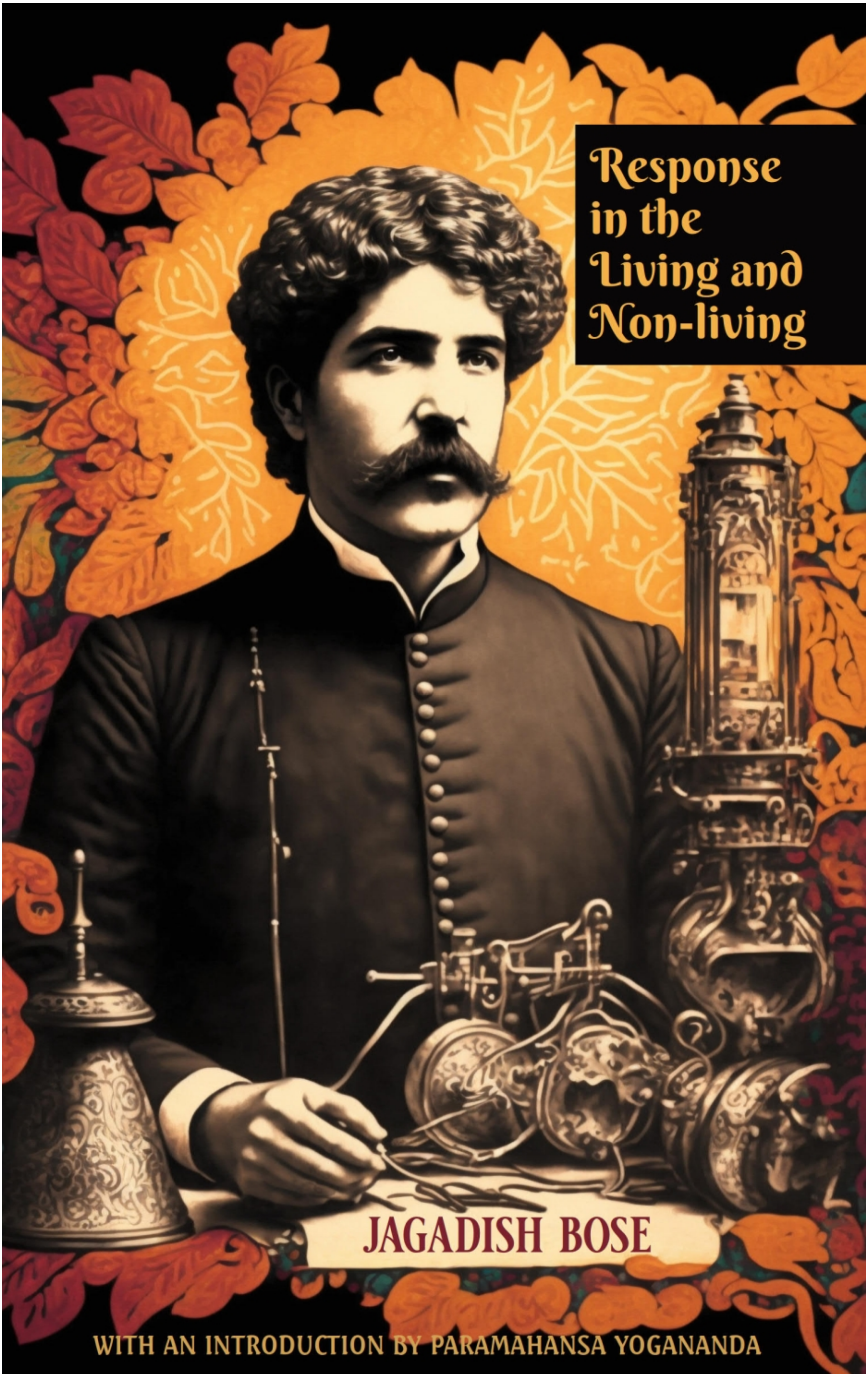
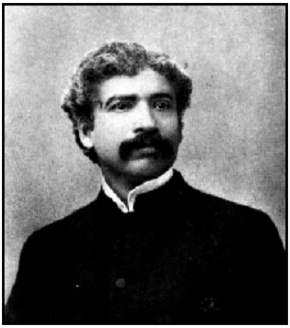

Response in the Living and Non-living
JAGADISH BOSE
WITH AN INTRODUCTION BY PARAMAHANSA YOGANANDA



JAGADISH CHANDRA BOSE was born on November 30, 1858, Mymensingh, Bengal, India (now in Bangladesh), and died on November 23, 1937, Giridih, Bihar.

His work as both a physiologist and physicist led to the invention of highly sensitive instruments for the detection of minute responses by living organisms to external stimuli. This enabled him to measure the similarities in response between animal and plant tissues noted by many later researchers.

Bose's experiments on the quasi-optical properties of very short radio waves led him to make improvements on the *coherer*, an early form of radio detector, which contributed to the development of solid-state physics.

After earning a degree from the University of Cambridge (1884), Bose served as professor of physical science (1885–1915) at Presidency College, Calcutta. In 1917, he founded the Bose Institute in Calcutta, which still exists today (*www.jcbose.ac.in*).

To facilitate his research, he constructed automatic recorders capable of registering extremely slight movements; these instruments produced some striking results, such as his demonstration of the sense of feeling in plants.

Bose also found that non-living matter exhibits the same types of response to stimuli as do both animal and plant matter. This demonstration that everything exists in the field of consciousness was one of his most important discoveries.

RESPONSE IN THE LIVING AND NON-LIVING

Jagadish Chandra Bose

With an introduction by
Paramahansa Yogananda

A DISTANT MIRROR

adistantmirror.com

ISBN 9780980297690

First published 1902.
This edition 2020.

Available in paperback, Kindle and epub.

A Distant Mirror
adistantmirror.com.au
admin@adistantmirror.com.au

PREFACE

I have in this present work put in a connected and a more complete form results, some of which have been published in the following papers:

De la Généralité des Phénomènes Moléculaires produits par l'Electricité sur la matière Inorganique et sur la matière Vivante. (Travaux du Congrès International de Physique. Paris, 1900.)

On the Similarity of Effect of Electrical Stimulus on Inorganic and Living Substances. (Report, Bradford Meeting British Association, 1900. – Electrician.)

Response of Inorganic Matter to Stimulus. (Friday evening discourse, Royal Institution, May 1901.)

On Electric Response of Inorganic Substances. Preliminary Notice. (Royal Society, June 1901.)

On Electric Response of Ordinary Plants under Mechanical Stimulus. (Journal Linnean Society, 1902.)

Sur la Réponse Electrique dans les Métaux, les Tissus Animaux et Végétaux. (Société de Physique, Paris, 1902.)

On the Electro-Motive Wave accompanying Mechanical Disturbance in Metals in contact with Electrolyte. (Proceedings Royal Society, vol. 70.)

On the Strain Theory of Vision and of Photographic Action. (Journal Royal Photographic Society, vol. xxvi.)

