

Perfect Form. Don S. Lemons. Princeton University Press, 41, William Street, Princeton, NJ 08540, USA. 1997. Price: \$ 19.95. 117 pp.

If there is a profound lesson that has emerged from the study of physics for some three hundred-odd years now, it is perhaps this: the 'structure' of the laws governing the physical world is largely dictated by symmetry and transformation-invariance, while the various laws themselves arise, at a fundamental level, from extremization or optimization principles – almost all of which can be traced back to one form of action principle or the other. Thus the underlying 'dynamical' principle in a vast physical regime (ranging from non-relativistic Newtonian mechanics to relativistic quantum field theory and even beyond) appears to be an extremal-action principle. While one only begins to appreciate this deep-seated unity fairly late in one's study of physics, it would certainly be helpful and instructive to learn of its existence at a much earlier date. The book under review is an attempt to do just this, at the undergraduate level. To quote from the preface, 'Variational principles and methods unify much of physics. Their study is fascinating and useful and also prepares one for more advanced work.'

The subtitle of this nice little book is 'Variational Principles, Methods and Applications in Elementary Physics', and the contents justify the subtitle. The subject is developed in easy stages via short chapters titled 'Least time', 'Calculus of variations', 'Curved light', 'Least potential energy', 'Least action', 'Hamilton's principle – restricted', and, finally, 'Hamilton's principle – extended'. As Lemons states in the preface, this approach 'slowly unfolds the subject'. The examples chosen are based on elementary physics, and involve ray optics, particle trajectories, mechanics, etc. Each chapter ends with five to ten problems that have been chosen with some care, again illustrating the application of the theory developed up to that point to cases of physical interest. Moreover, the problems are mostly of the 'Show that...' kind, so that the student knows what to aim at.

In a topic such as this, in the process of telling undergraduates about the deep underlying principles, it would be easy to get somewhat lost in philosophizing about causality, action at a distance, local versus global descriptions, final causes, and so on.

Lemons has avoided such temptations very wisely, and made brief and matter-of-fact comments wherever necessary, e.g. in pointing out that Hamilton's Principle encompasses, and (under appropriate conditions) leads to, the principle of least action, the principle of least potential energy, Newton's equation of motion, etc. Remarks of a general nature are not dwelt upon at any unnecessary length. The concluding sentences of the main text read, '...Such thinking does bear fruit. General relativity and quantum mechanics both originated from variational principles.'

The inclusion of a short annotated bibliography for further reading would have enhanced the usefulness of this book.

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Aging and human longevity. Marie-Francoise Schulz-Aellen, Birkhauser Verlag, Postfach 133, CH-4010, Basel, Switzerland. 1997. Price: DM 148. 283 pp.

The book has two parts. Part I deals with the phenomenon of aging and attempts to explain its mechanism at the cellular level. In part II, interventions and preventive measures to eliminate the handicaps and diseases of old age in humans are covered. The book focuses on human aging. The author gives the life spans of 19 animals, but only of two plants. If the longevity of plants was to be given, a longer list would have been more useful. Furthermore, under the life spans of invertebrates, only two insects – honey bee and *Drosophila*, are listed. The life span of honey bee has been dealt with well.

Genetic influence on longevity in humans is sketchy. It is mentioned that the sex difference in human longevity is decreasing. There is no data to substantiate this statement. Likewise, influence of personality and social status on longevity does not have adequate scientific support. This may just be due to their better living conditions. One would have liked to see some information in depth in the section on stress as the author works in the field, but only hormonal stress has been dealt with well. The discussion gives the impression that all types of stress lead to hormonal

changes which influence longevity. Such a generalization cannot be made. On p. 35 it is mentioned that 'The hormone/receptor complex undergoes a conformational change that reveals a site known as the steroid-responsive element which binds to specific DNA sequences'. Actually a specific sequence present in the promoter of a gene is the element. A specific domain of the receptor protein binds to this element.

Premature aging such as Werner syndrome, progeria, Cocayne syndrome, etc. have been covered well with clinical bias. This is a useful section as one generally does not get such information from books on aging. One would have expected an in-depth description on Alzheimer's disease as the book focuses on human aging, and so much more on its biochemistry has been published.

Chapter 3 deals with human physiology. The section on longitudinal studies conducted in the National Institute of Aging, Baltimore, is useful for the reader. However, the remaining part is superficial. The causal relationship between melatonin and longevity, and loss of biological rhythm in old age have been highlighted. Also, the deterioration of the immune system, especially of T cells has been covered adequately. Homeostasis has been dealt with only at physiological level. A biochemical and molecular explanation of why homeostasis deteriorates would have made this section more interesting. The section on theories of aging is very sketchy. The reader will not get a clear understanding of what the theories propounded, particularly the somatic mutation and error theories. There are better sources for such information such as C. E. Finch's *Longevity, Senescence and the Genome* (Chicago Univ. Press, 1990) and M. S. Kanungo's *Genes and Aging* (Cambridge Univ. Press, 1994). It is desirable to mention the names of those who advanced the theories. Not all programmed theories are covered, and those mentioned are superficially dealt with.

On intrinsic mechanisms of aging, *age-1*, *ced-3* and *ced-4* mutants of the free living worm, *C. elegans*, are adequately covered, but the more recently discovered mutants, *daf 2* and *daf 23*, by Kenyon *et al* (1993) are conspicuously missing. These mutants live twice as long as the wild ones. Conversely, in the wild type, the products of *daf 2* and *daf 3* accelerate aging. Two other mutants, *daf 16* and *18*, influence longevity.

