

chapters of his book encompass material he presented to mathematics students at the Royal Military College in Australia and at the Australian Defence Force Academy. In these chapters, he primarily addresses the mathematics of exterior ballistics for students who have a substantial background in classical mechanics and mathematics including differential equations and their numerical solutions; for example, there are important references to Runge-Kutta procedures but no description of this approximation method. In his last chapter, which constitutes about 25% of the book, he uses the techniques developed to describe the trajectories of shot and shell to address the paths of missiles projected more peacefully in sport. The book is written in the form of a textbook, with a set of exercises at the end of each chapter.

The spirit of the book is mathematical: It emphasizes analytic approximations and numerical methods for solving the relevant differential equations while the physical bases of the equations are considered minimally. The approximation techniques, which are elegant and interesting for their own sake and occupy much of the book, will appear to be misplaced to those who just want answers and have minimal access to computers. My obsolete PC had sufficient power to solve the problems that were posed by the most naive of iteration methods—never mind application of the intelligence de Mestre provides.

The transition to sports elements—usually balls, but shuttlecocks and javelins, as well as human long jumpers and even motorcycles are considered—is not wholly successful. In general, I found de Mestre's comments on individual sports interesting, sometimes amusing (as in his claim that many rugby passes are illegal), but by no means definitive; certainly some of his statements about baseball are at best arguable. The parameters used to describe the effects of the air on moving objects can be used to gain some insight into the trajectories of many sports missiles, but the approximations used are not always adequate for calculation of the accuracy of interest to sports fans. For example, the drag on a baseball traveling at 40 m/sec is understated by almost a factor of two. And though the inadequacy of the discussion of the Magnus force—and hydrodynamics in general—can be blamed on the references consulted by de Mestre, the resultant errors are troublesome. The graph presented in Chapter 8, which shows the variation of the lift coefficient as a function of

spin and velocity for a smooth rotating sphere, predicts that a table tennis ball thrown with spin will curve in the opposite direction from that which is observed.

These caveats are of minor importance for those who would use the book as a text, but I doubt that there is a substantial American clientele for a course on this subject. Those who are interested primarily in the sport aspects will find—as I did—matters of interest, but the book will not teach one to calculate accurate baseball trajectories.

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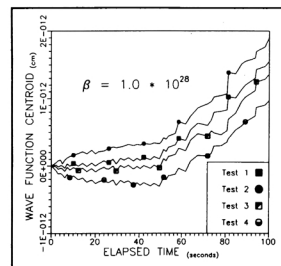
Unification of Fundamental Forces: The First of the 1988 Dirac Memorial Lectures

Abdus Salam
Cambridge U. P., New York,
1990. 143 pp. \$14.95 hc
ISBN 0-521-37240

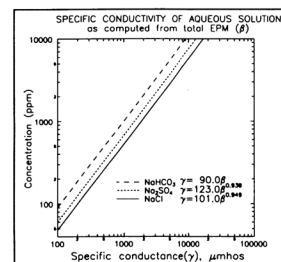
This engaging little book consists mainly of a personal history by Abdus Salam of unification in physics, supplemented by two contrasting lectures by Werner Heisenberg and Paul Dirac. My reactions to the book were molded by the circumstances in which I read it: on a train through Central Europe, two days after the end of the Gulf War, immediately after reading an English newspaper article making light of the demise of the French intellectual and shortly after a visit to Salam's International Centre for Theoretical Physics in Trieste. Salam's book distracted me from the beautiful scenery and set me musing about the conditions and relations of the Western and Eastern scientific traditions.

Salam's history of unification takes us from the Al-Biruni, who lived in what is now Afghanistan and was apparently the first to assert explicitly that physical laws are the same in different parts of the universe, to the possibility that superstrings might provide a "theory of everything," and ends with a humbling quotation from the Holy Koran. The stages in between are not reviewed in great scholarly detail but are entertainingly illustrated by apposite anecdotes, such as the travails of a journalist interviewing Dirac, the story of how Theodore Kaluza started working on the theory of swimming and Dirac's "minus two fish" solution to the Cambridge Archimedes problem. I particularly enjoyed the tale of an encounter between Dirac and Richard Feynman at a Solvay conference and the perspective on the fundamental

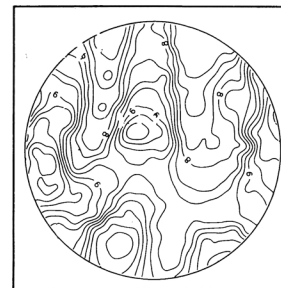
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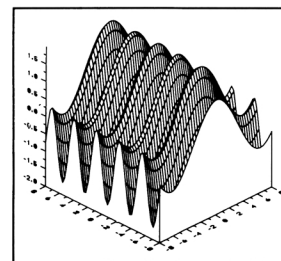
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forces from the Jhang school in pre-independence Pakistan. I do not know how much formal knowledge of physics a lay reader would acquire from reading this book, but the lay reader and the professional physicist would both be inspired by Salam's openness and enthusiasm.

The other two physicists whose lectures appear in this book debate alternative approaches to theoretical physics—philosophical, mathematical, pragmatic and experimental. Their viewpoints do not always agree with Salam's: For example, Dirac is quite skeptical about unification and Heisenberg extols the S-matrix. Thus the inclusion of these other essays gives the reader some welcome perspective, as well as revealing recollections of a European intellectual world that was sundered by a previous dictator's insane egoism and destructive war.

Recalled in this book are the days of "string and sealing wax" in the Cavendish laboratory of the 1930s, and Crick and Watson's bicycle sheds of the 1950s, which are light years removed from the giant modern electronic "Nintendo" experiments at LEP and elsewhere. Has the recent revival of European particle physics been part of a general renaissance of European culture and intellectual ferment, or has it been accomplished by adopting and adapting a materialistic trans-Atlantic approach? The advance of science flourishes on a diet of cultural diversity, as shown by the stories of Al-Biruni and indeed Salam himself. The most advanced scientific culture in the Middle Ages was that of the ancestors of the Gulf War's "Nintendo" victims. We should remember this before patronizing their apparent inaptness for contemporary Western science and technology. Salam has devoted much of his own energy and prestige to encouraging scientific and intellectual culture in developing countries, notably at his International Centre for Theoretical Physics. Such efforts at intellectual unification should be more widespread if science is to maintain its healthy mutation and evolution. If this book gives to many readers as much food for thought as it did to me, it will help towards this goal of human unification.

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Nonlinear Evolution Equations That Change Type. *The IMA Volumes in Mathematics and its Applications* 27. Proc. Wksp., Minneapolis, Minn., 1988-89. B. L. Keyfitz, M. Shearer, eds. Springer-Verlag, New York, 280 pp. \$35.00 hc ISBN 0-387-97353-2

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