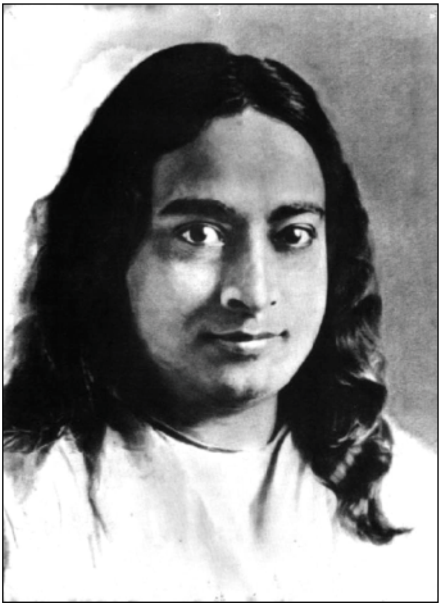
These investigations were commenced in India, and I take this opportunity to express my grateful acknowledgments to the managers of the Royal Institution, for the facilities offered me to complete them at the Davy-Faraday Laboratory.

J. C. Bose.
Davy-Faraday Laboratory, Royal Institution,
London, May 1902.

CONTENTS

ILLUSTRATIONS

Figure



Paramahansa Yogananda

INTRODUCTION

The following is from Paramahansa Yogananda's *Autobiography of a Yogi*. It describes conversations between the swami and Jagadish Bose.

India's Great Scientist, J. C. Bose

"Jagadish Chandra Bose's wireless inventions antedated those of Marconi."

Overhearing this provocative remark, I walked closer to a sidewalk group of professors engaged in scientific discussion. If my motive in joining them was racial pride, I regret it. I cannot deny my keen interest in evidence that India can play a leading part in physics, and not metaphysics alone.

"What do you mean, sir?"

The professor obligingly explained. "Bose was the first one to invent a wireless coherer and an instrument for indicating the refraction of electric waves. But the Indian scientist did not exploit his inventions commercially. He soon turned his attention from the inorganic to the organic world. His revolutionary discoveries as a plant physiologist are outpacing even his radical achievements as a physicist."

I politely thanked my mentor. He added, "The great scientist is one of my brother professors at Presidency College."

*

I paid a visit the next day to the sage at his home, which was close to mine on Gurpar Road. I had long admired him from a respectful distance. The grave and retiring botanist greeted me graciously. He was a handsome, robust man in his fifties, with thick hair, broad forehead, and the abstracted eyes of a dreamer. The precision in his tones revealed the lifelong scientific habit.

“I have recently returned from an expedition to scientific societies of the West. Their members exhibited intense interest in delicate instruments of my invention which demonstrate the indivisible unity of all life.[1] The Bose crescograph has the enormity of ten million magnifications. The microscope enlarges only a few thousand times; yet it brought vital impetus to biological science. The crescograph opens incalculable vistas.”

“You have done much, sir, to hasten the embrace of East and West in the impersonal arms of science.”

“I was educated at Cambridge. How admirable is the Western method of submitting all theory to scrupulous experimental verification! That empirical procedure has gone hand in hand with the gift for introspection which is my Eastern heritage. Together they have enabled me to sunder the silences of natural realms long uncommunicative. The telltale charts of my crescograph[2] are evidence for the most skeptical that plants have a sensitive nervous system and a varied emotional life. Love, hate, joy, fear, pleasure, pain, excitability, stupor, and countless appropriate responses to stimuli are as universal in plants as in animals.”

“The unique throb of life in all creation could seem only poetic imagery before your advent, Professor! A saint I once knew would never pluck flowers. ‘Shall I rob the rosebush of its pride in beauty? Shall I cruelly affront its dignity by my rude divestment?’ His sympathetic words are verified literally through your discoveries!”

“The poet is intimate with truth, while the scientist approaches awkwardly. Come someday to my laboratory and see the unequivocable testimony of the crescograph.”

Gratefully I accepted the invitation, and took my departure. I heard later that the botanist had left Presidency College, and was planning a research center in Calcutta.

When the Bose Institute was opened, I attended the dedicatory services. Enthusiastic hundreds strolled over the premises. I was charmed with the artistry and spiritual symbolism of the new home of science. Its front gate, I noted, was a centuried relic from a distant shrine. Behind the lotus[3] fountain, a sculptured female figure with a torch conveyed the Indian respect for woman as the immortal light-bearer. The garden held a small temple consecrated to the Noumenon beyond phenomena. Thought of the divine incorporeity was suggested by absence of any altar-image.

Bose's speech on this great occasion might have issued from the lips of one of the inspired ancient rishis.

"I dedicate today this Institute as not merely a laboratory but a temple." His reverent solemnity stole like an unseen cloak over the crowded auditorium. "In the pursuit of my investigations I was unconsciously led into the border region of physics and physiology. To my amazement, I found boundary lines vanishing, and points of contact emerging, between the realms of the living and the non-living. Inorganic matter was perceived as anything but inert; it was athrill under the action of multitudinous forces.

"A universal reaction seemed to bring metal, plant and animal under a common law. They all exhibited essentially the same phenomena of fatigue and depression, with possibilities of recovery and of exaltation, as well as the permanent irresponsiveness associated with death. Filled with awe at this stupendous generalization, it was with great hope that I announced my results before the Royal Society—results demonstrated by experiments. But the physiologists present advised me to confine myself to physical investigations, in which my success had been assured, rather than encroach on their preserves. I had unwittingly strayed into the domain of an unfamiliar caste system and so offended its etiquette.

"An unconscious theological bias was also present, which confounds ignorance with faith. It is often forgotten that He who surrounded us with this ever-evolving mystery of creation has also implanted in us the desire to question and understand. Through many years of miscomprehension, I came to know that the life of a devotee of science is inevitably filled with unending struggle. It is for him to cast his life as an ardent offering—regarding gain and loss, success and failure, as one.

"In time the leading scientific societies of the world accepted my theories and results, and recognized the importance of the Indian contribution to science.[4] Can anything small or circumscribed ever satisfy the mind of India? By a continuous living tradition, and a vital power of rejuvenescence, this land has readjusted itself through unnumbered transformations. Indians have always arisen who, discarding the immediate and absorbing prize of the hour, have sought for the realization of the highest ideals in life—not through passive renunciation, but through active struggle. The weakling who has refused the conflict, acquiring nothing, has had nothing to renounce. He alone who has striven and won can enrich the world by bestowing the fruits of his victorious experience.

"The work already carried out in the Bose laboratory on the response of matter, and the unexpected revelations in plant life, have opened out very extended regions of inquiry in physics, in physiology, in medicine, in agriculture, and even in psychology. Problems hitherto regarded as insoluble have now been brought within the sphere of experimental investigation.

"But high success is not to be obtained without rigid exactitude. Hence the long battery of super-sensitive instruments and apparatus of my design, which stand before you today in their cases in the entrance hall. They tell you of the protracted efforts to get behind the deceptive seeming into the reality that remains unseen, of the continuous toil and persistence and resourcefulness called forth to overcome human limitations. All creative scientists know that the true laboratory is the mind, where behind illusions they uncover the laws of truth.

"The lectures given here will not be mere repetitions of second-hand knowledge. They will announce new discoveries, demonstrated for the first time in these halls. Through regular publication of the work of the Institute, these Indian contributions will reach the whole world. They will become public property. No patents will ever be taken. The spirit of our national culture demands that we should forever be free from the desecration of utilizing knowledge only for personal gain.

