ISSN 1471-7166

Number 8
June 2004

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Learning and Teaching Support Network

*Reviewed in this issue...*

5 software packages

1 web site

20 books

# Physical Sciences Educational Reviews

LTSN Physical Sciences
Part of the Higher Education Academy
*...supporting learning and teaching in chemistry, physics and astronomy*

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The journal of the LTSN Physical Sciences Subject Centre

# Physical Sciences Educational Reviews

ltsn Learning and Teaching Support Network
Physical Sciences

*Physical Sciences Educational Reviews is the journal of the LTSN Physical Sciences Subject Centre. It is issued twice yearly in Spring and Autumn.*

*The journal is free of charge to academics in UK higher education institutions. The material is also published electronically on our web site. Subscriptions are available for those outside the UKHE sector who wish to receive the paper version. Contact the Centre for details.*

*Items for review and offers to contribute to the review process are welcomed. Please contact the Centre.*

*LTSN Physical Sciences is part of the Higher Education Academy (http://www.heacademy.ac.uk) and is funded by the Higher Education Funding Councils of England and Wales, the Scottish Higher Education Funding Council, the Department for Higher and Further Education, Training and Employment of Northern Ireland and is supported by the Universities of Hull, Liverpool, Surrey and Leeds.*

## Editor

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## Editorial

Welcome!

This is our first issue as part of the **Higher Education Academy**. This is also a packed issue; there are 26 more reviews (including a comparative review - p29). We also have two responses from those supplying resources we have reviewed; one is within the review for Polarograph, the other is a Letter to the Editor.

Don't forget to register for the Physics Discipline Network Workshop and/or Variety in Chemistry Education (see inside back cover).

Roger Gladwin
Editor

## In this issue...

# Chemistry Topics

***Subject area***
Chemistry.

***Description***
Web-based teaching resources.

***Authors***
Various.

***Last updated***
2003.

***Level***
Undergraduate.

***Plugins required***
For on-line or off-line use, an MP3 player and a PDF files reader.

***Other features used***
For download, files need unzipping.

***Reviewed using***
PC with 512MB RAM, LAN, Windows XP Pro, Explorer 6.

***Web address***
http://www.rsc.org/lap/rsccom/dab/chemistrycassettes.htm/

Roger Gladwin
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February 2004

This is the set of audio cassettes and booklets originally created by the Educational Techniques Group Trust of the Royal Society of Chemistry. They have been reformatted as MP3 files for the audio cassettes and Adobe Acrobat PDF files for the booklets. They are available as a free download for personal, private study from the RSC web site (http://www.rsc.org/lap/rsccom/dab/chemistrycassettes.htm/). The content is well known thus this review will concentrate on this new incarnation of the resources.

## Summary Review

range: * very poor to ***** excellent

| | |
|---|---|
| Ease of navigation | ***** |
| Speed of response | *** |
| Ease of learning | *** |
| Content | *** |
| Relevance | *** |
| Accuracy | ***** |
| Usefulness to student | *** |
| Usefulness to teacher | *** |

The academic level is stated as post-16 and the resources are considered suitable for individual, self-paced learning in schools, colleges and universities.

The audio files can be used online by directly accessing the MP3 files or offline by downloading and unzipping a compressed (ZIP) version. Similarly, the booklet can be viewed online or downloaded and printed. The usual means of using the resources is to play the audio and access the booklet as directed by the commentary. Once the MP3 file is loaded into (say) Windows Media Player there is only need to view the play buttons on the player so you can pause the commentary when required, so overlaying the booklet for use on screen is quite adequate.

There are 27 titles in the series (see fig 1) covering many areas of chemistry (eg An Introduction to NMR Spectroscopy, Aromaticity, Entropy – The driving force of change, Ionic Crystals, pH and its measurement, The Periodic Law) and file sizes range from 16-49MB for the MP3 files, 14-45MB for ZIP files and 0.3-3.4MB for PDF files, so you need a good internet connection to get good responsiveness.

I had some initial difficulties with downloads despite having a fast connection (100Mbps). Download speeds of 10-20Kbps were the best I could get (bandwidth problems on the RSC site?) and using QuickTime I could not get audio streaming to work (despite downloading the latest version and setting it up beforehand) and the PC would just sit there for up to 30 minutes downloading the complete file before playing (and with little indication that anything was happening). I had better luck with Windows Media Player when I set it up as the default program to use for streaming of the MP3 files. The system then worked and downloads progressed smoothly and responsively.

So, what of the actual resources? It is obvious that although the audio files have been faithfully reproduced as MP3 files, the booklets appear to have been simply scanned in (warts and all!) from the originals and the quality is poor. No attempt has been made to clean up the scanned files and in some places the text is illegible and images are hard to interpret. This is a real pity.

# Chemistry Topics


| Title | MP3 audio Listen online | or | Zip audio Download | Workbooks PDF * |
|---|---|---|---|---|
| An Introduction to NMR Spectroscopy | MP3 (40 MB) | | Zip (33 MB) | PDF (1.3 MB) |
| Aromaticity | MP3 (47 MB) | | Zip (42 MB) | PDF (1.0 MB) |
| Competition Processes | MP3 (24 MB) | | Zip (19 MB) | PDF (0.9 MB) |
| Co-ordination Chemistry | MP3 (30 MB) | | Zip (27 MB) | PDF (2.3 MB) |
| Entropy - The Driving Force of Change | MP3 (20 MB) | | Zip (16 MB) | PDF (0.6 MB) |
| Heavy Metals as Contaminants of the Human Environment | MP3 (49 MB) | | Zip (45 MB) | PDF (1.6 MB) |
| Ionic Crystals | MP3 (39 MB) | | Zip (32 MB) | PDF (1.7 MB) |
| Ion-selective Electrodes | MP3 (21 MB) | | Zip (18 MB) | PDF (0.7 MB) |
| Ions in Solution | MP3 (31 MB) | | Zip (24 MB) | PDF (1.0 MB) |
| Linear Free Energy Relationships | MP3 (48 MB) | | Zip (42 MB) | PDF (0.6 MB) |
| pH and Its Measurement | MP3 (26 MB) | | Zip (22 MB) | PDF (2.1 MB) |
| Quantization | MP3 (43 MB) | | Zip (37 MB) | PDF (1.4 MB) |
| Radicals and their Reaction Pathways | MP3 (30 MB) | | Zip (26 MB) | PDF (0.4 MB) |
| Reaction Pathways of Carboxylic Acid Derivatives | MP3 (29 MB) | | Zip (25 MB) | PDF (0.5 MB) |
| Solving Inorganic Spectroscopic Problems | MP3 (23 MB) | | Zip (16 MB) | PDF (0.6 MB) |
| Some Aspects of the Electrochemistry of Solutions | MP3 (16 MB) | | Zip (14 MB) | PDF (0.5 MB) |
| Some Organic Reaction Pathways | MP3 (34 MB) | | Zip (27 MB) | PDF (0.7 MB) |
| Some Reaction Pathways of Double Bonds C=C and C=O | MP3 (42 MB) | | Zip (37 MB) | PDF (0.7 MB) |
| Symmetry in Chemistry (Part 1) | MP3 (20 MB) | | Zip (18 MB) | PDF (1.2 MB) |
| Symmetry in Chemistry (Part 2) | MP3 (31 MB) | | Zip (28 MB) | PDF (0.5 MB) |
| The Architecture of Matter | MP3 (19 MB) | | Zip (16 MB) | PDF (0.9 MB) |
| The Chemistry of Biological Nitrogen Fixation | MP3 (23 MB) | | Zip (17 MB) | PDF (0.3 MB) |
| The Periodic Law | MP3 (36 MB) | | Zip (31 MB) | PDF (1.8 MB) |
| The Theory of Transition Metal Changes | MP3 (43 MB) | | Zip (39 MB) | PDF (1.1 MB) |
| Using Chemical Abstracts | MP3 (23 MB) | | Zip (18 MB) | PDF (1.3 MB) |
| X-ray Crystallography (Part 1) | MP3 (46 MB) | | Zip (37 MB) | PDF (3.4 MB) |
| X-ray Crystallography (Part 2) | MP3 (46 MB) | | Zip (39 MB) | PDF (2.7 MB) |

*fig 1: The full list of Chemistry Topics*

That said, what about the learning and teaching? Undoubtedly there is a lot of good material here and a dedicated student could sit down and learn from the resources. But it is, I fear, for today's technology-aware, short-attention-span society, just too dry to hold interest. Certainly, problems in the booklets try to keep the brain active but it is just too easy to passively listen to the commentary and drift off.

It would be a real advantage if money were available to convert these resources into multimedia presentations. In the meantime, if you want to use these materials with students I think you need to divide each resource into manageable chunks and consider adding your own examples/resources to augment those provided in order to maintain interest (and hence effective learning).

# Amino acid and peptide synthesis

***Subject area***
Organic Chemistry.

***Description***
A softback Oxford Chemistry Primer aimed at a specialised organic chemistry course.

***Authors***
John Jones.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2002/2nd Edition.

***ISBN***
0-19-925738-8.

***Level***
Undergraduate, research.

***Price***
£9.99.

Simon Jones
Department of Chemistry
Dainton Building
University of Sheffield
Brook Hill
Sheffield S3 7HF
April 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | **** |
| Usefulness to teacher | **** |
| Meets objectives | **** |
| Accuracy | ***** |

Chemistry is one of the core sciences that by its very nature keeps growing and while the fundamental principles generally remain the same, more advanced topics keep expanding and require updating. For many of the core textbooks, this seems to have become an annual event, so it is especially gratifying to see that the hugely successful Oxford Chemistry Primer series have now started in this vein too. Since their original publication over ten years ago, nearly one hundred titles are now available covering all aspects of fundamental and modern chemistry. In 'Amino Acid and Peptide Synthesis' John Jones revises his original version with new material, bringing a classical cross-disciplinary subject up-to-date.

The book is still set out in the same style as the first edition, and there has really been little change in style or layout. One might argue that most modern day textbooks are full to the brim with colourful diagrams and pictures that the Primer series lacks. However in my mind this would add to the cost of the publication and in doing so detract from their core role in providing a cost effective method to obtain bite-size chunks of chemistry that are easy to digest for the student and teacher alike.

The book is logically structured and leads the reader through the relevant areas of amino-acid and peptide synthesis. The chapter detailing amino acid synthesis is a little short and could have been expanded upon in some respects, especially if one compares it to the later sections of protecting group strategies. Here there is sufficient core information in addition to clear explanations that not only make this material useful to expand the students knowledge base but also to help them better understand fundamental concepts in organic chemistry. This is again exemplified in the chapter on methods for peptide formation.

Once again a good proportion of the book is devoted to examples of peptide synthesis. This is particularly important in a field whereby a significant skill is in learning the strategy of synthesis, in addition to the core knowledge associated with the subject. In some respects one can think of peptide synthesis as a primer itself for introducing students to the strategies and logistics of more complicated synthetic challenges.

In an area that by the nature of the subject suffers more than most from a plethora of often near identical abbreviations and acronyms, a nice touch has been the use of a comprehensive list of abbreviations used throughout the field of peptide synthesis. There are not many books in the field of organic chemistry that do this so extensively.

Overall the book is well written and contains a wealth of information, with perhaps a little too much specific detail in places. It would have been nicer to see some end of chapter questions together with answers that would help students think their way through the book. Without this, many may use this book as a reference work instead, however this should not be taken as a negative point since a concise, well written introduction for a research worker in this field would probably be welcomed as well.

# An Introduction to Modern Cosmology

***Subject area***
Astronomy/Cosmology.

***Description***
An introductory book for third year undergraduates covering key areas of cosmological research today.

***Authors***
Andrew Liddle.

***Publishers/Suppliers***
John Wiley & Sons Ltd (http://www.wiley.com/).

***Date/Edition***
2003/2nd Edition.

***ISBN***
0-470-84835-9.

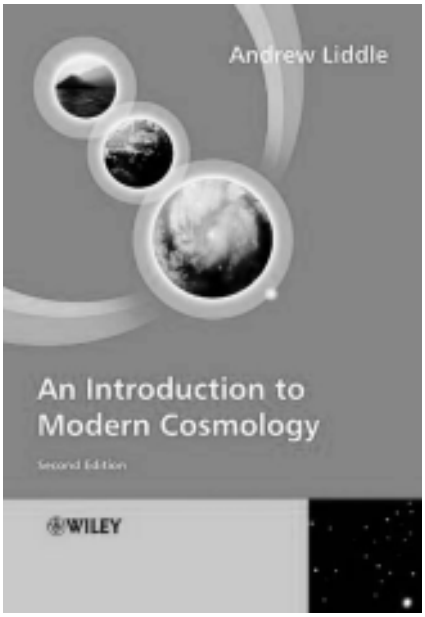
***Level***
Undergraduate.

***Price***
£18.99.

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Meets objectives | ***** |
| Accuracy | **** |

One of the first things that I liked instantly about 'An Introduction to Modern Cosmology' was that it is spread over 15 short chapters and manages to cover most of the core concepts on cosmology today. The main reason for this structure is, according to the author Andrew Liddle, so that it can be easily fitted into an average semester. The book mirrors what he himself teaches. It is a very concise book, yet manages to cover areas such as geometry of the Universe, cosmological models, Hubble parameter, cosmological constant, CMB, density, inflation and the origin of the light elements. There is also an advanced section at the rear of the book which delves deeper into topics such as general relativity, neutrinos and Baryogenesis. At the end of each chapter are problems for the students to solve with the answers or hints being given at the end of the book. One of key things I liked about this book is the listing of common cosmological entities which include a reference to the page where they are derived. Other listings include fundamental constants, conversion factors and further reading, but no glossary which other cosmology books pitched at the same level do include.




Now in its second edition, the author has included more up-to-date research and ideas that affect modern cosmology. Apart from the advanced topics mentioned earlier, the cosmological constant gets a chapter to itself which is an expansion on the paltry one page in the first edition. By keeping the book small and only including necessary black and white images, it is the authors intention to keep the total cost of the book to a minimum (ideal for the students), but by providing a web address, give the students an opportunity to get hold of the full colour images if they so need. This same website also contains a listing of errors and up to date information about the book and cosmology in general. When I visited the site, there were only a few colour images to replace the ones in the book; however a statement on the page ensures that it will be expanded upon in the near future.

'An Introduction to Modern Cosmology' is well written and is structured so the reader can smoothly move from chapter to chapter building up a bigger picture of areas previously covered. It is aimed at the final year undergraduate which is I think appropriate because at this level, the student should be able to tackle the mathematical problems encountered in the main text, although the non-mathematical content could be taught at first and second year.

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May 2004

# Atomic Physics - an exploration through problems and solutions

***Subject area***
General Physics.

***Description***
A guided tour of some of the highlights of modern atomic physics.

***Authors***
D. Budker, D. F. Kimball and D. P. DeMille.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2004.

***ISBN***
0-19-850950-2.

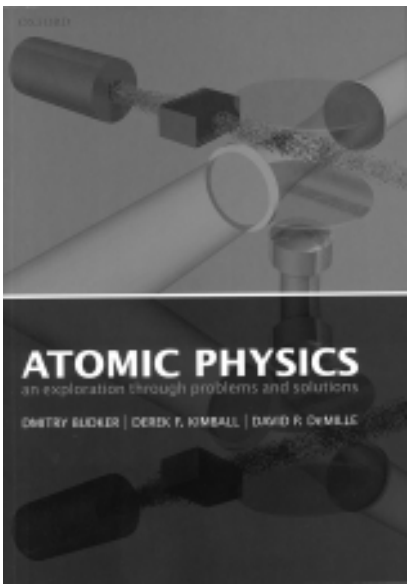
***Level***
Undergraduate, research.

***Price***
£24.95 (http://www.amazon.co.uk/).

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | **** |
| Usefulness to teacher | **** |
| Meets objectives | ***** |
| Accuracy | ***** |

I have often said, and I am far from being alone in this, that while physics courses are usually very good at telling students what the answers are, they are not so informative about what the questions were. True we set exercises after the material had been presented in order to test our students' ability to do the right thing; and in due course after much repetition they learn to do so. Eventually, when they themselves come to teach the material, they begin to understand what it is about. We can make an even simpler observation on the same point from our experience of research: we do not ask beginning research students just to 'read the literature'; we ask them to read it with a question in mind. And for the good reason that the former is impossibly difficult. And, finally, if you have ever been to a seminar on a subject outside of your field, you'll have been most puzzled to grasp exactly what the question was.




All this leads naturally to the notion that we should endeavour to present material to students by posing problems rather than stating theorems. This is the approach of Budker and his colleagues in Atomic Physics. It needs to be said straightaway that the intended audience is basically graduate level, although final year undergraduates may be able to benefit from some of the problems. The book starts with a problem on the ground state of phosphorus and, although it contains such standard material as the Zeeman effect in hydrogen, it proceeds through lasers and quantum optics to molecules and Bose-Einstein condensates with appendices on such matters as irreducible tensor representations. The problems are however independent, so (given sufficient background in quantum mechanics, Hamiltonian dynamics, electrodynamics and thermodynamics) the reader can go straight to the personally relevant material.

The subtitle of the book is 'an exploration through problems and solutions.' The 'and solutions' is important. This is not a collection of 'end-of-chapter exercises' but a guided tour of some of the highlights of modern atomic physics. To this end a number of the problems are treated as tutorial introductions to the subject matter and all have solutions provided. For the problems I looked at I could follow the solutions given, even where I was not familiar with the subject matter. But I doubt that I could have figured out very many of these for myself.

I have always found atomic physics a hard subject; hard to master the details, hard to do calculations; hard to make interesting at undergraduate level. This book is not, as I had misguidedly hoped from the title, a set of introductory problems to address those tasks. But for its intended audience this is a valuable resource. I'm not sure it makes atomic physics less hard, but it certainly makes it interesting.

Derek Raine
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Leicester LE1 7RH
April 2004

# Carbohydrate Chemistry

***Subject area***
Organic Chemistry.

***Description***
Designed as a concise introduction to carbohydrate chemistry, containing material that would normally be covered in an 8-10 lecture undergraduate course.