Genes involved in programmed cell

death (PCD) or apoptosis, *ced-3* and *ced-4*, in *C. elegans*, and the role of *ced-9* that protects cells from PCD have been described. Also the homology between *ced-9* and *bcl-2* (human B cell lymphoma) has been brought out. Mention of PCD in insect and frog would have made it more interesting. However, the author should have mentioned that PCD is necessary for formation of a mature organ during the developmental stage. Death of cells occurring after adulthood is reached is a random process.

The role of chromosome-1 in aging, and the relationship between telomere and aging have been covered in a limited manner. Mutation/deletion in mitochondria in relation to diseases has been covered, but a lot of interesting findings of Japanese workers are missing. Also, several diseases such as cystic fibrosis, triplet nucleotide-related diseases, cancer, etc. are described, but they have little relevance to aging or longevity *per se* as they do not occur in all individuals of a species. The author describes the role of telomere briefly while advancing the point that telomere shortening could be a consequence of aging, not the cause of aging.

Of the extrinsic mechanisms that influence aging and longevity, free radicals have been discussed in some detail. In the reaction (p.144) showing generation of superoxide and hydroxyl radicals, H_2O_2 has been wrongly mentioned as oxygen peroxide. In the text, however, it is mentioned correctly as hydrogen peroxide.

Part II of the book deals with prolongation of life. This section is even more sketchy and superficial, largely because too many topics with less serious scientific data have been covered. Food restriction no doubt has a positive effect on longevity of rats and humans, but even though this study was conducted by Mckay *et al.* over 60 years ago, we still do not know the components of the food that act at cellular, subcellular, molecular and gene levels to prolong longevity.

The author has tried to include every topic possible, whether it has any scientific basis or not, such as vitamins, fats, minerals, aspirin, hormones on the one hand and social work, sexuality, alcohol consumption, plastic surgery, replacement of body parts, etc. on the other. The scientific merit of the book has been severely eroded due to the inclusion of several topics in part II. For a single author to cover topics from telomere to social network in 232 pages is unrealistic.

So the book has remained superficial and sketchy throughout. The author should have restricted herself to biological or medical aspects to make the book useful. The book would be useful for geriatricians, in parts, and to general readers, but not for graduate students and those interested in research on biology and biochemistry of aging because the work of several authors dealing with biochemical and molecular aspects of aging is not discussed and certain books that cover these aspects in depth are not listed. There are some mistakes in editing: In the preface, the last but one sentence reads '... even eliminate, various of the handicaps...'. It should read '... even eliminate the handicaps...'. In the legend of Figure 9 (p. 52) is mentioned '...The evolution of four physiological functions with age'. It should be 'evaluation...'. On p. 86 is mentioned 'the gradual deterioration in the synthesis of control mechanisms or damage...'. It is not clear what is meant by *synthesis* of control mechanisms. On p. 89, phosphodiesterase is spelt wrongly. In the reaction showing production of free radicals, on p. 114, stoichiometry of the reactants should have been maintained.

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Software review

Macysma. Symbolic/numeric/graphical mathematics software. (Release 2.2 for Windows 3.1/Windows 95/Windows NT.)
PDEase2D. Software for obtaining numerical solutions of partial differential equations. (Release 3.0 for Windows 95/Windows NT).

To begin with a very brief summary: these two packages from Macysma Inc. form one of the best (if not the best) software products for scientific computations that I have so far come across. In terms of the range of things it can do, the ease of operations, and the speed at which the results are obtained, it can more than meet the requirements of almost everyone. If you want to do any kind of scientific computation, and have a pentium class computer, you would be well advised to go in for Macysma instead of one (or even

many) more computer/s. Macysma (with PDEase2D and Numkit, the advanced numerical analysis package that can further enhance the speed and power of these two) is capable of doing not only everything that you always wanted to do, but of inspiring you to undertake more ambitious computations as well. A few weeks with it, and you would wonder how you ever managed without it. (Of course, most good software packages do have their 'true believers'; I can easily imagine others using exactly the same expressions about, say Matlab or Mathematica.)

Macysma is supplied on a CD, accompanied by extensive documentation. The printed matter consists of a small booklet (*Introduction to Macysma*), two comprehensive books (a system reference manual and a tutorial cum user guide) and three spiral bound volumes (for PD2Ease, scientific notebook interface and scientific graphics reference manual). There is also the excellent glossy reference card, and the usual pamphlet of release notes, which also give a step-by-step procedure for installation.

The installation itself is extremely simple, straightforward and fast. I tried it out on a 486/66 MHz/16 mb for Windows 3.1, on a pentium 75 MHz/16 mb for Windows 3.11 and pentium 133 MHz/32 mb for Windows 95 as well as WindowsNT 4.0, and it took much less than 10 minutes even on the slowest of the machines. However, when one begins to use the software, there is a noticeable delay during loading. The windows 3.1 and 3.11 versions of Macysma took more time to load than what the machine took for booting!

One of the best features of the design of Macysma is the ease of use. You can start using it (even its advanced features) literally within minutes of installing it, even if you have had no previous experience with it (or its equivalents). Firstly, there is a very readable introduction in the documentation. Secondly, there is extensive on-line help. In fact, the menu-driven, natural-language query is a powerful and innovative interface; you can pose a question in ordinary English, and in response, you are taken to the appropriate section of the on-line manual. Thirdly, Macysma (and PD2Ease) comes with dozens of demonstration scripts/examples; just looking at a few of them would be enough for you to be able to begin using these packages directly for solving the problems at hand.

What are the things that Macysma can