"It is my further wish that the facilities of this Institute be available, so far as possible, to workers from all countries. In this I am attempting to carry on the traditions of my country. So far back as twenty-five centuries, India welcomed to its ancient universities, at Nalanda and Taxila, scholars from all parts of the world.

"Although science is neither of the East nor of the West but rather international in its universality, yet India is specially fitted to make great contributions.[5] The burning Indian imagination, which can extort new order out of a mass of apparently contradictory facts, is held in check by the habit of concentration. This restraint confers the power to hold the mind to the pursuit of truth with an infinite patience."

Tears stood in my eyes at the scientist's concluding words. Is "patience" not indeed a synonym of India, confounding Time and the historians alike?

*

I visited the research center again, soon after the day of opening. The great botanist, mindful of his promise, took me to his quiet laboratory.

"I will attach the crescograph to this fern; the magnification is tremendous. If a snail's crawl were enlarged in the same proportion, the creature would appear to be traveling like an express train!"

My gaze was fixed eagerly on the screen which reflected the magnified fern-shadow. Minute life-movements were now clearly perceptible; the plant was growing very slowly before my fascinated eyes. The scientist touched the tip of the fern with a small metal bar. The developing pantomime came to an abrupt halt, resuming the eloquent rhythms as soon as the rod was withdrawn.

"You saw how any slight outside interference is detrimental to the sensitive tissues," Bose remarked. "Watch; I will now administer chloroform, and then give an antidote."

The effect of the chloroform discontinued all growth; the antidote was revivifying. The evolutionary gestures on the screen held me more raptly than a "movie" plot. My companion (here in the role of villain) thrust a sharp instrument through a part of the fern; pain was indicated by spasmodic flutters. When he passed a razor partially through the stem, the shadow was violently agitated, then stilled itself with the final punctuation of death.

"By first chloroforming a huge tree, I achieved a successful transplantation. Usually, such monarchs of the forest die very quickly after being moved." Jagadis smiled happily as he recounted the life-saving maneuver. "Graphs of my delicate apparatus have proved that trees possess a circulatory system; their sap movements correspond to the blood pressure of animal bodies. The ascent of sap is not explicable on the mechanical grounds ordinarily advanced, such as capillary attraction. The phenomenon has been solved through the crescograph as the activity of living cells. Peristaltic waves issue from a cylindrical tube which extends down a tree and serves as an actual heart! The more deeply we perceive, the more striking becomes the evidence that a uniform plan links every form in manifold nature."

The great scientist pointed to another Bose instrument.

"I will show you experiments on a piece of tin. The life-force in metals responds adversely or beneficially to stimuli. Ink markings will register the various reactions."

Deeply engrossed, I watched the graph which recorded the characteristic waves of atomic structure. When the professor applied chloroform to the tin, the vibratory writings stopped. They recommenced as the metal slowly regained its normal state. My companion dispensed a poisonous chemical. Simultaneous with the quivering end of the tin, the needle dramatically wrote on the chart a death-notice.

"Bose instruments have demonstrated that metals, such as the steel used in scissors and machinery, are subject to fatigue, and regain efficiency by periodic rest. The life-pulse in metals is seriously harmed or even extinguished through the application of electric currents or heavy pressure."

I looked around the room at the numerous inventions, eloquent testimony of a tireless ingenuity.

"Sir, it is lamentable that mass agricultural development is not speeded by fuller use of your marvelous mechanisms. Would it not be easily possible to employ some of them in quick laboratory experiments to indicate the influence of various types of fertilizers on plant growth?"

"You are right. Countless uses of Bose instruments will be made by future generations. The scientist seldom knows contemporaneous reward; it is enough to possess the joy of creative service."

With expressions of unreserved gratitude to the indefatigable sage, I took my leave. "Can the astonishing fertility of his genius ever be exhausted?" I thought.

No diminution came with the years. Inventing an intricate instrument, the "Resonant Cardiograph," Bose then pursued extensive researches on innumerable Indian plants. An enormous unsuspected pharmacopoeia of useful drugs was revealed. The cardiograph is constructed with an unerring accuracy by which a one-hundredth part of a second is indicated on a graph. Resonant records measure infinitesimal pulsations in plant, animal and human structure. The great botanist predicted that use of his cardiograph will lead to vivisection on plants instead of animals.

"Side by side recordings of the effects of a medicine given simultaneously to a plant and an animal have shown astounding unanimity in result," he pointed out. "Everything in man has been foreshadowed in the plant. Experimentation on vegetation will contribute to lessening of human suffering."

*

Years later Bose's pioneer plant findings were substantiated by other scientists. Work done in 1938 at Columbia University was reported by The New York Times as follows:

It has been determined within the past few years that when the nerves transmit messages between the brain and other parts of the body, tiny electrical impulses are being generated. These impulses have been measured by delicate galvanometers and magnified millions of times by modern amplifying apparatus. Until now no satisfactory method had been found to study the passages of the impulses along the nerve fibers in living animals or man because of the great speed with which these impulses travel.

Drs. K. S. Cole and H. J. Curtis reported having discovered that the long single cells of the fresh-water plant nitella, used frequently in goldfish bowls, are virtually identical with those of single nerve fibers. Furthermore, they found that nitella fibers, on being excited, propagate electrical waves that are similar in every way, except velocity, to those of the nerve fibers in animals and man. The electrical nerve impulses in the plant were found to be much slower than those in animals. This discovery was therefore seized upon by the Columbia workers as a means for taking slow motion pictures of the passage of the electrical impulses in nerves.

The nitella plant thus may become a sort of Rosetta stone for deciphering the closely guarded secrets close to the very borderland of mind and matter.

The poet Rabindranath Tagore was a stalwart friend of India's idealistic scientist. To him, the sweet Bengali singer addressed the following lines:[6]

O Hermit, call thou in the authentic words
Of that old hymn called Sama; "Rise! Awake!"
Call to the man who boasts his shastric lore
From vain pedantic wranglings profitless,
Call to that foolish braggart to come forth
Out on the face of nature, this broad earth,
Send forth this call unto thy scholar band;
Together round thy sacrifice of fire
Let them all gather. So may our India,
Our ancient land unto herself return
O once again return to steadfast work,
To duty and devotion, to her trance
Of earnest meditation; let her sit
Once more unruffled, greedless, strifeless, pure,
O once again upon her lofty seat
And platform, teacher of all lands.

* * *

Notes

1. "All science is transcendental or else passes away. Botany is now acquiring the right theory—the avatars of Brahma will presently be the textbooks of natural history."—Emerson.
2. From the Latin root, *crescere*, to increase. For his crescograph and other inventions, Bose was knighted in 1917.
3. The lotus flower is an ancient divine symbol in India; its unfolding petals suggest the expansion of the soul; the growth of its pure beauty from the mud of its origin holds a benign spiritual promise.

4. “At present, only the sheerest accident brings India into the purview of the American college student. Eight universities (Harvard, Yale, Columbia, Princeton, Johns Hopkins, Pennsylvania, Chicago, and California) have chairs of Indology or Sanskrit, but India is virtually unrepresented in departments of history, philosophy, fine arts, political science, sociology, or any of the other departments of intellectual experience in which, as we have seen, India has made great contributions. . . . We believe, consequently, that no department of study, particularly in the humanities, in any major university can be fully equipped without a properly trained specialist in the Indic phases of its discipline. We believe, too, that every college which aims to prepare its graduates for intelligent work in the world which is to be theirs to live in, must have on its staff a scholar competent in the civilization of India.”