***Authors***
Benjamin G. Davis and Anthony J. Fairbanks.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2002.

***ISBN***
0-19-855833-3.

***Level***
Undergraduate.

***Price***
£9.99.

Stuart Conway
School of Chemistry and Centre for Biomolecular Sciences
University of St. Andrews
North Haugh
St. Andrews
Fife KY16 9ST
April 2004

## Summary Review

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | **** |
| Meets objectives | ***** |
| Accuracy | ***** |

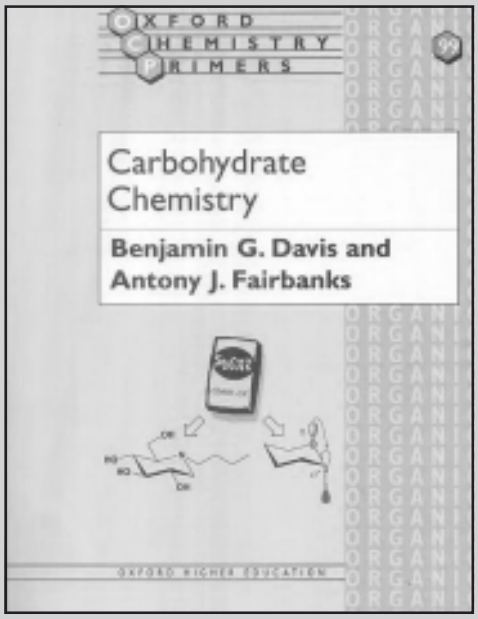
Carbohydrate chemistry is an important section of many undergraduate chemistry degree courses, but is often perceived as being very complex by students. Although this topic is treated well in general organic chemistry text books, there is often not sufficient space to cover this important area in the required detail[1]. This primer seeks to address both these problems and starts by concentrating on the fundamentals of carbohydrate chemistry. The authors spend some time attempting to dispel the 'complexity myth' surrounding carbohydrate chemistry by continually returning to the theme of the chemistry of complex molecules (such as sugars) being only the sum of the chemistry of the functional groups contained within the molecule. Written by two leaders of British carbohydrate chemistry, this book has an engaging and modern tone which renders it very readable and assists in the clarity with which examples are presented.

The book comprises nine chapters:
1. Introduction
2. Open chain and ring structure of monosaccharides.
3. Reactions of the anomeric centre Part I.
4. Reactions of the hydroxyl groups Part I.
5. Reactions of the anomeric centre Part II.
6. Reactions of the hydroxyl groups Part II: cyclic acetals.
7. Chemical disaccharide formation.
8. Enzymatic disaccharide formation.
9. Chemical glycobiology.

Chapter 2 deals with the structure of individual sugars and the fact that sugars can exist in either an open chain or closed ring form. This chapter contains a good explanation of how to draw sugars, which is augmented by some useful problems at the end of the chapter. In addition, an excellent appendix guides the reader through ways of representing the complex 3-D structure of sugars on a flat page and how to interconvert between the various representations that have been developed (Fischer projection, Haworth projection etc). For undergraduate students the book is worth buying for this chapter and appendix alone. Chapters 3-6 cover the basic chemistry of carbohydrates, clearly explaining the reactions involved. All reactions are discussed by considering their mechanism, often with a general, non-sugar example, to simplify matters. A basic level of organic chemistry knowledge is assumed and readers that are not sure of general stereochemical terms and rules (enantiomer, diastereomer, CIP rules etc) would be advised to brush-up their knowledge before reading this text, although helpful reminders are included in the margin. Chapter 7 takes the compounds 'synthesised' in chapters 2-6 and uses them to discuss the chemistry of glycosylation reactions. The problems associated with this reaction and some methods of solving them are discussed here. Chapter 8 complements chapter 7 by discussing enzyme mediated disaccharide formation. Importantly, the mechanisms of the enzymes are clearly described so as to emphasise that enzymes are no different to other catalysts used in chemistry. Chapter 9 provides a taste of the field of glycobiology and why sugars are such important molecules in nature. Each chapter concludes with some useful problems and a summary list of what the reader should have gained from reading the chapter.

*Continued on page 8*

# Carbohydrate Chemistry




## From the publisher...

**Carbohydrate Chemistry**

*B. G. Davis, Dyson Perrins Laboratory, Oxford University, and Antony J. Fairbanks, Dyson Perrins Laboratory, Oxford University*

Carbohydrates are a vital part not only of metabolism, but are implicated as key coding molecules in a host of subtle biological events. The exploration of the role and the manipulation of this wonderful class of molecules is an exciting and ever changing field. This primer seeks to strip off some of the mystery that often surrounds carbohydrate chemistry, a subject taught in all undergraduate courses, by highlighting and summarizing some of the central principles and ideas and by illustrating them with both classical and state-of-the-art examples.

*0-19-855833-3 104pp 2002 £9.99*

*Continued from page 7*

Minor criticisms of this book are that chapters 3 and 4 proceed at a pace that weaker students may find confusing. Additionally, I feel that more time could have been spent on the anomeric effect. Although the section included is very clear and well explained, I think more examples need to have been included; one page in a book dedicated to carbohydrate chemistry is not really enough. These comments aside, this is an excellent book for the purpose it is intended. I am certain that all undergraduates studying carbohydrate chemistry will find this text invaluable. PhD students who are not researching in this field will also find this book a useful refresher. Whilst the tone of the book is clearly aimed at undergraduate students, this book will provide a useful update for professional chemists who wish to revise their carbohydrate chemistry. Those teaching a course on carbohydrate chemistry should consider recommending this book, and may find useful and well thought-out examples in it.

Although there are a number of more detailed books on carbohydrate chemistry[2,3] with an absence of other tutorial texts on this subject, this book does not have any obvious immediate competition, but this is not a problem as it is very good. Overall I would recommend this book to those studying, teaching or interested in carbohydrate chemistry.

**References**

1. (For example) Clayden, J., Greeves, N., Warren, S. & Wothers, P. *Organic chemistry* Oxford University Press, Oxford (2001).
2. Collins, P. & Ferrier, R. *Monosaccharides: Their chemistry and their roles in natural products* John Wiley & Sons, Chichester (1995).
3. Robyt, J. F. *Essentials of carbohydrate chemistry* Springer-Verlag, New York (1998).

# Chemical Analysis in the Laboratory - A Basic Guide

***Subject area***
Analytical Chemistry.

***Description***
An Introduction to Chemical Analysis.

***Authors***
I. Mueller and R.M. Baker.

***Publishers/Suppliers***
The Royal Society of Chemistry (http://www.rsc.org/).

***Date/Edition***
2002.

***ISBN***
0-85404-646-1.

***Level***
Undergraduate.

***Price***
£18.95 (http://www.amazon.co.uk/).

Ron Cole
School of Applied Medical Sciences and Sports Studies
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Jordanstown
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Co. Antrim BT37 0QB
April 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

The forward to the book says: "There are many good analytical textbooks now available, however most concentrate on a detailed discussion of analytical techniques". By this the authors are making it clear that this is not their aim.

The description given on the back cover outlines the aims: "The aim of this book is to provide basic training in the whole analytical process for students, demonstrating why analysis is necessary and how to take samples, before attempting to carry out any analysis in the laboratory. This is followed by a look at issues of quality control and accreditation and the basic equipment and techniques that are required. Throughout, safety issues are addressed, and examples and practical exercises are given."

Does it fulfil its aims?
Should it be a recommended text for those studying analytical chemistry?

With the time constraints placed on our laboratory classes we expect the students to become familiar with analytical techniques and emphasise accuracy and good handling techniques but do we give the preliminary preparations enough importance?

For those of us involved in Industrial Placement it is very obvious that the employers soon ensure that they are introduced to Good Laboratory Practice and all it involves.

The book could be considered to emphasise good practice. It is divided into five chapters:

**Chapter 1: Getting organised for Useful Analytical Results.**
This chapter discusses the importance of making sure that there are no misunderstandings of what is required, that records are kept, that costings are undertaken and suitable methods are available for the proposed analysis.

These considerations set the scene and then a number of problems are presented to allow the reader to apply the principles outlined.

**Chapter 2: The Sampling Plan, Sample Collection and Preparation**
This must be central to good analysis and it would be good to think that it is central to all studies of analytical methods. But is it actually undertaken? If it is this chapter will provide an excellent introduction to the subject before it is undertaken, otherwise it will provide an insight into the way samples should be collected and prepared.

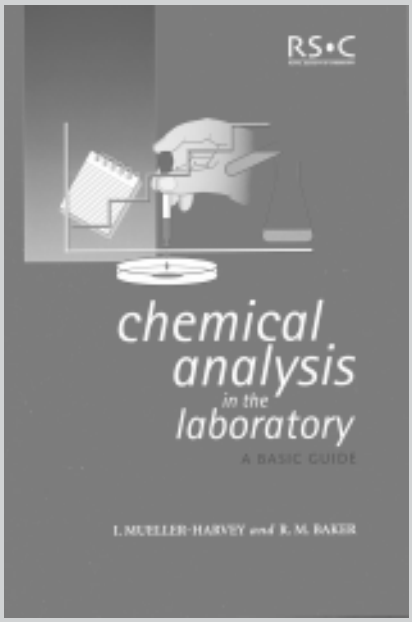
Once again suitable exercises are provided.

**Chapter 3: Planning the work in the Laboratory**
All to often time rules our laboratory programme. We provide laboratory work sheets, sometimes combined with pre- and post-laboratory exercises with all the necessary reagents provided.

This chapter outlines the steps required for planning the laboratory work. The exercises associated with this chapter look at hazards and good working practice as well as consideration of the apparatus and reagents needed.

*Continued on page 10*

# Chemical Analysis in the Laboratory - A Basic Guide




## From the publisher...

**Chemical Analysis in the Laboratory: A Basic Guide**

*I Mueller-Harvey, R M Baker.*

The aim of this book is to provide basic training in the whole analytical process for students, demonstrating why analysis is necessary and how to take samples, before they attempt to carry out any analysis in the laboratory. Initially, planning of work, and collection and preparation of the sample are discussed in detail. This is followed by a look at issues of quality control and accreditation and the basic equipment (eg. balances, glassware) and techniques that are required. Throughout, safety issues are addressed, and examples and practical exercises are given.

*0-85404-646-1 92pp 2002 £18.95*

*Continued from page 9*

**Chapter 4: Weights and Measures**
Do we have to admit that we only touch on the subjects treated in chapter1-3?

The subjects considered in this chapter are ones that we have all spent a great deal of time over, but are often poorly understood by students: units (their meaning and relationships to one another), accuracy & precision, care and use of balances and glassware and validating results.

**Chapter 5: Determinations**
This takes some examples and looks briefly at the essential aspect of using atomic absorption and colorimetric measurement.

I posed two questions as I started and I would now like to answer them.

Does it fulfil its aims?
Should it be a recommended text for those studying analytical chemistry?

I would like to suggest that the answer to both questions is “yes”.

This is a very readable book that covers the essential aspects of analysis in approx. 80 pages and fills the gaps that many larger books leave.

Students and teachers should find this book useful.

# Chemistry: Structure and Dynamics

***Subject area***
General Chemistry.

***Description***
A textbook to support and supplement undergraduate courses in introductory general chemistry.

***Authors***
James N. Spencer, George M. Bodner and Lyman H. Rickard.

***Publishers/Suppliers***
John Wiley & Sons Ltd (http://www.wiley.com/).

***Date/Edition***
2003/2nd Edition.

***ISBN***
0-471-45279-3.

***Level***
Undergraduate.

***Price***
£29.95.

Julian Perfect
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Department of Chemical Engineering
Torrington Place
London WC1E 7JE
May 2004

## Summary Review

range: * very poor to ***** excellent

| | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

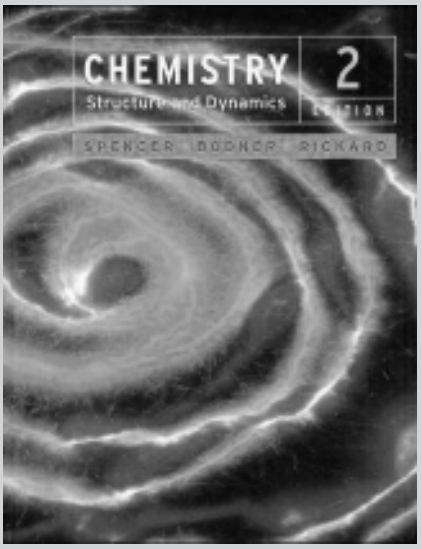
This book was written for first year undergraduates taking introductory chemistry courses and covers the fundamental concepts that are necessary for a deeper understanding of chemistry. The hardcover volume consists of core material in the form of fifteen chapters, seven of which are supplemented by associated chapter appendices (called "Special Topics") for further reading on related subjects. The book is also supposed to be accompanied by additional material in the form of a pack of optional modules that include such subjects as biochemistry and polymer chemistry, although this material did not accompany the review copy and it does not appear to be available with the book when ordering it from suppliers in the UK. The core material is free-standing, however, provided that the chapters are read sequentially and the authors suggest that an advantage of organising the book in this way (i.e. core, appendices and modules) is that it provides greater flexibility for its use by students studying for courses with differing curricula than is provided by "..both the traditional 1000-page texts and new shorter texts".

The book is written is a concise style that is easy to read and it contains little, if any, superfluous material. The students' understanding of the various concepts introduced in the text is assisted by the presence of a combination of "Checkpoints" and "Exercises" which make the book particularly suitable for self-study. Checkpoints are self assessment questions situated in the margins of the text that encourage the reader to pause and check their understanding of a topic before moving on to the next one, while Exercises are examples of relevant problems, with accompanying solutions, that are embedded in the main body of the text. There are also plenty of problems at the end of each chapter which are conveniently grouped under headings that correspond to those used in the chapter, and these are followed by a number of integrated problems. Answers to a selection of these problems, and all of the Checkpoints, are included in separate appendices at the end of the book, along with a very useful appendix that deals with units, errors, significant figures and the graphical treatment of data. A further appendix contains important chemical and physical data, and the final chapter of the book introduces the student to the most commonly encountered analytical techniques (high-performance liquid and gas chromatography, mass spectrometry, electrophoresis, uv/visible and infrared spectroscopy, nuclear magnetic resonance, atomic absorption spectrometry and potentiometry) by reference to some interesting case studies.

When producing this second edition of the book the authors took note of feedback from readers of the first edition. Two points upon which they received comments were the durability and cost of the book. The former point was addressed by releasing this second edition as a hardback volume, and its price (in the UK) is significantly less than some comparable textbooks (e.g. 'Chemical Principles: The Quest for Insight' by Peter Atkins and Loretta Jones, and 'Chemistry: An Introduction to Organic, Inorganic and Physical Chemistry' by Catherine Housecroft) although the lack of availability of the Structure and Dynamics modules pack in the UK also needs to be considered when comparing these books. However the perceived need to keep production costs of the book down may also have resulted in a few minor shortcomings in its presentation.

*Continued on page 12*

# Chemistry: Structure and Dynamics




## From the publisher...

**Chemistry: Structure and Dynamics**

*James N. Spencer, George M. Bodner, Lyman H. Rickard*

The second edition of Spencer's Chemistry: Structure and Dynamics has been the most successful reform project published for the General Chemistry course. The authors have revised the text, by building on the recommendations of the ACS's Task Force on the General Chemistry Curriculum and suggestions from the adopters of the first edition. This innovative text provides a fifteen-chapter introduction to the fundamental concepts of Chemistry. A collection of additional topics at the end of each chapter allow instructors to supplement and tailor their courses according to individual need. Three major themes link the content of the book: the process of science, the relationship between molecular structure and physical/chemical properties, and the relationship between the microscopic and macroscopic levels.

*0-471-45279-3 832pp 2003 £29.95*

*Continued from page 11*

The use of colour for diagrams and text is limited to shades of blue. While limiting the use of colour is not in itself a bad thing (many current textbooks make excessive use of it), the use of more than one different colour would have been beneficial. It is known that certain colours (e.g. red) are more effective at drawing the attention than others[1]. Also, the fly-leaf at the front of the book contains a periodic table that has been printed vertically, which necessitates rotating the book to refer to it. A more satisfactory arrangement would have been to display a larger periodic table, which could contain more information about the individual elements, horizontally across both halves of the fly-leaf. Furthermore some use of colour coding (e.g. for groups or metals/non-metals/metaloids, etc.) in this periodic table would have been appropriate. There are also a few instances where diagrams appear on the following page to that on which they need to be referred, and yet it is not at all clear as to why this may have been considered necessary by the publishers.

Leaving aside the few minor criticisms made above this is an excellent book, and I would certainly recommend its use with appropriate courses. In the UK such courses are most likely to be introductory chemistry courses that form part of the degree programmes of other subjects or disciplines. Although the target audience is that of first year undergraduates the amount of prior knowledge of chemistry that the book assumes a reader will have is sufficiently modest that the book could also be used to considerable advantage by A-level students. Given the current trends in the publishing of chemistry textbooks I was initially a little surprised that this book was not accompanied by a CD. However it soon became clear that no obvious purpose would have been served by including a CD, and by the time that I had finished my reading of it the lack of the requirement for a computer to access additional material was a definite advantage. In the 'developed world' we undoubtedly now take the use of computers for granted, so it is certainly to the credit of this book that it could also be used with no apparent disadvantage by those who are learning or teaching in any parts of the world that remain less well resourced.

**Reference**

1. Child, Dennis *Psychology and the Teacher* Cassell Educational Ltd, London. Fourth edition, pp 68-9 (1992).

# Foundations of Science Mathematics and Worked Problems

***Subject area***
Mathematics.

***Description***
Two books in the Oxford Chemistry Primers series which cover the mathematics needed by science students with the companion volume giving worked examples.

***Authors***
D.S. Sivia and S.G. Rawlings.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
1999.

***ISBN***
0-19-850428-4 (primer),
0-19-850429-2 (workbook).

***Level***
Undergraduate.

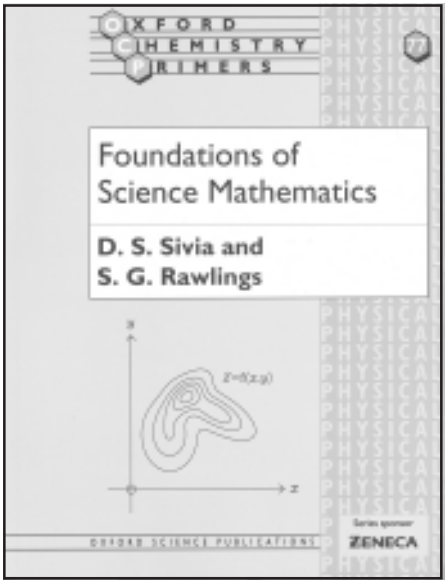
***Price***
£9.99 each
(http://www.amazon.co.uk).

