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100 years of the Divine Teacher - Student relationship among the three Generations of Indian Geoscientists (1920s – 2020s): A remarkable Story of Knowledge transfer from T. N. Muthuswami Iyer “TNM” through A. Parthasarathy to G. Shanmugam and beyond

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Abstract

The divine teacher-student relationship that covers 100 years of knowledge transfer is the underpinning of this remarkable personal story. Importantly, this narrative is about an Indian genius and a geologic pioneer, Professor T. N. Muthuswami Iyer, known as TNM. The first generation (1920s-1960s) TNM began his teaching career as a crystallographer and a mineralogist at the University of Madras-Gundy Campus (Chennai) in 1924, and continued at the Presidency College (Madras), Sager University (Madhya Pradesh), and Annamalai University (Tamil Nadu). One of his early students at Presidency was A. Parthasarathy, who later studied at the Imperial College in London (UK) and earned his Ph.D. in Engineering Geology from the London University (UL) in 1954. The second generation (1940s-1980s) Prof. Parthasarathy became the Head of Applied Geology section in the Civil Engineering Department at the Indian Institute of Technology (IIT) Bombay in 1964. The third generation (1960s-2020s) G. Shanmugam earned his B.Sc. in Geology and Chemistry from Annamalai University with a First Class (1965) and started teaching science in a local high school in his hometown of Sirkazhi, Tamil Nadu. TNM, who was the Head of Geology at Annamalai University in 1965, motivated G. Shanmugam to quit his teaching job and pursue M.Sc. in Applied Geology at IIT Bombay. Shanmugam earned his M.Sc. in Applied Geology at IIT Bombay under the guidance of Prof. Parthasarathy. Education and training at IIT Bombay propelled Shanmugam to receive his second M.S. and Ph.D. degrees in the USA. His Ph.D. research under the guidance of Prof. Kenneth R. Walker at University of Tennessee on Ordovician tectonics and sedimentation in the Southern Appalachians led to securing a research position with Mobil Oil Company in Dallas, Texas in 1978. Because of his global research on multiple domains while at Mobil and as post-retirement consultant since 2000 for oil companies in India and China, Shanmugam has to his credit 382 published works that include three Elsevier books on process sedimentology and petroleum geology, with the first two books were translated into Chinese language. He has authored 6 invited Encyclopedia Chapters for Elsevier and McGraw Hill Book Companies and has delivered 89 lectures worldwide during 1980-2021 period. He won the top "Special Prize" from Springer Journal of Palaeogeography in 2020 for "Excellent Papers" based on Science Citation Index (SCI) of five articles published during 2012-2018. Shanmugam's efforts in knowledge transfer during the COVID-19 global pandemic included giving virtual lectures on Zoom, Google Meet, and WebEx platforms to academia (e.g., Royal Holloway, University of London, IIT Bombay, and Ohio University). Shanmugam organized 23 onsite workshops on "Deep-water sandstone petroleum reservoirs" worldwide, which included (1) the UK Government Department of Trade and Industry (DTI), Edinburgh, UK, (2) Reliance Industries Ltd., Kakinada, India, (3) Hardy Oil, Chennai, India, (4) Oil and Natural Gas Corporation (ONGC), Mumbai and Kajuraho, India, (5) Petrobras, Rio de Janeiro, Brazil, (6) Research Institute of Petroleum Exploration and Development (RIPED) of PetroChina, Beijing, China, and (7) China University of Petroleum, Qingdao, China. The T. N. Muthuswami - A. Parthasarathy - G. Shanmugam lineage, spanning over 100 years, is unique and phenomenal in knowledge transfer among geoscientists. On the economic front, TNM and his lineages contributed directly to the petroleum, atomic mineral, cement, gemstone, and geothermal energy industries, among many others. The acronym "TNM" for T. N. Muthuswami Iyer is just perfect for a Transformational, Neoteric and a Motivating teacher and a noble soul!

Introduction

In the ancient Vedic Culture of India (Mazumdar, 1994; Olivelle, 1998; Parpola, 2015), the *guru-shishya* tradition, or the *parampara* (lineage), represents a succession of teachers and disciples. It is the divine and spiritual relationship and mentoring where teachings are transmitted from a *guru* "teacher"

(Sanskrit: गुरु) to a *shishya* "disciple" (Sanskrit, शिष्य). In documenting this Vedic tradition, the primary purpose of this review is to synthesize the history behind the divine teacher-student relationship that existed among three generations of geoscientists over a span of 100 years (1920s-2020s) across two countries (India and USA). This remarkable story involves Professor T. N. Muthuswami Iyer (TNM), his student A. Parthasarathy

at Presidency College, Madras (Chennai), and his student G. Shanmugam at IIT Bombay (Mumbai). The historical importance of this story revolves around the timely contributions of TNM on basic geologic concepts during the critical period in Indian history when India became an independent nation from the United Kingdom on August 15, 1947.

Specific objectives are:

- To demonstrate the close link between key events of this story with former faculty and students of the Presidency College in Madras (Chennai).
 - To provide a coherent historical account of TNM family heritage and his biography that has direct implications for the growth of geosciences in India since its Independence. In particular, his seminal publications on mineralogy and petrology from the Presidency College in Madras (Chennai) are of significance (Muthuswami, 1949, 1950, 1951, 1953).
 - To document the lineage of three teachers of G. Shanmugam, namely A. Parthasarathy, S. Viswanathan, and V. Panchapakesan, who were students of TNM.
 - To discuss G. Shanmugam's evolution from a local science teacher to a global petroleum geologist because of the motivation from TNM in 1965.
 - To provide specific cases of other successful geoscientists who were benefited from TNM.
- To track the evolution of the department of Earth Sciences at IIT Bombay since 1964, which was initiated by Prof. A. Parthasarathy, who was a student of TNM.
 - To illustrate the undisputed influence of TNM on knowledge transfer through his students and by their disciples in academia, industry, and government agencies not only in India but in other countries.
 - To combine non-academic events, such as India's Independence, with academic dignitaries like Sir C. P. Ramaswami Iyer, for a historical perspective.
 - Finally, to express my profound gratitude to all my teachers and others who have helped me during the past 70 years.

In narrating this story, I have chosen visual medium using photographs, illustrations, and cited references on satellite images and experimental videos. These vivid images capture the true essence of past events producing a powerful, strong, and informative picture with clarity. Because some photographs were taken in 1935 (87 years ago), they are of poor resolution. One can simply browse through 64 images and 3 tables, and assimilate the whole story. The text adds details in capturing the global influence of TNM in transferring knowledge by his students and their disciples (Table 1). By design, this is a compendium of anecdotal data on personal, empirical, and historical events. In preserving the authenticity of events, certain images contain Tamil scripts (with English translations).

Table 1: Key global geoscientists and dignitaries cited in the story. Note influence of TNM and his students in transferring geological knowledge. Most geoscientists are Indian citizens, unless otherwise identified differently.

Serial number	Geoscientist and Dignitary	Institution, Organization, Position, & Publication
1	T. N. Muthuswami Iyer or "TNM" (a crystallographer and a mineralogist) Birth: 1898 Death: 1980	Professor: University of Madras, Guindy Campus, India (1924-1942) Professor: Presidency College, Madras (Chennai), India (1942-1953) Professor: Sagar University, Madhya Pradesh, India (1955-1957) Professor: Annamalai University, Tamil Nadu, India (1958-1966) Fellow of the Indian Academy of Sciences (F.A.Sc.) (Since 1940s) TNM motivated Shanmugam to pursue M.Sc. in Applied Geology at IIT Bombay (1965). Publications: Muthuswami (1949, 1950, 1951, 1953; Muthuswami and Gnanasekaran, 1962)
2	A. Parthasarathy (an engineering geologist and a quantitative sedimentologist) Birth: 1925 Death: 2015	D.I.C., Imperial College, London, UK (1954) Ph.D., London University, UK (1954) Professor: Presidency College, Madras (Chennai) (1945-1959) Professor: Indian Institute of Technology (IIT) Bombay (1959-1985) Head: Applied Geology, Civil Eng., IIT Bombay (1964-1982) Head: Dept. Earth Sciences, IIT Bombay (1982-1984) Wiley book (Parthasarathy et al., 2003) Prof. Parthasarathy, a student of TNM at Presidency, was Shanmugam's M.Sc. dissertation adviser at IIT Bombay (1965-1968).
3	G. Shanmugam (a process sedimentologist and a petroleum geologist)	B.Sc., Geology and Chemistry, Annamalai University (1965) M.Sc., Applied Geology, IIT-Bombay (1968) M.S., Geology, Ohio University, Athens, OH, USA (1972)

	<p>Birth: 1944 (Madras Presidency, British India) U.S. Citizen</p>	<p>Ph.D., Geology, University of Tennessee, Knoxville, USA (1978) Employment: Mobil Research and Development Corporation, Dallas, Texas, USA (1978-2000) Teaching and Consulting: The University Texas at Arlington, Arlington, USA (2003, 2004) Dept. Trade and Industry (DTI), Edinburgh, UK (1995, 1997) Petrobras, Brazil (1998, 1999) Oil and Natural Gas Corporation (ONGC), India (1998, 2002, 2004, 2009) Reliance Industries Ltd. (RIL), India (2003 - 2010) Research Institute of Petroleum Exploration and Development (RIPED), PetroChina, Beijing, China (2009, 2010) China University of Petroleum, Qingdao, China (2014) Editorial Board: Journal of Palaeogeography (Springer & Elsevier) (2014-2022) Petroleum Exploration and Development (Elsevier) (2017-2022) Jour. of the Indian Association of Sedimentologists (2018-2022) Professional Society: Emeritus Member: Society for Sedimentary Geology (SEPM) (Member since 1970) Publication: Table 3 Elsevier books (Shanmugam, 2006a, 2012a, 2021a)</p>
4	<p>S. Viswanathan Birth: 1927 Death: 2016</p>	<p>Student: Presidency College, Madras (Chennai), India (1940s) Processor: IIT Bombay (1964-1985) Moscow Geological and prospecting Institute (known as 'EMGREE' – MGPI) (1973) Publication: Viswanathan (1975) Prof. Viswanathan was Shanmugam's teacher of structural geology at IIT Bombay (1965-1968).</p>
5	<p>V. Panchapakesan</p>	<p>Annamalai University (1958-62). He was a student of TNM. Faculty Member: IIT Bombay (1964-2003) Ph.D., IIT Bombay (1976) Wiley book (Parthasarathy et al., 2003) Prof. Panchapakesan was Shanmugam's teacher at IIT Bombay (1965-1968).</p>
6	<p>B. Bhaskar Rao</p>	<p>Prof. Bhaskar Rao was Shanmugam's M.Sc. field adviser in Tankhala area, Gujarat, when Shanmugam was a student at IIT Bombay (1965-1968) Publication: Bhaskar Rao (1986)</p>
7	<p>D. Chandrasekharam</p>	<p>Student at Presidency College (1969) M.Sc., Student of S. Viswanathan, IIT Bombay (1972) Ph.D., IIT Bombay (1979) Head: Earth Sciences, IIT Bombay (2000-2003) Visiting Professor: IIT Hyderabad (2022) Book: AA Balkema Pub. (Chandrasekharam and Bundschuh, 2002) Publications: https://www.geos.iitb.ac.in/dc/</p>
8	<p>Santanu Banerjee</p>	<p>Ph.D., Jadavpur University, Kolkara (1997) IIT Bombay (Joined 1999) Head: Earth Sciences, IIT Bombay (Since 2020) Editor: Journal of Palaeogeography (Springer & Elsevier) (2012-2022) Indian Association of Sedimentologists (Life Fellow) Geological Society of India (Life Fellow) Award-winning publication: Banerjee et al. (2016) Other publications: https://www.geos.iitb.ac.in/sb/</p>
9	<p>G. N. Jadhav</p>	<p>Faculty Member: IIT Bombay (1981-2021) Prof. V. Panchapakesan was his Ph.D. co-adviser along with Prof. K. C. Sahu at IIT Bombay (1982-1989) Publications: Jadhav et al. (1988, 1993, 2012) https://iitb.irins.org/profile/11130</p>
10	<p>S. D. Shah</p>	<p>IIT Bombay (1966-2002)</p>
11	<p>T. M. Mahadevan</p>	<p>Presidency College, Student of TNM (1944-1949) Employment: Geological Survey of India (GSI) (1949-1969) Employment: Atomic Minerals Directorate (AMD) (1969-1987)</p>

		Retired as the Director of AMD (1987) Publications: Mahadevan (1994, 2002, 2003, 2014; Mahadevan and Maithani, 1966)
12	S. Asokan	M.Sc., Student of Prof. A. Partgasarathy, IIT Bombay (1971) Ph.D., Cambridge University, UK (1974) Corporate Head and General Manager: GEM Division, of ACC (The Associated Cement Companies Limited), India (1975-1991) Chief Executive: Titanium Project, TATA Steel, India (2003) Recipient: "Distinguished Alumnus Award", IIT Bombay (2003) President of the Indian Geological Congress (IGC) (2006-2007)
13	K. Swaminathan	B.Sc. in Geology, Annamalai University (1964) Prof. TNM motivated Swaminathan to attend IIT Bombay (1964) M.Sc. in Applied Geology, First Batch, IIT Bombay (1967) Founder and Patriarch of the Swathi Group of Companies in Chennai (2022)
14	Stanley P. Fisher Birth: 1919 Death: 1992 U.S. Citizen	Ph.D., Cornell University, New York, USA (1952) Chair: Geology, Ohio University, Athens, USA (1970-1975) Assoc. Dean: College of Arts & Sci., Ohio University, Athens, USA (1978-80) Employment: Gulf Oil Corporation, South America (1954-1959) Prof. Fisher was Shanmugam's M.S. Thesis adviser at Ohio University, Athens, USA (1970-1972).
15	Kenneth R. Walker U.S. Citizen	Ph.D., Yale, New Haven, Connecticut, USA (1969) Chair: Geology, The University of Tennessee, Knoxville, USA 1977-1987) Prof. Walker was Shanmugam's Ph.D. dissertation adviser at the University of Tennessee, Knoxville, USA (1974-1978).
16	Garrett Briggs U.S. Citizen	Ph.D., University of Wisconsin, Madison, Wisconsin, USA (1962) Prof. Briggs was Shanmugam's clastic sedimentology teacher at the University of Tennessee, Knoxville, USA (1974-1978). Prof. Briggs introduced Shanmugam to the rocks of the Ouachita Flysch in Arkansas and Oklahoma, USA (1975). Prof. Briggs also secured Shanmugam a job interview with Mobil Oil Company in Dallas, Texas, USA (1978).
17	R. J. Moiola U.S. Citizen	Ph.D., University of California, Berkeley (1969) Mobil, Dallas, Texas (1978-2000) Shanmugam's Mentor: Sedimentology Publication: Shanmugam and Moiola (1995)
18	D. W. Kirkland U.S. Citizen	Ph.D., University of New Mexico (1963) Mobil, Dallas, Texas (1978-2000) Publication: Kirkland and Anderson (1970) Shanmugam's Mentor: Source rocks and Sandstone diagenesis
19	J. E. Damuth U.S. Citizen	Ph.D., Columbia University (1973) Lamont-Doherty Geological Observatory, Columbia University, New York (1974-1982) Shanmugam's Colleague: Mobil, Dallas, Texas (1983-1991) Adjunct Professor: University of Texas at Arlington (1993-2012) Publication: Shanmugam et al. (1995)
20	John G. McPherson New Zealand Citizen Australia Citizen	Ph.D., Victoria University of Wellington, New Zealand (1976) Shanmugam's Colleague: Mobil, Dallas, Texas (1985-2000) Exxon Mobil, Melbourne, Australia (2000-2013) Director: SED&RQ Pty Ltd, Melbourne, Australia (Since 2014) Publication: McPherson, Shanmugam and Moiola (1987)
21	R. A. Bagnold Birth: 1896 Death: 1990 U. K. Citizen	M.A., Engineering, Cambridge University, UK British Army (1920) Mentor: Sedimentology Publication: Bagnold (1966)
22	J. E. Sanders Birth: 1926 Death: 1999 U.S. Citizen	Ph.D., Yale University, New Haven, Connecticut, USA (1953) Mentor: Sedimentology Publication: Sanders (1965)
23	G. D. Klein Birth: 1933	Ph.D., Yale University, New Haven, Connecticut, USA (1960) Shanmugam's Mentor: Sedimentology (1988-2018)

	Death: 2018 U.S. Citizen	Journal of the Indian Association of Sedimentologists (JIAS) dedicated a Special Issue for G. D. Klein (Shanmugam, 2018d)
24	F. P. Shepard Birth: 1897 Death: 1985 U.S. Citizen	Ph.D., University of Chicago, Illinois, USA (1922) Mentor: Oceanography Publication: Shepard and Dill (1966)
25	C. D. Hollister Birth: 1936 Death: 1999 U.S. Citizen	Ph.D., Columbia University, New York, USA (1967) Mentor: Oceanography Publication: Hollister (1967)
26	T. Ramkumar	Ph.D., Annamalai University (1997) Professor and Director: Dept. of Earth Sciences, Annamalai University (2022) Publication: Ramkumar (2016)
27	Dave Eby U.S. Citizen	Ph.D., SUNY, Stony Brook, New York (1977) Mobil, Dallas, Texas (1982) Eby Petrography and Consulting, Denver, Colorado (2022)
28	W. D. West Birth: 1901 Death: 1994 U. K. Citizen	D.Sc., Cambridge University, UK (1945) Employment: Geological Survey of India (GSI) (1923-1951) First Director of the Geological Survey of India (GSI) since the Independence of India from the United Kingdom (1945-1951) Employment: Sagar University, Madhya Pradesh, India (1951-1977). Dr. West established Applied Geology Department at Sagar University (1951). TNM joined Dr. West at Sagar University (1955-957).
29	M. S. Krishnan (MSK) Birth: 1898 Death: 1970	B.A. Hons, Presidency College, Madras (1919) D.I.C., Imperial College, London, UK (1923) Ph.D., London University, London, UK (1924) First Indian Director of Geological Survey of India (GSI) after India's Independence from the United Kingdom in 1947 (1951-1955). First Director, Indian School of Mines, Dhanbad, India (1957). Both TNM and MSK completed their B.A. Hons. in Geology in Madras the same year (1919). However, while TNM remained in India and pursued his research and teaching career, MSK went to the UK and received his higher degrees in Geology. Both TNM and MSK remained close colleagues throughout their professional careers since graduation in 1919. It is worth noting that Parthasarathy, a student of TNM, followed exactly the same path as MSK in pursuing his D.I.C., and Ph.D, from Imperial College and London University, respectively.
30	Sir C. P. Ramaswami Iyer Birth: 1879 Death: 1966	a) Sir C. P. Ramaswami Iyer is a notable alumnus of the Presidency College in Madras (Chennai). b) Sir C. P. Ramaswami Iyer and Pandit Jawaharlal Nehru, the first Prime Minister of India (1947-1964), served together as Joint Secretaries of the Home Rule League in 1916. c) When Annie Besant was elected as the President of the Indian National Congress, Sir C. P. Ramaswami Iyer served as the Secretary of the Indian National Congress in 1917. d) Sir C. P. Ramaswami Iyer served as a Member of the Executive Council of the Viceroy of India (1931-1936). e) Sir C. P. Ramaswami Iyer was appointed as the Diwan of Travancore (1936-1947). f) Shanmugam's B.Sc. degree in Geology and Chemistry was signed by Sir C. P. Ramaswami Iyer as the Vice Chancellor of Annamalai University in 1965. g) TNM was the Head of Geology Department at Annamalai University and motivated Shanmugam to pursue M.Sc. in Applied Geology at IIT Bombay in 1965.

