

The Four Equations

The heart of the generalized theory of gravitation is expressed in four equations, shown in the accompanying illustration.

$$\partial_{\mu} h_{\nu\lambda} = 0; \quad \Gamma_{\mu} = 0; \quad R_{\mu\nu} = 0; \quad g_{,\mu}^{\mu} = 0$$

German
lower
case
G

The equations have the mathematical properties which seem to be required in order to describe the known effects, but they must be tested against observed physical facts before their validity can be absolutely established.

Albert Einstein, world-famous physicist and author of the theory of relativity, has developed a new "generalized theory of gravitation", which attempts to inter-relate all known physical phenomena. The new theory may well rank with the original publication of relativity as a milestone of scientific achievement. Intended to bring relativity and the quantum theory into a single system, it is impossible to say certainly at this time whether the theory is successful. Preliminary indications are favourable.

theory not completely satisfactory,
Einstein may be relied on to con-
tinue with what he elsewhere calls
"the holy curiosity of inquiry" and
arrive at a perfect formula. This
is the secret of his greatness.



THURSDAY, DECEMBER 29, 1949.

EINSTEIN'S NEW THEORY

EINSTEIN has done it again. His comprehensive imagination and penetrating insight have succeeded in producing "a new generalised theory of gravitation", to quote from the somewhat sketchy report that has reached us from Princeton where the great scientist has been at work in recent years. 1905 was his *annus mirabilis*—a year that witnessed his contribution to the Quantum Theory of wave mechanics, his paper setting forth his Special Theory of Relativity with the modest title "On the Electrodynamics of Moving Bodies" and the enunciation of his famous formula of the relation between mass and energy which led directly to the possibility of atomic fission. Einstein persevered in his revolutionary work; he demonstrated that space, like time, was a relative conception, that no object could move faster than light and that the Newtonian theory of gravitation, which had held the field for two centuries, must be modified to fit in with the newer conceptions of science. Einstein, thus, went on to construct his General Theory of Relativity besides which, it has been stated, his Special Theory "appeared almost an incident.... The General Theory of Relativity is more than an imposing intellectual structure. It has a grandeur that is also aesthetic. From the idea of curved space-time the equations governing gravitation flowed with such inevitability and logical economy as to make the General Theory a masterpiece of art as well as science." It was later found that Einstein's gravitational equations bore striking similarity to those of Maxwell governing the electro-magnetic field and this opened a new vista for research. The problem of the structure of matter and the nature of radiation has specially held Einstein's attention for a quarter of a century. By means of intuitive apprehension and abstract reasoning, he has now been enabled to announce his new "Generalised Theory of Gravitation." His work has been methodical and, therefore, slow. He has had to proceed from a few general assumptions and try many avenues to his goal, rejecting one by one those that do not accommodate all known facts. Experimental verification has to follow and may take years. But Einstein and the world may take heart from the fact that his earlier notions of Relativity, also worked out in his brain, were so splendidly and successfully vindicated by the findings of a British expedition observing the solar eclipse. What had been "pad-and-pencil work", albeit directed by a supreme genius, was dramatically justified and it was proved beyond doubt that a ray of light, passing the sun, was bent exactly as Einstein had formulated. The *enfant terrible* of science of the early years of this century is now acclaimed as one of its principal patriarchs. In March last, on the eve of his seventieth birthday, he authorised the publication of an extract from his *Autobiography*, which reveals the inner workings of his mind: "I soon learned to scent out that which was able to lead to fundamentals and to turn aside from everything else, from the multitude of things which clutter up the mind and divert it from the essentials." Even if facts come to light which render his latest

NEW THEORY OF GRAVITATION

NEW YORK, Dec. 27.—A new "generalized theory of gravitation," completed by Dr Einstein after 30 years' work, is believed to provide the answer to a riddle about the forces of the universe which physicists have sought for years.



