PRAFULLA CHANDRA MITTER

1882-1957

PRAFULLA CHANDRA MITTER was born on 22nd June, 1882 in Barisal town, now in East Pakistan. His ancestral home was in the village, Khajura, in the district of Jessore. He was the fourth son of his parents. His father, Beni Madhab Mitter was a Subordinate Judge. His mother, Jaladmohini, was a very devoted and pious lady. From his early boyhood, Prafulla Chandra showed great promise as a scholar. He had his school education all through at Baidyanathdham (Deoghar) in Bihar, a place of considerable scenic beauty. After his early school education at the R. Mitra School, Deoghar, he moved to the Deoghar H. E. School. He passed the Entrance Examination from this school in 1898, and gave ample proof of his prospective future as a scholar at this examination standing tenth in order of merit and securing a Grade I Government scholarship.

After finishing his school education he came to Calcutta and joined the First of Arts (F.A.) Class at the Presidency College. Here he came in close contact with Acharya Prafulla Chandra Rây and this contact had considerable influence in his future career as a chemist, a teacher and a social worker. He passed the F.A. examination of the Calcutta University in 1900. After this he continued his studies at the Presidency College and had his B.Sc. of Calcutta University in 1902 and M.A. in Chemistry of the same University in 1904. Throughout this period he maintained excellent record as a regular scholar and was a very favourite student of Acharya Rây.

After his M.A., Prafulla Chandra became somewhat interested in taking up the legal career and joined the Law College, Calcutta. In those days, chemists had very little scope in this country. Moreover, his father was intimately connected with members of the legal profession as a Judge. It was possibly for these reasons that he became interested to study in the Law College. In view of the persuasion, however, of Acharya Rây he discontinued his studies in that college and took up research work in Chemistry as a career.

In the first instance, he carried on researches in a small laboratory in the compound of the Presidency General Hospital, Calcutta, under Sir Ronald Ross. From there he went to Dehra Dun. In 1906, he came back to Calcutta and joined the teaching staff of the Bengal Technical Institute at 92, Upper Circular Road so that he could continue his researches in the laboratory of Acharya Rây at the Presidency College. At

P. C. Mitter

the same site the University College of Science, Calcutta was established a decade later.

In 1909, he proceeded to Germany on his own for higher studies and research in Organic Chemistry. At the University in Berlin he worked on Friedel-Crafts reaction under the guidance of Professor Carl Liebermann for about three years. He had his Ph.D. (Berlin) in 1912 and shortly after this he came back to Calcutta. He was the first Indian to have the Doctorate in Chemistry from Berlin. On his return to Calcutta, he was appointed a Lecturer in Chemistry of the Calcutta University.

About this time, serious attempts were being made by Sir Asutosh Mookerjee, the then Vice-Chancellor of the University of Calcutta, to start a nucleus for having the desired laboratories for higher studies and research in the various science subjects including Chemistry. In this matter, he was very much influenced and guided throughout by Acharya Prafulla Chandra Rây. In 1914, four posts of Professorship, called Sir Rashbehari Ghosh Professorships, were created by the University of Calcutta, in each of the following subjects: Applied Mathematics, Physics, Chemistry and Botany. Dr. P. C. Mitter was straightway appointed the first Sir Rashbehari Ghosh Professor of Chemistry, a post he held with credit up to 1937, that is for a period of twenty-three years. The nucleus for the Department of Chemistry of the University of Calcutta had to be started at the Presidency College, Calcutta, as was the case with many other departments of this University.

After joining the Chemistry Department, he had to work extremely hard in connection with necessary planning and erection of the building for the proposed University College of Science at 92, Upper Circular Road (now Acharya Prafulla Chandra Road). The foundation of this building was laid by Sir Asutosh Mookerjee on March 25, 1914.

Before actual planning for this building and proper fitting up of the laboratories, he was entrusted with the task of visiting some of the laboratories existing in various parts of the country in those days and making his suggestions in this respect for consideration by the University authorities including Acharya Rây. Throughout the period of construction of the building and fitting up of the laboratories he looked after the progress of the work with keenest interest and attention and it was quite a hard job for him.

Acharya Rây retired from Government service as Professor and Head of the Department of Chemistry, Presidency College in 1916 and joined the Calcutta University as the first Sir Tarak Nath Palit Professor of Chemistry in the same year. The new building of the University College of Science at Upper Circular Road housed the laboratories of Physics, Chemistry, Applied Mathematics and Experimental Psychology. The biological laboratories were housed at 35, Ballygunge Circular Road, which was originally the residence of Sir Tarak Nath Palit. Accordingly,

the former was commonly called the 'Science College' and the latter the 'Ballygunge Science College'.

It may also be mentioned in this connection that another favourite student of Acharya Rây, Jnanendra Nath Mukherjee, worked during 1915-1919, first as an Assistant Lecturer and then as a Lecturer, in the newly started Chemistry Department of the University of Calcutta. He then went to England and carried out research work at the London University. After his D.Sc. there, he came back in 1921 and rejoined the University of Calcutta as the Guru Prasad Singh (of Khaira) Professor of Chemistry. Thus the three Chairs in Inorganic, Organic and Physical Chemistry were filled up at this stage by Acharya Rây, Prof. Mitter and Prof. Mukherjee, and this arrangement continued up to 1937.

