

VOL. 35: NO. 9
December 15, 1988

Price Rs. 4-00

BHAVAN'S
JOURNAL



Maulana Abul Kalam Azad
(1888 - 1958)



Dr. C. V. Raman
(1888 - 1970)

Salutations to Centenarians



The Raman Saga

DR. Sir C.V. Raman was born of Sri Chandrasekhara Iyer and Smt. Parvati Ammal. The parents belonged to two well-known Brahmin families of Tamil Nadu. Raman was born on the 7th November in the year 1888, at Ayyanpettai near Tiruchirappalli in the then Madras State. The family had been for many generations pursuing the profession of the agriculturists and they were middle-class in status. In fact, the first to take a bold step and break off from the ancestral profession was Raman's father, who became a teacher in a High School, then rose to the position, after duly qualifying himself, of a Lecturer and ultimately the Professor of Physics in the Hindu College, Visakhapatnam. Rather, he came back to the ordained profession of the brahmin, giving up the Apaddharma of his ancestors.

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Raman's mother, Parvati Ammal, hailed from a family renowned for Sanskrit scholarship. It is said of the father of Parvati Ammal that he trekked all the way from Tiruchirappalli to Nadia, the famous seat of Navya Nyaya or modern Indian Logic, where the greatest intellectuals like Gadhadhara lived and propagated their school of logic, in order to learn Logic, and returned also on foot. Parvati Ammal possessed in an unusual degree the qualities of patience, self-reliance and perseverance and would never be content with the run-of-the-mill in life. She was a stickler for details and would never let things drift and happen for themselves.

No wonder, Raman inherited the best from his parents and in the process excelled both.

Educational Career

At Visakhapatnam, Raman studied at the Hindu College High School and had the distinction of being a first-ranker throughout. Right from the middle-school stage, science was his first love. It is said, in those days, Raman designed a prototype of a dynamo, starting literally from scratch.

He passed his Intermediate (1902) from the Hindu College, and joined Presidency College, Madras, for B.A. (Physics). His relatives impressed upon him that he should take history or economics as a special subject, but Raman would not budge. He had made up his mind to opt for physics; and in 1904, he passed out as No. 1 of the University, bagging a host of medals, prominent among them the Elphinstone Medal and the Arni Jagirdar Memorial Gold Medal.

Continuing his post-graduate studies in physics, Raman received V.I.P. treatment at the hands of fellow-students as also teachers. Not for him any imposition of regular attendance; not for him any restriction at reference libraries.

Raman, the Researcher

A little incident of those days served as an eye-opener to what was in store for the immediate future. While engaged in a prism experiment one day, he was struck by a peculiar phenomenon. His inquiring mind would not rest without finding an explanation. Late into the night, Raman probed into all relevant literature, but the answer still eluded him.

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Next morning, he repeated the experiment — and gave his own theory to the 'unusual'. Later in the day, he submitted the thesis to Physics Professor Jones. Months elapsed, still there was no comment from the Professor.

A restless Raman later approached Jones with a suggestion: 'May I enlarge the theory, in the light of freshly-attained knowledge on the subject?' Collecting the papers from the Professor, Raman published them in a British science journal. Still apprehensive, he showed his master the publication — his maiden effort at writing — only to receive a bear-hug from the Guru.

In January 1907, Raman secured a first class, in M.A. (Physics) — first in the history of Madras University — and was all set to go to the U.K. for advanced studies. But his poor physique proved a stumbling block.

The Physicist in Hybernation

For a moment it looked as though the physicist's career was all over, barring the "Good Bye". Pestered by friends and relatives, Raman at last appeared for a competitive ex-

amination at Calcutta in February 1907. The subjects — history and economics — were Greek to him, yet he came out first of the lot.

While still awaiting his posting, Raman got married to Loka Sundari, setting a revolutionary precedent to inter-sect marriages in the Brahmin community.

In June 1907, Raman was appointed Dy. Accountant-General, in Calcutta. A good monthly salary, a loving wife, a well-furnished house, prospects galore in days to come — all these would have made a white-collar happy and contented. But Raman's yearning was still for science. Physics had become a part of him; he could not go far away from it.

