



THE S.I. FACTOR ?

Southern India seems to have produced a remarkably high proportion of India's top mathematicians and scientists. How come?

**By Anvar Alikhan
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A couple of months ago I was browsing at a Bombay bookshop with a friend. Prominently on display in the shelf marked 'New Arrivals' was the recent biography of Dr. S. Chandrashekhar, the Nobel Prize-winning physicist, and the autobiography of Dr Raja Ramanna, the one-time head of the Atomic Energy Commission. On another shelf nearby I discovered a biography of S. Ramanujam, the legendary mathematical genius.

"Why is it," pondered my friend, "that so many of India's top scientists and mathematicians hail from Southern India?"

"Do they?" I asked.

"Sure they do," she replied. "Just for example, try doing a quick head count at the Tata Institute of Fundamental Research here in Bombay, or at the Bhabha Atomic Research Centre.

Or, to take a different kind of example, consider the fact that 2 out of India's 3 Nobel Prize-winning scientists have been from the South: Sir C. V. Raman and Dr. S. Chandrashekhar. (And I'm not counting Dr K. S. Krishnan, who, in his own right, should have got the Nobel for his contributions to the Raman Effect.) Maybe it's something to do with their diet," she added flippantly.

The whole question intrigued me. Was it *really* a fact? Or was it just another example of the sweeping regional typecasting that we Indians seem to be so fond of (like "one Bengali is a poet; two Bengalis are a political party; three Bengalis are two political parties, ha ha ha"?)

Was there any way – any reasonably scientific way – of verifying whether this was true or not? An idea suddenly struck me that night...



Southern India accounts for roughly 24% of the population. Yet, amazingly, Southern Indians account for 40% of India's science awards, 47% of the Fellows of the Indian Academy of Science ... and 10 out of the 15 living Indians who are Fellows of the Royal Society!

The following Saturday found me ferreting around in the TIFR library. Tentatively I went through the list of the winners of every major Indian science award since 1950, and tried counting all the Southern Indian sounding names among them. I did a quick calculation: whereas the four Southern states – Tamilnadu, Karnataka, Kerala and Andhra Pradesh – account for roughly 24% of India's population, they contributed almost 40% of the names on this list. Hmm...

I then looked up the list of Fellows of the Indian Academy of Sciences (broadly, the body that honours scientific achievement in India): 47% of them hailed from the South. Aha!

But it was when I laboriously compiled a list of Fellows of the Royal Society that I was really taken aback:

of the fifteen living Indian scientists who have been admitted into this elite circle, no less than nine seemed to be South Indians. Could I have made some kind of mistake? I went back and re-checked the whole thing. Yes, sure enough there *was* a mistake: in actual fact, 10 of the 15 turned out to be South Indians!

My friend's casual, sweeping observation all of a sudden seemed to be rather accurate, after all. But the question now was, what could be the factors – cultural, social, historical, whatever – that accounted for this remarkable fact? (I refused, of course, to entertain her theory of "something in the diet": *idli-sambar* as brain-food – but more on this later.)

Since then, over the past couple of months, I have been talking to various

leading Indian scientists (as well as eminent Southern Indian intellectuals) on this subject, to find out whether they could shed any light on it. At first, they seemed somewhat embarrassed by the subject, and wary of any lunatic theories that I might be trying to peddle. But when I presented my statistics to them, they were invariably slightly startled. They'd never realised this, most of them confessed – because, quite obviously, they'd never gone around viewing their fellow scientists in terms of their geographic origins – and nor, frankly, did they intend to.

"I can give you a ready-made formula for winning a Nobel Prize," joked one of them, a distinguished computer scientist, "You should have been born in Tamil Nadu, lived in Lahore and worked for a while in Calcutta. Because that, after all, was the pattern of both Sir C. V. Raman's life, as well as Dr Chandrashekar's. And I don't think you can get more pan-Indian than that, can you?"

As I carefully began to probe them, though, a fascinating variety of theories and speculations began to emerge.

"You must understand that with a subject like this you can't talk in terms of absolutes," a well-known nuclear physicist cautioned me at the outset, "you can, at best, talk only very generally." He then put forward what he thought might be one of the very basic factors leading to the academic and scientific traditions of Southern India: the region's relatively stable political history over the millennia. This, I found, was a point that was brought up, again and again, by the various people I spoke with....

