Preface

Fracture affects everything. On a grand scale fracture has played a part in the evolution of the world as we know it. The evolution of life has seen constant interplay between plants and animals avoiding being torn or eaten, and the need of other animals to eat. Human evolution has been greatly affected by the fact that stones were easily flaked to produce sharp tools. Without stone tools human evolution might have been radically different. Civilization has required the development of means to cut and fracture to fashion artefacts and structures as well as the development of the technology to avoid fracture. As civilizations became more sophisticated, so the need to control fracture grew. New technologies and materials brought new fracture problems. Fortunately, scientists and engineers are now largely very successful at controlling fracture so that most people do not even think about its possibility apart from breaking their own bones.

Man's understanding of fracture has developed with time. Even before we became human our hominid ancestors knew how to flake sharp stone tools. The very attribute that made stone tools easy to flake also made them easily broken and more durable metal tools finally replaced them. The ancient civilizations produced enduring stone buildings that required the development of the means to quarry and fashion stone. Building techniques had also to be developed to ensure that the buildings did not fracture and collapse. The control of fracture, until relatively recently, has been pragmatic. It was the Greeks who first began to try to understand fracture, but not until the Renaissance did the theory of fracture start to be developed. Practical problems caused the development of fracture theory. The Sun King, Louis XIV of France, wanted fountains of great height for Versailles and so Edme Marriotte developed an understanding of the mechanics of pressure piping so that he could avoid burst pipes. The Industrial Revolution saw an exponential growth in technology requiring professional engineers for the first time. From the Industrial Revolution to the mid-twentieth-century, fracture was to some extent out of control. Fortunately now fracture is well controlled and

the new discipline of fracture mechanics, which began in the mid-twentieth century, has come to maturity. In my professional life I have witnessed and made a small contribution to the growth of this new discipline. It seems a good moment to record how fracture has affected our lives and how it has been understood.

The concept for this book first arose during a 1996 visit to Peter Rossmanith in Vienna, where the idea of jointly writing a history of fracture mechanics was conceived. Unfortunately for many reasons that book was not written then, but over the years it has been in the back of my mind. Since retiring I have had the time to revisit the concept. Although I have broadened the scope of the book, it still uses much of the framework that was worked out with Peter Rossmanith. What I have attempted to do is to show how fracture has affected our world and the efforts that have been made to understand, exploit, and control it. The book is written from a historical aspect but it is not a history as such. I have deliberately not given any mathematical derivations, concentrated on the physics and I have tried to keep the number of equations to a minimum. It is very much of a personal view. When Isaac Todhunter, the English nineteenth-century mathematician, wrote his classic history of the theory of elasticity, he could be exhaustive. That was not an option for this book. What I have tried to do is to cover what I see as the main developments in fracture. It has been very difficult to know what to exclude, not what to include. I know that in writing this book I will probably have made more enemies than friends. I have almost certainly unjustifiably excluded many whose work does form part of the main fracture developments and there are very many more researchers who have made a significant advance in fracture than I have been able to mention in this short book. It does not mean that because a particular researcher is not mentioned that I think their contribution was not important, in fact in many cases it just shows my own ignorance.

The book is written for a wide audience and I hope that it will be read by anybody whose interest or work touches on fracture. I am very much of the view that to really understand a piece of research it is necessary to know its background and what motivated the work. Also, genuine advances can be made by applying knowledge from one field to another. Because of the increasing complexity of knowledge, young researchers, while having expertise in their field, often do not have a wide knowledge. I would like to think that a researcher starting out to do research on any aspect of fracture would benefit from reading this book.

The book uses more general histories and reviews and I would like particularly to mention the exhaustive *History of the Theory of Elasticity and of the Strength of Materials, from Galilei to Lord Kelvin*, by Issac Todhunter, the reliable *History of Strength of Materials*, by Stephen Timoshenko, and the two wonderfully written books by Jim Gordon: *The New Science of Strong Materials, or Why You Don't Fall Through the Floor* and *Structures, or Why Things Don't Fall Down*. My writing style for this book has also been greatly influenced by the two books of Jim Gordon who had a marvellous personal style. To make the book more personal I have used people's preferred personal names where they are known to me. To maintain consistency I have given the personal names of Chinese people before their surname.

A book like this one relies on the work of others and I acknowledge my debt to a great number of people. My gratitude goes to Alan Wells who first introduced me to the wonderland of fracture when I joined the British Welding Research Association fifty years ago and taught me my first steps in fracture. Alan Wells was one of the greats of fracture and a true gentleman. Throughout my professional life I have gained much from formal and informal contacts in a wide field of fracture and I thank all colleagues and students with whom I have worked over the years. I thank Peter Rossmanith for the idea of writing a history of fracture and for his continued support. Gordon Williams is warmly thanked for writing the Foreword and making many valuable suggestions for the improvement of the book. My thanks also go to the following colleagues who have read various chapters of the book for me and made valuable suggestions: Tony Atkins, Yiu-Wing Mai, Jo Kamminga, Tony Kinloch, Peter Lucas, and Peter Rossmanith. They have all improved the book; the remaining errors are mine.

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