T. N. Muthuswami Iyer or "TNM" (1920s-1960s): A crystallographer and a mineralogist

TNM Family Heritage

Professor T. Muthuswami Iyer, popularly known as "TNM", has a rich family heritage (Fig. 1). His

father, P V Naganatha Sasthri (1867-1939), also known as Thanjavur Naganatha Sastry, was a distinguished Sanskrit Scholar and a lawyer of great repute. TNM was

born in the Madras Presidency under the British India, which includes present-day Tamil Nadu, in 1898. TNM was one of 11 children that his parents, Naganatha Sastry and Meenakshi Ammal (1875-1925), had (Fig. 1). Professor T.N Muthuswami Iyer initiated the publication of the Sanskrit treatise 'Sidhantha Kaumudhi' (Published by Motilal Banarsidas). Prof. Muthuswami Iyer chose to use "TN" rather than "PVN" as his initials in order to emphasize the "Thanjavur" heritage. Thanjavur exemplifies South Indian religion, art, architecture, in particular the Chola temples, which are UNESCO World Heritage Monuments. TNM and his wife Rajalakshmi had two sons and two daughters (Fig. 2). TNM has an impressive biography (Fig. 3). TNM and his wife celebrated TNM's 80th birthday with their two sons and their wives in 1978 (Fig. 4). TNM family history is available on a Blog called "Sattanathapuram Roots" at <http://snp-roots.blogspot.com/2008/08/thanjavur-p-v-naganatha-sasthri-1867-to.html?m=1>

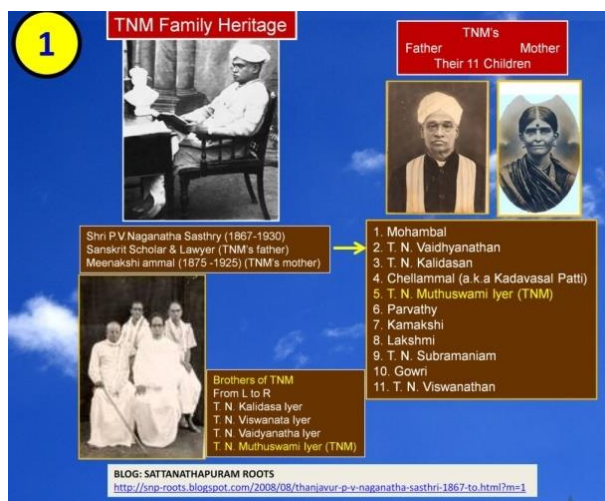


Fig. 1: T. N. Muthuswami Iyer (TNM) Family Heritage

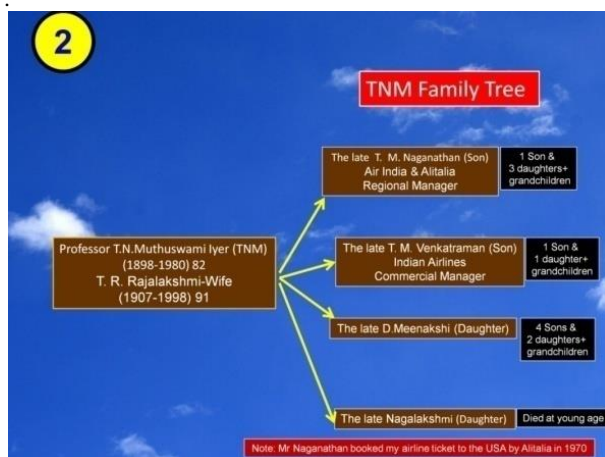


Fig. 2: T. N. Muthuswami Iyer (TNM) Family Tree.

3 TNM Biography

TNM: Biography and Legacy

Place of Birth: Thanjavur, Tamil Nadu
 Date of Birth: 28 June 1898
 Date of Death: 10 December 1980
 Degree: B.A. Hons. 1919, Geology (University of Madras, Gundy Campus)
 M.Sc. Geology 1924 (Univ. Madras)
 1924-1942, Lecturer/Professor (University of Madras, Gundy Campus)
 1942-1953, Presidency College Professor and Head, Geology
 A classmate of Dr. M. S. Krishnan, who became the First Indian Director of Geological Survey of India (GSI) 1951-1955
 1955-1957, Sagar University, Madhya Pradesh
 Worked with Eminent British Geologist Dr. W. D. West, who established Applied Geology Department at Sagar University.
 Dr. West was the First Director of Geological Survey of India (GSI) after India's Independence in 1947. 1945-1951
 1958-1966, Annamalai University, Tamil Nadu Professor and Head
 TNM was a Fellow of the Indian Academy of Sciences (F. A. Sc.)

Fig. 3. T. N. Muthuswami Iyer (TNM) Biography

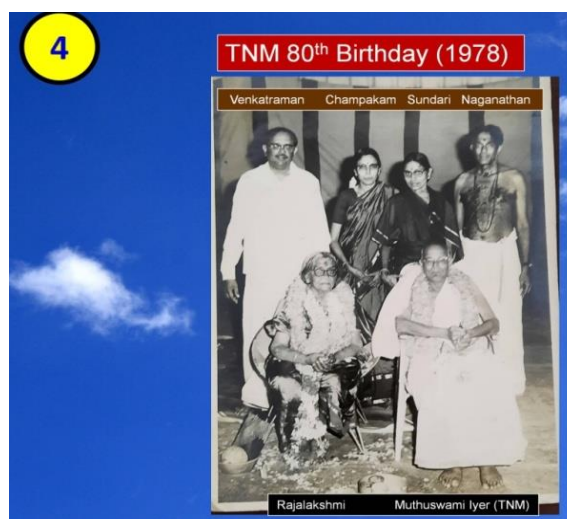


Fig. 4: T. N. Muthuswami Iyer (TNM) 80th Birthday (1978)

TNM Legacy at Presidency College, Madras (Chennai)

The Presidency College in Madras (Chennai) was established in 1840 by the British in India (Fig. 5). Notable alumni of this prestigious academic institution include (1) C. V. Raman, Nobel laureate in Physics (1930), (2) S. Chandrasekhar, Nobel laureate in Physics (1983), and (3) Sir C. P. Ramaswami Iyer, Diwan of Travancore (1936-1947). Sir C. P. Ramaswami Iyer played a major role in India's Independence along with Pandit Jawaharlal Nehru, the first Prime Minister of India during 1947-1964 (Table 1).

At Presidency, Geology as a discipline was first introduced in 1886. However, the Department of Geology started in 1916. The department celebrated the 125th year on May 29, 2013. Following a teaching career at University of Madras (Gundy Campus) from 1924 to 1942 (Fig. 3), TNM joined the Presidency College in Madras (Chennai). TNM was a classmate of renowned Indian geologist Dr M. S. Krishnan, who was the First Indian-born Director of the Geological Survey of India (GSI) (1951-55). In the field, it was a great experience to learn from Prof. Muthuswami as he

would explain and show intricate geological features like pygmatic folding, unconformity, joints, spheroidal weathering, etc.

A. Parthasarathy, S. Viswanathan, and T. M. Mahadevan were TNM's students at Presidency (Fig. 5), TNM taught Crystal Optics, Mineralogy and Petrology. He was a Fellow of the elite Indian Academy of Sciences (F.A.Sc.). TNM's research articles (Muthuswami, 1949, 1951, 1953), published in affiliation with Presidency College, were so influential in Crystallography and Mineralogy (Figs. 6 and 7); they were cited by the mineralogy giants of the day. For example, in 1955, in his seminal chapter "XVIII.—The Geochemistry of the Charnockite Series of Madras, India", R. A. Howie (1955) cited two articles by Muthuswami (1951 and 1953). Robert Andrew Howie (4 June 1923 – 10 March 2012) was a notable English petrologist. For example, W A Deer, R A Howie and J Zussman (1966) authored the series 'Rock-Forming Minerals', a widely known mineralogy text book. TNM resigned from Presidency in 1953 and went to Sager University in Madhya Pradesh.



Fig. 5: T. N. Muthuswami Iyer (TNM) at Presidency College in Madras (Chennai).

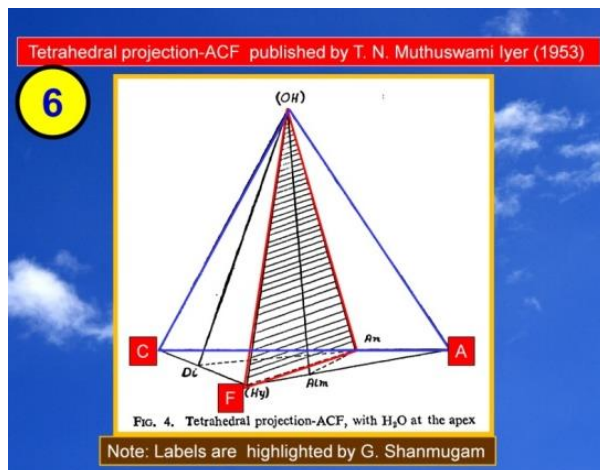


Fig. 6: Tetrahedral projection-ACF published by T. N. Muthuswami Iyer (1953)

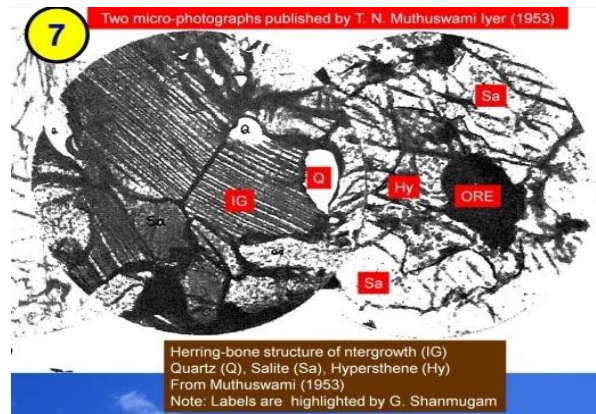


Fig. 7: Two micro-photographs published by T. N. Muthuswami Iyer (1953).

TNM Legacy at Sager University, Madhya Pradesh

TNM served Sager University in Madhya Pradesh, India during 1955-57. At Sager (Fig. 8), TNM worked with the eminent geologic pioneers of India, such as Dr. William Dixon West. Dr. West, who earned his D. Sc. from the Cambridge University (UK), was the First Director of Geological Survey of India (1945-1951), after India's Independence from the Britain in 1947. Furthermore, Dr. West established the Applied Geology Department at Sager in 1951. At Sager University, TNM presumably taught Crystal Optics, Mineralogy, and Petrology.

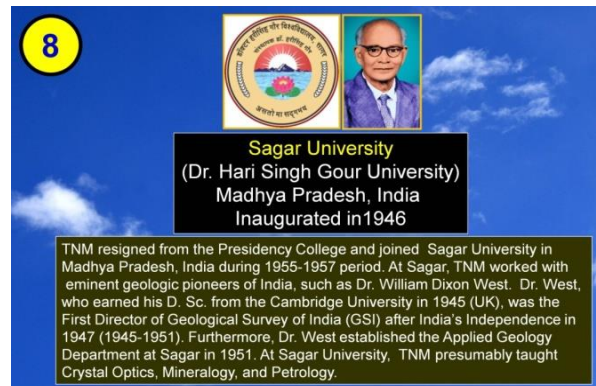


Fig. 8: T. N. Muthuswami Iyer (TNM) at Sager University.

TNM Legacy at Annamalai University, Tamil Nadu

The Department of Geology at Annamalai University in Tamil Nadu started with Prof. N. Rajagopalan in 1953. He was teaching geology for Civil Engineering and B.Sc. students. During the time period 1957-1958, TNM joined the geology department at Annamalai University (Fig. 9). TNM was the first Head of the Geology Department at Annamalai University with faculty strength of 5 members. In 1958, TNM introduced B. Sc (Hons) degree course. During his tenure, essential equipment for microscopic studies of rock and mineral specimens were procured. The petrographic microscopes were purchased from different countries like Germany and Italy with good

optical systems. TNM also purchased diagnostic rock specimens from different parts of the world with a characteristic record of the geological processes and time scale. Later, he also initiated the development of crystallographic wooden models for teaching purposes for better understanding about crystals and mineral structure. At Annamalai, V. Panchapakesan was a student of TNM during 1958-62. Panchapakesan would later join IIT Bombay in the faculty of Applied Geology. After TNM's retirement, Prof. N. Rajagopalan, a renowned paleontologist, became the Head of Geology Department at Annamalai University, where he introduced M.Sc. Geology in the Curriculum with strength of 12 students. In 2022, the Department of Earth Sciences at Annamalai University has 20 faculty members with Prof. T. Ramkumar as the Director of the program.

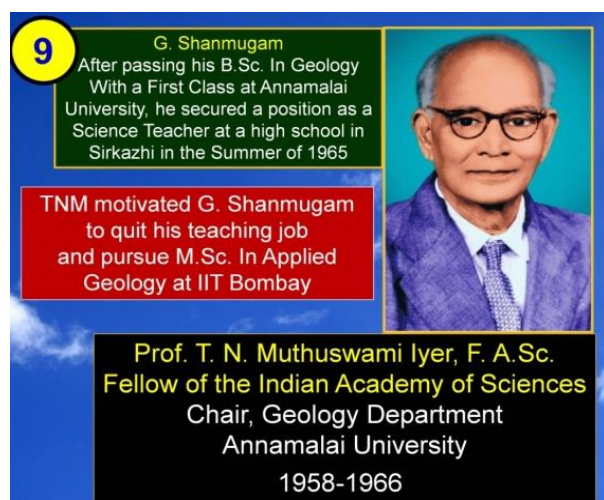


Fig. 9: T. N. Muthuswami Iyer (TNM) at Annamalai University.

G. Shanmugam's transformation from a local science teacher to a global petroleum geologist

TNM was solely responsible for Shanmugam's successful career as a global petroleum geologist. In telling my story, it is imperative to set the stage, which is my family history.

Family History

Shri Andiyappa Mudaliar, my maternal grandfather, was a wealthy diamond merchant in the 1920s and 1930s in Sirkazhi (Fig. 10), present-day Tamil Nadu (then Madras Presidency under the British India). He travelled to Johannesburg in South Africa to trade diamonds. He was a philanthropist (Fig. 11) and known for feeding the poor in large numbers frequently in Sirkazhi. He passed away in 1947.

Before I was born, my father was married to my mother's elder sister (Fig. 11). Because of her terminal illness, my aunt insisted that my father and my unmarried mother should get married, so that my mother could raise my

aunt's two young children, namely G. Venkatesan (Fig. 11) and his younger brother, G. Rethinasami.

My parents got married while my aunt was still alive. My aunt prophesied to my parents that their first child would be a boy and that boy should be named "Shanmugam", after her favorite Hindu deity. Thus, I was given the name "Shanmugam". My aunt passed away before I was born. This is a true story!

I was born into this affluent family in 1944. When I was a toddler in the mid 1940s, I was often dressed up with all kinds of jewelry (Fig. 12). However, in 1952, my family would suffer a devastating financial loss due to a major robbery at my father's jewelry store in Sirkazhi. In those days, there were no insurance policies to protect wealth. Our family became poor overnight. There was a drastic downward spiral in our lifestyle.

My parents, although uneducated, thought that the only salvation from their poverty was for me to go to college, earn a degree, and get a steady job/income. So, my education became the central focus of my family.

Although I understood the family situation, I was unable to excel in studies because I was affected by chronic asthma as a young boy. I could not sleep. I would sit up all night long in order to enable me breathing normally. When I was a B.Sc. student in Geology at Annamalai University (Fig. 10), I had to memorize hundreds of mineral names, crystal structures, fossil names, etc. So, instead of sitting idle all-night long just to breathe, I started using that time to memorize mineral names, crystal structures, and other topics. This effort was immediately reflected in my exam grades. I passed the B.Sc. final exam in First Class (GPA 4). This incident has taught me the lesson of "Turning obstacles into opportunities". I have been systematically applying this philosophy since 1962 for nearly 60 years now! Results have been phenomenal! In fact, my Keynote Lecture was on this theme at "Protolith 20", a biennial event, at IIT Bombay on December 29, 2020.

With the advice from TNM, I went to IIT Bombay and then to the USA (Fig. 13). Dr. G. Rajan, Rio Grande Community College, Ohio, and Dr. V. Anantharaman, Professor of Economics at IIT Madras, were helpful in organizing my trip to the USA (Fig. 13). My father came to the Madras Airport to give me send-off to the USA (Fig. 13). That was the last time I saw him because he passed away in 1974 when I was a student in the USA. In 1973, my maternal grandmother passed away in Sirkazhi, ending an important part of our family history.

In 1977, I visited my mother and family in Sirkazhi from the USA for the first time to celebrate our close-knit family traditions in my family home (Fig. 14). After my employment with Mobil in 1978, I built a new house for my mother. She immensely enjoyed her new house with all the modern amenities during the final 10 years of her life (Fig. 15). She passed away the same week in September 1997 that memorials for Princess

Diana and Mother Teresa were performed. I would never forget that historic and hectic weekend transiting through the London Gatwick Airport to attend my mother's funeral in Sirkazhi, Tamil Nadu, India.

Following my grandfather, I also instituted an annual program to feed nearly 1,000 young students in a day in my hometown of Sirkazhi (Fig. 16). A school bag with gift items (pen, pencil, notebook, sweets, fresh fruits, and Indian rupees) was distributed to each participating student of a "Feast in Memory of the Late G. Savithri" (my deceased younger sister) (Fig. 17). This annual feast was organized in Sirkazhi, Tamil Nadu, India during the 1995-2003 period (Fig. 17). In the year 2000, impressed by my efforts, Ms. Pam Luttrell, Vice President of Exploration, Mobil Oil Company in Dallas, Texas, visited the program in Sirkazhi. The entire program was brilliantly managed by my close family friend, the late N. Swedaranyam. The program was terminated in 2003 due to local regulations. In the 1980s, I fully restored our family status to its former glory days of the 1930s because of my employment with Mobil Oil Company in Dallas, Texas, USA.

Having told my family history, let me continue my story about TNM.



Fig. 10: India map showing locations of Sirkazhi, Annamalai University near Chidambaram on the east coast, and IIT Bombay on the west coast. Distance between Sirkazhi and Chidambaram = 19 km (12 miles).

Science Teacher

Our family consisted of my parents, myself, and four younger sisters, namely Dhanalaxmi, Saraswathi, Chandra, and Savithri (deceased). My par-ents' primary concern was dowries associated with my sisters' forthcoming weddings. This financial background is important to this story.

