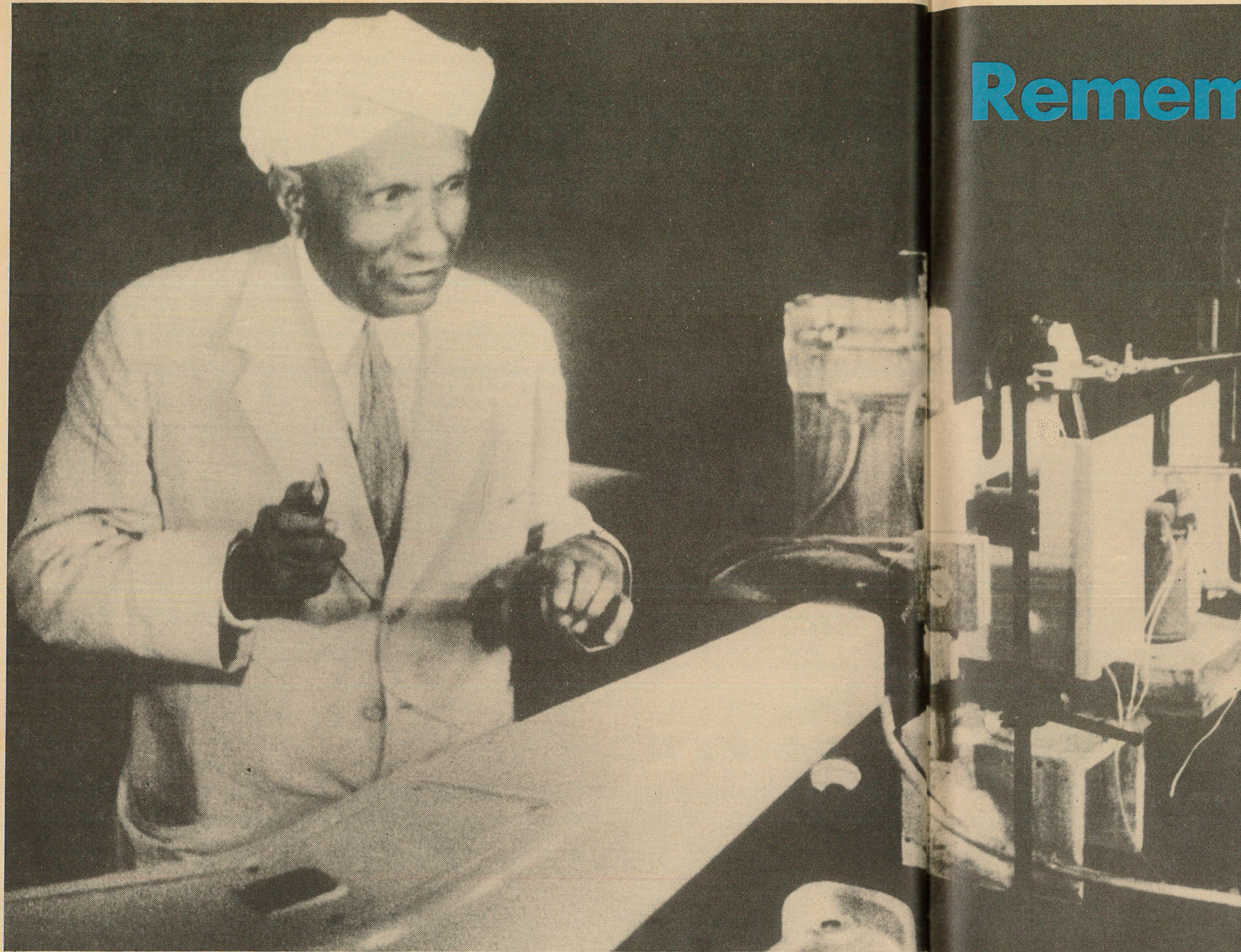


Remembering Raman

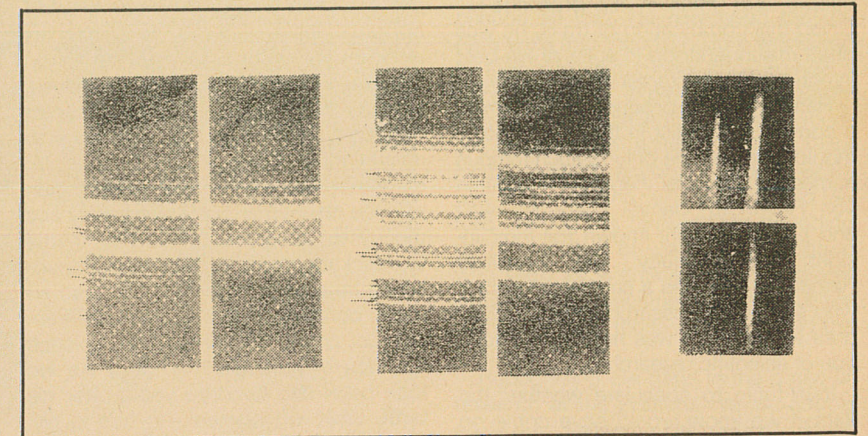


Sir C. V. Raman was not just a Nobel Prize-winning scientist; he was a staunch nationalist who relentlessly tried to build a true Indian science in the face of the several obstacles raised by the colonial Government. An assessment of the man and the genius, on the occasion of his birth centenary.
By R. RAMACHANDRAN.

Pictures: Courtesy A. Jayaraman and Birla Museum

IN 1930, when C. V. Raman, unarguably the greatest physicist India has produced, was awarded the Nobel Prize, the then Charge d'Affaires of the U.S. in Sweden wrote to the Secretary of State in Washington, reporting the Nobel ceremony at Stockholm. The letter was extraordinarily revealing. It read: "Of all the prize-winners, the day was easily carried, however, by Sir Venkata Raman, the Indian prize-winner who, upon returning to his seat on the platform after receiving the prize from the hands of the king, was visibly moved by his emotion and sat with tears streaming down his face"

Years later, Raman's wife showed this letter, which she had received from a friend in America, to S. Ramaseshan, one of Raman's students now at the Raman Research Institute, Bangalore, and he ventured to ask Raman about it. Raman replied: "Yes, it is true. When I received the (Nobel) Prize from King Gustav, it was a moment of personal achievement. But when I saw the sea of Western faces surrounding me, the only Indian and that too in my turban and close coat, I felt more than ever in my life that I was really representing my country, India. It was a moment of great emotion for me. And, when I turned



Sir C. V. Raman in his laboratory; the first spectrograms showing Raman Effect, taken by K. S. Krishnan, one of Raman's students..... the heyday of physics.

