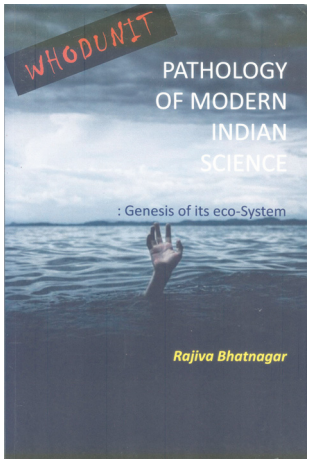

Pathology of Modern Indian Science: Genesis of its Eco-System. Rajiva Bhatnagar. 2019. 313 pages. Price: Rs 1166.

The author of this book, Rajiva Bhatnagar, was part of the Atomic Energy establishment of India before his retirement. In the Introduction, he tries to set his agenda as follows: What are the factors responsible for such an unsatisfactory state of Indian Science? Why do we fare so low in any index that reflects the achievements of science in the world? The author admits his limitations: 'The subject of the growth and decline of science in India is so wide and multidimensional that it will not be possible to cover all aspects in a single book.'

In chapter 1, the author gives a brief introduction about the pre-independence science. Modern science came to India with the Europeans in 1542, when St Paul's College and the first printing press was founded by Portuguese Jesuit Francis Xavier in Goa. After 1857, India came under the British Crown and some institutions were organized for the geological, geographical, botanical and zoological surveys. S. Chandrasekhar presents a very glamorous picture of pre-independence science: 'Ramanujan became famous in four years. Saha's second paper produced the ionization theory attached to his name, Satyendra Nath Bose became associated with Einstein in the second or third paper he ever wrote. And Raman made a discovery and got a Nobel Prize.'

Chapter 2 discusses the spread of western science in India. The British rulers did not take adequate measures to help Indians develop science and technology and instead focused more on arts and humanities. The first science subject to be introduced in Hindoo College, Calcutta in 1872 was Chemistry. The University of Bombay offered a BSc degree in sciences followed by Calcutta in 1907. In 1947, 21 universities and 496 colleges were in operation. However, modern science and industry did not fall within the priorities of the British Indian Government.

Chapter 3 discusses briefly the formation of Science Societies in India on the pattern of their counterparts in UK. The Indian Science Congress formed in 1914 had objectives similar to that of the British Association for the Advancement of Science. During 1930–35, India had three Science Academies and regionalism thus became a dominant factor and it took a toll on the collective conscience of the scientific workers.

In Chapter 4, the author reveals another trait of Indian Science: 'In India, the complex social, cultural, regional and family background of an individual has profound bearing on one's development, roots of conflicts and interpersonal relationships. The four protagonists who influenced post-independence Indian science to a large extent, Bhatnagar, Saha, Raman and Bhabha, had very diverse social, economic, regional, and political background.' Interpersonal relations of these individuals with the political leaders also had a bearing on the development of science. Regionalism has an ugly face that runs as undercurrent in Indian society along with several other divisive attitudes.

Saha–Raman controversy is well documented in this volume: 'Saha's antipathy towards Raman dates back to the time he was denied a position after Raman left Calcutta. The animosity became so strong that at the time when Saha was seeking funds from Rockefeller Trust for buying a spectrograph for experimentally verifying his theory, Raman could not rise above his negative feelings towards Saha and gave adverse opinion, saying that he is not an experimentalist and a good organizer.'

In Chapter 5, the author brings out vividly the controversy regarding the sharing of the Nobel Prize by C. V. Raman with K. S. Krishnan. It has been said that Krishnan's contribution to the discovery was no less than that of Raman and yet Krishnan did not get his dues. Raman was extremely possessive of the discovery and was wary of sharing the credit with anybody else. Krishnan as a true disciple never said a word about the controversy. He walked out of Raman's shadows and charted an independent course and established himself in a different field. Raman may be a great scientist but failed as a human being and could not rise above self-interest in promoting himself as the sole discoverer. What impact Raman–Krishnan controversy had on the growth of Indian science and on the morale of future generation of scientists?