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | **** |
| Usefulness to student | **** |
| Usefulness to teacher | *** |
| Meets objectives | **** |
| Accuracy | **** |

The title of these books suggest that they have been written to target a wider audience than only undergraduates in chemistry or chemical science. Indeed the books may be of interest to students of physics or related courses. However, this review will focus on their usefulness to chemistry students - given that they form part of the successful and popular Chemistry Primers series.

The book(s) aim to "bridge the gap between school and university" in covering a wide range of mathematics topics. In this they are, I feel, only partly successful. A wide range of topics is covered and certainly there is coverage of all the topics that might be needed on chemistry degrees. Indeed, some of the topics (e.g. Fourier series) would not be covered or necessary in many courses. The depth of coverage is also appropriate.




However, this means that the speed with which the book moves is very fast. For example, the first book starts on pg 1 with elementary algebra and priority of multiplication, addition etc. but by page 3 we have dealt with quadratic equations and are well on our way to solving simultaneous equations! The first text contains no worked examples; these are provided in a separate book. This means that to be useful, both must be purchased. There are though a good number of exercises with answers to provide practice for students. A good number of examples are provided in the second text but relatively few of these were provided with any chemical context.

The "problem" of mathematics support in chemistry courses is one that is familiar to most lecturers. So, will these books help to address the problem? I think that it might be a useful text for students already well qualified in school mathematics to remind them of the important concepts and to provide extra study examples. However, I do not feel that it could be used for the (increasing) number of students without good A-levels or equivalent. The material is presented too quickly and there is little to build up their confidence in the basics as they move to more complex concepts.

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May 2004

# Mathematical Techniques

***Subject area***
Mathematics.

***Description***
Comprehensive coverage of mathematics useful to undergraduates in the physical sciences and engineering.

***Authors***
D. W. Jordan and P. Smith.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2002/3rd Edition.

***ISBN***
0-19-924972-5.

***Level***
Undergraduate.

***Price***
£26.99 (http://www.amazon.co.uk/).

John Leaver
10 Willow Bank Drive
Bollington
Macclesfield
Cheshire SK10 5DG
April 2004

## Summary Review

range: * very poor to ***** excellent

| | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

This book is very effectively summed up by its title and sub title. It is aimed at undergraduates in engineering and the physical sciences but would also be useful to mathematicians as a readily accessible summary of useful applied mathematics. The 'physical sciences' here lean rather towards physics than chemistry; however chemists will still find much useful material present. The book is divided into eight sections, the first of which contains a very useful coverage of relevant basic mathematics, much of which would be familiar to an A-level mathematics student; and which will be very helpful to those whose knowledge of some particular area of mathematics at this level has become 'rusty'. The content of the book is very well planned and the mathematical techniques covered are presented with sufficient information and examples to make them readily intelligible but without being weighed down by excessive amounts of mathematical background material. The authors are very effective at getting straight to the point on the various topics they cover and this should make it a very popular book with physical science students who want to make use of the mathematics as a tool (because they have been given a scientific problem which requires mathematical knowledge for its solution), rather than study it as a subject in its own right.

As mentioned the book is in eight sections, the first has already been alluded to and the others cover differentiation, complex numbers, matrix algebra and vectors, integration and differential equations, transforms and Fourier series, multivariable calculus, discrete mathematics, probability and descriptive statistics, with the final section (which is relatively short), on applications projects using symbolic computing. The quality of presentation is excellent throughout; the text is very clearly written, all diagrams are clearly produced and relevant to the text. The book provides many (more than five hundred) clearly explained examples to elucidate the mathematical topics being covered. Considering its size, more than 800 pages, Mathematical Techniques stands out for having a complete absence of irrelevant, irritating or superfluous content; there is no waffle and every topic is clearly and concisely explained. The sections are also well provided with problems to allow students to determine the extent to which they have grasped a given topic. The solutions to the problems are provided on an accompanying website. Unusually, I have no weaknesses or dislikes to point out; this is the best mathematics book of its type that I have encountered.

As someone who has, from time to time, been distressed by the weak mathematical knowledge of some science students, I would thoroughly recommend this book both to students (please obtain a copy and make use of it, it will accelerate your progress in engineering, physics etc and make the lives of your lecturers less frustrating) and to their tutors (have a copy available in your office it will be a valuable aid to helping your students move forward when they encounter a mathematical stumbling block). It is pleasant to be able to recommend a book wholeheartedly and I would like to congratulate the authors on having created such a useful resource!

# Modern Classical Optics

***Subject area***
Physics.

***Description***
This book gives a non-quantum account of optics, some of its applications and a very comprehensive set of problems with their solutions.

***Authors***
Geoffrey Brooker.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2003.

***ISBN***
0-19-859965-X.

***Level***
Undergraduate.

***Price***
£24.95.

| Summary Review | |
|---|---|
| range: * very poor to ***** excellent | |
| Academic content | *** |
| Usefulness to student | **** |
| Usefulness to teacher | ***** |
| Meets objectives | **** |
| Accuracy | **** |

The four year M. Phys. degree in physics has made more time for students to study some aspects of physics in greater depth than is possible in a three year course, and also the time to study recent advances in physics. This book is intended for students in the fourth year of an M. Phys. degree course. It provides the material for a more extensive treatment of physical optics than that available in traditional optics textbooks. The book is not intended to be a replacement or competitor to the traditional optics texts used in the first or second year of a course. Indeed it is assumed that the reader is familiar with the level reached in a 3 year physics degree and has a strong mathematical background. The style is clear and modern. All the mathematical results are stated although the derivations are often omitted, but then form the basis of a problem at the end of the chapter. This makes the book easier to read. There are appropriate references throughout the book.

The title of the book is a good indication of the content of the book, which gives a non-quantum account of optics, some of its applications and a very comprehensive set of problems with their solutions. There are 16 chapters in this book of nearly 400 pages. At the end of each chapter there are problems and these account for 138 pages of the book with an additional 37 pages devoted to hints for the solution and the answer to some of the questions. Extensive use is made of the problems to supplement and extend the explanations given in the main text. The problems are graded a, b or c for difficulty and e for problems for 'entertainment'. Throughout the book there are numbered comments in the wide edge margin to each page. These notes vary in length from reference to an end of chapter problem, to a fuller explanation about a point or word in the main text. This has the benefit of keeping the main text free of non-essential material.

The first chapter is devoted to a brief resumé of electromagnetism and the ray optics of lenses necessary for the rest of the book. In the second chapter Fourier series and transforms are reviewed. The main content of the book starts in the following chapters where the conventional topics of diffraction, the Fabry-Perot, thin films and coherence are treated in depth. The less common topics such as Gaussian beams, optical cavities, image formation are followed by chapters on optical fibres, polarization and the modern optical devices namely the CD/DVD and the confocal microscope.

A welcome feature of the book is that some of the practicalities of instrument design, such as the factors that determine the optimization of optical instruments, the physics that limit their performance, and the measurement of their performance when built, are considered at appropriate places in the text. This is done either by specific examples or by a general discussion when there are a large number of factors to consider. The necessary compromises in optical component design are also mentioned. The details of design and optimization are however beyond the scope of this book. References to useful publications about particular components are provided.

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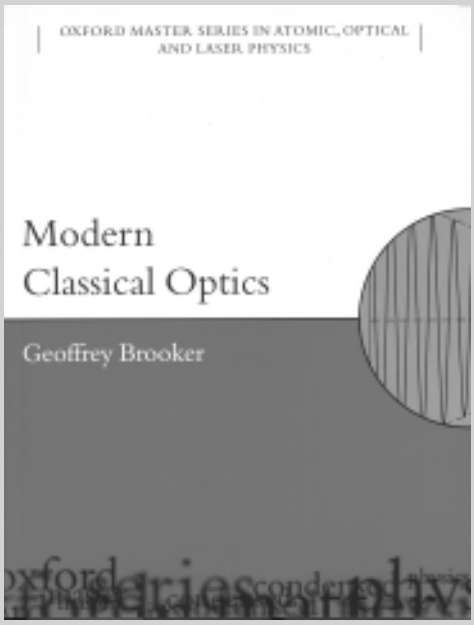
April 2004

*Continued on page 16*

# Modern Classical Optics




## From the publisher...

**Modern Classical Optics**

*Geoffrey Brooker, Department of Physics, University of Oxford*

Describes principles and phenomena at a down-to-earth level
Fundamental principles are subjected to unusual searching scrutiny, which will enhance both the reader's understanding and critical faculty
Standard material is presented with a fresh slant
Addresses the important modern topics of étendue, Gaussian beams and laser cavities, the system for reading a compact disc and the confocal microscope which are under-represented in other textbooks aimed at a similar level
Geared towards undergraduate students in the final years of their physics degree, as well as to graduate students studying optical physics, either for itself or as support for instrumentation or as a tool in atomic and laser physics

*0-19-859965-X 412pp 2003 £24.95*

*Continued from page 15*

This book is excellent as an undergraduate text for the fourth year of an M. Phys. course and could provide plenty of material for discussion in tutorial sessions. It is also suitable as a reference for undergraduate project students and beginning graduate students and others who seek a deeper understanding of optics. There is certainly more material in this book than could be covered in a one semester course but different courses can make different selections.

# Particle Astrophysics

***Subject area***
Astronomy and Particle Physics.

***Description***
This book is designed to present the twin fields of elementary particle physics and astrophysics at a level suitable for undergraduate students in physics.

***Authors***
D.H. Perkins.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2003.

***ISBN***
0-19-850952-9.

***Level***
Undergraduate.

***Price***
£22.95 (http://www.amazon.co.uk/).

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | **** |
| Usefulness to student | **** |
| Usefulness to teacher | *** |
| Meets objectives | **** |
| Accuracy | ** |

Particle astrophysics (PAP) is rapidly establishing itself as a branch within physics in its own right. For many years work in this area was seen as not-quite particle physics and not-quite astronomy and sat uncomfortably between these two established areas with consequent difficulties in recognition and obtaining research funding. The recent establishment of a separate funding stream within PPARC for particle astrophysics is perhaps confirmation that, at last, PAP is recognised.

Donald Perkins will be known to many as a senior high-energy experimental particle physicist who has been able to present particle physics in a form that is easily accessible to undergraduates. His textbook Introduction to High Energy Physics (4th ed., Cambridge University Press, 2000) has been a classic for many years; I was introduced to it as an undergraduate and its new editions have been added to my bookshelves as they have appeared – frequently to replace copies that have 'gone missing'.

The emergence of particle astrophysics lends itself to featuring in an undergraduate physics course and so a textbook covering this area should be welcome. The present book is designed to "present the twin fields of elementary particle physics and astrophysics at a level suitable for undergraduate students in physics"; by concentrating on selected topics and avoiding the use of general relativity and quantum field theory the author has succeeded in producing a text that should be accessible to all physics undergraduates. Chapters include

1. Quarks and leptons and their interactions
2. The expanding universe
3. Conservation rules and symmetries
4. Dark matter and dark energy in the Universe
5. Development of structure in the early Universe
6. Cosmic particles
7. Particle physics in the stars

The author uses a very readable style, concentrating on physical rather than mathematical understanding. It includes useful worked examples and a good set of varied problems (with solutions) at the end of each chapter. More challenging problems are flagged up for the reader. The author also adopts current pedagogic practice by including summaries at the end of each chapter. There is a useful set of references and bibliography which should lead a student researching an essay or project in this area into the literature.

The book is written assuming that the reader has some knowledge of special relativity and quantum mechanics. In this the author succeeds; however, the necessarily brief treatment of the fundamentals of elementary particle physics and basic astrophysics will make the book more accessible to a student who has already had some exposure to these topics.

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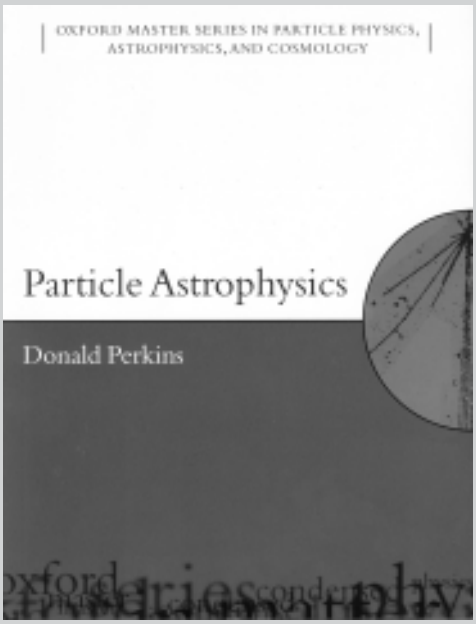
May 2004

*Continued on page 18*

# Particle Astrophysics




## From the publisher...

**Particle Astrophysics**

*D.H. Perkins, Department of Physics, University of Oxford*

This book presents in a single text the latest dramatic developments in the related fields of elementary particle physics and the astrophysics of the early universe. Both experimental and theoretical aspects are presented at a level suitable for the average physics undergraduate.

*0-19-850952-9 268pp 2003 £22.95*

*Continued from page 17*

My main concern about the book is that it contains a number of glaring errors, particularly apparent in the chapter on Cosmic Particles. Some of the most serious are

1. Fig 6.13 is a map of the very high energy sky (> 100 GeV), not that detected by EGRET (> 100 MeV). EGRET has, of course, detected at least 270 point sources, not the six shown in the figure.
2. The treatment of gamma ray bursts (Section 6.8) is flawed. The author seems to have confused two separate phenomena - gamma ray bursts and gamma ray emission from AGNs. Blazars are a category of AGNs which exhibit rapid variability in some wavebands, which includes the TeV gamma ray region, where variation on time scales as short as 10 minutes has been observed.
3. The section on fluorescence from air showers (Section 6.5.3) will also confuse, if not mislead, the reader. The Whipple Observatory uses the air Cerenkov technique to detect VHE gamma rays – and was not the first system to do so. The fluorescence technique is used at much higher energy by facilities such as the Fly's Eye to detect the highest energy cosmic rays. What the Whipple facility did do was pioneer the single-telescope imaging technique to separate VHE gamma rays from the background of cosmic rays.

The presence of such errors must unfortunately limit the usefulness of this book and I am afraid I would have reservations about recommending it for student use.

# Practical Laboratory Skills Training Guides

***Subject area***
Analytical Chemistry.

***Description***
Guides to measuring Mass, Volume, pH, Gas Chromatography and High Performance Liquid Chromatography.

***Authors***
Elizabeth Prichard (Co-ordinating author).

***Publishers/Suppliers***
Royal Society of Chemistry (http://www.rsc.org/) in conjunction with Valid Analytical Measurement.

***Date/Edition***
2003.

***ISBN***
0-85404-463-9, 0-85404-468-X, 0-85404-473-6, 0-85404-478-7, 0-85404-483-3.

***Level***
Undergraduate.

***Price***
£69.75 for complete set, £9.95 each for Measurement of Mass, pH or Volume, £19.95 each for GC or HPLC.

Elizabeth Barron
Science Dept.
Inverness College
Midmills Campus
Crown Ave.
Inverness IV2 3NF
February 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

This selection of Lab Skills books is ideal for introducing students to analytical chemistry and lab skills. They cover a good range of topics, from mass measurements to HPLC, but all in separate 'notebook' sized publications. This format is great for practical classes where students may need to borrow one of the books or work at different 'stations'. They cover all the relevant information whilst still being easy to understand.

Mass measurement is covered in detail in the first volume (Measurement of Mass, Richard Lawn - ISBN 0854044639), with units, terminology and types of balance clearly explained. It also covers location, calibration and use of the balance with several practical exercises to put into practice what has been learned.

The 'Measurement of Volume' book (Richard Lawn - ISBN 085404468X) covers bulb and graduated pipettes, burettes, automatic pipettors, volumetric glassware, graduated cylinders and syringes. It also stresses the importance of temperature, calibration and accuracy and has several practical exercises that cover accuracy, repeatability, delivery time and dilution precision.

'Measurement of pH' (Richard Lawn - ISBN 0854044736) is a particularly well explained volume. A useful book to have when many first years can struggle with both principles and measurements! Buffers are also well covered, in addition to pH electrodes - their care and selection for particular applications.

'Gas Chromatography' (Brian Stuart - ISBN 0854044787) is great book for those beginning to use GC. It begins with a basic overview and then goes on to give tips and requirements for carrier gas, injection and sampling, columns, temperature regimes, detectors, data handling, checks and standards. There is also a very useful troubleshooting section followed by some well designed practicals that illustrate the basics very well.

On the same lines, 'High Performance Liquid Chromatography' (Win Fung Ho and Brian Stuart - ISBN 0854044833) begins with the basics then goes on to outline the options for the variables such as mobile phase, pumps, injectors, columns and detectors. The section covering system parameters and suitability checks is particularly well structured - as is the HPLC test. External and internal standards are covered and again - there is the useful problem solving section near the end.

The last two books also have a guide to finding further information as well as listed references. (Useful, but could be expanded slightly further.)

My only complaint is that there aren't more of these books! (Then I could just give them to my students and go home...)

(These training guides were supported under contract with the Department of Trade and Industry as part of the National Measurement System Valid Analytical Measurement (VAM) programme. The guides were written by staff at LGC in collaboration with members of the SOCSA Analytical Network Group.)

# Relativity Visualized

***Subject area***
General Physics.

***Description***
An introductory text for Special and General Relativity presented via a series of diagrams hand drawn by the author.

***Authors***
Lewis Carroll Epstein.

***Publishers/Suppliers***
Insight Press, San Francisco (http://www.appliedthought.com/InsightPress/index.html).

***Date/Edition***
1997.

***ISBN***
0-93-521805-X.

***Level***
A-level, access, undergraduate.

***Price***
$17.95 (+ $2.95 shipping).

This is a delightful book running to 206 pages with several diagrams on most pages. The theory of Special Relativity, Big Bang, Gravity and Curved Space are all introduced via a series of illustrations drawn by the author. The presentation given in the text regarding the cause of Gravity and 'Space Warped' serve as a plausible introduction to General Relativity.

