

with destinations). (c) Mode choice (estimating the mode choice). (d) Route assignment (choice of path). Further, it discusses in detail the travel demand modelling, which refers to simulations based on the replication of real-world multi-modal transport network conditions. The chapter also deals with the routing and scheduling of public transport and explaining optimum transit unit (TU) capacity.

Chapter 7 focuses on practical solutions pertaining to urban transport management. These fall under the purview of the transportation system management (TSM) programme which is the short-term element of the overall transportation improvement plan (TIP). The TSM includes less capital-intensive options that can improve transportation in the short term. Most of these pertain to aspects such as improved vehicular flow, preferential treatment of high-occupancy vehicles, reducing peak-period travel, parking management, and so on. The chapter also analyses the performance of public (State Transport Undertakings (STUs)) and private transport operators in India, and outlines the major impediments encountered by each of them.

Chapters 8 and 9 deal with the financial performance and economics of public transport in India. The data presented here reveal that barring a few, most of the STUs in India make perpetual losses. The major causes for this poor economic performance have been identified as high motor vehicle taxes, uneconomic fare structure and high manpower costs. In the light of the growing debt burden of the STUs, a strong case is made for establishing an institutional financing channel to cater to their funding requirements. Further, a range of innovative methods is suggested for generating revenue surpluses – such as peak-load pricing, ridership points (similar to airlines mileage points), variety in bus services (to cater to diverse sections of the population), all aimed at enhancing the ridership and revenue. Moreover, it is recommended that an approach of estimating the benefits of public transport cannot be based on an assessment of the direct financial benefits alone. Rather, there exists a strong case for performing a social cost–benefit analysis. In this context, it is proposed that the economic value-added methodology be adopted to incorporate the opportunity cost of meeting socio-economic objectives.

Overall, the book is informative and insightful, and presents rich data supported by relevant case-studies. However, the flip-side is the overload of information that may often cause the reader to get lost in the wide array of figures and tables. Given the fact that each chapter touches upon a range of diverse issues, it might be useful from the viewpoint of the reader, if a clear outline was laid out at the beginning of each chapter. This will also serve the purpose of logically linking each sub-section to the next one. In its current form, many of the sections often appear abrupt and leave the reader wondering how the same are related to what has been discussed in the earlier part of the chapter. There are also some issues with respect to formatting, typographical errors and resolution of the figures. Moreover, it would have been useful if the authors could have thrown light on how some of the more recent phenomena such as the arrival of app-based taxi operators (Uber, Ola, etc.) or car rentals (Zoom cars) would impact the existing public transport infrastructure. Further, it would have been interesting to understand the Indian experience in terms of the usage of electric and hybrid vehicles (particularly since these contribute directly to sustainability). To summarize, the book scores high on content, but low on readability. Nevertheless, as stated earlier, it might still be a one-stop-shop for students/researchers looking for consolidated information related to this topic at one place.

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**Annual Review of Neuroscience, 2014.** Steven E. Hyman, Thomas M. Jessell, Carla J. Shatz, Charles F. Stevens and Huda Y. Zoghbi (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 37. x + 550 pages. Price: US\$ 96.

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Neuroscience is the scientific study of the nervous system whose huge advances in the last few decades is strongly linked

to the progress in other related fields like molecular biology, electrophysiology and computational neuroscience. It emerged as a unified discipline only around 1971. This has enabled neuroscientists to better understand aspects related to the structure of the brain, its development, function, neurological disorders and ways to treat these abnormalities. Its interdisciplinary nature is becoming stronger and closely linked with subjects like computer science, chemistry, mathematics, psychology, medicine and engineering. The interdisciplinary work has resulted in the emergence of different branches of neuroscience like molecular neuroscience, cellular neuroscience, developmental neuroscience, computational neuroscience, cognitive neuroscience, neurophysiology, behavioural neuroscience, affective neuroscience, clinical neuroscience, neuroinformatics, neuro-engineering, neuroimaging and systems neuroscience.