   —Extracts from an article by Professor W. Norman Brown of the University of Pennsylvania which appeared in the May, 1939, issue of the *Bulletin of the American Council of Learned Societies*, 907 15th St., Washington, D. C. This issue (#28) contains over 100 pages of a bibliography for Indic Studies.

5. The atomic structure of matter was well-known to the ancient Hindus. One of the six systems of Indian philosophy is Vaisesika, from the Sanskrit root *visesas*, “atomic individuality.” One of the foremost Vaisesika expounders was Aulukya, also called Kanada, “the atom-eater,” born about 2800 years ago. In an article in East-West, April, 1934, a summary of Vaisesika scientific knowledge was given as follows:

   > “Though the modern ‘atomic theory’ is generally considered a new advance of science, it was brilliantly expounded long ago by Kanada, ‘the atom-eater.’ The Sanskrit *anu* can be properly translated as ‘atom’ in the

latter's literal Greek sense of 'uncut' or indivisible. Other scientific expositions of Vaisesika treatises include:

(1) the movement of needles toward magnets,

(2) the circulation of water in plants,

(3) akash or ether, inert and structureless, as a basis for transmitting subtle forces,

(4) the solar fire as the cause of all other forms of heat,

(5) heat as the cause of molecular change,

(6) the law of gravitation as caused by the quality that inheres in earth-atoms to give them their attractive power or downward pull,

(7) the kinetic nature of all energy; causation as always rooted in an expenditure of energy or a redistribution of motion,

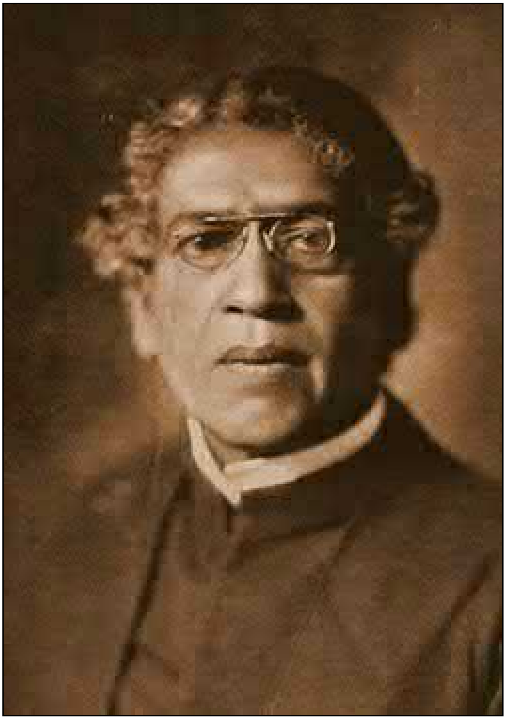
(8) universal dissolution through the disintegration of atoms,

(9) the radiation of heat and light rays, infinitely small particles, darting forth in all directions with inconceivable speed (the modern 'cosmic rays' theory),

(10) the relativity of time and space.

Vaisesika assigned the origin of the world to atoms, eternal in their nature, i.e., their ultimate peculiarities. These atoms were regarded as possessing an incessant vibratory motion. The recent discovery that an atom is a miniature solar system would be no news to the old Vaisesika philosophers, who also reduced time to its furthest mathematical concept by describing the smallest unit of time (kala) as the period taken by an atom to traverse its own unit of space."

6. Translated from the Bengali of Rabindranath Tagore, by Manmohan Ghosh, in Viswa-Bharati.



Jagadish Bose

Chapter I

THE MECHANICAL RESPONSE OF LIVING SUBSTANCES

Mechanical response – Different kinds of stimuli – Myograph – Characteristics of the response curve: period, amplitude, form – Modification of response curves.

One of the most striking effects of external disturbance on certain types of living substance is a visible change of form. Thus, a piece of muscle when pinched contracts. The external disturbance which produced this change is called the stimulus. The body which is thus capable of responding is said to be irritable or excitable. A stimulus thus produces a state of excitability which may sometimes be expressed by change of form.

Mechanical response to different kinds of stimuli

This reaction under stimulus is seen even in the lowest organisms; in some of the amœboid rhizopods, for instance. These lumpy protoplasmic bodies, usually elongated while creeping, if mechanically jarred, contract into a spherical form.

If, instead of mechanical disturbance, we apply salt solution, they again contract, in the same way as before. Similar effects are produced by sudden illumination, or by rise of temperature, or by electric shock.

A living substance may thus be put into an excitatory state by either mechanical, chemical, thermal, electrical, or light stimulus. Not only does the point stimulated show the effect of stimulus, but that effect may sometimes be conducted even to a considerable distance.

This power of conducting stimulus, though common to all living substances, is present in very different degrees. While in some forms of animal tissue irritation spreads, at a very slow rate, only to points in close neighbourhood, in other forms, as for example in nerves, conduction is very rapid and reaches far.

The visible mode of response by change of form may perhaps be best studied in a piece of muscle. When this is pinched, or an electrical shock is sent through it, it becomes shorter and broader. A responsive twitch is thus produced. The excitatory state then disappears, and the muscle is seen to relax into its normal form.

Mechanical lever recorder

In the case of contraction of muscle, the effect is very quick, the twitch takes place in too short a time for detailed observation by ordinary means.

A myographic apparatus is therefore used, by means of which the changes in the muscle are self-recorded. Thus we obtain a history of its change and recovery from the change.

The muscle is connected to one end of a writing lever. When the muscle contracts, the tracing point is pulled up in one direction, say to the right. The extent of this pull depends on the amount of contraction. A band of paper or a revolving drum-surface moves at a uniform speed at right angles to the direction of motion of the writing lever. When the muscle recovers from the stimulus, it relaxes into its original form, and the writing point traces the recovery as it moves now to the left, regaining its first position. A curve is thus described, the rising portion of which is due to contraction, and the falling portion to relaxation or recovery. The ordinate of the curve represents the intensity of response, and the abscissa the time (*Figure 1*).

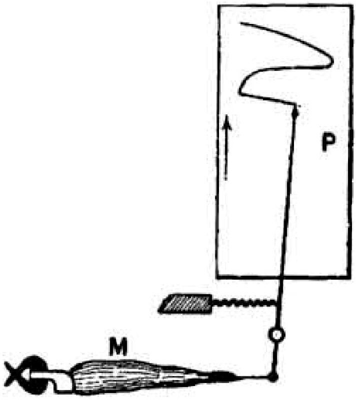


Fig. 1 – **Mechanical lever recorder**

The muscle **M** with the attached bone is securely held at one end, the other end being connected with the writing lever. Under the action of stimulus the contracting muscle pulls the lever and moves the tracing point to the right over the travelling recording surface **P**. When the muscle recovers from contraction, the tracing point returns to its original position. See on **P** the record of muscle curve.

