SCIENTIFIC COMPUTATION, Gaston H. Gonnet, Ralf Scholl, Cambridge University Press, 2009; pp. 236; ISBN: 978-0-521-84989-0 (hc); Price: $65.00.

STOCHASTIC PROCESSES IN PHYSICS AND CHEMISTRY, N. G. Van Kampen, Elsevier, 2007; pp. 463; ISBN: 978-0-444-52965-7 (pbk); Price: $126.50.

THE FUTURE OF THEORETICAL PHYSICS AND COSMOLOGY: CELEBRATING STEPHEN HAWKING'S CONTRIBUTIONS TO PHYSICS, G.W. Gibbons, E.P.S. Shellard and S.J. Rankin, Cambridge University Press, 2009; pp. 879; ISBN: 978-0-521-14408-7 (pbk); 978-0-521-82081-3 (hc); Price: $55/94.

THE STABILITY OF MATTER IN QUANTUM MECHANICS, Elliott H. Lieb, Robert Seiringer, Cambridge University Press, 2009; pp. 293; ISBN: 978-0-521-19118-0 (hc); Price: $50,00.

BOOK REVIEWS / CRITIQUES DE LIVRES

Book reviews for the following books have been received and posted to the Physics in Canada section of the CAP's website : http://www.cap.ca. When available, the url to longer versions are listed with the book details.

Des revues critiques ont été reçues pour les livres suivants et ont été affichées dans la section "La Physique au Canada" de la page web de l'ACP : http://www.cap.ca. Quand disponible, un lien url à une critique plus longue est indiqué avec les détails du livre.

ENSEIGNER DES CONTROVERSES, Virginie Albe, Presses Universitaires de Rennes, collection "Paideia", 2009, pp. 223, ISBN 978-2-753-50818-7 (Diffusion La Canopée).

Qu'il s'agisse de changements climatiques, de nouvelles énergies, de téléphonie mobile ou de nanotechnologies, les divergences de vues auxquelles on a longtemps assisté dans le cercle restreint des colloques scientifiques réservés aux savants et experts sont devenues progressivement des débats de société faisant la "une" dans les médias, et certains de ces débats ambivalents se sont même transportés dans les salles de cours. Ces nouveaux enjeux de société sont désormais identifiés en France sous le vocable de "Questions socialement vives".

Virginie Albe enseigne la didactique des sciences et des techniques à la fameuse École Normale Supérieure (ENS) de Cachan, en France. Pour son premier livre, elle propose de centrer les cours de sciences sur certaines controverses scientifiques et sur les débats de société qui en font l'écho. Cette approche pédagogique a l'avantage d'éviter de dire aux élèves qu'il existe une seule manière de penser et de concevoir tel problème lié à des enjeux de société comme la surpopulation ou le réchauffement climatique.

Dans sa préface, Andrée Tiberghien (du CNRS) se demande si les cours de science véhiculent toujours cette vision univoque et idéalisée d'une science infaillible et unanime qui la caractérisait pendant très longtemps : "la science enseignée et en particulier la physique a-t-elle suivi l'évolution de la citoyenneté?" (p. 7). S'inquiétant de la désaffectation récente de la jeune génération française envers les sciences physiques, Andrée Tiberghien rappelle en outre que "l'une des raisons du rejet de la physique par de nombreux élèves est liée à ce décalage entre les valeurs actuelles du citoyen et donc des jeunes et celles implicitement supposées de l'enseignement de la physique" (p. 8).

Virginie Albe reconnaît le caractère "idéologiquement chargé" des sciences (p. 112); elle conçoit que l'élaboration des sciences se fait habituellement "par consensus ou dissensus" (p. 122). Plusieurs exemples confirment qu'il est devenu plus difficile d'exposer en classe des notions de sciences et de techniques sans aborder du même souffle les doutes, les divergences de vues, les réticences d'une partie de la population à propos du téléphone mobile (p. 135); du réchauffement climatique (p. 138); ou sur la place des éoliennes dans le paysage (p. 144). Or, la recherche de Virginie Albe réalisée à partir de questionnaires auprès de divers groupes de jeunes élèves et à la suite de rencontres d'enseignants français démontre que ceux-ci mobilisent en réalité très peu de notions scientifiques et techniques pour "se faire une opinion" à propos des enjeux scientifiques, mais qu'ils restent généralement ouverts pour en apprendre davantage sur ces sujets (p. 146).

