



*P. S. Saha*





# **PRAPHULLA CHANDRA GUHA**

**(1894–1962)**

**Elected F.N.I. 1935**

## **BIRTH AND EDUCATION**

PRAPHULLA CHANDRA GUHA was born on February 15, 1894, at Routhbhog in the Bikrampur section of the Dacca district, now a part of Bangladesh. He was the youngest child of Shri Govinda Chandra Guha and Brajalakshmi Guha. His mother whom the present author had the opportunity to know, was a pious lady and had a dominating influence on the life of Guha. His elder brother, Shri Suresh Chandra Guha, was a man of generous qualities from whom the young brother received considerable help of several kinds to remember all his life. He held his elder brother in high esteem. He received his early education in his village High School and passed the Matriculation examination (Calcutta University) in 1911 with High credit. Guha had a uniformly creditable academic career and secured scholarships, prizes and medals at all stages. He had his college education at the Dacca College (Calcutta University) from where he passed the B.Sc. (Hons) Degree examination in Chemistry in 1915 and the M.Sc. Degree in 1917, with the highest distinction.

## **FAMILY**

Professor Guha was married to Srimati Nalinibala, daughter of Late Rajendra Lal Ghosh and Charushila Ghosh. Much of the success of Guha as a scientist, teacher and researcher, was in a large measure due to the help which he received from his wife. She nurtured the energetic and rather impulsive and temperamental Professor and the host of students who worked with him, with a great deal of affection and kindness. She was a true mother to most of us who were associated with Professor Guha at the Indian Institute of Science, Bangalore.

## **RESEARCH CAREER**

Initially, Guha had his research training under the guidance of Dr Watson, who was well known for his researches in dye-stuff-chemistry. After Professor Watson's departure from India, he got in touch with Acharya P. C Ray. This was the turning point in his career, as Sir P. C. Ray took great personal interest in shaping the career of this bright, young scientist. A quotation from Professor P. C. Ray is of interest :





"In 1916, another young man of wonderful energy, pluck and perservance joined my laboratory. This was Praphulla Chandra Guha. He had just passed the B.Sc., from the Dacca College with Honours in Chemistry. Under ordinary circumstances he would have worked under Professor Watson but as the latter had gone home on furlough, Guha found himself nearly stranded. In despair, he wrote to me almost in piteous terms saying that his future career was about to be cut short abruptly and expressing an ardent desire to work under me. I welcomed him to my laboratory and thus began a happy and fruitful partnership. Guha was indefatigable in his labours and had a happy instinctive insight into the mechanism of reactions. I had now taken up the sulphur derivatives of mercury nitrite and he proved to me to be a God-send. In collaboration with him, I published two papers, but he was not long in striking out a path of his own. He has made substantial contributions on the chemistry of sulphur compound and has pointed out the untenability of the formulae of some of these as proposed by such veteran predecessors in the field as Freud, Arndt and Busch and has earned their congratulations. In due course, he came out with flying colours in his academic career also. He secured the first place in his M.Sc. and three years later his Doctorate and was also awarded the Premchand Roychand Scholarship."

Association with the illustrious scientist, reformer and social worker, Professor P. C. Ray, proved to be of great benefit in shaping the character and destiny of Guha. Opportunities and honours came to him in quick succession. He received the *Palit Scholarship*, secured the Doctor of Science (D.Sc.) degree from the Calcutta University in 1923 and was also awarded the prestigious *Premchand Roychand Scholarship* in the same year.

Subsequently, Guha joined the University of Dacca as a Lecturer and then became the Reader in Chemistry in the same Department. His interest in those days was in organo-sulphur compounds.

### *At the Indian Institute of Science, Bangalore*

When Professor J. L. Simonsen retired from the Chair of Organic Chemistry in the Indian Institute of Science, Bangalore, Professor Guha was selected to the Chair. He served the Organic Chemistry Department of the Indian Institute of Science, Bangalore, with great distinction for about 24 years (1928-52). He inspired a generation of students, many of whom have distinguished themselves. The influence of Professor Guha as teacher and guide, was vastly responsible for their success.

## CONTRIBUTION TO NEW KNOWLEDGE

In the Indian Institute of Science, Professor Guha did pioneering work on the synthesis of mono and sesquiter-penoids and bridged bi-cyclic compounds. His investigations also covered stereochemistry, geometrical isomerism, sterichindrance, steric-effects in aromatic substitution and heterocyclic compounds. He initiated work on synthetic drugs, established preparative synthesis for well-known anti-malarials, sulpha drugs, local anaesthetics and many other useful products. He also made significant contribution to our knowledge of turpentine oil containing high proportion





of  $\alpha$ -pinene, structure of rosin acids and other related products. Many derivatives were prepared from menthone and methods were established for the synthesis of  $\beta$ -aryl-glutaconic acids. He also studied the mechanism of addition of diazo compounds to conjugated double bonds with interesting results. Physico-chemical properties, such as parachors of certain bi-cyclic systems, were studied by him and he had drawn conclusions regarding their structure and stereochemistry.