This volume is a collection of articles on the current work being done in different branches of neuroscience, although not in any particular order. There are quite a few reviews related to cognitive neuroscience and the neurobiological basis of certain cognitive disorders. Cognitive neuroscience emerged as a combination of the theoretical aspects of cognitive science and neuroscience, including neuropsychology, and attempts to understand how the neural circuits in the brain produce behaviours or psychological functions, i.e. the brain–mind connection. Recent advances in functional neuroimaging such as functional magnetic resonance imaging (fMRI) and PET coupled with presentation of natural stimuli and tasks are used to understand these aspects. fMRI relies on blood-oxygen-level-dependent (BOLD) signal. The basis for the signals is the coupling between the local blood flow in the brain and neuronal activity by the process of neurovascular coupling. There is an interesting review by Hillman that examines the cellular (astrocytes, pericytes, interneurons and neuronal networks) and vascular bases of neurovascular coupling in the BOLD signals. In human languages, we have both syntax–grammatical structure using lexical building blocks, and semantics – the meaning associated with such grammatical constructions. Using meta-analysis, a statistical approach combining results from multiple neuroimaging studies, Hagoort and

Indefrey report findings of studies related to the brain structures involved in processing syntax and semantics, and their unification.

Caramazza *et al.* critically assess the embodied cognition theories that emphasize the role of perceptual and motor processes in cognitive abilities. The review also critically evaluates an embodied theory of cognition, viz. the mirror neuron theory. Mirror neurons are found in the brain and respond when an animal performs a motor action, and also when the animal observes a similar action. The neuron shows increase in firing rate, for instance, when the monkey holds an object with its hand and when it observes the experimenter grasping the same object by the hand. This peculiar property of the motor neurons has been associated with action understanding.

An important cognitive ability is pattern separation. It is a mnemonic function which allows us to separate spatially similar memory representations. A classic example is the difficulty in remembering the exact location where one has parked his/her car in a multilevel car parking area on previous consecutive days, because the spatial representations are so similar causing confusion in the brain. Pattern separation, therefore, requires accurate encoding and retrieval. Spatial pattern separation is facilitated by the dentate gyrus in the hippocampus and is affected in patients with mild cognitive impairment. The review by Christian *et al.* summarizes our current understanding of how adult neurogenesis in the dentate gyrus of the hippocampus contributes to this cognitive ability and how its dysfunction results in disorders of brain function.

There are certain human neurological disorders that are associated with cognitive dysfunction like Alzheimer's disease and in patients with Fragile X syndrome. The cognitive defects are associated with synaptic dysfunction. Buffington *et al.* review the recent studies on the dysregulation of the signalling pathways that regulate mRNA translation in neurons in response to synaptic activity and the translational control mechanisms in the neurons at the synapse. Yu *et al.* provide an update on apolipoprotein E (ApoE) in Alzheimer's disease. Late onset Alzheimer's disease (LOAD) is associated with the pathogenic nature of ApoE, where single amino acid differences among the ApoE isoforms modulate

ApoE structures to profoundly affect their functions.

There are also interesting reviews on the molecular and cellular basis of neurological disorders. Maintaining the neurons in a healthy state is important for brain function, and neurons and glial cells have adapted specific autophagic mechanisms that protect them from misfolded proteins and damaged organelles by delivering them to the lysosome, an intracellular organelle. Yamamoto and Yue review autophagy in normal and diseased states in the brain associated with neurological disorders like Parkinson's disease, Huntington's disease, and amyotrophic lateral sclerosis (ALS). ALS is a degenerative disease where motor neurons in the motor cortex, brain stem and spinal cord are affected. Inside living cells, protein aggregation is a continuous process; most protein aggregates are functionally important, while others are a result of misfolding and other stressors. In autophagy, damaged proteins are degraded by lysosomes. Aggrephagy is the selective destruction of harmful protein aggregates by macroautophagy. The review mentions the current work on two selective macroautophagy proteins, p62/SQSTM1 and OPTN linked to sporadic and familial ALS, that suggests defects in aggrephagy. However, it is still not known why motor neurons are selectively affected in ALS and why they depend on aggrephagy.