L'approche interdisciplinaire contenue dans Enseigner des controverses est richement documentée, proposant à la fois des stratégies pédagogiques destinées aux enseignants mais aussi des avenues théoriques et conceptuelles de pointe pour les didacticiens (à la fin du 3e chapitre et au 4e chapitre). En somme, Enseigner des controverses est un ouvrage stimulant et nuancé qui intéressera particulièrement les enseignants (actuels et futurs) en sciences et technologies désireux de connaître les tendances actuelles de la recherche didactique en France. On devine que certains de ces aspects existent déjà dans les institutions canadiennes ou pourraient y être transposés.

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PHYSICS IN DARWINISM AND ITS DISCONTENTS, Michael Ruse, Cambridge University Press, 2006; pp. 316; ISBN: 0-521-82947-X (hc); Price: $30.00.

Michael Ruse is a well-known historian and philosopher who has been prominent in defending Darwin in the creation/evolution debates. The preface states the purpose of this book: "Many people told me...that they could not see how any right-thinking person could be a Darwinian. This [book] is my answer to those people". The aim of this book, then, is to defend natural selection against not only the proponents of creationism and Intelligent Design, but also against other biologists like Gould and Lewontin who propose non-Darwinian modes of evolution. Thus, according to Ruse, it is natural selection – not genetic drift, not mass extinctions, not evo-devo, and certainly not supernatural intervention – which is the chief causal process in biology. In this book, Ruse aims to take on all pretenders.

Surprisingly, on page 2, Ruse even directs his invective against (some) physicists: "At the other end of the scientific spectrum, we now have physicists who tell us that their science can do it all for us—that there is no real need of natural selection. The laws of physics, unaided, can produce and explain everything worth knowing about organisms." Much later in the book (pg 159) we learn which physicists he is talking about. It is theoretical biologists like Brian Goodwin and Stuart Kauffman, who advocate that there are fundamental physical principles that determine the basic forms that organisms can take. In this sense, form is not merely adaptive, but is what it is because some underlying physical laws dictate the possible forms. As a physicist myself, I feel that Ruse is too dismissive of the importance of this approach. Darwinism (natural selection on variation) is merely a process that navigates the configurational landscape, analogous to a Monte-Carlo search algorithm. Darwinism in itself does not define what forms can exist to populate that landscape, so that it is at best half the story. Saying that it's all natural selection, there's nothing more to explain in biology is like saying that it's all Monte Carlo, there's nothing more to explain in high energy physics. There must be other principles that define the landscape that natural selection navigates and the forms that populate that landscape. Does thermodynamics not matter? Are the stable biological configurations not local minima of free energy in configuration space? Why is there a configurational landscape that is smooth enough to navigate in the first place? Worthwhile reading on these ideas can be found in Goodwin's book How the Leopard Changed Its Spots: The Evolution of Complexity and in Kauffman's book At Home in the Universe: The Search for the Laws of Self-Organization and Complexity.

