The Magic Of Light

A Vision of Nature in All Her Colours

G S Ranganath

Light and Color in the Outdoors
MGJ Minnaert
Springer-Verlag, 1993
pp.417, DM78

When we are face to face with the grandeur and beauty of nature we cannot remain mute spectators. Prof Marcel Gilles Jozef Minnaert was no exception. During his long and eventful career as an optical astronomer he could not help admiring the beauty of the rainbows, the glories, the coronae and so on. He studied them extensively and the book under review is a product of such a labour of love. In this book Minnaert explores the splendour and the spectacle of light in nature. The hallmark of this work is the variety and richness of natural optical phenomena that are described and discussed. More than 250 optical effects have been covered which remind us of the famous statement by Sherlock Holmes "we see but do not observe". One who reads this book will be tempted to look more closely and carefully at all that has only been casually seen earlier. In the end one is left with the impression that nature has revealed the beauty of light while manifesting herself optically. Before I undertake the exercise of justifying these statements I wish to make a few remarks. The book under review is a new and revised edition of an earlier book entitled *Light and Colour in the Open Air* published in 1940. The new edition which also happens to be a new English translation was brought out on the hundredth birth anniversary of Minnaert. I will first of all highlight features common to both these editions. Later I will emphasise what is new and interesting in the latest edition.

One who reads this book will be tempted to look more closely and carefully at all that has only been casually seen earlier. In the end one is left with the impression that nature has revealed the beauty of light while manifesting herself optically.

We have all seen our shadows in the open sunshine many times. Only a few of us would have observed that the shadow of our head is very hazy and fuzzy when the sun is low in the sky. It is also not always appreciated that the shadows of leaves, butterflies and small low flying birds are all nearly circular patches. Strangely, high flying birds do not cast shadows at all. Interestingly all these and many more equally intriguing shadows are manifestations of the sun not being a point source but a circular disk of light.

We generally take for granted that images seen in reflection are faithful to the objects

Box 1

Marcel Gilles Jozef Minnaert was born on February 12, 1893 in Bruges, Belgium. At the University of Ghent he studied biology and completed his doctoral thesis at the age of 21 on the effects of light on plants. After getting his second doctorate on anomalous dispersion, this time from the University of Utrecht, he worked at the Utrecht Observatory on solar astronomy, comets and the photometry of Venus and the Orion nebula.

It is very instructive to read the following passage from the preface to the first Dutch edition of his book *Light and Colour in the Open Air.*

"..... indeed there is hardly a branch of physics that is not applicable out of doors, and often on a scale exceeding any experiments in a laboratory. Bear in mind, therefore, that everything described in this book lies within your own powers of understanding and observation. Everything is meant to be seen by you and done by you! Where the explanations offered are perhaps too concise, I suggest that you refresh your memory of fundamental physics by turning to an appropriate elementary textbook.

The importance of outdoor observations for the teaching of physics has not yet been sufficiently realized. They help us in our ever increasing efforts to adapt our education to the requirements of everyday life; they lead us naturally to ask a thousand questions, and, thanks to them, we find later on that what we learned at school is to be found again and again beyond the school walls".

being reflected. This may not always be true. For example, when we see the reflected image of a rainbow against a patch of cloud, surprisingly we see a relative shift between the images of the cloud and the rainbow. If we look at our own shadow on a bed of dried leaves, strangely, we see halos around the shadow of our own head but not around the shadow of our neighbour's head. These and other equally tantalizing optical wonders described in this book, are elementary consequences of the laws of reflection of light under different settings.

A whole chapter is dedicated to rainbows, halos and coronae. The optics of refraction and diffraction in water droplets and ice crystals leads to a plethora of effects, the most famous being the rainbow. These are seen in a variety of situations and their discussion adds considerably to our appreciation of these beautiful optical spectacles. This is a highly educative and an instructive chapter.

Quite often our visual experiences are not the same as those seen in a photographic image of the same scene. This is largely due to the fact that our eyes do not work exactly like cameras. For instance, a faint star when

Box 2

Why do we not see the setting of stars? Generally, we do not see the setting of stars unless they are very bright like Sirius. This is because, atmospheric scattering considerably diminishes the light that can otherwise reach an observer. This effect becomes all the more important when the stars are approaching the horizon. Thus, they become too faint for our eyes to see.

looked at straight disappears from our view but the same can be seen through the corner of our eyes. Once in a while we seem to see a star wander, rather erratically, in the sky. While seeing a double star through a moving binocular, we observe a relative motion between them with the fainter star lagging behind the brighter one. All these are entirely due to the way the eye functions. Justifiably, Minnaert has elaborated this important subject over three chapters. To the non-expert this is probably the most impressive part of the book.

We could go on listing the optical mysteries of the world around us. Instead, I will now dwell upon the special features of the new edition. Apart from a good collection of new and colourful photographs, almost in every section we find an additional example to illustrate the point under discussion. It is rather surprising that many of these were not included in the first edition since they refer to phenomena that were known even then. As an example let me mention the halo sometimes seen around the sun and moon. This has a radius around 27°. It was first recorded by Scheiner and appears to have been seen only a few times in history. Interestingly, a recent analysis of this halo indicated that it might be due to cubic ice crystals. Since ice generally crystallizes in hexagonal symmetry, this suggestion was accepted with reservation. But a few years back it was experimentally demonstrated that sometimes under fast quenching, water crystallizes in the cubic form. The sky probably still holds many more secrets to be unravelled.

The only disappointment with both editions of this book is that once in a while it becomes a dull listing of information instead of a flow of a theme. But we should not be harsh on Minnaert who was probably burdened by the sheer weight of his observations which might have lead to some drab passages here and there. Every lover of nature, whether a student of science or a layperson, must read this book. It might be a bit expensive for an individual to possess it but is not beyond the reach of libraries.

G S Ranganath is with Raman Research Institute, Bangalore 560080, India. email: gsr@rri.ernet.in