Part II of this volume discusses 'Post-independence eco-system' and comprises three Chapters. Chapter 6 is devoted to 'Centralisation of science and rise of Sir S. S. Bhatnagar' and chapter 7 is focused on 'H. J. Bhabha: The Indian prometheus'. In fact, both these chapters are the core of this volume. The author tries his level best to bring out the discrepancies of Indian science by narrating case histories of scientists who suffered under the post-independence eco-system. He writes: In 1942, BSIR (Board of Scientific and Industrial Research) was rechristened as CSIR. Bhatnagar was the architect of the centralization of scientific research as the first Director of CSIR. He went on to establish a group of five laboratories aimed at industrial research in various areas in a short time. The centralization and growth of scientific institutions, in post-independence India, is synonymous with the growth in power and prestige of S. S. Bhatnagar and H. J. Bhabha, who set the agenda for post-independence scientific research.

The author points out the influence of P. M. S. Blackett (British Physicist) on decision making bodies of Indian science as he was close to the first Indian Prime Minister, J. L. Nehru. As a consequence, he served as a conduit for Indian scientists to get favours from the establishment. Blackett worked as adviser to the Prime Minister without holding any position in the government. Saha was opposed to the interference of the European scientists in the internal affairs arguing that no independent country does this. The author is highly critical of S. S. Bhatnagar's sycophancy: 'S. S. Bhatnagar's approach in dealing with the hierarchy of the government was typically a leftover of the Raj. His efforts at cultivating relationships were typical and go well beyond the professional conduct. Making high level contacts continued to remain important, after independence, as a legacy of the Raj and continued to influence development of Indian science.'

In chapter 7, the author sums up the rise of Homi Jehangir Bhabha on the horizons of Indian Science as follows: 'Study of the process of establishing the institute (TIFR) and along with it the rise of Bhabha on the Indian scientific horizon sheds some interesting light on how an intelligent and ambitious individual with appropriate connections could manoeuvre and outsmart contemporary scientists in achieving position of power and fame.' I consider this chapter as the best investigated on Bhabha and his mission in India. Rajiva writes about the intentions of Bhabha to stay in India after his failure to return to Cambridge after the Second World War: 'But in last two years I have come more and more to the view that provided proper appreciation and financial support are forthcoming it is one's duty to stay in one's own country and build up schools comparable with those that other countries are fortunate in possessing.'

On 12 March 1944, Bhabha wrote that famous letter to Sir Sorab D. Saklatvala of Tata Trust that became the seed of an institute, the Tata Institute of Fundamental Research: '…..There is at the moment in India no big school of research in the fundamental problems of physics, both theoretical and experimental. There are however scattered all over India competent workers who are not doing as good work as they would do if brought together in one place under proper direction. It is absolutely in the interest of India to have vigorous school of research in fundamental physics, for such a school forms the spearhead of research not only in less advanced branches of physics but also in problems of immediate practical application in industry. If much of the applied research done in India today is disappointing or of very inferior quality, it is entirely due to the absence of a sufficient number of outstanding pure research workers who would set the standard of good research……'

The author is highly critical of Bhabha's reluctance to accept the work of other Indian scientists. He reminds Bhabha about contribution of other Indians, e.g. Saha ionization, Bose–Einstein condensation, mm wave generation of J. C. Bose, Raman Effect and Mahalanobis distance. Raman's work had won him the Noble prize. Why did Bhabha downplay these achievements of fellow compatriots? In the same vein, he is not in a mood to give credit to the Tatas for setting up TIFR: 'Thus, the proposal of a new institute for fundamental research was more for rehabilitating Bhabha. It was not an act of purely supporting Indian science but was also of very personal gain. It is surprising that Pt. Nehru could not see through the game. Instead he was sufficiently enamoured by the charm of Bhabha to give him unparalleled power and freedom to usurp the scientific agenda of the country.'

