion, to discover that Truth by the very means which the Sruti has forbidden.

9. The Intellectual History of Europe: The perpetual Invasion and Denial of Each Other's Domain and Position by Philosophy, Religion and Science

The master impulse of man's nature is to yearn passionately towards the light and bliss from which he has fallen. Unable to find it at once and too impatient to perfect himself gradually for its reception, man, in his eagerness, has tried throughout the history to grasp at the instruments meant for a limited utility and to compel them, straining beyond their capacity, to serve this supreme object. "From this abuse of his parts of knowledge have resulted three illegitimate human activities, of which Philosophy, Religion and Science have severally made themselves guilty, the disputatious metaphysical philosophy of the schools, the theology of the Churches and the scientific philosophy of the

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laboratories. Philosophy, Religion and Science have each their appointed field and dominion; each can help man in his great preoccupation, the attempt to know all that he can about Sat, about Brahman. The business of Philosophy is to arrange logically the general modes of Sat, the business of Religion is to arrange practically and vitally the personal relations of Sat, the business of Science is to arrange observantly and analytically the particular forms and movements of Sat. They are really necessary to and ought to lean on each other; and, if all recognised proper limitations and boundary marks, could by their joint activity help man to his present attainable fullness; but by a sort of intellectual land hunger they are perpetual invaders of each other's dominion, deny each other's positions and therefore remain unprofitably at war through the human ages. Finally, all three after illegitimately occupying each other's fields insist on snatching at a knowledge of which they are all equally incapable – the essential nature of the world, the secret reality of Sat, the *uttamam rahasyam* of the Brahman."[67] From this error and confusion arises much, if not most, of the difficulty we experience as a race in escaping from darkness and suffering into light and bliss.

India has always attempted, more or less

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successfully, to keep the three to their proper division of labour or at least to maintain some harmony between them. The Gita is the standing monument and the most perfect example of this attempt. In Europe the situation has been entirely different. If we probe deeper into the intellectual history of Europe we can see the confusion working in its untrammelled force.

"There have been, properly speaking, two critical periods in this history, the Graeco-Roman era of philosophic illumination previous to Christianity and the era of modern scientific illumination which is still unexhausted. In the first we see the revolt of Philosophy (with Science concealed in her protective embrace) against the usurpation of religion. We find it, after achieving liberation, in its turn denying religion and usurping her sacred prerogative. In the modern era we see Science this time emerged and adult, keeping Philosophy behind her, in revolt against religion, first liberate herself, then deny religion and usurp her prerogatives, then, or as part of this final process of conquest, turn, deny and strike down her lofty ally and usurp also her ancient territory. For if Science has scorned and denied religion, she has equally scorned and denied Metaphysics. If she has declared God to be a barbarous myth, a fiction of dreams and terrors and

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longings and denied us the right of communion with the infinite, equally has she declared metaphysics to be an aberration of the ideative faculty, a false extension of logic and denied our right to recognise any metaphysical existence or anything at all which cannot be judged by or inferred from the results of the test tube, the scalpel, the microscope and the telescope. Neither, however, has she herself hesitated to dogmatise about the essential nature of existence and the mutual relations of its general modes, matter, life, mind and spirit. But for our immediate purpose it is only necessary to note the result in either of these eras of these tremendous usurpations. The result of the usurpations of philosophy was that mankind flung itself with an infinite sincerity, with a passionate sense of relief into the religion of an obscure Jewish sect and consented for a length of time which amazes us to every theological absurdity, even the most monstrous, so that it might once more be permitted to believe in something greater than earth and to have relations with God. The old philosophical spirit was torn to pieces with Hypatia in the bloodstained streets of Alexandria. Theology usurped her place and discoursed blindly and foolishly on transubstantiation and consubstantiality and one knows not what other barren mysteries. So far as