One fine evening, while returning home from office work, Raman was surprised by a banner on a sidewalk: "The Indian Association for the Cultivation of Science". Jumping out of the running tram impulsively, Raman made his way to the dilapidated building.

A conference was on; Raman lost no time in getting acquainted with all the scientists present. The Association's

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Secretary, Amrit Lal Sarcar, son of Mahendra Lal Sarcar who founded the Association in 1876, and Sir Asutosh Mookerjee, an active member of the Association, were highly impressed by Raman's works. Thus started anew another chapter in the physicist's career.

In 1910, Raman was transferred to Rangoon, bringing in its train a science holiday for him. While in Burma, news of a distant institution having bought a modern scientific instrument reached Raman. Past midnight, Raman reached the spot, shook up a snoring watchman, went with him to the Superintendent's residence and glanced gleefully at the apparatus, hours before dawn next day.

In 1911, Raman was deputed on promotion to Posts and Telegraphs, as Special A-G, to Calcutta. Time was when Sir Asutosh Mookerjee, as Vice-Chancellor of the Calcutta University, had just founded the University Science College, with the help of donations from Sir Rash Bihari Ghosh and Sir Taraka Nath Palit.

Sir Taraka Nath had earmarked part of his donation for appointing a distinguished Physics Professor, Raman was Asutosh's



natural choice and Raman's choice was physics, of course. In 1917, with scant regard to the monetary handicap in accepting the new assignment, Raman bid "Good Bye" to administration and joined the Calcutta University as "Palit" Physics Professor.

In 1919, following the death of Amrit Lal Sarcar, Raman was elected Secretary of the Indian Association for the Cultivation of Science. Two years later, he represented Calcutta at an All-British-Empire Universities Congress. In 1922, Raman was awarded D.Sc. by the Calcutta University.

In 1924, he was a guest speaker at a Scientists' Convention in Canada. Making good of the visit, Raman extensively toured Canada, the United States, England and Norway. While in America, he called on

Nobel Laureate Millican, at whose instance Raman served as a Visiting Professor, for four months, at the California Institute of Technology.

The Royal Society of London awarded him a Fellowship in 1924. The same year, he founded the Indian Science Congress. For years together, he worked as its Secretary and also presided over the 1929 Madras Convention.

In 1925, at the second centenary of the Russian Science Academy, Raman represented India. The return trip from Moscow gave him a chance to study firsthand the progress made by Germany, Switzerland and Italy in the sphere of Physics.

The year 1926 saw Raman publishing the Indian Journal for Physics. About this time, the German Physical Society made him a special request to contribute an exclusive article on musical instruments for its Handbook of Physics. In response, Raman dwelt on musical instruments, in general, laying a pointed stress on Veena, Mridangam and a host of Indian instruments.

The long years of his research work on light culminated in the

discovery of the Raman Effect in 1928. In 1930, the Nobel Prize for Physics was awarded to him — the first ever Asian to win this supreme honour.

At the prize-awarding ceremony in Stockholm, Raman demonstrated the "Effect", using a number of liquids, one of them alcohol. The dusk drew near and the stage was set for a grand cocktail reception to the Nobel Laureate. "This morning, Raman demonstrated his Effect on alcohol. Now we would see the alcohol's effect on Raman" an invitee cracked pushing a glass in Raman's direction. The reaction was not reversible, the effect was not reciprocal. With a modest "Thanks", the glass was returned, for Raman was a teetotaler.

The Golden Era

The Golden Era paved the way to one better in 1932. After 15 years' service with the Calcutta University Science College, he decided to go south, accepting a Directorship at the Indian Institute of Science, Bangalore. Raman was instrumental in fetching due importance to fundamental research, mathematics and physics, at the Institute.

The unceasing enthusiasm of Raman brought fresh honours to the Institute. In 1934, the Indian Academy of Sciences started functioning and 1948 saw the emergence of the Raman Research Institute.

Following the establishment of the Raman Research Institute, Raman resigned the Directorship of the Indian Institute of Science in favour of that of the Raman Research Institute. As Director of Raman Research Institute, he was able to realise his dream of a live-wire organisation devoted to the advancement of the many facets of physics. The institute has also sections devoted to meteorology, bio-chemistry and mathematics, and has a fullfledged observatory. It also publishes a periodical, Proceedings of the Indian Academy of Sciences.

