

Book Review: *Van der Waals Forces: A Handbook for Biologists, Chemists, Engineers, and Physicists*

Van der Waals Forces: A Handbook for Biologists, Chemists, Engineers, and Physicists. V. Adrian Parsegian, 380 pp, Cambridge University Press, 2005.

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Van der Waals forces appear everywhere around us, from interactions between molecules in gases (van der Waals' original work), to aerosols, nanoparticles, colloids and paints, to cell membranes, macromolecules and proteins, to the amazing adhesive power of geckos' feet. Interest in these forces spans the fields of Biology, Chemistry, Engineering, and Applied and Theoretical Physics. In this respect, van der Waals interactions are an ideal topic of interdisciplinary research, offering a sea of opportunities to young researchers looking to apply their skills to fundamental problems in a broad class of practical situations. Writing from decades of experience, Parsegian, Chief of the Laboratory of Physical and Structural Biology in the National Institute of Child Health and Development, and a former President of the Biophysical Society, has succeeded in putting together a thoroughly informative, useful, delightful handbook that is rapidly gaining recognition as the ultimate guide and reference text in the field.

The book is conveniently organized at different levels of scientific detail. A relatively short prelude provides an excellent overview of van der Waals forces and the various theories developed to explain them: pairwise summation of dipole-dipole interactions, the Derjaguin-Landau-Verwey-Overbeek theory, and the modern view of Casimir forces and the analysis of parallel walls with an intermediate medium of Lifshitz, Dzyalozhinskii and Pitaevskii. Through problems and examples the reader gains familiarity with basic applications and units, as well as a solid sense of the magnitude and importance of van der Waals forces in different situations. The mathematical formalism is expanded upon in *Level 1*, including a discussion of retardation and screening effects, and the meaning and use of "imaginary frequencies" in the evaluation of van der Waals forces. The basic form of formulae to be employed in actual computations is presented, and their meaning is thoroughly discussed. *Level 2* constitutes the heart of the book. Here we find

tables of formulae for every imaginable situation, in planar, spherical and cylindrical geometries. The tables list not only the most exact available expression for each particular case, but also address various limits of approximation (for short and large distances, zero temperature, small differences in permittivity, etc.) that, while less exact, greatly aid understanding and build physical intuition. Essays on the use of the formulae and detailed advice on computation techniques, including sample programs, conclude this part of the book. *Level 3* contains a detailed exposition of the theory behind the formulae, starting with a heuristic derivation of Lifshitz's general result for the interaction of two semi-infinite media across a planar gap, which is then extended to layered systems and inhomogeneous media, and ending with a discussion of ionic-charge fluctuations and of anisotropic media.

The book is largely self-contained, easily accessible to its intended broad audience, though, inevitably, the reader is occasionally referred to other sources (as for the Kramers-Kronig relations, in Sec. L.2.4). Excellent references are suggested in all such instances. Problems and examples are scattered throughout the book, including in its main (*Level 2*) section, and they greatly clarify and help mastering the material. Those of us fortunate enough to have met the author will recognize in the book Parsegian's inimitable style, depth of thought, wit and humor. The text creates the illusion of a blackboard discussion, perhaps over a cup of coffee (you'll need it to keep up with Parsegian's fast pace and enthusiasm), where all conceivable questions, big and small, surface up and are considered with the same degree of care. Parsegian has a gift with words and the text is enjoyable not only for its scientific insights and elegant exposure of ideas, but also for its beautiful prose.

There are very few improvements that I would dare suggest. I found myself flipping back and forth through the various sections of the book, as the text invites one to do, and my own copy is riddled with "post it" notes—to facilitate the task. It would be handy if the various sections were marked, as in thesauruses and other reference books. I would also prefer to have notes at the bottom of the page, rather than at the book's end, for all sections of the book, not just in the tables section. But none of this diminishes from the book's appeal. I feel, in fact, somewhat awkward reviewing a book that is already a hit. A student walked into my office as I was absorbed in the text. His face lit up in a smile as he remarked: "Ah, you too have discovered this book . . . I just got it myself. It is excellent!"—Indeed it is!

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