Another illustrious person joined this group at the University College of Science in 1920. He was Dr. Hemendra Kumar Sen, who was appointed the Sir Rashbehari Ghosh Professor of Applied Chemistry. In 1933, Prof. Mitter was awarded the Sir Rashbehari Ghosh Travelling Fellowship of the University. He, thus, paid a second visit to Germany but this time for a shorter period.

Acharya Rây retired from the Palit Chair in Chemistry in 1937 and Professor Mitter became his successor as the Sir Tarak Nath Palit Professor and Head of the Department of Chemistry. Professor Mukherjee became the Sir Rashbehari Ghosh Professor of Chemistry and Priyada Ranjan Rây, another illustrious student of Acharya Rây who later became a reputed inorganic chemist, was appointed the Khaira Professor of Chemistry. Thus the three Chairs were distributed between inorganic, organic and physical chemistry. After the death of Acharya Rây in 1944, and particularly after the retirement of Professor Mitter, however, this equidistribution of the three Chairs amongst the three branches of Chemistry has become an exception rather than the rule with its obvious consequences.

Professor Mitter retired from Calcutta University in 1946 after serving as the Palit Professor and Head of the Department of Chemistry for about nine years. This, coupled with the period of service as the Ghosh Professor and as the Lecturer, made a total of thirty-three years of devoted service at the University College of Science, Calcutta.

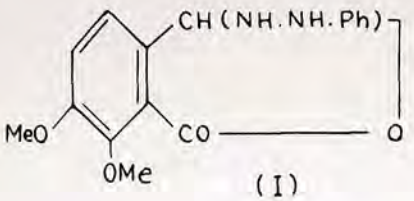
For a critical evaluation of the contribution of any person it is essential to take proper stock of the prevailing conditions and the facilities available. Acharya Rây, after his D.Sc. of Edinburgh, came back to Calcutta in 1889 and started on his pioneering project of building up a solid foundation for chemical research in this country by providing a band of research workers who were later recognized as top men in this country in the various branches of Chemistry. Prior to him, chemical activity in this country was of a sporadic type. This included analysis of mineral water in 1833 by J. Prinsep of Geological Survey of India, Calcutta, preparation of Strychnine in 1833 by J. T. Pearson, studies on effloresence of Sodium

Sulphate of Tirhut in 1834 by J. Stephenson, chemical and physiological examination of Indian herbs and drugs as published in 1840 in 'Bengal Pharmacopoeia' and studies on arsenical poisons and the effect of sea water on iron in 1843 by W. B. O'Shaughnessy of Medical College, Calcutta, separation of mercury from gold and silver by distillation in 1852 by H. Piddington at Calcutta, determination of monthly changes in the quantity of suspended silt in Ganges water at Calcutta in 1854 and of chemical nature of paraffins obtained from Burma in 1860 by D'Waldie, test for porphyroxin in Indian opium in 1867 by Dr. Kanai Lal Dey, analysis of coal gas and water supplies of Calcutta in 1875 by Sir Alexander Pedlar and Chandra Bhusan Bhaduri at the Presidency College, Calcutta and publication of a paper on cobra venom in the Proceedings of the Royal Society, London, by Pedlar and Pulin Behari Soor as also their work on the effect of light on chemical changes. Dr. Aghore Nath Chattopadhyay, father of Smt. Sarojini Naidu and grandfather of Smt. Padmaja Naidu, had his D.Sc. of Edinburgh in 1875, the first Indian to have this distinction.

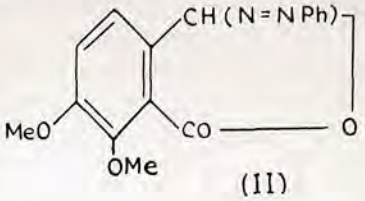
With this background, the University College of Science was founded in Calcutta. The Chemistry Department was started under the leadership of Acharya Rây and Professor Mitter as the second in command. Original scientific papers of a high order started pouring in from his laboratory from the very inception. As a research student at Berlin University under Professor Liebermann, Prafulla Chandra Mitter worked on the action of Oxalyl Chloride on aliphatic-aromatic hydrocarbons. His thesis for Ph.D. (Berlin) was entitled 'Über Carboxylierung einiger fettaromatischer Kohlenwasserstoffe mit Oxalylchlorid'.

After his return to Calcutta and joining the Calcutta University, in the first few years he was extremely busy in connection with the planning and construction of the building of the University College of Science at Upper Circular Road and in fitting up of the laboratories. His first paper from Calcutta came out in the Journal of the Chemical Society, London in 1917 in collaboration with J. N. Sen. This paper was on the action of phenylhydrazine on opianic acid, nitroopianic acid and phthalonic acid. It was previously observed by Liebermann that condensation of phenylhydrazine with opianic acid and nitroopianic acid in presence of acetic acid yielded phthalazoles with loss of two molecules of water. Mitter and Sen found that in ether solution, in the absence of acids, only one molecule of water was lost with formation of hydrazophthalides. Thus phenylhydrazomeconin (I) was prepared from opianic acid and phenylhydrazonitromeconin from nitroopianic acid. The latter product was found to be identical with Liebermann's nitroopianic acid phenylhydrazone. The hydrazocompounds were oxidized to phenylazomeconin (II) and phenylazonitromeconin with red mercuric oxide.

