



Doves, Diplomats and Diabetes: A Darwinian Interpretation of Type 2 Diabetes and Related Disorders. Milind Watve. Springer Science + Business Media, New York. 2013. 392 pp. Price: US\$ 209.

Diabetes has fascinated clinicians and laymen alike for several decades and volumes have been written on almost every conceivable dimension of the disease. Invariably dysregulation of carbohydrate and lipid metabolism associated with insulin deficiency are advanced as the causal factors. In this book, Watve stands to confront the established thoughts, bit by bit, and attempts to make a case for his novel interpretation of what might cause diabetes. He questions the relevance of high blood glucose, insulin resistance and exhaustion of the beta cells as the central factors and embarks on his search in the most unlikely arena – the Darwinian principles of evolution. Admittedly, this is a tall order. But the frankness with which the author approaches the subject gives him a rare freedom to debate, contest and reanalyse the established views. Provocative at times, the ideas are penetrating as well as self-critical, and that is where the book finds its strength.

For very long, the peripheral factors have been blamed for type 2 diabetes (T2D). However, the last few years have witnessed a surge of interest in the hypothalamic circuitry which monitors energy balance and plays an important role in hunger, appetite and reward associated with food intake. Since these circuitries greatly overlap with the limbic system, the possibilities that emotional behaviour and stress may impact metabolic dysfunction have been surfacing. In a sense, this book may be viewed as an attempt at taking the concept a step further. It tries to explore the possibility that the meta-

bolic dysfunction could have its roots in the evolution of brain and behaviour.

Diabetes has been considered as a disease, inheritance, maladjustment, or just toxic side effects of modern lifestyle. The author considers these as the proximate factors and urges the reader to focus on likely ultimate factors. In chapter 3, the dogma that diet rich either in carbohydrate, fat or protein invokes insulin resistance has been questioned. Obesity is generally defined as a consequence of positive energy balance, or attributed to the net energy intake being greater than the net energy expenditure. Watve brings in focus a range of experimental studies on rodents which prove to the contrary. Even in humans, if obesity and insulin resistance are causal to T2D, then weight loss, so often encountered in diabetics, should have cured the disorder. While the logic is impeccable, one uncomfortable thought persists. How does one rule out the possibility that excessive consumption of food may be triggered by hedonic appetite, which in turn may cascade into obesity and T2D. A phenomenon that could have emerged after humans took to agriculture. And again this may be specific to humans, for we still do not have a reliable rodent model to test hedonic food intake. Further, the author points at the futility of glycaemic control, a standard clinical practice to address T2D. Or the need to take higher doses of antidiabetic drugs to control blood sugar as the diabetes matures. Both the arguments effectively define the lacunae in the contemporary literature on diabetes.

In chapter 5, Watve has created an interesting model based on the evolution of hawk or dove-like traits and considered its implications. Animals have central mechanisms of judging their size and strength vis-à-vis the opponent and these judgements will influence their decision to adopt hawk or dove-like behavioural choices. These traits are important since they directly impact the individual's capability to compete for food or mate. While relatively stronger individuals will have hawk interactions more frequently than weaker individuals, consistent difference in these frequencies will help shape their physiology as well as personality. It is quite likely that the dominant individual will show high testosterone, insulin sensitivity and low cholesterol. By the same logic, should the subordinate show insulin resistance and metabolic health problems? The author goes

on to argue how the adaptive metabolic syndrome might actually be supportive of the weak. The insulin resistance need not be considered as a negative development, rather as a trait that helps the subordinate animal to successfully manage his energy budget and thrive in spite of its subordinate status. The argument has been elegantly supported by the studies on MIRKO mice. In these muscle-specific insulin receptor knockout mice, the post-meal glucose uptake by muscles is reduced; instead the glucose is taken to adipocytes which are insulin-sensitive. Even in the case of primates, it is possible that insulin resistance, in a proportion of individuals, may turn into an inherent part of the complex social life and may not have a pathological origin at all. The possibility that different forms of glucose transporters might have evolved to tightly regulate energy budgeting in the body is a fascinating thought. The main glucose transporter in muscle and viscera is glut-4, which is necessary for normal insulin function, while brain has glut-1 which is completely insulin-independent. The concept also resonates with a recent view that glut malfunction in the brain may cause T2D. Indeed for unicellular organisms, no insulin-like molecule is needed for glucose uptake. The author has been able to construct a logical chain of thought underlying how hawk-like or dove-like traits might evolve – what selective advantage each might confer – how both the traits might co-exist in the same individual – how these changes might translate into the interplay of mutually impacting behaviour and metabolism, and finally how this may lead to the evolution of insulin sensitivity or resistance. Although a bit convoluted, the chain of arguments persuades the reader to evaluate the possibility that that insulin resistance could indeed be a natural response evolved to meet dove-like status. Closer to humans, the author has developed the soldier versus diplomat paradigm. In an individual, the deficiency of soldier traits, and over-indulgence in diplomat behaviour, may trigger neuroendocrine and metabolic changes leading to increased susceptibility to diet-induced metabolic syndrome. While the thought per se has certain merit, the author fails to convince how these traits might actually translate into diabetic-like conditions.