The fact seems to be that over the millennia, while northern India, for instance, went through all kinds of political and military upheaval, the South, through some accident of history (or was it geography?) remained largely untouched by all this. Here, at the southern tip of the Indian peninsula, life remained by and large peaceful. There was relatively little conflict, relatively little strife. And, therefore,

slowly the faculties that came to the fore tended to be intellectual rather than martial. (It is probably significant, as someone pointed out to me, that in large parts of Southern India, there was no specific *Kshatriya* or warrior class in the caste system.) Thus, undisturbed by any major turbulence, the people of this region came to enjoy an enviable luxury: the luxury to "sit and ponder". It was this freedom to ponder, perhaps, that led with the passage of the centuries to a very special kind of intellectual flowering, and to the emergence of a scientific temper.

"Mind you," added an eminent mathematician, "when I talk of political stability, I don't only mean the past 2,500 years. I'm referring equally to the stability we've enjoyed over the past century-and-a-half – while other parts of India have been through the trauma of events like the Mutiny, the Freedom Struggle, Partition etc. And all this, I believe, has helped."

"If political stability formed one of the pillars on which this intellectual and scientific tradition stands," a well-known expert on alternative technologies explained to me, "another important pillar was religious stability" For here in the deep South, undisturbed through the millennia, the roots of religion have grown deep and strong into the soil – and this seems to have given rise to a particular spirit of mind. This aspect of religious tradition, it would appear, worked at different levels. At one level, for example, with the premium it placed on learning, it led to the imposition of a set of rigorous mental disciplines – disciplines that trained the mind, ordered it, and prepared it for other fields of serious intellectual pursuit. Meanwhile, on another level, as the alternative technologies expert stressed, "religion gives you a very strong foundation in *logic*. Whether you like it or not, this is true" It was this basic training in logic, he explained, that may have led to the development of an inclination towards analysis, towards philosophy – especially given the influence in the South of a monistic

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The religious traditions of the South seem to have played an important role. With the premium they placed on learning, they instilled rigorous mental disciplines, as well as a strong foundation in logic... which combined to prepare the mind for other fields of serious academic pursuit.

philosophy like the *advaita*. (Classical Hindu logic, by the way, admits seven different values, while western logic knows only two: True and False. Just think what an advantage the ability to handle ambiguities like this must be in the more abstract realms of physics and mathematics!)

Another significant factor that was pointed out to me was the simplicity of life that one tends to observe in the South. A certain modesty of approach, a certain lack of ostentation. ("A spirit of detachment", as someone put it, linking it back to the basics of Hindu philosophy... and the strong religious traditions of the region.) The significance of this, as the computer scientist I quoted earlier explained to me, is that, "High living and high thinking don't usually go together. And this is important to understand. In the South there seems to be something in the way of thinking that has made for a willingness to trade off material well-being for the pursuit of knowledge. When I, for instance, decided to enter the world of scholarship, it made my family extremely happy. They couldn't care less if I made lots of money or not. *It simply didn't matter.*"

Another interesting adjunct to the religious tradition was the development of astrology in Southern India – and the amazingly complex mathematical calculations that it called for. "This was probably one of the earliest expressions of our mathematical genius", a member of the C. V. Raman – S. Chandrashekar clan informed me (the two Nobel laureates, were uncle and nephew, by the way). "What those ancient astrologers achieved thousands of years ago was quite astounding," she said, "Imagine: based purely on mathematics, on geometry, they were able to accurately predict planetary positions decades in advance – and then cross-relate them to your own horoscope. Yet they were a people who never even knew the telescope." This brilliant mathematical tradition remained alive and ticking in Southern India down through the ages...

foretelling, in a sense, all the outstanding South Indian mathematicians and scientists that have emerged over the past eighty years or so.

There was a variety of other theories that came up in the course of my interviews, ranging from the solidly pragmatic to the somewhat metaphysical. One, for instance, was simply that the land here was fertile and well watered, and the climate equable: given all this, man did not have to scabble for a living, and could devote himself to the pursuit of higher things. Another was the fact that Southern India was a geographical cross-roads, and had historically exchanged trade and, more important, *ideas*, with places as far away as Rome, Egypt, Arabia and China. (Don't forget, for instance, that St Thomas the Apostle came from Palestine to Kerala and Tamilnadu just two years after Christ died!) Meanwhile, at the other end of the metaphysical spectrum was a theory about the proximity of the ocean: a theory that "people who live close to the ocean tend to have a larger viewpoint. The ocean removes all your pettiness. You tend to stop thinking of yourself".

