

different string theories and the 11-dimensional supergravity theory is certainly meant for the 'connoisseurs' who have a substantial background of differential geometry and topology.

Talking of mathematics, there are two articles dealing with classical general relativity; on dynamics of null surfaces by Kozameh and on Einstein's equation and geometric asymptotics by Helmut Friedrich. As Kozameh points out quite clearly, the null surface formalism gives a fresh viewpoint towards the quantization issue and preserving the geometric character of Einsteinian theory of gravity it provides a new, fully gauge-fixed scheme for generating new perturbation solution. The conformal structure, which was first introduced in general relativity by Roger Penrose, has yielded a rich haul of insight into understanding of the large-scale structure of space-time and later work by Friedrich demonstrated the possibility of analysing the asymptotic behaviour of solutions (asymptotically flat) to arbitrary precision. More recently, the approach has led to the understanding of numerical methods for analysing space-times without cut-off. Friedrich, in his article, has given a review of the development of these ideas, emphasizing the necessity of understanding the interaction between conformal geometry and Einstein propagation in all its detail. The concept of an isolated system which has played an important role in the classical general relativity, was criticized by Ellis in the context of cosmological solutions, and as Friedrich points out it would be useful to reconsider the technical aspects of Ellis' critique in conjunction with the new developments of using conformal field equations, which offer the possibility to calculate numerically entire asymptotically flat space-times together with their conformal boundary on finite grids.

Deviating from these main themes, there are two excellent articles by Ashby on relativistic effects on the GPS and by Zeilinger on quantum coherence experiments. As Ashby reports, the global positioning systems which use accurate stable atomic clocks in satellites and on earth, need accurate determination of various special and general relativistic effects, viz. Sagnac effect, time dilation and frequency shift. The synchronization so provided after including all these effects has varied applications. The arti-

cle discusses the conceptual basis for navigation using GPS and lists some applications like military navigation, communication, pulsar timing measurements, search and rescue, etc. The article is well-presented without too much technicality and reads easily. While mentioning Zeilinger's article I cannot help recalling the excellent response he received during the lecture and for the large community of theorists present, the amazing achievement of 'teleportation' was very revealing. That one can identify few photons and follow them in practice as entangled states is indeed a crown in the technological achievements of the present millennium. As Zeilinger says, if this can lead to tests of a possible decoherence mechanism caused by gravitational interaction, one may really get a better understanding of the conceptual issues raised by quantum mechanics. It is again a pity that the full version of Penrose's lecture on 'Science and the Mind' is not available in the proceedings. Vishveshwara's article 'After the Fall', which was the toast of the conference reflects the inimitable style of presentation that can make a good reading for experts and non-experts alike. Had it been possible to intervene the text of a speech with the laughter it evokes, this article would have covered the whole book. Vishu covers the historical developments of Newton's gravity to super and quantum gravity, punning upon almost every technical word, and enlivening with cartoons which have been popular among the GR community for over ten years. The article is indeed extremely refreshing and several facts which Vishu brings out could have been new to many in the field.

After all these plenary talks, the proceedings picks up some repertoires of workshops which need no special mention. It is a little surprising why there is no report concerning the session B1 on 'Relativistic Astrophysics' and C2 on 'Tests of Special and General Relativity'. While many of the workshop chairs have taken trouble to read the various presentations and summarize, the one on B2 - Observationally Oriented Cosmology has simply put together the abstract sheets supplied by the contributors. Though the abstract says that it gives truncated summary, it is strange to see a lot of 'print space' being wasted in giving the long affiliations of the contributors.

All in all, it could be mentioned that the proceedings does contain some very good 'state of the art' presentation of the topics in gravitation and would be useful as an overview for serious researchers. However, now-a-days apart from a triennial conference like GR, there are many topical meetings at the rate of two or three per year, many an article gets repeated in different volumes with new headings. In spite of this foreseeable danger, the book could be of use for selective topics and thus should be on the shelves of every scientific library.

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**Eco-restructuring: Implications for Sustainable Development.** Robert U. Ayres (ed.). United Nations University Press, The UN University. 1998.