round and saw that I was sitting under the British Union Jack I realised that India did not even have a flag of her own. That is what triggered the breakdown and I wept without shame."

"Then," continued the letter, "at the banquet that evening Sir Venkata Raman's speech was a masterpiece of eloquence which called forth tremendous applause from the banquet-weary gathering not noted for its responsiveness..... Less appreciative was perhaps the British Ambassador..... who was forced to listen with equanimity to Sir Venkata Raman's reference, brief though it was in passing only, to the congratulatory telegram 'from my dearest friend who is now in jail.'"

This, as one could easily guess, was a reference to the congratulations from Mahatma Gandhi, whom he revered and loved much. In his later days Raman gave much importance to the Gandhi memorial lectures at his institute in Bangalore. He believed that the only way of paying homage to a person he admired was to give him something of what he could do best. Hence the annual lectures on science, a field in which Raman was king.

The incident in Stockholm was indicative of the staunch nationalist Raman was, a facet of his personality which has been largely ignored, clouded as it became in the controversies that surrounded him, first in Calcutta and later in Bangalore. As Ramaseshan said in his inspired address at the Centenary Celebrations in Calcutta, "Ra-

man always found himself at the centre of a storm, which was often his own creation."

Raman could not tolerate mediocrity. In his relentless pursuit of excellence, he would not settle for anything short of the best. He was a man in a hurry, wanting to keep Indian science abreast with the achievements that were being made in Europe, and he felt time was running out.