But of all the theories I came across, the one that fascinates me the most is the one about the role played by Carnatic music in the development of this scientific temper. *What? Carnatic music?* Sure, just follow this argument closely: You see, there seems to be a fairly well-established relationship between music in general and mathematics. (I won't go into any details here, but just for example, Sir C. V. Raman's Nobel Prize-winning work on the molecular diffusion of light was apparently inspired by his great love and knowledge of music.) Now in the South there has been a strong – and very special – Carnatic music tradition that has flourished over the centuries. The strength of this tradition lies in the fact that it hasn't just been the pastime of a small cognoscenti, but it has had a genuine mass following, drawing people from all social, economic and age groups (as you can see for yourself today at the annual music festival

in Madras, for instance, when, for two weeks each December, virtually the entire city goes into a musical frenzy). If that has been the strength of the Carnatic music tradition, its special-ness lies in the fact that it is supposedly far more precise, refined and mathematical than other forms of classical music. (Whereas western classical music, say, works to 12 notes to an octave, Carnatic music has an incredibly finely calibrated 22-note framework of *shrutis*.) Putting all this together, the theory goes, Carnatic music may have been responsible for instilling a set of highly precise, highly mathematical cadences into the South Indian mind... and thereby in some way helping to “programme” it for scientific thought!

All these factors (and numerous others, no doubt) combined to prepare the intellectual soil of Southern India over a period of maybe 2,500 years. The next step came in 1835 – on the 7th of March to be precise....

For that was when the proposal was first made by Lord Bentinck to introduce Western education to India. “To impart to the native population knowledge of English literature and science through the medium of the English language.” Some of India’s very first Western style schools and colleges were set up here – and this caused a quantum leap in the intellectual growth of the region, for sections of the people avidly enrolled, eager to synthesize the old knowledge with the new. Things would never be the same again. (Along with this, a well-known Madras intellectual told me, “There was also, in the South, a willing acceptance of the English language itself. This was significant, because it led to the opening of new horizons for the people, and an access to new ideas. It also led, incidentally, to the joke that in Madras, Tamil is only the regional language, but it is English that is the mother tongue!”)

Initially, the field of study that was the most commonly aspired to in Southern India was perhaps the Law. But by the 1920s, the sciences and mathematics began to come into their own. This was –

at least partly – because of an interesting phenomenon: the ‘ripple’ effect caused by just two or three remarkable individuals, who became role models for the community around them.

The first of these role models was Srinivasa Ramanujam – an obscure young middle-class clerk in the Madras Port Trust, who suddenly, dramatically, came to be recognised by the world as “one of the greatest mathematical geniuses of all time”. At the age of 27 this self-taught prodigy was invited to Cambridge, where he collaborated with Professor G. H. Hardy on “some of the finest mathematical papers ever written”. At 31 he became the first Indian ever to be elected Fellow of the Royal Society. And by 33 he was dead, of tuberculosis. His short but meteoric life inspired many young middle-class South Indians like himself to take up mathematics or the sciences as a career. (There’s a lovely anecdote about Ramanujam’s magical genius for numbers: Once, Hardy, his mentor and collaborator, commented on the number of a taxi he had just gotten out of. “It was 1729,” he said, “a rather dull number.” “Oh no, Hardy!” exclaimed Ramanujam, “On the contrary it’s a particularly interesting number – it’s the smallest number that can be expressed as the sum of two cubes in two different ways!”)

Another important role model, of course, was Sir C. V. Raman, who won the Nobel Prize for his discovery of “the Raman Effect” and became almost as much of household name as Gandhi or Nehru all over India. Yet a third (now sadly forgotten), was a French Jesuit priest named Father Racine, who taught in Madras and Tiruchi, and who played a great role in popularising the cause of mathematics – and almost single-handedly developing an entire generation of South Indian mathematicians.

This process fed on itself: Dr S. Chandrasekhar – inspired by Ramanujam as a child – himself became something of a cult figure while still a teenage prodigy at Presidency College, Madras in the 1920s. (Amazingly, the work for which he won his Nobel Prize – and which ultimately led to the theory of

According to another fascinating theory, Carnatic music may have been another contributing factor. Being so very precise and mathematical in its structure, it apparently imparted a sense of highly precise, mathematical cadences to the mind... thereby somehow “programming” it for scientific thought!