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'Sustainable development' is amenable to many interpretations and there is still no acceptable definition of what sustainable development is and is not. Viewed against this backdrop, this book, under review, reflects a 'growing concern for environmental degradation associated with industrial development, economic growth and energy use ranging from local air and water pollution, soil contamination, and reduced bio-diversity to stratospheric ozone depletion and the damage potentially caused by global climate change' (p. 149) without prejudice to two fundamental premises, viz. (i) that economic growth must continue at least for the foreseeable future, and (ii) the nature of that growth must change radically in order to satisfy the basic requirement of long-term eco-sustainability. It is equally true that lack of economic growth and development translate into increased poverty and population growth which, in turn, lead to accelerated environmental deterioration (p. 173). In order to arrest this trend and save the mankind from possible total extinction, the contributors stress on the imperative need for global

eco-restructuring which alone can act as an effective deterrent to the emerging ecological imbalance; but whether it would be compatible with eco-sustainability and how far it is attainable on a global scale, has not been addressed adequately. These two approaches are mutually contradictory and resemble a two-in-one transistor which would be discernible in review. Controversial issues have been avoided without realizing that it will boomerang on the essential objective of eco-sustainability. The threat of environmental degradation is no longer controversial; but the magnitude of threat perception varies enormously. This threat perception variance is one of the many critical issues that needs to be tackled from a socio-political angle, on priority, and in right earnest to lend credence to the attainable prospect of 'Our Common Future' envisioned in the Brundtland Report (1987). The contributors are silent on this. The prospect seems quite unlikely because the cost of protecting the environment should not exceed the benefits – a product of irrepressible economic logic.

The contributors cover a wide gamut on a key range of critical issues on eco-restructuring and its implications for sustainable development; while doing so, they scan the technical contours from a perspective which can neither be called 'global' nor 'regional/national'; with an inappropriate mix of these two ingredients, the contributors keep vacillating between these two extremes and in the process, the impression that is sought to be given is that it breaks new ground in raising and resolving the contentious issues. The answer to this is a qualified yes. Whether the prospect of better 'planetary governance' is attainable, however intractable and elusive, is very much suspect (p. 403). With a complex subject such as eco-restructuring, it is unfortunate that not a single contributor is drawn from the group of Asia and Latin America which between them account for a populace of nearly three billion to express its viewpoint *vis-à-vis* its varied technical knowledge, experience and expertise which would have greatly enriched the utility of the book. The two Indian contributors along with the editor are based in the USA and cannot be said to represent the third world.

Faye Duchin (p. 265) has classified the world community under four groups – (1)

the rich industrialized countries; (2) the economies of eastern Europe and the former Soviet Union; (3) the newly industrializing countries, and (4) the rest of the developing countries. The grouping is fairly in order notwithstanding the fact that each group differs in terms of its natural endowment of soil, water, primary materials, its infrastructure, pool of skilled manpower and the characteristic ways in which these factors of production are used. As a corollary, the type of technology deployed by each of these groups also tends to vary. What has been lost sight of is that, there is, presently, no common denominator on issues concerning the global eco-restructuring not only between those four groups but also within each of them. This aspect has not been adequately addressed as the efficacy of eco-restructuring compatible with eco-sustainability hinges on the emergence of a common denominator.

The world population has doubled in a single generation and continues to grow at an alarming rate; if this is not contained drastically, either voluntarily or by any other acceptable means, it will culminate in social, political and maybe, even give rise to insurgency forces from within the society triggering a military conflict. A catastrophe of this kind would be most undesirable negating all the social and economic achievements that the last two groups value so highly and assume to be guaranteed (p. 288). This warrants the challenging of conventional models of development and the policy frame which continues to rule the roost; ironically, the institutional framework of the society as it is structured today is not likely to allow any solutions to emerge spontaneously (p. 47). The soft option resorted to is to confine the eco-restructuring issues within the domain of technology free from any bumpy ride. In the process, social and cultural issues have been pushed into the backyard (as the editor himself admits with resignation on p. 2). Even though economics has taken a back seat there is no need to despair, for, it has played its role for too long as a contributory factor to the present environmental malaise. The other social scientists (from Sociology, Anthropology and Philosophy for example) have not played a useful role towards the objective of eco-sustainability. The key to the attainable goal of eco-sustainability lies in resolving the *sensi-*

*tive* demographic issue; if it succeeds, 'half the battle' will have been won and the other half would have to be concentrated on bringing about the necessary changes impeding the developmental process with a multi-pronged attack, in particular, on poverty. This demographic issue does figure in the eco-restructuring process but most nonchalantly, for, to side-track this human factor would have meant a travesty of what the contributors are aiming for. The bulk of discussion is concentrated on technological issues, knowing full well that these cannot be evaluated in isolation (p. 79).