In the following paper in the same journal, published in 1919, they described the action of phenylhydrazine on phthalaldehydic acid and



(I)



(II)

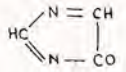
phthalonic acid. From phthalonic acid was obtained the 'phenylhydrazone' which with dilute hydrochloric acid gave phenylphthalazonecarboxylic acid identical with Henrique's anhydrophenylhydrazinecarboxyphenyl-glyoxalic acid. Phthalaldehydic acid yielded phenylhydrazophthalide which with mercuric oxide in acetone gave phenylazophthalide and with acetic acid was converted into phenylphthalazone. Phthalaldehydic acid with one mol. of phenylhydrazine in presence of sodium carbonate yielded quantitatively phthalaldehydic acid phenylhydrazone.

He then took up the investigation on the condensation of amidines with ethoxymethylene derivatives of β-ketonic esters and of β-diketones. The first paper in this series came out in the Journal of the Chemical Society, London in collaboration with his illustrious student, Jogendra Chandra Bardhan. The paper of Mitter and Bardhan on the amidines appeared in 1923. About this time, the University College of Science was working in full swing. The synthesis of pyrimidines by the action of amidines on EtO.CH=CR.CO.Me was not systematically investigated prior to this. As a result of this investigation it was possible to develop a general method for the synthesis of pyrimidines. A large number of pyrimidines were prepared by him and his students in this way.

This work was followed up by him with Nirmalendu Palit. As about this time the Indian Chemical Society was founded and the publication of the Journal of the Society was started, this paper appeared in 1925 in this new Journal. Since then he became a regular patronizer of the Journal of the Indian Chemical Society. In the previous paper with Bardhan it was shown that benzamidine and *p*-toluamidine condense readily with ethyl ethoxymethyleneacetoacetate and ethyl ethoxymethylenemalonate with formation of pyrimidine derivatives. In the paper with Palit condensation of aliphatic amidines like acetamidine and guanidine and even some of the complex amidines like anisamidine and naphthamidine were described. Condensation of amidines with ethyl ethoxymethylenecyano-acetate was also carried out.

He next turned his attention to the synthesis of iminazoles. With Nripendra Nath Sinha he studied the action of oxalyl chloride, oxalic ester and oxaminic ester on amidines. With benzamidine and *p*-tolu-amidine, dioxo-dihydro-iminazoles were readily obtained. From the dioxo-compounds the oxo-chloro-derivatives were prepared by the action of

phosphorus oxychloride. The oxo-chloro-compounds prepared by him were the first set of compounds belonging to a new group which was named by him as the isiminazole group.



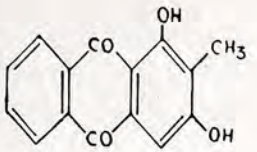
Isiminazole

Professor Mitter and Asutosh Bhattacharya undertook the preparation of bz-tetrahydroquinazolines by extending the method of Pinner by the action of amidines on β-diketones and β-ketonic esters and observed that β-ketonic esters are, in general, more reactive than the β-diketones.

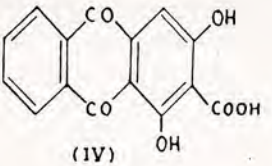
Thus up to 1927 he was engaged in the preparation of all these classes of nitrogenous compounds but he had still a soft corner for the anthraquinones regarding which he had his initial experience in the laboratory of Professor Liebermann. After his work on the pyrimidines, quinazolines, hydrazo- and azophthalides, isiminazoles etc. he started on his project on the anthraquinones which was crowned with immense success as in this line it was possible for him to publish a series of extremely valuable papers and make a contribution of fundamental importance on general properties and structure of natural anthraquinones, their classification and syntheses.

A number of anthraquinone derivatives like chrysophanic acid, emodin etc. were previously regarded as derivatives of α-methylanthraquinone. These were later found to be really derivatives of β-methylanthraquinone. Rubiadin (III) was also regarded previously as an α-methyl derivative but shown by Stauder and Adams to be a β-methyl derivative by an indirect method, as they found that rubiadin of madder root, *Rubia tinctoria,* was not identical with 1,3-dihydroxy-4-methylanthraquinone. About the same time Mitter arrived at the same conclusion independently by carrying out the condensation of cresorsellenic acid with benzoic acid in presence of sulphuric acid. This work was carried out in collaboration with Monmohan Sen and Prafulla Kumar Paul. Schunck and Marchlewski rejected structure (III) for rubiadin as it differed from 2-methyl-1,3-dihydroxyanthraquinone prepared by them by condensation of 2,6-dihydroxy-*p*-toluic acid with benzoic acid. Mitter and Priyalal Gupta repeated the same condensation, but using a very large excess of benzoic acid to avoid self-condensation of 2,6-dihydroxy-*p*-toluic acid, and got pure rubiadin. Thus rubiadin was synthesized for the first time and its structure settled conclusively as (III) by Mitter and Gupta. They also observed that naturally occurring anthraquinones are all derivatives of β-methylanthraquinone and that derivatives of α-methylanthraquinone do not occur in nature. This work appeared in 1928. Later, Mitter and Haragopal Biswas synthesized rubianic acid by an alternative method from 2,6-dimethoxytoluene and phthalic anhydride followed by ring closure of the product and demethylation.

