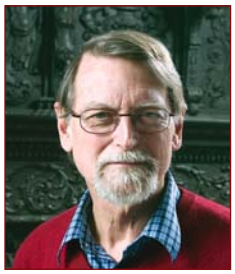

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Passages to India

David Mumford

MY CONNECTION with India started through an unexpected letter. I had written a short paper for the *Proceedings of the International Congress* at Stockholm in 1962 on the idea of "stability" of orbits of a representation of an algebraic group and included an application of this idea to the construction of a moduli space for vector bundles on curves. Unknown to me, Seshadri and Narasimhan had found a construction of this same moduli space using unitary representations of the fundamental group of the (complex) curve. We had converged, from totally different directions, on the same definition for "stable" vector bundles, those that can be included in one Hausdorff moduli space. This felt quite wonderful, both from the mathematical perspective, to see that one definition could arise in such different contexts, and from the geographical perspective, that ideas worked-on half way across the world – in Boston and Mumbai – could turn out to be so close. Naturally, we wanted to work together and push these ideas further. Seshadri was first to come to Harvard and, while he was there, said – "would you ever consider coming to India?"

The world has become such a small place in the intervening 40+ years that it is hard for anyone today to recall (if they were then alive) or believe (if they were not) how exotic this seemed then. India, even today, is a sensory overload for Western visitors accustomed to well-regulated streets and middle class societies. In the 60s, India still retained many of the trappings of a medieval country. We used to wait for cows as safe escorts in order to cross the traffic-filled British boulevards of Mumbai and naked sadhus were still seen walking in the city with their begging bowls. Repairs to the exterior of our apartment building were made from bamboo scaffolding, rising twenty stories and held together only with string! A village of fishermen, their fires, animals and tents, subsisted in the very middle of the downtown area. Gold smuggling supported the "District of Song", the neighboring slum. In the midst of all of this, Homi Bhabha, like Kublai Khan, had built his Xanadu: the Tata Institute of Fundamental Research (TIFR), an ultra-modern paradise for scientists. Clean, air conditioned, efficiently run, this was where all this wonderful math was being done.

In back row, from left: M. S. Narasimhan, C. S. Seshadri, his wife Sundari and my wife Erika; in front row, from left: Seshadri's nephew Narasi, his son, also Narasi, Steven and Peter (at the Gateway of India, 1967).

My family spent the academic year 1967/68 at the TIFR. My wife Erika and I rented an apartment in a tall new apartment building near the Colaba post office. Scribes could be found in front of the post office, reading and writing letters for anyone in need of their services. We had two sons then, Steven and Peter, who went to the Bombay International School where they learned some Hindi (they loved to say the numbers *"ek, do, teen, char, paanch"* after which they performed the action that their English ears heard in the last word) as well as correct English spelling – a vanishing skill in the US, then and now. We enjoyed the afterglow of the British Raj, swimming in the pool of the Breach Candy Club alongside the Arabian Sea. Our whole family became very close friends with the Seshadris as well as the Ramanans and Narasimhans. We travelled north to Gujarat, Delhi, Agra and Nepal. Back home, I had been friends since college with Rohit Parikh, and his Gujarati family received us with great hospitality, both in Bombay and in his hometown of Palanpur. We traveled south to Tamil Nadu. There, in the town of Chingleput, we visited Seshadri's family home. I was astonished when his father appeared, straight from court, in a wig and proceeded to put my Harvard education to shame quoting his favorite lines from Wordsworth.

I used to commute to the Institute by 'BEST' buses for a fraction of a cent each way. On the same buses were women workers with their babies, brightly clad in sarees, and chatting animatedly, who carried concrete on their heads all day under the broiling sun, for the new Navy construction adjacent to TIFR. The idea that poverty crushes the spirit is obviously not always correct. At the end of the ride, TIFR appeared like a mirage with the Arabian Sea as a backdrop, so chilled by air conditioning that I always kept a sweater in my office. Bhabha himself had just died in a tragic airplane crash but his legacy was this amazing institute, filled with wonderful classic and contemporary Indian art and a brass and wood-paneled elevator, kept

Erika with Peter and Steven near Colaba Post Office.