Presently, there is a dichotomy in the solutions offered by technologists and economists. The latter take the stance that given the right incentives – prices – and enough time (time frame is ambiguous) technology is capable of finding a way to avoid essentially any physical resource bottleneck, as long as the product or service in question is produced and exchanged within the competitive market system (p. 33). Whether the 'incentives' provided by the nation-states are equitable and in order has not been answered.

The underlying problem is that many current demographic, economic and industrial trends currently seem to point 'unmistakably' in the wrong direction, i.e. 'away from sustainability'. The emphasis on the adverb 'unmistakably' is not supported by evidence or facts. As a matter of fact, as the title of the book itself indicates, whether eco-restructuring and its implications can be compatible with eco-sustainability implies a moratorium on economic growth. There is already a genuine concern about a potential conflict between economic advance in the countries of groups (3) and (4) and the protection of the environment *vis-à-vis* what the environment impact would be if economic growth is halted or slowed down (p. 172). To say that these countries are insensitive to environmental degradation is a figment of imagination. In saying so, there is a need to distinguish between environmental deterioration and environmental degradation. The former can be mitigated by appropriate international and national policy instruments. The latter is irretrievable. These two are not synonymous but there is a certain confusion about this on the part of the contributors. The affluent societies of the West are also confronted with this dilemma. (p. 172).

While focusing on eco-restructuring of agriculture, the fundamental problem of food as a basic right has not been given any importance. If this right is conceded by the United Nations unanimously and ratified by all nations and the UN General Assembly to be implemented both in letter and spirit, agricultural surpluses and shortages will loom large as socio-political issues; neither the FAO nor the WTO has shown any concern on these issues. The characteristic signs of agricultural unsustainability include soil erosion, deterioration of soil structure, exhaustion of soil nutrients, salinization of irrigated areas, over-use of water resources, desertification, deforestation (now contributing 14% to global climate warming potential), reduction of bio-diversity, pest and disease build-up and pollution from agricultural chemicals in ground water and finally toxic chemicals intruding into our food supply (p. 284). These apply in varying degrees in all the under-developed regions of the world. The industrialized West is no exception. This enumeration of critical inadequacies and limitations, the third world is already aware of and what it calls for is that different local conditions need prescription as is applicable to the area under consideration. There is no global solution to a local problem.

Mechanization and large-scale agriculture dominates the international scene. Within two generations, this has turned out to be unsustainable and calls for corrective action if civilized mankind is to survive. Evaluation of agricultural strategy, however, on a short-term basis in raising inappropriate expectations by driving the third world towards the industrial model has not undergone any material change. This 'systems coercion' has adversely affected (p. 285) ecosystemic requirements which need biodiversity, site orientation and a massive reduction of material flows. Western-style agro-business has only led to the massive problem of soil erosion and three quarters of this destruction is now taking place in the third world. As a corollary, productive agricultural area has declined by a staggering 16 million ha per year which is incommensurate with an ever-increasing population. Another most important limiting input is water.

Much of the future energy demand growth stems from the relative price-insensitive transportation and heavy industrial sectors and once capital is