**Summary Review**

range: * very poor to ***** excellent

| | |
|---|---|
| Academic content | **** |
| Usefulness to student | ***** |
| Usefulness to teacher | **** |
| Meets objectives | ***** |
| Accuracy | ***** |

Formulae and algebra are kept to a minimum and the only small section using simple calculus appears in a box labelled 'teachers only'.
Any A-level student following an option involving Special Relativity would be well advised to read this book as a way of extending their study without any fear of being troubled by the mathematics one usually associates with Relativity. Indeed I would argue that their teachers/tutors should be directing them to this text prior to moving onto something like Adams (1997) .

For undergraduate students new to Relativity this really should be the starting point since it will both make them think about the fundamental concepts and question their understanding. Too often, I feel, students hide behind their ability to solve problems in relativity, for example length contraction and time dilation, by using the mathematics rather than by understanding the concepts that lie behind the mathematics. This unique book takes the reader on a very gentle journey towards just such an understanding dealing with the concepts and introducing the philosophy required to think through each situation. For example, when introducing the limiting value of 'c' no mention of Maxwell's equations here, but rather a simple 'story':

"Why can't you travel faster than light? the reason you can't go faster than the speed of light is that you can't go slower. There is only one speed. Everything, including you, is always moving at the speed of light ...."

This is then used to develop the notion of space-time and the slow running of moving clocks. The development taking place via a series of diagrams which really do make things clear.

The questions at the end of sections follow a similar style to that in the text with the emphasis of thinking through the logical reasoning for the answer rather than the mechanical processing of data. For example:

Suppose that one day you come across a thing moving backwards in time. Could you recognise that it was moving backwards?

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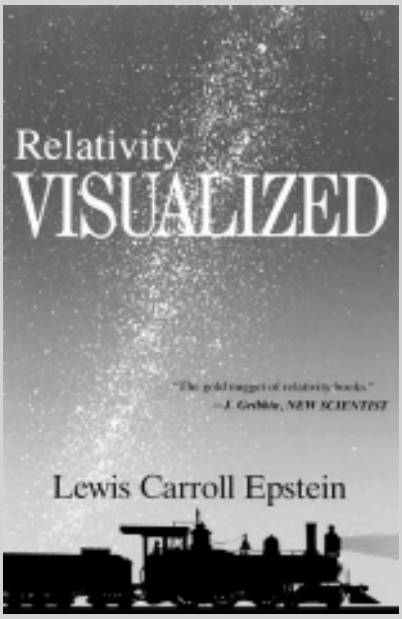
Matthew Arnold Building
Loughborough University
Loughborough
Leicestershire LE11 3TU
April 2004

# Relativity Visualized




## From the publisher...

**Relativity Visualized**

*Lewis Carroll Epstein*

Why can't you travel faster than light? The reason you can't go faster than the speed of light is that you can't go slower. Everything, including you, is always moving at the speed of light. How can you be moving if you are at rest in a chair? You are moving through time. Why are clocks moving through space perceived to run slower and slower as they travel faster and faster? Because a clock properly runs through time, not through space. If you compel it to run through space, it is able to do so only by diverting some of the speed it should use for traveling through time. As it travels through space faster and faster, it diverts more and more speed. How much speed can it possibly divert? The clock can divert ALL its speed. Then it is going through space as fast as it possibly can, but there is nothing left for traveling through time. The clock stops ticking. It stops aging.

*0-935218-05-X 206pp 1981 $17.95*

This obviously needs the reader (student) to think through the situation and offer an explanation which can be used to elicit understanding. Having built the foundations for understanding teachers/lecturers and students should all be better placed to share the more traditional mathematical description of Special and General Relativity.

Due to the sparing use of even simple mathematics no student should feel the need for any pre-requisite study before starting out on a study of Relativity.

Whilst the book appears fresh and new it is interesting to note that it first appeared in 1981 and the eight reprints speak highly of its impact. However, unless used as suggested above I am unsure how it would fit into a typical UK Higher Education programme where the mathematical demand remains so much higher.

# Structure and Dynamics: An atomic view of materials

***Subject area***
Physics, Materials Science.

***Description***
Structure of solids at the atomic level, with treatments of symmetry, binding, lattice dynamics, and phase transitions.

***Authors***
Martin T. Dove.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2003/1st Edition.

***ISBN***
0-19-850678-3.

***Level***
Undergraduate, research.

***Price***
£24.95 (http://www.amazon.co.uk/).

Tony Harker
Department of Physics
and Astronomy
University College London
Gower Street
London WC1E 6BT
April 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | **** |
| Usefulness to teacher | ***** |
| Meets objectives | **** |
| Accuracy | **** |

Oxford University Press launched its Master Series in Condensed Matter Physics into a field which already contains many well-established and well-respected introductory texts on Condensed Matter Physics, and it is worth asking what this series offers that the other texts do not. The clue lies in "well-established": despite continuous programmes of revision the repertoires of examples used in the classic texts tend to remain the same, with the consequence that the subject sometimes seems to have come to a halt three-quarters of the way through the 20th century. The Master Series, as exemplified here by Martin Dove's book, is remarkable for its discussion of recent work: here is clearly a subject that continues to thrive and evolve.

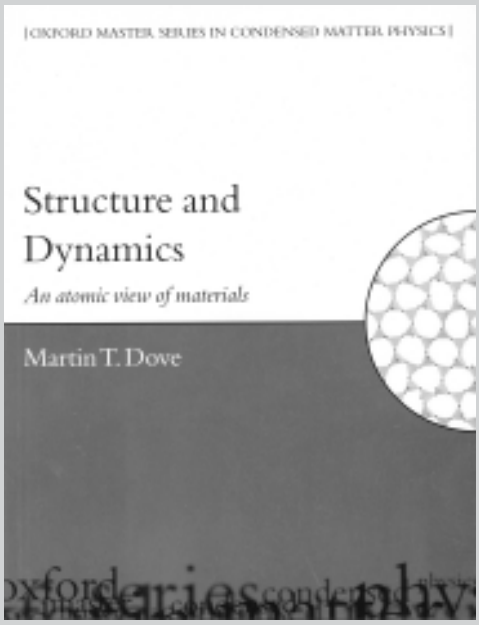
This book begins with the structure of solids, emphasising the underlying symmetries of crystals but giving ample space to amorphous and quasicrystalline forms. In discussing the forces which hold the materials together the electronic structure of solids is briefly addressed. Techniques for structure determinations are covered in detail, with descriptions of up-to-date experimental facilities including synchrotrons for X-rays and spallation sources for neutrons. The level is described as suitable for final year undergraduates or first year graduates: for the former it is likely to be accompanying their first serious course on condensed matter physics, so it is important to assess its merits in that context. Structural properties are covered very well (although there is an unfortunate interchange on page 146 of the conditions for missing orders of diffraction in face- and body-centred structures). The idea of the reciprocal lattice is introduced in a very natural way.

When it comes to the dynamical properties of solids this volume is less successful. The relationship between the Debye model and reality is not explored, and for a newcomer to the subject one would hope for more careful discussions of the total number of classical degrees of freedom and of the distinctions between the statistical mechanics of bosons and fermions. The treatment of lattice thermal conductivity is very brief, and this would certainly not be the place to learn about umklapp processes. The novice might come away from this section unaware of the wavelength dependence of phonon mean free path for defect scattering as opposed to boundary scattering. Experimental techniques for measuring vibrational frequencies are nicely described.

One of the strengths of Structure and Dynamics lies in areas beyond the conventional condensed matter course, especially the material on phase transitions. Here it is refreshing to see ferroelastic and ferroelectric transitions described, and an introduction to order parameters and Landau theory.

As a text book, a few minor details need to be ironed out. Some quite complicated ideas are introduced with too little explanation. Other problems range from simple typos ($E^2=p^2/(2m)$ on page 124) to wording (having just been told what a simple cubic structure is, a beginner is going to be confused by the last line on page 96 which refers to a table of 'simple cubic structures' which includes face- and body-centred cases). The book's layout is good, and it is well illustrated with carefully executed figures. The problems are interesting and challenging: many students and some lecturers will be grateful that solutions are included.

# Structure and Dynamics: An atomic view of materials




## From the publisher...

**Structure and Dynamics - An Atomic View of Materials**

*Martin T. Dove, Department of Earth Sciences, University of Cambridge*

This book describes how the arrangement and movement of atoms in a solid are related to the forces between atoms, and how they affect the behaviour and properties of materials. The book is intended for final year undergraduate students and graduate students in physics and materials science.

| | | | |
|---|---|---|---|
| *0-19-850677-5* | *356pp* | *2003* | *£49.95/hard* |
| *0-19-850678-3* | *356pp* | *2003* | *£24.95/paper* |

The author could well respond to some of the above criticisms by saying that they refer to topics which were merely incidental to the book. But this highlights a problem with a series of this kind. Unless there is strong editorial control of all the volumes, the sum of the parts may not adequately cover a basic condensed matter syllabus. To be fair, the publishers do not claim that it should, but there is a warning here to students. It is possible to spend a good deal more buying this series than one would spend on a traditional text, yet to find some key areas inadequately treated. So, students, read this book, please, and find out some of what is new and exciting in the field, but keep one of the old standards on your shelf to cover the basics. For lecturers, here is a rich source of examples to show that there are crystals other than sodium chloride.

# Studying Physics

***Subject area***
Physics.

***Description***
A unique guide to the essential skills in physics that a student will need to acquire by the time they graduate.

***Authors***
David Sands.

***Publishers/Suppliers***
Palgrave Macmillan (http://www.palgrave.com/home/).

***Date/Edition***
2003.

***ISBN***
1-4039-0328-X.

***Level***
Undergraduate.

***Price***
£12.99 (http://www.amazon.co.uk/).

Dick Bacon
Department of Physics
University of Surrey
Guildford GU2 7XH
April 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | *** |
| Meets objectives | ***** |
| Accuracy | ***** |

There is currently a wide variation in the types of students coming to study physics at university level, and consequently a wide range of abilities, preconceptions, expectations, aspirations and aptitudes. This book provides a wealth of useful information to help this wide diversity of student material to rationalise the various components of the courses they are taking, to put them into the context of the knowledge and skills bases necessary for an understanding of the subject, and to maximise the benefits of their educational experiences.

The book is primarily for undergraduates and would be most use if read by students at the start of their degree programmes as well as being available to refer to later. It is very easy to read and entirely suitable for first year students. Guidance is given about how to use it and how to deal with sections dealing with unfamiliar topics or using unfamiliar nomenclature in expressions. One of the pleasures of the book is the way that the author draws on such a wide range of examples, using the history (both ancient and recent) of the development of scientific methods and theories as well as modern examples.

In order to make good use of this book the one essential prerequisite is that the reader must want to do well in his or her degree, and must have a real interest in physics. A point that is reiterated several times is that learning is an activity that is something the student has to do, not something that someone else can to do for them. Without a sufficient interest in the subject matter a student is unlikely to do well, and is also unlikely to find this book of much help (or entertainment).

The first chapter, innocently titled “Studying Physics: An Introduction”, provides a particularly useful and comprehensive explanation of the way in which physics education comprises activities, understanding, methods and philosophies, and why it is inextricably linked to mathematical representations. This is one chapter that could be of as much help to academics as to students, in reminding them of a student’s perspective of a physics course. The chapter includes an interesting consideration of the differences between the university learning experiences of current lecturing staff and that of their students.

All the other chapters deal with particular aspects of the studying of physics, but always from the point of view of how particular methods and activities are needed and how they can best be used. A chapter on mathematics deals primarily with how mathematical relations form the basis for most experiments so that numerical results can be tested against our theoretical understanding. It also describes how to use mathematical methods and tools to do this. A chapter on statistics and probability provides a useful counterpoint to this by discussing the role of statistics and ‘randomness’ in measurements as well as the concepts of statistical phenomena in physics.

Another very useful chapter encourages the student reader to consider the purposes of experiments undertaken (even those specified by laboratory scripts) in order to develop an understanding of the ways in which measurements can be made, accuracy can be optimised and the appropriate precision can be recognised. A chapter of the role of theory

# Studying Physics


## From the publisher...

**Studying Physics**
*David Sands*

An essential guide to the undergraduate wishing to develop skills in physics. Drawing on physics education research and the author's own extensive experience in teaching, this book addresses the skills needed by the undergraduate to become a physicist. As well as chapters on the design of experiments, mathematical modelling, written reports and oral presentations, the book gives clear and practical advice on studying physics.

*1-4039-0328-X 240pp 2003 £12.99*

within physics will provide considerable help and support for students as they work though their degree programs, with the mixture of experiments that sometimes 'do not work', lecture materials that describe physical 'facts' in obscure mathematical forms, problems and exercises that leave them struggling to see either the wood or the trees. This chapter illustrates the importance of mathematically based symbolic logic by showing the concise form such arguments can take. It also exposes the existence of hidden assumptions and implications in arguments and discusses the role of global and localised theories for areas of physics linked by common themes.

The discussion of the role of theory within physics is followed by a chapter dealing with the role of modelling. This brings together several strands that have appeared earlier, showing how physical situations can be modelled in mathematical terms, yielding results that can be interpreted in terms of the original physics. Empirical, phenomenological and ab initio models are described and mathematical methods appropriate to both analytical and numerical methods are discussed.

The last chapter is devoted to advice on the writing of reports and preparing oral presentations. It is a very readable account of how to go about presenting scientific information, with arguments for the suggested styles and methods based firmly upon the fundamental purpose of the presentation - to give an honest account of what has been achieved, but to get the maximum impact by taking care in the way the information is presented.

I would recommend this book to any physics undergraduate, but particularly to those just embarking on their degree courses.

# Successful Study for Degrees

***Subject area***
General.

***Description***
Generic Study text for undergraduates.

***Authors***
Rob Barnes.

***Publishers/Suppliers***
Routledge
(http://www.routledgefalmer.com/).

***Date/Edition***
1995/2nd Edition.

***ISBN***
0-415-12741-6.

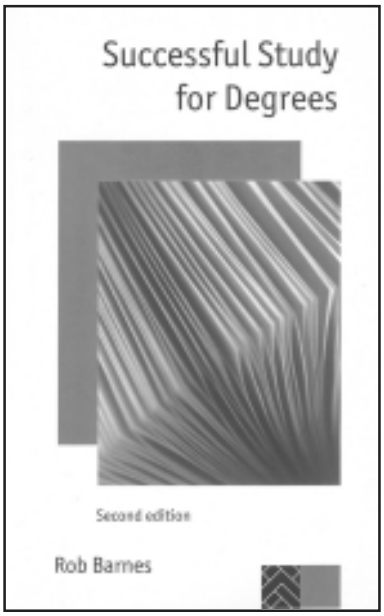
***Level***
Undergraduate.

***Price***
£14.99 (http://www.amazon.co.uk/).

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | **** |
| Usefulness to student | **** |
| Usefulness to teacher | **** |
| Meets objectives | **** |
| Accuracy | **** |

This is an excellent, interesting and stimulating text that would make useful reading for all undergraduate students regardless of their subject area. It is written from a generic standpoint by a Senior lecturer in Education but is readily accessible and avoids over-use of jargon. The approach is one that will not be familiar to many scientists and the style is often reminiscent of a good personal tutorial, which is refreshing as well as readable. The book invites us to reflect on why we study, what it is that we are trying to achieve and what the qualities of a good learner might be.




There is some excellent material on study strategy and reading academic texts as well as two valuable chapters towards the end of the book on dissertations. Here, beginning is wisely separated from analysis and writing but both the approach and the emphasis on constructing and carrying an argument have rather less relevance to hard science students than to the undergraduate community in general. There is a fine chapter too on essay writing, and well worth reading, but this is not a frequently encountered mode of assessment in hard science degrees, so that its usefulness to chemists, physicists and astronomers is perhaps limited. Perhaps more useful is the chapter on seminars, which includes a discussion of group dynamics: reading this would be time well spent for any undergraduate, or post-graduate student.

Two important areas for science students are conspicuous by their absence: practical and laboratory sessions, probably the finest learning opportunity we have in our subject area are not discussed and neither is fieldwork. Curiously too, little time is spent on the lecture: it would have been very useful to have a lot more on this topic and on the thorny subject (for first years in particular) of note-taking, as well as advice on the construction of secondary notes.

This will not perhaps be the most practically useful study book for a science student to read but nevertheless it raises some very interesting questions that are important for any serious university student to reflect upon and it does so in a manner which is both accessible and stimulating. It is well worth a read!

David Harwood
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March 2004

# The Elements of Physics

***Subject area***
General Physics.

***Description***
First year undergraduate physics text.

***Authors***
I. S. Grant and W. R. Phillips.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2001/1st Edition.

***ISBN***
0-19-851878-1.

***Level***
Undergraduate.

***Price***
£29.99.

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | **** |
| Usefulness to teacher | ***** |
| Meets objectives | **** |
| Accuracy | ***** |

For many years those concerned with teaching physics to first year students in England have had a problem in recommending a suitable text book. In the absence of a text designed specifically for our market, most lecturers have resorted to recommending one of a plethora of attractive and reasonably priced texts designed for the huge market in the USA. Unfortunately, these are pitched at a level somewhat lower than has traditionally been thought to be appropriate for first year physics undergraduates in the UK, but they have a pedigree that in some cases stretches back over half a century and have been carefully refined and honed through many editions. Furthermore, most now come with supplementary web based support material, and some claim to reflect the latest results of physics education research. So is there a case for an alternative English text ? The short answer has to be yes, for although the level of American texts has grown closer to UK requirements as a result of the erosion in preparedness of UK students for a traditional undergraduate degree programme, it is arguable that the American books have become too long, too detailed (and too heavy) for many UK students. This is particularly true for those majoring in physics who do not require every step to be spelled out in minute detail.

The book 'The Elements of Physics' published in 2001 by Grant and Philips is aimed squarely at meeting the requirements of the UK market, in a well laid-out single volume of 742 pages. The contents match accurately enough the core content of a typical traditional first year physics course, and generally speaking the authors have achieved a satisfactory mid-Atlantic style; ie with a sufficient level of detail and number of examples to get the message across, but not overly laboured to a point that a reader is likely to be overwhelmed. For example, in developing special relativity, almost all American texts delay mention of the Lorentz transforms, preferring to introduce time dilation and length contraction by means of lengthy and sometimes confusing arguments involving observers travelling on trains. By contrast, although Grant and Phillips take the process of synchronising clocks for granted, and don't emphasise sufficiently the importance of defining measurements in terms of mutually observable events, they do introduce the Lorentz transforms at an early stage, which enables the key results on length contraction, time dilation etc to be established without excessive explanation.