Almost every leading Indian physicist has had his association with Raman. The man who ushered our country in the Atom Era, Dr. Homi Bhabha, and Dr. Vikram Sarabhai, were two of his illustrious disciples.

Raman was a member of many international scientific organisa-



tions. The German Academy, Munich, the Physical Society, Zurich, the Royal Philosophical Society, Glasgow, the Royal Academy of Ireland, the Science Academy of Hungary, and the Academy of Sciences, Paris, are but a few of them.

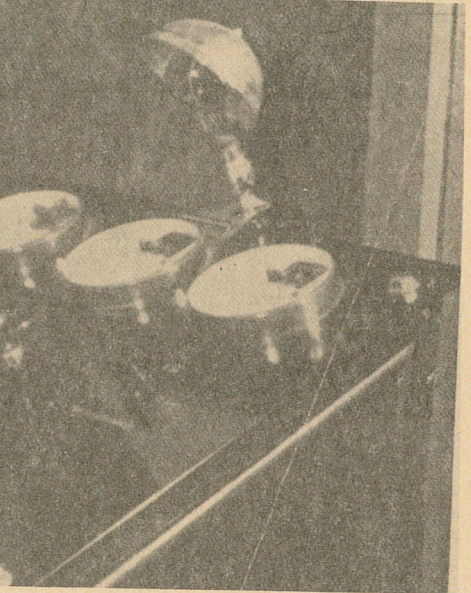
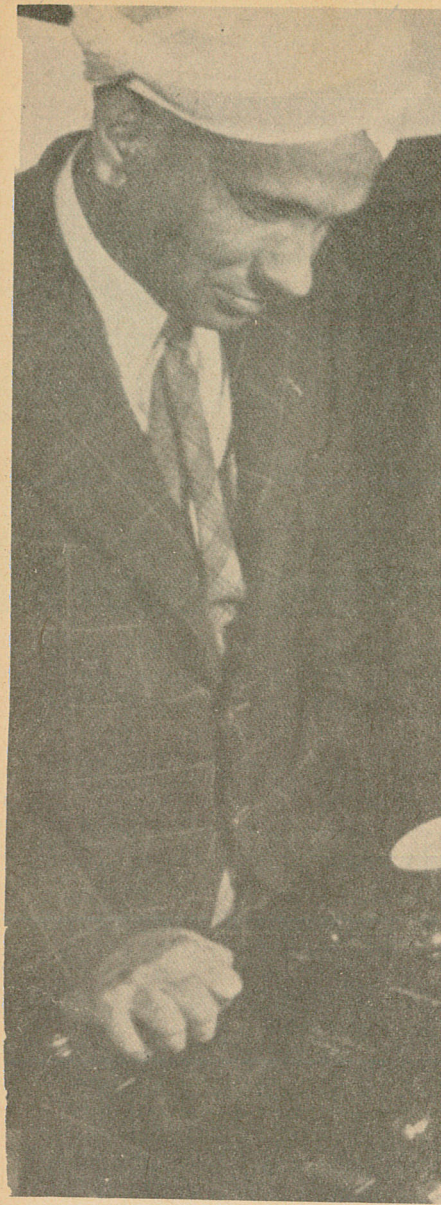
He was Chairman of the Indians Academy of Sciences, since its inception in 1934.

In 1951, the Philadelphia Institute of America awarded the Franklin Medal to Raman. In 1954, the topmost honour to an Indian — Bharat Ratna — went to him. The Soviet Union honoured him with the International Lenin Prize, in 1957.

Raman and His Students

Dr. A. Jayaraman

WITH Professor Raman, pursuit of Science was the very breath of his life. Single-minded devotion to work, intense concentration in whatever activity he was engaged in and a remarkable capacity to reduce complex problems to the fundamentals were the secrets of his success. He also knew how to relax. He was deeply interested in Nature in a broad



sense. Anything beautiful immediately engaged him be it a plant, a flower or a piece of rock. He could enjoy himself and be lost in thought looking at a tree. Often he used to burst into ecstatic joy over a colourful sunset. Great men have the ability to enjoy and appreciate common sights (common to the ordinary eye).

