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# Superstrings and Other Things

*Carlos Calles*

What is physics? We all have our own definitions, ranging from the tautological "Physics is what physicists do" to Carlos Calle's "Physics deals with the way the universe works at its most fundamental level". He has written a book covering the entire subject, as he sees it, aimed at non-experts – an awesome task.

Standing now at the start of the 21st century, many physicists seem to feel a little hesitant, and slightly uncertain about the status of their subject. Long gone is the boom time of the 1960s when all physics departments expanded, with applicants of superlative quality clamouring at their doors. Enrolments have fallen, on a world-wide basis. Most physics graduates do not practice their discipline directly. And it is being widely suggested that, where physics was the key subject of the 20th century, biology will be that of the 21st. Given the phenomenal successes of biology in recent years, the latter remark has an uneasy resonance. Adding to the sense of isolation is the realisation that few people – at least in the UK – know what physics is. This has been underlined for me on a couple of occasions when seemingly highly-educated and sophisticated social contacts, on hearing that I was a physicist, responded along the lines "Oh, so you work down at the hospital, then?".

This ignorance is astonishing, considering the extent to which physics has permeated almost every aspect of modern life. The same ignorant public happily use their mobile 'phones, televisions, CD players, microwave ovens, refrigerators and so on. But, although they may connect these things with science, they do not appreciate that it has been discoveries in physics that made them possible. Most people seem to have very little idea of what electricity is, or of how the electricity supply to their house is organised, and no idea at all of how their domestic appliances work.

What is to be done? There is probably no single, simple magic solution to the problem. Rather, action on a broad front is needed, part of which must be the provision of reading material for non-experts. So Carlo Calles' book is especially welcome at this juncture.

He says it is "intended for the informed reader who is interested in learning about physics". It is also aimed at scientists in other disciplines, and professionals in non-scientific fields. In other words, he is addressing a readership who already know, at least

vaguely, what physics is about. This obviously excludes a fair fraction of the intelligent public, but there will surely still be a very large potential readership.

The first chapter sets the context. It opens with a description of what physics is, quotes Schrödinger "I know not whence I came nor whither I go nor who I am", and points out that humans have probably been preoccupied with the origin and nature of the world for as long as we have been human. Having aroused the reader's interest, Calle then tries to maintain it with highly personalised accounts of some of the discoveries by Einstein, Fraunhofer and Heisenberg. He discusses scientific method (learning from our mistakes), and the relationships between physics and other sciences, and between physics and mathematics.

Calles then launches into the main part of his opus, and the 24 chapters that follow attempt to cover the whole of physics. They are grouped into 6 sections devoted to: mechanics; structure of matter; thermodynamics; electricity and magnetism; waves; and modern physics. The latter includes relativity (both special and general), quantum mechanics and particle physics. There are appendices on powers of ten, the elements, physics Nobel Prizes and the history of physics. There will be an index (not included in my proof copy of the book).

Inevitably, most professional physicists will feel that essential topics are skimped or missing (e.g. superfluidity – which has yielded two Nobel prizes – is one that I personally would have included). But the coverage is genuinely broad and remarkably inclusive. The style is chatty and friendly, but the author does not shrink from the use of simple algebra. The more concentrated blocks of equations are boxed, as are some specialised topics, and can be skipped. There are numerous illustrations, sketches, diagrams and photographs – many of which are missing from my proof copy.

Again, perhaps because it is in proof, there are some ambiguities and awkwardnesses. One example is the Calles' discussion of very small numbers in the introduction. He considers how long it would take to reach the level of single molecules when repeatedly slicing a grain of common salt into tenths. He argues that if it takes one second per 10-way slice, it would take $10^{10}$ years, "roughly the age of the universe to arrive at a single molecule of salt". Of course this would be true if one were to separate all the molecules. But if one chose to divide only one slice at each successive iteration (which is what I initially assumed was intended), it would take only 19 seconds to reach the level of single

molecules – and this seems to me a better illustration of what very small numbers are about.

Has the author succeeded in his aims? I think that to a large extent he has, at least where scientists in other disciplines are concerned. I am not so sure about the professionals in non-scientific fields, who may find this book hard going (e.g. the unglossed use of "spectrum" in relation to solar radiation on page 6 of the introduction). I suspect that only those with at least some prior elementary knowledge of science, are likely to embark on Calles' 631 pages of enthusiastic exposition and explanation of the universe we find ourselves in. Most will dip in selectively, and those that do will be enriched by what they find.

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