A spokesman of Princeton University said the new theory set forth, in one series of equations, the law governing the two fundamental forces

of the universe—gravitation and electro-magnetism.

The theory was announced at a Press conference at the University at the opening of the annual meeting of the American Association for Advancement of Science. Dr Einstein was not present.—P.T.I.-Reuter.

High German honour for Indian woman

Bonn: One of Germany's highest honours has been given to a woman of Indian origin for her "outstanding contribution" to bringing together people of different cultures and races. German President Roman Herzog has conferred the Cross of the Order of Merit of the Federal Republic of Germany (Verdienstkreuz am Bande des Verdienstordens der Bundesrepublik



Deutschland) on 64-year-old Saraswati Albano Mueller. The award ceremony was held in her home town Schwelm, near Bonn. The former German Commissioner for Foreigners, Ms Liselotte Funeke, who belongs to the German liberal FDP party, and the Indian ambassador in Bonn, Mr S K Lambah, were present. The citation states the recipient, who was born as Saraswati Sundaram in Varanasi, has been honoured for promoting cultural exchanges and 'peaceful social co-existence' in Germany for the past two decades. Married to a German businessman, Ms Albano Mueller has been involved in promoting social and cultural issues in Germany. In 1968 she founded the 'Colloquium Feminarum' which organises meetings, courses, exhibitions etc.

• MALAVIYA'S SPECY

Research on mineral sands of Travancore

Arrangements with Indian Govt and British concerns

TRIVANDRUM, May 19: The Travancore Government have entered into an arrangement with the Indian Government for joint research on mineral sands and on mica. They had also entered into certain arrangements with influential British concerns (and not the British Government as reported earlier) for joint research and exploitation of the mineral sands of Travancore, and the production of atomic energy, stated the Dewan of Travancore in a Press interview recently.—
A.P.I.

Sardar

The Bose Institute

To The Editor, "Forward"

Sir,—I have read the criticisms published in your issue of the 17th August, regarding the researches of Sir J. C. Bose, by a scientific contributor of the "Manchester Guardian." Sir J. C. Bose's position as a scientist and Plant-Physiologist may also be gathered from the "Nature", the highest journal of science of the world (15th August, 1931). Sir J. C. Bose is now fully convinced that what he gained as a Physicist he has entirely lost in Physiology. He has therefore launched on a deliberate and systematic policy of abolishing Physiology from his Institute.

To stop Physiological work in his Institute and bitter criticisms he has approached Dr. M. N. Shaha to join his Institute so that the Institute may be changed completely to a Physics Laboratory very soon. This is one of the reasons why Prof. Shaha has not yet been able to make up his mind definitely, to join Calcutta University—as Palit Professor of Physics. He has, however, obliged Sir J. C. Bose by sending two of his students, Dr. S. C. De, D. Sc. and Dr. A. K. Dutt D. Sc to work in Sir Bose's Institute.

Arrangements are almost complete to place fragments of all his Physiological instruments in a room in front of the main building in the form of a Museum so that they may serve as a scientific curio with historical importance for the future, a sad imitation of similar arrangements existing in the corridor outside the Lecture Theatre of the Royal Institute, London; where I saw exhibited the prices of apparatus which had been used by great scientists of the last century.

Yours etc.,

K. GANGULY.

P. 6/2 C. Rashbehari Avenue.
Ballygunj.

THE ELIGIBILITY OF WOMEN FOR ADMISSION INTO THE FELLOWSHIP OF THE ROYAL SOCIETY

The question of the eligibility of women for admission into the Fellowship of the Royal Society has now been raised in a practical form by the presentation of two certificates on behalf of women candidates. The legal position has accordingly been reviewed by the Officers and Council, with the assistance of the legal advisers of the Society. The position is as follows.

Before the passage, in 1919, of the *Sex Disqualification (Removal) Act*, the Charters on which the Society's Statutes are based made no provision for the consideration of women as candidates or their election to the Fellowship. Opinion given by Counsel in 1902 had made it clear that the consideration of a certificate then submitted for a particular woman candidate would not be in accordance with the Charters.