Professor Guha would be particularly remembered for his work on Indian essential oils. He also took a keen interest in the study of other natural products, such as oils and fats, carbohydrates, colouring matters, etc.

During the War, Professor Guha took deep interest in the synthesis of important organic chemicals, many of which were synthesised and produced on substantial scale using indigenous devices. Some of the results directly helped the war effort of the Government.

Professor Guha's activities as a researcher actually covered almost all facets of organic chemistry. His papers, numbering about 300 have appeared in the leading national and international journals.

### QUALITIES

As a person, Professor Guha was generous and hospitable to a fault. He would suddenly invite a large group of his students for lunch and dinner without the slightest notice and would leave the rest to Srimati Guha, who always rose to the occasion to accommodate the impulsive Professor. He took great interest in gardening and maintained one of the finest collections of Dahlias in Bangalore, not a mean feat, as the citizens of Bangalore are well-known for their enthusiasm for floriculture.

He had a large family, with 13 children—6 boys and 7 girls. He and his wife brought them up with great care. All the children did well in life and their professional career. Two of them were ace pilots of the Indian Air Force and sacrificed their lives while in active service.

### LAST DAYS

After retirement in the year 1952, Professor Guha shifted to Calcutta and settled down in the Ballygunge area where he built a house. The later years of his life were not very comfortable.

He was sick for a long time, developed high blood pressure, diabetes and suffered paralytic strokes which practically immobilised him. The death of his two pilot sons had a stunning effect on him. He died on November 6, 1962 and was mourned by a wide circle of friends and a large number of students and admirers.

### HONOURS

In his professional life Professor Guha received many honours. He was elected President of the Chemistry Section of the Indian Science Congress in 1936. He was





also a Foundation Fellow of the Indian Chemical Society, was a member of its Council for many years and also its Vice-President. He was elected a Fellow of the National Institute of Sciences of India (now the Indian National Science Academy) in 1935. He was associated with many other academic and professional bodies. A man of his enthusiasm and dynamism is hard to come by.

### ACKNOWLEDGEMENTS

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S. C. BHATTACHARYYA

### BIBLIOGRAPHY

1919. (With RAY, P. C.) Mercury mercaptide nitrites and their reaction with the alkyl iodides IV chain compounds of Sulphur. *J. chem. Soc.*, **115**, 261-271.  
 — (With RAY, P. C.) Mercury mercaptide nitrites and their reaction with the alkyl iodides V chain compounds of sulphur. *J. chem. Soc.*, **115**, 541-548.  
 — (With RAY, P. C.) Mercury mercaptide nitrites and their reaction with the alkyl iodides VII chain compounds of sulphur. *J. chem. Soc.*, **115**, 1148-1155.  
 — (With RAY, P. C., and DAS, R. K.) Reaction of Potassium salts of 2-thiol-5-thio-4-phenyl-4,5-dihydro-1,3,4-thiodiazole and 2,5-dithiol-1,3,4-thiodiazole with halogenated organic compound. *J. chem. Soc.*, **115**, 1308-1312.
1922. Constitution of the so-called dithiourazole of Martin Freund. *J. Am. chem. Soc.*, **44**, 1502-1510.  
 — New methods of synthesis, isomerism and polyderivatives. *J. Am. chem. Soc.*, **44**, 1510-1517.
1923. Ring closure of hydrazodithio- and monothiodicarboxamides with acetic acid. *J. Am. chem. Soc.*, **45**, 1036-1042.
1924. (With DEY, S. C.) Preparation of thiocarbohydrazine-mono- and di-thio-*p*-urazine. *J. Am. chem. Soc.*, **105**, 1215-1218.  
 — (With DEY, S. C.) Hetero-ring formations with thiocarbohydrazide. *Q. J. Indian chem. Soc.*, **1**, 141-149.
1925. (With RAY, H. P.) Constitution of the so-called dithiourazole of Martin Freund. III. Synthesis of some monosubstituted thio-diazoles. *J. Am. chem. Soc.*, **47**, 385-390.  
 — (With CHAKLADAR, M. N.) Dithiocatechol. *Q. J. Indian chem. Soc.*, **2**, 318-335.  
 — (With DEY, S. C.) Hetero-ring formations with thiocarbohydrazide II condensation with diketones and aldehydes. *Q. J. Indian chem. Soc.*, **2**, 225-239.  
 — (With RAY, S. K.) *O*-Aminophenylhydrazine and some heterocyclic compounds derived from it. *Q. J. Indian chem. Soc.*, **2**, 83-94.
1926. (With DEY, M. K.) *O*-Aminophenyl hydrazine and some interesting heterocyclic compounds derived from it II synthesis of azoles, azines, heptazines and octazines. *Q. J. Indian chem. Soc.*, **3**, 41-58.
1927. (With GUHA, S. C.) Action of different ring-closing agents upon 4-R-thiosemicarbazide-dithiocarboxylates and 4-R-semicarbazide-dithiocarboxylates-formation of different types of thiobiazoles and oxybiazoles. *Q. J. Indian chem. Soc.*, **4**, 161-172.  
 — (With GUHA, S. C.) Formation of heterocyclic compounds I. Action of methyldithiocarbazinate on *O*-diketones and their monoximes and on chlorides and esters of dibasic acids. *Q. J. Indian chem. Soc.*, **4**, 239-246.





