

## Editorial

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The regular readers of *Resonance* may recall that the natural indigo dye is closely associated with India and has played a significant role in the economic and social life of the people of part of Bihar and Bengal for many centuries in the past (*Resonance*, Vol.16, pp.1168–1174, 2011). The synthetic indigo ended the commercial worth of its natural counterpart thereby causing anguish in a considerable section of the Indian people in the early twentieth century who depended on indigo farming and trade. The resulting unrest was the origin of Mahatma Gandhi's Civil Disobedience Movement against the British rule.



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The etymology of 'indigo' is quite interesting. It is derived from the Latin 'indicum' and the Greek 'indikón' meaning 'Indian (substance)'. There was a time when all commodities imported from India into Europe were called 'indicum' or 'indikón'. In course of time, the usage of these Latin and Greek words was restricted to the dye. (I do not know for what reason, but I guess the import of other substances had stopped or were not so important). In India it was being called by the Sanskrit name 'neela' (also spelt 'nila' and 'nili') and was known even at the time of the *Rig Veda*. It is difficult to understand why the Sanskrit name was not taken by European traders of the dye. However, the major product obtained from distilling indigo was named 'aniline' (from Sanskrit 'nila' to Persian 'al-nil' to Arabic 'an-nil'; the suffix 'ine' in French means 'derivative') in 1841 by the German chemist Carl Fritzsche (1808–1871).

Several eighteenth century chemists took pleasure in working on indigo chemistry, but ultimately the mystery of its correct molecular structure was unravelled by the relentless efforts of Adolf Baeyer and his co-workers. By the present-day standards of the complexity of organic molecules, indigo structure is ridiculously simple. However, for an organic chemist of even the



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latter half of the nineteenth century, it was a daunting task which was successfully accomplished by Baeyer after working for more than fifteen years with the assistance of several doctoral and postdoctoral associates.

Although Friedrich Wöhler's urea synthesis of 1828 had shattered the myth of the 'vital force theory' and fired the imagination of chemists to enthusiastically embark on the synthesis of organic compounds, they did not have logically sound synthetic methodologies. It took almost four more decades for organic synthesis to start evolving into a truly scientific endeavour, and Baeyer was a pioneer in developing the classical processes of structure determination of a molecule through degradative studies followed by systematically preparing it by assembling together much smaller molecules of known structure using known chemical reaction routes. Thus, he achieved the first ever synthesis of a natural product, the red dye alizarin, in the late 1860s. However, it was a much easier problem to solve than the indigo structure. Both dyes were of huge commercial importance. (Even today indigo is the dye sold in the largest quantity.) The chemical company, BASF, which had come into existence in the early 1860s and is one of the biggest chemical industries in the world today, greatly benefited by Baeyer's work on natural alizarin and unnatural phthalein dyes in its formative years and in establishing itself as a great industry. Readers will find that Baeyer's work was not restricted to the study of dyes, but extends across many varied areas of organic chemistry.

Another great contribution of Baeyer was to train a large number of organic chemists who vastly enriched early classical organic chemistry. Several of them won Nobel Prizes like Baeyer, and one, Emil Fischer, even surpassed him as one of the greatest synthetic chemists of all time and won the Nobel Prize three years before him, and another, Eduard Büchener, who got the Prize two years after him. (About Büchener, Baeyer seems to have stated, "This [discovery of cell-free yeast extract] will make him famous, even though he has no talent for chemistry".)

Baeyer's story presented in this issue is particularly fascinating to Indian readers as his work on indigo had great influence on the economy and history of the early part of the last century. The relation between the land-owners and the peasants cultivating indigo crop had always been skewed and exploitative. There had been resistances and minor nonviolent revolts by the farmers against their exploitation, much before the synthetic indigo was made. The synthetic dye in a way unshackled the indigo farmer of the early 20th century, eventually through the intervention of Mahatma Gandhi. The cartoon 'Science Smiles' on p.488 depicts the part played by Baeyer in successfully solving the structure of indigo, its preliminary synthesis and the following social consequences.

Apart from the life and work of Baeyer, the current issue of *Resonance* brings to you a few more useful and interesting articles: 'Causality in Classical Physics', which explains the relationship of time-space locality and non-locality with causality and non-causality; 'Crypto currencies' which introduces us to the world of fascinating invisible money; 'Understanding the Physiology of High-Altitude Acclimatisation' tells us about the physiological consequences we face when we go to higher altitudes; and 'Ramanujan's Circle', curiously, has nothing to do with the geometric figure but with the well-wishers and promoters who surrounded him.

I wish the readers great educative enjoyment.