Childlike simplicity is yet another characteristic of Prof. Raman. His reactions were spontaneous and straight and he would do and say the unusual. There are many interesting anecdotes.

At the Raman Research Institute, we were a small band of research students and associates. Prof. Raman would meet every one of us at least once during the day to discuss about work, or exchange a few words. It was not the custom for us to exchange any formal greetings. Many a time on his birthday we wanted to wish him, but none of us did so. Perhaps we felt that being insiders it was not proper for us to do so; perhaps it was the age difference which prevented us from communicating sentiments. I forget the exact year. It must have been in the middle 50's when we all decided that

we should wish him on his birthday. We got the Institute gardener to make a rose bouquet and I was chosen to be the person who would hand the bouquet over to Prof. Raman. I accepted the assignment on one condition, that the others should follow me. We all stood in the veranda in front of Prof. Raman's room and when he came out I promptly stuck the rose bouquet in his hand and all of us said, "We greet you on your birthday." Prof. Raman, for a moment was taken aback by this act of ours and was deeply moved. In those days he would not show emotions outwardly. He took a sniff at the scent emanating from the roses and said, "I say, these are lovely roses, where did you get them? I suppose they are not from my own garden." We could not lie about the roses and admitted that they were from the Institute garden. Professor said, "You should have left them on the plants. They would have looked more gorgeous there than in the bouquet. Anyhow I thank you all." That was our first and last formal wishing.

When you are closetted with Prof. Raman, he always did much of the talking. When he was doing experiments in the

Laboratory, it was his habit to describe what he was observing and how wonderful such and such effect is. The person who stood by him would automatically be saying, "Yes, Sir." However, many a time awkward situations can arise. I have gone through this many a time myself and it would go something like this. Professor would say, "I say, I am seeing a most remarkable effect in this crystal. It is absolutely fantastic and marvellous." — Yes, Sir. — The next statement after a few minutes of further observation would be, "I think I still see it. It may be there." — Yes, Sir. — A few minutes later he would say, "I don't think there is any effect. It is all my imagination. I think I was foolish." Here an 'yes, sir' would be awkward of course!.....

It was in November 1949, two of us, Sri Padmanabhan and myself, had just joined the Raman Research Institute. We were the first two to start work in the new Institute. Prof. Raman wanted us to arrange some of the things he had bought for his museum collection. There were two beautiful stuffed Himalayan pheasants, which he had bought from a Taxidermist in Calcutta. We left the pheasants in an open

almirah and forgot to lock the door of the room. In those days there was no electricity in the Institute and we had just started organizing the place. As ill-luck would have it, two mongrels got wind of the stuffed birds. They gained entry into the room in the night and destroyed one of the pheasants beyond recognition. The next morning when we came and saw the spectacle, it was such a shock. We knew that Professor would get very upset with us for not locking the room and something had to be done to cover up the catastrophe. We quickly ordered the servants to clean up the place and bury the remnants of the pheasants in a far off place. Prof. Raman came, and went straight into the museum room. Not finding one of the pheasants he wanted to know what happened. It was part of our decision to maintain that only one pheasant was there. Professor repeatedly said that he definitely bought two and was scratching his head as to how one could have disappeared. Since we strongly maintained that there was only one pheasant, he convinced himself that although he paid for two, only one specimen actually was brought to Bangalore. Then he went for a walk in the garden satisfied with his reasoning.

After a few minutes he returned with a feather of the same pheasant which the mongrels tore to pieces. The man who took the remnants must have dropped a feather on the way. It was difficult to cover it up but we managed to convince Professor that some bird must have dropped a feather on its flight. Professor must have wondered about it but did not ask any further questions. We felt very bad for having hidden the truth from

him. Since we had just joined, we did not want to run the risk of being sent away, by telling what happened. If that had been the case, we would not be telling you this interesting episode!

Prof. Raman was warm-hearted, generous and would never let down his students and associates. If we did anything worth-while, however small it may be, it was readily appreciated. Such was his noble nature.