Two-thirds of Raman's life was spent in colonial India. He caused colonial India to be noticed as a scientific centre. His motivations, according to Ramaseshan, were the result not so much of his intense love of science and nature but, as he himself has written, "of the belief in the value of human spirit and the virtue of human endeavour and achievement. And when I read Edwin Arnold's 'Light of Asia' I was moved by the story of the Buddha's renunciation, of his search for truth and of his final enlightenment. It showed that the capacity of renunciation in the pursuit of an exalted aim is the very essence of human greatness."

Raman used to talk of the Mahatma, Christ and the Buddha even on his death bed. It is this inspiration that appears to have driven him in his untiring efforts, in the face of heavy odds, to build a true Indian science, but he could not achieve as much as he could have because circumstances failed him.

Raman's personality was a complex one. He had his shortcomings too. Max Born once said: "Raman is a very able

physicist, full of enthusiasm..... There is really no other Indian physicist who is of his rank..... His European intensity alone would be enough to make Raman suspicious to the average Indian professor. Now Raman, too much aware of his own superiority, likes to make other people feel small in his presence....." Given this combination of traits, he was often misunderstood in spite of his best intentions in the interest of the country.

Raman was a product of his times, a complete scientist in the 19th century mould, comparable only to such famous names as Michael Faraday, Hermann von Helmholtz, James Clerk Maxwell and Lord Rayleigh, known for their insight and ingenuity. Like Srinivasa Ramanujan, he was a self-taught genius who started his research activity in Madras where there was hardly any tradition of scientific research.

It is futile to speculate whether the Raman we know would have come on the scene if he had not gone to Calcutta as the Assistant Accountant-General after topping the Indian Financial Civil Service Examination, though the intellectual ferment in Calcutta those days, not only in science but also in national politics, was certainly of a different order. Calcutta is the city which produced such outstanding contemporaries of Raman as Satyendranath Bose, whose name goes with no less a person than Albert Einstein in the so-called Bose-Einstein statistics, Meghnad Saha who became famous for the Saha ionisation formula, Jagadis Chandra Bose who did his remarkable experiments in biology, and Prafulla Chandra Ray who was not only a scientist of repute but also a man of vision. Ray had a role to play in Raman's rise as a scientist.

Raman himself had once remarked that he would ever be grateful to the Surgeon-General who had not permitted him on health grounds to undertake a journey to England to pursue higher studies. Though his research began when he was barely 17, he did not go abroad till he was 33. Later when he was sailing back to India from England, he made a remarkable observation, from the deck of the ship, on the blue colour of the sea. This led to the discovery of the phenomenon in the scattering of light from media, called Raman Effect.

Raman's times were the heyday of physics. To be ranked along with such names as Ernest Rutherford, Robert Millikan, J. J. Thomson, William Goldschmidt, A. H. Compton, Niels Bohr, Max Born, Paul Dirac and Werner Heisenberg is certainly no mean achievement. The story of Raman as a scientist and his work in Calcutta

and Bangalore are well known, but his achievements become even more remarkable when one notes that they were made in colonial India, where opportunities for basic research were practically non-existent. Raman created opportunities for himself; he started his work on light with a heliostat set up on a makeshift platform outside his house, whether it was in Calcutta, Nagpur or Rangoon. The British spent millions to maintain their army in India but their indifference to the growth of Indian science meant that there was hardly any money for research. "And yet," notes G. Venkataraman in his recently published biography, "Raman, and also so many contemporaries of his, did manage to spark the growth of science (physics in particular) in India. As we look back one hundred years after his birth, what we perceive in him is not merely a great scientist but a microcosm of India with all her problems."

Raman was typically Indian. Though he was not religious at all, he never gave up his tuft. In public he always wore a turban and he is reported to have once quipped: "How else could Lord Rutherford have recognised me in the crowded Cavendish Lecture Hall?" His attitudes seem to have sprung from the strong conviction that one need not be born in the West to become a scientist of world calibre.