Characteristics of the response curve: (1) period, (2) amplitude, (3) form

Just as a wave of sound is characterised by its (1) period, (2) amplitude, and (3) form, so may these response curves be distinguished from each other. As regards the period, there is an enormous variation, corresponding to the functional activity of the muscle. For instance, in tortoise it may be as high as a second, whereas in the wing muscles of many insects it is as small as 1/300 part of a second.

> "It is probable that a continuous graduated scale might, as suggested by Hermann, be drawn up in the animal kingdom, from the excessively rapid contraction of insects to those of tortoises and hibernating dormice." [1]

Differences in form and amplitude of curve are well illustrated by various muscles of the tortoise. The curve for the muscle of the neck, used for rapid withdrawal of the head on approach of danger, is quite different from that of the pectoral muscle of the same animal, used for its sluggish movements.

Again, progressive changes in the same muscle are well seen in the modifications of form which consecutive muscle-curves gradually undergo. In a dying muscle, for example, the amplitude of succeeding curves is continuously diminished, and the curves themselves are elongated. Numerous illustrations will be seen later, of the effect, in changing the form of the curve, of the increased excitation or depression produced by various agencies.

Thus these response records give us a means of studying the effect of stimulus, and the modification of response, under varying external conditions, advantage being taken of the mechanical contraction produced in the tissue by the stimulus. But there are other kinds of tissue where the excitation produced by stimulus is not exhibited in a visible form. In order to study these we have to use an altogether independent method; the method of *electric response*.

Footnotes

1. Biedermann, *Electro-physiology*, p. 59.

Chapter 2

ELECTRIC RESPONSE

Conditions for obtaining electric response – Method of injury – Current of injury – Injured end, cuproid: uninjured, zincoid – Current of response in nerve from more excited to less excited – Difficulties of present nomenclature – Electric recorder – Two types of response, positive and negative – Universal applicability of electric mode of response – Electric response a measure of physiological activity – Electric response in plants.

Unlike muscle, a length of nerve, when mechanically or electrically excited, does not undergo any visible change. That it is thrown into an excitatory state, and that it conducts the excitatory disturbance, is shown however by the contraction produced in an attached piece of muscle, which serves as an indicator.

But the excitatory effect produced in the nerve by stimulus can also be detected by an electrical method. If an isolated piece of nerve be taken and two contacts be made on its surface by means of non-polarisable electrodes at A and B, connection being made with a galvanometer, no current will be observed, as both A and B are in the same physico-chemical condition. The two points, that is to say, are iso-electric.

If now the nerve be excited by stimulus, similar disturbances will be evoked at both A and B. If, further, these disturbances, reaching A and B almost simultaneously, cause any electrical change, then, similar changes taking place at both points, and there being thus no relative difference between the two, the galvanometer will still indicate no current. This null-effect is due to the balancing action of B as against A. (See *Figure 2a*)

Conditions for obtaining electric response

If then we wish to detect the response by means of the galvanometer, one means of doing so will lie in the abolition of this balance, which may be accomplished by making one of the two points, say B, more or less permanently irresponsive. In that case, stimulus will cause greater electrical disturbance at the more responsive point, say A, and this will be shown by the galvanometer as a current of response. To make B less responsive we may injure it by means of a cross-sectional cut, a burn, or the action of strong chemical reagents.

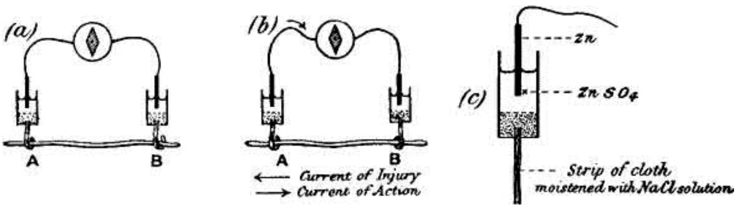


Fig. 2 **Electric method of detecting nerve response**

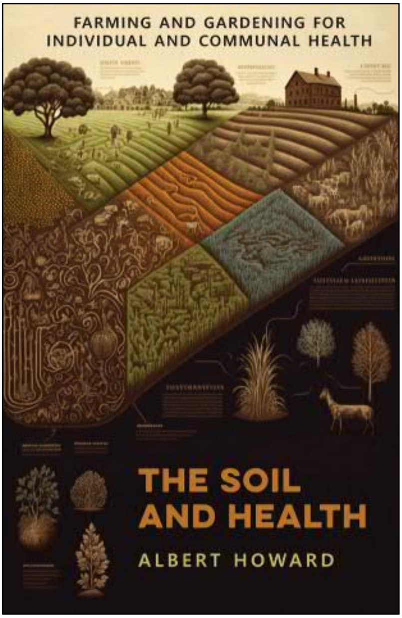
(a) Iso-electric contacts; no current in the galvanometer.

(b) The end **B** injured; current of injury from **B** to **A**: stimulation gives rise to an action current from **A** to **B**.

(c) Non-polarisable electrode.

Current of injury

We shall revert to the subject of electric response; meanwhile it is necessary to say a few words regarding the electric disturbance caused by the injury itself. Since the physico-chemical conditions of the uninjured A and the injured B are now no longer the same, it follows that their electric conditions have also become different. They are no longer iso-electric. There is thus a more or less permanent or resting difference



The Soil and Health

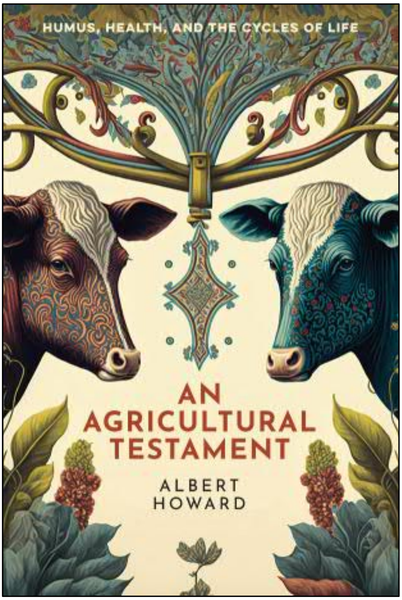
Albert Howard

This valuable book is a detailed analysis of the vital role of humus and compost in soil health – and the importance of soil health to the health of crops and the humans who eat them. The author is keenly aware of the dead end which awaits humanity if we insist on growing our food using artificial fertilisers and poisons.

Paperback, epub

More information

Download sample PDF



An Agricultural Testament

Albert Howard

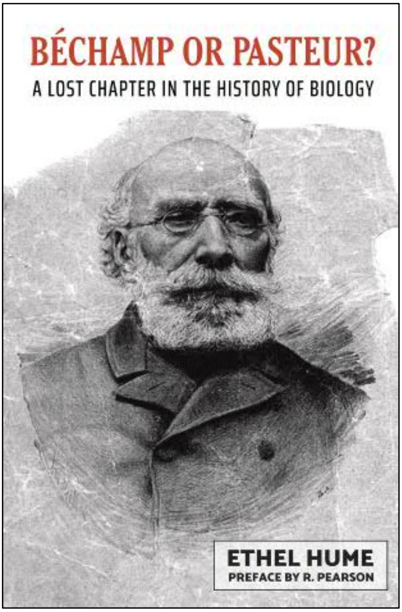
A new edition of Howard's classic work from the early days of the organics movement in Britain.

