In chapter 5, the authors extend the original HVH theorem to an asymmetric system and show its general validity for multi-component systems as well as for multi-body forces, especially the three-body force. The INM model is formally developed in chapter 6 using the generalized HVH theorem as would be appropriate for an asymmetric system consisting of both neutron and proton, consistently with the view that the nucleus incorporates both types of properties 'collective' as well as 'individualistic'. The model has been successful in separating the ground-state energy of a nucleus into a universal part represented by a sphere made up of INM common to all nuclei, and a characteristic part η, called local energy comprising contributions from specific features like 'shell', 'deformation', 'diffuseness', etc. which vary from nucleus to nucleus. The model has three distinct equations, the first two describe the INM sphere determining the universal part once for all; the third is a differential equation for determining the local energy η, with the input of the known nuclear masses and the derivatives (neutron and proton) of the corresponding energies in each case.

Chapter 7 addresses the saturation properties of INM. Solving the first two equations (see above), the saturation properties of INM are determined. The density so obtained yields $r_0 = 1.138$ fm in agreement with that of electron scattering and thereby resolving the long-standing 'r_0-paradox'. Chapters 8 and 9 deal with the perennial problem of nuclear incompressibility (K_∞). In the former, exhaustive discussion on the present status of its determination together with the associated defects is presented. A microscopic study using the Skyrme interaction is carried out here, to show that unlike the energy, the LDM expansion of finite nuclear incompressibility (K_A) does not converge, thus ruling out its possible use in the case of INM. Chapter 9 presents a new promising method for the determination of K_∞ called ab initio method – free of all existing drawbacks. This uses the energy and density of two states of INM and determines $K_\infty = 288 \pm 20$ MeV using its very definition in a more or less model-independent manner, making use of about 4500 data on nuclear masses and their corresponding energy derivatives. Nuclear equation of state is then obtained using this value.

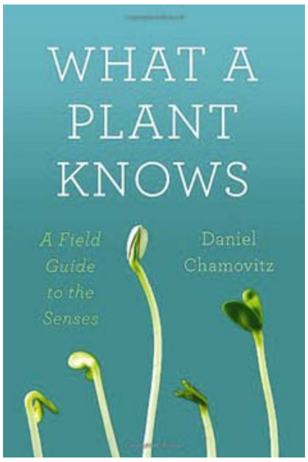
Chapter 10 presents the prediction of masses and other nuclear phenomena in the INM model. The latest mass predictions using 2198 known masses yields root mean square deviation of 342 keV, the lowest in the known literature. It predicts much expected shell quenching in $N = 82$ and 126 shells, and new islands of inversions showing that it is a general feature of nuclear landscape. Needless to say, the spectacular success of the INM model is due to its microscopic many-body basis, accounting of three-body force by the use of the HVH theorem, and repeated use of data pertaining to three properties of nuclei, while not using any nuclear interaction in any way (to avoid double counting).

Chapter 11 is devoted to a critical study on the predictive potential of the model in respect of the following two aspects. (1) The INM model has introduced in nuclear physics a new entity, the local energy η. It contains all the characteristic properties like shell, deformation, etc. hence uniquely defined, thus extending its scope beyond the Strutinsky shell effect. As a result, its systematics predicts new magic numbers and associated new islands of stability around Sm^{162}, Pt^{228} and Th^{254} in drip-line regions, corroborated by microscopic study in RMF theory. This reveals a new effect in nuclear physics wherein the 'shell' overcomes the instability due to repulsive components of nucleon–nucleon force (this is analogous to the phenomenon of superheavy elements in which repulsive Coulomb instability is stabilized by the same). While the latter effect elongates the stability-peninsula, the former broadens it. (2) Global analysis of the predictions of different mass formulae numbering about 15 has demonstrated the unique ability of the INM model to predict the masses of nuclei far from stability in unknown regions. It is interesting to note that the predictive power of the INM model stems directly from its non-trivial feature of a differential equation representation – in company with the 'greats' in physics – and not merely a set of (BW type) mass formulae whose predictive power is necessarily limited.

The INM model developed in this book has convincingly brought out the most important facet of the nucleus, viz. a quantum mechanical many-Fermionic nuclear matter, which is its true nature, in contrast to a (simplified) classical liquid drop or a weakly shell-manifested entity. Precisely for this reason the INM model is able to describe quantitatively thousands of data, and reveal many new phenomena, in addition to resolving some longstanding issues and thereby putting our understanding of nuclear physics on a firm footing. In this respect, while many-body theories like Brueckner–Bethe are based on equally firm foundations, they are generally considered to be rather complex – hence not of much practical use for teaching at universities by practitioners of nuclear physics. The present book in contrast, has succeeded considerably in dispelling this notion, and thus bringing many-body theory to the centre stage of nuclear physics as a first step towards integrating it to the main stream. Hope it will play a significant role in providing the necessary impetus for revamping the study of this subject on a wider scale. I feel this book is eminently suitable for a course in M Phil/Ph D preliminary classes, and as a special paper in advanced nuclear physics in an M Sc level programme.