My most serious criticism of this book is that I found it tedious to read, because Ruse frequently writes in a long-winded, meandering fashion, distracting the reader by leading him onto tangents of questionable relevance. This is especially true in the first seven chapters, which contain most of the scientific discussion. He would do better to just focus the reader's mind on a small number of simple, crisp arguments. For example, on page 38, when bio-geographical distribution is introduced as evidence for evolution, Ruse could have asked a few pointed questions such as “Why are marsupials and not mammals found in Australia, if it were not for an ancestral marsupial first reaching Australia and populating that continent in isolation from the others? Why do New Zealand and Madagascar, which are geographically isolated, have unique life-forms found nowhere else? Why is geographical isolation so strongly correlated with biological uniqueness, if evolution were not true?” Instead, we are treated to a long, boring quote from Darwin's book from the 19th century, which may be of historical interest, but is not in itself the best presentation of the biogeographical evidence for evolution. In far too many places, there are secondary asides inserted into the middle of already too-long sentences to further confound the reader. At the bottom of page 99, for example, we read this convoluted sentence: “Even if we agree that much of the classificatory procedure is not evolutionary – although today, surely, in many branches (especially those with some fossil record) it is going to be difficult to separate out what is not evolutionary from what is – this does not mean that classification has no relevance to evolution, or that evolution has no relevance to classification.” Stronger editorial oversight is badly needed to prune away the extraneous details and to just cut to the chase! If reader is seeking a clear presentation of the scientific evidence for evolution, there are more lucid books available.

The best part of the book is to be found in chapters 8 to 12, where the content is more philosophical rather than scientific. Here, Ruse the philosopher comes to the fore. Chapter 8, “Fact or Fiction” tackles some of the alleged implications of biological Darwinism: the inevitability of progress, social Darwinism and the moral implications of Darwinism. Chapter 9 deals with honesty and dishonesty in science. The discussion of Darwin vs. Wallace regarding the credit for the theory of natural selection, Haeckel's inaccurate pictures of embryonic development, and the hoax of Piltdown man, make for entertaining reading. In Chapter 10, Ruse pursues his stance that “if we humans are an end product of a long, slow, law-governed process of natural selection rather than the favored of God created miraculously on the Sixth Day, Darwinism simply has to be relevant to philosophy” (pg. 237). Chapter 11, entitle “Literature” explores how the views of several literary figures relate to Darwinism. Samuel Butler, George Bernard Shaw, H.G. Wells, Herbert Spencer and Ian McEwan are some of the authors critiqued. Issues of social Darwinism and determinism are addressed here. Chapter 12, “Religion”, deals with the religious implications of Darwinism. I found this to be a fair-minded, respectful treatment of the interface between Darwinism and Christian faith; as a former Christian himself, Ruse obviously retains respect for those of faith, in contrast to other writers like Richard Dawkins.

In summary, this book will be of greatest interest for readers of a more philosophical bent who want to read one philosopher's defense of Darwinism and his views on its social and philosophical implications.

Stanley Yen
TRIUMF

FUNDAMENTALS OF PLASMA PHYSICS, Paul M. Bellan, Cambridge University Press, 2008; pp. 609; ISBN: 978-0-521-52800-9 (pbk); Price: $75.00.

As a natural product of his graduate course at Caltech, Professor Paul Bellan wrote this elegant textbook. He employed powerful, but as simple as possible, mathematical techniques in the book to help readers get deeper insights into plasma behaviours relevant to diverse plasma applications in fields of, e.g., controlled fusion, cosmic and space plasmas, and experimental plasmas.

The book contains 17 chapters and three appendices. The first three chapters (1-3) introduce basic plasma concepts, equations from Vlasov, two-fluid, and MHD models, and classical theories on single particle motion with particular attention to adiabatic invariance. The next five chapters (4-8) examine types of plasma waves and the issue of Landau damping, including elementary plasma waves, streaming instabilities and the Landau problem, cold plasma waves in a magnetized plasma, waves in inhomogeneous plasmas and wave energy relations, and the Vlasov theory of warm electrostatic waves in a magnetized plasma.

Chapters 9 to 12 focus on fundamental magneto-hydrodynamic (MHD) theories and hot topics, such as, MHD equilibria, stability of static MHD equilibria, magnetic helicity, self-organization, and magnetic reconnection. In particular, chapter 13 exposes the Fokker-Planck theory of collisions. After that, all the following chapters (14-17) provide an extensive picture to readers about modern topics in plasma physics, e.g., wave-particle / wave-wave nonlinearities, non-neutral and dust plasmas. The appendices list vector calculus identities, vector calculus in orthogonal curvilinear coordinates, and frequently used physical constants and formulae.