Howard's discoveries and methods, and their implications, are given in detail. They are of enormous usefulness to gardeners and farmers, and to anyone who may be interested in the history and the problems of land use.

Paperback

More information

Download sample PDF



Béchamp or Pasteur?

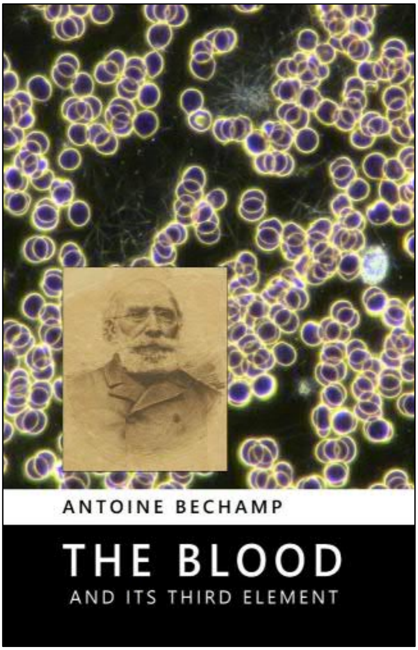
Ethel Hume / Robert Pearson

Pearson's *Pasteur: Plagiarist, Imposter* was originally published in 1942 and is a succinct introduction to both Louis Pasteur and Antoine Bechamp, and the background to the troubled relationship that they shared for their entire working lives. Ethel Hume documents the evidence in detail, so that there is no escaping the obvious conclusion – Pasteur was a fraud.

Paperback, epub

More information

Download sample PDF



The Blood and its Third Element

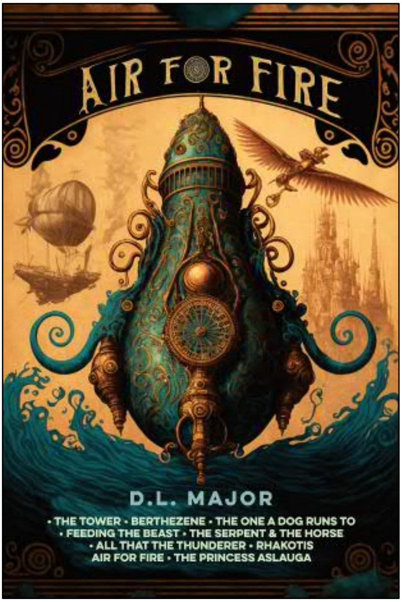
Antoine Béchamp

There is no single cause of disease. The ancients knew this. Béchamp proved it with meticulous research, and was written out of history for his trouble. The relevance of his work to the dilemmas that plague the modern medical world remains to this day unrealized by mainstream science and medicine.

Paperback, epub

More information

Download sample PDF



Air for Fire

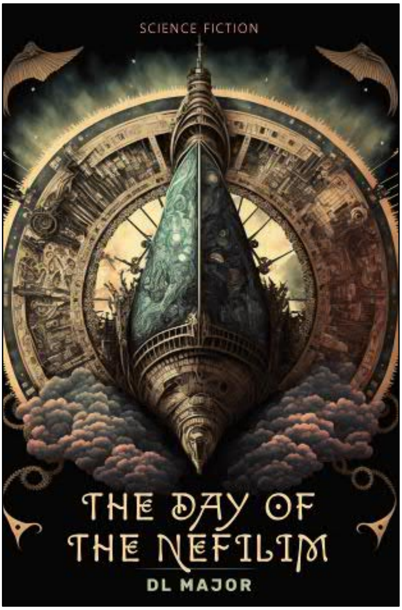
D.L. Major

A collection of short stories and poetry by the author of *The Day of the Nefilim*. While *The Nefilim* was a meandering trip through some of the world's great conspiracy theories, *Air for Fire* is a collection of short tales that happen in every timeline but this one. Shameless historical revisionism.

Paperback, epub

More information

Download sample PDF



The Day of the Nefilim

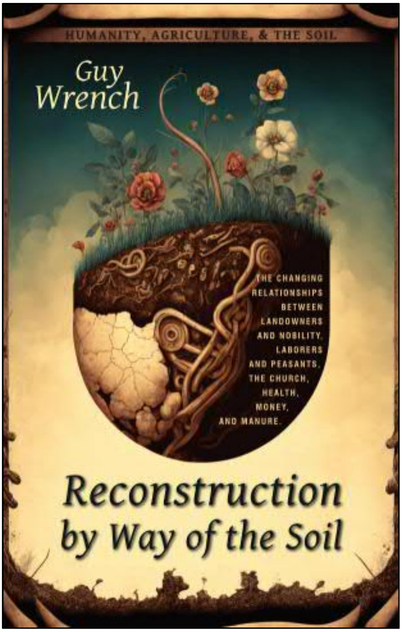
D.L. Major

"...one of the best SF novels I have read since I began reading. I read it straight through, in one sitting. Yeah, that's right, I did not put the book down until I finished reading it. Couldn't. Well done, David. Keep writing. Can't wait to read your next book… you would make Robert Anton Wilson proud, and Douglas Adams smile." – *reader review*

Paperback, epub

More information

Download sample PDF



Reconstruction by Way of the Soil

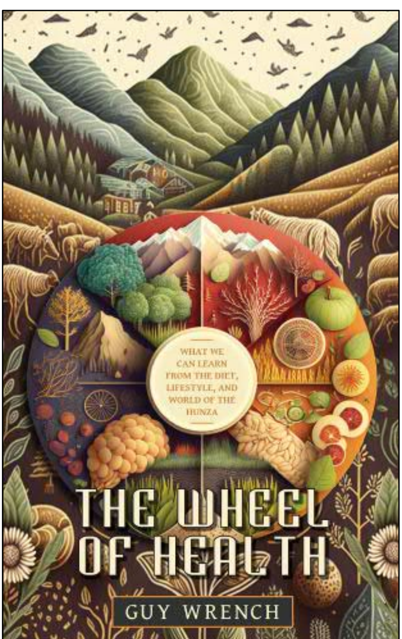
Dr Guy Wrench

Includes case studies from Ancient Rome, nomadic societies, medieval England, Africa and Egypt, the West Indies, Russia, Australia and the USA to show that nothing is more important than the relationship between civilization and the soil. The way that the soil is treated has brought about both the rise and fall of civilizations.

Paperback, epub

More information

Download sample PDF



The Wheel of Health

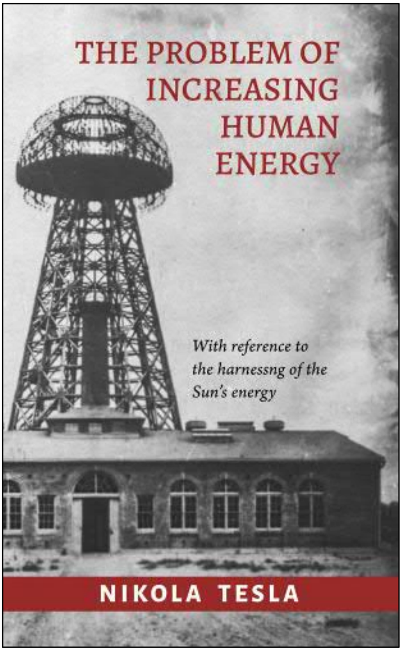
Dr Guy Wrench

The Hunza of northern Pakistan were famous for their extraordinary vitality and health. Dr Wrench argues that in part at least, this is because their food was not made 'sophisticated', by the artificial processes typically applied to modern processed food. How these processes affect our food is dealt with in great detail in this book. What Dr Wrench uncovered in his researches goes deeper than just food, though. It's about water.