In section 7.3, the author blames Bhabha squarely for the exit of prominent scientists like Piara Singh Gill, D. D. Kosambi, K. S. Chandrasekharan and E. C. G. Sudarshan from TIFR. The manner in which these eminent scientists were treated points to the direction in which the value system that was developing. It is seen from the events related to the administration of TIFR that the scientists at the premier research institution were made subservient and answerable to the dominant non-scientific members from the Tata trust on the institute council.

The author also blames the political leadership of the country for giving unlimited powers to Bhabha: 'It is clear that the political leadership of that time, particularly Pt. Nehru, placed too much faith in an individual who worked for his own benefit and whose control on funds for nuclear research resulted in marginalisation and weakening of nuclear physics research in teaching institutions.'

In Section 7.4 'Marginalisation of Indian universities', I agree with the author that the process has started even before independence by S. S. Bhatnagar who was ruling the roost to develop Science laboratories as Director CSIR: 'In the period between 1946 and 1948, Bhatnagar played an important role in ensuring that one laboratory emerged as the central laboratory of nuclear research, within the reigning CSIR logic of developing one good laboratory dedicated to one purpose – in fact the logic of the state of concentration and nominateon.' Indian universities were left in the lurch due to loss of funds and faculty moving to CSIR laboratories.

Chapter 8 'Other debilitating factors' recounts the following four factors: (i) The relationship between the political class and the scientist; (ii) Appointment of eminent scientists to head the new institutions, often a case of square peg in a round hole, without caring for their suitability and qualifications for the post; (iii) The cavalier manner in which the first national awards were bestowed, on some favoured government scientists ignoring other deserving scientists; (iv) The tendency of power wielding administrators to favour individuals who can be termed as the 'blue eyed boys' the practice of which spoils the working atmosphere.

In section 8.3, the author is critical of selection process for national awards and political bosses who recommended: 'The political class, particularly Pt. Nehru, with his western education and commitment to the democratic principles miserably failed in setting up a healthy tradition, namely that of judging scientists by their contributions to science alone and not by any other extraneous factors like political belief, personal likes, dislikes and disagreements, etc.' When all topmost scientists of India were given national awards on 15 August 1954, M. N. Saha was ignored by the establishment as he was critical of Nehru and his policies.

Chapter 9 of part III represents an elaborate study by the author delineating the causes of historical development of science in divergent cultures. I consider it a useful study to evaluate the deterioration of scientific ethos in the Indian society. The author highlights the reasons for growth of Science in Western societies: 'It can thus be summarised that relegation of religion to background, democratic form of government, low level of corruption and high index for freedom of expression are facilitating factors that have helped western countries to make advances in science. Rise of western science was driven by pursuit of wealth which was declared as a form of worship.' On the contrary, India lagged behind in developing modern science due to its religious ethos: 'Science and religion co-exist in the Indian society with religion having a higher status. Renouncing wealth and worldly comforts have always been regarded as supreme sacrifice and the ascetics are treated by the society with extreme reverence.'

Chapter 10 'Where do we stand' tries to sum up the state of affairs for poor quality of Indian science as follows: (i) The questions that now face us are, where do we stand? Is there a way out?; (ii) Did the Prime Minister of the time pick up right persons for the job? Did he have enough foresight of the manner in which science was to progress? Which model for scientific growth was the

country to follow?; (iii) The scientist has to work in an ecosystem which is full of committees. It has a labyrinth of committees, procedures and rules through which a working scientist has to meander his proposals for procurement of equipment and consumables before he can settle down to do some worthwhile research; (iv) Who needs scientific temper? When governments of the day are promoting sadhus, mendicants, pujaris and jyotishies with all the perks and privileges in the country; (v) In early twentieth century two linear models of the innovation process namely, science-push model and demand-push model, were in vogue. On what model, in India, the centralized research institutes were established?; (vi) Research in basic science at the universities, that could have been the harbinger of innovative technology, was missing; (vii) The dismal education system and lack of opportunities within the country lead to migration of talented Indian students for study and research in basic sciences in the western universities.

