Semiclassical Physics. Matthias Brack and Rajat K. Bhaduri. Addison–Wesley Publishing, 1 Jacob Way, Reading, Massachusetts 01867, USA. 1997. 444 pp.

Ever since its development in the 1920s, quantum mechanics has proved to be spectacularly successful in describing the microscopic world of atomic and nuclear physics. Although quantum mechanics represents a radical departure from the concepts of classical mechanics, there is often a close relationship between the behaviour of a quantum mechanical system and its classical limit. Indeed, this is the main idea behind the Bohr–Sommerfeld quantization condition which played a major role in the early history of quantum mechanics before its mathematical structure was fully developed. The connection between classical and quantum mechanics becomes more transparent in the path integral formalism which was introduced by Feynman and developed further by Van Vleck, Gutzwiller and others. The path integral technique clearly shows when and how the concept of classical trajectories of particles can be useful in quantum mechanics. Very briefly, the path integral method consists of identifying the classical trajectories of particles, and then calculating the quantum fluctuations around those trajectories in a systematic expansion in powers of Planck's constant. This is called a semiclassical approach and it is the main subject of the book under review.

For a small number of particles or degrees of freedom, the path integral method can be a more convenient and geometrically appealing way of studying a system than solving the Schrödinger equation. This is particularly true if the classical system is not integrable. In that case, the Schrödinger equation governing the quantum mechanical system is generally not exactly solvable by analytical methods. While the equation can certainly be solved numerically up to any desired accuracy, many features of the numerical solutions may be difficult to understand in a physically intuitive way. This is where a path integral approach may prove to be fruitful. It turns out that the classical periodic orbits, which generally exist even in nonintegrable systems, play an important role in determining certain features of the quantum mechanical solutions, such as 'scars' in the wave functions of a single particle in a confined region, and shell structures in the energy spectra of multiparticle systems like atomic nuclei, metal clusters, and quantum dots. The high point of the periodic orbit theory is the Gutzwiller trace formula which expresses the quantum mechanical amplitude for a particle to go from one space-time point to another in terms of the appropriate classical trajectories and the fluctuations around them. The discussions of the trace formula and its applications form a major part of the book. To this end, the authors examine a variety of classically integrable and nonintegrable systems, and the different methods which are required to study them quantum mechanically.

The authors also consider a related semiclassical technique called the Thomas–Fermi method. This method and its various extensions are particularly useful for studying systems with a large number of particles, either at zero or at finite temperature. The Thomas–Fermi and path integral methods are presented in most books as unrelated topics. However they can be connected to each other through the single-particle density of states, as is demonstrated in this book.

The introductory chapter of the book lists a number of experimental results which can be understood in a fairly simple way using semiclassical ideas. The examples include wave packets of an atomic electron with a high Rydberg number, the spectra of atoms in a strong magnetic field, the electrical resistance of mesoscopic systems particularly in the presence of a magnetic field, and the energy levels of quantum dots in semiconductors. This chapter provides a strong motivation for learning the theoretical tools explained in the rest of the book.

The authors have presented lots of worked out examples as well as problems for the reader to solve at the end of each chapter. The problems often lead to more advanced topics for which ample references are provided. The lucid style of writing and the large number of figures make the book a pleasure to read. There are brief notes on a number of topics such as chaotic motion, the Riemann zeta function, the quantum theory of scattering, and Hartree–Fock and density functional theories which make the book extremely self-contained. The entire book should be understandable by someone who knows elementary quantum mechanics. It is indispensable for anyone who plans to begin work in this area and is highly recommended for those who are just curious about the subject. This book is the latest addition to the Frontiers in Physics series which has over the years covered almost the entire spectrum of modern physics. Libraries of science would certainly benefit by acquiring this book written by two experts in the field.

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Annual Review of Physical Chemistry 1997. vol. 48, Annual Reviews Inc., 4139, El Camino Way, Palo Alto, California 94303-0897, USA. Price: Individuals $ 69, Institutions $ 138. 875 pp.

At the beginning of each calendar year, I look forward to the arrival of the latest issue of *Annual Review of Physical Chemistry (ARPC)*. This year, I was pleasantly surprised when I was asked if I would review *ARPC* 1997. I agreed readily. There is a Tamil proverb that sums up my feeling:

கரும்பு தின்னக் கூலியா வேண்டும் ?

(Do you need to be paid to chew sugarcane?)

In these days of rapid growth in scientific literature, it is extremely difficult to keep up with the literature in one's own area of research, let alone other areas of physical chemistry, and other branches of science. One learns with envy how people like Pauling could read cover-to-cover each issue of the *Journal of Chemical Physics* those days. It is in this background that the review journals and monographs assume special significance and keep us from becoming scientifically outdated. Each review journal has its character. *ARPC* has its own. Being an annual issue, it tries to indicate the state-of-the-art in physical chemistry, a kind of annual stock-taking. Each chapter is written by some of the practitioners in the field. In contrast to *Chemical Reviews*, these are not comprehensive but

personalized (re)views of the recent developments.