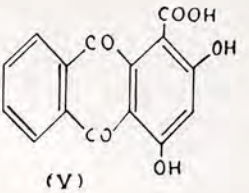
In connection with his researches on the anthraquinones he was naturally interested in munjisthin. It was previously obtained from Indian madder, *Rubia munjista*. Schunck and Romer found that it gave phthalic acid on oxidation and when heated gave purpuroxanthin and carbon dioxide. Accordingly, munjisthin was stated by them to be either (IV) or



(III)

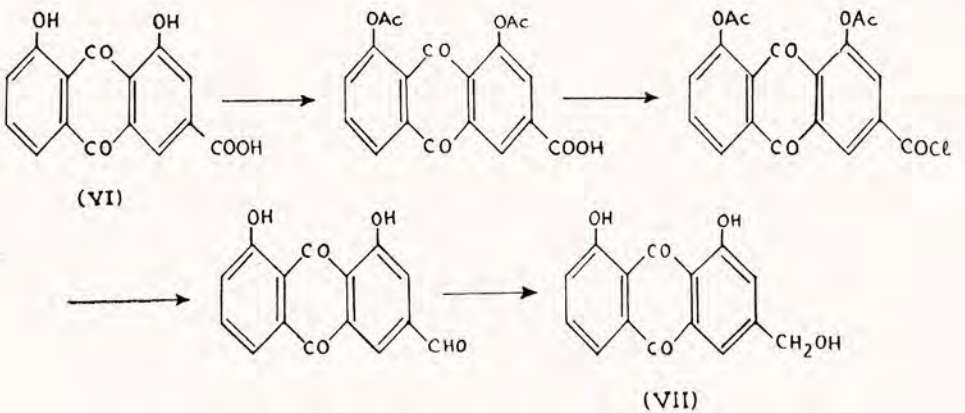


(IV)



(V)

(V). Mitter, however, observed that the carboxyl group of munjisthin is obviously formed by oxidation of a methyl group during its biogenesis, and in line with his previous observation that derivatives of α-methylanthraquinone do not occur in nature he at once concluded that munjisthin must be (IV). Thus it may be regarded as the oxidation product of rubiadin (III). In collaboration with Haragopal Biswas he ultimately synthesized munjisthin. For this purpose 2-chloro-6-methoxytoluene was condensed with phthalic anhydride in presence of aluminium chloride when 2′-chloro-3′-methyl-4′methoxybenzoyl-2-benzoic acid was obtained. This on

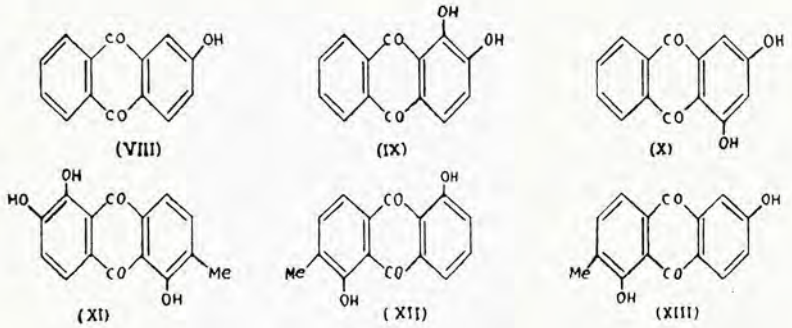


cyclization with sulphuric acid afforded 2-chloro-3-methyl-4-methoxyanthraquinone. Demethylation with aluminium chloride yielded 2-chloro-3-methyl-4-hydroxyanthraquinone. This on oxidation with nitrous acid in presence of boric acid and sulphuric acid gave munjisthin (IV).

With Asoke Kumar Sarkar he carried out the synthesis of a large number of anthraquinones related to emodin and morindone. Aloe-emodin (VII) was synthesized by him in 1932 with Dilip Kumar Banerjee. It was

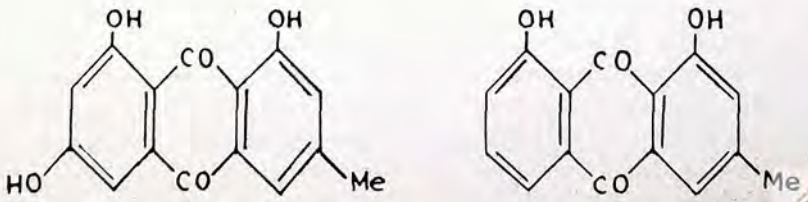
accomplished by them in accordance with the following scheme starting from rhein (VI). Rhein was converted into diacetylrhein chloride which was reduced with hydrogen in presence of palladized barium sulphate to 1,8-dihydroxyanthraquinone-3-aldehyde. On further reduction with hydrogen in presence of platinum oxide with ferrous chloride as promoter, this aldehyde was converted into aloe-emodin (VII).

He divided the natural anthraquinones into four distinct classes, Chay-root type, Madder type, Morindone type and Emodin type. The Chay-root type includes 2-hydroxyanthraquinone (VIII), alizarin (IX), alizarin-1-methylether, anthragallol-1,3-dimethyl ether, anthragallol-1,2-dimethyl ether and hystazarin monomethyl ether. The Madder type anthraquinones were divided into two subgroups: (i) those containing OH groups like purpuroxanthin (X), and (ii) those containing in addition, methyl or carboxyl groups like rubiadin (III), rubiadin-α-methylether, munjisthin (IV) and pseudopurpurin.



The morindone type includes morindone (XI), morindadiol (XII) and soranjidiol. Mitter and Haragopal Biswas synthesized morindadiol (XII) from 1,5-dinitro-6-methylanthraquinone by converting it into the corresponding dimethoxyanthraquinone and demethylating the product. They also showed soranjidiol to be 2,5-dihydroxy-6-methyl-anthraquinone (XIII).