On record are the remarks of a visit-

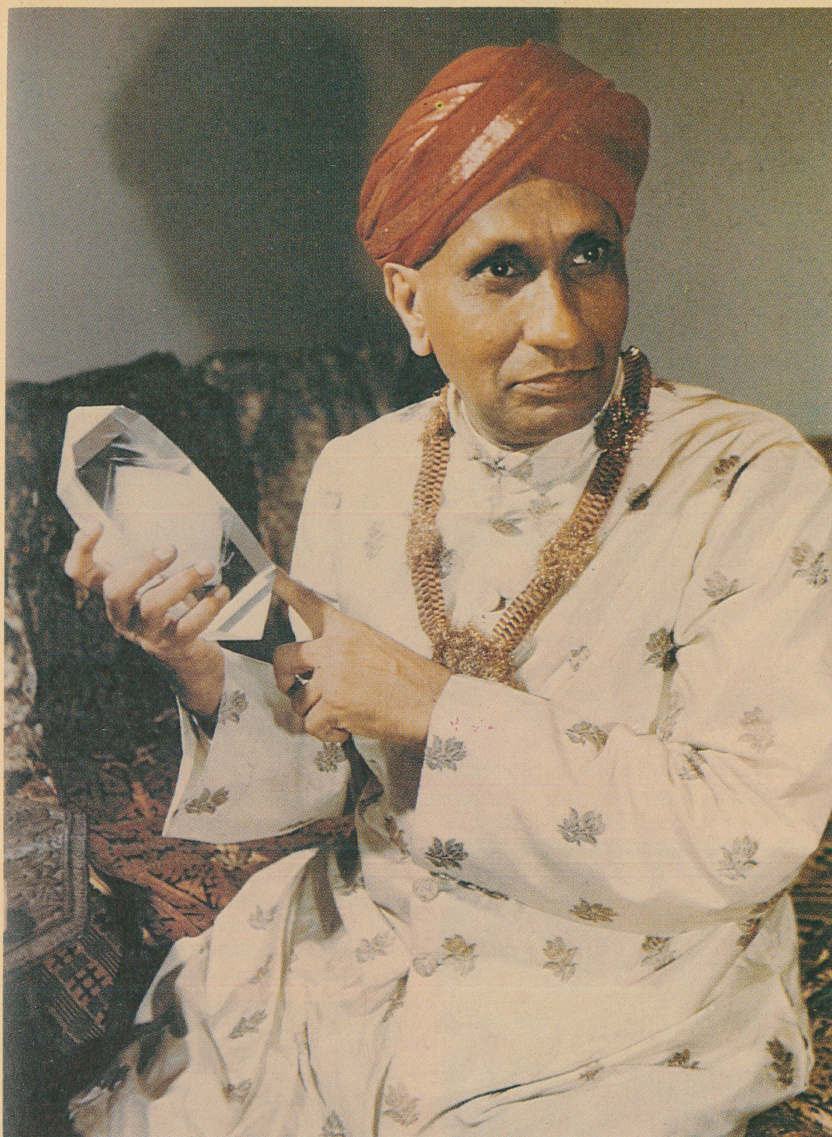
ing scientist from Caltech in 1924, who relates how he met a "crazy Indian scientist" who imagined that he was going to discover a quantum effect in light scattering which would win for India the Nobel Prize. Then the scientist ends his anecdote this way: "The unbelievable part of it is that this crazy man does make the discovery (1928) and he does get the Nobel Prize (1930)."

It is also known that in 1925 Raman had written to G. D. Birla that he needed money for an instrument called spectrograph. "If I have it, I think I can get the Nobel Prize for India." Birla's donation of Rs. 1,900 came only a year after the epoch-making discovery which Raman actually made with equipment costing not more than Rs. 500.

Raman once remarked, while addressing young graduates: "I can assert without fear of contradiction that the quality of the Indian mind is equal to the quality of any Teutonic, Nordic or Anglo-Saxon mind. What we lack is perhaps courage, the driving force which takes one anywhere. We have, I think, developed an inferiority complex. What is needed in India today is the destruction of that defeatist spirit. We need a spirit of victory, a spirit that will carry us to our rightful place under the sun, a spirit which will recognise that we, as inheritors of a proud civilisation, are entitled to a rightful place on this planet. If that indomitable spirit were to arise, nothing can hold us from achieving our rightful destiny."