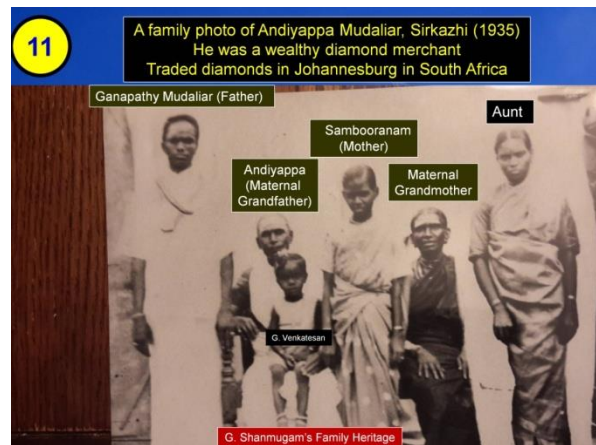


Fig. 11: A family photo of Andiyappa Mudaliar, Sirkazhi (1935).

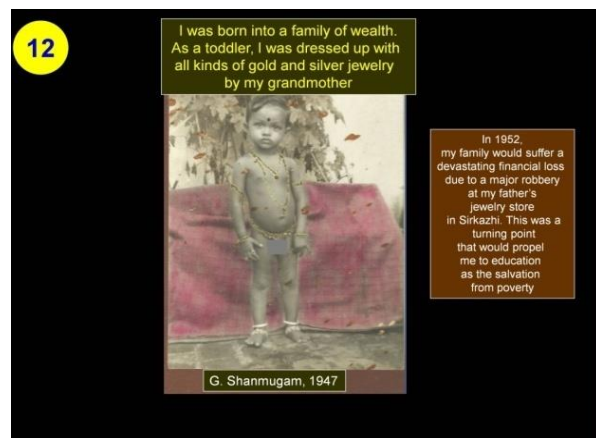


Fig. 12: A photo of Shanmugam in 1947 wearing gold and silver jewelry.



Fig. 13: A group photo of Shanmugam with family and friends at the Madras Airport before departure to the USA, August 1970.



Fig. 14: A 1977 family photo showing me sitting in the middle wearing traditional white turban (arrow) at his tiled family home in Sirkazhi.



Fig. 15: A. Exterior of a new house built for Shanmugam's mother in Sirkazhi in 1992.

B. Living room. C. Shanmugam's mother in 1995 in a new house. In the 1980s, Shanmugam restored his family status to its former glory days of the 1930s because of his employment with Mobil Oil Company In Dallas, Texas, USA since 1978.

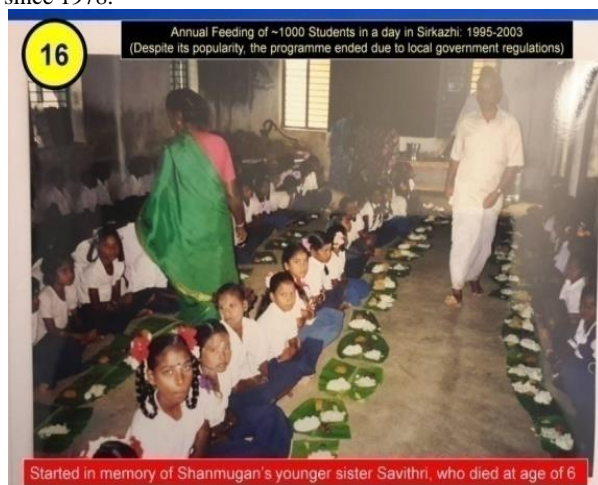


Fig. 16: Photo showing annual feast for young students in memory of Shanmugam's younger sister Savithri, who died at age of 6.

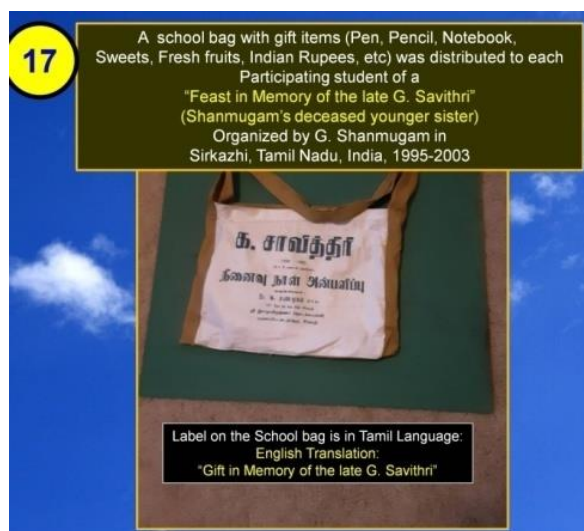


Fig. 17: Photo of school bag with gift items distributed to students.

I attended Annamalai University for my B.Sc. in Geology and Chemistry as a train student, commuting every day from Sirkazhi to Chidambaram. I earned my B.Sc. degree in geology with a first class (equivalent to "A" grade in the United States). In the summer of 1965, I secured a position as a science teacher at Krishnamoorthy Arunachala Mudaliar High School, located a few kilometers from my ancestral home. My parents were ecstatic because for the first time they would have a monthly income from my salary. Normally, my story would have ended as a science teacher, but the story took a drastic turn and continued myself as a petroleum geologist because of TNM.

Motivations from TNM

During my employment as a science teacher in 1965, I received a postcard from TNM. The card simply read "Come see me." His postcard was a surprise to me. Anyway, I went to AU and met with TNM in his office. This was my first face-to-face meeting with the Head of the Department. I was rather nervous, not knowing what to expect. TNM greeted me with great affection like a grandfather. He first congratulated me in passing my B.Sc. exams with a First Class. He wanted to know what my plans were for the future. I explained to him that my life is settled in Sirkazhi as a science teacher. He said, "You are one of our top students, you have unlimited potential to become a successful geologist, and you should pursue your graduate studies in Applied Geology at IIT Bombay". At that time, I did not know anything about IIT Bombay. Given my family's financial challenges, I knew that TNM's proposal was impossible. I explained my family situation to TNM. He said in a rather commanding tone, "I cannot let you miss this rare opportunity. Do something to get a loan and go to IIT." At that point, I realized that I should do something to resolve the financial problem. Although I

did not know how to resolve the problem, I told TNM that I would resolve the problem and would attend IIT. He was pleased with my determination and with my positive response. I did resolve the financial problem by obtaining a long-term loan from a local businessman, Shri. D. Sambandam, who was an elder brother of my childhood friend, Shri. D. Arumugam (see "Dedication" section below).

At IIT Bombay, I studied under the supervision of Professor A. Parthasarathy. My M.Sc. thesis at IIT was on fluvial sedimentology and statistics of textural analysis. I received the Institute Medal for the top-ranking student in Applied Geology (1968). As part of the curriculum, I received my first field training from Oil and Natural Gas Corporation (ONGC) in the Great Rann of Kutch in the Thar Desert under Dr. S.K. Biswas and laboratory training in the Ahmadabad office (Gujarat). IIT Bombay not only prepared me for my sedimentology and petroleum geology career but also led me to pursue graduate studies in the United States.

Throughout my studies at IIT Bombay, I kept TNM informed of my academic progress. Finally, I informed him about my plans to go to the United States in the fall of 1970. At that point in time, TNM had retired from Annamalai University and settled in Madras. In his response, he wrote me a letter in August 1970. After 50 years, I still have his letter in my possession (Fig. 18). Because of poor resolution of the scanned copy of letter, I have transcribed the letter content below:

"First Main Road
Raja Annamalaipuram-Madras: 10-8-70

My Dear Shanmugam,

Very happy to see your kind letter. I am sure you will have a very successful and bright career in Ohio University. It is very good of you to think of me. Few people have this affection and regard.

I have permanently shifted to Madras. I am staying with my son Naganathan, who is Area Manager-ALITALIA. If you have to book your passage to Ohio he will do everything for you. His office address...

Hope to meet you when you go next to Madras.

Yours sincerely,

T.N. Muthuswami
(Signature)"

Indeed, his son Naganathan (Fig. 2) did book my passage to America by ALITALIA Airlines. Of course, I did go to his house in Madras and did meet him in person before my departure to the United States. TNM was very proud of my achievements. He would have been even more thrilled to witness my achievements since then, including the arrangements of weddings of all my three sisters. He is in Heaven and smiling down on me, I am sure!

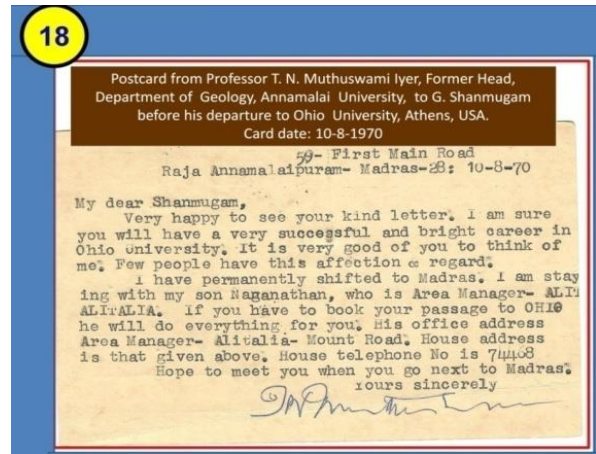


Fig. 18: A postcard from T. N. Muthuswami Iyer (TNM) to Shanmugam in 1970.

A. Parthasarathy (1940s-1980s): An engineering geologist and a quantitative sedimentologist

A. Parthasarathy was born in 1925 in the Madras Presidency, British India. He was an Assistant Professor at Presidency College in Madras from 1945 to 1959. He joined IIT Bombay in 1959 as a faculty member in the Civil Engg. Dept. (Fig. 19) and retired in 1985 (Fig. 20).

Evolution of the Department of Earth Science at IIT Bombay

In many respects, TNM was either directly or indirectly responsible for the birth of Earth Sciences at IIT Bombay. For example, his students at Presidency, namely A. Parthasarathy and S. Viswanathan, solely initiated geology program at IIT Bombay. His student V. Panchapakesan joined the faculty at IIT Bombay as well. Furthermore, TNM sent students from Annamalai University to IIT Bombay (e.g., K. Swaminathan and G. Shanmugam). The following is a brief summary of the evolution of Earth Sciences at IIT Bombay.

Department of Civil Engineering started a geology program for Civil Engineering students in 1959 with Prof. Parthasarathy as the single faculty member. K. S. Balasubramanian joined as a supporting hand as Senior Technical Assistant probably in 1960 or year later. In 1964, V. Panchapakesan joined as a Senior Technical Assistant. In 1976, he earned his Ph.D. and became a full Professor.

Since 1964, Mr. S. P. Vernekar was part of the Applied Geology technical staff. He performed many critical functions that range from maintaining equipments to typing manuscripts. Another staff was Mr. Mukundan who used to make thin sections.

In 1964, the first Batch of M.Sc. in Applied Geology degree program started under the Civil Engineering Department (Fig. 19). K. Swaminathan, prompted by TNM, joined the first batch. Following is the list of students in the first batch:

S. No.	Name	Courses Enrolled	Current Organization OR Institute
1	K Muthuraman	M.Sc	NA
2	K Swaminathan	M.Sc	NA
3	N Krishnamoorthi	M.Sc	NA
4	Ranganatha Ramachandran	M.Sc	NA
5	S P Muniappan	M.Sc	NA
6	S Muthukrishnan	M.Sc	NA
7	Shashidar Shamrao Oka	M.Sc	NA
8	Subramania Sathyamoorthy	M.Sc	NA
9	Tallapragada Purnachandra kishore		

In 1965, G. Shanmugam, prompted by TNM, joined the second batch of M.Sc. students in Applied Geology. Following is the list of students in the second batch:

S. No.	Name	Courses Enrolled	Current Organization OR Institute
1	Anil Dattatraya Mungee	M.Sc	NA
2	D Emile	M.Sc	NA
3	Ganapathy Shanmugam	M.Sc	NA
4	Gopalan Viswanathan	M.Sc	NA
5	K Ramanathan	M.Sc	NA
6	K Shanmugam	M.Sc	NA
7	Sujit Kumar Dutta	M.Sc	NA
8	Venkataraman Mohan		

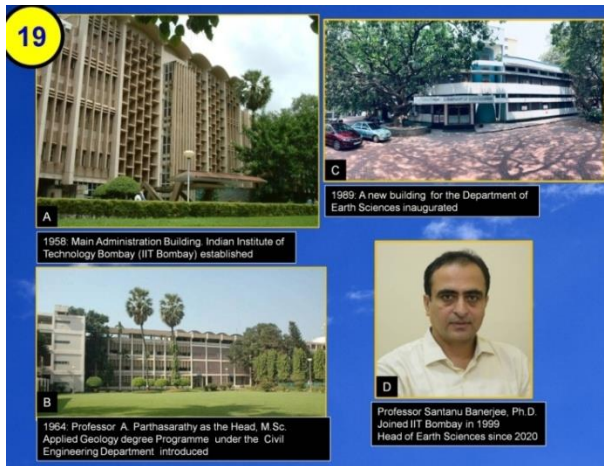


Fig. 19: Indian Institute of Technology Bombay (IIT Bombay). A. Main Administration Building. B. Civil Engineering Department. C. Department of Earth Sciences. D. Prof. Santanu Banerjee. He is currently the Head of the Department in 2022.

1965: A minor digression. In the above list of my classmates, Mr. Mohan reminds me of an encounter with a mega Bollywood star of the 1960s, Miss Vijayanthimala. Mohan's uncle was her personal manager. For three Applied Geology students from IIT Bombay, he arranged a meeting with her at the Santa Cruz Airport in Bombay in 1965. At that time, she was at the height of her popularity because of the release of a box-office hit movie "Sangam" with legendary actor Raj Kapoor in 1964. She was gorgeous, kind, cordial, and very curious about Applied Geology at IIT Bombay!

In 1966, Prof. S. D. Shah joined as a Senior Technical Assistant. Profs. K. C. Sahu, B. Bhaskar Rao, K. V. Subbarao, B. K. Sahu joined later. The group, still under Civil Engineering Dept. functioned with limited funding. In 1968, I completed my M.Sc. dissertation on "Geology of Tankhala Area, Gujarat State" under the supervision of Prof. Parthasarathy. Prof. B. Bhaskara Rao of Applied Geology section guided and supervised me in the remote field study area amid many challenges for lodging and food. Laboratory investigation was aided by Dr. S. Satyanarayana, Dr. G. Mandal, and Dr.

A. Sundarajan. Mr. S. P. Vernekar typed my dissertation. In 1968, S. Asokan joined the fifth batch of M.Sc. students in Applied Geology at IIT Bombay.

In 1969, D. Chandrasekharam joined the sixth batch of M.Sc. students in Applied Geology at IIT Bombay.

During 1964-82, Prof. Parthasarathy was the Head of Applied Geology Section of the Civil Engineering Department (Fig. 20).

In 1982, the Applied Geology section of Civil Engineering Department was granted the status of full-fledged independent Department of Earth Sciences.

During 1982-84 (Fig. 20), Prof. Parthasarathy was the Head of the Department of Earth Sciences. Prof.

Parthasarathy was followed by K. C. Sahu, K. V. Subbarao, and B. K. Sahu.

Prof. Parthasarathy retired from IIT Bombay in 1985 (Fig. 21).

Prof. A. Parthasarathy celebrated Prof. S. D. Shah's retirement in 2002 (Fig. 22),

In 1989 (Fig. 19), a new building was dedicated to the Department of Earth Sciences.

During 2000-2003 (Fig. 23), Prof. Chandrasekharam was the Head of the Department of Earth Sciences. Now, retired from IIT Bombay, he is a Visiting Professor at IIT Hyderabad in both Department of Civil Engineering and Department of Climate Change. For his impressive list of Awards and Publications visit: <https://www.geos.iitb.ac.in/dc/>

On October 1, 2003 (Fig. 24), I delivered a Special Lecture at the Institute Colloquium, entitled "Deep-water processes and turbidite facies models: a paradigm shift". It was organized by Prof. D. Chandrasekharam and was attended by Prof. Parthasarathy from his retirement. In the IIT lecture auditorium, the packed audience gave a Standing Ovation to Prof. Parthasarathy in recognition of his 26 years of service to the Earth Sciences community at IIT Bombay.

In 2013, Wiley Textbook entitled "Engineering Geology" was authored by A. Parthasarathy, V. Panchapakesan, and R. Nagarajan (Fig. 25).

In 2015, Prof. Parthasarathy's 90th Birthday was celebrated with Prof. Chandrasekharam

& his wife at the Residence of Prof. Parthasarathy (with his wife) in Mumbai (Fig. 26).

In 2015, Prof. Parthasarathy passed away at the age of 90.

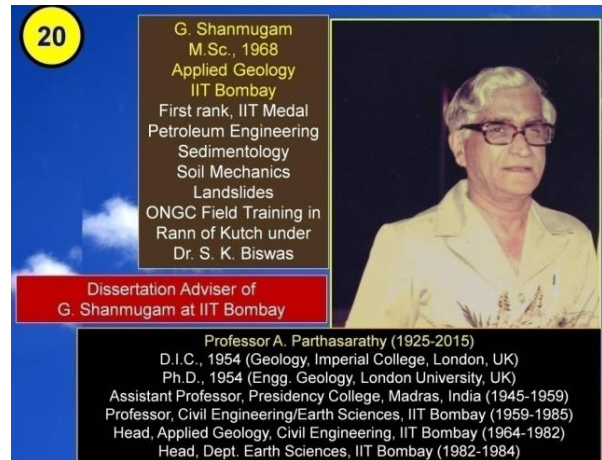


Fig. 20: Professor A. Parthasarathy (1925-2015).

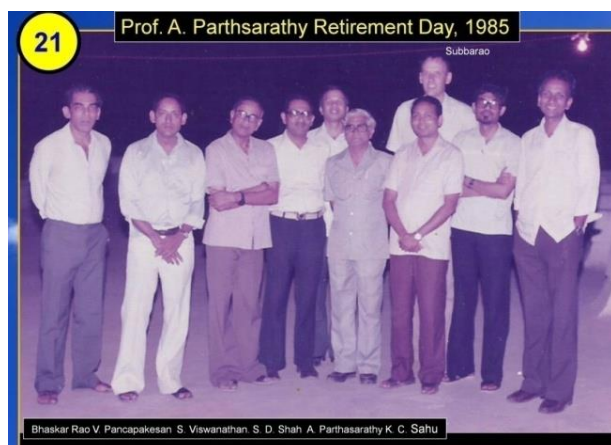


Fig. 21: Prof. A. Parthasarathy Retirement Day in 1985.



Fig. 24. Institute Colloquium in 2003.

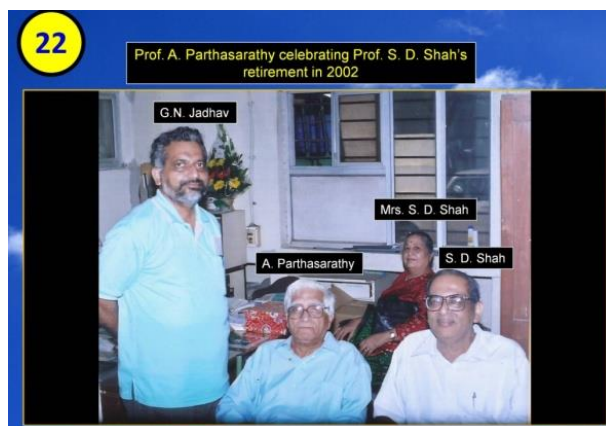


Fig. 22: Prof. A. Parthasarathy celebrating Prof. S. D. Shah's retirement in 2002.

