Sambasiva Swaminathan (1923–2020)

Professor Sambasiva Swaminathan, known to many of us as Professor SS and 'Sama' to his close friends, one of the senior most and distinguished organic chemists of this country passed away on 24 February 2020 at the age of 97 at his residence in Chennai. It was only a week before (on 17 Feb), one of the authors and his former Ph D student (SCN) visited him and had long chat with him about his health. While he appeared cheerful at that time, it was clear that he was slowly sinking and the end came a week later. It is truly the end of an era.

Swaminathan was born on 20 April 1923 at Madras (now Chennai), Tamil Nadu, India. He received his college education at Annamalai University, Chidambaram and passed with Honors in Chemistry in 1943. Immediately thereafter, he joined the Indian Institute of Science, Bangalore, where he worked with P. C. Guha and was awarded the Associateship of the Institute (AIISc), equivalent to a Master's degree, by thesis (1946). In those days it was rather unusual for a talented young man to take to a career in science rather than the Civil Service that was most attractive. His passion for chemistry, however, propelled him to take up a career in chemistry. Swaminathan was offered a Government of India Scholarship to work with H. R. Snyder at the University of Illinois, Urbana-Champaign, USA. After being awarded the Ph D degree in 1949, he moved to the Ohio State University to work as a post-doctoral fellow with M. S. Newman for three years. Subsequently he worked as a Research Chemist for a few months with Upjohn & Co. At this stage SS decided to go back to India and start his independent academic research. In 1953 he joined the Department of Organic Chemistry, University of Madras as a Reader and he continued this association for over five decades. He took upon himself the task of building up a modern organic chemical research laboratory in Madras. In 1960 he became Professor and Head of the Department and in the following years the department became one of the most active and visible centers of research in organic chemistry in India. SS established strong interactions with the academic community in the country and organized joint Symposia and Seminars. In all such gatherings, after presentation, SS used to raise questions in his booming voice with a slight Yankee slang 'I do not understand this. I doubt it', very often to stimulate the younger audience.

Swaminathan received many awards and recognitions for his outstanding contributions to organic chemistry including the Prof. T. R. Govindachari Award (1980), the Sir P. C. Ray Medal (1981), a Life-time Achievement Award of the Chemical Research Society of India (2001), Fellowships of Indian Academy of Sciences (Bangalore) and Indian National Science Academy (New Delhi). He mentored over 35 Ph D students and many of his students now occupy important positions in industry and academia.

He was one of the five Founding-Trustees of the National Organic Symposium Trust (NOST) formed in 1983 for periodically organizing Symposia in Organic Chemistry in India. His association with NOST may be considered equally important as his research contributions. He had closer interactions with T. R. Govindachari when they were together in Illinois and it continued after SS joined Madras university. TRG had an active Research Group at Presidency college, Madras by this time. He teamed with TRG to embark on the ambitious project of establishing the NOST. He offered his house for official address of the Trust and he and TRG seeded the NOST fund with contributions of Rs 1000 each, a substantial sum in the year 1983. With enthusiastic participation from other stalwarts in organic chemistry at that time, Drs Nitya Anand, Sukh Dev and S. C. Bhattacharyya, a board of trustees was formed thus planting a seed. Lo and behold, today NOST has grown into a mighty oak from the little acorn. This organization continues to promote interactions among active organic chemists from India and abroad and has become a global platform for discussion of organic chemistry and related interdisciplinary areas. SS was also actively associated with the activities of Madras Science Association formed in 1969 to promote the popularization and teaching of science.

Swaminathan made significant contributions in the following areas: (1) synthetic approaches to non-aromatic steroids; (2) molecular rearrangements; (3) alicyclic chemistry; (4) chemistry of indole and related heterocycles; (5) stereochemistry of hindered benzophenones and related compounds; and (6) asymmetric synthesis.

Swaminathan was one of the earliest to synthesize the well-known and important intermediate known as, Wieland–Miescher ketone on a preparative scale and elaborated it to the synthesis of non-aromatic steroids. He was also the first to develop an efficient synthesis of 2-methyl-cyclopentane-1,3-dione used as a pre-formed ring D in many steroid syntheses reported in later years.