The Act of 1919 changed this position. In reply to a question submitted in 1922, Mr Barrington-Ward, K.C., and Mr Dighton Pollock gave the following opinion :—

- “(1) We agree that it is very doubtful whether the Charters in themselves admit of the election of women (see Joint Opinion of 1902); but neither sex nor marriage, in view of the *Sex Disqualification (Removal) Act 1919*, can now be a bar to the admission of women to a Society incorporated by Royal Charter. S.1. of the Act reads: ‘A person shall not be disqualified by sex or marriage . . . for admission to any incorporated society (whether incorporated by Royal Charter or otherwise) . . .’

In view of S.1. of the Act we consider that both single and married women are now eligible for the Fellowship under the Charters, and there is now no need for a supplementary Charter to admit women. The present Statutes only contemplate the admission of men. In order to make the position clear, we think that they should be amended on the basis of (2) below. The exclusion of women henceforth rests with the Fellows themselves, who can reject women on voting for the election of Fellows from among the candidates (See Statutes, Chap. 1, ss. 7, 8, 9).

- (2) We would, however, advise the following alterations in the Statutes. There is power for the President and Council to make, alter and amend the laws in accordance with Chap. XXI, s. 92.
- (i) A general clause making it explicit that words importing the male gender shall include the female (unless the context requires a contrary construction).
 - (ii) At the end of Chap. I, s. 1. ‘Nothing herein contained shall debar the admission of women as candidates.’

We do not think any other section need be amended, as, once a woman has established her position as an eligible candidate, the resulting privileges of Fellowship will accrue on election, as in the case of male Fellows, irrespective of sex or marriage.”

The effect of this opinion is to make clear that the provisions of the Act of 1919 must be read into the Society's Charters, so as to remove any legal bar to the candidature of women or their election to the Fellowship. The amendments of the Statutes recommended by Counsel would not be required to make the change in the legal position effective, but would be desirable in order to make that change clear to all the Fellows. Since no proposals of women candidates were then, or till now, before the Society, no action has hitherto been taken to amend the Statutes in the manner recommended.

Now that certificates for women candidates have been presented, the Council have decided to recommend to the Society the appropriate amendments of the Statutes, so that all Fellows may be made aware of the legal position. Notice in writing of the proposed amendments was given to the Council at its meeting on 30 November 1943. It was decided that they should be considered at the meeting of Council on 16 December 1943, when, after verbal amendment, both proposals were provisionally agreed upon, for presentation to the Society in accordance with Ch. XXI of the Statutes, Statute 92. Normally it would now be the duty of the President to summon a Special General Meeting of the Society to discuss these proposals. The Council, however, took the view that a Special General Meeting summoned under present conditions could not be regarded as representative of the general opinion of the Fellows. Although the proposed alterations of the Statutes will only record a change which legislation has effected, the Council took the view that it was desirable that all the Fellows should be informed of the proposals and afforded the opportunity of expressing their opinions by vote. They decided, accordingly, to take advantage of the discretionary powers afforded by War Emergency legislation, to substitute a consultation of the Fellows by a postal poll for the summoning of a Special General Meeting. The amendments proposed by the Council are on the opposite page.

You are requested on the enclosed card to record your vote for or against the proposals.

To ensure as complete a poll as possible, votes will be accepted up to and including 30 June 1944.

In case of delay in receipt of these documents by those Fellows resident overseas, and doubt as to the delivery of the voting card by 30 June 1944, a vote may be sent by cable.

(Signed) H. H. DALE,

President.

The proposals :

- [i] To add at the end of Statute I the following words :
- ‘ Nothing herein contained shall render women ineligible as candidates.’
- [ii] To add a new Statute, to be entitled Chapter XXII, Statute 93, to read as follows :
- ‘ In the foregoing Statutes and in any Standing Orders of the Council and in any Rules or Regulations adopted by the Royal Society or by any Joint Committee for the administration of Trusts to which the Royal Society is a party, words importing the male gender shall include the female unless the context requires a contrary construction.’