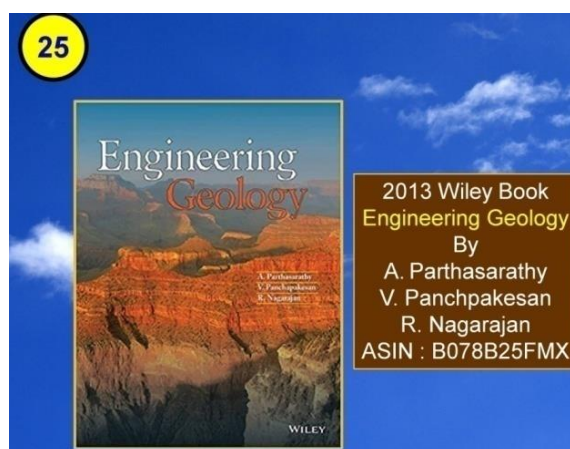


Fig. 25: 2013 Wiley Book "Engineering Geology" By A. Parthasarathy, V. Panchpakesan, and R. Nagarajan.

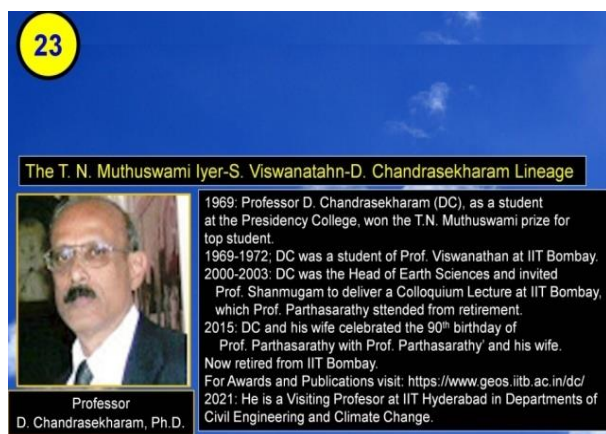


Fig. 23. Prof. D. Chandrasekharam.

The T. N. Muthuswami Iyer - S. Viswanathan - G. Shanmugam Lineage

1. Professor S. Viswanathan was one of the early students of Professor T. N. Muthuswami Iyer at the Presidency College, Madras (Chennai).
2. In 1964, Prof. Viswanathan joined IIT Bombay as a faculty in the Civil Engineering Department.

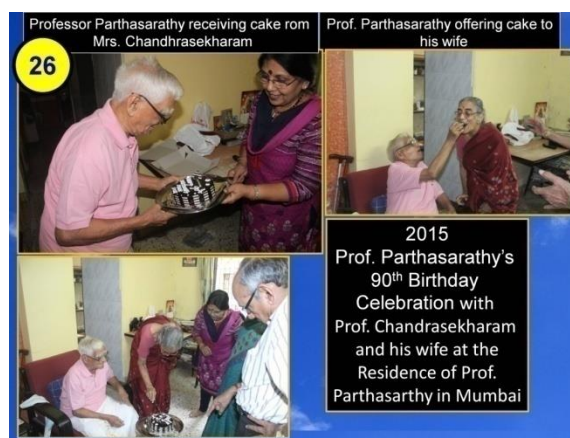


Fig. 26: 2015: Prof. Parthasarathy's 90th Birthday Celebration.

3. In 1964, Prof. Parthasarathy and Prof. Viswanathan introduced the M.Sc. program In Applied Geology at IIT Bombay under Civil Engineering Department (Fig. 27).
4. Professor Viswanathan was the first to earn Ph.D. degree in geology from IIT Bombay (Fig. 27).
5. Prof. Viswanathan had interests in several fields of earth sciences, though much of his research work

focused on mineralogy, igneous petrology (Deccan Traps) and structural geology.

6. In 1973 Prof. Viswanathan was selected for postdoctoral work at the Moscow Geological and prospecting Institute (known as 'EMGREE' –MGPI).

7. I was a student of Prof. Parthasarathy, Prof. Viswanathan, and Prof. Panchapakesan at IIT Bombay (1965-68). Prof. Viswanathan taught me structural geology.

8. D. Chandrasekharam was a student of Prof. Viswanathan at IIT Bombay (1969-72).

9. Following his teacher (Muthuswami, 1953), Prof. Viswanathan (1975) also conducted research on Charnockites.

10. In 1985, Prof. Viswanathan retired from IIT Bombay.

11. In 2016, Prof. Viswanathan passed away at the age of 89.

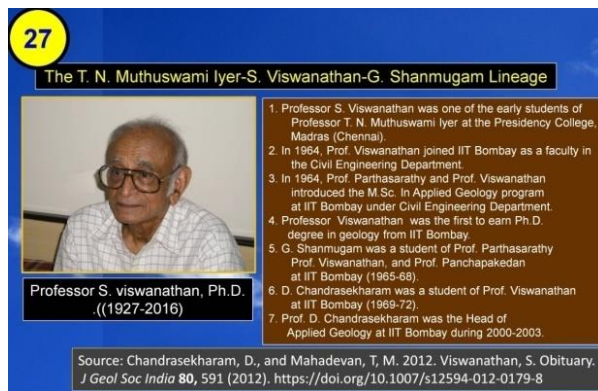


Fig. 27. Prof. S. Viswanathan.

The T. N. Muthuswami Iyer - V. Panchapakesan - G. Shanmugam Lineage

1. Professor V. Panchapakesan was a student of Professor T. N. Muthuswami Iyer at Annamalai University during 1958-62.

2. In 1964, V. Panchapakesan joined IIT Bombay as Senior Technical Assistant in the Civil Engineering Department (Fig. 28).

3. During 1965-68, he was my teacher at IIT Bombay.

4. In 1976, he earned his Ph.D. in Geology from IIT Bombay

5. In 1990, he was appointed as a full Professor in Applied Geology program at IIT Bombay (Fig. 28).

6. In 2003, he retired from IIT Bombay and settled in Bengaluru.

7. In 2013 (Fig. 25), Prof. Panchapakesan co-authored a book on "Engineering Geology" with Prof. Parthasarathy in 2013, after a successful career at IIT Bombay.

8. In 2021, in an email to me dated March 3, 2021, he shared the following details about TNM in the field with Panchapakesan while studying Madras Charnockites, "There are several episodes. He used to have me near him during the field trip to Pallavaram for two reasons,

one was to teach me and point out significant features of the exposure and the second was to make me carry his flask filled with hot coffee. The first one made me understand geology of the area to some extent and the second one gave some coffee to me which he so lovingly shared. Dr. V. Panchapakesan." The divine teacher-student relationship was the hallmark quality of TNM throughout his extraordinary life as a teacher.

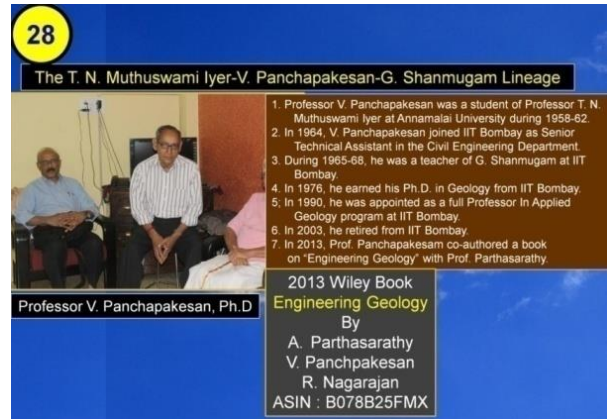


Fig. 28. Prof. V. Panchapakesan

The T. N. Muthuswami Iyer - S. Viswanathan - D. Chandrasekharam Lineage

1. 1969: Professor D. Chandrasekharam, as a student at the Presidency College in Madras, won the T.N. Muthuswami prize for the top-ranking student (Fig. 23).

2. 1969-1972: Chandrasekharam was a student of Prof. Viswanathan at IIT Bombay.

3. In 1979, Chandrasekharam received his Ph.D. from IIT Bombay.

4. 2000-2003: Chandrasekharam was the Head of Earth Sciences at IIT Bombay.

5. Now retired from IIT Bombay. For his Awards and Publications visit: <https://www.geos.iitb.ac.in/dc/>

6. 2022: Chandrasekharam is a Visiting Professor at IIT Hyderabad in Departments of Civil Engineering and Climate Change.

Prof. Santanu Banerjee: Head of Earth Sciences at IIT Bombay

Since 2020, Prof. Santanu Banerjee has been the Head of the Department of Earth Sciences (Fig. 19). In 2022, both Banerjee and I serve on the Editorial Boards of two journals: a) Journal of Palaeogeography (JoP) and b) Journal of the Indian Association of Sedimentologists (JIAS). Both Banerjee and I won "Excellent Papers" Awards from JoP in 2020, making the IIT Bombay being the only academic institution in the world to produce two winners in the same year. His award-winning paper is Banerjee et al. (2016).

In response to Banerjee's invitation, on December 29, 2020 (Fig. 29), I delivered a virtual lecture

on WebEx entitled "Transforming obstacles into opportunities by breaking up of orthodoxies in process sedimentology, physical oceanography, and petroleum geology." Webinar 2 at Protolith 20. IIT Bombay, 9 AM (India Time), Tuesday, December 29, 2020. <https://www.youtube.com/channel/UCXLo-JjeJ06GBOcaTYBYadQ>

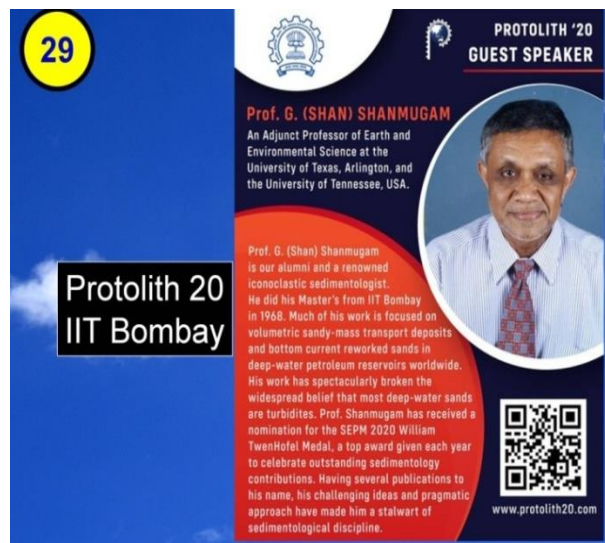


Fig. 29: Protolith 20, IIT Bombay.

G. Shanmugam (1960s-2020s): a process sedimentologist and a petroleum geologist

Biography

From India, I emigrated to the U.S. in 1970 and became a naturalized U. S. citizen in 1990. I have been married to an American, Jean, since 1976. I am a pragmatic and an iconoclastic deep-water process sedimentologist.

My primary contributions are aimed at documenting the volumetric importance of sandy mass-transport deposits and bottom-current reworked sands in deep-water petroleum reservoirs worldwide and at dispelling the popular myth that most deep-water sands are turbidites.

Importantly, I debunked the myths of facies models on high-density turbidites (Shanmugam, 1996), questioned the validity of the Bouma Sequence (Shanmugam, 1997, 2002), emphasized bottom currents (Shanmugam, 2003, 2008, 2013; Shanmugam et al., 1993, 2009), documented problems with the sequence-stratigraphic concept of basin-floor fans (Shanmugam et al., 1995), reinterpreted the Ouachita flysch (Shanmugam and Moiola, 1995), argued the concepts of (1) tsanamites (Shanmugam, 2006a, b), (2) seismites

(Shanmugam, 2016c), (3) contourites (Shanmugam, 2016b, 2017b), (4) hyperpycnites (Shanmugam, 2018a, b), and (5) hybridites (Shanmugam, 2021b).

For the first time, I published a comprehensive global satellite survey of density (sediment) plumes (Shanmugam, 2018c).

I documented the importance of deflecting sediment plumes in interpreting provenance (Shanmugam, 2019a), and synthesized gravity flows (Shanmugam, 2020).

Professional Preparation

1978: Ph.D., Geology, University of Tennessee, Knoxville, TN., USA

1972: M.S., Geology, Ohio University, Athens, OH., USA

1968: M.Sc., Applied Geology, Department of Civil Engineering, IIT-Bombay, India

1965: B.Sc., Geology and Chemistry, Annamalai University, Tamil Nadu, South India

Note: I served as a research scholar under the Council of Scientific and Industrial Research (CSIR), Government of India, at IIT Bombay during 1968–1970.

Teachers and Endowments in India and USA

My teachers in the USA, Professors Stanley P. Fisher (Fig. 30), Kenneth R. Walker (Fig. 31), and G. Briggs (Fig. 32) played vital roles in my earning M.S. and Ph.D. degrees. In expressing my profound gratitude to these three American Professors as well as to my two Indian Professors (TNM and Parthasarathy), I have established five endowments in both countries to a total amount of \$130,000 (USD) at the following institutions:

- 1) University of Tennessee, Knoxville, USA: \$60,000.
- 2) Ohio University, Athens, USA: \$50,000
- 3) IIT Bombay, India: INR700,000 (\$10,000, 2021 June exchange rate)
- 4) Annamalai University, India: INR700,000 (\$10,000, 2021 June exchange rate, pending)

In addition, I established an endowment for my late friend D. Arumugam at the Sabhanayaka Mudaliar Hindu High School (SMHHS) in Sirkazhi worth INR100,000 (\$1,400, 2021 June exchange rate) (see "Dedication" below).

At Ohio University, Stanley Fisher (Fig. 30) helped me at many levels to get adjusted myself in a new country. He obtained samples from the Ordovician Simpson Sandstone from Texaco to conduct research for my Master's thesis. He was not only my science adviser, but also my financial adviser and social adviser. He held many important positions, such as the Department Head and the Associate Dean of the College of Arts and Sciences.

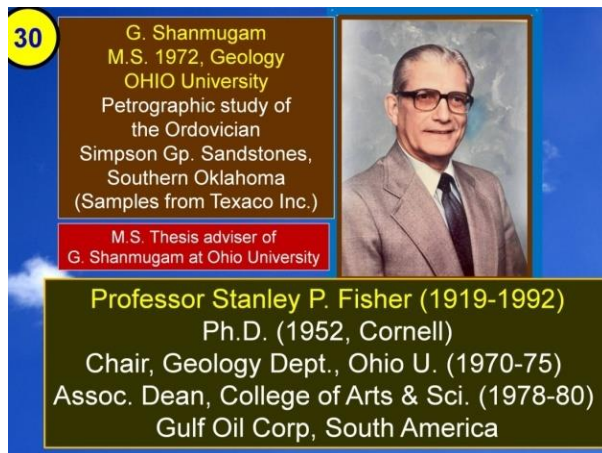


Fig. 30: Professor Stanley P. Fisher (1919-1992).



Fig. 31: Professor Kenneth R. Walker.

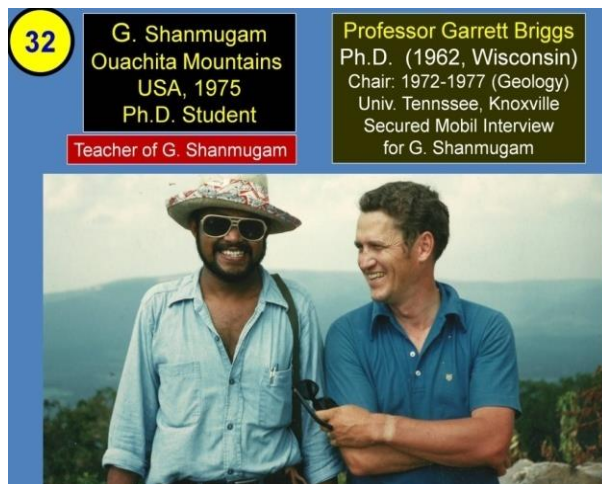


Fig. 32: Professor Garrett Briggs.

I would like to emphasize that Professor Ken Walker (Fig.31) was my perfect teacher during 1974-78. His suggestion to conduct research on the Middle Ordovician Sevier Shale for my Ph.D., although

unpopular at the time, was a turning point in my life. The Sevier Shale project allowed me to make a name for myself in sedimentology and tectonics through numerous controversial publications. He taught me how to be a pragmatic and a no-nonsense geologist both in the field and in the laboratory. His philosophy was to follow the data, even if it leads to unpopular conclusions. By watching him and by being with him, I learned how to plan and organize research proposals, how to write research papers, how to set priorities, etc. He held many impressive positions at University of Tennessee. He was the Department Head from 1977 through 1987. From 1996 until his retirement in 2007, he held various research administration positions including Assistant and Associate Vice Chancellor at the Campus Level and Assistant and Associate Vice President at the System Level. His talents were phenomenal. I was blessed to have him as my mentor and friend.

Similarly, I was fortunate to have Garrett Briggs (Fig. 32) as my teacher of clastic sedimentology. He introduced me to the Ouachita Flysch in Arkansas and Oklahoma that would become a major research project with R. J. Moiola at Mobil. Briggs was the one who secured me a job interview with Mobil by convincing Moiola to invite me for an interview. Mobil offered me the unlimited opportunity to travel the world and conduct research on multiple domains. Importantly, Mobil offered me the opportunity to publish profusely.

Mentors

In addition to my teachers, I consider the following as my mentors throughout my professional career: 1) R. J. Moiola (Mobil), 2) D. W. Kirkland (Mobil), 3) A. J. Koch (Mobil), 4) Ralph Alger Bagnold (1896-1990), 5) John Essington Sanders (1926-1999), 6) George Devries Klein (1933-2018), 7) Francis Parker Shepard (1897-1985), and 8) Charles Davis Hollister (1936-1999) (Table 1).

Employment with Mobil Research and Development Corporation, Dallas, Texas

I conducted research at three Mobil research laboratories in Texas, United States (Fig. 33) during 1978-2000. Mobil provided me great opportunities to study cores and outcrops worldwide and publish results (see "60 Years of Knowledge Transfer" section below).

Employment positions held at Mobil:

1978-1982	Research Geologist
1982-1985	Senior Research Geologist
1985-1989	Research Associate
1989-1993	Senior Research Associate
1993-1996	Assoc. Geological Research Advisor
1996-2000	Geological Scientist (retired)

Dr. R. J. Moiola, who was primarily responsible for offering me an interview with Mobil, served as my Mentor at Mobil (Fig. 34). I am grateful to all my colleagues at Mobil who helped me in the following areas (Figs. 35, 36, 37, 38, 39):

Core description worldwide.
 Outcrop description worldwide .
 Rain forest investigation in New Zealand.
 Coal field study in Australia.
 Estuarine field study.
 Flume experiments.
 Artificial Intelligence investigation.
 Satellite images.
 Petrographic microscope and SEM study.
 Geochemical analysis of oil.
 Graphics and photography.
 Training courses at Mobil.
 Core workshops worldwide.
 Virtual lectures on digital platforms.
 Publications.