Perhaps the most important contribution by SS and his group was the discovery in 1962 of a novel molecular rearrangement leading to a two-carbon ring expansion. The first report described the rearrangement of a certain class of allyl alcohols to the ring enlarged diketones when treated with a base. Several studies bearing on the scope of this rearrangement and also its mechanistic aspects were carried out. Incidentally, this reaction was the first example reported in the literature of a rearrangement which came to be known as 'anionic oxy-Cope rearrangement'. Ideally, this reaction should have been named after Swaminathan. Such anionic oxy-Cope rearrangements came into great prominence in 1975 for the synthesis of many carbocyclic systems. From further studies of the rearrangements, SS reported that transannular interactions occur along with ring expansion. He also worked out the synthesis of benzotropones based on the anionic oxy-Cope rearrangement. His group demonstrated that the mechanism of the base catalysed rearrangement of an

oxy-Cope system could be either concerted or stepwise, depending on the solvent and the reagent used. With a view to extending the scope of the anionic oxy-Cope rearrangement, SS synthesized a number of bicyclic diketones of potential use in the synthesis of natural products. The crowning glory of his contributions came in January 2020 when Kohei Inomata, a Japanese colleague published a paper on the chiral synthesis of 'Swaminathan Ketone' paying rich tributes to SS's pioneering work on the synthesis of this class of compounds.

In other studies, on acetylenic compounds, Swaminathan reinvestigated the Diels–Alder reaction of acetylenic ketones with cyclopentadiene and showed that the adducts obtained were dimeric in nature. He also reported the photochemistry of these dimers. SS and his group were the first to show that contrary to the earlier belief, 3-substituted indoles undergo the Mannich reaction to give N-Mannich bases. He also developed new practical synthesis of thieno [2,3-b] and thieno [3,2-b] pyrrole systems. His work on the synthesis of 6-aryl-4-methoxy-α-pyrones turned out to be very useful because these compounds are analogues of the naturally occurring Marindenin and as such are potential tranquilizers.

Swaminathan's group made significant contributions to the field of stereochemistry as well. He demonstrated for the first time the existence of optical isomerism caused by steric interactions in suitably substituted benzophenone derivatives. Interest in the stereochemistry of similarly substituted diphenyl ethers led SS to obtain evidence for the participation of an ortho-substituted carbonyl group in aromatic nucleophilic substitution reactions. This was the first convincing chemical evidence for the participation of a neighbouring group in aromatic nucleophilic substitution reactions.

Although he retired formally in 1983, he continued his research with considerable enthusiasm and passion to embark on the challenging area of asymmetric synthesis. He published an important paper in 2004 on the chiral synthesis in the absence of solvent of the important Wieland–Miescher and Hajos–Parrish diketones after his 80th birthday! A remarkable feat indeed!

SS was an excellent teacher, researcher and mentor. He was one of those way ahead of his time in terms of his views and attitudes. For a man of his generation, he abhorred hierarchy and practised egalitarianism. He was fiercely independent and brutally frank in expressing his views, sometimes to the detriment of his professional interests. Generally, when he talked people listened attentively. He had that command over people. Having spent all his academic life in the University system in India, he always felt that the State Universities were not getting their due. Whenever he had an opportunity, he fought for the rights of the students and faculty of the universities and championed their cause.

When this author (SCN) joined Swaminathan as a graduate student in 1968, senior students in the laboratory used to talk about an incident that took place in the department a few years earlier demonstrating his presence of mind and act of bravery. One day when he was sitting in the office, he heard a lot of commotion in the research laboratory of his colleague. He rushed out of his office and saw a young student of his colleague engulfed in a ball of fire. Some of those who were present were shell-shocked and dumbfounded and did not know what to do. In a split second, Swaminathan jumped in, pulled the student out of the fire, provided first-aid, put him in his car and drove to the hospital. That day, he saved the life of a young student. This was an act worthy of folklore and awe. The student not only did survive but years later, he pursued chemistry with passion and served with distinction as a Professor in an IIT.

One of the authors (KN), although not his student and seven years younger than SS, established cordial relations with him and their friendship flourished with frequent visits to both his lab and home. In fact, in 1960 when KN wanted to return to India, SS encouraged him to apply for a vacant Readership in the Organic Chemistry Department at Madras University which KN dearly coveted but it was not to be.

Swaminathan's passing is a great loss to the community of organic chemists and to the NOST that he loved and cherished. Those of us who have been fortunate enough to know and work with him have lost a great teacher and mentor.

Swaminathan was married to Mallika, a gracious and charming lady, who provided ample support throughout his professional and personal life and nursed him through the difficult times in recent years. He leaves behind his wife and two daughters.

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