However, I would like to mention a few shortcomings found in reading the book. Firstly, there is a lack of time-dependent MHD theories in the text, though relevant experiments are mentioned. Secondly, an important concept, the magnetic Reynolds number is missing, though this parameter is indispensable in dealing with the effects of magnetic advection and diffusion. Lastly, a popular subject, nonlinear solitary waves in a cylindrical geometry, is not included, even a word.
In general, this book can be used as a good reference for undergraduates and graduates.

John Z. G. Ma
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GEOMETRY AND TOPOLOGY, Miles Reid and Balazs Szendroi, Cambridge University Press, 2005; pp. 196; ISBN: 0-521-61325-6 (pb)0-521-84889-X (hc); Price: $45/95.

This introductory undergraduate level book actually dedicates more than half of its chapters towards geometry. The authors start with a thorough introduction on Euclidean and non-Euclidean geometry, including spherical and hyperbolic geometry, affine and projective linear geometries. As a side, you will learn some basics of group theory as the authors utilized the Erlangen program to unify geometry and group theory. The Erlangen program simply studies the invariant properties of a geometric system under a certain set of transformations, i.e. a group of transformations. This is important as special relativity utilized the same idea of invariance to study geometric system properties that are invariant under the Lorentz transformation group.

Building on that, topology is introduced as the study of some invariant properties of a certain mathematical space. Topics on topology are elementary and scratch the surface of how topology applies to physics, in particular there is a big chunk on particles and spin.

Geometry and Topology uses a typical mathematically rigorous language for theorems and proofs but is made very easy to understand with copious graphical illustrations, examples and exercises at the end of each chapter, with hints for the readers. This book is based on years of teaching experience, mostly on a second year module taught at Warwick with an informal writing style similar to Introduction to Quantum Mechanics by David J. Griffiths., with words in the book like “I” referring to an imaginary teacher, and “you” referring to you as the student. You will find this fun and will hardly get lost at any page.

Miles Reid is a Professor of Mathematics at the Mathematics Institute, University of Warwick. Balazs Szendroi is a Tutor and Martin Powell Fellow in Pure Mathematics at St Peter's College, and a Faculty Lecturer in the Mathematical Institute, University of Oxford.

Chang Wei Loh
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PHYSICS FOR DUMMIES, Steven Holzner, John Wiley & Sons, 2009; pp. 360; ISBN: 0-764-554-336 (pbk); Price: $25.99.

'Physics for Dummies' by Steven Holzner, PhD, aspires to be your 'plain-English guide to everything from relativity to supernovas'. It's written in the clear, familiar voice characteristic of the For Dummies series. There are three audiences in particular that may appreciate such an approach: a senior high school or first year college /university student (particularly, a non-physics major) to consider as a nice assist; for the general interest, pleasure reading public, as either first contact with the material or to help brush up on old lessons; and the third group was my own position, an instructor looking for tips, tricks, and insight into presenting material to students and getting back into a beginner's frame of mind.

Holzner presents his assumptions that his readers have no previous physics knowledge, but are versed in at least some algebra and trigonometry. However, he does provide the uninitiated with a very brief introduction to algebra, trigonometry, and vector basics.

There are twenty-two chapters in all covering the range of topics in kinematics, work-energy, thermodynamics, electricity and magnetism, and bonus chapters such as "ten amazing insights on relativity". Conservative vs. non-conservative forces, Hooke's Law, specific heat capacity, the laws of thermodynamics, Lenz's Law; it's all here, in small digestible bits with humorous examples.

Holzner has done an exceptional job at summarizing concepts neatly and with pleasant prose. The strength of the book is in the ease of the explanations; a student struggling with lessons in a textbook may find Physics for Dummies a nice, light, easy read to help them process some basic ideas and relationships. Each 'Big Idea' is presented with usually just one or two examples. These explanations and examples are far from rigorous; however, neither are they cursory or trivial. The odd subtlety is explored, along with tips and cautionary remarks for things that normally trip people up.