With German theoretical physicist Arnold Sommerfeld and Krishnan, soon after the Nobel-Prize winning discovery.



In the Mysore durbar dress, holding a crystal of ammonium dihydrogen phosphate presented by the Bell Laboratories..... king in his field.

It is that indomitable spirit in him that enabled him to turn the sleepy hollow of the Indian Association for the Cultivation of Science (IACS) in Calcutta into a beehive of scientific activity. But little did he realise that in the end he would be a loner in his crusade. He became a victim of the canard that he was favouring South Indians, which led to the unfortunate rift between him and Saha but history has shown who was in the right. The split, however, sounded the death knell of the IACS which otherwise would have grown into one of the outstanding scientific institutions of the world.

Raman's hopes of realising his dreams as the Director of the newly established Tata Institute (now the Indian Institute of Science) in Bangalore, where he moved from Calcutta in 1933,

were also belied as he became the victim of the worst kind of colonial attitudes of the British administration. The IISc was conceived by J. N. Tata who, like Mehendra Sircar who founded the IACS, felt that science alone held the ultimate solution to the problems of India. Though Curzon, the Viceroy, thought that this conception itself was an act of sedition and tried to abort it, the institution finally came into being. But the Tatas leaned heavily on the British. Initially the Director and a large part of the faculty were British. It was at the height of the Civil Disobedience Movement that Raman was appointed its first Indian Director. As Ramaseshan says, obviously the British knighthood conferred on Raman had duped the imperial Government of India and the Tata family. (It is interesting to note that Raman

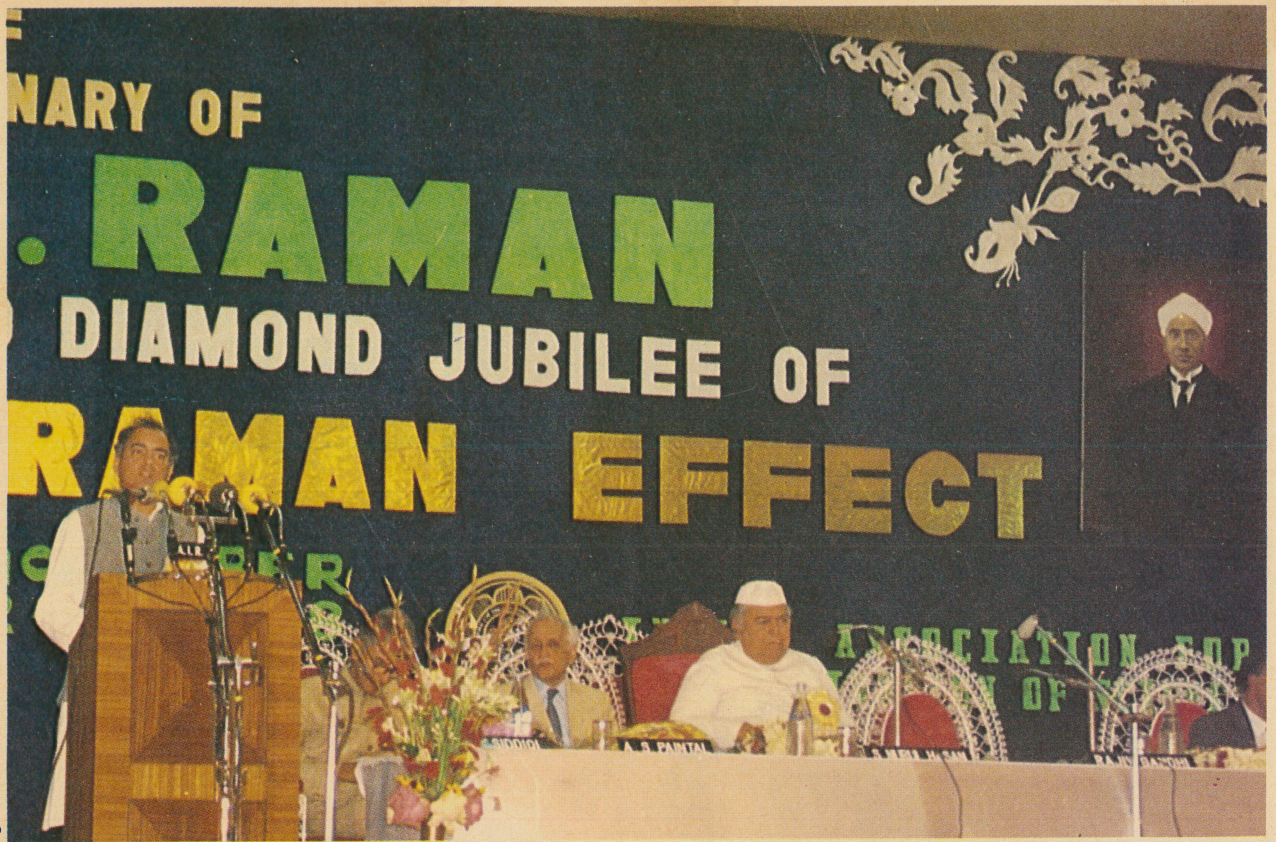
never dropped the prefix 'Sir' in the research papers he had authored as if to show to the world that Indian scientists were as capable as those in the West.)