As has been indicated, the material covered in 'The Elements of Physics' is fairly typical of a traditional first year course in physics at an English university, but the authors, perhaps responding to the common practice of teaching core physics in a number of discrete units, have written the book in six independent parts: dynamics, vibrations and waves, quantum physics, properties of matter, electricity and magnetism, and relativity. The importance of mathematical skills is recognised by the inclusion of a helpful mathematical review, and the book is well endowed with examples and problems. The inclusion of biographical details of a few of the giants of physics, including Newton, Boltzman, and Einstein adds a welcome human touch.

The book is generally well written and presented, and contains much to be admired in terms of physical insight. Perhaps inevitably there are a few points where one might disagree with the choice of material. For example,

*Continued on page 28*

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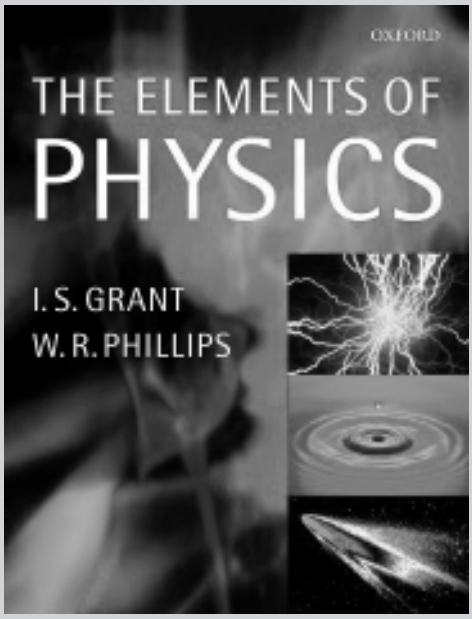
April 2004

## The Elements of Physics




### From the publisher...

**The Elements of Physics**

*I. S. Grant, Department of Physics and Astronomy, University of Manchester, and W. R. Phillips, Department of Physics and Astronomy, University of Manchester*

A complete and authoritative text for a first-year course in physics for physics majors; an accessible and concise alternative to the big American freshman texts. Drawing on their teaching experience in one of the largest physics departments in the UK, the authors guide the student through the foundations of university physics. The clear two-colour design and over 500 diagrams are an aid to focused study, and the text uses worked examples, graded problems, mathematical and information inserts, highlighted key equations and laws, and an appendix on necessary mathematics in order to meet all the needs of the modern student.

*0-19-851878-1 788pp 2001 £29.99*

*Continued from page 27*

it is arguable that the H field in electromagnetism should be avoided at this level, and the section on active circuits is extremely cursory, and might better have been omitted altogether. But, overall, this book is a valuable addition to the literature at this level, and should find favour with those teaching first year physics, and with relatively advanced and mathematically competent students. Unfortunately, the book is less appropriate for the significant proportion of students now emerging from schools and colleges whose experience of problem solving is limited to the A-level requirement to complete one or two lines in a pre-printed examination booklet. For this group, one of the more recent American texts such as 'Physics for Scientists and Engineers' by R Knight[1] is likely to be more helpful, despite the disadvantages referred to earlier.

**Reference**

1. Knight, R. *Physics for Scientists and Engineers: A Strategic Approach with Modern Physics* Pearson, ISBN 0805386858 (2003).

# The Physics of Everyday Phenomena & Conceptual Physics

***Subject area***
Physics.

***Description***
These two books are both aimed at students on *physics for non-scientists* courses.

***Authors***
The Physics of Everyday Phenomena: W. Thomas Griffith (Editor).
Conceptual Physics: Paul G. Hewitt.

***Publishers/Suppliers***
The Physics of Everyday Phenomena: McGraw Hill (http://books.mcgraw-hill.co.uk/).
Conceptual Physics: Addison Wesley World Student Series, Pearson Education (http://www.pearsoned.co.uk/).

***Date/Edition***
The Physics of Everyday Phenomena: 2001/3rd Edition.
Conceptual Physics: 2002/9th Edition.

***ISBN***
The Physics of Everyday Phenomena: 0-07-117983-6
Conceptual Physics: 0-321-10677-6.

***Level***
A-level, access, undergraduate.

***Price***
The Physics of Everyday Phenomena: £34.99.
Conceptual Physics: £35.99.

Tom Brown and Bruce Sinclair
School of Physics and Astronomy
University of St. Andrews
St. Andrews
Fife KY16 9SS
May 2004

These two books are both aimed at students on *physics for non-scientists* courses. This is a large market in the USA, where these books originate, and probably a significant one in the UK. In the range of topics covered, these books are not dissimilar to such standards as Halliday, Resnick, and Walker or Tipler, but they contain much less quantitative work.

**Summary Review**

| range: * very poor to ***** excellent | Griffith | Hewitt |
|---|---|---|
| Academic content | **** | ***** |
| Usefulness to student | *** | ***** |
| Usefulness to teacher | *** | ***** |
| Meets objectives | *** | ***** |
| Accuracy | *** | ***** |

Griffith's book has the title of 'The Physics of Everyday Phenomena', whereas Hewitt's is 'Conceptual Physics'. Our feeling is that both are trying to do pretty much the same job, and that there is not a huge difference in the amount of "everyday phenomena" covered by the two books.

The preface describes Griffith's book as being suitable for a one-semester course in conceptual physics for non-science majors. It suggests that understanding how rainbows are formed, how ice skaters spin, etc is one of the best motivators for building scientific literacy. There is a fantastic picture on the cover showing the lensing effect of a water droplet. As in more mainstream physics texts such as Halliday, Resnick, and Walker, each chapter starts with a motivational example. In this book these include such things as the forces on kids on a roundabout, the waves rolling onto a beach, and a collision between football players.

Hewitt speaks to the student at the start of his book from a speech bubble in a photo stating "You know you can't enjoy a game unless you know its rules; whether it's a ball game, a computer game, or simply a party game. Likewise you can't fully appreciate your surroundings until you understand the rules of nature. Physics is a study of these rules, which will show you how everything in nature is beautifully connected." His sections all start with a photo of a person with a speech bubble appropriate to what follows, and each chapter has a shot of a science educator doing some demonstration.

Both books are well illustrated with drawings and photographs. Both books have lots of connections to "everyday life". Both seem to us to do a pretty good job at putting across important concepts without the rigorous mathematical framework which non-science based students often find intimidating. In this respect, Hewitt uses slightly less maths even than Griffith, which comes complete with a set of appendices on mathematical techniques. We like the cartoon-like drawings in Hewitt, but these may not be to every student's taste. We also like the numerous "check yourself" boxes in Hewitt's conceptual developments. Both books have end-of-chapter summaries and questions of various forms. In terms of 'look and feel', Griffith's book looks more like a standard physics textbook that Hewitt and we wonder whether non-specialist students may find his approach a little less attractive?

Both books also have sections covering some of the more challenging areas of modern physics, for example relativity and quantum mechanics. It is important that these are present as, in our experience, these topic areas provide a draw to non-specialist students. Hewitt perhaps has slightly more coverage in this area providing, in particular, a good build-up to the development of quantum mechanics. Griffith has an excellent section on the development of silicon chips and the physics behind computing.

*Continued on page 30*

# The Physics of Everyday Phenomena & Conceptual Physics

*Continued from page 29*

Let us take a detailed look at the chapter on electrostatic phenomena in the two books.

In Griffith, we find a motivational starter section talking about electrostatic repulsion in combed-hair and static electricity. There is then a nice clear discussion of electrostatic charging, electrical polarisation, and Coulomb's torsion balance, all in the context of pith balls, electroscopes, etc. The ideas of insulators, conductors, and semiconductors are introduced in terms of ability to let charges flow through them, though the statement that carbon is a familiar example of a semiconductor seemed to us to be a strange thing to highlight. Electric fields and field lines are sensibly qualitatively introduced, and the electric field vector is defined in terms of the electrostatic force per unit charge. Electric potential is introduced in the context of the work done on a charge being pulled between two plates of a large-area plane-parallel plate capacitor. With no calculus tools available the potential difference in non-uniform fields is stated to be "more complex, and different". How different is this treatment from a "standard" textbook used in secondary schools in the UK?

In Hewitt there is a similar approach. It starts with a girl with magnet and nails commenting that being able to name magnetism does not mean she understands it. Hewitt starts with a nice comparison between gravitational and electrostatic forces, and moves on to talk about the charges in the atom. Conservation of charge and Coulomb's law follow. We prefer the chunk on insulators, semiconductors, and metals in this book, and like the link here to photocopiers. We like the comment that "In a common appliance cord, electrons flow through several meters of wire rather than flowing directly across from one wire to the other through a small fraction of a centimeter of rubber insulation". Charging by rubbing and induction follow, with links to lightning conductors and plastic seat covers. Electric fields are defined sensibly, and a link is made to microwave ovens. Electric potential energy is introduced with comparisons with gravity and springs, and electric potential derived from this. The idea of equipotentials does not come up at all. The chapter finishes with a discussion of capacitors, the Van de Graaf generator, and stored energy.

Let us look at a couple of "everyday phenomena" covered by both books.

In explaining the rainbow Griffith shows how light of different colours is refracted by different amounts, but the concept of having an angle to the antisolar point at which there is a concentration of reflected light rays is entirely missing. Without this part of the argument we feel there really is no explanation of the rainbow formation. We feel that Hewitt does much better here, though we would have been inclined to go a bit further into the distribution of angles of rays leaving the drop.

Griffith's explanation of ocean tides is within the chapter on circular motion, but the explanation for the two high-tides a day does not seem to include any real reference to the effects of the moon and earth orbiting each other. We contrast this to the beautifully clear (if more advanced) explanation in Epstein's 'Thinking Physics' reviewed elsewhere in this issue. Hewitt takes almost five pages to talk about tides, and involves the centripetal acceleration of the earth towards the moon as a core part of his argument.

Griffith's book comes with a CDROM for no extra charge. This CD contains a pdf document of the entire book, including useful internal links, and links to the publisher's website for more material. The CD boasts access "to animations that enhance the material for a more clear understanding". There are 18 of these, which appear in the style of video-clips with audio commentary. One example is of two people with an arrow, one dropping it and one firing it horizontally. Both arrows hit the ground at the same time, but one travels a lot further horizontally. We can see this being useful for the intended audience. Another is of a convex lens being used for imaging. We were worried that some of the statements being made correctly about the specific situation shown might be interpreted more generally, for example that the virtual image was twice the height of the object. This is true if the object distance is half the focal length of the lens, but this was not explicitly stated. As in the book, images are drawn with no account taken for the depth of the object affecting the imaging involved. None of the animations that we tried included any user-interaction other than controlling the playing of the "video".

Hewitt's book has a supporting website rather than a CDROM. This requires registration with the publisher. This site has some wonderful QuickTime video of the author enthusiastically demonstrating some key concepts in his class. These downloaded quickly on our network, but if a student was on a phone line these would be considerably less speedy to access than a CDROM. The website also includes access to text and diagrams from the book, as well as quizzes etc. An excellent instructor's manual is available for the Hewitt book. This includes detailed answers to all of the questions and exercises in the text and suggestions for lecture plans. This is much to be recommended to anyone basing a course on this text.

We feel that both these books largely succeed at being text-books giving introduction to the main fields of physics for students with little mathematical skills, and with some links to everyday life. Our personal feeling is that we would continue to opt for Hewitt's book as a class text for a non-specialist undergraduate course in physics.

# Thinking Physics: understandable practical reality

***Subject area***
General Physics.

***Description***
This is a book of "interesting" questions about the world around us, each tackling an idea from physics.

***Authors***
Lewis Carroll Epstein.

***Publishers/Suppliers***
Insight Press, San Francisco (http://www.appliedthought.com/InsightPress/index.html).

***Date/Edition***
2002/3rd Edition.

***ISBN***
0-93-521808-4.

***Level***
A-level, access, undergraduate.

***Price***
£17.23 (http://www.amazon.co.uk/).

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

In my opinion 'Thinking Physics' is a book that should be on the bookshelf of every physics educator. One of my colleagues bought a copy a few years ago, and that was eagerly borrowed by several of us at work, partly for providing inspiration for questions in teaching, and partly for our own interest. The third edition is now out. This seems to be more easily available in the UK than sometimes previously, and most of us have now bought our own copies.

'Thinking Physics' is a book of "interesting" questions about the world around us, each tackling an idea from physics. Most questions require no calculation, and most demand the explorer to do some real thinking. There is not much room for "chug and plug" in answering these questions, but plenty of room to ponder, and to explore one's own conceptual understanding. Epstein gives the reader a choice of several possible "answers", and asks them to think for themselves which one is correct. He then gives us his explanation on which is the correct answer. As such, this book is in the same sort of territory as 'The Flying Circus of Physics' and 'Thinking Like a Physicist', providing problems on which people can test their ingenuity and their understanding of physics. Epstein takes a more informal approach to both his questions and his answers than the other two books, but they are no less good for that. Indeed, some of his answers I regard as beautifully crafted to explain the science involved. Most of his questions are firmly focussed on a specific bit of physics. Most of Epstein's problems I would expect to be accessible to students in the final year school and early stages of university physics. However, such is the range of material, and the probing nature of the questions, that many of these questions can be usefully addressed by final year students, and their teachers!

Epstein's introduction on how to use the book states "The most important problem in physics is perception, how to conjure up mental images, how to separate the non-essentials from the essentials and get to the heart of the problem." He cautions the reader that they "must guard against letting the quantitative superstructure of physics obscure its qualitative foundation." While I regard the "quantitative superstructure" as a positive feature of physics, I also think I see exactly where he is coming from with his statement. Some students are keen to "hide behind the mathematics" and start university life by believing that physics is about solving problems of known type by a known mathematical recipe. This book is a resource to them and to their educators, showing that concepts can be useful, interesting and challenging.

I have worked my way through many of the questions and answers, and am yet to find a solution that I disagree with. I like the diagrams in the book, though I can see that their cartoon-like nature will not appeal to all.

I have the author's permission to use some of his questions and diagrams in my teaching. One place where I use these is in my level-one and level-two lectures. I find that stopping the lecture for a few minutes and posing an Epstein-like question for the class to work on helps keep them thinking, focussed, and involved. For these, tutorials, and other occasions, Epstein's book is a great resource.

Bruce D. Sinclair
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St. Andrews
Fife KY16 9SS
May 2004

# Why chemical reactions happen

***Subject area***
Organic Chemistry.

***Description***
An explanation of chemical reactions from a theoretical approach rather than a mathematical or kinetic approach.

***Authors***
James Keeler and Peter Wothers.

***Publishers/Suppliers***
Oxford University Press (http://www.oup.co.uk/).

***Date/Edition***
2003.

***ISBN***
0-19-924973-3.

***Level***
Undergraduate.

***Price***
£16.99 (http://www.amazon.co.uk).

Brenda Fredette
Medaille College
18 Agassiz Circle
Buffalo NY 14214
USA
May 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Academic content | **** |
| Usefulness to student | **** |
| Usefulness to teacher | **** |
| Meets objectives | **** |
| Accuracy | **** |

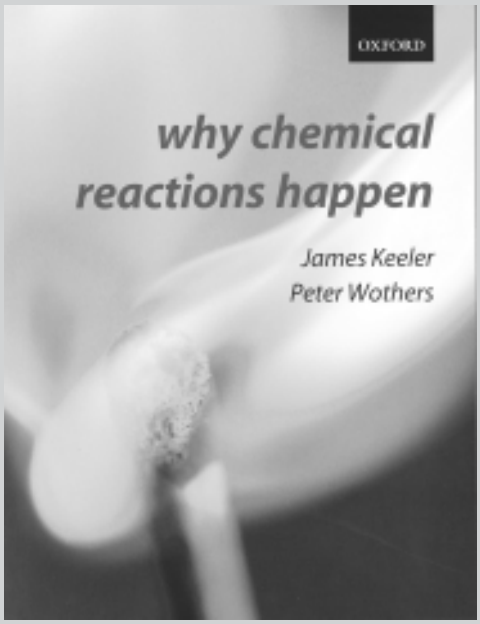
'Why chemical reactions happen' is a well written book that would be a wonderful supplement to a traditional organic chemistry textbook. James and Peter have successfully achieved their goal of explaining why chemical reactions occur using a soundly based set of ideas that are presented in a very logical fashion. I do believe, though, that the book would be most useful to students that have completed one year of general chemistry. The book was written with the intention of providing an overview of key concepts in an effort to present traditionally difficult theories in a clearer perspective. While I think that James and Peter have done a beautiful job of achieving this, I believe that a first year or pre-university student would not fully appreciate their perspective without having prior knowledge of these theories.

The style and format of the book is very conducive to student learning and comprehension. I would begin to use this book in an organic chemistry course and continue to use it throughout biochemistry. James and Peter begin the book with a good introductory review of molecular and hybrid atomic orbitals. I currently teach general, organic, and biochemistry courses. It has been my experience that molecular orbital theory and hybridization of atomic orbitals are the two most problematic topics for chemistry students. James and Peter's presentation of chemical reactions in terms of molecular and hybrid atomic orbitals provide the students with a real life context for these theories. I have found that students traditionally have a difficult time visualizing orbitals and how they will change during a chemical reaction. The authors use accurate surface plots as well as the wonderful diagrams that use molecular orbitals to depict electron redistribution during a chemical reaction. These diagrams will help visual learners understand chemical reactions in terms of these difficult topics.

The material in the book did not appear to contain any inaccuracies. James and Peter seem very dedicated to ensuring that the material presented is accurate. Again, this is particularly evident in the graphics and diagrams throughout the book. The authors state upfront that the pictures are based on actual calculations. They also state that because of the aforementioned, the pictures of orbitals can be considered accurate but will not resemble the most common pictorial representations found in other textbooks. While I think that students may initially have a difficult time with these inconsistencies I also feel that it is important that students realize that this topic, as in other disciplines, is subject to the interpretation of the person presenting it.

James and Peter have provided the student an explanation of chemical reactions from a theoretical approach rather than a mathematical, or kinetic, approach. I was very impressed with their use of molecular orbitals and hybridization as a means to describing a broad range of chemical reactions. The authors' explanation of transition energy in terms of bond angle stability and geometry was insightful. My students struggle with the concepts of transition state simply because it is not an entity that they can see. Bond angles and geometry are more readily understood because the valence shell electron pair repulsion theory is something that the students can easily visualize. Justifying transition states using bond angles and geometry brings visualization to a topic that is generally difficult to visualize.

