



NATURE'S THIRD CYCLE – A STORY OF SUNSPOTS by Arnab Rai Choudhuri, Published by Oxford University Press, 2017, Paperback Rs 695.00, pages 304

During sometime in 2015, I was travelling on a train where I observed that a young co-passenger was reading a hard-bound book entitled 'Nature's Third Cycle-A Story of Sunspots'. The name seemed to me very charming. With definite motivation, I requested the youngman to extend his good heart so that I can see the book for few moments. He readily agreed. Later I came to know that my young friend was a research student of the author of the book.

When a book is hard-bound, its price hardly becomes interesting. However, I prepared my mind to have one copy of the same in near future. I never thought, future can knock the door in the following way.

The chief editor of the Journal '*Science and Culture*' put up a proposal for reviewing the paperback edition of a book. I felt wondered by seeing that the book was the same one for which once I decided to be a buyer. As I had a temptation already in mind, I instantly agreed.

Without explaining anything of the subject, let us concentrate our attention first on few lines quoted from back cover of the book.

"Nature's first two cycles – the cycle of the day and night and the cycle of seasons—are familiar cycles around which many human activities are organised. The 'third' sunspot cycle was discovered less than two centuries ago, but is becoming increasingly important for us as human society becomes more dependent on technology."

The dedication page contains a line from Rigveda 3.62.10 translated by the philosopher-teacher S. Radhakrishnan which is as follows :

'We mediate on the adorable glory of the radiant sun; may he inspire our intelligence.'

Next we have a foreword written by Nigel Oscar Weiss, FRS, an astronomer and mathematician and leader in the field of astrophysical and geophysical fluid dynamics. Presently he is an Emeritus Professor of Mathematical Astrophysics at the University of Cambridge. In fact, a competent person of finest variety has taken the responsibility of writing the foreword.

We know that the sunspots on the surface of the Sun is being observed through telescopes since the time of Galileo. They are undoubtedly very erratic and chaotic (adjectives taken from the foreword) but has a cycle of 11 years. Professor Weiss assigned the 'lively and unusual' book as 'scientific autobiography'. In fact, this is a book where the magnetic activity of the Sun has been discussed in a very lucid and simple manner. The subject itself may be complex but the presentation is graceful.

The first chapter of the book begins with a known incident that happened on 13th March 1989 in Canada. There was no electricity and it was restored after about eight hours. Why it was so ? The solar flare that happened on 9th March 1989 'appears to have been the cause of power blackout...'

The sun gently warms the earth which is essential for the survival of the life kingdom. It is a very long time story. Will there anything happen differently for which the effect on the earth will also be different ? Richard Christopher Carrington (1826-1875), an English amateur astronomer in 1859 demonstrated the existence of solar flares and suggested an electrical influence upon the earth. The 1859 episode has been efficiently described by the author. The solar flare after a cycle of 11 years was discovered by Heinrich Schwabe (1789-1875) in 1844.

In this book the author mentioned a third cycle of Nature. We know the day-night cycle as first cycle, coming up seasons as second cycle. An understanding of the above two cycles has made the human civilization. Ancient humans had to know 'when to sow seeds and when to do the harvesting'.

Real breakthrough in the sunspot research developed when George Ellery Hale (1868-1938), an American solar astronomer in 1908 discovered magnetic fields in sunspots. Thus it became evident that the 11-year sunspot cycle is nothing but a magnetic cycle of the sun. Solar flares are connected with this magnetic field. That's why, the earth's magnetic field changes suddenly after major solar flares. The author has discussed the reason for having a magnetic cycle over the sun. There is a fourth state of matter known as plasma state. More than 99% observable matter in the universe is in plasma state. Earth is an exception where plasma is not the major abundant state of matter. The development in solar flare research and its consequences have been presented so nicely and wisely that a complex area of cosmology took the shape of a popular science book.

Eugene Newman Parker (1927-), the research guide of the author first theoretically settled the reason for having sun's magnetic field including the 11-year cycle. Eugene published the paper in 1955. It was almost unattended. Otherwise he should have a permanent faculty position in the University of Utah. In fact, S. Chandrasekhar invited Eugene in the University of Chicago.

He accepted the offer and remained in this wonderful University for ever. He is ninety now. We all wish to see him riding over 100 years without much trouble.