- (With SEN, P. C.) Action of urea upon thiosemicarbazides-simultaneous formation of thiol-ketotriazoles, aminoketothiodiazoles, endoxytriazoles and aminothioltriazoles. *Q. J. Indian chem. Soc.*, **4**, 43-50.
- (With GHOSH, T. N.) *O*-Aminophenyl hydrazine and some interesting heterocyclic compounds derived from it III. Lengthened *o*-derivative of benzene and their ring closure. *Q. J. Indian chem. Soc.*, **4**, 561-572.
- 1928. (With ROY, S. N.) Hetero-ring formation of thiocarbohydrazide III. Reactions of substituted thiocarbohydrazides. *J. Indian, Chem. Soc.*, **5**, 149-161.
- (With GHOSH, T. N.) *O*-Aminophenol-hydrazine and some interesting heterocyclic compounds derived from it IV. Lengthened *O*-derivatives of benzene and their ring closure. *J. Indian chem. Soc.*, **5**, 439-451.
- (With ROYCHOWDHURY, S. N.) Hetero-ring formation with thiocarbohydrazide IV. Reactions of 1-phenol-thiocarbohydrazide. *J. Indian chem. Soc.*, **5**, 163-174.
- (With BANERJEE, K.) Bis-semidione imersion in aromatic dihydrazo compounds. *J. Indian Inst. Sci.*, **11A**, 231-239.
- (With CHAKLADAR, M. N.) Extension of Michael Reactions. *Proc. 15th Indian Sci. Congr.*, 150.
- (With DUTTA, N. C.) *Cis-trans* isomerism in ethyl carbethoxythiocarbamate. Synthesis of four, five, six and seven membered heterocyclic compounds from ethyl carbethoxythiocarbamate. *Ibid.*, 157.
- (With CHAKLADAR, M. N.) Action of hydroxylamine upon mustard oil : formation of dianiline—1,2,5—oxdiazole. *Ibid.*, 157.
- 1929. (With DUTTA, D. N.) Formation of heterocyclic compounds from ethylxanthioformate. *J. Indian chem. Soc.*, **6**, 65-82.
- (With CHAKRABORTY, T. K.) Ring closure hydrazomonothiodicarboxamides with acetic anhydride. Formation of iminothiodiazolones and iminothioltriazoles. *J. Indian chem. Soc.*, **6**, 99-110.
- (With GHOSH, T. N.) Attempts to synthesize *O*-thiolphenolhydrazine. *J. Indian Inst. Sci.*, **12A**, 31-35.
- 1930. (With JANNIAH, SHAHA L.) Constitution of the so-called dithiourazole Martin Freund. IV. Isomerism of hydrazodithiodicarboxamides, iminothiolthiobiazoles and iminothiobiazolones. *J. Am. chem., Soc.*, **52**, 4806.
- (With MISTRY, S. M.) An improved method of preparation of substituted amides and hydrazides. *J. Indian chem. Soc.*, **7**, 793-797.
- (With HAI, Md. A.) Monosubstituted carbohydrazines, their typical derivatives and formation of heterocyclic compounds from them. *J. Indian chem. Soc.*, **7**, 933-944.
- 1931. (With MENON, B. K.) Attempted asymmetric synthesis of sulphur compounds. *Ber.*, **64B**, 544-546.
- (With ARNDT, F.) Ring-closure of *O*-aminophenol semicarbazides to benzotriazines. *J. Indian chem. Soc.*, **8**, 119-202.
- (With IYER, B. H.) Cantharidine from *Mylabris pustulata* Fb., India. *J. Indian Inst. Sci.*, **14A**, 31-39.
- 1932. (With MISTRY, S. M.) Aryldi- and poly-stiboric acids distibinous oxides and di-stilino compounds. *J. Indian Inst. Sci.*, **15A**, 25-40.
- (With MAYURANTHAN, P. S.) Bridge formation. II. Formation and stability of a bridge, cyclohexanone, 1-dimethylkethane-III cyclobutan-2-one. *J. Indian Inst. Sci.*, **15A**, 131-137.
- (With PATEL, P. P.) Bridge formation. I. Attempts to synthesize bicyclic terpene derivatives by a new method, *Ibid.*, **15A**, 125-130.
- 1933. (With JANNIAH SHAH, L.) Constitution of the so-called dithiourazole of Martin Freund. V. Isomerism of hydrazodithiodicarboxamides, iminothiolthiobiazoles and di-R-iminothiobiazoles. *ibid*, **16A**, 11-18.