Duties at Mobil

My research covered a wide range of topics (sedimentology, sequence stratigraphy, tectonics, diagenesis, paleobotany and organic geochemistry) on petroleum exploration and production. Duties also included teaching (Fig. 37) and core & outcrop description, worldwide. Mobil provided an ideal academic environment for conducting research (Fig. 40). In 1999, Mobil merged with Exxon and became Exxon Mobil.



Fig. 33: Three Mobil Research Laboratories in Dallas, Texas, where I worked from 1978 to 2000 until my retirement when Mobil merged with Exxon to become ExxonMobil.

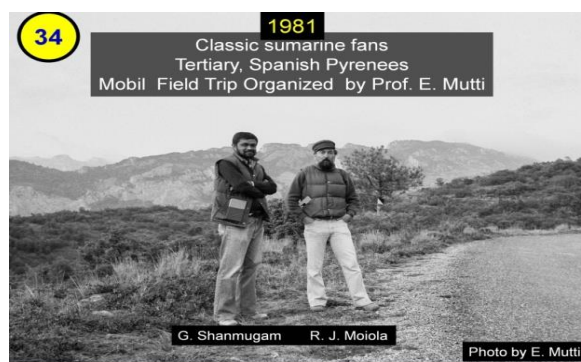


Fig. 34: Shanmugam and Moiola during a Mobil Field Trip Organized by Prof. E. Mutti to Spanish Pyrenees to examine Tertiary classic submarine-fan deposits, 1981.

35 Mobil Colleagues	Technologists Group 1	Technologists Group 2	Staff
Managers	K.A. Alhilali	J.M. Armentrout	T. A. Allison
G.K. Baker	R. B. Bloch	W.J. Beamish	P. Bell
M.G. Bloomquist	H.M. Chung	C. A. Clayton	C. Branson
P. Braithwaite	R.T. Clarke	K.P. Dean	S.L. Dunham
T. Cooley	J.E. Damuth	R. Evans	S. Dykes
N.J. Guinzy	D. Eby	U. Ewherido	J.T. Edwards
E.L. Jones	G. Eisenstadt	S.B. Famakinwa	R. Gilcrese
K.C. King	J.R. Gormly	S. Gabay	A. Gonzales
A.J. Koch	J. Helwig	W. Gardner	V. Goulet
J.E. Krueger	J.B. Higgins	W.E. Hermance	N. Houghton
P.E. Luttrell	C.T. Kalkomey	R.J. Hodgkinson	S.A. Kizer
S.J. Moncrieff	D.W. Kirkland	L.R. Lehtonen	M.K. Lindsey
R.J. Moiola	P.L. Kirkland	S. Malecek	J. Livermon
P. Nixon	R. Koepnick	S.M. Mitchell	A.F. Long
M. Northam	R.D. Kreisa	P.H. Naylor	D. Magill
V.K. Oyoyo	M. Lee	J.O. Olaifa	J. Mathews
R. Peacock	M.H. Link	M. Poffenberger	D.R. Miller
M.P. Ramage	M.E. Mathisen	D.H. Rofheart	A.S. Pearce
S.E. Sommer	J.G. McPherson	C. E. Shepard	M. Pearce
J.W. Stinnett	R.K. Nishimori	K.E. Shields	B.J. Phillips
D.M. Summers	H. Olson	J.W. Snedden	N.D. Pine
P. Venuto	J.K. Sales	T.D. Spalding	F.B. Roof
	J.F. Sarg	T. Straume	S. Thomson
	G. Shanmugam	S.E. Syvertson	C.M. Wall
	E. Sprunt	J.B. Wagner	
	T. Tsui	B.J. Welton	
	J. Vizgirda	G. Zimbrick	
	J.E. Welton		
	J. S. Wickham		
	M. O. Withjack		

Fig. 35: A tribute to all my Mobil colleagues.

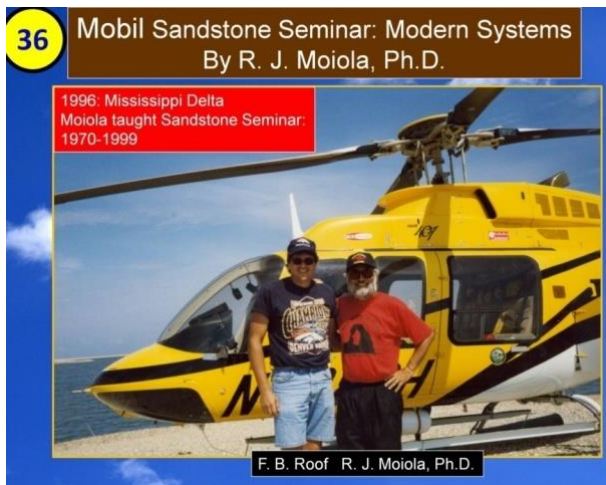


Fig. 36: Dr. R. J. Moiola during a field trip to the Modern Mississippi Delta. He was responsible for organizing sandstone seminars on both modern and ancient systems from 1970 to 1999. I assisted him in teaching modern systems on select years.

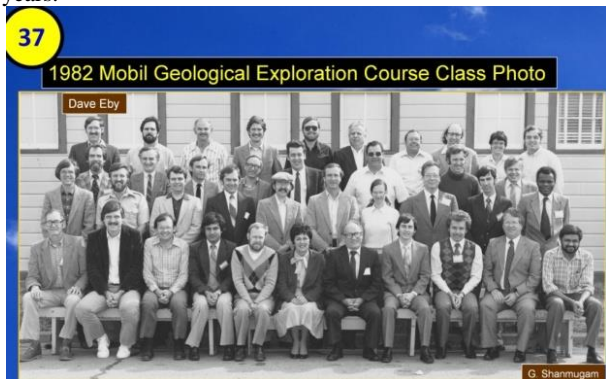


Fig. 37: 1982 Mobil Geological Exploration Course Class Photo with instructors Dr. Dave Eby and Dr. G. Shanmugam. Eby covered carbonate reservoirs and I covered sandstone reservoirs.

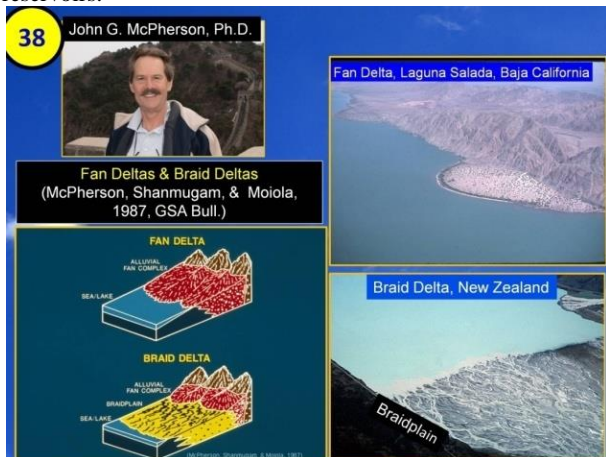


Fig. 38: Dr. John G. McPherson. He also assisted Moiola in teaching sandstone seminars.

Awards, recognitions, and nomination

1968: Received the IIT Medal for the top-ranking student in Applied Geology, Civil Engineering Department, IIT Bombay, India (Fig.41).

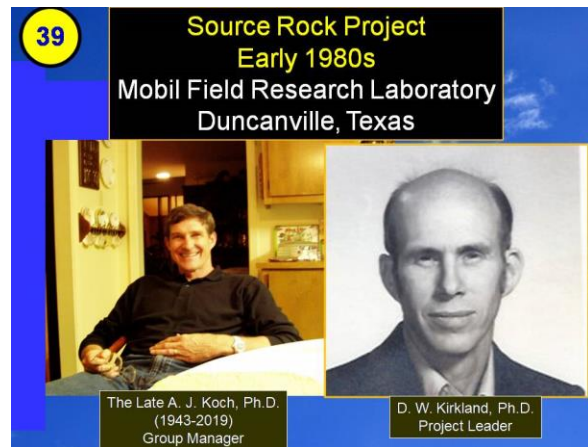


Fig. 39: Dr. A. J. Koch and Dr. D. W. Kirkland. Source rock project.



Fig. 40: Special attributes of Mobil research laboratories.

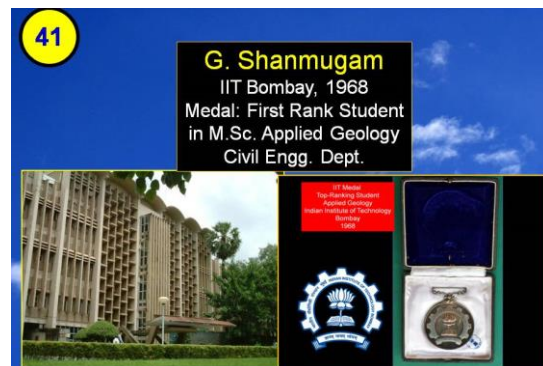


Fig. 41: IIT Medal for top-ranking student in Applied Geology awarded to G. Shanmugam in 1968.

1995: Received the Best paper award from NAPE (Nigerian Association of Petroleum Explorationists) for the paper “Deepwater Exploration: Conceptual Models and their Uncertainties.”

I was interviewed by the SUN TV, Chennai, India (televised on December 30th, 2003) on controversial

research papers on turbidite sedimentation and their implications for petroleum reservoirs. (Fig. 42). Mr. D. Arumugam's son Balamurali, his friend Ramesh, and my sister Saraswathi attended the interview in the TV Studio (Fig. 42) (See "Dedication" section below).

Emeritus Member of SEPM (Society for Sedimentary Geology); member since 1970.

2018: Recipient of FeTNA 2018 "Tamil American Pioneer" Award for extraordinary professional achievements in academia. FeTNA: Federation of Tamil Sangams of North America. Award Date: June 30, 2018. Frisco, Texas (Fig. 43). <http://tap.fetna.org/category/2018/>.

2018: Recipient of the University of Tennessee College of Arts & Sciences 2018 Professional Achievement Award. Award Date: September 21, 2018. Knoxville, Tennessee (Fig. 44). <https://artsci.utk.edu/dialogue/honor-college-alumni/>.

2019–21: Nominated for the SEPM 2020 William F. Twenhofel Medal, which is the top award given every year for contributions in sedimentary geology.

2020: Recipient of the Springer Journal of Palaeogeography Special Prize for "Excellent papers" based on Science Citation Index (SCI) (see Fig. 64).

2021 (May 7): Recipient of the "Distinguished Alumni Award" by the Department of Earth and Planetary Sciences of the University of Tennessee, Knoxville, Tennessee (Fig. 45).



Fig. 42: G. Shanmugam with host Ramesh Prabha after SUN TV interview in Chennai in 2003.

60 Years of knowledge transfer by G. Shanmugam: 1960s-2020s

I have used multiple means for transferring knowledge to the global geosciences community. One of my early sedimentological contributions was a paper given at the Indian Science Congress with my thesis adviser (Parthasarathy and Shanmugam, 1969). The following is a summary of my efforts.

The following is a summary of my efforts.

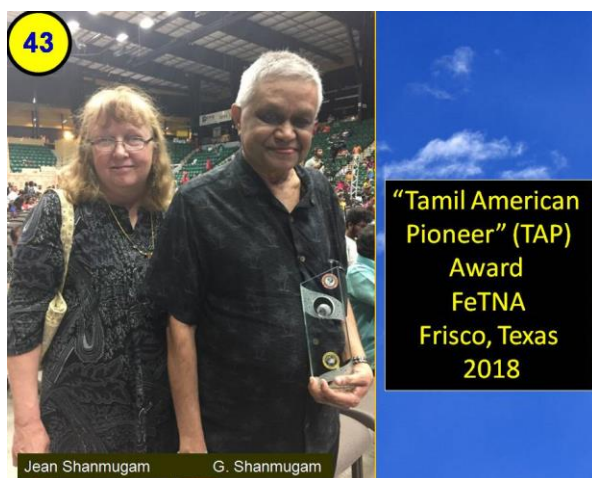


Fig. 43: G. Shanmugam and his wife Jean at the "Tamil American Pioneer" (TAP) Award, by FeTNA, 2018, Frisco, Texas, 2018



Fig. 44: G. Shanmugam with "Professional Achievement Award" by the College of Arts and Sciences, University of Tennessee, Knoxville (2018).



Fig. 45: G. Shanmugam received the 2021 "Distinguished Alumnus Award" by the Department of Earth and Planetary Sciences, University of Tennessee, Knoxville.

1. Knowledge transfer through published works: 382.

2. Knowledge transfer through Google Blog Spot site on "Deep-water processes"). Blog: <http://g-shanmugam.blogspot.com/2013/06/g-shanmugams-deep-water-processes-blog.html> Accessed: January 7, 2022

3. Knowledge transfer through Google Scholar https://scholar.google.com/citations?view_op=list_works&hl=en&user=le2tYg8AAAAJ

Accessed: October 10, 2022
Publications: 178
Citations: 10823
h-Index: 48
i10-Index: 99 (Number of publications with at least 10 citations)

Top-cited work (Number of citations: 719): "50 years of the turbidite paradigm (1950-1990): deep water processes and facies models – a critical perspective" (Shanmugam, 2000)

4. Knowledge transfer through Semantic Scholar

<https://www.semanticscholar.org/author/G.-Shanmugam/49145488>

Accessed: October 10, 2022
Publications: 142
Citations: 6,928
h-index: 41
Highly Influential Citations: 328

Top-cited work: Deep-Water Processes and Facies Models: Implications for Sandstone Petroleum Reservoirs (Shanmugam, 2006a)

5. Knowledge transfer through Research Gate

Stats: <https://www.researchgate.net/profile/G-Shanmugam-2/stats>

Accessed: October 10, 2022
Number of works posted: 210
Full-texts: 150
Books by Elsevier: 5 (3 in English and 2 in Chinese)
Chapters: 14 (Encyclopedia, Reference Module, and Thematic volumes)
Reads: 161,873
Citations: 7,816
h-Index: 44
Research Interest Score: 5,808
RG Score: 38.55 (out of maximum 43)

My score is higher than 95% of all ResearchGate members' scores. On May 2020, the number of ResearchGate users was 17,000,000.

a) Top-cited work: "50 years of the turbidite paradigm (1950s—1990s): deep-water processes and facies models—a critical perspective" (Shanmugam, 2000)

b) Highest number of reads of a single article: "The seismite problem" (Shanmugam, 2016c): 7,800

6. Knowledge transfer through Social Media by G. Shanmugam in association with the following institutions and organizations

a) University of Minnesota: Video of flume experiments on Sandy debris flows (no audio)

You Tube URL site <https://youtu.be/uMO7jffZwK0>

b) Dallas Geological Society: "Deep-Water Turbidites and Density Plumes" Lecture by G. Shanmugam

You Tube URL site <https://www.youtube.com/watch?v=sawE2mDSvdQ>

c) "Transforming obstacles into opportunities by breaking up of orthodoxies in process sedimentology, physical oceanography, and petroleum geology." Keynote Lecture: Webinar 2 by G. Shanmugam at Protolith 20. IIT Bombay, 9 AM (India Time), Tuesday, December 29, 2020. You Tube URL site <https://youtu.be/t6j5BMramaU>

d) "The turbidite – contourite – tidalite – hybridite problem: Orthodoxy Vs Empirical Evidence behind the "Bouma Sequence" Keynote Lecture by G. Shanmugam for Journal of Palaeogeography Global Conference on "Deep-Water Systems".

You Tube URL site <https://www.youtube.com/watch?v=gWn6QT5sA9Y>

e) University of Tennessee Social Media Announcements on G. Shanmugam's Award

https://eps.utk.edu/newsitem.php?news_id=1916

<https://www.facebook.com/UTEPS/photos/pb.315950981885081.-2207520000..2283160721830754/?type=3&theater>

f) Ohio University Social Media Announcements on G. Shanmugam's book

<https://www.ohio-forum.com/2020/11/alumni-news-shanmugam-publishes-book-wins-award-for-research-contributions/>

g) Facebook Watch. "Turning obstacles into opportunities by a Tamil geologist". Special Lecture given by G. Shanmugam at the Dallas MTS (Metroplex Tamil Sangam) 2021 India's Republic Day Celebration on January 26, 2021, Tuesday, 7 PM, Dallas, Texas, USA. Zoom

<https://fb.watch/3gFUvXamOb/>

h) YouTube Link: "Recent advances in interpreting deep-marine deposits". 2021 OHIO University Geological Sciences, Alumni Symposium Talk given by G. Shanmugam, Saturday (April 17, 2021) at 12.05 PM ET. Zoom

YouTube Link: https://www.youtube.com/watch?v=v0n3mp_XQBY

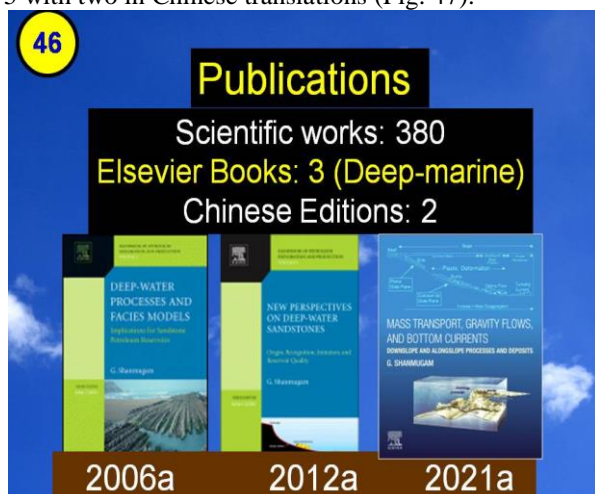
i) An expanded version of the article:

"100 Years of the divine teacher-student relationship among three generations of Indian geoscientists (1920s-2020s): a remarkable story of knowledge transfer from T. N. Muthuswami Iyer or "TNM" (a crystallographer and a mineralogist) through

A. Parthasarathy (an engineering geologist and a quantitative sedimentologist), to G. Shanmugam (a process sedimentologist and a petroleum geologist) and beyond”

was posted on the IIT Bombay Earth Sciences page. <https://www.geos.iitb.ac.in/wp-content/uploads/TNM-AP-GS-story-2021.pdf>

7. Knowledge transfer through Elsevier books (Fig. 46): 5 with two in Chinese translations (Fig. 47).



46. Publications by G. Shanmugam, which include 380 published works and 3 Elsevier books (2006a, 2012a, and 2021a).



Fig. 47: Two Chinese editions of Elsevier books by G. Shanmugam.

8. Knowledge transfer through publishing cutting-edge articles. My paper ‘High-density turbidity currents: are they sandy debris flows?’ published in the *Journal of Sedimentary Research* in 1996, has achieved the status of the single most cited paper in sedimentological

research published in three world-renowned periodicals - *Journal of Sedimentary Research*, *Sedimentology*, and *Sedimentary Geology* - during the survey period of 1996-2003 (Source: International Association of Sedimentologists Newsletter, August 2003) (Racki, 2003).

9. Knowledge transfer through organizing 23 "Deep-Water Sandstone Workshops" worldwide:

1995 (October): UK Department of Trade and Industry (DTI), Edinburgh, Scotland, UK.

1996 (November): Mobil, Dallas, Texas, USA.

1997 (July): UK Department of Trade and Industry (DTI), Edinburgh, Scotland, U.K.