The need to look for alternatives in our fight against diabetes cannot be overemphasized. Perhaps we may search for the

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causal link between seemingly disparate parameters like population density, aggression, reproductive strategies, lipid metabolism, insulin signalling and longevity. The suggestion that the phenomena of stress may be reevaluated on Darwinian principles is worth pursuing. In the chapter on 'Time to give up stress', the author classifies different forms of stress and points towards an interesting observation that low incidences of diabetes were recorded during the war time. The prescription that one may resort to additional soldier-style stress, in our otherwise diplomat way of life, seems quite relevant.

On occasions, the narrative strays from the main course and gets mired in the web of preparative arguments. The chapter 'Hawks and doves' ponders on an interesting evolutionary question as to why they may resort to differing energy budgeting strategies. However, the transition of the argument as to how these may influence metabolism is rather tenuous. Similarly, in chapter 12, the reader finds himself in a maze of arguments justifying the needs to have glucose-sensing systems, in the brain as well as the periphery, and the relative speed with which each might swing following glucose dysregulation. Why can we not resort to simpler logic? Since glucose is an extremely important source of energy, the regulatory systems have evolved glucose-sensing mechanisms in a number of places in the brain as well as the periphery. And these systems, redundant as they seem, may interact at several levels and manage glucose homeostasis. This should be straightforward and convincing enough. A lot of conclusions are based on presumptions, not adequately validated in the literature. Similarly, in the chapter on 'Why blood sugar goes up', the author argues that the mechanisms must have evolved not to protect the brain from a drop in plasma glucose, but to ensure adequate glucose supply under conditions of increased brain demand. The frame of this logic is rather unsettling.

This book is a great source of information. Particularly to those interested in the literature on diet and insulin resistance. The information collated in Appendix I through IV will be much useful in deciphering diabetes-related jargon. Watve has shed a part of his responsibility by admitting 'ignorance' of the subject. This gives him the rare freedom of uninhibited imagination. But this strat-

egy has a negative side, it reduces the impact of the message, and how far the author has achieved his goal depends much on the reader. In spite of these limitations, Watve has been greatly successful in his mission – pursuit of truth in uncharted waters.

N. K. SUBHEDAR

*Indian Institute of Science Education and Research,
Pashan,
Pune 411 021, India
e-mail: subhedar@iiserpune.ac.in*

Annual Review of Plant Biology, 2012. Sabeeha S. Merchant, Winslow R. Briggs and Donald Ort (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 63, x + 726 pp. Price: US\$ 89.

There is a significant change in the character of plant science from observational science of morphology, anatomy, cell biology (light microscopic cellular structure), classical physiology and Mendelian genetics to presently molecular genetics, proteomics, genomics, gene analysis and gene engineering. In addition, new emerging techniques have revolutionized plant science research with unprecedented expansion of knowledge with the development of incredible conceptual framework and excellent models that have improved our understanding of complex plant systems. The reviews in the current volume of the *Annual Review of Plant Biology* distinctly reflect the significant changes and advances made in plant science in recent years. Not surprisingly, most of the articles in this volume focus on the recent works with *Arabidopsis thaliana* as a model plant system, of course, with citation of the literature relating to other plant systems to understand the basics of plant structure, function and behaviour in general. In addition, most of the articles provide coloured illustrations, tables and concluding remarks that make the reviews impressive and more informative.

This volume contains 27 articles, which could be grouped under the following themes: plant evolution, transport mechanisms, regulation, signalling systems, plant development, metabolism, techniques and environmental biology. The titles of most of the articles are catchy and fascinating that immediately draw

attention of researchers and students of plant biology. The reviews not only provide current updates in different areas, but also provide critical discussion in the areas of controversies and future challenges in plant science.

The first article by Joseph A. Berry (Carnegie Institution for Science, Stanford, California) is an excellent review on the use of equations and models that can lead to the development of our understanding of science on a global scale. Berry, an outstanding plant biologist, provides a critical analysis of historical development of knowledge in the area of C₄ photosynthesis and suggests how equations and models can provide means to organize principles to link the basic plant physiology to atmospheric science, hydrology, ocean sciences and climate change on Earth. It is a wonderful review that covers the journey of his scientific career from chemistry to photosynthesis (plant biochemistry) and finally to science of Earth system. The author has beautifully narrated his experience and interaction with top plant biologists working in the area of C₄ photosynthesis and photorespiration. He opines how sharing of information and input of ideas and their analysis help in the performance of experiments to develop models in interdisciplinary research.

Currently, evolutionary biology is emerging as a major discipline of plant science with new ideas and concepts.

The origin and evolution of C₄ pathway through several characteristic transients is the focus of the review by Sage and colleagues. The article critically describes the initiation and evolutionary modifications that finally have resulted in the establishment of C₄ metabolic cycle. The authors have proposed conceptual models of major phases of C₄ evolution, which provide a base to explain phylogenetic relationships. The next article by Losi and Gartner tells the story of photoreceptor flavoproteins, specifically their structure, functional significance and evolution. It briefly describes new ideas that are emerging on evolution of flavoproteins with genomics, metagenomics and phylogenetic relationship.

On the other hand, Young and Bharti provide a beautiful comparison of known legume genomes, their analysis and implication in shaping the development of legume-specific characteristics during evolution. The article concludes with a critical discussion on the impact of genome