Are there genetic differences that predispose individuals to certain kinds of behaviours? This explosive question can be studied well in eusocial insects such as honey bees and ants. Friedman and Gordon present a review on the genetics and behaviours of ants. An ant colony is a super organism. The colony consists of workers, which are sterile females, reproductive queens and males that are short-lived. By looking at genome sequences of each of these 'castes', one can determine genetic bases for certain kinds of behaviours such as nursing or foraging or for longevity and reproductive success. Whole genome sequences are available for seven ant species, in addition to transcriptomics data from different castes and developmental stages. Interestingly, the most interspecies differences in expression levels occurred for genes associated with chemosensation. Genes associated with the synthesis of cuticular hydrocarbons (CHCs) show an expansion in ant genomes. Within species, whole-body transcriptome comparisons revealed differences in genes associated with longevity between queens and the comparatively short-lived workers.

To study behaviour quantitatively, such as in the studies described above, advanced computational methods are required. To analyse behaviours, scientists most often rely on video recordings at suitable frame rates. Once videos are made, how does one extract the most useful features for an understanding of the behaviour? The review by Roian Egnor and Branson describes the latest tools and techniques available to researchers for automated and semi-automated behavioural analysis. The first task is to segment the animal from the background such that in every frame, each pixel is either labelled as being part of the animal or the background. This is readily achieved in high quality videos with proper lighting and when the camera is stable. A frame is captured prior to introduction of animals, which is then subtracted from every frame of the video to detect the animals. When multiple animals are present, it is also necessary to identify each animal such that they can be individually tracked. This can be done using the position and pose of each animal in one frame to estimate the direction of its motion in the next. After this is achieved, specific behaviours can be detected and quantified using rule-based approaches, supervised machine learning or unsupervised machine learning. While these approaches work well with behaviour recorded in the lab under controlled conditions, automated analysis of behaviour recorded in the wild still presents huge challenges because of variations in lighting, background texture and number of individuals. Increasing collaborations between biologists and computer scientists will pave the way for working out appropriate solutions to these problems.

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Chemistry: The Impure Science, 2nd Edition. Bernadette Bensaude-Vincent and Jonathan Simon. Imperial College Press, 57 Shelton Street, Covent Garden, London WC2H 9HE. 2012. 296 pages. Price: £79. ISBN 9781848168114.

Picture this: A far-off, bucolic land that you have heard of, but never stepped into. A land that on the one hand draws you to it because of its ideologies, and on the other, is overshadowed by the eminence of bigger, easily-accessible countries nearby. An almost Shangri-la in the sense that not everyone knows this country exists, and you have never heard of a Frommer's travel guide to reach and explore this place.

If academic disciplines were countries, Philosophy of Chemistry would be this remote, idyllic land.

Modern chemistry labs are not really the breeding grounds for philosophy of chemistry talk, but on the rare occasion when a philosophical or historical reference is made regarding an experiment, it is but natural that it should evoke a sense of wonder in the lab coat-latex gloves-safety goggles attired chemist who can tell barium from strontium, but in all probability would be hard-pressed to tell, say, how Kant's enlightenment philosophy helped shape the concept of element as it emerged.

The book under review shows by way of several examples that philosophy and chemistry have much to say to each other. The book is a delightful synthesis of thought beginning with chemistry as we know it – the good and the not-so-good, and traces a path back to the alchemical period. The second section of the book puts chemical philosophy on its forward journey with significant milestones along the path like atomism, elemental theory, the periodic table, chemical positivism, etc. In the last section, the reader finds looking at the path's map with a *You Are Here*, placed at 'nanosciences,' with pointers heralding the terrain's final destination – Chemistry for Future.

The authors begin by emphasizing the importance of chemistry in modern life and add that despite chemistry's ubiquity in our lives, it gets a bad press at times due to its deleterious effect on the environment. It is this downside of pollution that half persuades the authors to term chemistry an impure science. Conviction emerges from the secondary status of chemistry held to the helm of physics and mathematics, and by the rather hybrid nature of chemistry today, in being a mix of science and technology.

The negative image of chemistry, it turns out, the authors indicate is not something new, but has been around right from the days of alchemists toiling over their pots. The discipline's image was not helped either by early chemists who were intent on playing God. Literature too contributed to these Faustian ambitions of chemists. A case in point being the rather infamous Frankenstein's monster. Chemistry emerges from its shroud of negativity as the authors take us along on a philosophical journey of chemistry's history.

Chemistry, the authors point out, has been a cognitive toolkit of synthesis in that it has always created its object unlike other sciences. Citing Berthelot, it is pointed out that he thought of synthesis as a means to know the world and to delve deeper into nature.

The concept of matter is handled in much detail in the book, spanning the imaginary phlogiston, Kant's noumenal world, the concepts of element and atom, and finally leading to a discussion on whether chemistry is the heir to Aristotle's philosophy. This could well be one of the highlights of the book for those who have questioned 'How did Chemistry come to be?'

The dialogue on the elemental theory is moved forward with the introduction of Mendeleev's periodic table. An account of the epistemological status of chemistry by Fredrich Paneth here, makes an interesting read.