From left: Musili, Seshadri, Narasimhan, Raghunathan and myself at TIFR (1967).

polished like the brass door handle in the Gilbert and Sullivan song. Bhabha had started not only TIFR but its associated nuclear research center BARC and, I assume, was centrally involved in every aspect of India's atomic programme. A friend of Nehru and of the industrialist Tata, Bhabha's Institute put the newly-independent India on the international mathematical and scientific circuit. After his death, he became the God whose decisions were never questioned. In the math department one felt equally, the presence of K. Chandrasekharan, who started with a core of Jesuit educated south Indian Brahmins and created and shaped this department on a world-class model before he left for Switzerland.

I lectured on Abelian Varieties. The intellectual stimulation was intense: It felt as though half the world's algebraic geometers were there and the other half came through for a visit. There were always large numbers of brilliant graduate students and willing, highly-skilled note-takers who fed the manuscript to a legion of typists, transforming with ancient Remington typewriters my often confused and garbled lectures into a polished set of lecture notes – almost overnight. It was a highly interactive place: We talked continuously over lunch in the cafeteria, tea and coffee breaks, walks in the lush gardens amid the astonishing hoopoes and brilliantly colored parrots. This article is too small space to mention all the interactions I had but I do want to mention specifically, the pleasure I had talking with the brilliant Ramanujam who passed away tragically at an early age. He added many marvelous insights to these notes, which TIFR subsequently published (originally as an imprint of Oxford University Press, who, apparently still thinking that India was a British colony, could never find it in their catalogs when I inquired). While I was there, TIFR held one of its quadrennial international conferences, this one on algebraic geometry. The state of the field was laid out. Both Weil and Grothendieck were there, Weil having just come from a stay with the President of India, an old friend from his 2-year stay in India in the 1930s. Bombay was still, in principle, a dry state but we as Western residents, had obtained permits stating that we would die if we did not receive our daily alcoholic "medicine". So we were able to host a proper cocktail party in our apartment.

We came again many times for short visits as well as for another academic year in 1978/1979. Each time we came, Bombay seemed more crowded and the British Raj receded further into the past. In 1978/1979, I lectured on Theta Functions, with equally superb note-takers. And this time, we were with our third son Jeremy and our adopted Indian daughter Suchitra. Seshadri was Suchitra's godfather and, with our many stays in Bombay, it hardly seemed that we had taken her off to a foreign land.

I know that these years abroad gave all my children a truly international outlook. Jeremy and Suchitra attended the John Cannon Cathedral School, also mastering the art of spelling. At this time, TIFR had built much of its housing colony and we stayed in Ramanan's apartment in Bhaskara since they were on leave. The shady, paved areas underneath the buildings were a roller skating paradise where all the children of the Institute played together after school. We had hired

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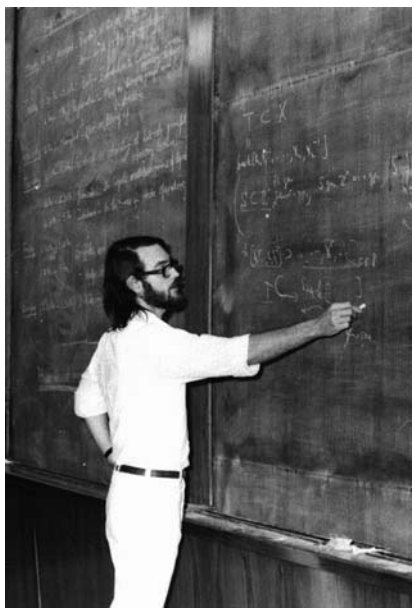

Me lecturing at the 1972 Colloquium.

From left: Me, Jeremy, Suchitra and Erika in Bhaskara (1979).