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The Raman-Effect

C. Rajagopalchari



THE Raman-Effect is concerned with pure optics, with that happens to rays of light impinging on molecules that make up transparent substances. When a beam of sunlight falls on a polished surface, it is reflected in a straight



line at an angle equal to that of the incidence. If it falls on an opaque substance, a great part of the light is just absorbed and the rest is scattered in an irregular way. What is absorbed becomes heat. What is scattered gives the colour to the substance. The substance selects the colour that it wants out of the mixture called sunlight. A rug of one kind of material scatters about the blue of the sunlight and absorbs the rest of the rays. So it is called a blue rug. So a rose scatters about the particular colour that we attribute to the rose.

The Raman-Effect deals with what happens to a beam of light of a pure unmixed single colour that enters a transparent substance. Much of it goes through without change, but a part is scattered about. The emerging ray exhibits a change in colour, something different from what it was. This was a

phenomenon not previously observed by scientists. This discovery by Raman led to a great many important developments in the world of science. It furnished scientists with a powerful method of probing into the constitution of molecules and helped them to give answers to a variety of questions arising in physics and chemistry. Instrument makers of the world have designed many new instruments for its proper study. Over 6000 original papers, it is said, have been written by scientists in various Universities on the Raman-Effect.

Dr. Raman is a great teacher. His knowledge is not confined to physical science. In this over-specialised world his breadth of knowledge is remarkable. He combines highest intellectual integrity with a winning warmth of heart. His latter feature sometimes comes out of his utterances which are delightfully free and frank. He is our most illustrious scientist, and we fervently hope that he will continue for many years to guide the scientific progress of India.

— Dr. S. Radhakrishnan

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Every one knows that light travels in a straight line, not like sound which travels in all directions. Let us for a moment imagine the sound too travels only in a straight line like light. If I sing out from one end of a hall — 'Ma' — if sound travelled just like light only in a straight line, then the sound would go only in a straight line in front of me. People in front of me would hear me sing 'Ma'. A part of my voice, however, — and this is the Raman-Effect — would be reflected off the bodies of people seated in all hall. At a certain angle they would hear me sing, but they would not hear 'Ma', but strangely enough, they would hear me singing 'ga'. If I changed my note and sang 'ga', they would at that angle hear me singing "Ri" and so on. This would be wonderful; but this does not really happen with sound. This is just what does happen, however, to the beam of light in the Raman-Effect. The beam of light — let us call it 'Ma' — is a portion of it, scattered by the molecules on which the beam impinges, but in the process it is altered in pitch to 'Ga'. If the beam of light were "Ga", it is changed to "Ri", and so on. The wave-length is changed in the scattering. We have now something of the Raman-

Effect.

But do not imagine it is all so simple as this. It is a very complicated affair in reality.

"For the chair of Physics created by Sir Taraknath Palit, we have been fortunate enough to secure the services of Mr. Chandrasekhara Venkata Raman, who has greatly distinguished himself and acquired a European fame by his brilliant research in the domain of Physical Science, assiduously carried on under the most adverse circumstances amidst the distraction of pressing official duties...

I shall fail in my duty if I were to restrain myself in my expression of the genuine admiration I feel for the courage and spirit of self-sacrifice with which Mr. Raman has decided to exchange a lucrative official appointment for a University Professorship, which, I regret to say, does not carry even liberal emoluments. This one instance encourages me to entertain the hope that there will be no lack of seekers after truth in the Temple of Knowledge which it is our ambition to erect."

— Sir Asutosh Mookerjee

March 1914

RAMAN LETTERS

Dr. Sir C. V. Raman was a great friend of the Bhavan. Below is given his message on the occasion of Bhavan's Silver Jubilee:

"The wide range of the Bharatiya Vidya Bhavan's activities and the success they have achieved can only be described as most remarkable."

Facsimiles of three letters from Dr. C. V. Raman, are given here.—Ed.

SIR C.V. RAMAN, F.R.S., N.L.,
DIRECTOR

RAMAN RESEARCH INSTITUTE
HEBBAL POST, BANGALORE.6.