Paperback, epub

More information

Download sample PDF



The Problem of Increasing Human Energy

Nikola Tesla

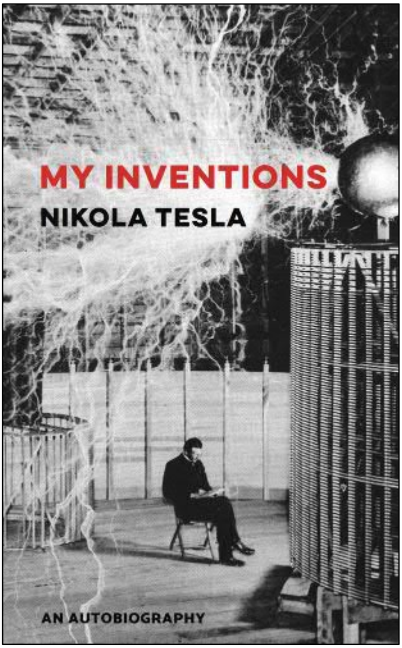
Contains Tesla's thoughts on humanity's relationship with the universe, and also his explanation of the technological wonders embodied in his work.

This text was first published in *Century Illustrated Magazine* in June 1900.

Paperback

More information

Download sample PDF



My Inventions

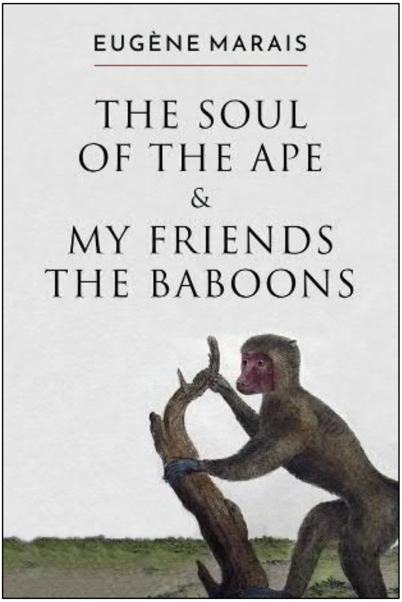
Nikola Tesla

Not only is this book an invitation to meet one of the greatest minds of the last century, and to hear him talk about his inventions;
it is also a chance to get to know Tesla as a person, as the book is filled with anecdotes of his early life.

Paperback

More information

Download sample PDF



The Soul of the Ape

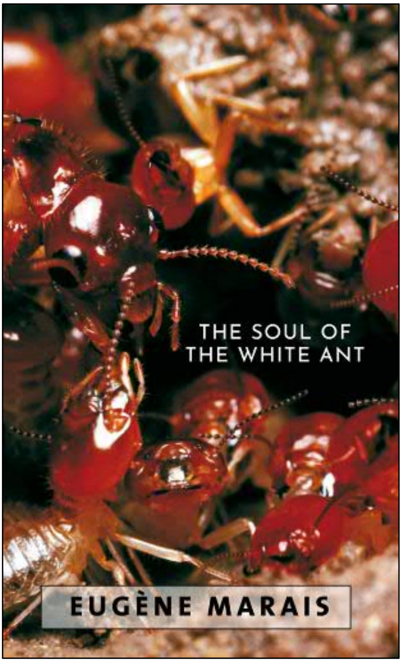
Eugène Marais

Includes two works by Marais written after his period spent living among a troop of baboons in the South African veldt. *My Friends* was written for a newspaper readership. *The Soul of the Ape* was the more serious scientific document. The excellent introduction by Robert Ardrey was part of the 1969 edition, and adds greatly to an appreciation of the importance of this text.

Paperback, epub

More information

Download sample PDF



The Soul of the White Ant

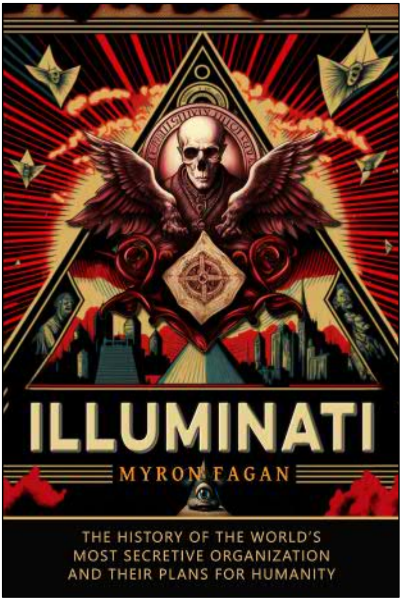
Eugène Marais

The amazing results of a long, close study of the lives of termites. Eugène Marais compares the infrastructure of a termitary to that of the human body. Writing from the heart, this scientific author who is also a poet instills a wonder in the reader, of the incredible intricacies of nature, in a light-hearted, easily readable manner.

Paperback, epub

More information

Download sample PDF



Illuminati

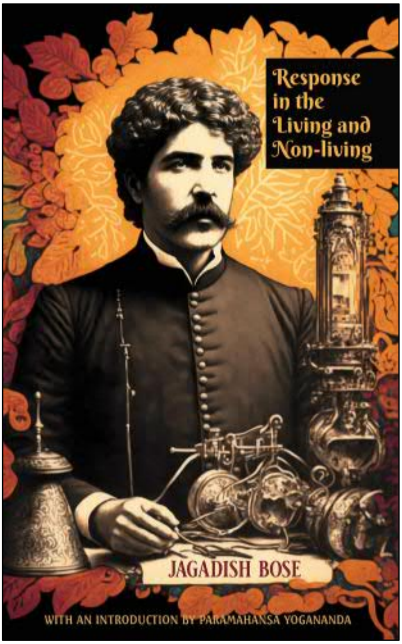
Myron Fagan

This book describes how the Illuminati became the instrument of the Rothschilds to achieve a One World Government, and how every war during the past two centuries has been instigated by this group. This is an historical text with names, dates, organizations and mode of operations, all exposing the octopus gripping the world today.