Mitochondria are intracellular organelles that produce the energy-rich ATP molecules through the electron transport chain. The review by Haelterman *et al.* discusses the role of impaired mitochondrial structure-fusion and fission, dynamics, function and trafficking including impaired clearance of dysfunctional mitochondria in Parkinson's disease. This is a progressive neurological disorder affecting about 1% of the older adult population associated with the loss of dopamine neurons in a region of the brain called the Substantia nigra. It is rather intriguing that the dopaminergic (DA) neurons in the Substantia nigra are specifically lost due to their susceptibility to oxidative stress, while the other DA neurons in the brain remain unaffected. Dopamine inside the neurons undergo oxidation, and it is believed that the oxidized DA forms covalent bonds with proteins inside the cell leading to aggregation. The production of reactive

oxygen species via DA oxidation coupled with the demand on ATP production and supply due to the continuous pacemaker activity of the DA neurons that are not met by impaired mitochondrial function probably make the Substantia nigra DA neurons more vulnerable to damage.

One of the approaches to understand brain function is by perturbing distinct neuronal types to cause alterations in the dynamics of neuronal circuits and observe animal behaviour. Sternson and Roth review the current status of research on chemogenetic tools using DREADDs-designer receptors exclusively activated by designer pharmacological drugs to analyse brain function. A case in point is the activation of DA neurons expressing TRPV1 ion channels involving cell-type selective Cre recombinase-dependent expression of TRPV1 on a global *Trpv1* knockout background. Intraperitoneal injection of capsaicin that activates TRPV1 receptors on DA neurons selectively increases locomotion in mice.

The reviews in neurophysiology include cortical control of whisker movement (Petersen) through the whisker motor neurons via the brainstem in rodents like rat and mice that sample sensory information about their immediate environment by forward and backward movement of their whiskers at high frequencies during exploratory behaviour. The other interesting reviews are on the control of sleep-wake cycle by neuropeptides (Richter *et al.*), and the role of basal ganglia in decision making (Nelson and Kreitzer) involving parallel-flexible (initial learning) and stable mechanisms (long-term learning).

In the branch of cellular neuroscience, there is an interesting review by Pasca *et al.*, on generating human neurons *in vitro* to understand neuropsychiatric disease, which opens up experimental possibilities that appear to be more relevant than using transgenic mouse models.

The development of the human brain is complex and one of the important steps during embryogenesis is the closure of the neural tube involving morphogenetic changes, whose failure results in neural tube defects. Greene and Copp review the involvement of candidate genes and gene-environment interactions in producing neural tube defects in humans.

Brain damage due to trauma or stroke can lead to loss of control on bodily

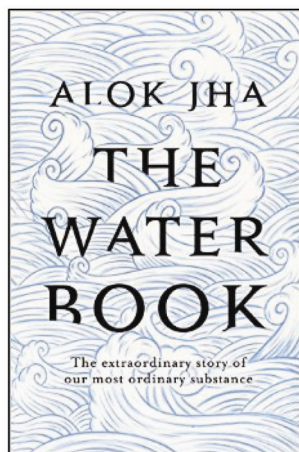
## BOOK REVIEWS

functions and in extreme cases, the patient goes into coma. One of the serious dilemmas that the doctor faces is to know if the patient is conscious or not, and the degree of consciousness. The review by Gosseries *et al.* deals with the clinical assessment of consciousness, its neural correlates and the integrated information theory of consciousness which considers that it is related to the capacity of the brain for information integration.

This volume has an interesting breadth of coverage of the different aspects of neuroscience. It should be useful to experimental neuroscientists and clinicians interested in the science of brain disorders. I like the hard-bound volume, which I hope they will continue to publish in the era of e-books.