DR. KRISHNAN'S NEW ASSIGNMENT

We are credibly informed that Dr. K. S. Krishnan F.R.S., Director of the National Physical Laboratory is taking over charge of the Directorship of Scientific and Industrial Research in succession to the late Sir Santi Swarup Bhatnagar. Dr. Krishnan will naturally be in charge of the National Laboratories of the country.

22 FEB 1955

Amrita Bazar Patrika, Ltd.

ESTABLISHED 1888

HEAD OFFICE { "PATRIKA HOUSE"
14, ANANDA CHATTERJEE LANE, CALCUTTA 3
CITY OFFICE :-CHOWRINGHEE SQUARE, CALCUTTA 1 3

TELEPHONES

HEAD OFFICE Bz. 5231
(14 LINES)
CITY OFFICE CITY 2058
EDITOR Bz. 1958

February 21, 1955.

WITH EXTENSIONS & PRIVATE LINES

Ref. No.....

Dr.K.S.Krishnan, F.R.S.,
Director of the National
Physical Laboratory,
New Delhi.

Dear Sir,

We have the pleasure to enclose herewith a cutting of Amrita Bazar Patrika dated 19.2.55 (published in the "City Notes" column at page 9) containing the news of your taking over charge of the Directorship of Scientific and Industrial Research.

With kindest regards,

Yours faithfully,

Manilal Ganguli

(Manilal Ganguli)

P.A. to Mr.Sookamal Ghose,
Director.

Encl: 1

Editorial Notice

All letters sent to the Hitavada for publication must contain the name and address of the writer, not necessarily for publication, but as a guarantee of good faith. Anonymous communications will be destroyed at once. Correspondents are requested to write on one side of the paper only. The Editor cannot undertake to return rejected communications unless a stamped and addressed envelope is enclosed for the purpose. He cannot enter into any discussion regarding rejected communications. The copyright in all contributions published in the Hitavada is reserved to the Proprietors of the paper and reproductions without acknowledgment are strictly forbidden.

All Business communications should be addressed and remittances made payable to the Manager. Subscribers must always quote their wrapper number in their communications as this will facilitate immediate attention being paid to them.

The Hitavada

They are slaves who dare not be
In the right with two or three
—J. R. Lovell.

NAGPUR, JULY 19, 1936

PROVIDENTIAL ESCAPE

THE REPORT THAT AN attempt was made on the life of His Majesty the King Emperor when he was going in a procession and that the attempt was foiled by the timely intervention of the police will be received with joy throughout the country. We can think of nothing more dastardly than this attempt on the life of a person who has endeared himself to the peoples of the Empire by his wide and humane sympathies. The assailant, we are told, is a journalist, a Mr. McMahon, and the members of the journalistic profession throughout the world will hang their heads in shame for one of their fraternity being responsible for this cowardly and atrocious act. The assailant, according to his confession, made this attempt as a protest against the Home Secretary, an excuse which is so fantastic as to suggest that the man was demented when he threw his revolver at the King. The Empire will be grateful to Providence for having saved the King from assassination. His Majesty deserves well of all the peoples of the Empire, for his heart is with the poor, the down-trodden and the hapless. We wish to offer our congratulations to him on his providential escape. It is hoped that the Home Office would take greater precautions to protect the person of the King. The fact that the revolver was first seen by a woman and then only the attention of the police was drawn to it shows that the protection arrangements were not perfect.