1933. (With JANNIAH SHAH, L.) Constitution of the so-called dithiourazole of Martin Freund VI. Isomeration of hydrazomonothiodicarboxamides, iminothiobiazolones and monothiourazoles. *ibid*, **16A**, 19-27.
- (With DASGUPTA, R. C.) Synthesis of Pinene: Synthesis of *cis* and *trans* ketonorpnic acids. *Curr. Sci.*, **2**, 52-53.
- (With GAIND, K. N.) Synthesis of norpinic acid. *J. Indian chem. Soc.*, **11**, 421.
- (With GAIND, K. N., and MEHTA, D. R.) Synthesis of bicyclic compounds. *Curr. Sci.*, **2**, 53.
- (With RAO, V. ANNA). Walden inversion. I. Dependence of the direction of reaction in the Walden inversion upon the numbr of free carbonyl group. *J. praxd. Chem.*, **138**, 167-183.
- (With MAZUMDER, D. N.) Indian Medicinal plants I. *Ania somnifora*. *J. Indian Inst. Sci.*, **16A**, 29-33.
- (With MAZUMDER, D. N.) Indian Medicinal plants II. *Swertia chirreta*. *Ibid*, 34-39.
- (With PATEL, S. M.) Bisiminocamphor derivatives with exalted optical activity. *Curr. Sci.*, **2**, 97-98.
- (With GHOSH, T. N.) Extension of Michael's reaction III. *J. Indian Inst. Sci.*, **16A**, 103-112.
- (With MAZUMDER, D. N.) Heterocyclic compounds from derivatives of ethyl carbanate. *J. Indian chem. Soc.*, **10**, 685-692.
- (With MAZUMDER, D. N.) Conversion (hetero-ring formation with thiocarbohydrazide) IV. Reactions of 1-phenyl-thiocarbohydrazide. *J. Indian chem. Soc.*, **10**, 692.
1934. (With PAREKH, V. C.) Synthesis of *p,p'*-diphenylene disulphide. *J. Indian chem. Soc.*, **11**, 95-100.
- (With GANGULLY, S. K.) Chemical Investigation of the high-boiling bases from Anthracene oil. *J. Indian chem. Soc.*, **11**, 197-206.
- (With ANNA RAO, V.) Walden imersion : II. The mutual conversion of the tartaric acids by the Walden inversion : Conversion of meso-tartaric acid into active tartaric acids. *Ber.*, **67B**, 741-749.
- (With ANNA RAO, V.) Conversion of meso-tartaric acid into an optically active form by Walden inversion under asymmetric conditions. *Curr. Sci.*, **2**, 479-480.
- (With GAIND, K. N.) Two new methods of synthesis of norpinic acid. *Curr. Sci.*, **2**, 479.
- (With ANNA RAO, V.) The Walden inversion III. Conversion of meso-tartaric acid with and optically active form under asymmetric conditions. *Ber.*, **67B**, 1358-1362.
- (With SESHADRIENAGAR, N. K.) New method of synthesis of bicyclic terpenes : synthesis of ethyl cyclohexanone-2,6-dicarboxylate. *Curr. Sci.*, **3**, 20-21.
- (With GAIND, K. N.) Two new methods of synthesis of norpinic acid. *J. Indian chem. Soc.*, **11**, 421-425.
- (With KOTNIS, M. S., and SANJIVA RAO, B.) Optical reaction. Rotary powers of oxylbiscamphor-quinone hydrazones and camphorylthiocarbamyl hydrazides and attempts to prepare compounds processing abnormal rotation. *J. Indian chem. Soc.*, **11**, 579-593.
- (With RAMASWAMY, M. N.) Attempts to synthesise uric acid from nine-membered cycloids. *J. Indian chem. Soc.*, **11**, 811-822.
- (With Patel, S. M.) Bisiminocamphor derivatives with exalted optical activity. *J. Indian chem. Soc.*, **11**, 87.
1935. (With JAGANNATH HEGDE, B., and SANJIVA RAO, B.) Indian Coal tar. *J. Indian Inst. Sci.*, **18A**, 15-18.
- (With RÁMASWAMY AYYAR, P.) The steric factors in organic chemical reactions, Part I, Influence of esterification on the mode of addition of bromine to  $\beta$ -phenylpropionic acid. *J. Indian Inst. Sci.*, **18**, 123.
- (With KOTNIS, M. S., and SANJIVA RAO, B.) Studies in Indian Essential oils VII. Essential oil from the flower heads and stalks of *Cymbopogen polyneuros*, stapf. *J. Indian Inst. Sci.*, **18**, 129.
- (With GANAPATHY, K.) Synthesis of pinononic acid. *Curr. Sci.*, **3**, 484-485.
- (With RANGANATHAN, S. K.) Bicyclo [1, 2, 3] octane-2,4-dione, *Curr. Sci.*, **4**, 26.