If one goes through the various volumes of *ARPC* over the years, one gets a sense of how different areas have emerged, attained eminence and fell by the wayside. *ARPC* 1997 is a clear indicator of 'What is hot and what is not' in physical chemistry. It covers structure as well as dynamics. It covers research in gas, liquid and solid phases, surfaces and interfaces. It clearly indicates how the field is going: towards materials and biology. This does not mean that traditional topics have lost their relevance. The ubiquitous hydrogen bonding, for example, is enjoying renewed attention. It seems to occur everywhere – weaker in some places and stronger in some others (when compared to the 5 kcal/mol that Pauling gave it). The subject is being reviewed in this journal after a span of 25 years, with special emphasis on the 'strong' ones by Perrin and Nielson. It becomes clear from their article that the hydrogen bond remains an enigma – far from being understood.

There are 25 chapters in the 1997 volume of *ARPC*. The first one, as always, is a scientific autobiography by a senior physical chemist of repute. This time, by Sydney Leach of France. He brings out the difference between the physicists and chemists by recalling what Lagarrigue said to him, 'Well, when you have done hydrogen there is nothing else to be done'. That probably explains why there is more unemployment among physicists than among chemists. While reading the account of Leach's inability to reproduce the absorption spectrum of lead tetraethyl published in the *Journal of Chemical Society* in 1934 by H. W. Thompson, and learning from the author that it was due to benzene impurity in his (Thompson's) lead tetraethyl, one is reminded of the efforts of Raman and his students in removing the non-existent impurities in benzene before announcing to the world the discovery of Raman effect. It is gratifying to note Leach recording his appreciation of R. K. Asundi (an unsung hero in this country) and his original research in spectroscopy and combustion.

The rest of the chapters take us from the down-to-earth topic of physical and chemical properties of ultrathin oxide films (S.C. Street, C. Xu and D. W. Goodman) to the microphysics and heterogeneous chemistry of polar stratospheric clouds (T. Peter). The ones devoted to theory cover a range of topics, from *ab initio* quantum chemistry to protein folding. They are: theoretical studies of chemical dynamics (H. Nakamura), *ab initio* dynamics of surface chemistry (M. R. Radeke and E. A. Carter), molecular structure and dynamics at liquid–liquid interfaces (I. Benjamin) and the theory of protein folding (J. N. Onuchic, Z. Luthey-Schulten and P. G. Wolynes). Theory is complemented by experiment (or is it the other way around?). Loomis and Lester review the current status on $OH–H_2$ entrance channel complexes, while Gutman and Nachliel report on the recent findings on time-resolved dynamics of proton transfer in proteinous systems. State-to-state chemistry *per se* may not be fashionable any longer. But the fact that state-resolved collision-induced electronic transitions, femtosecond dynamics of electrons on surfaces and at interfaces, subfemtosecond processes in strong intense laser fields and active control of the dynamics of atoms and molecules are being vigorously pursued becomes evident from the reviews of Dagdigian, Harris *et al.*, Corkum *et al.* and Gordon and Rice.

How to do single-molecule spectroscopy without isolating a single molecule is the subject of the review by Plakhotnik *et al.* Spectroscopy in its umpteen different versions is the staple diet of modern day physical chemists. This becomes evident from the reviews on spectroscopy of metal ion complexes (M. A. Duncan), Stark spectroscopy (G. U. Bublitz and S. G. Boxer), two-photon-induced fluorescence (P. R.Callis), infrared and Raman vibrational optical activity (L. A. Nafie), fast natural and magnetic circular dichroism spectroscopy (R. A. Goldbeck *et al.*) and structural information from methyl internal rotation spectroscopy (L. H. Spangler). The review on molecules in high Rydberg states by Merkt covers the recent developments in the investigation of these exotic states and illustrates how in turn they are leading to chemical applications.

The reviews on kinetics in solids by Vyazovkin and Wight and new EPR methods for investigating photoprocesses with paramagnetic intermediates by Stehlik and Möbius are reminders to the point that the traditional physical chemistry tools can be put to modern use. One is also reminded of the lesson that developments in physics can have their offshoots in chemistry by reading the review on dissociative recombination with ion storage rings (M. Larsson).

There is an old belief in this country. Nothing is perfect on earth and anything that is, doesn't belong in here. The excellent reviews do contain some typographical and some grammatical errors. This is understandable, considering the size of the volume (822 pages in small print) and the time constraints with which they are produced. But what is surprising is that Sydney is spelled wrong and fullerenes are referred to as the largest of simple *compounds* in the preface.

For any practitioner of physical chemistry, a look through *ARPC* 1997 is a must. Because of the budget constraints, many libraries are deleting *ARPC* from their list of standing orders. This is a pity. What complicates matters is the difficulty in acquiring it in India. To those who do not get it in their library, my advice is the age old one: beg, borrow or steal (temporarily)!

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Annual Review of Cell and Developmental Biology 1997, (J. A. Spudich, ed.). Annual Reviews Inc., 4139 El Camino Way, Palo Alto, California 94303-0139, USA. Price: Individuals $ 69, Institutions $ 139.

E. B. Wilson's 1925 *magnum opus* '*Cell in Development and Heredity*' was a path-breaking attempt to bring together the then available knowledge in disciplines that, in our current terminology, we may identify as 'cell biology' and 'developmental biology'. Unfortunately, however, as each of these areas grew in information content, their developments were 'autonomous', often bordering on some kind of 'contempt' for the other area. Fortunately, however, we seem to have covered the circle fully and come round to the position where 'cell biology' and 'developmental biology' are no more antago-