# Why chemical reactions happen




## From the publisher...

**Why Chemical Reactions Happen**

*James Keeler, Senior Lecturer in Chemistry, University of Cambridge and Fellow of Selwyn College, Cambridge and Peter Wothers, Teaching Fellow in Chemistry, University of Cambridge and Fellow of St. Catherine's College, Cambridge*

By tackling the most central ideas in chemistry, Why Chemical Reactions Happen provides the reader with all the tools and concepts needed to think like a chemist. The text takes a unified approach to the subject, avoiding the traditional divisions of physical, inorganic and organic chemistry and so helps the reader to develop a real overview of chemical processes.

*0-19-924973-3 254pp 2003 £16.99*

Additionally, I really enjoyed the chapters that discuss conjugation, nucleophilic substitution, elimination reactions, and the process of solvation. Students have a difficult time understanding competition between substitution and elimination reactions. James and Peter did an incredible job of explaining this competition in terms of conjugation and sigma and pi bond character. Again, I feel that this approach will give students an additional perspective to help explain why one process is driven over the other.

In conclusion, I feel that Peter and James have done a tremendous job of explaining chemical reactions using perspectives that are not used in the traditional text books. They explain reactions in terms of bonding theories and orbitals rather than solely using kinetics and equilibrium. The authors' use of visual representations throughout the book increases the comprehension of the material covered in the text. I look forward to using this textbook in my organic chemistry courses.

# BearEduPhysics-1

***Subject area***
Physics.

***Description***
Basic physics program to be used in conjunction with lectures during the first semester at university.

***Authors***
BearEdu Technologies.

***Suppliers/Distributors***
BearEdu Technologies (http://bearedu.com/).

***Date/Version***
Version 1.1.

***Level***
Undergraduate.

***Type of package***
Computer assisted learning.

***Price***
$29.95.

***Hardware required***
Windows or Macintosh compatible PC.

***Software required***
Windows 95 (or later) or Mac OS 8.1 (or later).

Mark Robertson
Portlethen Academy
Bruntland Road
Portlethen AB12 4QL
December 2003

## Summary Review

range: * very poor to ***** excellent

| | |
|---|---|
| Ease of use | **** |
| Ease of learning | *** |
| Documentation quality | n/a |
| Academic content | *** |
| Usefulness to student | ** |
| Usefulness to teacher | ** |
| Portability | ***** |
| Meets objectives | *** |
| Accuracy | *** |

The BearEduPhysics program comes in two forms; both a java based web accessible form and as a downloaded stand-alone program. The web based version can be viewed on any up to date browser. The stand-alone version is programmed in JAVA and so works on MAC (OS 8.1-9.x and OS X) and PC (Windows 95,98,ME,2000,NT) with a 133MHz processor with, at least, 15MB of hard drive space and 16MB of RAM. No documentation was received with the reviewed package but does not seem necessary due to the simple user interface used.

The program uses a mixture of text and basic animation in order to provide support to those undertaking initial undergraduate work in basic physics and covers many topics from vectors and motion to the physics of solids, liquids and gases. The individual topics are reached by a simple menu system and are in a page format with previous and next buttons to switch pages. All main topics end with a very useful summary and set of practice exercises. Many of these exercises are animated also and all come with detailed answers.

The descriptions themselves are detailed enough to allow some follow up revision after a class or lecture but would be more difficult to follow without any background knowledge.

The range of subjects covered by the package is also admirable with most of the main areas of Newtonian physics covered. This could allow for a wider use of this program as a revision/re-enforcement aid for the upper years of secondary education.

However, the program has a few drawbacks. The formatting of the text, for example, is a little close together which makes it a little difficult to read on screen. The font displayed can be altered though only a small range of font options are given with no control of the font size or line spacing available. It may be easier to read the text as a hard copy but the installed program lacks a print option so this is not a possibility. Also, the use of units in the program often strays for the standard SI units typically used in physics – especially in the use of “pounds” for force/weight and the use of foot-pounds and ergs for work, which can only cause confusion for an unwary user; especially those in the UK.

Overall, this program meets its aims admirably well. It may be difficult to use the program to its full effect without a strong link between the topics studied in the particular physics course and the BearEduPhysics program but it may find worth as a revision aid to “dip into” or to provide extra re-enforcement of a topic covered in a student’s own time. The animations, although basic when compared to other, more expensive, simulation software on the market, may also help with classroom visualisation via a PC screen or multimedia projector. This is especially true of the animations associated with the end of section exercises.

# Blackboard Learning System

***Subject area***
General.

***Description***
Course Management System.

***Authors***
Blackboard Inc.

***Suppliers/Distributors***
Blackboard Inc., 1899 L Street NW, 5th Floor, Washington, DC 20036, USA (http://www.blackboard.com/).

***Date/Version***
Version 6.1.0.

***Level***
Undergraduate, research.

***Type of package***
Information management.

***Price***
Contact supplier for details.

***Hardware required***
Institution-wide network.

***Software required***
Depends on system.

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College of Science
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Al Ain
United Arab Emirates
March 2004

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Ease of use | ***** |
| Ease of learning | ***** |
| Documentation quality | ***** |
| Academic content | ***** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Portability | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

## 1. Introduction to the Blackboard Learning System

The Blackboard Learning System is a comprehensive and flexible e-Learning software platform that delivers a complete course management system. Blackboard itself was developed in 1997 and the Washington DC based Blackboard Inc. Software Company is now one of the main software companies worldwide for e-Education. In this regard, the two leading course management systems used in tertiary Institutions worldwide at present are Blackboard and WebCT.[1] The purpose of this review is not to compare and contrast these two individual web course tools, but rather to outline some of the features of Blackboard, as a course management tool, and describe its advantages and short-comings in particular in relation to its use as a course management tool for Chemistry courses. This review is based on my own personal experience at the Department of Chemistry at UAE University, where we currently use Blackboard 6.1 as the standard course management tool across the university campus. Blackboard has customizable institution-wide portals, online communities and has an advanced architecture, which means that the system allows excellent web-based integration with administrative systems. This latter feature makes Blackboard an excellent choice for Universities in adopting a complete course management system.

## 2. Utilities and Ease of Use

All users have to register and need a username and password to access the software. At UAE University, students and faculty have the same ACE domain username and password for both the Oasis and linked Banner system and Blackboard 6.1, which makes it convenient. Once the user logs into Blackboard, a personal My Institution page is displayed. This main page has several main areas including a series of Navigation buttons, Navigation tabs (where the user can navigate between different sections of the program), a Module area (which contains announcements, course links etc.), a Tools area (containing utilities such as My Grades, Send an E-mail, Calendar etc.) and a Search Box (which can be used for information retrieval on the web from the Blackboard site itself). Within the Module area, students can see the courses they are registered for on Blackboard. The courses can also be accessed by clicking on the My Courses tab within the My Institution page.

The Blackboard course environment consists of two views. The Student View is the only view available to students enrolled on a course. In this view, a number of navigation buttons can be accessed. The exact navigation buttons themselves can be customized by the instructor, but typically include buttons such as Announcements, Course Information, Course Documents, Faculty Information, Assignments, Websites for the Course, Tools, Communication and Assignments. In contrast, the Control Panel is only available to Instructors, and this is the place where the Instructor manages the entire course and essentially constructs and tailors the course in their own way. As a user of Blackboard for several semesters now, I would highly recommend Blackboard as a course management tool for Instructors. Most Instructors need only general familiarity with the standard Windows environment to quickly come to

*Continued on page 36*

# Blackboard Learning System

*Continued from page 35*

grips with the system. In our Department and College, we have run introductory workshops in-house for new faculty on Blackboard, and it is our experience that this initial kick-start training period can even be limited to approximately ninety minutes. Once faculty are au fait with the basic features of Blackboard, the numerous additional features of the system can be explored at a later stage, when the Instructor begins to post material on the system, do on-line quizzes etc. Of course, it is essential that the University has a central Blackboard Support and Help Centre on a permanent basis to help faculty using the system and to run more comprehensive training programmes of some of the more advanced features. Additional features can then be explored and newsletters outlining tips on using Blackboard for Active Learning purposes, problems encountered, new features etc. are also a useful way of showing faculty the true benefit of this powerful software.

The ease of use of Blackboard is exceptional. As a former user of WebCT, I must admit I found the Blackboard interface and navigation easier to learn at the beginning especially in relation to the posting of course information, announcements etc. One of the nice new features of Version 6.1, is the WYSIWYG (What You See Is What You Get) and spell-check facilities of the text-box editor. This facility was not available in earlier editions, and having access to standard Word buttons such as Bold, Italics, Justification etc. is a welcome new feature. However, as a chemist, it still is not possible to create subscripts and superscripts smoothly using Blackboard i.e. the panel of buttons is limited and it was not possible to create the customary superscript and subscript buttons, as can be done neatly in Word, by dragging these down via Tools, Customize and Commands. Of course, one can easily work around this problem by creating your text in FrontPage, and pasting the HTML code in the textbox, or simply include the HTML tags. Another possibility is to use the embedded WebEQ Equation Editor. However, all these methods are somewhat cumbersome, especially for chemists.

Adding course information is also similar to posting an announcement, and the information can be added as an item, folder, external link etc. Faculty information can also be posted readily. A nice feature of this utility is that separate folders can be created for faculty; for example if you have joint faculty co-teaching on a course. Within each folder, separate profiles can be created, with useful information for the student such as an Instructors office hours, their e-mail address, the location of their office on campus, their homepage URL etc. In addition, the photograph of the Instructor can be posted. However, it is advised that for optimum results, a picture of 150 x 150 pixels in size should be used. Course Documents also has similar features to Course Information, and PowerPoint slides, Word documents etc. can be posted here, which may correspond to different chapters of a textbook etc. Furthermore, as the course is only accessible to the students and the Instructor teaching the course, not everybody can see the material. PowerPoint slides can also be posted in such a way that the students can only see the slides, without being able to edit them if an Instructor wishes. An e-mail can also be sent to all students and Instructors having access to the course, which is an excellent facility of the system. This makes efficient and prompt direct contact with the students.

One other new feature which was introduced in the 6th release of the Blackboard Learning System has been that of the Assignment Manager. This new tool actually combines the file exchange capabilities of the Digital Drop Box, with the functionality of the Gradebook in Blackboard. The Digital Drop Box is still present in the system, and can be used to transfer files to users. This is an excellent feature, as instead of forwarding e-mail attachments, one can send a file to a student very quickly through Digital Drop Box. I have used this facility several times in my own classes teaching General Chemistry and Engineering Applications, where the students use their own personal Laptops in class, in a wireless Network environment.[2] However, one problem with this facility that I found is that you can only remove one file at a time. This can be tedious if you receive say twenty-five files from students as homework assignments. There is no select all, delete facility. In contrast, the new tool, Assignment Manager is an area where course assignments can be posted, related files can be uploaded and grades published. It is the latter point that really distinguishes this feature from the Digital Drop Box. The Digital Drop Box should be used if you wish to exchange files between students etc, but where you do not wish to give grades. The former in comparison should be employed where a final grade will be assigned to a student's work.

One of the most useful facilities of Blackboard has to be its Assessment facilities. In Pool Manager, a bank of questions with no point values can be created by an Instructor. Pool Manager can then be used to generate questions for on-line quizzes, exercises and tests. This facility should be used before importing the question banks into the Test Manager. One key advantage of Pool Manager is that the pool of questions can easily be readily exported. This gives great flexibility in courses where multiple Instructors are involved, as each can create banks of questions and transfer them to each other. With this utility, vast libraries of question banks can be built up in a Department on an ongoing basis each semester. Blackboard itself has the provision for seven different types of questions: multiple-choice, true/false, fill in the blank, order, multiple answer, match two lists and essay. Although

# Blackboard Learning System

the latter can be used, in the opinion of this reviewer, this type of question is probably not best suited to Blackboard, as there is a limit on the twenty answer patterns that can be used, and spelling mistakes, additional spaces and punctuation can invalidate an answer. In addition, an essay type question needs the Instructor to grade it. Having created a pool of questions in Pool Manager, the questions can then be imported into Test Manager for use in a test. One slightly annoying feature in Version 6, is that when you import a bank of questions from Pool Manager, there is no select all facility, which surprisingly was present in an earlier version. Hence, one has to physically go through each question and tick its box to import the question. This can be very time-consuming especially if you create an MCQ test for students of approximately 100 questions. Another cautionary note which academic users should be aware of is in relation to undesired student's behaviour during online assessments. In several classes I have had the problems that students get an error message during an on-line test stating that they have already chosen to go to the next question, and please wait etc. These messages according to my colleagues at the Blackboard Support Unit at the University, appear to be due to the undesired behaviour of double-clicking the submit or next button. As the Web is a single-click environment, where double-clicking is not necessary on standard web pages, this seems to be the root of this problem, which can throw some students out in on-line assessments. The problem became so widespread in some of my classes, that I now have to mention this to them on a continuous basis to get the message across in order to avoid such error messages. Hopefully the developers will try and see some way round this potential problem in a future release.

I tried also bringing chemical structures, which I created in ISIS Draw 2.5[3] into Blackboard in the Test Manager. This can easily be done, using the Creation Settings button. I saved a structure of an organic ligand, which I created initially in ISIS Draw, and converted it to a gif file using Microsoft PhotoEditor. I then was able to import this directly into Test Manager.

However, the best feature of the Assessment Tools is that of the Gradebook. This can easily be customized and rearranged to include mid-Semester and final examinations, quizzes, progress examinations etc. Once an on-line quiz or progress examination is taken on Blackboard, the grades are automatically imported into the Gradebook, which then can be weighted accordingly and can even be downloaded into an Excel spreadsheet in CSV file format. This feature is excellent, and with the collective utilities of the Test Manager and Gradebook, it has saved me personally hours of monotonous grading for many of my courses, where I employ MCQ type questions. I would definitely recommend Blackboard to any faculty thinking along the lines of a Laptop project type initiative.[2]

Blackboard has several other neat advanced features such as a Discussion Board, a Collaboration Session facility, Survey Manager and an excellent Course Statistics package, where you can track your student's usage of the course materials.

**3. Requirements**

At UAE University, Blackboard is served with two Dell PowerEdge 6600 servers, each with quad Xenon 1.4 GHz processors, 4GB redundant RAM and 140 GB hard disk space.

**4. Conclusion**

In summary, I think Blackboard is an outstanding course management system. The latest release 6.1, also convinces me of the value Blackboard developers put on feedback from the academic community. The positive changes seen in the new Version are most welcome. I recommend this system to both faculty and University administration. It is an investment extremely well justified. Interestingly, many of the new textbooks coming on stream on the market in Science now come with a Blackboard cartridge as supplementary material, which may be a consideration of faculty in choosing which textbook to adopt for their course. Finally, the time spent in designing a course on Blackboard is time well spent, as your course can be archived for future use and the course copy facility is a welcome feature for those of us teaching multiple sections of a course.

**Acknowledgements**

Waleed Hakim and UAEU Blackboard Support Team are acknowledged for ongoing support for faculty of Blackboard. Dr. Yasser Sakr, IT Technical Advisor at the DVCAA Office at UAEU is also thanked for Blackboard support on campus.

**References**

1. WebCT, http://www.webct.com/
2. Laptop Project at UAE University, http://academics.uaeu.ac.ae/computing/laptop.asp/
3. ISIS Draw, Version 2.5, http://www.mdli.com/

# Mathematica Version 5

***Subject area***
General science.

***Description***
A mathematics package combining interactive calculation, visualisation tools and a programming environment.

***Authors***
Wolfram Research.

***Suppliers/Distributors***
Wolfram Research Europe Ltd,
10 Blenheim Office Park, Lower Rd, Long Hanborough,
Oxon OX29 8RY.
(http://www.wolfram.co.uk/).

***Date/Version***
2003/Version 5.0.

***Level***
Undergraduate, research.

***Type of package***
Calculation, simulation, programming.

***Price***
£745 - full retail, £80 - academic
(http://www.pugh.co.uk/).

***Hardware required***
A PC, Mac, Unix or Linux computer. For more details see supplier's web site.

***Software required***
For PC: Windows 95/98/NT/2000.
For PowerPC: Mac OS 7.5.3 or later.
For 680x0: Mac OS 7.1 or later.
For more details see supplier's web site.

Steve Walker
LTSN Physical Sciences
University of Liverpool
Liverpool L69 7ZD
May 2004

## Summary Review

range: * very poor to ***** excellent

| | |
|---|---|
| Ease of use | **** |
| Ease of learning | ** |
| Documentation quality | ***** |
| Academic content | ***** |
| Usefulness to student | * |
| Usefulness to teacher | **** |
| Portability | ***** |
| Meets objectives | ***** |
| Accuracy | ***** |

When I was asked to look at version 4 of Mathematica nearly four years ago in Physical Sciences Educational Reviews **1** (1) 18-19 (2000), I wrote "This is a difficult review for a variety of reasons. Mathematica has been around for a long time (1988) and has gathered such a well-deserved reputation for excellence that it is hard to say anything new. On the other hand, the program is so vast and versatile that even an expert will not have explored all of its potential." I was quickly taken to task over the first point as many had not encountered it previously so I will attempt to restore some balance in this review but the second remains valid and it is possible only to scratch the surface of this magnificent program.

**The Principal Elements of Mathematica**

*Automatic Algorithms*
With automatic algorithm selection, you choose the task you want performed, and Mathematica picks the best algorithm(s) for performing it. For example, you might want to solve a differential equation numerically. With Mathematica you would use the function NDSolve, which would "decide" which of its dozens of algorithms to deploy to get you an accurate answer quickly.

*Notebook Document-Centred Interface*
Mathematica notebooks are a sophisticated manifestation of the document-centred approach to user interfaces and are a departure from the normal dialog box-based approach. Traditionally, graphical user interface software uses dialog boxes for actions and documents for user data on which those actions operate. Dialog boxes are distinguished as having non-scrolling, fixed layouts of buttons, menus, and so on, while documents are scrolling, increase in size as necessary, and have interactive structure and updatable content. With a document-centred interface approach, the actions, control elements for them, and structural information all reside together with the user data in the document itself.