- (With SESHADRIANAGAR, N. K.) Action of trimethylene bromide on acetoredicarboxylic ester, A new and more convenient method of synthesis of ethyl cyclohexanone-2,6-dicarboxylate. *Curr. Sci.*, 4, 158.
- (With GANAPATHY, K.) Synthesis of "Ketonopinone" (4,6-diketopinane). *Curr. Sci.*, 4, 312-413.
- 1936. (With GANAPATHY, K.) Synthetic experiments in the pinane group I. Synthesis of pinonic acid and "Ketonopinone" (4,6-diketopinone), *Ber.*, 69B, 1185-1194.
- (With RANGANATHAN, S. K.) Synthetic experiments in the camphor group. I. Attempts to synthesize apocamphorquinone. *Ber.*, 69B, 1195-1198.
- (With RANGANATHAN, S. K.) Synthetic experiments in the camphore group II. A synthesis of ketohomonorcamphor bicyclo (1,2,3)-octene-2,4-dions. *ibid*, 1199-1206.
- (With SESHADRIENGAR, N. K.) Synthetic experiments in the thujane group I. Synthesis of ketopolymethylene-1,3-dicarboxylic esters. *Ber.*, 69B, 1207.
- (With SESHADRIENGAR, N. K.) Synthetic experiments in the thujane Group II. Synthesis of northujone-2,6-dicarboxylic esters. *ibid*, 1212-1218.
- *p*-Bridging of succinosuccinic esters. *Curr. Sci.*, 5, 19-20.
- (With GANAPATHY, K.) Synthesis of trans-syn-homopinonic acid. *Curr. Sci.*, 5, 244.
- 1937. (With RANGANATHAN, S. K.) Resolution of bicyclo (2,2,2)-octane-2,5-dione-1,4-dicarboxylic acid. *Curr. Sci.*, 5, 387.
- (With SANKARAN, D. K.) A new method of synthesis of Caronic acid homocaronic acids. *Curr. Sci.*, 5, 388.
- (With SANKARAN, D. K.) A new method of isodihydroapocamphoric acid. *ibid*, 388-389.
- (With SUBRMANIAN, V. K., and SANKARAN, D. K.) Synthetic experiments in the pinone group II, Attempted synthesis of pinocamphone and synthesis of trans-syn-homopinonic acid. *Ber.*, 70B, 736-742.
- (With ANNA RAO, V.) Influence of phenyl and carboxyl groups on the course of reaction in Walden inversion processes. *Curr. Sci.*, 5, 650.
- (With SANKARAN, D. K.) Synthetische Versuche in der camphor-Reiche, III, Mittell. Eine neue methoden für synthese von iso-dehydrocamphensaure und 4-cyclopentenedicarbonyl (1.3). *Ber.*, 70, 2109.
- (With SUBRAMANYAN, K. S.) Synthetische versuche in der camphor-Reiche, IV, Mitteil Eine dicke synthese von dihydrolauronolsaure und iso-lauronolsaure. *Ber.*, 70, 2228.
- (With BOLA NATH) Synthetic experiments in the thujane group III. Synthesis of thujene. *Ber.*, 70B, 931-936.
- (With GANAPATHY, K., and SUBRAMANIAN, V. K.) Synthetic experiment in the pinane group III. Synthesis and configuration of pinic acid. *Ber.*, 70B, 1505-1512.
- (With SANKARAN, D. K.) Synthetic experiment in the carane group I. Synthesis of 2,2-dimethylcycloheptane-1,3-dicarboxylic acid. *Ber.*, 70B, 1683-1688.
- (With SANKARAN, D. K.) Synthetic experiment in the carane group II. A new method for the synthesis of caronic acid homocaronic acid. *ibid*, 1688.
- (With KRISHNAMURTY, S.) Synthesis of thujane. *Curr. Sci.*, 6, 56-57.
- 1938. (With NARASIMHA RAO, P. L.) Synthetische versuche in der Pinan-Gruppe, IV. Mitteil : Versuche Zur Synthese Von Pinon saure. Synthesen von trans-2,2-dimethyl-3-acetonyl-cyclobutan-carbonsaure-(1), Die konstitution der Ketocarbonsaure C<sub>10</sub>H<sub>16</sub>O<sub>3</sub> von Fujita. Eine kurze Mitteilung über die synthese von Nopinon and Verbenon.
- (With NARASIMHA RAO, P. L.) Synthetische versuche in der Pinan-Gruppe, V Mitteil. : Konfiguration von Brom-und oxy-Pinsauren. *Ber.*, 71, 2663.
- (With MUTHANNA, M. S.) Synthetische versuche in der Thujan-Gruppe, VI. Mitteil. Eine neue verfahren zur synthese der umbellulasaure; versuche zur darstellung von Thyujadicarbonsaure und Thujaketonsaure. *Ber.*, 71, 2668.
- (With MEHTA, D. R.) Constitution of the so-called dithiourazole of Martin Freund. Ring Closure of hydrazodithiodicarbonamide and its mono- and di-substituted derivatives.





