Thinking about Physics. Roger G. Newton. Princeton University Press, 41 William Street, Princeton, NJ08540, USA. 2002. 191 pp. Price: $ 29.95.

Are physicists (or for that matter scientists) spending enough time *thinking* about physics (science)? Roger Newton in his thought-provoking book entitled *Thinking About Physics* has forcefully argued that the answer to the question is unfortunately NO. He believes that if only physicists (scientists) start doing that, they will be better skilled in doing science.

This is an unusual book. It is primarily addressed to readers with good undergraduate education in physics though some parts of the book can also be appreciated by scientists other than physicists. Newton has raised several fundamental issues and has very strong views on many of these issues.

Is physics really an experimental science? And if yes, then exactly in what way? Newton thinks that while experimental facts are of central importance in physics, but only in the context of a theory – the theory leads us to understand the facts, and the facts, in turn, undergrid the theory. Undoubtedly, greatest discoveries are those of interesting new facts as yet unexplained. For example, in High Energy Physics, the last such discovery was made in 1974 when J/ψ particle was discovered. All other discoveries have merely tested theoretical ideas already extensively discussed in the literature. Of course testing theoretical ideas is an important part of experimental science. However, it appears to me that the experimentalists are getting too biased by theories going round and there is a real danger that the way the experiments are being planned, one might miss surprises because of this strong bias of experimentalists.

There is an extreme view which is being held by some theorists, specially those working in string theory. They believe that experiments are no more necessary and the beauty and consistency of the theoretical structure can itself give us the final theory. I completely disagree with this viewpoint. Physics or for that matter science is a very conservative exercise and verification of our ideas by experiments forms a very important part of this exercise. Unless there is strong experimental verification, the theoretical ideas cannot become part of science, but must remain as possible ideas.

The other issue which Newton addresses is about the role of computers in building physical theories? Is there no use of theories any longer? After the computers have come in a big way in science, some scientists seem to think that we do not need theory any longer. I agree with Newton that computers will never replace grand theories like quantum mechanics or relativity. However, there is no doubt that computers can and do act as stimulants, leading to new discoveries. The best example of this type is the discovery of solitons. While the initial computer results indicated the unusual behaviour during the soliton–soliton scattering, only the mathematical analysis was able to uncover this beautiful concept. In fact around 1980, several physicists including Stephen Hawking had expressed the belief that Theoretical Physics will come to an end in about twenty years and the remaining job can all be done by computers! How wrong was Hawking! I have no doubt that even after hundred years Theoretical Physics will still be alive and kicking.

The other issue which Newton addresses is about the role of Mathematics in Physics. There is no doubt that modern physics is unthinkable without very many ideas in mathematics. This has been well expressed by the famous quotation of Wigner: *the unreasonable effectiveness of Mathematics in the Natural Sciences*. Why is that many of the ideas in mathematics find application in science? Is it because mathematics is also a creation of human mind?

Newton has also discussed at length the distinction between classical and quantum mechanics. He feels that unlike classical physics, quantum mechanics has abandoned strict causality. He has discussed two key concepts which make quantum mechanics so different from classical physics. One is the role played by probabilities in quantum mechanics, but as he has rightly pointed out, this is not confined to quantum mechanics alone, but even many-particle systems or classical dynamical systems, most of which behave chaotically, require probabilistic methods for their interpretation. The other concept, which according to him has led to the greatest unease among physicists is the concept of *entanglement*. This has no analogue in other probabilistic particle theories. As John Bell has shown, there can be no local probabilistic theory that would always give the same result as quantum mechanics. The point is, quantum entanglement is a matter of *phases* of wave functions and rests on wave–particle duality. It leads to mutual dependencies of particles at large distances from one another which is sometimes interpreted as a non-local character of quantum mechanics. But the point is, since quantum mechanics attaches a wave aspect to all entities called particles, the term non-local, which for particles has derogatory connotations – such as *spoonky* – is not quite apposite. After all, waves by their very nature are non-local, and we have no trouble understanding long-range phase correlations among them. It is only in the particle language that our intuition baulks.

Newton has also discussed several other issues. For example, what is the fundamental entity in quantum field theory, a field or a particle? Can one extend Heisenberg's uncertainty principle to other areas of science? What is the role of symmetries in physics? What exactly do we mean by causality? But he is honest in warning people not to accept what he says without questioning. Without any hesitation, I would recommend this book to every serious researcher in physics.

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Biology of Dermatophytes and other Keratinophilic Fungi. Rajendra S. Kushwaha and J. Guarro (eds). Revista Iberoamericana de Micologia, Apartado 699, E-480980, Bilabao, Pais Vasco, Spain. 2000. 174 pp. Price not mentioned.

Dermatophytes are a unique group of fungi whose discovery as a separate entity dates back to the middle of the last century, wherein a simple technique such as enrichment using hair resulted in the recovery of unique forms from the soil.

Such keratin-degrading fungi, the keratinophiles, can be both saprophytic and pathogenic; the latter causing various kinds of skin diseases and are therefore aptly termed 'dermatophytes'.