1998 (June): Petrobras, Mobil, and Unocal, Sao Mateus, Brazil, South America.

1998 (August): Oil and Natural Gas Corp. (ONGC), Dehra Dun, India.

1998 (November): Petrobras, Mobil, and Unocal, Rio de Janeiro, Brazil, South America

1999 (June): Mobil, Dallas, Texas, USA.

1999 (August): Petrobras, Mobil, and Unocal, Sao Mateus, Brazil, South America.

2002: Oil and Natural Gas Corporation (ONGC), Mumbai, India (Fig. 48).

2002: Oil and Natural Gas Corporation (ONGC), Chennai, India.

2002: Hardy Exploration and Production (India) Inc. Chennai, India.

2004: Oil and Natural Gas Corporation (ONGC), Kajuraho, India (Fig. 48).

2006: Reliance Industries Ltd. Kakinada, India.

2007: Reliance Industries Ltd. Kakinada, India.

2008: Reliance Industries Ltd. Kakinada, India.

2009: Reliance Industries Ltd. Kakinada, India.

2009: Oil and Natural Gas Corporation (ONGC), Karaikal, India (Fig. 48).

2010: Reliance Industries Ltd. Gadimoga, India (Figs. 49, 50, 51). A T-Shirt was distributed to each participant of the Reliance “Deep-water Rock Expo” (2016)

Organized by G. Shanmugam in Kakinada, Andhra Pradesh, India (Fig. 52). Reliance Industries Ltd. (RIL) Managers: Anil Kumar, Rabi Bastia, Bhagaban Das and S. K. Shrivastava.

2009: Research Institute of Petroleum Exploration and Development (RIPED) of Petro China, Beijing, China (Fig. 53).

2010: Research Institute of Petroleum Exploration and Development (RIPED) of Petro China, Beijing, China.

2010: Society of Petroleum Geophysicists (SPG), Hyderabad, India.

2014 (May) China University of Petroleum, Qingdao, China (Fig. 54).

2014 (May): Yanchang Oilfield Exploration and Development Research Institute of Yañan Branch Yañan, China.



Fig. 48: ONGC Deep-Water Sandstone Workshops by G. Shanmugam.

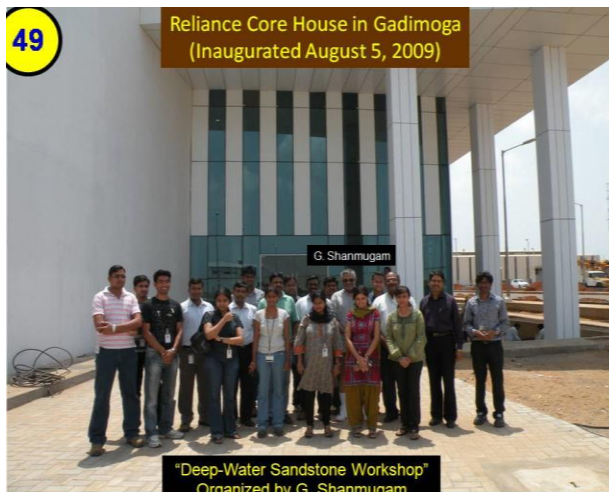


Fig. 49: Reliance Core House in Gadimoga, 2009.

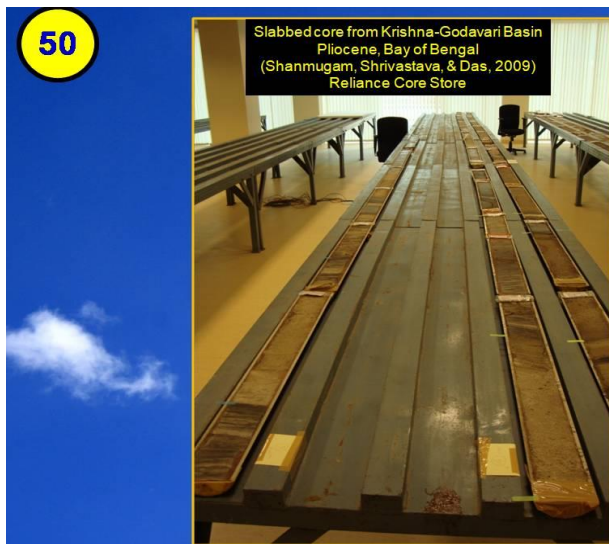


Fig. 50: Display of slabbed cores from the Krishna-Godavari Basin, Bay of Bengal, at Reliance Core House in Gadimoga.



Fig. 51: G. Shanmugam at a Reliance Core Workshop.

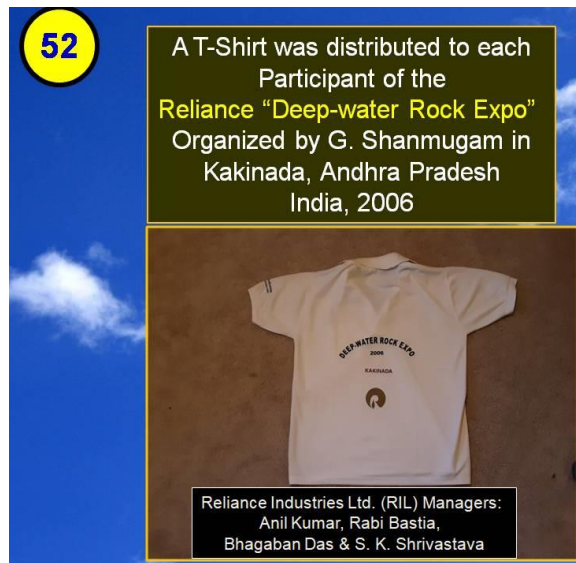


Fig. 52: A T-Shirt was distributed to each participant of the Reliance "Deep-water Rock Expo" Organized by G. Shanmugam in Kakinada, Andhra Pradesh, India, 2006



Fig. 53: Group photo showing G. Shanmugam and Dr. C. Zou, Vice President of Research (Right) at Research Institute of Petroleum Exploration and Development (RIPED). Workshop on Global Deep-water Sedimentary Reservoirs. PetroChina, Beijing, China, 2009. (Zou et al., 2012).

10. Knowledge transfer through organizing clastic facies field course (3 weeks) for Saudi Aramco, Dhaharan, Saudi Arabia:

1990 (3-21 November), Saudi Aramco, Saudi Arabia. Field area includes Qassim and vicinity. Modern and

ancient deposits were investigated in the field. Seismic profiles, well logs, and cores from petroleum-producing fields were used in class exercises.



Fig. 54: Group photo showing G. Shanmugam at China University of Petroleum, Qingdao, 2014.

11. Knowledge transfer through invited lectures In an effort to transfer knowledge from my research, I have delivered a total of 89 lectures worldwide during 1980-2022 period (Table 2).

Table 2. Knowledge transfer through 89 lectures given by G. Shanmugam during 1980-2022.

Serial Number	Year	Topic/Institution/Organization	Location
1	1980	Lamont-Doherty Geological Observatory of Columbia University	New York, USA
2	1980	Graduate School of Oceanography, University of Rhode Island	Kingston, RI, USA
3	1982	University of Texas at Arlington	Texas, USA
4	1982	University of Texas at Dallas	Texas, USA
5	1983	University of Texas at Arlington	Texas, USA
6	1983	University of Texas at Dallas	Texas, USA
7	1983	Victoria University of Wellington	North Island, New Zealand
8	1984	University of Texas at Arlington	Texas, USA
9	1984	University of Texas at Dallas	Texas, USA
10	1984	University of Parma	Parma, Italy
11	1984	NATO Advanced Study Institute - Conference on "Reading Provenance from Arenites"	Calabria, Italy
12	1984	Nigerian Association of Petroleum Explorationists, Annual Conference	Lagos, Nigeria
13	1984	Southern Methodist University	Dallas, Texas, USA
14	1985	Southern Methodist University	Dallas, Texas, USA
15	1985	University of Texas at Dallas	Texas, USA

16	1985	University of Bergen	Bergen, Norway
17	1985	Norwegian Petroleum Society	Stavanger, Norway
18	1985	Dallas Geological Society	Texas, TX, USA
19	1985	Abilene Christian University	Abilene, TX, USA.
20	1985	University of Tennessee	Knoxville, TN, USA
21	1986	West Texas Geological Society	Midland, TX, USA
22	1987	University of Texas at Arlington	Texas, USA
23	1987	University of Texas at Dallas	Texas, USA
24	1987	Fort Worth Geological Society	Fort Worth, TX, USA
25	1987	Society of Exploration Geophysicists	Dallas, TX, USA
26	1987	AAPG Research Conference on "Prediction of Reservoir Quality through Chemical Modeling,"	Park City, Utah, USA
27	1988	Abilene Geological Society	Abilene, TX, USA
28	1988	COMFAN II	Parma, Italy
29	1989	AAPG Research Symposium on "Application of Chemical Modeling to the Prediction of Reservoir Quality"	San Antonio, Texas, USA
30	1989	West Texas Geological Society Symposium "Search for the subtle trap hydrocarbon exploration in mature basins"	Midland, Texas, USA
31	1990	Fort Worth Geological Society	Fort Worth, TX, USA
32	1990	Dhahran Geological Society	Saudi Arabia
33	1991	Geological Society of London Symposium: Diagenesis at Unconformities- Implications for Reservoir Quality	London, UK
34	1991	Dallas Geological Information Library	Texas, USA
35	1992	Arthur Holmes Conference on Deep-water massive sands	Cefalu, Sicily, Italy
36	1993	Norwegian Petroleum Society	Stavanger, Norway
37	1994	Lafayette Geological Society	Lafayette, Louisiana, USA
38	1994	Geological Society of London Symposium: Progress in Sequence Stratigraphy	London, UK
39	1995	AAPG International Conference and Exhibition	Nice, France
40	1995	Azerbaijan Association of Petroleum Geologists 2nd Intl Conference	Baku, Azerbaijan
41	1995	Nigerian Association of Petroleum Explorationists 13th Annual Conference	Lagos - Nigeria
42	1996	Geological Society of London Conference "Reservoir Modeling of turbidite systems"	London, UK
43	1996	AAPG International Conference and Exhibition	Caracas, Venezuela
44	1997	Houston Geological Society	Texas, USA
45	1997	Bureau of Economic Geology	Austin, Texas, USA
46	1997	SEPM Debate on deepwater processes at the AAPG Convention in Dallas. Moderator: Ed Clifton; Panelists: Arnold Bouma, Jed Damuth, Don Lowe, Gary Parker, and G. Shanmugam	Dallas, TX, USA
47	1997	AAPG International Conference and Exhibition	Vienna, Austria
48	1998	Geoscience 98	Keele, UK
49	1999	Petrotech -99	New Delhi, India
50	1999	AAPG, San Antonio	San Antonio, Texas, USA
51	1999	Gulf Coast SEPM Conference	Houston, Texas, USA
52	2000	"John E. Sanders and the turbidite controversy" In: Conference on the History of Geologic Pioneers, Organized by Prof. G. M. Friedman, Rensselaer Center of Applied Geology	Troy, New York, USA
53	2002	Dallas Geological Society International Group	Dallas, Texas, USA
54	2002	Association of Petroleum Geologists (APG)	Mussorie, India.
55	2003	IIT, Bombay	Mumbai, India
56	2004	Association of Petroleum Geologists (APG)	Kajuraho, India
57	2006	Association of Petroleum Geologists (APG)	Goa, India
58	2006	Reliance Industries Limited	Mumbai, India
59	2007	Reliance Industries Limited	Mumbai, India
60	2008	Reliance Industries Limited	Mumbai, India
61	2009	Reliance Industries Limited	Mumbai, India

62	2009	SIPES Houston Continuing Education Seminar, Jan. 12, 2009	Houston, Texas, USA
63	2010	Reliance Industries Limited	Mumbai, India
64	2010	6 th China National Petroleum Sequence Stratigraphy Conference	Hangzhou, China
65	2010	8 th International Conference & Exposition on Petroleum Geophysics, "Hyderabad-2010", SPG	Hyderabad, India
66	2011	CAPG (Chinese Association of Petroleum Geologists)	Beijing, China
67	2014	China University of Petroleum	Qingdao, China
68	2014	Yanchang Oilfield Research Institute	Yañan, China
69	2015	Earth and Planetary Sciences, University of Tennessee	Knoxville, TN, USA
70	2016	Earth and Environmental Sciences, University of Texas at Arlington	Texas, USA
71	2016	1) Contourites 2) SSDS and Earthquakes 3) The landslide problem India Lecture Tour: Reliance Industries Limited, Mumbai Contact: Mr. Bhagaban Das, Manager, Reservoir Characterization, RIL	Mumbai, India
72	2016	1) Contourites 2) SSDS and Earthquakes India Lecture Tour: IIT Bombay, Mumbai Contact: Prof. M. Radhakrishna, IITB, Earth Sciences Prof. Santanu Banerjee, IITB, Earth Sciences	Mumbai, India
73	2016	1) Contourites 2) SSDS and Earthquakes 3) The landslide problem India Lecture Tour: Indian Statistical Institute, Kolkata Contact: Prof. Sarbani Patranabis-Deb, Indian Statistical Institute, Geological Studies Unit, Kolkata	Kolkata, India
74	2016	1) SSDS and Earthquakes India Lecture Tour: Annamalai University, Annamalai Nagar, Tamil Nadu Contact: Prof. T. Ramkumar, Annamalai University, Earth Sciences, Tamil Nadu	Chidambaram, India
75	2016	1) SSDS and Earthquakes India Lecture Tour: IIT Madras Contact: Prof. P. Shanmugam, IITM, Ocean Engineering	Chennai, India
76	2018	Earth and Planetary Sciences, University of Tennessee	Knoxville, TN, USA
77	2018	Earth and Environmental Sciences, University of Texas at Arlington	Texas, USA
78	2018	"Reflections on a personal story of challenges, failures, and achievements (1944-2018)" 31st Annual Convention: FeTNA: Federation of Tamil Sangams of North America. Frisco, Texas, USA. http://tap.fetna.org/category/2018/	Texas, USA
79	2018	"Deep-Water Sand Reservoirs: A Global Satellite Survey of Density Plumes Does Not Support Conventional Turbidite Fan Models" Dallas Geological Society. International Dinner, November 14, 2018	Texas, USA
80	2019	YouTube Link: Geologic phenomena of volcanism (Deccan Trap), meteorite impact (Shiva Crater), plate tectonics (Lemuria/Kumari Kandam), and the 2004 Indian Ocean Tsunami (Mahabalipuram). Presidential Address on Geologic Processes and Products in India delivered at the Lakshmi Tamil Learning Center Annual Day held on March 30, 2019 in Atlanta, Georgia.	Atlanta, Georgia, USA
81	2020	The turbidite – contourite – tidalite – hybridite problem: Orthodoxy Vs Empirical Evidence behind the “Bouma Sequence”. Special Virtual Lecture organized by the Indian Association of	Google Meet

		Sedimentologists. Virtual Lecture on Google Meet Platform. July 2, 2020 at 10:00 am (Indian Standard Time)	
82	2020	The turbidite – contourite –tidalite – hybridite problem: Orthodoxy Vs Empirical Evidence behind the “Bouma Sequence”. The Drifters VGT (Virtual Get-Together) Zoom Lecture organized by F. J. Hernandez-Molina, Dept. Earth Sciences, Royal Holloway, University of London (UK), July 27, 2020, Monday, 2.30 PM London (UK) Time	Zoom
83	2020	Transforming obstacles into opportunities by breaking up of orthodoxies in process sedimentology, physical oceanography, and petroleum geology: Webinar 2, Protolith 20. Department of Earth Sciences, IIT Bombay	Webex
84	2020	The turbidite-contourite-tidalite-hybridite problem: Orthodoxy vs. empirical evidence behind the "Bouma Sequence“ Zoom Journal of Palaeogeography Global Conference on "Deep-Water Systems", October 17, 2020, Beijing, China	Zoom
85	2021	Facebook Watch. "Turning obstacles into opportunities by a Tamil geologist". Special Lecture given at the Dallas MTS (Metroplex Tamil Sangam) 2021 India's Republic Day Celebration on January 26, 2021, Tuesday, 7 PM, Dallas, Texas, USA. Zoom Platform. URL: https://fb.watch/3gFUvXamOb/	Facebook
86	2021	YouTube Link: "Recent advances in interpreting deep-marine deposits". 2021 Ohio University Geological Sciences, Alumni Symposium Talk, Saturday (April 17, 2021) at 12.05 PM ET. Zoom YouTube Link: https://www.youtube.com/watch?v=v0n3mp_XQBY	Athens, OH, USA
87	2021	Zoom Interview Meeting (2 Hrs) with a renowned scholar of international repute on "Deep-Water Systems": Prof. G. Shanmugam Interviewer: Journal of Palaeogeography Editor Dr. Yuan Wang on "Recent Advances in Interpreting Deep-Marine Deposits" and related topics. May 29, 2021 9:00 AM: Interview (Beijing Time)	Zoom
88	2022	“Sedimentary Basins: Processes, deposits, palaeogeography, and challenges.” Keynote Lecture, 37th Convention of the Indian Association of Sedimentologists, University of Jammu, India, April 27, Wednesday, 10:00 AM (Jammu, India Time), 2022, (Shanmugam, 2022d)	Zoom
89	2022	“150 Years (1872-2022) of research on deep-water processes, deposits, settings, triggers, and deformation: A difficult domain of progress, dichotomy, diversion, omission, and groupthink.” Keynote Lecture. 5 th International Conference on Palaeogeography. May 14, Saturday, 9:50-10:20 AM (Beijing Time), 2022, Wuhan, China. (Shanmugam, 2022e)	VooV

12. 2003-2004: Courses taught at the University of Texas at Arlington

Spring 2003: Geology 3442: Sedimentology and Stratigraphy

Fall 2003: Geology 5344 and 4305: Clastic Depositional Environments

Spring 2004: Geology 3442: Sedimentology and Stratigraphy

In 2000, Prof. John Wickham, Chair of Geosciences Department, appointed me as an Adjunct Professor at UTA.

In 2021, Prof. Arne Winguth is the Chair of Earth and Environmental Sciences at UTA.

13. Knowledge transfer through serving in the Editorial Boards of journals by G. Shanmugam (2014-2021)

Associate Editor-in-Chief of the *Journal of Palaeogeography* (Springer & Elsevier)

Editorial Board Member of the *Petroleum Exploration and Development* (Elsevier).

Editorial Board Member of the Journal of Indian Association of Sedimentologists.

14. Knowledge transfer through publications by G. Shanmugam and his colleagues during 1969-2022 (Table3)

Table 3. Knowledge transfer through publications on diverse domains by G. Shanmugam and his colleagues during 1969-2022. Selected publications are listed to illustrate diversity of fields.

