

pedogenic provenance analysis has been presented in chapter 6, and has largely been illustrated through case studies that have employed techniques such as SEM-EDX and WD-XRF to obtain insights into the provenance of soil materials. Finally, this volume also raises the question ‘Can geodiversity help to save the soil archives?’ This discussion is a recognition of the fact that soils are an integral part of nature’s diversity, and that there are ‘threats to soils and palaeosols as elements of geodiversity’. The larger view advanced in this study is that although soil conservation is commonly limited to combat soil erosion and land degradation, it should additionally include the aspects of soil heritage and soil diversity, just like it is done in the case of biodiversity. Case studies have been provided and the one on the soil loss and erosion rates of the European Union is worth mentioning here. A key message emerging from this study is that soils should be protected at various scales from local, to national, to global. Consequently, actions are required through protection and legislation to preserve soils and geodiversity from local to transnational levels. Why should we be so concerned about our geodiversity and the related soil heritage? We need to remind ourselves that soils, like water and air, form the foundation of our societies (food security); as well as that palaeosols are important as they are the recorders of both environmental changes of the past and our collective heritage (as inherited through the Holocene).

Reading the *Soil Archives* has been an illuminating experience; it is a valuable addition to the literature in the area of Earth Surface Processes, and is of particular relevance for those interested in using the soil archive to unravel the geoecological code of palaeosols and sediment cores. This volume will remain an important reference particularly for gaining knowledge about the methods that are in use for analysing the soil archives and sediment cores. Overall, this volume fits well into the larger Quaternary science perspective of the earth’s surface systems and subsystems, as they evolve in an Anthropocene world.

The examples and case studies used in nearly all of the chapters of this volume are from the Netherlands. Although this may be somewhat limiting from the point of view of the readers who work in other regions of the globe, it does provide an

interesting perspective of research being carried out in that part of Europe on the soil archive in the larger Quaternary perspective. This volume is highly recommended particularly to those interested in employing the wide range of methods and techniques that are increasingly being used for the description, characterization, and interpretation of the soil archives as part of understanding earth surface systems and processes in a Quaternary science perspective.

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The recent issue of *Annual Review of Neuroscience* is a fun volume to browse. It is a collection of state-of-the-art articles that deal with topics of wide contemporary interests, in addition to less frequented niche areas demanding urgent attention. As expected, hippocampus draws maximum coverage. Although we know a lot about the connectivity over DG, CA3 and CA1, CA2 continues to be poorly understood. The article on ‘CA2: A highly connected inrahippocampal relay’ unravels the circuit complexities within CA2 and debates its special role in social memory. Magee and Grienberger take a different line of enquiry. They review the development of post-Hebbian concepts leading to the directed type of synaptic plasticity. How the plasticity may enable a neuronal population to refine its activity toward a specific target or goal is an exciting concept being pursued. While formation of memory continues to mystify, amnesia, another side of same coin, begs for resolution. In their engaging review on ‘Impairments to consolidation, reconsolidation, and long

term memory maintenance lead to memory erasure’, Haubrich *et al.* evaluate the mechanisms underlying amnesia. They evaluate competing hypotheses on whether amnesia should be attributed to eradication of memory traces or that the traces are already present, but inaccessible. The weight of the current literature seems to favour the former view.

To decipher how brain processes time is perhaps as hard as understanding time itself. This challenge has been shouldered by Issa *et al.* We are introduced to the brain regions and behaviours associated with encoding of time across a broad range of time scales. The authors borrow ideas from our understanding of navigation in space, and then apply those rules for interpreting the role of circuits in measuring time. One way to understand brain is to isolate a circuit on the basis of its function and determine how it interacts with other circuits. Mesolimbic-reward system strikes as a classical example with dopamine as a prime agent for its output. However, in the article entitled ‘Reward contributions to serotonergic function’ Lie *et al.* provide insights on the serotonergic regulation of behavioural functions in the context reward processing. Serotonin seems to work both synergistically and antagonistically with midbrain dopamine system and shape motivational character that drives the response to rewarding stimuli. Mechanisms that enable the newly born mammals to suckle milk constitute the theme of the article by Maynard *et al.* The review gives the essence of biomechanics, circuits and genes necessary to regulate normal suckling behaviour and shape development.