When Raman arrived on the scene, the institute had gained the reputation of being "a nice sinecure where people draw high salaries." Raman wanted to change all that. He revamped the departments and tried to build a workshop to fabricate instruments and provide a strong base for experimental research. (Raman can be called the father of modern experimental science in India.) But his big mistake, according to Max Born, was in not waiting for a year or two before starting the reforms. His speeding up of the pace of work at the institute was seen as a criticism of the former setup, and he became the victim of the manoeuvres of those who resented the changes.

Recognising the gaps in the areas of research at the institute, Raman adopted a bold strategy. He tried to recruit faculty members not from Britain, but from Europe where reputed scientists were trying to flee the tyranny of Hitler. This annoyed the British rulers. A similar induction of European refugee scientists into America paid off very well for the U.S. by improving the quality of its science. As Ramaseshan observes, "But then, the U.S. was a free country. We were still slaves." So Raman's idea was doomed right from the start, but he persisted, only to be disillusioned and humiliated in the end.

Raman had made a long list of subjects as diverse as quantum mechanics, radioactivity, crystal chemistry, vitamin chemistry, enzymology and astronomy, which speaks of his concern for the growth of science in the country. On his list of scientists to be invited were Max Born, Erwin Schroedinger, William Goldschmidt (whom Hitler had insulted and disgraced), George Hevesy (of radioactivity fame) and a host of others who were to win the Nobel Prize later. "It shows Raman's discrimination and it is remarkable that most of them agreed to come but did not after what happened to Max Born," points out Ramaseshan.

To expose the members of the institute to the new developments in quantum mechanics and nuclear physics, Raman wanted to create a permanent chair in mathematical physics at the IISc. He had wanted to offer it to Born. Rutherford was made chairman of the selection committee. As would be expected, and as Raman had wished, Born was selected. But, at the Institute's Senate meeting, Aston, a professor of electrical engineering who, according to Born, had been sent by the empire to "clean up the institute," spoke in the



By special arrangement



Prime Minister Rajiv Gandhi speaking at the Raman Centenary celebrations in Calcutta; a section of the gathering; S: Ramaseshan, Raman's student, speaking..... homage to an indomitable spirit.



most derogatory manner against Born, describing him as "a second-rate foreigner driven out from his own country." Born, it is said, wept and decided to leave. Schroedinger too was prepared to come to Bangalore but, much to the misfortune of India, he did not.

One can imagine what the institute would have become if people like Born and Schroedinger had adorned its faculty. Raman failed because the British faculty resented working under an In-

dian, and they gained the support of the colonial Government which could easily influence the Tata family. Raman was stripped of the Director's post. He wanted to resign, but Rutherford intervened. Raman continued as a professor till he set up his own institute, now called the Raman Research Institute. He moved there in 1948.