The emodin type includes emodin (XIV), chrysophanic acid (XV) and aloe-emodin (VII). Amongst his various other synthetic work in this field



mention may be made of synthesis of a large number of anthraquinones related to morindone and emodin carried out with Asoke Kumar Sarkar, synthesis of 1,6-dihydroxy- and 1,7-dihydroxy-3-methylanthraquinones with Nripendra Nath Chatterji, synthesis of derivatives of 1-hydroxy-anthraquinone having carboxyl, carbinol and aldehyde group in 6-position with Satindrajiban Das Gupta and in 3-position with Sumatichand Bachhwat.

(Miss) Tanima Sen Gupta is possibly *the first Indian girl* to carry out researches in Chemistry. In collaboration with her, Professor Mitter published a paper on synthesis of anthraquinone carboxylic acids of the morindone type in 1936.

Thus his main field of activity was the anthraquinones and in this field he made valuable contribution of considerable volume. While working on the natural anthraquinones, he developed a keen sense about the biogenesis of such products which was helpful to him in the matter of settlement of the structures of both rubiadin and munjisthin. He tried to develop this biogenetic approach and apply it in other fields. In his Presidential Address entitled "Some aspects of biochemical synthesis" at the Chemistry Section of the Seventeenth Indian Science Congress at Allahabad in 1930 he summarized his ideas in this respect covering such diverse classes of compounds as anthocyanidins, anthraquinones, lichen acids, flavones, chalkones, flavanones, isoflavones, flavonols, terpenes, alkaloids, aminoacids.

An account of his work in other fields, such as those on hydrazo- and azo-phthalides, condensation of amidines with ethoxymethylene derivatives of β-ketonic esters, isiminazoles, bz-tetrahydroquinazolines etc. has been presented earlier. A short account of his work in other fields is presented below.

He carried out some work on the Michael condensation with Asoke Chandra Roy and on Friedel-Crafts reaction with Hirendra Chandra Ray. With Prafulla Kumar Paul he carried out the synthesis of a number of derivatives of 4-phenylchroman, with Nripendra Nath Chatterji the synthesis of purine derivatives from glyoxaline, with Srish Kumar Saha studies in the flavone series, with S. S. Maitra studies in the *iso*flavone series, with Sudhir Chandra Ray synthesis of a large number of amides related to capsaicin and with Shyamakanta De synthesis of some derivatives of tetrahydronaphthalene and studies on γ-ketonic acids. His work on fused ring systems covering the synthesis 7-methyl-[0 : 3 : 3]-bicyclooctan-1-one-2, 3-dicarboxylic acid with Dilip Kumar Banerjee was of immense help in infusing keenest interest in synthetic work in terpenes and steroids amongst his students.

Professor Mitter developed a special fascination for the anthraquinones and in view of this he became interested in the bright colouring matter of lac. While working in this line, he gradually became interested in the acidic constituents of lac which includes aleuritic acid as the principal

product. During the latter part at the University College of Science he was mostly interested in work on these long chain acids. The first paper in this series came out in 1939 with Phanindra Nath Bagchi covering an extension of the isoprene rule for offering an explanation for the formation of some 12- and 16-carbon acids occurring in nature. The formation of larger molecules from isoprene was assumed to occur in one of the three following ways:

(1) By direct linear head to tail union, a polymerization which may result in either acyclic or cyclic hydrocarbons and which is generally recognised as the origin of the terpenes $(C_5H_8)_n$

(2) By a similar type of polymerization with concurrent hydrogenation which would explain the formation of such hydrocarbons as that from which the alcohol, phytol ($C_{20}H_{40}O$) is derived.

(3) By addition with accompanying dehydrogenation in 1 : 4-position.

$$CH_2:CMe\text{-}CH:CH_2 \xrightarrow{-H_2} :CH.CMe:CH.CH:$$

These C_5H_6 units then combine to form longer chains as in the carotenoids.

The formation of a large number of long chain aliphatic acids, both mono- and di-basic, was explained on the basis of an additional assumption:

(4) Head to tail union of isoprene units; addition of H_2O at a conjugated double bond at one end of the chain; partial or complete hydrogenation and removal of side-chain methyl groups by oxidation, and complete or partial oxidation of the terminal groups.

Shortly after this, Mitter and Bagchi synthesized *bis*-nor-oleic acid (Δ^6-hexadecenoic acid), $CH_3(CH_2)_7CH:CH(CH_2)_5\ COOH$ from oleic acid by subjecting it to a two stage Wieland degradation. Synthetic work on aleuritic acid was initiated with Phanindra Chandra Dutta. Starting from pentamethylene bromide, ethylacetoacetate and half ester chloride of sebacic acid they synthesized ethyl 16-acetoxy-10-ketopalmitate, $CH_3COO.CH_2(CH_2)_5CO(CH_2)_8CO_2C_2H_5$. With Bidyut Kamal Bhattacharyya, he converted aleuritic acid $HOCH_2(CH_2)_5.CH(OH).CH(OH).(CH_2)_7CO_2H$, obtained from shellac, into *epi*-ambrettolic acid (16-hydroxy-Δ^9-hexadecenoic acid) and *epi*-ambrettolide, a seventeen-membered lactone, as also into ethyl 16-cyano-Δ^9-hexadecenoate and homocivetic acid. 16-Methoxy-Δ^9-hexadecenoic acid was synthesized by him with Sailendra Mohan Mukherjee. Ultimately with Munindra Chandra Sen Gupta and Amalendu Bose, a geometrical isomer of aleuritic acid was synthesized starting from ethyl 16-chloro-Δ^9-hexadecenoate.