In chapter 11 (Is there a way?), the author gives some suggestions to improve the situation: (i) Since the universities form the backbone of western science and technology it is important to reinvigorate the universities. The universities should be made autonomous with no government control and political interference in all matters including academic appointments, curriculum and research. (ii) The scientist opting to remain active in research should be given all the financial and procurement powers which he can exercise independently of the administrator. The allocation of funds also should be suitably done amongst the scientists at various levels. The work of scientists should be evaluated by the citation index of their work or projects successively.

The author has left no stone unturned to dig up archives to prepare this comprehensive volume. I praise the daredevil feat of Rajiva Bhatnagar in calling a spade a spade to bring out the truth about the ethos of modern Indian science and its eco-system.

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Annual Review of Neuroscience, 2019. Botond Roska and Huda Y. Zoghbi (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 42. xii + 509 pages. Price: US$ 116.

Annual reviews are a source of in-depth reviews of most recent and exciting developments on specific topics for both interested academics and researchers. These reviews not only serve as a source of most relevant references but also enable readers to read a comprehensive and critical view of a specific topic and what is likely to be future research challenges in a particular field. Like any other field, if not more, the interest in neuroscience research has been growing at a fast pace both in basic and application areas. Researchers are consistently engaged in uncovering new cellular and molecular functional components of our mighty brains, whereas at the same time, there have been significant advances in the understanding of how brain shapes, orders and organizes its functions and downstream physiology and behaviour, and how brain and associated structures are closely linked with illness and general health. Growing evidence suggests that neuroscience research is far more important than has hitherto been appreciated, at least until recently in India. To a beginner in the field, two important cell types that make our brain and enable it to execute its over-arching control over body are the neurons and glia (astrocytes). For a long time, the neuroscience research focus has exclusively been on the neurons, perhaps because one could relatively easily measure the activity of neurons in the form of an action potential; glia has been considered as the supporting cells. Recent extensive researches have realized the importance of glia functions, and glia research has come into great prominence at the current time. In a significant *Cell Reports* paper in January 2017, based on gene expression studies, Soreq *et al*. claimed that the presence and function of glia, not the neuron number, differentiates between a young brain and old brain; this perhaps makes glia an exciting candidate for 'aging' research. Subsequent researches further implicated that stressful events could alter the epigenetic code of certain glial cell progenitors, and this might account for an increased susceptibility to chronic illnesses, most importantly the psychiatric disorders. Evidence suggests that glial dysfunction was a more likely cause of stress-related mental disorders. In this volume, three articles in different ways have addressed on the astrocytes diversity and neuronal–glia functional relationships. The overall take-away from researches that has been reviewed in this volume is that astrocytes influence almost much of the brain circuits; therefore, the functional relationship between neuron and glia could be perhaps future neuroscience research frontier because of its direct implication to health and diseases.

The nervous system integrates directly and indirectly with most, if not all, regulatory mechanisms underlying the body function in eukaryotes. Although this is reflected in several articles in this volume, the starting article treats this in a unique way. Romanov *et al*. presents a perspective of how the hypothalamus through its extensive synaptic connectivity with other tissues enables an efficient coding of the endocrine responses. The authors have reviewed different cell types based on molecular fingerprints matched with anatomical and biochemical principles. Importantly, the authors have attempted to present a novel classification that reinforces neuronal heterogeneity and neurotransmitter–neuropeptide relationships in the hypothalamus. I believe the proposed classification is timely, as it will help to understand the functional convergence of candidate molecules in the regulation of behaviour and physiology. Perhaps, such a taxonomic relationship would lead to the emergence of a better map of the neuronal circuits underlying the regulation of different behavioural and physiological processes. However, it remains to be seen whether the relationship as suggested in the review will stand with seasonal changes in the behaviour and physiology.

A unique example of brain-mediated important daily routines is sleep. Sleep is as crucial to us as eating and drinking. This is because sleep affects almost every tissue and system in our body including the brain, heart, and lungs to metabolism, immunity, mood, and disease resistance. Sleep is an outcome of several brain regions including the hypothalamus (suprachiasmatic nucleus – SCN, which provides timing of sleep during the day), thalamus (which relays sensory information), basal forebrain, midbrain,