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philosophy was allowed an independent existence, she was compelled to do not her own work but the work of science; so we find the schoolmen elaborately determining by logic and *a priori* word fencing questions which could only be properly determined by observation and analysis. For Theology, for Mediaeval Religion herself did not care for this field of knowledge; she had no need for scientific truths just as the Jacobin Republic had "no need of chemists"; in fact she guillotined Science wherever its presence attracted her attention. But all injustice – and that means at bottom all denial of truth, of the *satyam* and *ritam* – brings about its own punishment or, as Religion would put it, God's visitation and vengeance. Science liberated, given in her strenuous emergence the strength of the Titans, avenges herself today on her old oppressors, on Religion, on Philosophy, breaks their temples, scorns their gods and prophets and seeks to deprive them even of the right to existence. That was the result of the Graeco-Roman illumination. And what will be the result of the scientific illumination, the modern enlightenment, the fiery triumph and ardent intellectual bigotry of the materialist? It is too early to foresee the final denouement, but unformed lines of it show themselves, obscure masses arise. Mysticism is growing obscurely

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in strength, as Science grew obscurely in strength in the Middle Ages. We see Titanic and mystic figures striding out of the East, building themselves fortresses and points of departure, spreading among the half-intellectual, capturing even the intellectual – vague figures of Theosophy, Spiritualism, Mental Science, Psychical Research, Neo-Hinduism, Neo-Buddhism, Neo-Mahomedanism, Neo-Christianity. The priests of Isis, the adepts and illuminates of Gnosticism, denied their triumph by the intervention of St. Paul and the Pope, reborn into this latter age, claim now their satisfaction. Already some outworks of materialism are giving way, the attack grows more insistent, the defence more uncertain, less proudly self-confident, though not less angry, contemptuous, bitter and intolerant; the invaders increase their adherents, extend the number of their strongholds. If no wider and higher truth intervenes, it would almost seem as if the old confusion in a new form might replace the new. Perhaps an Esoteric Society or a Spiritualist Circle of High Mediums will in a few centuries be laying down for us what we shall think about this world and the next, what particular relations with Gods will be permitted us, what Influences or Initiates we shall worship. Who knows?

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The fires of Smithfield may yet reblaze to save heretics from the perdition.

These are not mere fantastic speculations. The history of humanity and the peculiar capacities of that apparently incalculable and erratic thing, human nature, ought to warn us of their possibility – or at least that they are not entirely impossible, in spite of the printing press, in spite of the clarities of Science. No doubt with so many Schools and Academies, such spread of education, never again would enlightenment be dimmed and the worship of gods and ghosts would in the end amuse none but the vulgar. We must accept these things as possible and examine why they are possible. This reaction is inevitable because Philosophy, though exceedingly high and luminous, tends to be exclusive and narrow and Science, though exceedingly patient, accurate and minute, tends to be limited, dry and purblind. They are both apt to be as dogmatic and intolerant in their own high way or in their own clear, dry way as Religion in her way which is not high, but intense, not clear but enthusiastic; and they live on a plane of mentality on which humanity at large does not yet find itself at perfect ease, cannot live without a struggle and a difficulty in breathing. They both demand

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from man that he shall sacrifice his heart and his imagination to his intellect, shall deny his full human nature and live coldly and dryly. You might just as well ask him to live without free breathing. The mental world in which we are asked to live, resembles what the life of humanity would be if the warmth of the sun had diminished, the earth were growing chill and its atmosphere were already too rarefied for our comfort. It is no use saying that he ought to live in such an atmosphere, that it will improve his mental health and vigour. Perhaps he ought, though I do not think so, but he cannot. Or rather the individual may, – everything is possible to individual man, – but the race cannot. The demand can never be allowed; for it is a denial of Nature, a violation of the great Mother, a displacement of her eternal facts by the aridities of logic; it is a refusal of the Truth of things, of the Satyam, Ritam, and if it is persisted in, it will bring its own revenges. Philosophy and Science, if they are to help mankind without hurting it and themselves, must recognise that mankind is a complex being and his nature demands that every part of that complexity shall have its field of activity and every essential aspiration in him must be satisfied. It is his nature and his destiny to be *aptakāma*, satisfied in his desires, in the individual and in the race – though

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always in accordance with the *satyam*, the *ritam*, which is also the *sukham* and *sundaram*, not lawlessly and according to aberrations and caprices. It was the great virtue of the ancient Hinduism, before Buddhism upset its balance and other aberrations followed, that it recognised in principle at least this fundamental verity, did not deny what God insists upon but strove, it does not matter whether perfectly or imperfectly, to put everything in its place and create a natural harmony."[68]

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