invested, it is locked-in for many decades thereafter. While projecting the future scenario of global energy in this context—a most important component of the eco-restructuring process—and the impending crisis of potential change caused by indiscriminate fossil-fuel use, Rogner (p. 159) seems worried about what he calls a zero-order understanding of the structure of a fully sustainable energy system. The model which he himself builds up is hypothetical and not factual; apparently, it fails to concentrate on the essentials of a global perspective. This is reinforced by the fact that the analysis is confined to the industrialized countries only and the third world has been left out from the discussion. At the same time, there is a philosophical flirtation that we must mimic nature's path, for, it is here that we come across a symbiotic relationship between solar energy, hydrogen, oxygen and carbon. His study of a sustainable energy system also does not take into account the sector balance of the economy; one of them is Weaver's study of the transport sector *equally exclusively* based on the industrialized West, which currently, poses the greatest environmental burden and badly needs restructuring (p. 339); all that the third world should do is to draw inferences and make appropriate changes in its transport infrastructure (p. 343) which is very much supply-based incommensurate with its existing scarce technological and financial resources while the need of the hour is proper balancing of demand and supply. We all know that West is characteristically autocentric and the third world influenced as they are by the World Bank, IMF and other funding agencies, have moved towards the same mobility patterns as in the West aggravating cumulatively the environmental deterioration by way of air pollution, fumes, smoke, noise pollution, time cost of chaotic traffic congestion, infrastructure not based on demand, etc. and what is more, is consuming a little over one-fourth of the world oil for commercial use. Paradoxically, there is no discernible change in fuel economy. Although it is the automobile that is overwhelmingly responsible for the present carbon emissions and the build up of atmospheric concentrations of GHG as compared with freight transport, these two have to be considered together in considering the overall impact on environment. A shift in

emphasis towards a combination of public transport and lowered mobility in rich as well as developing countries will ease pressure on the energy sectors and correspondingly, on the eco-restructuring of the deep energy system. Rogner himself recognizes that settlement patterns, infrastructures and workplace arrangements that encompass telecommuting, dematerialization and decarbonization of the production process and recycling *vis-à-vis* environmentally reliable service technologies are all intimately tied up to be viewed as an integral part of the sustainable energy system. All these have been ignored for discussion. The energy system does not operate in a vacuum. If evolution has come about by a sequence of replacements, as Montroll puts it, the expectation of Rogner's anti-thesis moving towards a carbon-free currency (towards a hydrogen age) is equally preposterous and unrealistic.

To sum up, Usui realizes the need for a supra-national authority based on the image of a 'third-generation world organization' or a UN renaissance (p. 366). Whether he is contemplating two organizations—one to deal with the maintenance of international security and peace-keeping operations a task now assigned to the UN Security Council and the other, because of declining importance in social-economic issues of the third world, this task is to be assigned to the new third-generation world organization, is unclear. What Usui fails to understand is that the UN as it is presently constituted with its veto power, renaissance is ruled out. He needs to be reminded that if any drastic amendment to the UN Charter is attempted and assuming that it would succeed, USA would cease to be a Member of the reformed UN. Efforts to subject the World Bank and IMF to some measure of accountability to the UN have not succeeded. The 1992 UN Conference on Environment and Development (UNCED) has brought about an environmental awareness which is manifested by the establishment of an Environment Department and there is hardly any nation today that has not taken some step or the other mandatorily to improve its environment. There is a bewildering maze of environmental laws which need to be monitored and reviewed from time to time at the national, regional and international levels. Currently, the greatest damage to environment has been done by

the industrialized West and their growing anguish is enhanced by the fact that the third world should not make the same mistake by contributing its quota. The growing conflict is how to reconcile between the fast depleting finite fossil resources and the renewable resources which are emerging slowly. Exploitation of resources can only be carried to a logical limit beyond which even human ingenuity cannot provide the answer. Presently, all the international organizations are engaged in the task of environmental protection but confined to merely collecting, collating, analysing and exchanging information without disclosing the status of the environment. Since nation-states are governed by its permanent interests, its erosion in the eye of international law is, by and large, a fiction notwithstanding the fact that the 'globalization of the world's societies has become a physical reality through modern telecommunications and modern transportation – the former has exposed the people in all but the remote locations instantaneously to the world's crisis situations and the ground realities in far away places and the latter has made it possible to travel and to trade and shift investments amongst distant locations quickly and extensively than ever before' (p. 259). This is the human tragedy that has to be faced squarely, in other words, the eco-restructuring process will remain totally impractical. This will remain like the Plato's ideal – the fundamental dilemma between what is and what ought to be – will always continue to plague mankind.