In the early 20th Century, mathematics and science suddenly became popular. This was perhaps largely because of the role models provided by brilliant individuals like S. Ramanujam and Sir C.V. Raman.

Black Holes – was basically done when he was barely 20!) In fact, there's a widespread folk-theory prevalent in the South today that *vendakai* (lady's finger) is a brain-food. I think I have managed to track this myth right down to Chandrashekhar's childhood: according to his biographer, an awed teacher once asked him what his favourite vegetable was. When Chandra replied that it was *vendakai* the teacher seriously urged all the other students, too, to eat *vendakai* every day, saying "Look at Chandra!"

Backing all of this, meanwhile, was an excellent academic infrastructure. For instance, India's foremost institution of scientific learning was located here in Bangalore: the Indian Institute of Science, set up by the Tatas and presided over by no other than Sir C. V. Raman. And preparing a career path to it was Madras University – which then covered a large portion of Southern India. It was not only one of the oldest universities in the country, but also one of the finest, producing, it was reputed, at least one out of India's two Rhodes Scholars every year. (Which was probably why the Rhodes Scholarship office itself was located here in Madras!)

All that we've talked about so far is fine – but the truth is that this article would remain incomplete without a special tribute to a small but remarkable community which has been at the very forefront of mathematical, scientific and technological achievement in India. And that community, of course, is the Tamilian Brahmins. (Although they number not more than maybe 2½ million people, they have contributed an amazingly high proportion of India's scientific talent over the years – including no less than 7 out of India's 15 living Fellows of the Royal Society.

Douglas Hofstadter, the well-known author of *Metamagical Themas*, is said to have once referred to the Tamilian Brahmins as "the Jews of India" – and in some respects I suppose the analogy is true. For, as in the case of the Jewish community, here, too, what started out as a respect for the scriptures, became

generalised over the centuries as a respect for knowledge. Thus a very special value system emerged, where it was the scholar, the intellectual, who was admired above all others: you admired a man for, say, his mathematical skills or his knowledge of Sanskrit or music – and *not* for merely the size of his house, the cut of his clothes or his prowess on the hockey field. Yet, as much as social recognition, it was a matter of economic reality – for the Tamilian Brahmins were, by and large, not a propertied class, and all one could hand down to one's children was a first-class education, and hope they could make a decent living off it.

However, I have found that the Tamilian Brahmins as a community seek to be as low-profile as they are intellectually outstanding. And the ones I talked with in the course of my interviews seemed a little embarrassed to draw any undue attention to their own community's achievements. When I asked an engineer friend of mine, for instance, what he attributed all these achievements to, he jokingly said "simple living and Iyer thinking" and just left it at that.

Researching this article has been a delightful process of discovery for me. For instance, the other day I phoned a scientist I wanted to interview and said I wanted to talk to him, broadly about "the reasons why the Southern region has managed to produce such geniuses as Sir C. V. Raman, Dr S. Chandrashekhar, S. Ramanujam and Dr K. S. Krishnan. He chuckled in reply and said, "The real question to ask, my friend, is not why the Southern region produced them, but why *Thanjavur District in particular has produced all four of them!*" I have subsequently learned that Thanjavur District – just one of India's 412 districts – has also, incredibly, produced the three greatest Carnatic musicians of all time, the great "Trinity" of Thyagaraja, Shyama Shastri and Muthuswami Dikshitar. (There we are again: the leitmotif of mathematics, science and Carnatic music!) OK, so maybe that will be the subject of my next article. Watch these pages...

THE SWAMYS OF SCIENCE

■ **DR. V. S. ARUNACHALAM**
Metallurgist. Scientific Adviser to the Defence Minister. Has led India's Defence R&D programme into developing a new generation of sophisticated, high-tech weapons systems.

■ **DR. S. CHANDRASHEKHAR**
Physicist and astrophysicist. Won the Nobel Prize in 1983 for his propounding of "The Chandrashekar Limit". Morton Hull Distinguished Service Professor Emeritus, University of Chicago. Two of his students, Lee and Yang, have themselves gone on to win Nobel Prizes.