*Depth of Algorithmic Knowledge*
Mathematica contains thousands of functions covering many areas: numerical computation, symbolic computation, graphics, and general programming. Its collection of mathematical algorithms alone covers most published algorithms and also contains a significant number of proprietary algorithms.

*Symbolic Programming*
Mathematica is also a uniquely powerful programming language based on symbolic programming - the unifying idea that every element can be represented as a symbolic expression. In this paradigm all different kinds of objects - formulas, lists, data, and graphics, to name a few - are represented in a uniform way as expressions. A prototypical example of a Mathematica expression is f[x]. This expression can represent a mathematical function, a graphic, a sound, a program, or even a complete Mathematica notebook. Functions can be both input and output of another function, enabling very concise and simple coding. Also, since algorithms can be parameterized not only by numbers or some fixed number of parameters but also by functions, algorithms are infinitely more flexible.

*Fully Interactive Maths Typesetting*
Mathematical expressions are used in virtually every field from medicine to engineering to social policy research to economics and finance.

# Mathematica Version 5

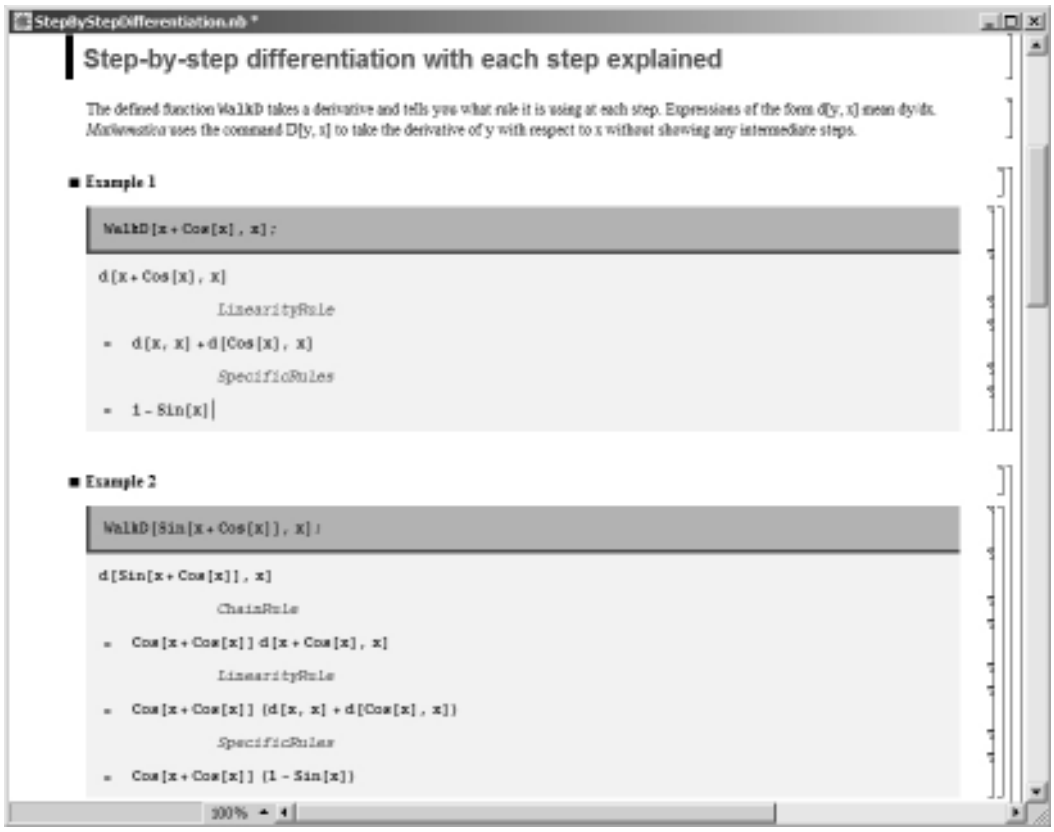


*fig 1: Example of a workbook showing the ability to differentiate step-by-step and explain the rules being used.*

Mathematica provides a robust, platform-independent file format that allows mixed text and graphics and that fully supports mathematical expressions embedded in both text and graphics.

*Symbolic XML*

XML has become the universal file format, and Mathematica is the ideal universal processing system for converting, analyzing, mining, or otherwise working with XML files. Rather than being a single language, XML is a framework in which specific languages can be defined - for example, MathML, ChemML, XHTML, SVG for graphics, and countless other field-specific languages. Some XML files represent printable documents, while others are pure data that represent financial information, medical data, real-time transaction records, and other information.

**New in Version 5**

There are a very large number of additions which, quite frankly, will only interest those specialising in advanced mathematical methods. For ordinary mortals, the upgrade is not so compelling, but some useful items are,

*Speed*

This is estimated at 3-4 times faster than version 4.2.

*NDSolve*

New additional solving methods include explicit and implicit Runge-Kutta methods of arbitrary order. More-efficient implementations lead to large speed increases for many types of differential equations. New options EvaluationMonitor and StepMonitor allow monitoring of the progress of the solution and more fine-tuning of the solving procedure.

*Connectivity*

The included .NET/Link technology preview provides full integration with Microsoft's .NET Framework. Mathematica users can load any .NET object into Mathematica and extend it. .NET/Link also provides an easy way to call any DLL or COM object from within Mathematica.

*Import/Export*

XHTML – Mathematica notebooks export directly to the web preserving their formatting – a very useful addition for those using VLEs to exhibit their lecture notes and other material.

Additional graphics formats such as PNG.

*Extended Statistics*

*Continued on page 40*

# Mathematica Version 5

balance “$C_1O_2 + H_2O_1 \rightleftharpoons C_6H_{12}O_6 + O_2$”
output $6C_1O_2 + 6H_2O_1 \rightleftharpoons C_6H_{12}O_6 + 6O_2$

balance “$K_2Cr_2O_7 + H_2O_1 + S_1 \rightleftharpoons S_1O_2 + K_1O_1H_1 + Cr_2O_3$”
output $2K_2Cr_2O_7 + 2H_2O_1 + 3S_1 \rightleftharpoons 3S_1O_2 + 4K_1O_1H_1 + 2Cr_2O_3$

balance “$K_1Cl_1O_3 + C_{12}H_{22}O_{11} \rightleftharpoons K_1Cl_1 + C_1O_2 + H_2O_1$”
output $8K_1Cl_1O_3 + C_{12}H_{22}O_{11} \rightleftharpoons 8K_1Cl_1 + 12C_1O_2 + 11H_2O_1$

balance “$H_2 + I_2 \rightleftharpoons H_1I_1$”
(Mathematica usually reserves I for $\sqrt{-1}$)
output $H_2 + I_2 \rightleftharpoons 2H_1I_1$

balance “$Zn_1 + H_1N_1O_3 \rightleftharpoons Zn_1N_2O_6 + N_1O_1 + H_2O_1$”
(Zinc nitrate must be entered without parentheses)
output $3Zn_1 + 8H_1N_1O_3 \rightleftharpoons 3Zn_1N_2O_6 + 2N_1O_1 + 4H_2O_1$

In the following example there are oxygen atoms on the left side but not the right side.
balance “$H_2 + O_2 \rightleftharpoons H_2$”
output atoms don’t match

*fig 2: Balancing equations*

*Continued from page 39*

**Teaching Chemistry with Mathematica**
I am afraid that my comments from 2000 are still valid: “I am aware of several chemistry departments using this program as part of their ‘remedial’ mathematics courses and I admire them for it but I cannot see it working for most of us. In an era when an A-level mathematics qualification is a rarity, I can see very little scope for using this program. I am afraid that the majority of us are unlikely to encounter students who can make the effort required to learn even the simplest applications”.

One interesting feature is the ability, in some instances, to ‘show working’. This could be useful in teaching situations (see fig 1).

I have searched the literature and found very few published examples in chemistry. Kinetics is an obvious candidate for differential equation solving and solutions in this area tend to dominate. However there is a wealth of dedicated tools for this purpose and, for most, there is little need for this powerful program. However, I did find one unusual example in balancing equations (see fig 2). This facility requires **chemBalance** (a separate library which is made available) and there are possibilities for undertaking atomic orbital calculations (see fig 3)

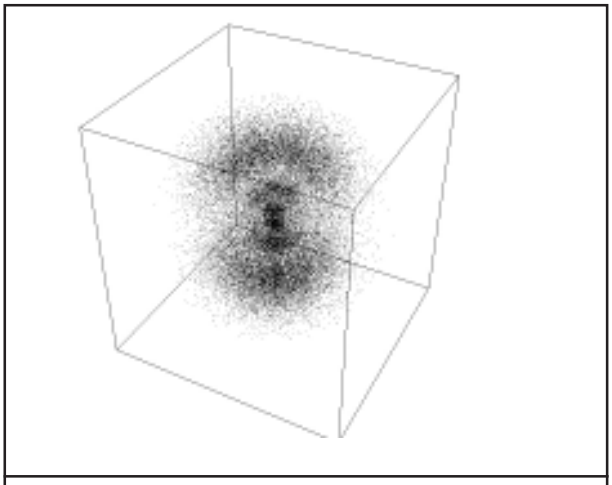

*fig 3: The electron cloud for n=4 l=1 m=0*

**Conclusion**
I love it. I couldn’t live without it. I use it. Regrettably, I see little use for the teaching of chemistry in a typical chemistry department.

# Polarograph.com

***Subject area***
Analytical chemistry.

***Description***
Electrochemical simulation and data analysis.

***Authors***
W. Huang.

***Suppliers/Distributors***
Available from www.DrHuang.com to download.

***Date/Version***
October 2003/Version 5.2.18.

***Level***
Undergraduate, research.

***Type of package***
Simulation.

***Price***
Freeware.

***Hardware required***
Windows-compatible PC.

***Software required***
Windows.

Geoffrey W. H. Potter
Faculty of Applied Sciences
University of the West of England
Coldharbour Lane
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November 2003

An earlier version of this simulation package was reviewed in October 2002 (Physical Sciences Educational Reviews **3** (1) 26-27). Many of the comments about the capabilities of the program still apply, of course, and there will be some improvements to the presentation but these are not apparent if the previous version has not been used.

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Ease of use | *** |
| Ease of learning | *** |
| Documentation quality | ** |
| Academic content | **** |
| Usefulness to student | *** |
| Usefulness to teacher | **** |
| Portability | ** |
| Meets objectives | **** |
| Accuracy | **** |

The simulation is undoubtedly powerful, covering most of the voltammetric methods from linear sweep to staircase voltammetry. There is little constraint on the choice of parameters that can be input and simulations are produced immediately (I would have liked to have the option to mimic a 'real-time' acquisition and display of data). Once a simulation has been obtained, data can be manipulated in all the ways you might expect.

I have to say, however, that unless you are an experienced electrochemist, you will have great difficulty knowing what you are doing and how to interpret the results. So, if you are wondering whether this package could be incorporated into an undergraduate teaching scheme (as I was) then a lot of introduction to voltammetric systems would have to be done first and much guided study pursued before undergraduates would benefit from the package. Postgraduate students, who had already followed a substantial course in voltammetry, would probably be able to explore all the variables and rapidly become familiar with a wider range of results than is possible in the laboratory.

I also have several reservations about the program as I encountered it. I should emphasise that these are to do with familiarity with using and setting up hardware and software and not with the capabilities of the program as such. The first screen of the program is a blank window with some menu options but, without guidance, I was unsure where to start. Further difficulties were that some of the dialogue boxes overfilled the screen and OK buttons were inaccessible. It seems that this was because my PC resolution was set at 800 x 600. Once it had been changed to 1024 x 768 it was fine but still looked rather odd with the dialog box stretching beyond the top and bottom of the main window. So, should I have known about this or was the requirement detailed in the documentation? Not that I could find.

In the 'Instrument' dialog box deleting the default value of 'E end (V)' using backspace worked unless a minus sign was left with no digits, in which case a run-time error box appeared but closing this closed the whole program and I had to start again from scratch.

I was disappointed to find that the only techniques available as Freeware were linear sweep and cyclic voltammetry, which to my mind are not the best point to introduce the topic as a whole. To get simple DC voltammetry, I would have had to purchase a licence (not expensive, in fact). And, again, although the program is named 'Polarograph', there is no mention of polarography in the techniques nor of a dropping mercury electrode in the instrument options. There is, however, one sentence in the specimen tutorial. Perhaps it is unrealistic to expect polarography to be simulated.

*Continued on page 42*

# Polarograph.com

*Continued from page 41*

My first attempts to view the manual through the downloaded htm file didn't show the diagrams and I had to go online to the website to get them. I am informed that a pdf file would be a better format for the download and would avoid having to stay online while using the manual. I'm afraid I did not find the manual helpful as a guide to using the program. There is considerable detail about the theoretical aspects of voltammetry and the equations used but it is high level stuff and does not give an approach that would lead students into the topics or the software gradually. The section that describes the menu options really does no more than slightly expand the option heading, e.g. Auto Fit: Automatically fit the simulated curve into experimental data.

A Tutorial is available that gives an indication of the sort of exercises that Dr. Huang expects his students to pursue. It is graded introduction to DC voltammetry where students are guided through the topic with the student being challenged to predict responses from the system. This is a very good approach but the tutorial gives no indication to the student as to what to do if the prediction does not match the simulated outcome. This tutorial will only work if a tutor is available for consultation. Also, I found several minor but not trivial differences between the tutorial text and the text appearing in the dialog boxes. (Note - you can't do this tutorial properly if you only have the Freeware version since, as noted above, the technique is unavailable in it.)

So, is this package worthwhile? In line with the previous review, I am impressed with its power of simulation but I must qualify that with the fact that it is not learner-friendly. If you know what you are doing you will be able to make good use of it. Postgraduates and researchers can get useful predictions from it. Teachers may find it useful but they will probably have to spend a lot of time devising accompanying material that suits their students.

**Editor's note**
*This review was received shortly after the completion of the last issue of the journal and, as time permitted, was sent to the supplier for comment prior to publishing. Below is his response (some of his comments refer to an earlier version of this review). Finally, there is a short follow-up report from our previous reviewer (see Physical Sciences Educational Reviews* ***3*** *(2) 26-27 (2002). The program was then called* ***Polar****.*

**Response from Dr Huang**
Thanks for your review. May I explain some problems with your reviewer?

1. Your review said: "So, if you are wondering whether this package could be incorporated into an undergraduate teaching scheme (as I was) then a lot of introduction to voltammetric systems would have to be done first and much guided study pursued before undergraduates would benefit from the package."

Your review on last year said: "Activating the help system calls up a web page (providing you are connected to the WWW). This on-line manual is very thorough in its introduction to all of the electrochemical techniques and includes the major equations that are used in the simulations."
Manual "Chapter 2 Polarography and Voltammetry" has a lot of introduction to voltammetric systems. Many universities used my program for undergraduate courses for many years, e.g. RMIT University in Melbourne, University of Melbourne, etc.

2. Your review said: "An initial problem downloading the new version was resolved by Dr Huang and a substitute file published on his web site. Even so, it was not clear how to obtain it nor where to put it on my hard disc."

Your review on last year said: "Installation was quick and very straightforward." This problem is only for some PC. If he read my download page in my website where he download my program from, he may have not this problem. My page say: "If you have a problem on setup, e.g. it asks for setup again and again, please replace old Setup.lst file from polar.zip with following new Setup.lst file, then run setup."

3. Then your review said: "Once the program was installed there was a blank window on screen with some menu options but without guidance I was unsure where to start."

Everyone should know how to start, i.e. just by click on the RUN menu.Your review last year said: "The program is easy to use in that it uses standard pull-down menus". If he read manual, he may have not this problem. First line in Chapter 6 in Manual say: "Chapter 6 Playing Around, 6.1 Simulating over 30 Factors. A simplest way to run simulation is just to click the Run menu and then the Simulate submenu. It uses the default values to simulate a linear sweep voltammogram."

4. Then your review said: “Further difficulties were that some of the dialogue boxes overfilled the screen and OK buttons were inaccessible. It seems that this was because my PC resolution was set at 800 x 600. Once it had been changed to 1024 x 768 it was fine but looked rather odd“. I think he was wrong. If PC resolution is 800 x 600, there is not such problem. Display problem is only for PC resolution 640 x 480, that is about ten year old display. The resolution for VGA is 800 x 600. Almost every PC on market now is with super VGA for resolution 1024 x 768.

5. If he let me know he need other voltammetry such as DC voltammetry, I will offer him a password to activate this function without any charge.

I was happy for your review last year, but not for this one. May I suggest you will not publish this review as this review conflicts with your review on last year? May I suggest you ask your old reviewer on last year to review this year? He will know how new version changed in comparison with old version. What do you think?

**Update notes from previous reviewer**
A previous version of this software was reviewed in November 2002.

The website from which the program is downloaded states that the new version (5.1) contains new features of colour and checking. Certainly, this version will overlay plots using different colours and symbols (under the operator’s control) and this aids clarity when investigating the effect of changing a single variable.

However, I repeated the experiment mentioned in the original review: that of a solution at pH -4. The software allowed this as a valid input and gave me an appropriate-looking CV. Once again I have to repeat that depending upon the use to which you want to put this program, this can be considered as either a strength or a weakness.

There are no other changes that I can find in the unregistered version of the shareware program and therefore my original comments in the previous review are as valid. It is excellent for PhD work and it can be used for undergraduate work, but care will be needed in the supporting text to ensure that the results are as expected.

Roy Lowry
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January 2004

# Quantum Mechanics

***Subject area***
Quantum Mechanics.

***Description***
Two CDROM based resources for teaching a range of topics in Quantum Mechanics.

***Authors***
The Open University.

***Suppliers/Distributors***
The Open University
(http://www.ouw.co.uk/).

***Date/Version***
2003.

***Level***
Undergraduate.

***Type of package***
Simulation, computer aided learning, teaching aid.

***Price***
Single-user licence £29.36 per CD. Contact supplier for multiple user licence.

***Hardware required***
A PC with Pentium 450MHz processor, 32X CDROM, 800x600 resolution, High Colour, 64MB of memory (RAM) and a video card.

***Software required***
Windows 95, 98, NT and 2000.

Simone Richardson
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School of Electronics and Physical Sciences
University of Surrey
Guildford
Surrey GU27XH
May 2004

**Introduction**
The first CD consists of seven interactive tutorials covering a wide range of topics in Quantum Mechanics. It forms part of the resources for an Open University undergraduate course Quantum Mechanics (SM355). Each tutorial provides the user with interactive simulations and self-assessed questions. The authors have also provided, easy to read and understand, documentation that is useful to everyone using this tool. The material is aimed at students wishing to gain a good understanding of the principles and methods of quantum theory.

