

## An Important Mathematical Theory Explained

A Well Written Book for the B.Sc. and M.Sc. Student

*S Thangavelu*



*Fourier Series.*  
**Rajendra Bhatia**  
 Hindustan Book Agency, Delhi. 1993  
 pp.106. Rs.95.

The theory of Fourier series is one of the most powerful theories that mathematicians have developed. It has a wide range of applications, not only in mathematics and natural sciences, but also in engineering fields. Any student of science and engineering must learn the rudiments of the theory. Although there are several excellent text books on the subject they are of no use to poor Indian students studying in remote colleges without access to good libraries. It is a pity that in a vast country like ours, good text books are not written and published at affordable prices. The book under review, a small book on Fourier series, is the outcome of an attempt to alleviate the scarcity of reasonable mathematical text books in the country.

A most books on Fourier series would do, this one introduces the subject through a partial differential equation, in the present case, the equation of Laplace. Once Fourier series is defined, one can take off and develop the subject in several directions. As this book is mainly

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aimed at B.Sc. final year students or M.Sc. first year students without any knowledge of functional analysis, only very basic material like pointwise convergence and convergence in  $L^2$  and  $L^1$  are treated. To exemplify the power of Fourier series the author has included some results from ergodic theory and number theory, a discussion on the isoperimetric problem and of course the solution to the wave equation. The book abounds in exercises and has a nice appendix on the historical development of the subject.

There are five chapters in this book. In the first chapter the author treats the Laplace equation  $\partial_x^2 u + \partial_y^2 u = 0$  in the unit disc in the complex plane. He solves this equation in polar coordinates and in the process defines the Fourier series of a periodic function. Chapter 2 deals with convergence of Fourier series; the author treats Abel and Cesaro summability, and proves the celebrated theorem of Fejer regarding the pointwise convergence of the Cesaro means of Fourier series of continuous functions. The third chapter deals with sine and cosine series, functions with arbitrary periods and the Gibbs phenomenon. The  $L^2$  convergence of Fourier series is considered in chapter 4 and, as already mentioned, the last chapter deals with some applications.

This is a very well written book and can be used effectively at the B.Sc. final year and M.Sc. first

## Suggested Reading

The following books will be suitable at the M.Sc. second year level:

**Henry Helson. Harmonic Analysis.** Hindustan Book Agency, New Delhi. 1995.

**Gerald B Folland. Fourier Analysis and its Applications.** Belmont, California: Wadsworth Inc. 1992.

**T W Körner. Fourier Analysis.** Cambridge University Press. 1989.

year levels. The author has done justice to the good cause of writing text books for Indian students.

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## A Haldane Primer: Getting Messages Across

"A Box of Reusable Chocolates that can be Savoured Afresh Each Time"

**S Krishnaswamy**



*On Being the Right Size  
and Other Essays*

**J B S Haldane**

Oxford University Press, Delhi. 1992.

pp. 187. Rs. 90.

Haldane was a scientist known for his contribution to the theory of evolution. He and others developed the theory of population genetics. He was a liberal individualist, a leading communist who contributed a weekly article to the *Daily Worker*. He was supreme as a popularizer of science, because he saw connections that others missed. This book is a collection of his essays, compiled by John Maynard Smith who in his introduction mentions their impact on him when he came across them in school. Maynard Smith says "fifteen years later, when I decided to leave engineering and train as a

biologist, I entered University College, London, where Haldane was at that time a professor, and became his student and later his colleague."

The essays covered in the book range from articles intended for a scientific readership to others written for a daily newspaper, and are comprehensible without the need for any special technical knowledge. The book is inexpensive enough to make it affordable and worthy enough to make efforts to locate and buy it. The introduction by Maynard Smith is evocative and gives an endearing perspective of Haldane and his essays. There are in all nineteen essays here, with three small bits in the appendix. The essays are arranged in chronological order and cover the period from the 1920s to the 1940s. The articles: 'Is History a Fraud?', 'God-Makers', 'The Origin of Life', 'What "Hot" Means' and 'Cats' appeared in the *Daily Worker*. Most of the other essays have appeared earlier in the

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### J B S Haldane (1892-1964)

Haldane is today remembered mainly for his work on evolution, but that is only because his first rate work in several other areas pales in comparison with his work on evolution.