ALEX TAYLOR'S CUP

My measuring cup
is a tin mug, found
in a heap of broken forks
and bottles, in the Maine woods:
Old Alex Taylor's, who owned the land,
and used to feed the truants
who came to swim. Tossing the dirty plates
under his bed till they were needed again.

He'd have liked his cup
to travel so far,
and I took it with me to India
though its bottom is round and wobbly.
My Indian ayah can't believe that this
dented old thing is American. She drinks
her tea from it, thinking it
the humblest cup in my house.

I tell her I don't care
what she drinks from, just so
my measuring cup isn't half full of tea
when I need it. She has no use
for measuring cups. She cooks
by eye and handful, the way
her mother taught her.

And every day she boils
her strong, sweet, milky tea,
and sits on my kitchen floor to drink
from Alex Taylor's cup. It has become
hers, and when I leave
she shall have it.
I think old Alex would enjoy
the thought of his measuring cup
in its place in Moti's shack
besides the dabbas and kathoris
and the thalis and the great black
grinding stone.

a woman from the "District of Songs" who made lentils and Buffalo milk curd every day and wondered at our french toast, the "American khana" my children relished along with the Indian fare. We spent Christmas at the Krishnarajasagar Palace, built by the Maharaja of Mysore and now a hotel overlooking the water garden he had created along with the dam which irrigated his lands. The monsoon found us in Goa watching hippies in bikinis bathe next to Hindu matrons in full sarees taking a salt water cure. After this year, Erika wrote many poems about India that were published in her book *The Karma Bazaar*. (One of her poems is reproduced here).

Erika passed away in 1988 and subsequently, I have come to India several times with my second wife, Jenifer, an artist. For her, the breathtaking thing about India is its art, folk art as well as professional and its vivid, uninhibited use of color: a splash of red on a rock and there is the presence of Ganesh. Below are two of her photographs – one showing folk art in Rajasthan and the other, a Siva festival in Khajuraho.

Folk art in Rajasthan.

Siva festival in Khajuraho.

India's mathematical universe has now expanded by orders of magnitude. Adding to the older mathematical success stories of TIFR and ISI (the equally illustrious Indian Statistical Institute built by the great statistician Mahalanobis), there are numerous other flourishing centers of mathematics in India. Many of the universities now have first class math departments, the Indian Institutes of Technology are world renowned and the Indian Institute of Science in Bangalore, the Institute of Mathematical Sciences in Chennai and, most recently, the Chennai Mathematical Institute (CMI) are all very exciting places.

In the winter of 2008, Jenifer and I visited Chennai Mathematical Institute. This remarkable Institute is the creation of Seshadri. It is a unique blend of an American style liberal arts college with traditional Indian guru one-on-one teaching, adding physics, computer science, history and music to its maths curriculum. Only in India could an intellectual with no business or management experience, who spends all his spare time singing classical south Indian music, have been the catalyst for such a unique educational experiment. My visit was especially exciting because it coincided with an intense seminar on the History of Indian Mathematics and Astronomy. In the last 5 years, I have become very interested in a variety of topics in the history of Math, and Chennai is a center for Indian historical studies. The extraordinarily rich Indian history has been a revelation to me: From the occurrence of 'Pythagoras's theorem' in India c. 800 BCE through the discovery of the second order difference equation for sines and cosines in the 5th century CE, to working out the power series for sine, cosine and arctangent in the 14th century, it is an amazing story. Raised to see math in the lineage, Greece to Baghdad to Renaissance Europe, it is clear to me now that a rich development occurred in India in parallel, with fragmentary exchanges between the two, benefiting both sides. There is a major revival of Sanskrit scholarship

How ancient Indian math survived – a palm-leaf mathematical manuscript.

The old and the new India, seen from the road by the Chennai Math Institute.

in India which is re-examining and deepening our understanding of the country's heritage.

I look forward to more visits in the future: India has been a huge part of my life and has made it richer and more exciting in countless ways.

It is wonderful that, thanks to the untiring efforts of Raghunathan and countless others, India is now hosting the 2010 International Congress of Mathematicians.

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