

## Polarised Light in Science and Nature

Professor David Pye, born in 1932, was educated at Queen Elizabeth's Grammar School, Mansfield, University College of Wales, Aberystwyth and Bedford College for Women, London. He was lecturer and then reader at King's College and has been Professor of Zoology at Queen Mary, University of London since 1973. He developed an early fascination for bat 'radar' and the electronic instrumentation necessary for the study of animal ultrasound. He was a Founder Director in 1976 of QMC Instruments Ltd, which produced large numbers of commercial ultrasound detectors, mainly for biological studies. He has travelled widely in order to study tropical bats and latterly has developed an interest in ultraviolet light and polarisation in the visual world of animals. A strong supporter of demonstration lectures, he gave the Royal Institution Christmas Lectures in 1985, and shares the Dodo's opinion that 'the best way to explain it is to do it'. This book arose from a demonstration lecture which he calls 'Polar Explorations—in Light'.

# **Polarised Light in Science and Nature**

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## Preface

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We humans cannot see when light is polarised and this leads us to unfortunate misapprehensions about it. Even scientists who should know better, often assume that polarised light is an obscure topic of specialised interest in only a few rather isolated areas; in fact it is a universal feature of our world and most of the natural light that we see is at least partially polarised. In the Animal Kingdom, insects and many other animals exploit such natural polarisation in some fascinating ways since they do not share this human limitation and can both detect and analyse polarisation. It may be our unfamiliarity with this aspect of light that also makes many people think it is a ‘difficult’ subject, yet the basis is extremely simple. When such misconceptions are overcome, the phenomena associated with polarisation are found to be important throughout science and technology—in natural history, and biology, geology and mineralogy, chemistry, biochemistry and pharmacology, physics and astronomy and several branches of engineering, including structural design, communications, high speed photography and sugar refining, as well as crafts such as glassblowing and jewellery. They also involve some very beautiful effects, most of which are easy to demonstrate and manipulate.

Our general unawareness of what we are missing is indeed a great pity. This book hopes to put all this right and enrich its readers’ perception of the world. A small degree of repetition and overlap has seemed necessary in order to make each topic complete; I hope it does not become trying. The text deliberately uses no maths and only the minimum of technical terms—it is hoped that rejecting jargon, however precise and convenient it may be to the specialist, will make the stories more accessible to the newcomer. In any case, the book covers such a wide range of science that each chapter would need a separate vocabulary to be introduced and defined, which would become

tedious and might well deter many readers. Descriptive terms or even circumlocutions are sometimes quicker in the end. In any case this is not a textbook; it does not aim to help directly with any particular course of study but is essentially interdisciplinary, hoping to interest any enquiring mind: a reader taking any course or none at all. Such cross-cultural influences appear to be deplorably unfashionable at present and this volume hopes to defend them by dealing with some simple unifying principles.

The book grew from a demonstration lecture, called 'Polar Explorations in Light' that I first developed for young audiences, initially at the Royal Institution of Great Britain. The 1874 classic book on polarised light by William Spottiswood also developed from a series of public lectures and I only hope that following such illustrious footsteps will achieve similar success. My own lecture has expanded to become a show that can now be adapted to almost any kind of audience. I was greatly drawn to the subject precisely because it brings in such a wide variety of phenomena across science, and because it allows one to perform some extremely beautiful demonstrations that never fail to elicit satisfying reactions from audiences of any age. It was gratifying, therefore, when the publishers suggested the possibility of a derivative book. I have tried to retain an element of the demonstration approach and, although no actual do-it-yourself-at-home recipes are given, I hope the descriptions are sufficiently helpful (and stimulating) to enable any resourceful reader to try things out. It is very rewarding to do and often quite easy, while many of the effects are much more beautiful than can be shown in photographs. Polaroid, as described in chapter 1, is widely available but if the larger sizes of sheet seem a little expensive, then the reflecting polarisers described in chapter 7 allow much to be done with the expenditure of nothing but a little ingenuity.

A reading list has been included in the hope that readers will want to find out more about some of the fields introduced here. This book does not attempt to be comprehensive in its treatment, simply to attract and intrigue. As always there is much to learn about a topic once you begin to get into it.

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