A. N. MITRA

244, Tagore Park,
Delhi 110 009, India
e-mail: gargimitra@vsnl.com



What a Plant Knows – A Field Guide to the Senses. Daniel Chamovitz. Scientific American/Farar, New York, USA. 2012. 1st edn. 177 pp. Price: US$ 23.

Man has been enjoying intellectual supremacy since ages owing to his ability to make fullest use of the sensory inputs, information encoding, its storage and retrieval when needed.

This fascinating book by Daniel Chamovitz underlines the astonishing similarities between plants and humans regarding perception of sight, smell, hearing, touch, proprioception and memory. The information in the book is based on authentic scientific experiments conducted by scientists of high calibre (including the author himself), expressed in a language that is lucid and written for lay people. These attributes make this book thoroughly enjoyable.

The author takes his readers on a step-by-step journey into the life of plants. He has elucidated the parallels regarding the ways in which plants interact with their surrounding and how humans do the same. In some respects, the author feels that plants are even superior in making sense of their environment. The book is divided into six main chapters, each of which is devoted to a particular sense like sight, smell, proprioception, touch and memory. Each chapter describes by comparison the human and plant mechanism for the perception of these senses. A plant needs to perceive its surroundings in order to device survival strategies as it cannot leave its place like animals to avoid stressful situations.

The first chapter compares sight of humans and plants. Man can perceive the intensity and colour of light to 'see' the world, with the help of photoreceptor proteins that absorb light. Human retina is covered with rods and cones. Rods with rhodopsin protein receptors enable us to perceive light intensity whereas cones with photopsin protein receptors help us to see the colours like red, blue and green. These light signals are processed by the brain to form an image. Plants too respond to light by showing phototactic movements like photosynthesis, flowering induction thorough photoperiodism, etc. with the help of photoreceptor pigments known as phytochromes. Another kind of light receptors – cryptochromes, regulate circadian movements in plants. The experimental proofs for these facts provided by scientists right from Charles Darwin to Julius Sachs, Garner, Allard, Harry Borthwick, Warren Butler, Maarten Koorneef point to the ability of plants to 'see' with a comparable human mechanism of seeing with eyes.

As far as smelling ability is considered, plants have been found to be sensitive to different odours emitted by chemicals in the air. Ripening of fruits by ethylene gas is a classic example of this. David Rhoades and Gorden Orians showed that when willows get infested with caterpillars, they alert their neighbouring healthy plants by emission of airborne pheromone messages! The plant parasite dodder (*Cuscuta*) 'smells' beta myrcene – a volatile compound emitted by the host plants and chooses them as its prey. Martin Heil and co-workers studied the gaseous, chemical communication or signalling in the healthy and beetle-infected Lima beans. With the help of gas chromatography–mass spectrometry technique they found that the infected leaves of Lima beans produce methyl salicylate to signal neighbouring healthy leaves! Humans and other animals sense smell with the help of olfactory receptors in their noses that are connected to the limbic system of the brain. But in plants, the olfaction mechanism is yet to be fully understood. Till 2011, only one chemical receptor for volatile chemical ethylene has been identified. However, sufficient proof has been provided to show that plants can detect volatile chemicals in the air and can convert this into a physiological response.

We can perceive different kinds of touch like burning or cool air, with the help of nerve endings in the skin that send signals to the brain. Touching a plant cell initiates a cellular change in ionic concentrations that results in an electric signal, exactly in a similar manner when human skin is touched, and creates electric signal through the neurons in the skin. Burdon-Sanderson studied the mechanism of opening and closing of the lobes of the leaves of an insectivorous plant – Venus flytrap and found that the depolarization type of electrochemical reaction – similar to the one involved in the sensory mechanism of touch in humans – is also triggered in this plant when touched by insects. It results in closing of the leaves at once and the insects are trapped.

In the sensitive plant, 'touch-me-not' (*Mimosa pudica*), the leaves droop when touched. In 1901, Jagdish Chandra Bose, first reported this to be initiated due to electric action potential. The pulvinus cells found at the base of *Mimosa* leaves are found to play an important role to induce opening or drooping of the leaves through regulation of potassium levels, a reaction which starts as a response to electric signal triggered by touch. A similar reaction takes place in humans too. In both plants and animals, calcium ions help regulate the electric charge of the cell. Janet Braam found that *TCH* genes in the case of *Arabidopsis* get activated by simply touching the plant. These genes encode the proteins involved in calcium signalling in the cells. Plants cannot escape from damage or stress, but they certainly can modify their metabolism to adapt to different environments.

Hearing in animals evolved mostly as a means of communication of information regarding some danger followed by quick response. Plants do not seem to show evolution of hearing sense. Experiments conducted to find the response of plants to sounds could not provide concrete evidence to show that plants can 'hear', and respond in the form of any physiological or morphological reaction. Roman Zweifel and Fabian Zeugin found that pine and oak trees produced ultrasonic vibrations resulting from changes in water content of xylem vessels. But it is doubtful if these vibrations serve as communication signals to other plants regarding drought conditions.