Haldane's contributions to developing a quantitative theory of evolution, or population genetics, were fundamental. The gigantic task of proving beyond all doubt that Mendelian principles could provide the link between genetics and evolution as demanded by natural selection (as Darwin's theory was called) was accomplished by J B S Haldane, R A Fisher, S Wright and S S Chetverikov.

Haldane's interest in genetic structure was lifelong. At the age of 16, he discovered the phenomenon of *linkage* (in mice), which means that genes are not free to 'move' independent of one another. He was also the first to discover linkage in humans; he presented the

first genetic map of a human chromosome and the first estimate of a human mutation rate. Realizing the importance of Garrod's studies on the inborn errors of metabolism, he considered the 'one gene one enzyme' hypothesis well before Beadle and Tatum.

A general sympathy for the underdog, the attraction of socialist ideals and disgust for the workings of capitalism made him a marxist. He spent the last seven years of his life in India working initially at Indian Statistical Institute, Calcutta, and later at the Genetics and Biometry Laboratory in Orissa. His behaviour sometimes seemed eccentric but behind his rough exterior was an extremely charming and kind man, full of humour, a truly humble person with the curiosity which is the hallmark of most great scientists.

(Courtesy V Nanjundiah, adapted from *Current Science*)

collections *Possible Worlds and Other Essays*' and *A Banned Broadcast and Other Essays*'. The articles that featured in the *Daily Worker* differ stylistically from the other essays and are aimed at a readership with less formal education. However his perspectives on the science-society relation remain the same as in the other articles.

A few words from Maynard Smith will emphasize how Haldane's articles are different from regular popular science articles. "It was characteristic of him (Haldane) to use popular articles to propose original ideas. 'The Origin of Life' is

perhaps the most important. The ideas presented here contributed significantly to the fact that the topic is now one for experimental study and not for philosophical speculation...I do not think that anyone today is writing scientific articles for the daily press that equal these in scientific content or entertainment value. To illustrate their scientific content, the article 'Beyond Darwin' contains a particularly clear account of Darwin's idea about the relationship between sexual dimorphism and polygyny, which has since become a popular topic of research. I was amused to find that the same article contains a false argument about species which



destroy their food supply and starve to death. I learnt the fallacy of such ‘group-selectionist’ arguments from Haldane himself when I was his student.”

The article on ‘How to write a Popular Scientific Article’ that is part of this collection gives a glimpse of how Haldane wrote essays whose general sense of argument was so clear. In very conversational terms he builds upon the writing of popular science articles and leads you on to the different aspects such as the audience, the subject matter, the place where you want to publish it, the depth to which it must be written, the language to be used, etc. The essay is actually aimed at science practitioners and aims to help them convey their work to the larger public. Some excerpts will help you get the general trend. “So far you have probably written two main types of articles. Firstly, answers to examination questions in which you tried to show how much you knew about some topic. And secondly, scientific papers or technical reports which dealt very exhaustively with a small point. Now you have to do something different. You are not trying to show off; nor are you aiming at such accuracy that your readers will be able to carry out some operation. You want to interest or even excite them, but not to give them complete information. You must therefore know a very great deal more about your subject than you put on paper. Out of this you must choose the items which will make a coherent story.” He then goes on to give an example of a skeleton of an article on cheese to illustrate his points.

Another article I found very entertaining was the one on ‘Cats’. He starts off with a simple observation that the number of cats in Britain is not known unlike the number of adult dogs which are kept track of since they are taxed. He builds up to talk about how there are no peculiar shapes or sizes in cats. He goes on to compare the social and breeding behaviours of cats and humans. In this manner we are introduced to how different animals have their sensory areas on the body mapped on to the brain. It concludes with “A cat or dog can be gentle with its whole body. So dogs and cats can play with us, and we with them. In fact they play with children very much as equals, and quite understand that they must not use their full strength.”