The book contains a total of nine chapters excluding Epilogue, Appendices, Notes, Suggestions for further Reading and Index. The chapters are as follows :

- Chapter – 1 : Explosions, Blackouts and Cycles
- Chapter – 2 : The Mysterious Sunspots
- Chapter – 3 : Here Comes the Sun

Chapter – 4 : The Fourth State of Matter

Chapter – 5 : Floating Magnetic Buoys

Chapter – 6 : Dynamos in the Sky

Chapter – 7 : The Conveyor Belt inside the Sun

Chapter – 8 : A Journey from the Sun to the Earth

Chapter – 9 : We Look Before and After

The names of the chapters are undoubtedly appreciable as they entirely qualify the criteria of a popular science book.

In the second chapter of the book, the nature of the sunspots and their movements during differential rotation of the sun have been discussed. The subsequent chapters provide explanations for many of the solar phenomena. The author himself in the book (p-47) mentioned the content of different chapters. According to him, the 3rd and 4th chapter describe certain background of the sun-spots.

'Since the sunspot cycle is produced by Magneto Hydro Dynamics (MHD) processes in the sun's interior, you need to know something about the sun's interior and about MHD before we get into the theory of sunspot cycles. Chapter 3 will introduce you to the sun's interior and tell you how we can make many important inferences about the sun's interior on the basis of theoretical principles. The basics of MHD have been explained in Chapter 4.

According to the author again, Chapter 5-7 constitute the central backbone of this book. Here the writer has told us why we have something like the sunspot cycle. He has also mentioned how the toroidal magnetic field is obtained from the poloidal magnetic field. Chapter 6 and 7 have created a space to look at the heart of dynamo theory. Chapter 8 Contains informations about the impact of explosion on earth. The last chapter raises the question why the sunspot cycle is not completely cyclic and why all the cycles are not equally strong. The writer is concerned about certain issues which are debatable. He has not put those issues aside but presented the disagreements as well as his own viewpoints.

The first line of the 3rd Chapter is 'Why do stars shine ?' In order to reach at the answer, the author critically discussed the nature of science and the relevant discoveries of the scientists. Contributions of Eddington and Schwarzschild have been presented. Ultimately the author analysed the interior of stars. In the same chapter, works of S. Chandrasekhar have appeared in detail. Properties of neutrinos have been discussed. Interior of a star is just inaccessible for scientific investigation. But laws of physics help us to have a complete picture of the interior. The

fourth state of the matter, the plasma state, the magnetic fields associated therein – all have been discussed in the fourth chapter. The subheadings of the fifth chapter are self-explanatory. Here the ‘personal note’ is very unique and thought provoking. The author had Prof Amal Raychaudhuri as his teacher in Presidency College, Kolkata. His teaching was evergreen and original. Similar kind of teaching the author received from Prof. Parker of the University of Chicago. In fact, the very intimate description of the ambience of the Chicago University is a bonus point for the readers. In a sense, the ‘making’ of a future solar physicist is honestly recorded in between lines. There is a science part of this chapter which needs proper and serious attention. Chapter-6 is associated with dynamos theory. We have little scope to explain the science of the theory in this review article. But this chapter is a treasure for any passionate student of solar science and cosmology.

The next chapter addressed the question, why do sunspots die and what determines their lifetimes ?

The important papers have been referred. But at the end, the writer was compelled to remark on certain disagreements mentioning certain responses of the practitioners of science.

Chapter-8 is taking care of the questions why spectacular explosions like solar flares sometimes occur above sunspots ? What are the mechanisms by which the explosions yield different effects on the earth ? There are two important points to be remembered at this Juncture. The author is thoroughly equipped with the historical development of solar physics and also the philosophical connotations of those works. These points have made the book more pleasing. A book of this kind must contain sufficient number of figures and photographs. Needles to say, it is entirely fulfilled.

In the later part of the preface, the author introduces himself by saying ‘an author who had never written even a small piece of popular science in English before this book’ What’s the problem ? The first foothold is an outstanding one. Will it be irrational to expect more from him? In the introduction about the author, probably ‘regarded at’ should be substituted by ‘regarded as’. one ‘s’ for one ‘t’, that’s all. □

Syamal Chakrabarti
Department of Chemistry
University of Calcutta, Kolkata
E-mail : schem1957@gmail.com