Raman never appeared to have recovered from the shock of the humiliation. Though he continued to do re-

search till the end and appeared to retain his enthusiasm and spirit, he was never his old self again. He became increasingly prone to mistakes and faulty judgments where both persons and scientific matters were concerned. An unfortunate fallout of this was the controversy between him and Born on a theory of lattice dynamics by Born, the very scientist whom he had so much wanted to get to Bangalore. It should be pointed out that Raman was not alto-

gether wrong in this controversy, as is commonly understood in retrospect, but he had failed to grasp the full implications of Born's theory.

Raman became a witness to racial prejudices from various other quarters too. Soon after Born's departure from India, the Zeeman Chair in physics, which had been instituted in the Netherlands, was offered to Raman. Given his patriotic feelings, he wanted to refuse it but did not know how. Much to his relief, it turned out that the shortened 'Sir Raman' had misled the City Committee which had to approve his appointment. It had been under the impression that the name was of East European origin till it discovered that Raman was an Indian. The offer was promptly withdrawn.

An earlier incident has been pointed out by the famous physicist, F. Zachariasen. Apparently in the Twenties, when Raman had already made his name in the world physics community, none less than the great A. H. Compton invited him for lunch at the faculty club in Chicago to which Dean Guayle, a specialist in optics who ought to have been familiar with the name of Raman, had also been invited. When he saw Raman he simply looked at him and walked away. It seems Compton felt immensely ashamed of his countryman's behaviour but Raman pretended not to take notice of it so as not to embarrass his host. Much later when asked by Ramaseshan, Raman said: "Like here there are many fools in every country. But I would like to remember America as the land of Jefferson and Franklin, Walt Whitman and Thoreau, Millikan and Compton."

Apart from building research institutions, Raman also felt the need to establish a scientific academy at the national level for the allround growth of Indian science. This he thought would serve as a forum for the scientists of the country to exchange ideas. Though his original concept was thwarted again by myopic differences of opinion, resulting in not one but a multiplicity of academies which continue to function even today, he founded the Indian Academy of Sciences in 1934 and also established the important tradition of Indian journals and enabled them to attain international standards by publishing all his research work in them. Raman had once said: "Continuance of the practice of publication in foreign journals will retard the process of building up a scientific tradition for India and keep her in a position of semi-dependence in the world of science." This much deplorable practice, unfortunately, continues even to this day. Raman's first detailed paper, entitled "A New Radiation," including the description of the experiments which led to the discovery of Raman Effect, was first presented in Bangalore on March 16, 1928, and printed in the March 31 issue of the *Indian Journal of Physics* thus establishing his priority of claim over the finding when efforts were afoot all over Europe to find the effect, notably in the Soviet Union and France. The short note sent to *Nature* appeared only in its April 21 issue, after the So-

In a gathering of Nobel laureates..... typically Indian.

viets had made a similar finding:

Raman's science was rooted in the Indian situation, whether it be ideas, facilities or resources. His research on Indian diamonds, flowers, birds, musical instruments and the like was indicative of the national spirit in him. One of his students was engaged in the study of the geology of the Indian subcontinent, in which Raman was deeply interested.

Money was always a problem for him. One of his students went to him complaining of the availability of only a 1 kW lamp instead of a 10 kW lamp. His suggestion was: "Don't worry. Put a 10 kW brain on the problem."

Raman was committed to basic science and fundamental research, and he did not favour the Nehru-Bhatnagar model of organised science in the form of institute-industry interaction arising out of a laid down policy or the later paths of big science followed by H. J. Bhabha and Vikram Sarabhai. Raman said: "I have always felt that science can only flower out when there is an internal urge. It cannot thrive under external pressures. I strongly believe that fundamental science cannot be driven by instructional, industrial, governmental or military pressures. This was the reason why I decided, as far as possible, not to accept money from the Government I will not put it as a condition that no governmental funds should be accepted by the institute. I would, however, strongly urge taking only funds that have no strings attached."