Someone who hasn't had their head in the subject matter for some years might find this a compact little refresher of introductory level physics. If everyone who studied first-year university physics understood and remembered this much, it would be truly impressive! They might even like to try and tackle the additional problems in the companion workbook available. As for myself, personally I was left unsatisfied with the brevity and simplicity, but this treatment of the material did well to emphasize what are the main ideas that I would like my students to know, and it gave me a few cute examples to help explain them.

Lisa Di Lorenzo
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PHYSICS OF SPACE PLASMA ACTIVITY, Karl Schindler, Cambridge University Press, 2006; pp. 508; ISBN: 978-0-521-85897-7 (hc); Price: $80.00.

This monograph presents studies of more than 30 years in the past on space plasma activities pioneered by the author and his colleagues, along with a substantial body of relevant results drawn from the work of others. It provides a thorough insight into the physics of large-scale plasmas beyond the scope of our Solar System. The text is concise and easy to read, and a lot of references are cited.

In the book, there are four main parts following an introductory chapter 1: Part I. Setting the scene; Part II. Quiescence; Part III. Dynamics; and Part IV. Applications. At the end, there are three appendices.

Part I contains two chapters. Chapter 2 introduces sites of activity in geospace, the solar atmosphere, and other places. Chapter 3 describes basic plasma models, such as kinetic models, fluid models, and discusses the validity of MHD models, electron MHD, conservation laws, and discontinuities. Part II consists of four chapters: Chapter 4. Introduction; Chapter 5. Magnetohydrostatic states; Chapter 6. Particle picture of steady states; Chapter 7. A unified theory of steady states; Chapter 8. Quasi-static evolution and the formation of thin current sheets.
In Part III, efficient background materials are chosen to elucidate the dynamic processes. It is comprised of four chapters. Chapter 9 introduces non-ideal effects, including generalized Ohm's law, resistivity, micro-turbulence, and non-turbulent kinetic effects. Chapter 10 emphasizes several macro-instabilities, e.g., the ideal MHD stability, resistive tearing instability, collisionless tearing, etc. Chapter 11 is dedicated to 2D and 3D magnetic reconnection models. Chapter 12 demonstrates aspects of bifurcation and nonlinear dynamics. It deserves to mention that an important topic, self-organized criticality, is also covered in this chapter.

By contrast to previous Parts, Part IV is easy to read because it contains few mathematical derivations. To some extent, it looks like a series of physical review articles divided into three chapters. Chapter 13 and 14 discusses magnetospheric and solar activities, respectively, whereas Chapter 15 points out the problem of the reconnection model and depicts a general eruption scheme. Finally, the appendices describe the derivations of the unified theory, the principle for collisionless plasmas, and fundamental constants and symbols.

The book contributes to readers an exhaustive resource about the fundamentals of activity in space plasmas. However, in my view, it is not a reference for beginners without basic mathematical techniques and some knowledge of plasma physics, but is intended for high-level graduate students, professors, and scientists.

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PRINCIPLES OF MAGNETOHYDRODYNAMICS WITH APPLICATIONS TO LABORATORY AND ASTROPHYSICAL PLASMAS, Hans Goedbloed and Stefaan Poedts, Cambridge University Press, 2003; pp. 613; ISBN: 0-521-62607-2 (pbk); Price: $70.00.

Professors Goedbloed and Poedts offer an excellent and classic textbook on the magnetohydrodynamic (MHD) theory in plasma physics at all levels from laboratory to astronomical sites. The contents are extremely comprehensive, coherent, and rigorous with sufficient, well-knitted physical analyses, mathematical methods, and typical examples.

The book includes two parts: introduction to fundamental plasma physics, and MHD theories and their applications. In the first part, the authors used three chapters to guide readers into necessary preliminaries of plasma physics, such as, basic concepts of plasmas (chapter 1), elements of plasma physics (chapter 2), and the origin of macroscopic equations (chapter 3). In the second part, they made use of the following 8 important chapters to exhibit a comprehensive picture of MHD theories, along with applications in studies of both laboratory thermo-nuclear fusion and cosmic plasma processes happening in our universe.