INDIAN INSTITUTE OF SCIENCE

THE INDIAN INSTITUTE OF Science in Bangalore is shortly to celebrate its Silver Jubilee and there will be rejoicing all over the country that the Institute has completed a quarter of a century of its existence. The rejoicing is likely to be marred by the fact that drastic changes in the policy and direction of the Institute have

been recommended. The Quinquennial Committee under the presidency of Sir James Irvine which was set up to report on the working of the Institute has submitted its report, we understand, to Government, but great secrecy has been observed with regard to the recommendations and the contents of the report. However, Press forecasts of the reports suggest that the Committee has recommended that the object of the Institute should once for all be defined as being mainly to concentrate on scientific research applied to the immediate industrial needs of the country. This is meant to be a corrective to the alleged over-emphasis on physics and mathematics and abstract research which is said to be the policy of the present Director of the Institute, Sir C. V. Raman. The other recommendation deals with the drastic curtailment of the administrative powers of the Director and the appointment of a Government official under the control of Government with co-ordinate powers with regard to matters of general administration. It will be seen, assuming these press reports are true, that the recommendations of the Irvine Committee have been designed specially to meet the situation created by the directorship of Sir C. V. Raman. It is an open secret that the relations of Sir C. V. Raman with his colleagues in Bangalore are none too happy and that when the Irvine Committee surveyed the working of the Institute, it did so in an atmosphere of suspicion, accusation, prejudice and recrimination. Even the most impartial Committee will not pass unaffected by such an unfortunate atmosphere and it will not be too much to say that the Irvine report bears traces of the atmosphere in which the Committee reviewed the working of the Institute. It is this which makes it incumbent on the Viceroy to give the most careful consideration to the matter before taking action on it. He has to use his discretion and sift the recommendations of the Committee and see whether the interests of the Institute and justice are met by the recommendations of the report. Coming to the two principal recommendations of the Committee, we have to observe that the one relating to the need for research in the Institute being connected with the industrial needs of the country, is an unnecessary restriction sought to be imposed on the policy of the Institute. Such a hard and fast rule regarding research should not be laid down. Even the founders of the Institute did not have the distinction in mind which the Irvine Committee has recommended. The object of the Institute has been defined in the regulations as "the promotion of advanced instruction and original investigation in all branches of knowledge and their utilisation for the benefit of India". It will be seen that the founders of the Institute did not scoff at research which at first might seem academic. The point is that often what is called "abstract" research leads one to results which are of great benefit to industry. For example, when the electron was discovered, few dreamt of its practical value. The electro-magnetic theory of light would have been termed, we are sure, at the time of its enunciation, if the Irvine Committee had been asked its opinion on the subject, "abstract research." But those conversant with science know how this theory laid the foundations of modern wireless. We have said enough to show that there is no necessity to jeer

at research which is termed abstract. Everyone is aware that research must have practical value and nobody would object to the Irvine Committee recommending an emphasis on research which might have an immediate practical application, but to relegate "abstract" research to a side line will be as the *Hindu* rightly remarks "an unfortunate development." It is easy to see that behind the recommendation is the mass of accusations against the policy of the Institute. It has been said that the present Director has been neglecting departments other than his own, Physics. We have had personal evidence of students working in the Institute and we have it on their assurance that the charge is not correct. It seems that while there is only one assistant in the Physics Department, there is a larger staff in the Electrical Department, a department supposed to be neglected by the Director. The grant to the Electrical Department has also been increased, we are informed. The Director wanted to appoint a permanent professor for the Organic Chemistry Department, a demand made by the students themselves, and chose an eminent professor from the Continent to occupy the position. But the fractious attitude of some members of the Council resulted in the quashing of the appointment. The Central Workshop meant to manufacture scientific instruments and the course of Chemical Engineering and Technology were started by the present director. It is difficult in the circumstances to accept the view at its face value that the Director has neglected other departments. It is also admitted that since the present Director took charge, the volume of research done in the Institute and the number of original papers submitted have been considerable which prove that his direction has been efficient. We must now pass on to the second recommendation suggesting the appointment of a Registrar with administrative powers co-ordinate to those of the Director and directly under the control of Government. This recommendation seems to have been made with a view to redress the situation created by the alleged high-handedness of the present Director. We strongly object to a Government official being foisted on the Institute. In all likelihood, the official will be an I. C. S. man and the country will be treated to the spectacle, if an I. C. S. man is appointed, of the heaven born service dabbling in all things under the sun from Governorship to scientific research. Government must keep their hands off the Institute's administration and I. C. S. aggression has to be stopped. Whoever is the Director, A or B, he must have effective powers of Direction, otherwise he will be a Director only in name. If a Registrar is appointed having the present administrative powers of the Director, there is no need for a special office like the Director. We object on principle to the Director's powers being curtailed and a co-equal authority being appointed. The latter will lead to constant friction and bickering in the Institute and harmony will be in jeopardy. Further we are opposed to the intensification of Governmental control over the Institute. If this recommendation is meant for the special benefit of Sir C. V. Raman, we are sure, he would himself like to stand out of the way and allow Government to make happier arrangements. The need for efficient direction in the Institute is great. Some departments according to reports from students,