In the later part of his career at the University College of Science, Professor Mitter became a great source of inspiration to his students who were provided with enormous facilities to take up problems of their choice.

and work independently. This system was instrumental in producing a stream of good organic chemists. The success of this system depended mostly on his efficient maintenance of discipline in his laboratory and all with a loving heart and a laughing face. In view of his loving personality, it was possible for him to infuse the spirit of love and fellow-feeling amongst his students so much so that the whole atmosphere was of a congenial type to all the workers. There was general Indian type brotherly feeling amongst the research workers based on love and respect, and the younger worker used to address a senior worker as his elder brother and *vice versa*. This system was extremely helpful in the speedy training of the younger workers, and although a number of the senior workers were working independently there was never an occasion of any kind of misunderstanding between the different workers or any kind of ill-feeling for any reason. The credit for all this was wholly due to Professor Mitter.

In the words of Dr. Hara Gopal Biswas, Chief Chemist, Bengal Chemical and Pharmaceutical Works Ltd., Calcutta, the contribution of Professor Mitter towards the glorious record of the Chemistry Department of the University College of Science, Calcutta, during the first part of its existence after its inception may be justly described as immense, but as compared to this he did not receive appropriate recognition. As regards the reason for this, Dr. Biswas thinks that in front of the brilliance of Acharya Prafulla Chandra Rây as a scientist and in view of his perfectly selfless devotion for doing good to the country in every respect giving everything he had and living like a 'fakir', Professor Mitter was somewhat eclipsed. Nevertheless, it must be acknowledged that although in those days there were in Calcutta such notable scientists as Prof. H. K. Sen, Dr. R. L. Dutta, Dr. A. C. Sarkar and others, the eminence of the Calcutta School of Organic Chemistry was practically wholly due to the devoted services of Professor Prafulla Chandra Mitter. The present writer, though attended his lectures as a post-graduate student, is in a sense a grand-student of Professor Mitter, having started on his research career under Professor Jogendra Chandra Bardhan, one of the earliest students of Professor Mitter.

Professor Mitter took an active interest in many scientific and cultural organisations of the country. He was a Foundation Fellow of the National Institute of Sciences of India and for sometime a Vice-President of this body. He was for some years the Treasurer of the Indian Science Congress Association and also its Secretary for a short period. He was the President of the Chemistry Section of the Indian Science Congress in 1930. He was the Secretary and later the Treasurer of the Indian Chemical Society and the Treasurer of the Indian Science News Association. He was very much interested in the popularization of science. He was once the President of the Science Section of *Banga Sahitya Sammilanee*. He was also closely connected with *Bangiya Vignan Parishad* and was the first

Editor of *"Jnan O Vijnan"*, a magazine, published by this body for popularization of science in Bengali.

Professor Mitter was connected with many charitable institutions. He was one of the closest lieutenants of Acharya Rây in his social and relief activities and was one of the most active members of the famous *Sankat Tran Samity* of Acharya Rây. He was for a long time the President of the Athenium Institution, a school for boys, at Garpar in Calcutta and one of the organizers of the *Nari Shiksha Samity* which maintained a school for girls. Both these institutions gained immensely from his association, since through his sincere and effective efforts it was possible to tide over many serious difficulties. He was for some years a member of the Managing Committee of the Calcutta Academy, a boys' school, and the famous Deaf and Dumb School of Calcutta.

He had a great fascination for the languages, and was well-versed in German. In addition, he knew French and Italian languages and had workable knowledge in a number of others. During the last few years of his life he was keenly interested in the Russian language. Possibly he developed his fascination for the different languages from his keen interest in literature. He used to say, that he liked very much to go through the originals of Tolstoy and that inspired his interest in the Russian language. One of his chief hobbies was reading of books. G. B. Shaw's writings interested him most. In his personal library, there was a big collection of books, notable amongst these was his invaluable collection of Berichte der deutschen chemischen Gesellschaft from the very first volume up-to-date for which numerous research workers had to visit his house regularly.

In view of his closest association with Acharya Rây he was naturally connected in various ways with the 'freedom movement' of the country. He took up 'khaddar' as a *must* for his whole life time since the beginning of the 'khadi movement'. He used to attend every function or party in a *khadi dhoti,* a *khadi coa* and a *khadi cap,* even if it was at the Government House (before Independence) or arranged by a European. He never liked anything superficially. When he liked one, he liked it,—and so is the case with use of *khadi* dress.

As a teacher, he had a clear analytical mind and he used to dissect an organic molecule on the black-board as if with a surgeon's knife for a proper understanding of its chemistry. His attitude in binding up a complex molecule from simpler units was also the same, both in the laboratory and in the lecture room. One could well understand his conservative standpoint in expressing an elimination reaction in a synthesis by drawing circles instead of putting down bent arrows to indicate direction of electronic shifts according to modern concept of electronics, as the same reactions can as well be understood and remembered in the old way and the modern concept is practically like a new language in place of the old and more or less like 'old wine in new

bottles'. On the other hand, his way of exposition was really instructive when considered in the light of the average students in those days.

He was quite methodical in his lectures regarding which he used to take meticulous care indicating his high sense of moral responsibility as a teacher. The class lectures were punctuated with occasional jokes particularly to remove any monotonous feeling and create interest in the subject amongst the students. Outside the lecture-room he was a friend to his students and colleagues, and a philosopher, because of his humane approach to all problems.