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**The Water Book: The Extraordinary Story of Our Most Ordinary Substance.** Alok Jha. Headline Publishing Group, An Hachette UK Company, 338 Euston Road, London NW1 3BH. 2015. 376 pages. Price: Rs 499.

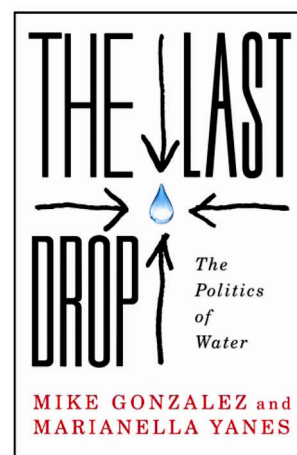
How would you fathom a contrasting situation when one is fighting crises of water supply at home and a distant friend

has gone shopping for a fishing gear to exploit the small stream flowing through his coffee farm? Envious undoubtedly; what is 'fish out of water' for one is 'catch a fish' opportunity for the other. That is what water does under differing situations, perhaps a grim reminder on its undisputed value for human existence, and more importantly, for being human. We seem to value the universal liquid when it is in short supply, but do we understand it well?

'Of all known liquids,' wrote the great water chemist Felix Franks, 'water is probably the most studied and least understood'. Taking cue, Alok Jha has set out to write a biography on this wonder molecule, and has come out with an exhaustive treatise on the subject. Of all mysterious properties of water, the dielectric constant sets it apart from other naturally occurring materials. At an incredible value of 80, its large dielectric constant breaks affinity between other molecules with ionic bonds and earns itself the title of a universal solvent. No wonder, whenever one thinks of a liquid, one is thinking of water with a small amount of other things dissolved or suspended within it. Could this be one of the reasons for its omnipresence on this planet?

Water has invented humans, and indeed sustains all other life forms on the Earth. Paradoxically, however, a liquid that is part of life is also one of fear and death. Some of the most dreaded creatures live under water, carrying on eternal war amidst them by preying on each other. There is nothing softer and weaker than water, and yet nothing as hard and strong too. Jha journeys through the hydrosphere, biosphere and cryosphere to capture the nature and properties of the second most abundant molecule in the universe.

Putting the works of several philosophers, chemists and hydrologists into perspective, the author marvels at the way the water molecule acts like a hawala system of informal cash transaction in transferring energy at impossible speed. Just as the hawala system works on trust and word of mouth, so do networks of hydrogen-bonded water molecules in carrying the charge of protons from one part of a cell to another. This book captures all this and much more, but is a trifle too long. While it is a useful addition to water literature, it could be worthy as a textbook.



**The Last Drop: The Politics of Water.** Mike Gonzalez and Marianella Yanés. Pluto Press, 345 Archway Road, London N6 5AA. 2015. 224 pages. Price: Rs 1357.

This book offers a study in contrast. Focusing on the trade and politics of water, the professor-journalist duo of Mike Gonzalez and Marianella Yanés lament the growing insanity of identifying with bottled water as a social drink – consumed by elegant people in elegant bars. It is no surprise therefore that some nine billion bottles of water are sold annually across the world. The massive expansion of the private water industry, including the bottled water industry, is an outcome of commitment of neo-liberalism to the privatization of all public services and public goods. Outwardly it may seem to be the only way out to address the issue of access and quality. The reality is that big corporations with turnover exceeding US\$ 40 billion annually have contributed literally nothing to the resolution of the water problem. This is not surprising when one learns that 34% of water and sewerage privatizations have failed across the world, with as many as 180 cities having re-municipalized their water operations.

Citing real-case stories of predatory privatization, from Mexico to Kerala and from Laos to Bolivia, the authors contend that capitalism is anything but blind to ecology. It transforms nature into commodities, homogenizing it into products which can be traded for profit. Calling for a new world water order, the book seeks collective engagement of all small movements in big picture change in favour of water peace, as opposed to the widely publicized prediction of