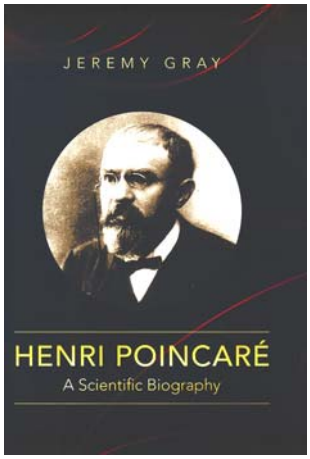

Henri Poincaré: A Scientific Biography. Jeremy Gray. Princeton University Press, 41, William Street, Princeton, New Jersey 08540, USA. 2013. ix + 325 pp. Price not mentioned.

The book under review is a commendable biography of an outstanding mathematician, physicist and philosopher of all time. It is indeed a difficult task to cover such a vast canvas in a single book and the author, Jeremy Gray has managed to do so remarkably well.

The book consists of 12 chapters (the 12th chapter containing the appendices) unfolding many petals of Poincaré's life. There is a well researched and detailed portrayal of his life starting from childhood and his subsequent journey towards becoming an established academic. Poincaré's family had travelled far and wide. This enabled him to learn several languages – Latin, Greek, German and English. Gray traces Poincaré's mathematical genius to his maternal grandmother who 'was thought to have a real but underdeveloped gift of mathematics'. His school teacher's statement that Poincaré would one day be a great mathematician indeed proved to be true. The book brings out multiple facets of his work ranging over the theory of functions, mathematical physics, topology, non-Euclidean geometry, investigations in celestial mechanics, chaotic motion and dynamical systems and philosophy of science. He was also an outstanding essayist. The topics of his essays included the three-body problem, projective geometry, physics at the popular level, the future of mathematics and so on. Poincaré was as creative as a mathematician as he was a physicist. He is considered to be one of the most influential scientific thinkers. His name is associated with a large number of ideas in mathematics and physics – Poincaré conjecture, Poincaré–Hopf theorem, Poincaré duality, Poincaré metric and Poincaré recurrence theorem, to name a few. Surprisingly, this book does not mention the Poincaré sphere, a beautiful construction, which geometrically represents the states of polarization of light.

Poincaré did not have an uniformly brilliant career so far as performance in examinations was concerned. For instance, when Poincaré sat for the baccalauréat és sciences, he scored zero in one of his papers. He had arrived late and misheard the questions and was unable to answer them. Gray points out that what was remarkable about Poincaré's mind was his ability to see the form of the answer to a problem prior to solving it explicitly. This, as Gray notes, is the mark of a mathematician. There were early signs of this trait dating back to his college days. His style was to focus on the broad lines and often leaving the detailed elaboration to others. Gray mentions Poincaré's boredom with precise design drawings and his focus on determining the relevant equations.

Gray, a professor of history of mathematics, shows remarkable command over the technical details of the various disciplines that Poincaré had worked on and at the same time presents it in a manner accessible to a broad audience. The language is lucid and easy flowing. The portrayal of Poincaré has been done with great sensitivity. The book begins with an insightful comment on a famous picture of 57-year-old Poincaré, standing alone at the seashore. The author remarks on the connection between this picture and Newton's famous statement about a child finding a smoother pebble on the seashore. The author speculates: 'We cannot know what he is thinking, but most likely the picture suggests to the viewers that Poincaré is lost in his own, remarkable thoughts'. He adds '... knowing how visionary and innovative was his mathematics, may see isolation and loneliness. Or just a middle-aged man enjoying a quiet holiday'. The last chapter is a reflection on Poincaré's philosophy of science, where Gray discusses various facets of the former's views ranging between that of an idealist, a skeptic and a structural realist.

Poincaré, as a professor of physics, had touched upon a wide variety of areas in physics – mechanics of fluids, theory of light, electricity and optics, thermodynamics, to name a few. His lectures on these topics, which were edited by his students, had Poincaré's unique stamp.

He had received many honours during his lifetime. The most notable one was the medal that he received as part of the Grand Prize for the mathematical sciences in 1880, where candidates were asked 'to improve in some important way the theory of linear differential equations in a single independent variable'.

Gray portrays Poincaré in a balanced manner, highlighting his successes as well as his failures in judging the worth of a scientific study. Around the time of the discovery of cathode rays in 1855, many experiments were done to ascertain whether these were wave-like objects or particle-like objects. At that time researchers attributed properties like momentum and charge to particles. In this context, Poincaré criticized the work of a Viennese physicist, Gustav Jaumann, who proposed that cathode rays were a form of wave in contrast to the prevalent notion, based on Perrin and Thomson's work that these were emission of electrical particles. Poincaré's theoretical conclusions contributed to the success of the emission theory. However, from a modern perspective, attributes like momentum and charge which pointed to particle nature can equally well be associated with a wave. Gray mentions one occasion where Poincaré's judgement was clearly flawed. René Blondlot, a French physicist from Nancy, proposed a new radiation which he called N-rays. Poincaré was supportive of Blondlot's discovery. The 'discovery' of N-rays was later debunked by the American physicist Robert Wood, an episode that considerably embarrased French Science.