The title essay “On Being the Right Size” is a gem and is reminiscent of d’Arcy Thomson’s *On Growth and Form*. He shows elegantly the connection between simple geometry, physics and biological forms. He throws light on why it is that if one were to drop a mouse down a thousand-yard mine shaft, on reaching the bottom it gets a slight shock and walks away. But if you did the same with a rat, a man and a horse in that order, they are respectively killed, broken or splashed. And why the eyes of small animals have to be in much larger proportion to their bodies than our own, while large animals only require relatively small eyes — those of the whale and elephant being little larger than our

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own. The message is that, for every type of animal there is an optimum size. In his characteristic manner he makes the connections with human societies: “And just as there is a best size for every animal, the same is true for every human institution... To the biologist the problem of socialism appears largely as a problem of size... But while nationalisation of certain industries is an obvious possibility in the largest of states, I find it no easier to picture a completely socialized British Empire or United States than an elephant turning somersaults or a hippopotamus jumping a hedge.”

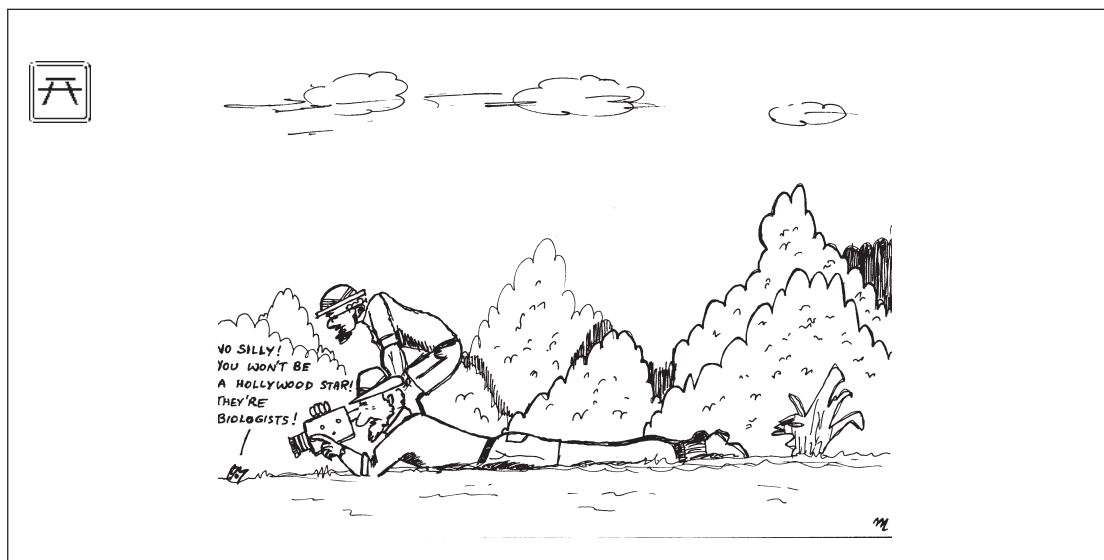
The final bits in the appendix again prove instructive with the explanation by Maynard Smith and his account of what has happened since then to Haldane’s ideas. Maynard Smith says: “Scattered through Haldane’s writings — both the popular articles and scientific papers — there are hints of things to come. He sketches some experiment, or theory, or field of investi-

gation which later, in other hands, has become important. There are many possible reasons why he failed to follow up these hints himself: he was too impatient to be good at raising grants to support experimental work, the techniques needed to test an idea were not yet developed, or he simply had too many other things to think about.”

In all, a box of reusable chocolates that can be savoured afresh every time with relish and pleasure. If you are not one already you will turn a Haldane fan.

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