Serial number	Topic	Reference
1	ACE Language computer program for moment statistics in size-shape studies of sedimentary particles	Shanmugam (1970)
2	Annot Sandstone, SE France	Shanmugam (2002)
3	Bagh Sandstones, India	Parthasarathy and Shanmugam, (1969)
4	Basin-floor fans in the North Sea	Shanmugam et al. (1995)
5	Bioturbation and trace fossils in deep-water contourites, turbidites, and hyperpycnites	Shanmugam (2018b)
6	Bottom-current reworked sands: Gulf of Mexico	Shanmugam et al. (1993)
7	The Bouma Sequence	Shanmugam (1997)
8	Breccias and earthquakes	Shanmugam (2017d)
9	Coniferous rain forests and related Organic matter in generating commercial quantities of oil, Gippsland Basin, Australia	Shanmugam (1985a)
10	Contourites	Shanmugam (2016b, 2017b)
11	The constructive functions of tropical cyclones and tsunamis	Shanmugam (2008a)
12	Fine-grained carbonate debris flow	Shanmugam and Benedict (1978)
	Deep-marine facies models	Shanmugam (1990a)
13	Deep-water bottom currents and their deposits	Shanmugam (2008b)
14	Deep-water processes and deposits	Shanmugam (2021c)
15	A global satellite survey of density plumes at river mouths and at other environments	Shanmugam (2018c)
16	Double mud layers and sigmoidal cross bedding	Shanmugam (2002, 2003)
17	Duplex-like structures in submarine fan channels	Shanmugam et al. (1988)
18	Origin, recognition and importance of erosional unconformities in sedimentary basins	Shanmugam (1988)
19	Evolution of the Ordovician foredeeps, southern and central Appalachians	Shanmugam and Lash (1982)
20	Eustatic control of turbidites and winnowed turbidites	Shanmugam and Moiola (1982)
21	Eustatic control of calciclastic turbidites	Shanmugam and Moiola (1984)
22	Fan-deltas and braid deltas	McPherson, Shanmugam, and Moiola (1987)
23	Flume experiments on decrease in scour rate of fresh deposited muds	Karcz and Shanmugam (1974)
24	Flume experiments on sandy debris flows	Shanmugam (2000) and Marr, Harff, Shanmugam & Parker (2001)
25	Global significance of wind forcing on deflecting sediment plumes	Shanmugam (2019a)
26	Gravity flows	Shanmugam (2020)
27	High-density turbidity currents	Shanmugam (1996)
28	The hyperpycnite problem	Shanmugam (2018a).
29	Reply to discussions by Zavala (2019) and by Van Loon, Hüeneke, and Mulder (2019) on "The hyperpycnite problem"	Shanmugam (2019b)
30	Comment on "Ichnological analysis"	Shanmugam (2018f, 2022b)
31	Internal waves and internal tides along oceanic pycnoclines	Shanmugam (2013)
32	Review of research in internal-wave and internal-tide deposits of China, discussion	Shanmugam (2014)
33	The landslide problem	Shanmugam (2015)
34	Leaves in turbidite sand: the main source of oil and gas in the deep-water Kutei Basin, Indonesia: discussion	Shanmugam (2008c)
35	Manganese distribution in the carbonate fraction of shallow and deep marine lithofacies	Shanmugam and Benedict (1983)
36	Mass transport, gravity flows, and bottom currents	Shanmugam (2021a)
37	Comment on "A new classification system for mixed (turbidite-contourite) depositional systems	Shanmugam (2022c)
38	Ophiolite source rocks for Taconic-age flysch	Shanmugam (1985b)
39	Ordovician Sevier Shale Basin in East Tennessee	Shanmugam (1978)
40	Paleo-tsunami deposits	Shanmugam (2012b)

41	Pennsylvanian Jackfork Group), Ouachita Mountains, Arkansas and Oklahoma	Shanmugam and Moiola (1995)
42	Types of porosity in sandstones and their significance in interpreting provenance	Shanmugam (1985c)
43	Porosity enhancement from chert dissolution beneath Neocomian unconformity: Ivishak Formation, North Slope, Alaska	Shanmugam and Higgins (1988)
44	Porosity prediction in sandstones using erosional unconformities	Shanmugam (1990b)
45	Parameters influencing Porosity in sandstones: a model for sandstone porosity prediction: discussion	Shanmugam and Alhilali (1988)
46	Comment on “Late Holocene Rupture of the Northern San Andreas Fault and Possible Stress Linkage to the Cascadia Subduction Zone”	Shanmugam (2009)
47	Sandy debrites and tidalites of Pliocene reservoir sands in upper-slope canyon environments, Offshore Krishna-Godavari Basin (India)	Shanmugam et al. (2009)
48	The obsolescence of deep-water sequence stratigraphy in petroleum geology	Shanmugam (2007)
49	The seismite problem	Shanmugam (2016c)
50	Simpson Group (Ordovician) Sandstones, Southern Oklahoma	Shanmugam (1972)
51	Slides, slumps, debris flows, and turbidity currents	Shanmugam (2008d)
52	Slides, Slumps, Debris Flows, Turbidity Currents, Hyperpycnal Flows, and Bottom Currents	Shanmugam (2019c)
53	Slump and debris flow dominated upper slope facies in the Cretaceous of the Norwegian and Northern North Seas	Shanmugam et al. (1994)
54	Soft-sediment deformation structures (SSDS)	Shanmugam (2017a)
55	Submarine canyons. 7th Edition of Encyclopedia of Science and Technology	Shanmugam (1992)
56	Submarine fans: characteristics, models, classification, and reservoir potential	Shanmugam and Moiola (1988)
57	Submarine fans: a critical retrospective (1950–2015)	Shanmugam (2016a)
58	Tectonic significance of distal turbidites	Shanmugam and Walker (1978)
59	Sedimentation in the Chile Trench: depositional morphologies, lithofacies, and stratigraphy: discussion and reply	Shanmugam and McPherson (1987)
60	Tidal bottom currents in submarine canyons	Shanmugam (2003)
61	Tide-dominated estuarine facies, Ecuador	Shanmugam et al. (2000)
62	Tomboliths	(Shanmugam (2017c)
63	The tsunamite problem	Shanmugam (2006b)
64	Turbidite history	Shanmugam (2006a)
65	"Turbidite" case studies	Shanmugam (2006a, b)
66	Turbidite facies association	Shanmugam et al. (1985)
67	The turbidite-contourite-tidalite-baroclinitehybridite problem: orthodoxy vs. empirical evidence behind the “Bouma Sequence”	Shanmugam (2021b)
68	Book Review: "Principles of Sedimentology" by G. M. Friedman and J. B. Sanders	Shanmugam and Moiola (1979)
69	Book Review: "Petroleum Development Geology" by Parke A. Dickey	Shanmugam (1980)
70	Book Review: “Fine-Grained Turbidite Systems” edited by A.H. Bouma and C.G. Stone	Shanmugam (2001)
71	Book Review: “Fine-grained turbidite systems” edited by A.H. Bouma and C.G. Stone	Shanmugam (2002b)
72	Book Review: “Economic and Palaeoceanographic Significance of Contourite Deposits”. Edited by A. R. Viana and M. Rebesco	Shanmugam (2008e)
73	Book Review: “The Cambridge Handbook of Earth Science Data”, by Paul Henderson & Gideon M. Henderson	Shanmugam (2009b)
74	Book Review: “Deep-Sea Sediments” by Hüeneke, H., Mulder, T. (Eds.)	Shanmugam (2011)
75	Book Review: “River Planet: Rivers from Deep Time to the Modern Crisis by Martin Gibling”	Shanmugam (2022a)
76	150 Years (1872-2022) of research on deep-water processes, deposits, settings, triggers, and deformation: A difficult domain of progress, dichotomy, diversion, omission, and groupthink. Note: This article examines 22 critical topics including “Turbidite groupthink”, which is a case study in illustrating how turbidite groupthink functions, without sound scientific methods, on the basis of published	Shanmugam (2022f)

	information on modern turbidity currents in Bute Inlet (fjord and estuary), British Columbia, Canada.	
77	The peer-review problem: a sedimentological perspective	Shanmugam (2022g)
78	Book Review on “Fossil Future: Why Global Human Flourishing Requires More Oil, Coal, and Natural Gas--Not Less” by Alex Epstein	Shanmugam (2022h)

The T. N. Muthuswami Iyer - V. Panchapakesan - G. N. Jadhav Lineage

In 1981, G. N. Jadhav joined the Dept. of Civil Engg. at IIT Bombay as STA (Senior Technical Assistant) in Geology Section, headed by Prof. A. Parthasarathy (Fig. 22). He secured his Ph.D. under the able guidance of Prof. K. C. Sahu and co-guidance of Prof. V. Panchapakesan in 1989 on the topic "Fluid-melt inclusion and Thermoluminescence studies on Mica bearing Pegmatites of Koderma district, Bihar, India".


In 1992, Jadhav was appointed as a Visiting Faculty Member-Lecturer. He got promoted to full Professorship in 2009 at IIT Bombay. He retired in December 2021. He has published on various topics (e.g., Jadhav et al. (1988, 1993, 2012).

The T. N. Muthuswami Iyer - T. M. Mahadevan Lineage


Although this story is focused on the teacher-student relationship related to my career, there are numerous other such stories. For example, the story of T. M. Mahadevan is equally impressive. At Presidency College, Mahadevan did his M.Sc. by research guided by Prof. TNM during 1948-1949 and joined Geological Survey of India. Viswanathan was his classmate during his B.Sc. Honours (1944-1947) years at Presidency. T. M. Mahadevan eventually became the Director of Atomic Minerals Directorate (AMD) (Fig.55), and now retired from AMD. He and Chandrasekharam co-authored the Viswanathan's Obituary (Fig.27). T. M. Mahadevan has made significant contributions to our understanding of Indian Geology (Mahadevan, 1994, 2002, 2003, 2014; Mahadevan and Maithani, 1966).

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The T. N. Muthuswami Iyer-T. M. Mahadevan Lineage



T. M. Mahadevan
Retired Director
Atomic Minerals Directorate (AMD)
Department of Atomic Energy
Government of India



1944-1949: T. M. Mahadevan, B. Sc. Honours (MA) and M.Sc (By Research), at Presidency College, was guided by Prof. T. N. Muthuswami Iyer (TNM). Some highlights are:

1. TNM introduced advanced courses in Map Drawing.
2. TNM introduced a four axis Federov Stage.
3. TNM published an English version of how to calculate Niggli values (German method).
4. TNM introduced students to the concept of mineral phases.
5. TNM made students to plot the analytical results published in the American Journal of Science by the school of Bowen in USA in the trilinear diagrams.
6. Dr W. D. West, the first Director of GSI after India's independence visited the department and greatly impressed by the curriculum developed by TNM.
7. After Mahadevan completed his B.Sc Honours course in 1947, Prof. TNM hired him as a research scholar.
8. TNM introduced Mahadevan to Dr. M. S. Krishnan (MSK) a renowned Geologist who was then a Suppdt. Geologist in GSI in charge of Madras office.

1949-1969: Mahadevan worked for the Geological Survey of India (GSI).
1969-1987: Mahadevan worked for the Atomic Minerals Division (AMD).

55: The T. N. Muthuswami Iyer-T. M. Mahadevan Lineage.

The T. N. Muthuswami Iyer - A. Parthasarathy - S. Asokan Lineage

Both Shanmugam and Asokan followed similar paths in many respects.

1. Both were born in Sirkazhi, Tamil Nadu.
2. Both received their M.Sc, in Applied Geology at IIT Bombay.
3. Both were supervised by Prof. Parthasarathy at IIT Bombay on sedimentological topics (Parthasarathy and Shanmugam, 1969 and Parthasarathy et al., 1977).
4. Both received their IIT Medal for top-ranking student in Applied Geology.
5. Both earned their Ph.D. abroad, Shanmugam from University of Tennessee (USA), and Asokan from Cambridge University (UK).
6. Both have been successful in their professional careers in the industry.
7. Shanmugam excelled in publications and in the petroleum industry (see “60 Years of Knowledge Transfer” section above),
8. Asokan has been a Business Leader and a Geology & Mining professional.
9. 1975 – 1991: Asokan was the Corporate Head and General Manager, GEM Division, of ACC (The Associated Cement Companies Limited), India.
10. 2003: Asokan was a Chief Executive of Titanium Project, TATA Steel.
11. 2003: Asokan received “Distinguished Alumnus Award” from IIT Bombay (Fig. 56). <https://www.alumni.iitb.ac.in/en/awards/2003/distinguished-alumnus/dr-sundaresan-asokan>
12. 2021; Shanmugam received “Distinguished Alumnus Award” from the University of Tennessee, Knoxville (Fig. 45).
13. 2006-2007: Asokan served as the President of the Indian Geological Congress (IGC).

The Story of K. Swaminathan - G. Shanmugam - S. Asokan Trio from Sirkazhi who earned their M.Sc. in Applied Geology from IIT Bombay

It is truly remarkable that three students, namely, K. Swaminathan, G. Shanmugam, and S. Asokan, from Sirkazhi area would select IIT Bombay to pursue M.Sc. in Applied Geology during different years (Fig. 57). Both Shanmugam and Asokan were born in Sirkazhi town proper, but Swaminathan was born in a nearby (5 km) Kadavasal village, which is located within the Sirkazhi Taluk. Swaminathan and I have been friends for nearly 60 years.

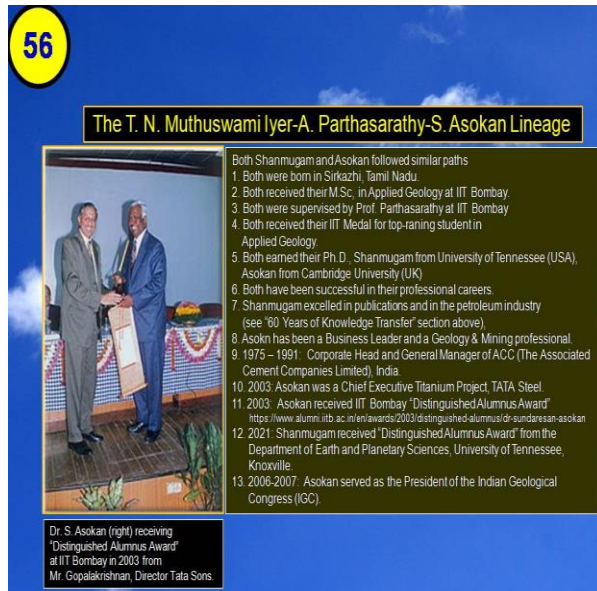


Fig. 56: Dr. S. Asokan (right) receiving “Distinguished Alumnus Award” at IIT Bombay in 2003 from Mr. Gopalakrishnan, Director Tata Sons.

We both (Shanmugam and Swaminathan) attended Sabhanayaka Mudaliar Hindu High School (SMHHS) in Sirkazhi. He was one year senior to me. Swaminathan was the top-ranking student in the final year 1960.

We both (Shanmugam and Swaminathan) attended Annamalai University, as train students, commuting from Sirkazhi to Chidambaram (Fig. 58).

At IIT Bombay, Swaminathan’s M.Sc. dissertation was supervised by Prof. K. S. Balasubramaniam. After M.Sc. from IIT Bombay, Swaminathan pursued a very successful business career in Chennai.

He is the founder and Patriarch of the Swathi Group of Companies in Chennai.

Visit swathigroup.com

He lives in a palatial home in the middle of T. Nagar, Chennai (Fig. 59).

He helped me during 1962-1970 periods in many aspects, which include books, notes, clothes, and financial affidavit to obtain visa for the USA. He did come to the Madras Airport to give me send-off to the USA (Fig. 13).

In his native village Kadavasal (near Sirkazhi), Mr. K. Swaminathan has constructed a new building (Fig. 60) in 2021 to impart VEDAS using Gurukulam-type education. In addition, a Veterinary Hospital will be opened in the road leading to my village Kadavasal, which will provide free dispensary. He is also considering a proposal to provide financial support to girls to continue their studies of 11th and 12th grades in surrounding villages.

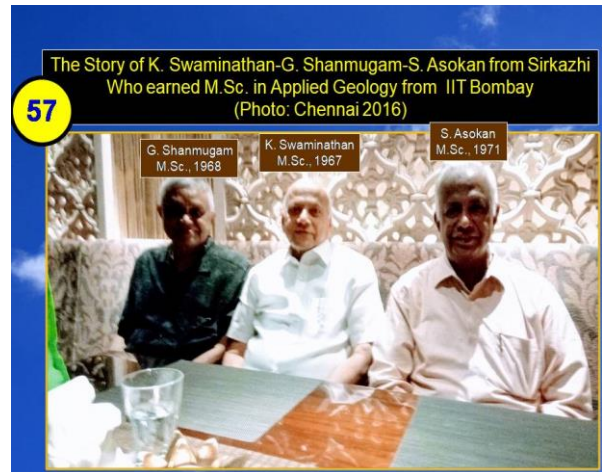


Fig. 57: K. Swaminathan, G. Shanmugam, and S. Asokan.



Fig. 58: G. Shanmugam and K. Swaminathan.



Fig. 59: K. Swaminathan (left) and G. Shanmugam (right) at Palatial Residence of Swaminathan in T. Nagar, Chennai 2006.

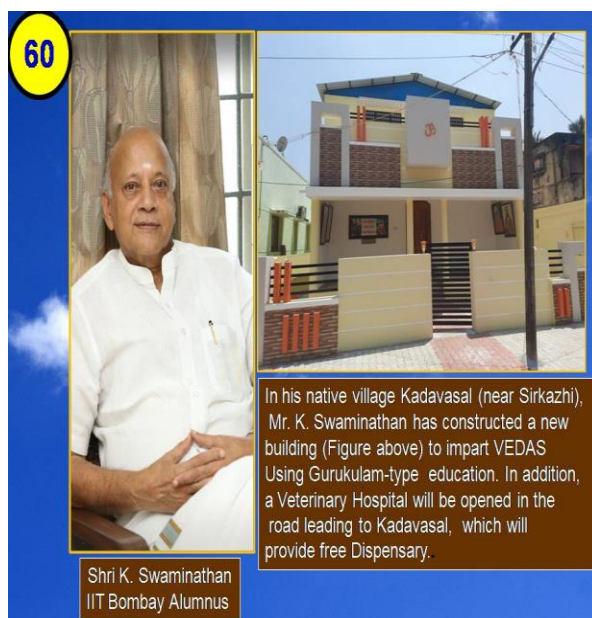


Fig. 60. In his native village Kadavasal (near Sirkazhi), Mr. K. Swaminathan has constructed a new building (Figure above) to impart VEDAS using Gurukulam-type education.

TNM: Transformational, Neoteric and a Motivating teacher & a noble soul

TNM was the embodiment of Teaching, Novel ideas, and Mentoring. He was known for efficiency, and cultivating Ethics and morality in students with a pioneering zest (Fig. 61). He exemplified these core principles throughout his professional and personal life, be it:

Teaching Crystallography in classrooms,
 Introducing and Operating E. S. Federov four-axis Universal stage microscope (which came into existence in 1892),
 Calculating Niggli value in Normative Mineralogy,
 Describing Madras Charnockites in Pallavaram, Tamil Nadu,
 Publishing innovative mineralogical studies,
 Documenting basic methods of geologic mapping,
 Developing new curriculum in Geology in the 1940s and 1950s that India critically needed,
 Keeping abreast of advances made in other countries (Russia, Germany, USA) with a view to keep knowledge transfer up-to-date in the Independent India,
 Motivating students like me to aspire for new heights,
 Maintaining an Intellectual honesty & heritage,
 Demonstrating excellence in geosciences by his association with pioneers of Indian Geosciences, like Dr. W. D. West (1945-1951: 1st English Director of GSI after India's Independence) and Dr. M. S. Krishnan (1951-1955: 1st Indian-born Director of GSI), and finally, Raising a wonderful family with two successful sons and two daughters and grandchildren.