Interestingly enough, *Arabidopsis* genome is found to consist of the same 'deaf' genes that are responsible for hearing impairment in humans when they undergo mutation. In view of these findings, the reviewer feels that plants have not developed the sense of hearing as they remain stationary and do not have any use for hearing to avoid danger.

Animals, including human beings can perceive their position in space and show effect of gravity on them. This sense is called proprioception. The coordination between input signals from the inner ears and specific nerves of the body helps us to balance our body. Human sense of proprioception, i.e. body position is shown to be due to the sunken small crystalline stones – otoliths – in the fluid present in the inner ear. The otoliths sink in the fluid if the position of our body changes and let us know whether our head is in an upward or downward position.

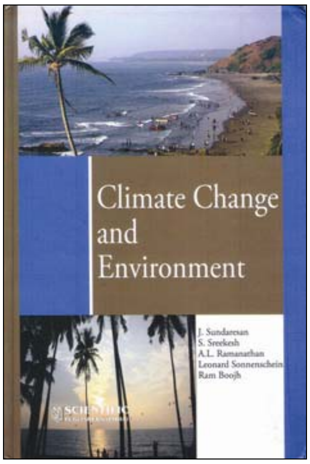
The static and dynamic awareness of body position is also seen in plants. Charles Darwin and Thomas Knight showed that gravity affects a plant's bidirectional growth. It was later experimentally proved in plants that in the roots and stems different proprioception mechanisms operate at the same time that let the plant know of its position and these mechanisms are quite similar to those in humans. The crystals similar to otoliths in human ears and called statoliths are found to be present in the root cap cells as well as in the endodermis cells of the stem. These are the gravity receptors and their displacement causes a plant to change its direction of growth. John Kiss used high-gradient magnetic field that stimulated gravity, and induced migration of statoliths, that indeed affected the direction of bending of the roots. He predicted that in space the statoliths will not move as there is no effect of gravity. In the space shuttle too, no gravitropic bending of roots was detected.

In the last part of the book, it has been shown that similar to human beings, but in a limited manner and through a different mechanism, plants also can form, store and retrieve memory. In *Arabidopsis thaliana* epigenetic mechanism of cellular memory regarding vernalization is discussed. Many plants require getting a cold period gap before flowering is induced. Whether a plant has or has not met with this cold period is remembered by it and used further to induce flowering. This involves the 'switch on' of the *FLC* gene for production of inhibitor protein. This stops the plant from flowering till it meets the cold period. Vernalization switches the gene off and remembering this, the plant begins to produce flowers. The process of production of inhibitory protein by *FLC* gene is due to epigenetic effect involving heritable genomic rearrangement; the exact mechanism is not yet fully understood.

While concluding the discussion on the plant senses, the author mentions that plants may not be intelligent as humans, but they are certainly aware of their surroundings. Though humans and plants share similar abilities to sense the world around them, the former are superior as they can render the sensory inputs as an emotional landscape. This is so because they have evolved along different paths.

ANJALI SUDHIR NAIK

Department of Botany,
SBES College of Science,
Dr Babasaheb Ambedkar Marathwada University,
Aurangabad 431 004, India
e-mail: anjali.naik360@gmail.com



Climate Change and Environment. J. Sundaresan *et al*. (eds), Scientific Publishers (India), 5A New Pati Road, P.O. Box 91, Jodhpur 342 001. 2013. xiii + 286 pp. Price: Rs 1950.

This edited volume is a collaborative effort of many researchers working in the area of global change. It has 25 contributed articles in a wide variety of subjects ranging from climate change at local or regional levels to ecosanitation. Papers are grouped under five subheadings: Climate change science (3), Changing weather (5), Climate change science and biological system (7), Physico-chemical aspects of environmental changes (6), Mitigation and adaptation climate change (4). The scientific rigour of the articles too, likewise, has wide variation. For example, the article dealing with Chennai's regional temperature variation and its correlation with sunspot numbers and CO_2 emission concludes on temperature trends without testing their statistical significance. The authors ignore the facts that: (i) datasets less than 30 years long are seldom useful in documenting clear trends and assigning causes, and (ii) CO_2 is a well-mixed gas in the Earth's atmosphere, and its radiative effects on climate are as global as are the effects of sunspots. Similar lack of scientific rigour is exemplified by several papers under the subheading 'Changing weather'. This is compensated to some extent by some good papers based on GCM simulations and data analysis. The editors could have done better with a thorough international review of the articles, but probably decided against it because then they would have to compromise on the breadth of the subjects the book deals with. This book might be useful to young researchers interested in the field of global change to choose where they need to put in more efforts.

RENGASWAMY RAMESH

Geoscience Division,
Physical Research Laboratory,
Navrangpura,
Ahmedabad 380 009, India
e-mail: rramesh@prl.res.in

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