- J. Indian Inst. Sci.*, **21A**, 41, 52, 57, **52**, Part VII. Action of heat. Part VIII. Action of Sodium hydroxide. **57** Part IX. Action of hydrochloric acid. Part X. Action of Acetic anhydride.
- (With JANNIAH, S. L.) Constitution of the so-called dithiourazole of Martin Freund. Part XI. Isomeric Changes of some triazoles and thiobiazoles. *J. Indian Inst. Sci.*, **21A**, 60.
- (With GANAPATHY, K.) The Chemotherapy of Bacterial Infections. Part I, Synthesis of some derivatives-sulphomilamide. *J. Indian chem. Soc.*, **15**, 525.
1939. (With NARASIMHA RAO, P. L.) Synthetical experiments in the pinane group Part VII. Total synthesis of verbenone: A new total synthesis of  $\alpha$ - and  $\beta$ -pinenes. *J. Indian Inst. Sci.*, **23A**, 326.
1939. (With MUTHANA, M. S.) Synthetical investigations in the Thujana series. Part IX. A new method of synthesis of umbellujeric acid. *ibid*, **22A**, 275.
- (With MUTHANNA, M. S.) Synthetical investigations, in the Thujane series. Part X. Experiments on a total synthesis of Thujane : Synthesis of an isomer of  $\alpha$ -Thuja-dicarboxylic acid (1-*iso* prophyl-1-carboxy-cyclopropyl-3-acetic acid). *ibid.*, **22A**, 278.
- (With MUTHANNA, M. S.) Synthetical investigations in the Thujane Series Part XI. Synthesis of an isomer of  $\alpha$ -Thujadicarboxylic acid (1-*isobutyl*-cyclopropane-1 : 2-dicarboxylic acid). *ibid.*, **22A**, 282.
- (With Guha, P. C.) Para-Brückenbildung beim succinylobern-steinsaure-athyl ester, I. Mitteil. Bildung von Bicyclo-[1.2.2]-heptan-, Bicyclo-[2.2.2]-Octan- und Bicyclo-[3.2.2]-nonan systemen. *Ber.*, **72**, 1359.
- (With KRISHNAMURTY, C.) Para-Brückenbildung beim succinoylbernstein-saure-athyl ester, II. Mitteil. : Synthese von Dicarboxy-substeinsaure-ester seine cyclisation zu bicyclo-[2.2.2]-octandion durch doppelte. Dickmannsche condensation. *Ber*, **72**, 1374.
- (With RANGANATHAN, S. K.) Zerlegung der Bicyclo-[2.2.2]-octandion-(2.5)-dicarbonsaure-(1.4) in die Optischen Antipode. *Ber.*, **72**, 1379.
- (With RANGANATHAN, S. K.) Experiments towards the synthesis of physiologically active lactones, Part I. cyclopentyl and cyclohexylsuccinic acids. Resolution of *dl*-cyclopentylsuccinic acid. *J. Indian chem. Soc.*, **16**, 107.
- (With HAZRA, G. D.) Investigations on the nature of addition of aliphatic diazo-compounds to conjugated double bonded systems. Action of diazomethane and ethyl diazo acetate upon cyclopenta- and cyclohexadienes and their derivatives. *J. Indian Inst. Sci.*, **22A**, 263.
1940. (With NARASINHA RAO, P. L.) Chemotherapy of bacterial infections. Part I. Substances related to Sulphanilamide. Synthesis of *p*-amino-benzylphonamide and its derivatives. *J. Indian chem. Soc.*, **17**, 227.
- (With RAJAGOPALON, S.) Synthetical experiments in the group of sympathomimetics. Part I. The naphthalene series. *ibid.*, **17**, 567.
1941. (With SUBRAMANIAN, K. S. and SREENIVASAN, V. R.) Synthetical experiments in the camphane series. Part VI. Synthesis of homocamphoronic acid. *J. Indian Inst. Sci.*, **23A**, 191.
- (With NARASINHA RAO, P. L.) Chemotherapy of bacterial infections. Part II. Chemistry of some organoselenium compounds related to sulphanilamide. *J. Indian chem. Soc.*, **18**, 1.
- (With ROY, A. N.) On the utilisation of Indian turpentine oils. Part III. (1) Catalytic isomerisation  $\alpha$ -pinene and  $\beta$ -pinene to camphene, (2) Synthesis of camphor from pinene-camphene mixture. *J. Indian Inst. Sci.*, **23A**, 217.
1942. (With MEHTA, D. R. and RAMASWAMI AYYAR, P.) Bromination of ortho-nitrotoluene, and the steric effect of the bromine atom on the relative yields of the 4- and 6 bromo-derivatives, *Univer. Bomb.*, **10**(5), 99.
1944. (With BHATTACHARYYA, S. C.) Studies in the santalol series. Part II. Synthesis of *d*- and *dl*-hydroxy-camphor, *d* and *dl* teresantalol, *d* and *dl*-tricycloeka-santallic acid. *J. Indian chem. Soc.*, **21**, 271.
- (With BHATTACHARYYA, S. C.) Studies in the santalol series. Part I. Separation of the santalols and the santalenes. *J. Indian chem. Soc.*, **21**, 261.
- (With BHATTACHARYYA, S. C.) Studies in the santalol series. Part IV. Chemistry of Guerbet's Santallic acid. *J. Indian chem. Soc.*, **21**, 333.