Regularity was his watchword. He observed strictest punctuality and used to come to the laboratory at 10 A.M. sharp every day. After his lecture in the class and after some office work he used to attend to his students in the laboratory. It was quite a sight to see him in his laboratory apron discussing with his students and working with them,—a tall and gigantic figure but very mild and amiable in his temperament. His voice could be heard from a long distance, but it was never rough. Everyday, either before or after lunch he must go round each student to find out his specific difficulties and suggest ways and means for proper solution of the problem.

He loved his students dearly and was always eager to help them in all possible ways. Even when any of his students did something wrong, he would most gladly forgive him forthwith without any hesitation, however serious the wrong might be. During his long tenure at the University College of Science he was never found to be cross with any of his students. He would always point out their mistakes with a loving heart and a laughing face. Although he loved all his students, he had special fascination for patient and hardworking students. He believed that good work was the outcome of tenacity and hard labour.

Professor Mitter was by nature meek and humble and a man of very cool temperament. It was quite a rare occasion to find him losing his temper. He was more interested to win the erring person by his love and helpful attitude. In view of this he was loved and respected not merely by his students but by everybody who came in his way. Plain living and high thinking was his motto of life. His residence at 22, Garpar Road, Calcutta, was a favourite place for practically all who knew him.

In addition to his love for languages and literature, he was fond of classical music, both Western and Indian. He developed a liking for scenic beauty and was very fond of walking. Udaipur was a very favourite place with him. Whenever he was there he must walk round the lakes everyday.

In 1905, after passing the M.A. examination, he married Shantilata, daughter of Jogendra Nath Ray of the Ray family of Narael. He had six sons and three daughters, Dr. Protul Chandra Mitter, M.B., Lt. Col. Pratap Chandra Mitter, Secretary, Calcutta Port Trust, Mrs. Abha Basu, Mr. S. Mitter, B.E., C.E., Dock Engineering Dip. (Holland), Agent, B.B.J., Mrs. Subha Ghosh, B.A., Mr. Ashoke Chandra Mitter, M.SC.,

Superintendent Geologist, Rajasthan, Mr. Mohan Chand Mitter, Director, IBCON Pvt. Ltd., Mr. Dilip Chand Mitter, Master Mariner, Lecturer in Navigation and Radar, Nautical and Engineering College of the Ministry of Transport, and Miss Reba Mitter.

On 12th July, 1957 Professor Prafulla Chandra Mitter died of cerebral thrombosis at the Seth Sukhlal Karnani Memorial Hospital, Calcutta, his wife having predeceased him by several years. Thus ended the life of a devoted scientist, his best contribution being the band of well-trained organic chemists, many of whom have won international recognition and are occupying responsible positions throughout the country. The depth of love and admiration he won from his students and colleagues was clearly evident to everybody present at the condolence meeting held at the University College of Science, Calcutta, organized by one of his oldest students, Professor Jogendra Chandra Bardhan.

R. N. CHAKRAVARTI

BIBLIOGRAPHY

1912. (With C. LIEBERMANN, M. KARDOS, W. RAHTS & D. BUTESCU) Über die Einwirklung des Oxalylchlorids und aromatische Kohlenwasserstoffe. *Ber. dtsch. chem. Ges.*, **45,** 1186-1217.
1912. Über Carboxylierung einiger fettaromatischer Kohlenwasserstoffe mit Oxalylchlorid. Dissert. Berlin, E. Ebering, pp. 40. (*Chem. Abstr.*, **7,** 488, 1913)
1917. (With J. N. SEN) Action of phenylhydrazine on opianic, nitro-opianic and phthalonic acids; some derivatives of hydrazo- and azo-phthalides. *J. chem. Soc.*, **111,** 988-993.
1919. (With J. N. SEN) Action of phenylhydrazine on phthaldehydic acids and phthalonic acids: Phenyl hydrazo- and azo-phthalides. *J. chem. Soc.*, **115,** 1145-1148.
1923. (With J. C. BARDHAN) Condensation of amidines with ethoxymethylene derivatives of β-ketonic esters and of β-diketones. *J. chem. Soc.*, **123,** 2179-2184.
1925. (With N. PALIT) Condensation of amidines with ethoxymethylene derivatives of β-ketonic esters, β-diketones and cyanoacetic ester. *Quart. J. Indian chem. Soc.*, **2,** 61-70.
1926. (With N. N. SINHA) Synthesis in the imidazole series: Some derivatives of isoimidazole. *Quart. J. Indian chem. Soc.*, **3,** 401-404.
1927. (With A. BHATTACHARYA) bz-Tetrahydroquinazolines. *Quart. J. Indian chem. Soc.*, **4,** 149-157.
1927. Synthesis of Rubiadin. *Nature, Lond.*, **120,** 729.
1927. (With M. SEN & P. K. PAUL) Rubiadin. Part I. Synthesis of 1-methyl-2, 4-dihydroxyanthraquinone. *Quart. J. Indian chem. Soc.*, **4,** 535-540.
1928. (With P. GUPTA) Rubiadin. Part II. Synthesis of 2-methyl-1, 3-dihydroxyanthraquinone. *J. Indian chem. Soc.*, **5,** 25-28.
1928. (With A. C. ROY) Studies in Michael Condensation. *J. Indian chem. Soc.*, **5,** 33-48.
1928. (With A. K. SEN) On munjisthin. Part I. *J. Indian chem. Soc.*, **5,** 631-638.
1928. (With H. BISWAS) On an inductive method for the study of natural products. Part I. The naturally occurring anthraquinone derivatives. *J. Indian chem. Soc.*, **5,** 769-778.
1930. (With H. BISWAS) Synthesis of munjisthin. *Nature, Lond.*, **126,** 761.
1930. Some aspects of biochemical synthesis. *J. Indian chem. Soc.*, **7,** 39-57.
1930. (With S. C. PAL) Nitration of 2-hydroxy-3-methylanthraquinone. *J. Indian chem. Soc.*, **7,** 259-262.
1930. (With A. K. SARKAR) Studies in the anthraquinone series. Synthesis of anthraquinones related to morindone and emodin. *J. Indian chem. Soc.*, **7,** 619-628.
1930. (With H. BISWAS) On munjisthin. Part II. *J. Indian chem. Soc.*, **7,** 839-841.
1931. (With P. K. PAUL) On some derivatives of 4-phenylchroman. *J. Indian chem. Soc.*, **8,** 271-276.
1931. (With R. GOSWAMI) Studies in the anthraquinone series. Condensation of 3, 5-dinitrophthalic acid with toluene. *J. Indian chem. Soc.*, **8,** 685-688.
1931. (With N. N. CHATTERJI) Studies in the anthraquinone series. Synthesis of 1, 6-dihydroxy- and 1, 7-dihydroxy-3-methylanthraquinones. *J. Indian chem. Soc.*, **8,** 783-786.