Introducing Auguste Comte's concept of positivism, the authors then go on to question whether chemistry's adherence to facts constitutes positivism. Invoking the example of salt, they indicate how seventeenth century philosophers ascribed a positivist status to chemistry due to salt's chemical to metaphysical to positive journey. In due course, with experimental proof that salt in fact was a product of a reaction between an acid and an alkali, Comte's positive ideal, the authors note, was seen to provide parallels to Lavoisier's concept of an element.

Students of chemistry know enthalpy from entropy, and it is definitely with a sense of awe that one then reads of how Ostwald reduced chemistry and physics to the principles of thermodynamics giving rise to energetism, which in turn served to establish the opposition between positivism and realism in science.

The last section of the book gives an introduction to nanotechnology and ends with a note on ethical and professional guidelines to be followed by chemists in order to do responsible science.

In all, the authors have done a commendable job in preparing a good introductory book for beginners in Philosophy of Chemistry. Beginners with either a chemistry or a philosophy background, will find in this book, their initial sense of wonder multiplied manifold. And if you went into the book thinking of that distant land you always wanted to visit, you will realize somewhere along the pages that this is indeed the guidebook to your Shangri-la that you hoped to find. Much like a good travel book, the authors succeed in invigorating the reader's mind and make one yearn for more of this land.

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Annual Review of Pathology: Mechanisms of Disease, 2016. Abul K. Abbas, Jon C. Aster and Stephen J. Galli (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 11. vi + 649 pages. Price: US$ 102. ISBN 978-0-8243-4311-8.

The 2016 edition of *Annual Review of Pathology* continues to maintain the high standard that the series has had over the years. This volume begins with a favourite section of mine, the autobiographical essay. This time it is by Michael B.A. Oldstone, one of the pioneers of the field of viral pathogenesis. His article tells us about his research on Lymphocytic choriomeningitis virus (LCMV) and how it has become a 'Rosetta stone for solving several important puzzles in biology' and has helped clarify many concepts in virology and immunology. It sparkles with wit. He tells us about his introduction to anatomy dissection where he has a 'nameless cadaver and four classmates with names...' and how he has been wedded to LCMV, but has had a number of intense affairs with measles and influenza viruses. That he has had 77 postdoctoral fellows from his lab in his career should give one an idea of his legacy. The essay illustrates that along with focus and hard work, serendipity is essential for success. How serendipity helped is seen when Oldstone tells us that he was initiated into the world of infectious diseases on the third day of medical school. One of his classmates was the son of a friend of the chair of medicine who was an expert in infectious diseases. Because this professor wanted to personally coach his friend's son, but did not want the act of favouritism to look so blatant, he invited a couple of other students along with his friends son – one of whom was Oldstone!

Besides this article, there are 22 more chapters, some of which I shall cover in this review. While most of the articles are on pathogenesis of diseases, one deals with technology. That essay is on organoids. While much research is done on transformed cell lines, we are aware of the deficiencies with them – cell lines are 2-dimensional, lack a matrix and often contain additional mutations, all of which make analysis and interpretation daunting and possibly biased. Organoids seem to address some of these issues. They are cultures of transformed and normal human tissues, which are three-dimensional and consist of cells within a scaffold or a matrix. These organoids recapitulate organ architecture, multi-lineage differentiation and stem cells. Because the cells in the organoids are of wild type, the effects of additional genetic insults can be interpreted with better clarity. Thus, organoids can be used to evaluate tumour-suppressor genes and oncogenes, identify novel cancer loci and study tumour evolution and heterogeneity. The most exciting and novel thing about organoids, however, is their potential to enter the field of personalized medicine. Organoids created from patient tumour samples can potentially be used to evaluate response to targeted chemotherapy; further, multiple combinations and drug dosages can be evaluated simultaneously. Attempts are currently being made to incorporate immune cells and endothelial cells in organoids, so as to recapitulate, as much as possible, the *in vivo* environment.

Chronic traumatic encephalopathy (CTE) was very much in the news in 2016. First, in March 2016, the National Football League in the USA accepted, at a congressional hearing that there was a direct link between football and CTE. Then, in June 2016, Muhammad Ali, the greatest heavyweight boxer of all time and one of the greatest sportsmen ever, died. As we all know, Ali did not 'float like a butterfly' for the past three decades, as a result of his Parkinson's disease, a disease likely to have been an occupational hazard. The earliest reports of repetitive trauma to the brain appeared in 1928 and was soon termed Dementia pugilistica, as the autopsied brains were those of boxers. We now know that other sports which lead to repeated brain injury – and surprisingly, even single episodes of moderate to severe brain trauma can lead to CTE. As one would expect, there are similarities and differences between brains subjected to single episodes of trauma and those subjected to repeated trauma. Deposits of hyperphosphorylated tau protein have been seen in the two brains of boxers which have been studied. These tau proteins are similar to those seen in brains of Alzheimer's disease. However, the tau protein is deposited in the superficial layers of the cortex in CTE, but in the deeper layers of the cerebral cortex in Alzheimer's disease. Diffuse axonal injury, as evidenced by