- (With BHATTACHARYYA, S. C.) Studies in the santalol series. Part VI. A note on the parachor of fused ring structure. *J. Indian chem. Soc.*, **21**, 339.
- (With BHATTACHARYYA, S. C.) Studies in the santalol series. Part V. Isolation of  $\beta$ -santalolic acid. A new constituent of sandalwood oil. *J. Indian chem. Soc.*, **21**, 337.
- (With KRISHNA MATTER, R.) Studies on anaesthetics and local anaesthetics. N-substituted Amides and Esters of Nicotinic, Picolinic, and Iso-Nicotinic Acids. *Curr. Sci.*, **13**, 206.
- (With NARASINHA RAO, P. L., and VERGHESE, G. T.) A new synthesis of  $\delta$ -diethylamino-*iso*-pentyl amine required for the preparation of atebtrin. *J. Indian chem. Soc.*, (New Edn.), **7**, 163.
- (With RAJAGOPALAN, S., and VENKATACHAM, K.) Experiments in the group of Sympathomimetics. V. Relation between chemical constitution and pressor activity of possible sympathomimetics derived from benzene, naphthalene, phenanthrene and isoquinoline rings. *Proc. Indian Acad. Sci.*, **20A**, 175.
- 1945. (With ROY, A. N.) Studies in sulphanilamides. Part II. Synthesis of sulphanilamide compounds possessing seleno-heterocyclic rings. *J. Indian chem. Soc.*, **22**, 82.
- (With IRANI, R. J.) Studies in the synthesis of some substituted benzenesulphonamides. Part III—A simple new method of synthesis of some N-substituted. Axobenzene-4,4'-disulphonamides. *Curr. Sci.*, **14**, 326.
- (With BAMI, H. L., and IYER, B. H.) Some N' & N<sup>4</sup> alkylene bis sulfanilamides. *Sci. Cult.*, **11**, 269.
- (With IRANI, R. J.) Synthesis of two new N'-substituted *p*-acetamino-benzene sulphonamides and the corresponding free *p*-amino compounds. Part IV. *Curr. Sci.*, **14**, 327.
- 1946. (With BAMI, H. L.) Antimalarials III, Preparation of Paludrine. *J. Indian Inst. Sci.*, **29A**, 1.
- (With DORASWAMY, K. R.) Studies in sulphanilamides. N'- and N''-substituted sulphanilamides; Schiff's bases of sulphapyridines and sulphathiazole. Part III. *J. Indian chem. Soc.*, **23**, 273.
- (With DORASWAMY, K. R.) N' and N<sup>4</sup>-substituted sulphanitamides; Acyclic acyl derivatives of sulphathiazole and sulphapyridine. Part IV. *ibid.*, **23**, 275.
- (With DORASWAMY, K. R.) N'- and N<sup>4</sup>-substituted sulphanilamides : cyclic acyl derivatives of sulphathiazole and sulphapyridine. Part V. *ibid.*, **23**, 277.
- (With DORASWAMY, K. R.) N'- and N<sup>4</sup>-substituted sulphanilamides, azo-dyes derived from sulphathiazole and sulphapyridine. Part VI. *ibid.*, **23**, 278.
- (With DORASWAMY, K. R.) N'- and N<sup>4</sup>-substituted sulphanilamides : N'-sulphonyl derivatives of sulphapyridine and sulphathiazole. Part VII. *ibid.*, **23**, 281.
- (With SWAMINATHAN S.) *p*-Acetsulphanilamide derivatives substituted in N<sup>4</sup>-position by mono and disubstituted thiourets. Part VIII. *ibid.*, **23**, 319.
- (With SWAMINATHAN, S.) N<sup>4</sup>-sulphanilamide derivatives of phenyl dialkyl thiol pseudo-dithiobiure. Part IX. *ibid.*, **23**, 324.
- (With BAMI, H. L., and IYER, B. H.) Some azodyes of ethylene *bis*-N'-sulfanilamide. *Sci. Cult.*, **12**, 153.
- (With BAMI, H. L., and IYER, B. H.) Some anils and diacryls of ethylene *bis*-N'-sulfanilamide. *ibid.*, **12**, 152.
- (With BAMI, H. L., and IYER, B. H.) Aliphatic acyls of ethylene *bis*-N'-sulfanilamide. *ibid.*, **12**, 154.
- (With BAMI, H. L., and IYER, B. H.) Paludrine. *ibid.*, **12**, 448.
- 1947. (With BHATTACHARYYA, S. C.) Studies in the santalol series. Part XIII. Synthesis of  $\alpha$ -Santalol acid and a new synthesis of  $\alpha$ -santalol. *Sci. Cult.* **13**, 208.
- (With BHATTACHARYYA, S. C.) Conversion of  $\alpha$ -santalol to  $\beta$ -santalol and  $\alpha$ -santalene to  $\beta$ -Santalene. Part XII. *ibid.*, **23**, 207.
- (With BHATTACHARYYA, S. C.) Synthesis of bicycloekasantalic acid and its degradation products. Part X. *ibid.*, **13**, 159.
- (With BHATTACHARYYA, S. C.) Synthesis of  $\beta$ -santalol and  $\beta$ -santalolic acid Part XIV. *ibid.*, **13**, 209.
- 1947. (With IYER, B. H., and BAMI, H. L.) Studies in sulphamildes. Some N' and N<sup>4</sup>-alkylene bis-sulphanilamides. Part X. *J. Indian. Inst. Sci.*, **24**, 31.