**Summary Review**

| range: * very poor to ***** excellent | |
|---|---|
| Ease of use | ***** |
| Ease of learning | **** |
| Documentation quality | **** |
| Academic content | **** |
| Usefulness to student | ***** |
| Usefulness to teacher | ***** |
| Portability | *** |
| Meets objectives | ***** |
| Accuracy | ***** |

The second CD contains two computer simulation programs MEASURE and SCHRÖDINGER. It is one of the resources used in an Open University residential course Quantum Mechanics: Experiments, Applications and Simulations (SMXR355). The programs are intended to be used by students wishing to gain experience with experiments relevant to Quantum Theory, and they both support and compliment the material in Quantum Mechanics (SM355).

**Quantum Mechanics (SM355)**
Quantum mechanics is a software package made up of seven student, self-paced tutorials covering a range of topics: Atomic Structure, Quantum Theory, The Schrödinger Wave equation, Wave Particle Duality, Heisenberg's Uncertainty Principle, Perturbation Theory and Pauli Exclusion Principle, The ammonia molecule. The package covers the fundamental principles and methods of quantum mechanics and explores how this leads to quantitative results such as in atomic structure.

The tutorials are:
*Alpha particle scattering* - An account of the experimental evidence for atomic structure by looking at the effect on scattering using a hard sphere, a Thompson atom and a Rutherford atom. These simulated scattering experiments are very easy to use, but also very effective at presenting the concepts.

*Qualitative properties of wave functions* – An examination of potential wells in order to study some qualitative aspects of wave functions. Each section uses a selection of simulations and mathematical expressions to reinforce different qualities of the solutions of the Schrödinger equation. For example, in infinite square well the user is looking at the values of energy and the wave functions in the well, outside the well and at the boundaries.

*Finding eigenvalues and eigenfunctions* – An examination of a finite square well in order to find the eigenvalues and eigenfunctions by solving Schrödinger's equation. Here the properties of a finite square well are looked at in more detail, including the limitations of analytical methods and the benefits of graphical methods.

# Quantum Mechanics

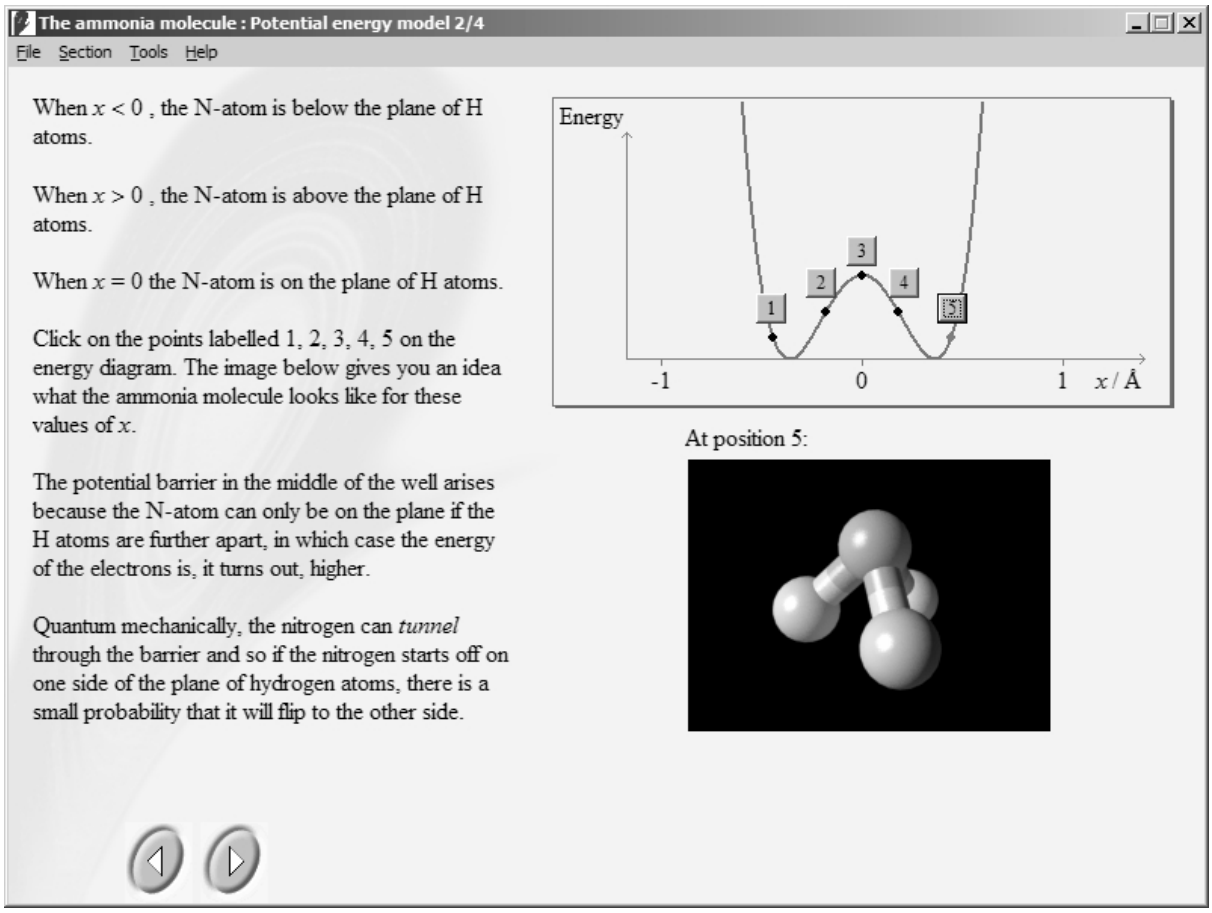


*fig 1: Example screen from* The Ammonia Molecule *tutorial*

*The simple harmonic oscillator* – A consideration of the classical simple harmonic oscillator and a quantum oscillator. I feel that the combination of graphs with questions will really help a student to gain a good understanding of the different properties. The summary section is particularly good for revision, as it organizes all the main facts on one screen page.

*Scattering from wells and barriers* – An examination using simulations of the reflection and transmission of particles by potential barriers and wells. The student studies how the solutions of the Schrödinger equation, presented in both mathematical and graphical forms, can be used to help model the scattering of particles.

*Wave packets* – An investigation of the scattering of wave packets from barriers and wells. This tutorial is more informative rather than instructive, due to the theoretical concepts discussed.

*The ammonia molecule* – Applications of quantum mechanical concepts. The opportunity to compare the simulation of the ammonia molecule in five different positions with the energy values for the potential well was very effective and helpful.

As you progress through the tutorials from the introductory concepts to the more complex ones the information is more informative and less instructive, clearly indicated by the absence of question pages in the later tutorials. This is more an observation, rather than a criticism, as the last two tutorials are presenting material that relies on theoretical concepts.

*Continued on page 46*

# Quantum Mechanics

*Continued from page 45*

**Quantum Mechanics: Experiments, Applications and Simulations (SMXR355)**
The program MEASURE allows the user to simulate a simple quantum mechanical system. You have a choice of seven windows, six of them each simulating an experiment and the seventh displaying a record of the experimental results. I found it easy to become familiar with changing the different parameters, but it takes a lot more effort to manipulate each experiment in order to fully appreciate the concepts and models being simulated. The Help (the help button on first screen page and not the help menu of the windows interface) is very useful. A student would also need either access to the course books or a worksheet giving them guidance on how to best use this program e.g. to plot a graph for a set of data or problems to solve.

The program SCHRÖDINGER is very informative and takes the user step by step to reach a numerical solution of Schrödinger's equation using the Numerov method. The user works through the mathematics involved in finding a solution, while occasionally having the opportunity to test their understanding with appropriate numerical questions. It is possible to work through the program without answering the questions, which is not beneficial to students. Hence, access to an assignment would guarantee a student's interaction with this resource. Otherwise this program is very effective; eg calculating the wave functions for different values of x for the infinite square well.

**Evaluation**
The Quantum Mechanics material is supplied on two CD-ROMs, which are easily installed using the accompanying installation program. I tested the software on two PCs one running with Windows 95 with a memory of 64MB of RAM and the other with Windows XP with a memory of 384MB of RAM and there was no noticeable difference between them.

As you open the program Quantum Mechanics (SM355) the user is presented with a user friendly graphical interface displaying a simple menu listing the seven tutorials. Once you have entered your chosen tutorial you can move forwards or backwards using two arrowed navigation buttons. As you progress through the material the user has the opportunity to read clear explanations of concepts, change parameters in many simulations and try out self-assessed questions to test their understanding. I found the organisation and structure of pages impressive as even with the variation in amount of information and white space, I feel that the user is presented with the appropriate information to effectively consider the different concepts. To avoid students working through the material passively the addition of assignments (worksheets of problems) would be a good idea. This is the case when the material is used in complete Open University courses.

The two Quantum Mechanics: Experiments, Applications and Simulations (SMXR355) programs offer very useful tools that would be a good addition to any Quantum Mechanics course. But it is clear that the user needs a good understanding of quantum theory and differential equations and more directed tasks to fully use the computer programs MEASURE and SCHRÖDINGER.

Whilst trying out both resources I noticed that once you complete a tutorial (or program) you need to exit the software before you can start a different tutorial (or program). It would be less frustrating if you could access other tutorials (or program) via a drop down menu.

As I worked through the resources I did not need to access any other printed materials as I had no problems running the programs. But it is important to appreciate that before students could use these resources they need a good understanding of physics (including Newtonian mechanics, electromagnetism and the wave nature of light) and mathematics (including differentiation, integration, vectors and complex numbers) to A-level standard, although no knowledge of quantum mechanics is required. Other Open University courseware can be used to present this pre-requisite knowledge; eg a level 1 science course Discovering Science (S103) and a level 2 physics course The Physical World (S207). Although I believe that all users would benefit from access to a good Introductory Quantum Mechanics textbook e.g. the book recommended in these resources is "An Introduction to Quantum Physics" by A. P. French and E. F. Taylor, even if it is just to use it like a glossary.

Overall I feel that these are two user-friendly resources that could easily be integrated into any traditional level 3 physics course to examine quantum mechanics concepts, to improve understanding with use of the simulated experiments and to compliment the material presented using different methods. Also it would be useful for postgraduate students to work through independently in order to review topics in preparation of their research work.

It is good to find some well designed software, with a very professional appearance, that is suitable to use as part of a level 3 Physics course.

# Letter to the Editor

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*Department of Physics, Box 351560*
*(206) 543-8692*

The Editorial in Volume 4, Issue 2, of the LTSN Physical Sciences Educational Reviews asks readers whether the reviews are useful to them. It seems to us that the reviews would be more useful if readers could have confidence in them. It was with some dismay that we noted that the two reviewers who expressed their opinions about *Physics by Inquiry* (John Wiley and Sons, Inc., 1996) and *Tutorials in Introductory Physics* (Prentice Hall, 2002) undertook a task for which they lacked sufficient familiarity with the intent and the content of the instructional materials to be able to make a credible evaluation.

*Physics by Inquiry* (Volumes I and II) is a set of self-contained, laboratory-based modules primarily designed for the preparation and professional development of primary and secondary teachers of physics and physical science. Teachers should possess a robust, coherent conceptual framework that enables them to recognize the logical steps needed for guiding students in the development of key concepts. Standard introductory and advanced physics courses typically do not help students develop the deep understanding of basic content that pre-university teaching demands. The carefully sequenced experiments and exercises in *Physics by Inquiry* are designed to help teachers learn (or relearn) physics as a process of inquiry. They also gain experience with a pedagogical approach that is consistent with how they are expected to teach. As teachers work through the modules, which are based on research on student learning, they develop an awareness of common difficulties that their students may have, even if they themselves do not.

The reviewer of Volume I expresses concern about the treatment of concentration. It is important to note that on page 100, the text states that there are “many ways to express concentration,” including the reviewer’s preference ($m_{solute}$/$volume_{solution}$). In fact, mass percent concentration of a solution, as used by health professionals, involves dividing the mass of the solute by the mass (not the volume) of the solution. The reviewer bemoans the absence of the mole from the text. However, one does not need a microscopic model of matter or the concept of the mole to accomplish the goals of *Physics by Inquiry*. The purpose is to direct the attention of students away from passive acceptance of an abstract model toward the development of a deep conceptual understanding through a chain of reasoning that begins with real world experience. Research has shown that young students and many of their teachers do not clearly distinguish such basic concepts as mass and volume from each other. Such difficulties are more appropriately addressed at this initial level with a macroscopic model for matter. Once understood, the basic concepts of mass and volume form the foundation for the study of density and concentration, another set of concepts that students often confuse.

Another example cited by the reviewer is an incomplete numerical solution to a heat and temperature problem that students are asked to interpret and explain. He fails to acknowledge the purpose of the exercise by not including any description of the questioning that follows. The implication is that this set of numerical calculations would be an acceptable solution. Even a quick glance at *Physics by Inquiry* would reveal the strong emphasis on explanation and interpretation. In the example in question, students are not given units as part of the solution by design. Without the units, they are forced to think carefully and critically about what quantities the numbers represent, why a particular mathematical operation is performed, and how each operation affects the interpretation of the resulting number. All calculations submitted in homework or on examinations must be accompanied by complete explanations. In our view, whether students use number or quantity calculus is not important provided that they are able to interpret the result of the mathematical operations involved in solving a problem.

The condescending tone of the review of Volume I weakens its intellectual value. For example, it is difficult to reconcile the allocation of space by the reviewer to concerns about the difficulty in obtaining shadow plots. Having students obtain data in order to construct a model to account for the apparent daily motion of the sun is a conscious choice consistent with the scientific process. The argument that an overcast sky makes this task difficult is trivial. (Seattle, like Manchester, is often cloudy.)

*Physics by Inquiry* and *Tutorials in Introductory Physics* are intended for different populations. While both share a common research base, the tutorials try to improve student learning within the context of a standard undergraduate introductory physics course. Given the difference in instructional goals and intended populations, *Tutorials in Introductory Physics* and Volume II of *Physics by Inquiry* should not have been evaluated in a single review. Although the topics in Volume II correspond more closely to material covered in a standard introductory university course, both volumes of *Physics by Inquiry* should have been reviewed together. Had this been the case, the reviewer of Volume II who claims that “the division of unlike quantities, such as space and time intervals, to form a meaningful ratio” does not receive enough emphasis would have realized that this very important idea is introduced in the context of density and is one of the central themes of Volume I.

*Continued on page 48*

# Letter to the Editor

*Continued from page 47*

*Tutorials in Introductory Physics* is designed for use in conjunction with a wide variety of introductory textbooks and course formats. As such, these materials have been incorporated into many existing courses without redesigning and overhauling the courses entirely. The carefully structured worksheets target those concepts in introductory physics that research has shown are particularly difficult for students. It is important to note that the conceptual difficulties addressed in *Tutorials in Introductory Physics* are extremely persistent. Evidence from research reported in peer-reviewed publications indicates that even graduate students, post-docs, and faculty in physics often demonstrate many of the same difficulties when responding to certain types of qualitative questions. Our experience at the University of Washington with graduate students from the UK and elsewhere indicates that these materials are not inappropriate for university students in the UK and other countries. Many of the difficulties that the tutorials are designed to address tend to be independent of student population and culture.

The LTSN Journal has a wide circulation and therefore it is particularly important that any statements made in the reviews be accurate. It is difficult to correct misstatements through a Letter to the Editor, which is likely to be read by only a relatively small number of readers. Perhaps the problems above could have been avoided, or at least minimized if we could have seen the reviews before publication. It would have been possible to correct misstatements about both the purpose and content of the materials before the reviewers' opinions were given wide distribution.

**Lillian C. McDermott, Peter S. Shaffer, and the Physics Education Group at the University of Washington, Seattle, Washington, USA**

**Editor's Note**

*Because of time scales it is rarely possible to allow authors/suppliers a sight of reviews prior to publication.*

*The reviewing process we undertake is essentially one person's snapshot view of a resource. It cannot be an in-depth, scientifically-based study, but is an opinion.*

*Individuals have divergent opinions, but I think it significant that both our reviewers, from different subject areas (one of whom had been to the lectures given by Lillian McDermott when she visited the UK as our guest in March 2003) gave similar reports for these resources.*

*Both reviewers were approached to comment on this letter. Neither was swayed by the arguments presented to consider a response was appropriate.*

## Physics Discipline Network Workshop X

**9th to 10th September 2004**
**University of Leeds**

***Physics Teaching & Learning: 10 Years of Progress***

The main thrust of this tenth, annual, Physics Discipline Network workshop is to review the progress in Physics T&L that has been made since the workshop's inception in 1994. It will be an opportunity to not only hear some popular speakers from previous workshops but also for delegates to contribute either posters or mini-talks about their own teaching and learning initiatives.

Amongst our speakers we have Dr Norman Reid (Glasgow University) who will chart the developments in physics pedagogic research and Dr Bob Lambourne (Open University) who will give a pan-European perspective. Val Butcher (Generic Centre, York) is in a unique position to discuss the latest thinking on graduate skills for employability agenda and the latest anarchic T&L ideas from Dr Dominic Dickson will be shared.

More details and registration forms at
http://www.physsci.ltsn.ac.uk/

## Variety in Chemistry Education 2004

**5th to 7th September 2004**
**University of Plymouth**

Variety in Chemistry Education is one of the major chemistry education conferences for Higher Education. It provides a forum for the exchange of ideas related to the learning of chemistry at degree level, the dissemination of good practice and innovation in chemistry education and pedagogic research as it relates to chemistry at university level.

Our students need to develop an understanding of chemical principles and an ability to apply their knowledge in unfamiliar situations. We can help them by increasing the variety of learning experiences available to them. Many individuals have developed interesting ways of stimulating learning in chemistry and related areas, but have had little opportunity to discuss their ideas with others. Variety in Chemistry Education offers that opportunity.

More details and registration forms at
http://www.physsci.ltsn.ac.uk/

Visit our web site...

http://www.physsci.ltsn.ac.uk

to find out more about the
LTSN Physical Sciences Centre.

Latest...
On May 1st 2004, the Centre
became part of the Higher
Education Academy.