1932. (With H. C. Ray) Friedel and Crafts' Reaction with phenolic acids. *J. Indian chem. Soc.*, **9,** 247-250.
1932. (With H. Biswas) Über die Synthese des munjisthins. *Ber. dtsch. chem. Ges.*, **65,** 622-625.
1932. (With D. K. Banerjee) Synthesis of aloe-emodin. *J. Indian chem. Soc.*, **9,** 375-377.
1933. Synthesis of anthraquinones occurring in nature. *J. Indian chem. Soc.*, Sir Prafulla Chandra Ray Seventieth Birthday Commemoration Volume, 285-292.
1934. (With S. K. Saha) Studies in the flavone series. *J. Indian chem. Soc.*, **11,** 257-264.
1934. (With N. N. Chatterjee) Synthesis of purine derivatives from glyoxalines. *J. Indian chem. Soc.*, **11,** 867-871.
1934. (With S. J. Das Gupta & S. Bachhwat) Studies in the anthraquinone series. *J. Indian chem. Soc.*, **11,** 893-897.
1935. (With Shyamakanta De) Condensation of succinic anhydride with phenols and phenolic ethers. Synthesis of derivatives of tetrahydronaphthalene. *J. Indian chem. Soc.*, **12,** 747.
1936. (With P. N. Dutt) Condensation of 3- and 4-nitrophthalic anhydrides with phenol and anisole. *J. Indian chem. Soc.*, **13,** 228-235.
1936. (With S. S. Maitra) Studies in the iso-flavone series. *J. Indian chem. Soc.*, **13,** 236-239.
1936. (With Tanima Sen Gupta) Studies in the anthraquinone series. Attempts to synthesise anthraquinone carboxylic acids of the morindone type. *J. Indian chem. Soc.*, **13,** 447-449.
1936. (With D. K. Banerjee) Untersuchungen über miteinander verschmolzene Ringe (I. vorläufig. Mitteil.) *Ber. dtsch. chem. Ges.*, **69,** 456-458.
1937. (With S. C. Ray) Synthesis of substances related to capsaicin. *J. Indian chem. Soc.*, **14,** 421-424.
1939. (With Shyamakanta De) Studies in γ -ketonic acids, Part I. *J. Indian chem. Soc.*, **16,** 35-42.
1939. (With L. K. De) Studies in the γ -ketonic acis, Part II. *J. Indian chem. Soc.*, **16,** 199-208.
1939. (With H. Mukherjee) Action of oxalyl chloride on phenolic ethers. *J. Indian chem. Soc.*, **16,** 393-395.
1939. (With P. N. Bagchi) Studies in long-chain acids. Part I. An extension of the isoprene rule. *J. Indian chem. Soc.*, **16,** 402-404.
1939. (With P. C. Dutta) Studies in long-chain acids. Part II. On aleuritic acid (I.) *J. Indian chem. Soc.*, **16,** 673-676.
1939. Researches in organic chemistry in India, 1896-1923. *Proc. nant. Inst. Sci. India*, **5,** 211-216.
1941. (With P. N. Bagchi) Studies in long-chain acids. Part III. On bis-nor-oleic acid. *J. Indian chem. Soc.*, **18,** 461-464.
1942. (With A. Bose & M. Sen Gupta) On aleuritic acid. *Sci. & Cult.*, **8,** 273.
1942. (With B. K. Bhattacharyya) Studies in long-chain acids. Part IV. *J. Indian chem. Soc.*, **19,** 69-75.
1942. (With S. Mukherjee) Studies in long-chain acids. Part V. On aleuritic acid. *J. Indian chem. Soc.*, **19,** 303-307.
1944. (With M. C. Sen Gupta & A. Bose) Studies in long-chain acids. Part VI. On aleuritic acid. *J. Indian chem. Soc.*, **21,** 295-296.
1944. (With M. C. Sen Gupta) Studies in long-chain acids. Part VII. *J. Indian chem. Soc.*, **21,** 301-302.