have become what the blunt would call "a drones hive" and research on haphazard lines are being conducted. We have before us the Report of the Past and Present Students Representative Committee submitted to the Quinquennial Committee. The student's report contains details about the slipshod manner in which work is being done in certain departments. A para in the report containing the view of the "minority" describes certain branches of work done in the General Chemistry department which seem to be rather removed from Chemistry. All these point to the need for vigilant direction and this is also another argument against the curtailment of the powers of the Director. Nobody would object to effective powers of appeal against the decisions of the Director for the aggrieved party and other legitimate safeguards against the misuse of the Director's powers being included in the constitution, but to curtail the powers of the Director to nullity is to reduce the office to a farce. Such being the case, we would suggest to the Viceroy to personally visit the Institute and see things for himself. The Institute is a national property and its destinies should not be trifled with by biased recommendations. The present Director has also a great responsibility. His greatness should make him take the initiative in being considerate to his colleagues and to respect their susceptibilities and we also would appeal to his colleagues not to carry on a personal vendetta against him. Sir C. V. Raman is the first Indian Director of the Institute and reckless allegations and sensation-mongering will harm not merely an individual but the prestige of our countrymen. Nothing should be done which would lower India's reputation, and we hope that ere long harmony and smooth-working will be restored in Bangalore.

"PHILOSOPHIC ATTITUDE"

Mr Sastri's Speech

CHIDAMBARAM, July 14
The Rt. hon. V. S. Srinivasa Sastriar, Vice-Chancellor, Annamalai University, presiding, the staff and students of the Philosophy Department of the University were "At home" to Mr R. Ramanujachariar, on the occasion of his appointment as Professor of Philosophy of the University.

The Vice-Chancellor delivered an interesting address on the 'Philosophic Attitude' and expressed the hope that the Annamalai University would develop a strong school of Indian Philosophy. He observed that the function of Philosophic studies was not the acquisition of much technical philosophic information but the creation of a philosophic attitude, an attitude which never takes anything for granted, which is impelled by an insatiable curiosity to ask the why of everything and which sifts evidence. The philosopher is under a special obligation to practice what he professes. In a sense the philosophic attitude is as much intellectual as it is moral.—A. P. I.

BIRTH OF TRIPLETS

FEROZEPUR, July 9

A woman in the city is reported to have given birth to triplets. The babies are all in a healthy state.—A. P. I.



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
Illustrations: Avinash Godbole**

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. Hmmmm...

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 Chandrashekhar'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 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

Over the millennia, while Northern India went through all kinds of political and military upheaval, the South was largely untouched by all this. This gave the people of this region the luxury “to sit and ponder”... resulting in a special kind of intellectual flowering and the emergence of a scientific temper.

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. Chandrashekhara 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 *sbrutis*.) 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. Chandrashekhar – 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.

My very special thanks to Dr. S. Ramani, Director of the National Centre for Software Technology, for having made this entire exercise possible.