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**Fish Genetics and Biodiversity Conservation.** A. G. Ponniah, P. Das and S. R. Verma (eds). Nature Conservators, 135, South Civil Lines, Circular Road, Charan Singh Colony, Muzaffarnagar 251 001. 1998. 474 pp. Price not stated.

Over 70% of all recorded living species and perhaps a much larger fraction of actual diversity exist in the tropical countries. With respect to domesticated biodiversity too, this region is a veritable goldmine. It is also known for a large segment of endemic species; for instance, more than 56% fish species, which occur in Periyar Lake, are endemic. The spectrum of biodiversity in terms of strains, varieties and animal breeds available in the tropics is indeed astounding (T. Khoshoo, Indian Science Congress, Plenary Lecture, 1986). Yet, poverty and ignorance, widely prevalent in this region, have led to widespread and large-scale loss of this precious biological resource. 'Even by the most conservative estimates, the number of species doomed for extinction is atleast 27,000 per year, i.e. 74 per day and 3 per hour'. In such a crisis, the endangerment of aquatic organisms, especially fishes is greater than that of terrestrial animals, due to lack of information on the conservation status of aquatic species and social bias for these small and cold-blooded species. Rightly, the National Bureau of Fish Genetic Resources, Lucknow organized a National Symposium on 'Fish Genetics and Biodiversity Conservation for Sustainable Production' in September 1996 and this book represents the proceedings of the symposium.

A series of 64 papers presented in the symposium have been classified under (i) Status of Biodiversity; (ii) *In situ* Conservation; (iii) *Ex-situ* Conservation; (iv) Introduction of Exotics; (v) Genetics and Biotechnology, and (vi) Genetics of Hatchery Breeding. The contents of these contributions may be briefly summarized as follows: India is fortunately endowed with bountiful fish germplasm resources distributed widely in varied aquatic ecosystems. About 10% (22,000 species) of the global ichthyodiversity is found in the Indian waters. Of them, 400 species are commercially important. Our cold water harbours 73 species, warm water of the plains 544 species, brackish water 143 species and marine ecosystem 1,440 spe-

cies. Of these, several have been recognized as endangered, vulnerable and rare. Factors responsible for such large-scale loss of fish species, as well as their germplasm resources are: (i) Loss of physical habitats due to construction of dams and weirs across the rivers, soil erosion due to deforestation and excessive utilization of waters; (ii) chemical pollution due to industrial and domestic wastes; (iii) over-exploitation and indiscriminate harvesting of juveniles and brood fishes; (iv) competition from the introduced non-indigenous species; and (v) spread of dreaded diseases. For instance, siltation from the catchment areas has destroyed the feeding and breeding grounds of many fish species; 5,334 million tons of soil is eroded annually from cultivable land and forests of India. Our rivers carry nearly 2,050 million tons of silt and deposit 480 million tons into the reservoirs, causing eutrophication and reduction in the productivity of the water bodies. Enormous amount of water is abstracted from our rivers, for different uses. For instance, the runoff in the Ganga basin is about 470 billion m<sup>3</sup>; of this 85 billion m<sup>3</sup> is diverted for storage in reservoirs. The canal network of this basin is 13,600 km and 60% of water from the Ganga is impounded in these canals for irrigation. Annually, 1.5 billion m<sup>3</sup> of industrial effluents and domestic sewage are discharged into the Ganga. The introduction of common carp into the Loktok Lake (Manipur) has led to the displacement of the endemic fish *Osteobrama belangeri*.

Since the editors look forward to constructive criticism, the reviewer has chosen to bring the following to their notice: (i) Avoidable spelling and grammatical errors are found all over the book. For instance, there are 5 errors in less than two paragraphs in p. 89 and expressions like 'morphological anatomy' (p. 245) must be avoided. (ii) Metric values must be given. Expressions like feet (p. 90) and lakhs (p. 139) must be avoided. (iii) Presentation of wrong information, as given in p. 286, must be avoided; for instance, Pandian and Varadaraj, 1987b have reported ploidy induction and not transgenesis in tilapia. (iv) Incompatibility between citation in the text and references must be avoided, e.g. see p. 286 and 292. (v) There are also incompatibilities between the legend and the actual figure, (e.g. p. 401; Figure 3) (vi) Several