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Physics of Solitons by Thierry Dauxois and Michel Peyrard, Cambridge University Press, Cambridge, 2006, pp. xii + 422. Scope: monograph. Level: undergraduate and postgraduate.

John Scott Russell's 1834 observation of what he called "The great solitary wave" was a remarkable discovery by an interesting man whose achievements were not appreciated within his own lifetime. He was riding his horse along the Union Canal near Edinburgh, watching a barge being pulled along the narrow channel by a pair of horses. When the barge suddenly stopped, the water that had been moving with it surged on to create a solitary wave – a "rounded smooth and well defined heap of water" travelling at eight or nine miles per hour, preserving its shape as it moved. On his horse, he was able to follow it, overtake it, watch it as it travelled, and cogitate about it. It made a deep impression on him, and he subsequently performed several experiments on such waves, both on canals and in tanks. His 1844 report summarising the results for the 14th meeting of the *British Association for the Advancement of Science* was so strongly criticised by Airy and Stokes, however, that he abandoned the research completely (though he continued to excel in other directions in his profession as an engineer). His discovery was successfully re-enacted during a conference at nearby Heriot-Watt University in 1995.

It was not until 1895 that a satisfactory understanding of Russell's observations and experiments was achieved, through the work of Kortweg and de Vries. Their KdV equation has remarkable mathematical properties that encompass the characteristic features of what are now called solitons. For example, there are solutions involving surface waves that travel without change of shape and proceed at supersonic velocity, i.e. exceed the speed of small-amplitude linear surface waves. Since then, it has become evident that solitons and soliton-like phenomena occur widely in physics and in the natural world, e.g. as tsunami and in optical fibres, nonlinear electrical lines, blood pressure waves, ferroelectric materials, ferromagnetism and antiferromagnetism, conducting polymers, Bose-Einstein condensates, and perhaps DNA.

Thierry Dauxois and Michel Peyrard have put together an extensive monograph describing the mathematical physics of solitons. Their book consists of 16 chapters grouped into four Parts, plus appendices. The text opens with a friendly and interesting introduction to motivate the reader and set the context. The four chapters of Part I cover respectively nontopological solitons and the KdV equation, topological solitons and the sine-Gordon equation, the nonlinear Schrödinger equation, and ion-acoustic waves in a plasma as an example of soliton modelling. Part II consits of three chapters giving an account of the mathematical methods available for treating solitons. There are seven chapters in Part III dealing with a diversity of different applications (and possible applications) of solitons. These include respectively: the 1955 Fermi-Pasta-Ulam (FPU) paradox, which was instrumental in stimulating the rediscovery and modern understanding of solitons; dislocations in crystals; ferroelectric domain walls; incommensurate phases; magnetic systems; conducting polymers; and Bose-Einstein condensates. There are just two chapters in Part IV discussing the possible role of solitons in energy localisation/transfer in proteins, and in the statistical physics of DNA. The three appendices provide respectively a derivation of the KdV equation for surface hydrodynamic waves, a synopsis of the main results of Lagrangian and Hamiltonian mechanics for continuous media (which is where, in practice, most systems soliton-like excitations arise), and a discussion of the coherent states of a harmonic oscillator. The text is very well-written, albeit with slightly too many exclamation marks, and should be accessible to a wide readership.

Just before the appendices there is a reflective Conclusion addressing directly the question of whether or not physical solitons can really be considered to exist – which in a sense is a philosophical problem. The discussion is motivated by the "overselling" of solitons by certain enthusiasts, and by the resultant critical reactions by sceptics. The problem, as the authors point out, is that the equations describing real physical systems are not precisely of soliton form, but may include extra terms. Consequently, their behaviour is soliton-like, rather than being precisely of the form predicted for idealised mathematical solitons. The authors discuss the issue sensitively and cautiously. In doing so, they point out that in treating real systems a choice may sometimes exist between using a linear model and then adding extra terms to reflect reality, or modelling with solitons and, again, adding some extra terms. They suggest, persuasively, that may be many instances where the latter aproach is the more appropriate and revealing.

A great deal of care and attention to detail has gone into making *Physics of Solitons* attractive and interesting on many levels. There are pictures and short vignettes of a dozen of the scientists whose work is featured in the book, including e.g. Davydov, de Vries, Fermi, Korteweg and Tsingou, as well as John Scott Russell himself. The many illustrations and figures have full and helpful captions, and there are striking photographs of some natural solitons such as internal waves on the Andaman Sea. There is an extensive (though select) bibliography. The authors have taken the opportunity of setting the historical record straight for Mary Tsingou who performed the computing (on MANIAC at Los Alamos) that led to the discovery of the celebrated FPU paradox, but who was not included in the authorship of the famous paper that resulted from her work.

The authors stress that "The book does not claim to be exhaustive", which is reasonable given the enormous literature on solitons. Nonetheless it is a substantial and carefully considered work with a broad coverage. It seems to me ideal as an introduction to the field for undergraduate or postgraduate physicists, or for any numerate scientist who wishes to learn something about solitons, and it can be recommended very warmly to them all.

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