The present monographic treatment of the group by Kushwaha and Guarro places these fungi in the right context, wherein 21 chapters discuss their environmental distribution, biological activity, taxonomy, disease potential and biotechnological relevance. As a specialized group, these fungi are generally imperfects and members of Ascomycetes. The most appropriate site for recovery is the soil, feathers of birds and other keratin-containing tissues of various animals. They have also been recovered from animal waste of polluted soil-sites where, over the years, there has been enrichment of such slow-growing fungal forms. Since the molecular structure of keratin varies amongst various species of animals, different keratinases are required for degradation, and therefore, certain amount of so-called host specificity is seen in their distribution and isolation. Within the dermatophytes, three genera are recognized as human pathogens, viz. *Epidermophyton*, *Microsporum* and *Trichophyton* (Oyeka, C. A.). There is a great deal of strainal variability which makes taxonomic identity a highly specialized job. On the other hand, the genus *Chrysosporium* has been recovered from various habitats globally on account of its high keratin-degrading ability and therefore, the potential to be used in biotechnological intervention relevant to the disposal of keratin-containing wastes, including those produced in hospitals. On the taxonomic front, phylogenetic relationships within the 57 species of this genus have been studied based on the nucleotide sequences of the 5.85 rRNA gene and their flanking ITS1 and ITS2 regions.

Based on neighbour-joining and parsimony analyses, this genus could be divided into nine highly-supported, monophyletic groups (Vidal *et al.*). Based on molecular analysis, the authors suggest that several pairs of species are, in fact, synonymous, i.e. *Chrysosporium articulatum* and *Aphanascus reticulosporus; Chrysosporoum keratinophilum* and *Aphanoascus keratinophilus*, etc.

According to Summer Bell (p. 30), the phenotype of dermatophytes has been radically influenced by two very different evolutionary paths for mostly sexual and asexual, non-soil-associated species. Some of these forms are characterized by unique secondary metabolites which are often observed as coloured compounds in culture. The presence of xanthomegnin, for example, reflects upon the deterence of bacterial competitors in skin and nails.

Ali-Shtayeh and Jamous (An. Najah National University, Palestinian Authority) have suggested a distinct role for raw city seepage-based irrigation in the recovery of high population densities of keratinophilic fungal communities. According to these authors, however, basic similarities exist in the biodiversity spectrum in polluted and non-polluted habitats, with the most frequent forms being *Alternaria alternata*, *Aspergillus candidus*, *Geotrichum candidum* and *Paecilomyces lilacinus*.

Keratinophilic fungi are unique among the fungal world since they can use proteins as a sole source of carbon and nitrogen (Kunert, J.). Whereas proteinaceous substrates contain up to 16% N, mycelia of dermatophytes usually have only 5 to 6%. Keratinophilic fungal forms remove excess nitrogen through intensive deamination and ammonia production, resulting in alkaline conditions which are prevalent during keratinolysis. Metabolism of sulphur is another of their key properties, since keratin is a sulphur-rich substrate. However, in addition to effective release of keratinases, this group of fungi also secretes proteases, lipases, esterases, phosphatase and other enzymes. The two main modes of attack on keratin include surface erosin and radial penetration.

It is interesting to highlight that many 'keratinolytic' saproptrophs have been recovered from human and animal skin, fur and feathers. However, it has been difficult to show their transient or occasional nature and their involvement in appearance of lesions. This has led to differentiation between 'keratinophilic', i.e. mostly occurring on keratinosic substrates, and 'keratinolytic', viz. keratin-decomposing forms. It is based on this differentiation that their distribution on homoiotherm (endotherm) vertebrates, domestic animals, captive wild-animals and those living in zoological gardens and other forms, has been studied. In fact, several species of *Microsporum* and *Trichophyton* are the main ethiological agents of dermatophytosis in cats and dogs (*M. canis*), horses (*T. equinum*), cattle, goats and sheep (*T. verrucosum*), rabbits (*T. mentagrophytes*), pigs (*M. nanum*) and poultry (*M. gallinae*). Gugnani has discussed the nondermatophytic, filamentous, keratinophilic fungi that comprise hyphomycetous and other taxonomic groups causing skin, nail and other infections in human beings. Based on their ability to colonize and invade the keratin of skin, nail and hair, Richardson and Edward have described experimental model systems that mimic these habitats and can help find better drugs for treatment of dermatomycoses. The epidemiological aspects of such infections are discussed in detail to highlight nonavailability of appropriate information, based on which proper management strategies could be evolved. For example, Torres-Rodriguez and Lopez-Jodra cite that HIV-positive children are prone to nail infection by *Candida* sp., *Trichophyton rubrum* and other aetilogical agents.

Considering the fact that both man and animal are prone to dermatomycoses of hair, nail and skin, topical and systemic antifungal therapy is used in the treatment of such infections. Three chapters discuss this issue in detail, including one by a group from Spain led by Palacio *et al.*, who discuss various components of treatment schedules.

This monographic treatment of the unique dermatophytic and keratinophilic fungi is not only the most comprehensive document written by the experts spread globally, but is profusely illustrated with high-class coloured plates and an extensive bibliography. The large format of the book contains much more than the 174 pages appear to convey.

This book will be useful for teachers and practising clinicians, as also for researchers working on this interesting fungal group.

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