Paperback, epub

More information

Download sample PDF



Response in the Living and Non-living

Jagadish Bose

This is one of the great Indian scientist's earlier works. His experiments showed that in the entire range of responses – regardless of whether the subject is metallic, plant or animal – the responses are identical. The living response, in all its diverse modifications, is a repetition of the responses seen in the inorganic. *Everything is alive.*

Paperback, epub

More information

Download sample PDF

Ten Acres is Enough

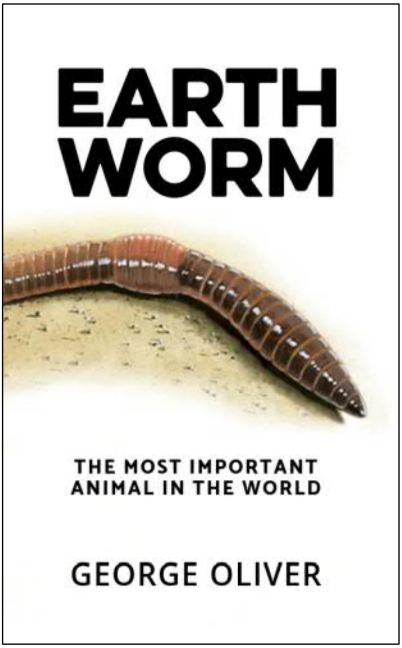
Edmund Morris

Recently we have seen a great back-to-the-land movement, with many young professional people returning to small scale farming; thus it is useful to read about someone who did exactly the same thing in 1864. In that year, Edmund Morris and his family gave up their business and city life for a farm of ten acres, where they made a go of mixed farming, and then wrote a book about it.

Paperback, epub

More information

Download sample PDF



Earthworm

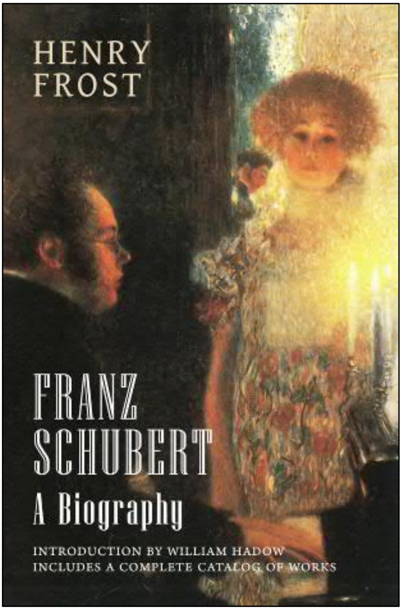
George Oliver

The author returns the reader to a time and methodology where people took responsibility for what they did and what they produced. In this world of spiraling food prices, huge landfills, diminishing food supplies, loss of topsoil, and water pollution, the reader is reminded that the world's most important animal could well be the humble earthworm.

Paperback

More information

Download sample PDF



Franz Schubert – a Biography

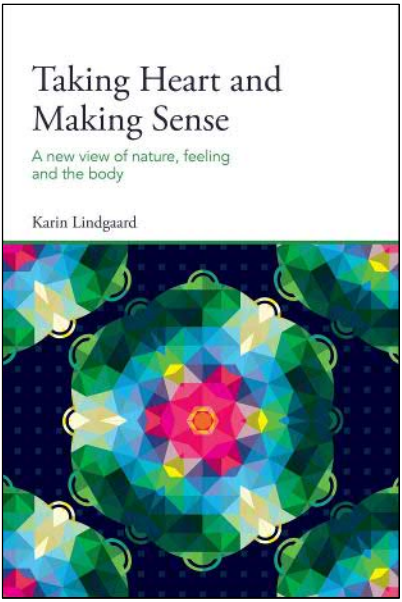
Henry Frost

"With faith man steps forth into the world. Faith is far ahead of understanding and knowledge; for to understand anything, I must first of all believe something. Faith is the higher basis on which weak understanding rears its first columns of proof; reason is nothing but faith analysed."
– *Franz Schubert*

Paperback

More information

Download sample PDF



Taking Heart and Making Sense

Karin Lindgaard

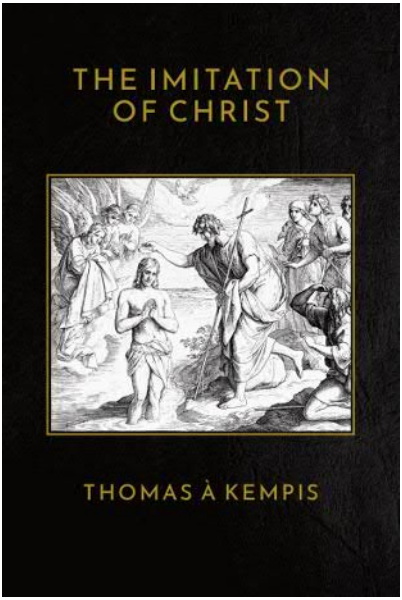
What do animals feel? How do living systems become conscious?

The author takes on these and many more questions about the natural world and human experience, helping us to understand our feelings and emotions, and our sense of meaning in life. Lingaard takes readers on a conceptual adventure across psychology, philosophy and cognitive science.

Paperback

More information

Download sample PDF



The Imitation of Christ

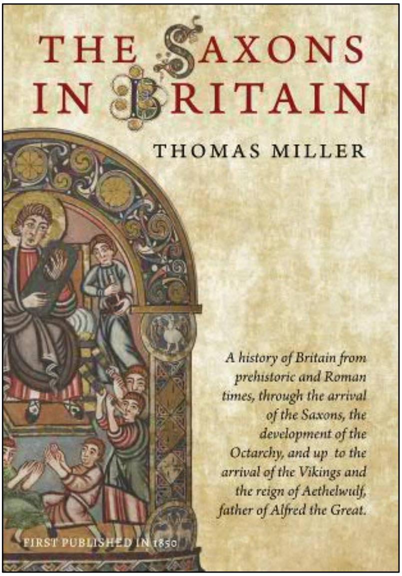
Thomas à Kempis

A new edition, extensively illustrated with prints by Julius Schnorr von Carolsfeld and featuring many bible passages from the RSVCE Bible. This text has long been a treasure trove for Catholics around the world. With its beautiful illustrations and carefully selected Bible passages, this new edition brings timeless wisdom to life like never before.

Paperback

More information

Download sample PDF



The Saxons in Britain

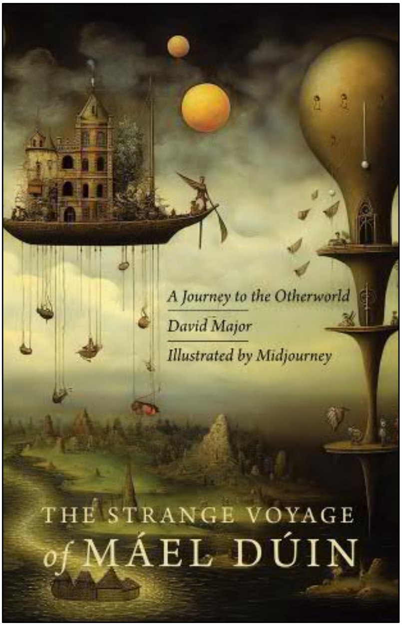
Thomas Miller

An illustrated history of Britain from prehistoric and Roman times, through the arrival of the Saxons, the development of the Octarchy, and up to the arrival of the Vikings and the reign of Aethelwulf, father of Alfred the Great.

Paperback

More information

Download sample PDF



The Strange Voyage of Máel Dúin

David Major & Midjourney

A new edition of one of the great stories of Irish mythology. It is extensively illustrated in full color by Midjourney, at the time of publication the leading AI illustration tool.

A collaboration between human and artificial intelligence, the Strange Voyage of Máel Dúin is a legendary tale from Gaelic literature that holds a significant place in the traditions of myth and history. It recounts the extraordinary maritime journey of the heroic Máel Dúin and his companions as they embark on a perilous quest.

Paperback

More information

Download sample PDF