In addition to knowledge transfer, TNM and his lineages contributed to the following domains of economic significance:

- TNM: Applied Geology and Mineralogy.
- A. Parthasarathy: Engineering Geology.
- G. Shanmugam: Petroleum Geology.
- T. M. Mahadevan: Atomic Minerals and Pegmatites.
- S. Asokan: Cement Industry and Gemstones.
- D. Chandrasekharam: Geothermal Energy and Groundwater Resources.
- G. N. Jadhav: Bauxite (Aluminium and Gallium).

In short, the acronym "TNM" for T. N. Muthuswami Iyer is just perfect for a Transformational, Neoteric and a Motivating teacher and a noble soul!

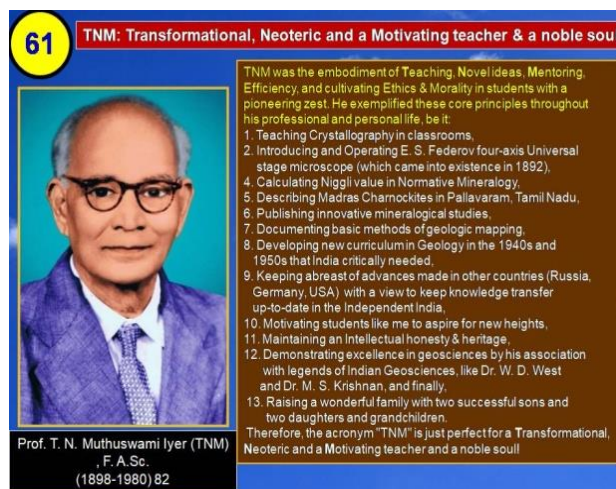


Fig. 61: TNM: Transformational, Neoteric and a Motivating teacher & a noble soul

The C. P. Ramaswami Iyer - T. N. Muthuswami Iyer - A. Parthasarathy - G. Shanmugam Culmination (1965)

In summary, the year 1965 marks the culmination of key events in my life (Fig. 62):

- (Sir C. P. Ramaswami Iyer (A notable alumnus from Presidency College), as the Vice Chancellor of Annamalai University, signed my B.Sc. degree (1965).
- Professor T. N. Muthuswami Iyer (A former faculty from Presidency College), as the Head of Geology Department at Annamalai University, motivated me to pursue M.Sc. in Applied Geology at IIT Bombay (1965).
- Professor A. Parthasarathy, who was a student of Professor T. N. Muthuswami Iyer at the Presidency College in Madras (Chennai), supervised my M.Sc. Thesis at IIT Bombay (1965-1968).
- The Presidency College in Madras was clearly the epicenter of this story (Fig. 62).
- India's Independence Movement is tied to Sir C. P. Ramaswami Iyer in this story (Table 1).

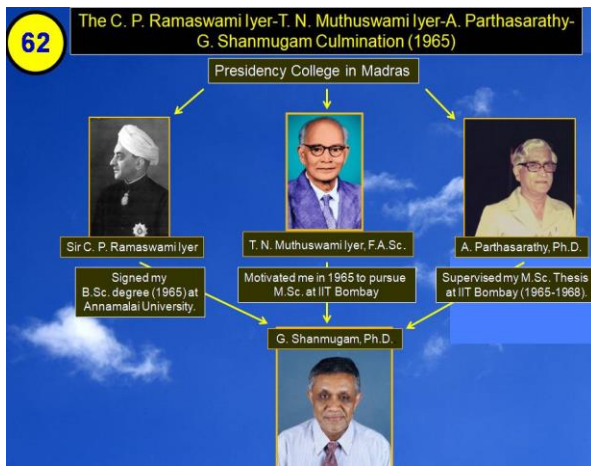


Fig. 62: The culmination of events in 1965 that would transform me from a local science teacher into a global petroleum geologist.

Concluding Remarks

1. I still remember vividly the day in 1965 when TNM advised me to quit my teaching job and go to IIT Bombay to pursue my M.Sc. in Applied Geology. That seminal moment truly and magnificently transformed my life.

2. I am truly blessed to have multiple teachers, who originated from the divine and supreme knowledge of TNM at various educational institutions in India and converged upon IIT Bombay at the same time, and transferred their knowledge to me is simply phenomenal. Consequently, the entire geosciences community worldwide benefits from TNM (Fig. 63).

3) The empirical data that document this global knowledge transfer come from the Special Prize for "Excellent Papers" that I received from the Journal of Palaeogeography. This prize was based on Science Citation Index (SCI) of five articles on different domains published during the 2012-2018 award period (Fig. 64).

4. I began this article with a statement on the ancient Vedic Culture of India and the *guru-shishya* tradition, or the *parampara* ("lineage"), which is the central theme of this document. It is only fitting that I conclude it with my most recent publication (Shanmugam, 2022g) that is a Book Review of "River Planet" by Martin Gibling (2021). Chapter 15 of this book discusses the geologic as well as historic aspects of the ancient "Saraswati River" in the Indus Civilization in the north-western region of the Indian Subcontinent (Fig. 65). The "Saraswati River" is quoted in the ancient Vedic-Hindu text Rigveda (1500-1000 BCE). The origin and role of this great river have been the focus of academic discussion among scholars worldwide (Oldham, 1874; Jamison, 2014; Chatterjee et al., 2019).

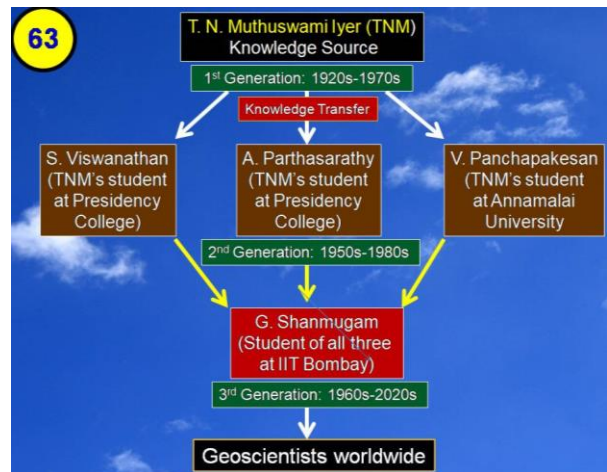


Fig. 63: Summary diagram showing knowledge transfer among three generations of geoscientists over a span of 100 years.

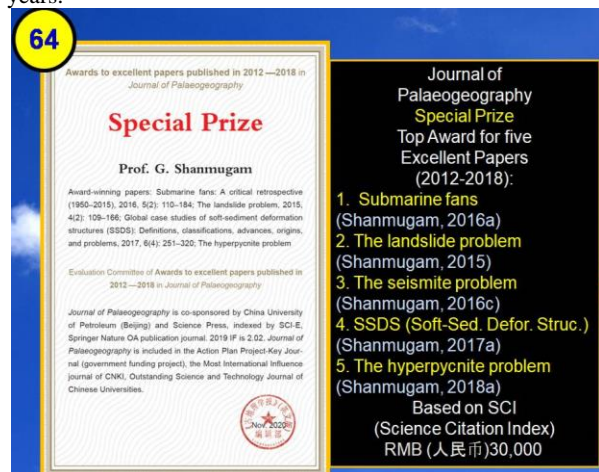


Fig. 64: The Top "Special Prize" awarded to G. Shanmugam by the Journal of Palaeogeography in 2020.

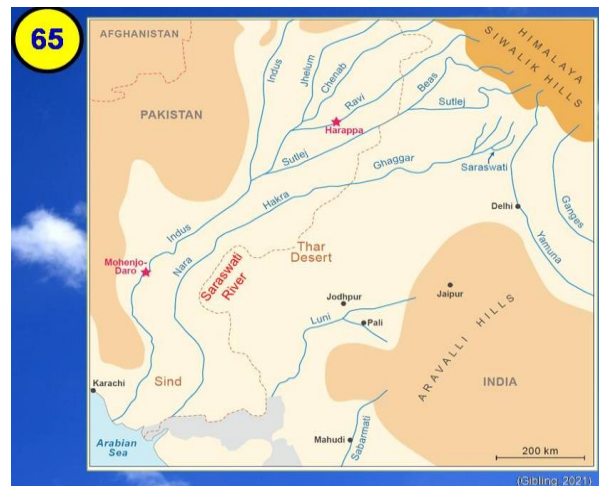


Fig. 65. Map showing the legendary Saraswati River of the north-western Indian Subcontinent. From Gibling (2021, his Fig. 15.1). Label "Saraswati River" added by G. Shanmugam.

Dedication

In ending this article of gratitude, I dedicate this compilation to the late D. Arumugam, who helped me financially during the critical period in my life (1960-1970) in India (Fig. 66). During that period, Arumugam, popularly known as “Mani”, paid for most of my expenses, such as, textbooks, college supplies, clothes, train tickets for commuting to Annamalai University (1962-65), wrist watch, even for movies, SEPM Membership Fees, Airline ticket to the USA, to list a few. When I was employed by Mobil in the USA, he was compensated in full and then some. Of course, he came to the Madras Airport to give me a send-off to the USA (Fig. 13). On June 1, 2021, I established Arumugam-Shanmugam endowment worth 1 Lakh Indian Rupees (INR1,00,000) at Sabhanayaka Mudaliar Hindu High School (SMHHS) in Sirkazhi, where we both attended. This endowment is expected to yield INR5,000 interest income per year. This income will be distributed annually as Prize money to the first-, Second-, and Third-ranking students in the 12th Grade

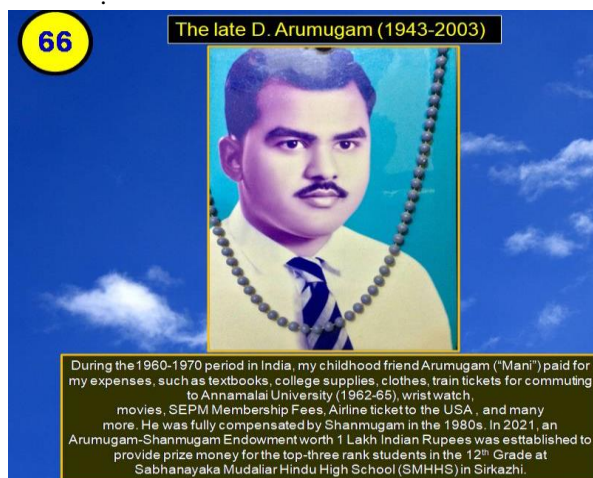


Fig. 66: The Late D. Arumugam (1943-2003).

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Seven articles:

- 1) 2018: An extended tribute to Professor George Devries Klein (Shanmugam, 2018e).
- 2) 2018: Bioturbation and trace fossils (Shanmugam, 2018b).
- 3) 2018: Preface to the Special Issue dedicated to George Devries Klein (Shanmugam, 2018d).
- 4) 2019: Global significance of wind forcing on deflecting sediment plumes (Shanmugam, 2019a).
- 5) 2020: Gravity Flows (Shanmugam, 2020),

- 6) 2022: The peer-review problem (Shanmugam, 2022g),
- 7) 2022: Book Review on “Fossil Future” (Shanmugam, 2022h).

Four Journal Cover Photos:

- 1) 2018: G. D. Klein (Shanmugam, JIAS, 35, 2).
- 2) 2019: Elwha River plume (Shanmugam, JIAS, 36,
- 3) 2021: Grain flows in Saudi Arabia (Shanmugam, JIAS, 37, 2).
- 4) 2022: The Bouma Sequence (Shanmugam, JIAS, 39, 1).

Two authors contributed to the Klein Special Issue by my invitation:

- 1) 2018: N. Kumar (2018).
- 2) 2018: G. J. Van der Lingen (2018).

JIAS Special Issue:

- 1) 2018: G. D. Klein Special Issue (JIAS, 35, 2). Prof. Bhat had decided to dedicate a Special Issue to Klein because of my extended tribute to Professor George Devries Klein (Shanmugam, 2018e). I might add that he had the foresight to publish this Special Issue. Consequently, JIAS has distinguished itself as the only sedimentological journal in the world to dedicate a Special Issue to a sedimentologic pioneer Klein.

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Declaration of Conflicting Interest

The author declares that there is no conflict of interest.

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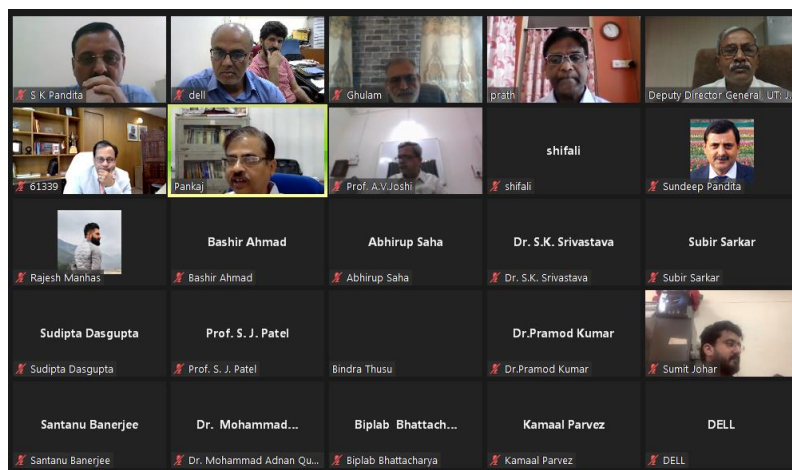
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Report On 37th Convention of IAS and National Conference on “Resource Potential of Sedimentary Basins

The National conference on resource potential of the sedimentary basins and 37th convention of Indian Association of Sedimentologists (IAS- 2022) was organized by the Department of Geology, University of Jammu, Jammu during April 26-27, 2022 in virtual mode. The Department of Geology, University of Jammu has the honour to conduct the IAS Convention meeting for 3rd time after 1999 and 2010. The Executive Council of the IAS in its last meeting at Hyderabad during 36th Convention decided to hold the 37th IAS convention at Jammu with Prof. S. K. Pandita as the Convener in the month of November, 2020. Due to Covid-19 pandemic the convention could not be held and was postponed for 2021 and then again to March 2022. But due to emergence of new Covid-19 variants the Executive

Council of IAS decided to conduct the 37th Convention in virtual mode and was organized during 26-27th April, 2022.

The virtual inauguration of the Convention was held at 10:30 am on 26th with Dr. Ashutosh Mondal, DDG, GSI, Jammu as Chief Guest and Dr. Ravi Misra, Executive Director, Chief Exploration & Development Directorate, ONGC as the Guest of Honour. The Convener started the inauguration proceedings by welcoming the guests and also presented a brief background about the Convention. Prof. G. N. Nayak, President, Indian Association of Sedimentologists briefed about the various important issues taken up by the association in last two years. Vote of thanks was presented by Dr. Yudhbir Singh, Organising Secretary of the convention.

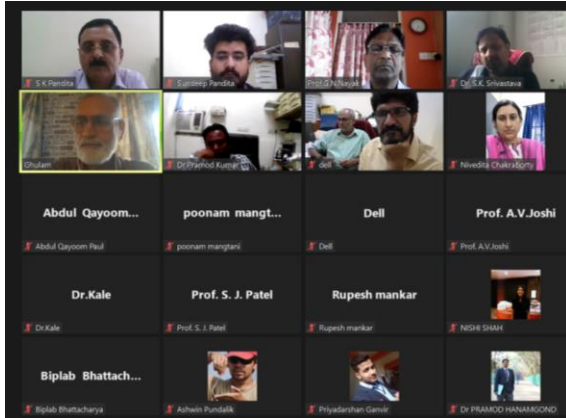


Prof. Nayak during his address highlighted that “**The Journal of Indian Association of Sedimentologists**” (JIAS) acquired both online and print ISSN numbers and has been added to the UGC Care list and obtained the DOI recognition. He also appreciated the efforts made by Prof. G M Bhat and Dr Bashir A Lone, Managing Editors of the journal for achieving these distinctions for the journal. He also put forth the new initiative to bring out online “IAS Magazine” which shall be “fellowship magazine” of the association with news about science, people, the society and articles of general interest and achievements of Sedimentologists of international repute and their contributions in Sedimentology. The Association lost Prof. Braham Parkash, Prof. I. B. Singh, Prof. Nilesh Bhat and Prof. A. K. Srivastava during last two years. A two-minute

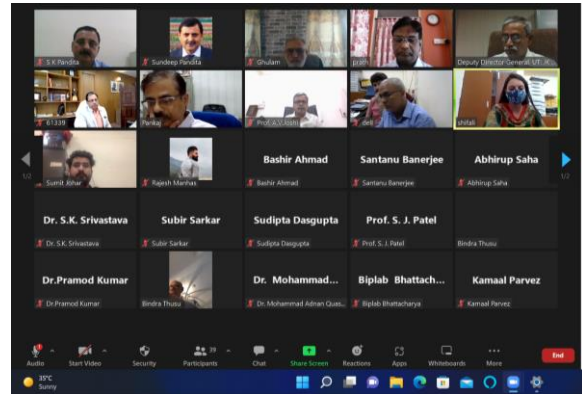
silence was kept to pay homage to these members after the inauguration of the Convention.

The scientific programme was divided into six technical sessions which started with the convention address by Dr Ravi Mishra on “Energy Scenario vis a vis climate change- road ahead for Hydrocarbon industry”. Four keynote addresses were delivered during the two days scientific programme. Prof. G. Shanmugam, University of Texas talked on “Sedimentary basins: Processes, deposits, palaeogeography, and challenges”; Prof. Sudipta Dasgupta, IIT Mumbai on “Unusual infaunal animal-sediment interactions: Unique ichnologic preservations around the Eocene shoreline of Kutch basin, Gujarat”; Dr. Soumen Paul, ONGC Agartala on “Sequence stratigraphy: A new paradigm” and Prof. Satish. J. Patel, University of Baroda on “Implications of

lithofacies and ichnofacies in sequence stratigraphic analysis: A case study from the Kachchh Sub-basins (Chorar Island-Wagad Highland)”. 45 oral presentations were made by the participants in six technical sessions. These technical sessions were chaired by Prof. G. N. Nayak, Prof. G. M. Bhat, Prof. A. V. Joshi, Prof. M. G. Kale, Dr. Biplab Bhattacharya and Dr. S. K. Srivastava. The Young Sedimentologists Award -



The General Body meeting of the association and valedictory function of the Convention was chaired by Prof. G. N. Nayak (President, IAS) and Prof. G M Bhat (Vice-President, IAS) who congratulated the organizers for conducting a very successful convention. Prof Pandita presented a report on the



2022 competition could not be held because of the required number of applications.

deliberations of the two day proceedings in which 45 oral presentations of high quality papers were made. The President announced that the 38th Convention of the IAS shall be held at University of Delhi during November, 2022 with Dr. Pramod Kumar as the Convener. Dr. Yudhbir Singh, Organising Secretary presented the formal vote of thanks.

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