■ **DR. S. CHANDRASHEKHAR**
Not to be confused with the Nobel Prize-winner. This one's an expert on liquid crystals and condensed matter. Fellow of the Royal Society. Professor at the Raman Research Institute.

■ **DR. C. GOPALAN**
Expert on nutrition and medical research. Fellow of the Royal Society. Former Director General, Indian Council of Medical Research.

■ **DR. ABDUL KALAM**
Expert on composite material and rocket technologies. Father of India's guided missile development programme. Director, Defence Research & Development Laboratory.

■ **DR. K. S. KRISHNAN**
Physicist. Worked with Sir C.V. Raman on developing "The Raman Effect" – his own contribution being so important that many believe he should have won a Nobel Prize in his own right.

■ **DR. M. G. K. MENON**
Physicist. Fellow of the Royal Society. Scientific Adviser to the Prime Minister.

■ **DR. R. NARASIMHAN**
Mathematician. Chairman of Department of Mathematics, University of Chicago.

■ **DR. Y. NAYUDAMMA**
Chemist. Known for his pioneering work in leather research. Later, Director General, Centre for Scientific & Industrial Research.

■ **DR. CYRIL PONNAMPERUMA**
Biochemist. Not exactly South Indian – but a Tamil from Sri Lanka. Known for his revolutionary work towards creating the genetic code (i.e. artificial life). Director, Laboratory of Chemical Evolution, University of Maryland.

■ **DR. G. N. RAMACHANDRAN**
Molecular biophysicist and crystallographer. Fellow of the Royal Society. Professor at the Indian Institute of Science.

■ **DR. V. RAMALINGASWAMI**
Expert on pathology, nutritional disorders and science policy. Fellow of the Royal Society.

Adjunct Professor, Harvard School of Public Health and Special Adviser to UNICEF.

■ **DR. RAJA RAMANNA**
Nuclear physicist. Father of India's nuclear device. Former Chairman of the Atomic Energy Commission and Defence Minister.

■ **SIR C. V. RAMAN**
Physicist. Won the Nobel Prize in 1930 for his work on the molecular diffusion of light – and the discovery of "The Raman Effect".

■ **S. RAMANUJAM**
One of the most amazing mathematicians the world has known. Though he died in 1920, his work was so far ahead of its time that it's only now beginning to be properly understood.

■ **DR. S. RAMASESHAN**
Crystallographer. Distinguished Professor-Emeritus, Raman Research Institute.

■ **DR. C. R. RAO**
Mathematical statistician. Fellow of the Royal Society. Eberly Professor of Statistics, Pennsylvania State University.

■ **DR. C. N. R. RAO**
Authority on solid state and structural chemistry. Fellow of the Royal Society. Director, Indian Institute of Science.

■ **DR. U. R. RAO**
Expert on space sciences and space technology. Father of India's space research programme. Secretary, Department of Space.

■ **DR. RAJ REDDY**
Authority on robotics. Director of Robotics Institute, Carnegie Mellon University.

■ **DR. C. S. SESHADRI**
Expert on algebraic geometry. Fellow of the Royal Society. Senior Professor, Institute of Mathematical Sciences.

■ **DR. RAMDAS SHENOY**
Radar scientist. Director, Defence Electronics Research Laboratory.

■ **DR. Y. SUBBARAO**
Biochemist. Professor at Harvard around the 1920s and '30s. Later became Director of the well-known Lederle Labs in the U.S.

■ **DR. GEORGE SUDARSHAN**
Particle physicist. Has been a nominee for the Nobel Prize. Professor of Physics and Director, Centre for Particle Theory, University of Texas.

■ **DR. M. S. SWAMINATHAN**
Geneticist and cytogeneticist. The man who made the Green Revolution possible by introducing "dwarf wheat" to India. Fellow of the Royal Society. Former Director General, International Rice Research Institute, Philippines. ●

To compile this list of eminent Southern Indian scientists, I sent out a message all over the world on the ERNET computer network – inviting scientists and academics to send in their nominations.

I received 51 nominations, out of which this is my own short-list. It includes 2 Nobel laureates, 2 Nobel might-have-beens, one of the greatest mathematicians in history ... and a total of 14 Fellows of the Royal Society. What's more, it covers a range of fields from particle physics to cytogenetics, from algebraic geometry to robotics.

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