- (With IYER, B. H., and BAMI, H. L.) Some azo dyes of ethylene-*bis*-N'-sulphanilamide. Part XI. *ibid.*, 24, 35.
- (With IYER, B. H., and BAMI, H. L.) Some dianils and diacyls of ethylene-*bis*-N'-sulphanilamide and some N'-sulphanilamidoaliphatic esters. Part XII. *ibid.*, 24, 129.
- (With IYER, B. H., and BAMI, H. L.) Antimalarials IV, Ammonolysis of aliphatic ketones with hydrogenation. *J. Indian Inst. Sci.*, 29A, 9-14.
- (With JAIN, B. C., and IYER, B. H.) Reaction with dicarboxylic acids. Some new N'- and N<sup>4</sup>-acyl and heterocyclic derivatives. Part XIII. *J. Indian chem. Soc.*, 24, 173.
- (With JAIN, B. C., and IYER, B. H.) Some new N<sup>4</sup>-heterocyclic acylsulphanilamides. Part XIV. *ibid.*, 24, 177.
- (With BAMI, H. L., and IYER, B. H.) Antimalarials, sulfabiguanide derivatives. *Curr. Sci.*, 16, 252.
- (With BAMI, H. L., and IYER, B. H.) Ammonolysis of aliphatic ketones with hydrogenation. *ibid.*, 16, 253.
- 1948. (With SUKH DEV) Studies in sesquiterpenes. Part V. The essential oils from the Oleo-Resin of *Hardwickia pinnata*. *J. Indian chem. Soc.*, 25, 495.
- (With SUKH DEV) Structure of cadenenic sesquiterpene present in the oil from oleoresin of *Hardwickia pinnata*. Part VI. *J. Indian. chem. Soc.*, 26, 263.
- (With BAMI, H. L., and IYER, B. H.) Antimalarials, sulfabiguanide derivatives. *Cur. Sci.* 17, 90.
- (With BAMI, H. L., and IYER, B. H.) Recent advances in the chemistry of sulfanilamides, 1940-1947. *Sci. Cult.*, 13, 406.