Ref: No. 497

5th November, 1965.

Dear Mr. Ramakrishnan,

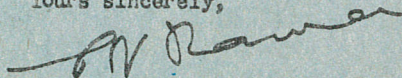
I have just seen the "Dipavali" Number of the Bhavan's Journal. The picture on the cover page is exceptionally fine. I would like to ascertain if possible:

(a) The particular brand of colour film used for taking the photograph; (b) the name and address of the firm who made the colour blocks, and (c) the name and address of the firm who printed the cover page.

Could you kindly assist me in obtaining this information?

Thanking you,

Yours sincerely,



Mr. S. Ramakrishnan,
Editor,
"Bhavan's Journal",
Bharatiya Vidya Bhavan, BOMBAY. 34.

Ref: no. 27

5th July, 1966

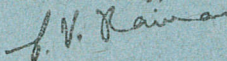
My dear Mr. Ramakrishnan,

I have just received your kind letter of the 30th June 1966, requesting me to contribute to the proposed symposium on national integration.

I am reminded of the famous adage, that those who sow the wind will reap the whirlwind. The real trouble started when the constitution pulled down the English language and put Hindi in its place in the face of a strong and well-justified opposition. The evil results of that foolish decision have just begun to show themselves. There is worse yet to come and I do not think that anything can stop its coming. No useful purpose would be served by my writing on this very unpleasant topic.

With apologies,

Yours sincerely,

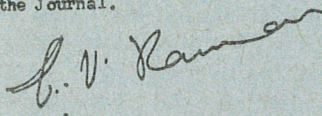


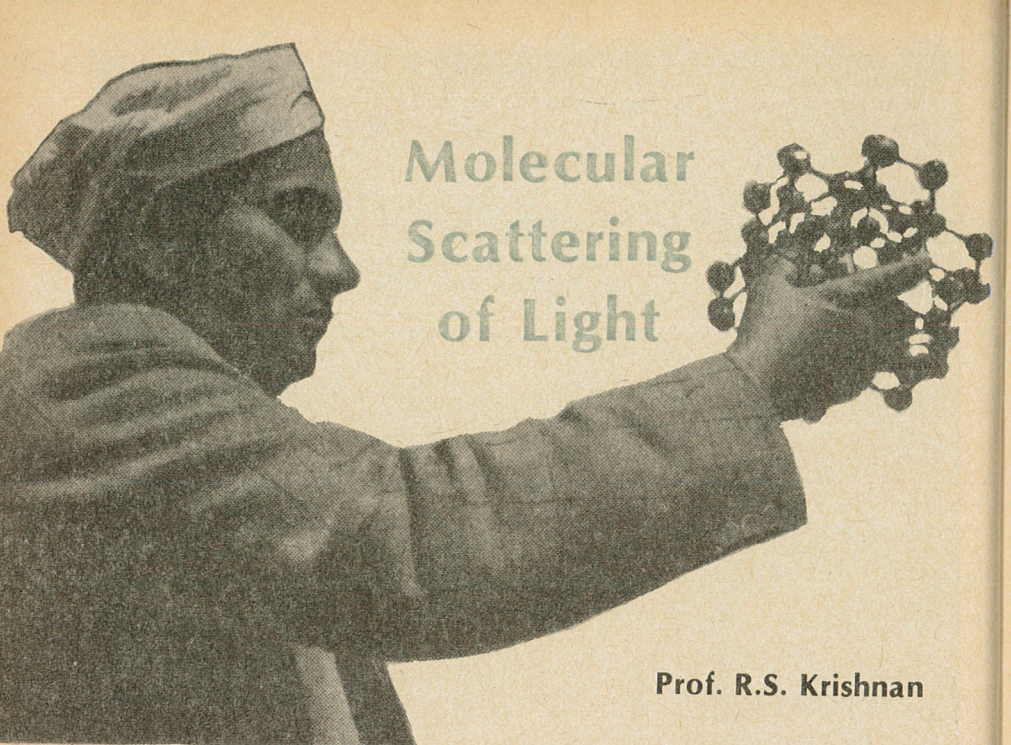
SIR C. V. RAMAN
Director

RAMAN RESEARCH INSTITUTE
BANGALORE-6

9th July, 1964.