Shifting the focus from the traditional circadian oscillators in the brain, Artushin and Sehgal make a compelling case for the role of astrocytes in circadian rhythms. Sifting through the information in fly as well as mammals, the authors evaluate the impact of genetic manipulations in glia on alterations in behavioural rhythms and ascribe a role for astrocytes in influencing rhythmicity in suprachiasmatic nucleus. How the odour representations are linked to perception has been a matter of enquiry for long. Unlike other sensory systems which are activated by a limited sensor types, the olfaction draws from a very large population of odour receptors driven by an equally large number of genes. The olfactory information goes directly to

cortex, bypassing the thalamus, and there is no cortical map for olfaction, as seen in the case of other sensory systems. In 'Finding the brain in the nose,' Brann and Dutta explore the neural ensembles that respond to odours through patterned neural activity. They explore the many ways in which neural firing can distinguish one odour from the other. Another sensory system – the itch – represents a less frequented area. Itch, mediated by pruriceptors, essentially belongs to the same peripheral sensation as touch and pain. Evolutionarily conserved, itch is believed to generate a response that will rid the organism of external threats. Lay and Dong categorize the itch receptors as GPCRs, cytokine receptors, Toll-like receptors and ion channels and lay bare the anatomy of the itch conveying afferent circuits. The article on 'Mechanosensitive ion channels....' comes at a propitious time. In view of the ubiquity of the mechanical forces, a variety of fundamental physiological processes depend on the activation of the mechanosensitive channels. A wide range of mechanosensitive channels have adapted to distinct mechanotransduction mechanism to suit diverse biological needs. Mechanosensitive properties have been detected in the acid sensitive channels, epithelial sodium channels, Piezo channels, potassium channel subfamily, and TRP channels to name a few. The review is a treasure trove of information on the wide variety of membrane proteins and how they respond to mechanical deformation.

Brain organoids is another emerging area that holds enormous promise. Human brain is not accessible during development and the animal models can only take you so far. Velasco *et al.* evaluate the advances in stem-cell derived models of human organogenesis, in the form of 3-D organoid cultures. With an engaging treatment, the authors usher in new tools to probe the development, evolution and pathology of human brain. The activity of brain is constantly in a state of flux. It has profound influence on the neural responses to sensory inputs, our ability to process information, and make and implement decisions. In the article on 'Neuromodulation of brain state and behaviour', McCormick *et al.* weave an appealing story around participation

of neurons, synapses and neuromodulators in large scale network activity generating perception and cognition. Using fMRI and other imaging techniques, they explain threadbare how the ability of mice to accurately respond to a sensory stimulus is significantly reduced if those stimuli are presented when the cortex is in slow oscillatory activity. With sumptuous illustrations, the review is a real page turner.

Escape behaviour, prevalent in diverse phyla, has evolved to protect animals from harm emanating from a predator. Branco and Redgrave in their review on 'The neural basis of escape behaviour in vertebrates' break up the escape behaviour into several high-order computational problems that must be solved if one aims to link sensory perception of threats with the escape movements. Immediate response to a threat may be a simple process, but prolonged response depends on predicting the attack by the predator, followed by an escape response that must draw on higher cortical computations. Park *et al.* shine light on the neural circuits that enable us to perform delicate and calibrated motor actions. Finely graded motor control is fundamental to the success of any goal directed action. The central role of the basal nuclei, midbrain and premotor centres in the hindbrain, in continuous specification of movements has been elegantly discussed. Literature on endogenous opioid peptides and their receptors continues to make rapid advances. Emery and Akil deal with the topic in a powerful, yet lucid manner. The review will be a joy to read, particularly for those tracking opioid addiction, and a valuable source of information for the advance level teachers in neuropharmacology.

Other articles in the volume take a less trodden path. The prevalent thought on the enteric nervous system generally deals with the regulation of peristalsis and secretions in gut. However, recent revelations on the occurrence of 'neuropod cells' comes as a fresh breath. It opens novel avenues for sensory transduction of the intestinal milieu and transfer of information to brain using fast acting neurotransmission via vagus. Interestingly, the neuropod cells not only distinguish the type of nutrients, but also

evaluate nutritional value of food in question. One of the exciting off shoots of the study posits a rather unusual concept. The observations that the stimulation of gut vagal neurons induce reward in mice calls for a renewed look at the reward system in the brain and open a whole new field in sensory neurobiology. Yet another rather ignored area in the brain is claustrum, probably because it is anatomically unapproachable. While identity of this subcortical structure and its connectivity with the cortex is described, its functional attributes remain obscure. Using electrophysiological tools, the authors evaluate the significance of tight connectivity of claustrum with the frontal and limbic areas and underscore its role in attention. The review entitled 'The anatomy and physiology of claustrum-cortex interactions' by Jackson *et al.* strikes as an indispensable source of information for those chasing this elusive part of brain. The volume bears one article on oligodendrocytes by Paez and Lyons. Traditionally, these cell types are known to generate myelin sheath, and facilitate rapid spread of action potential along an axon. However, the authors paint a different landscape where glia may dynamically regulate neuronal activity using Ca^{2+} as a key signalling agent.

Genetic blueprint has become a central motif and a widely used tool throughout the expanding field of autism. Durnell provides an update on how the breakthroughs in technologies like the whole-exome sequencing and whole-genome sequencing have helped in understanding autism. Some of the articles in the volume are a little too heavy on technical jargon, but this is a minor distraction. I am sure a wide spectrum of neuroscientists will find this volume engaging. In addition to the articles that appeal to your primary interest, other reviews may spur a wealth of novel ideas. It is worth a try.

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