Gray gives an interesting sketch of Poincaré's work habit. He typically liked to go straight to the essential result of a mathematical article and enjoyed reconstructing the analysis in his own way. Wherever possible he would search for simplifying transformations to solve problems. In the realm of mathematical physics Poincaré used fundamental principles like the principle of least action and conservation laws as guiding ideas. He believed in focusing on the broad qualitative features of a problem and using these as guidelines for understanding the quantitative details. He often found it useful to approach geometric problems by mapping them to their

lower-dimensional counterparts. He liked to focus on the basic features of finite dimensional vector spaces and considered infinite dimensional versions of these. In the domain of mathematical physics, Poincaré would often consider restricting to small regions where linear laws hold and then consider extension of the idea to generate a linear partial differential equation. He, however, abandoned this method in the case of quantum theory which was essentially discontinuous.

In Poincaré we see an amazing blend of mathematical thinking and physical intuition. His journey in the world of mathematics and physics has continually changed course from the abstract to the concrete and the concrete to the abstract. His mathematical mind was attracted to larger structures, which brought about economy of thought. He did not have much patience with isolated facts. One of his significant mathematical contributions has been the proof of the uniformization theorem. An example of his far reaching mind is, for instance, the conjecture on the characterization of the three-sphere that he came up with, which was successfully resolved only in recent times (2002). As many of us know, Poincaré had contributed significantly to the conceptual foundation of the theory of special relativity, which is associated with the name of Einstein. What is perhaps less known, and what this book brings out is that, Poincaré was in fact, well ahead of Einstein in speculating about a relativistic theory of gravity. Another remarkable idea was his belief that at the fundamental level, space and time might be discrete (atomic). Such an idea indeed forms the core of one of the present-day approaches to the quantum theory of gravity (causal sets).

Overall, this is a superbly balanced account of a brilliant mind and certainly worth reading, especially for researchers in physics and mathematics. Such a book should be included in university libraries across the world.

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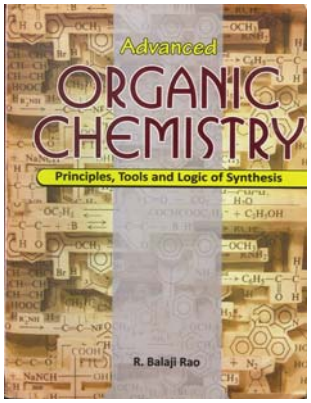

Advanced Organic Chemistry: Principles, Tools and Logic of Synthesis. R. Balaji Rao. Vishal Publishing Company, 2012. 856 pp. Price: Rs 570.

The book under review works on an 'all in one' principle and begins from the most fundamental concepts and works its way up to complex natural product syntheses. The usual arrangement of functional groups as seen in most textbooks does not occur. Interestingly, mechanisms and concepts of organic chemistry are explained together. One knows that a study of organic chemistry cannot be detached from functional group chemistry; nonetheless, it is a new shape to exam-oriented textbooks which gives the student a break from routinely organized textbooks.

The book is divided into 24 chapters, starting with basic nomenclature followed by stereochemistry and reaction intermediates and mechanisms. A typical arrangement of functional groups as seen in older textbooks does not occur. Therefore, it can be seen that a certain mechanism (e.g. the addition to a carbonyl group) can be applied to different functional groups. A dedicated chapter for protection and deprotection strategies is a welcome move. A large chunk of named reactions and reagents is covered, typically presented with a reaction scheme, one mechanism and a few variants of the same. This is concluded by a small number of well-chosen examples from the literature.

Having said this, the book is bulky and heavily loaded with information and may lead a student to stubborn memorization. The biggest drawback of the book is the lack of any format for chemical structures, especially stereo-descriptors, which may throw the reader into temporary confusion.

Although the book wants to make the readers to feel organic chemistry in a different way, it abruptly dives into an exhaustive listing of protecting group strategies and continues the thread into reactions and reagents. The highlight of the book is clearly the massive list of organic named reactions, arranged in alphabetical order, totalling 126 in number. The named reactions are discussed under a simple introduction followed by the mechanism and then closing the discussion with a few literature examples. The next section deals with a underdeveloped explanation of spectroscopic techniques and the book closes with examples of classic organic synthesis like reserpine, prostaglandins, steroids, etc.

The reviewers feel that the book is still very far from achieving its objective. In fact, it does not even define a clear target audience. One feels that the book is essentially meant for those who have already completed a course in functional group organic chemistry and are just looking at a physical repository of information which can be accessed when there is no internet connection.

The text is not explanatory and it is just a series of statements which are put in the right order such that the chapter looks organized. The content of the book does not concentrate on any specific audience; instead it tries to be a book for everyone, right from undergraduate or post-graduate students to lecturers. Due to the lack of any consistent style of explanation, the book, in our opinion, promotes only stubborn memorization. Unnecessary and undernourished explanations are in plenty, throwing the reader into the dilemma of sorting the valuable from the babble.

Any advanced book dealing with a few total syntheses is expected to have a rigorous treatment of disconnection approach, which is scanty in this book. The section on spectroscopy is equally bizarre. In a breathtaking pace and space, 30+ pages, the author finishes the discussion of NMR, starting from Larmor frequency and all the way up to a solved example of an oligopeptide using NOESY and ROESY!

There are several typographical errors in the book both with text as well as chemical diagrams, e.g. the author shows the ozonolysis of a terminal double bond and overlooks on converting the double bond into an aldehyde, and at a much later step shows a Wittig reaction of that