These chapters are categorized as follows: Chapter 4 exposes MHD models under various conditions. The conservation laws are discussed in great detail. Chapter 5 derives basic MHD waves and instabilities in homogeneous plasmas, and describes their properties. Phase and group diagrams are treated using the dispersion equation of wave phenomena. Chapter 6 continues to treat these waves and instabilities in view of spectral theory. The force operator of formulation and the energy principle are extensively discussed. Chapter 7 develops the spectral approaches to inhomogeneous plasmas. In particular, equations for gravito-MHD waves are solved under various limits. Chapter 8 illustrates enormous magnetic structures and bulk magnetic phenomena and their dynamics in astrophysics, especially in the solar system. Chapter 9 treats waves and instabilities in a cylindrical geometry, and presents the stability analysis of diffuse plasmas from the spectral perspective. Chapter 10 concentrates on one-dimensional initial value problems and related wave damping in inhomogeneous plasmas. Finally, Chapter 11 introduces resonant absorption and phase mixing, linked to the wave heating in solar and stellar coronae. At the end of the book, vector identities, coordinate systems, and the usual physical quantities are listed in two appendices.

This book provides effective methods and insights in the interpretation of MHD phenomena on all scales. It is an extraordinary reference for undergraduates, graduates, and professors in physics, space/planetary physics, and astrophysics.

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THE TROUBLE WITH PHYSICS, Lee Smolin, Thomas Allen Publishers, 2007; pp. 392; ISBN: 978-0-618-91868-3 (pbk); Price: $19.95 Cdn.

Smolin's book on `The Trouble with Physics' makes some bold claims on how string theory is stagnating theoretical physics and how, in fact, string theory isn't really science at all!

Smolin begins by dividing the current state of theoretical physics into five main problems: (1) quantizing gravity; (2) making sense of quantum mechanics; (3) unify the forces and particles of nature; (4) explain the constants of nature; and (5) explain dark matter/energy. He summarizes in an accessible fashion the previous century in physics leading to these questions. From there, he presents his personal, and arguably biased, account of the development of string theory and how it addresses these five fundamental problems of physics. He attempts to explain how a field could attain such widespread acceptance while devoid of experimental verification. He introduces the very uncomplimentary notion of `groupthink' and suggests an overly hierarchical structure amid string theorists, and theorists in general. Their combined effects quickly discourage incoming scientists from introducing fresh innovative ideas and, instead, if they're to advance in physics, they're forced to work on the very same problems as their superiors and therefore everyone else.

The last part of the book follows an interesting analysis of "what is science" starting with a firm basis in the theories of Popper (science must be falsifiable) and progressing into, for instance, the theories of Feyerabend who "attacks the whole idea that method is the key to scientific progress, by showing that at critical junctures scientists will make progress by breaking the rules". As a young scientist myself, I found discussion nicely refreshing.

Smolin closes the book with suggestions for reversing the degenerative trends of theoretical physics. He criticizes the peer review system in place in large funding agencies and hiring committees; but without a good alternative, I suspect that there is no hope of replacing it. He notes that academia has systematically preferred strong `craftsman' over the so-called `seers' of physics, those who may be slower at straight computation but will offer startling ideas and advances. I find it hard to accept when he suggests that to find such `seers' we should in fact turn to the older generation to choose them after he has spent the book exposing the dangers of always pleasing the older generation, as in string theory.

Overall, I must conclude that the book remains a fascinating read. A summary of the developments within a field is extremely difficult to write, particularly when the story is far from finished, and yet, Smolin's exposition is well done and interesting. But perhaps more importantly, it may serve to guide further developments within string theory and related fields, and as a lesson to other fields in science. It keeps us accountable to the general public and to our fellow scientists. The book has met with much skepticism, and downright outrage in a few cases, but at the very least it has generated some much needed discussion on the deeper ideas and workings of theoretical physics.

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