BEHAVAN'S JOURNAL has made a place for itself in the cultural life of India. It is unique in the nature and character of its contents. I am writing to send my cordial good wishes for the continued success of the Journal.





Molecular Scattering of Light

Prof. R.S. Krishnan

THE year 1921 was the turning point in Raman's career. He published his first paper on the scattering of light by sulphur suspensions in the "Proceedings of the Royal Society" of London along with the student B. B. Ray. In the summer of 1921 at the pressing request of Sir Asutosh Mookerjee, Raman made his first brief visit to Europe as a delegate to the Universities Congress held at Oxford. During this trip he

visited the St. Paul's Cathedral in London and marvelled at its whispering gallery and carried out a few experiments which finally resulted in the publication of two papers — one in "Nature" and the other in the "Proceedings of the Royal Society."

During the voyage Raman's attention was attracted to the problem of the origin of the blue colour of the Mediterranean

Sea. He conceived the idea that the molecular scattering of light in water was the primary origin of the colour of the deep sea, contrary to Lord Rayleigh's explanation that the blue was a reflection of the sky light by water. Observations with Nicol polarising prisms during the return voyage confirmed Raman's hypothesis. These observations furnished the inspiration for starting a comprehensive programme of research which he undertook in the Association on the molecular scattering of light in solid, liquid and gaseous media.

The laboratory with its facilities steadily improving under Raman's administration, became the natural centre of new activity. The assistance given by a succession of gifted collaborators, namely K.R. Ramanathan, K.S. Krishnan, L.A. Ramdas, S. Venkateshwaran, I.R. Rao, S.R. Rao, K. Seshagiri Rao, J. Kameshwara Rao etc. who were attracted to this laboratory from all parts of India, enabled Raman to push forward steadily with his investigations. Not only the studies on the **molecular scattering of light proved most** fruitful in themselves, but they also suggested and inspired numerous

researches in related topics in many branches of Physics.

Early in 1928, the work of the preceding seven years on molecular scattering of light in diverse media found its logical culmination and reward in the discovery of a new scattering phenomenon that bears his name — "Raman Effect" and for which he was awarded the Nobel Prize in Physics in 1930. **Using a simple experimental set up costing a couple of hundred rupees only, Professor Raman discovered that some new frequencies not present in the incident light appeared in the light scattered by any medium as a result of the interaction between molecules of the illuminated substance and the incident monochromatic radiation. Thus, in the spectrum of the light scattered by a substance Raman Effect discloses itself by the present of new lines adjacent to the original lines of the incident light.**

Prof. Raman and K.S. Krishnan immediately took up intensive experimental studies on the modified (Raman) scattering in liquids and vapours. Prof. Raman himself took an active part in setting up the experi-

ment and making observations. Thus under the interaction of light any scattering medium could simultaneously absorb one photon and emit another of higher or lower frequency compared to that of the absorbed one. The energies of the incident and scattered photons differ by an amount corresponding to the energy difference between two quantum mechanical states or energy levels of the scattering medium. Thus Raman was the first to recognise and demonstrate that the energy of the photon can undergo a partial transformation within matter. In a cable published in "Nature" of London, Prof. R.W. Wood of U.S.A. had stated that the beautiful discovery which resulted from Prof. Raman's long and patient study of the phenomenon of light scattering is one of the most convincing proofs of the quantum theory of light which was available at that time.

In a lecture presented to the

South Indian Science Association in Bangalore on March 16, 1928, Raman made it clear that this discovery had not only opened up a new branch of spectroscopy, but the results of its application would prove to be of great significance for Physics and Chemistry generally. These anticipations were amply fulfilled, as many investigators in all parts of the world entered the new field of research and by their contributions extended it rapidly in many directions. Investigations on the Raman Effect naturally formed a considerable part of the activities of the laboratory where it was discovered, and many significant contributions were made by students of Raman at the Association in Calcutta. During the same period Raman and his students published numerous memoirs on X-ray diffraction, magneto-optics, magnecrystalline action and crystal structure.

(Courtesy, 'The Hindu')