It is well known that Raman did not hesitate to seek donations from various quarters to build his institute but did not



BULLETIN No. 15.

The Indian Association for the Cultivation of Science.

Contents:

On the Mechanical Theory of the Vibrations of Bowed Strings and of Musical Instruments of the Violin Family, with Experimental Verification of the Results: Part I.

By C. V. Raman, M.A., Life-Member and Vice-President, Indian Association for the Cultivation of Science.

CALCUTTA:

Printed at the Baptist Mission Press and Published by the Indian Association for the Cultivation of Science, 210, Bow Bazar Street, Calcutta.

1918

Price, Rs. 2.50



private copy
C.V. Raman
29.6.1943
In memory of my
visit to the institute,
to an authority on
sound from an
ignorant violinist,
Yehudi Menuhin
March 11 1972

Raman's science was much more than pure physics — his research covered flowers, birds, musical instruments..... Here, the cover of a souvenir brought out in connection with the visit of an illustrious contemporary, Yehudi Menuhin, with a message from the violinist.

approach the Government. Whether this approach benefited Indian science or resulted in a truly industrialised and scientifically advanced country is debatable, but it is wrong to assume that Raman did not care for the industrial growth of the country.

One would be surprised to know today, when India's institutions such as the Council of Scientific and Industrial Research (CSIR) have failed to deliver the goods, that Raman during his IISc days had served in various capacities in the interest of Indian industry. He served as chairman of the Railway Board committee for the chemical preservation of timber, was involved in the establishment of a new chemical industry for the manufacture of rare earth chemicals at Bangalore, and helped institute the Sayajee Jubilee Technical Institute in Baroda. It is not that he felt obliged to serve the nation only after achieving eminence as a scientist. A fact brought to light by the late C. D. Deshmukh is that it was a paper initiated by Raman when he was the Assistant Accountant-General in Calcutta that led to the establishment of the Reserve Bank of India.

Given the scientific policies of the Government, it was men like Bhatnagar, Bhabha and Sarabhai who were destined to steer the course of Indian science. Raman was once offered the Vice-Presidency of the country but he would make no compromises. "What will I do with that ship?" he asked. He was pain-

ed whenever his former students or colleagues took up a Government assignment involving administrative duties, for to him that implied a desertion of the cause of science. He was increasingly seen as being unreasonable in his uncompromising attitudes. As S. BhagavantaĀm, one of his favourite students who himself went over to a Government post, wrote: "Men like him are not thrown up every day and if the rugged contours and the sharp corners of this giant did not compromise with the soft-spoken ways of the successful world, we can only describe the phenomenon by stating that it is no reproach on the Everest if you cannot play golf on it."

Venkataraman, the biographer, writes: "In Raman's case there was also a sly counter-attack by certain unscrupulous elements There were questions about his scientific abilities, his great discovery. No wonder he became like a wounded tiger. Deeply upset by the lies that were spread against him, he withdrew further and became a recluse, adding even more to his loneliness." In such a spell of depression he even resigned from the fellowship of the Royal Society — a rare incident in the history of the Society, the previous one being that of Newton.

But even during this period his love for children remained undiminished. In them he saw the future of India and its scientific growth. There was a time when only people below 18 were allow-

ed into his laboratory. He would demonstrate various experiments to them, take them into the gardens and tell them about the colours of the sky, the flowers, the gem-stones and the rocks. As Ramaseshan said, he was like the Pied Piper who could attract crowds of children running after him as he took them along in his scientific journeys into nature. But the rest of the world had effectively lost him though he continued to head the Academy and the Raman Research Institute till his death in 1970.

In the words of Ramaseshan, "To those who knew him, he was a soul in agony. He was veritably like Timon of Athens — bitter and cynical To him science was a personal endeavour, an aesthetic pursuit and above all a joyous experience He saw the enormous expenditure of large sums of money in the belief that science and therefore technology will automatically be created. He saw the replacement of quality by quantity. He saw the choice of research topics dictated mostly by foreign fashions and this hurt him most 'My life', he once cried, 'has been an utter failure. I thought I would try to build true science in this country. But all we have is a legion of camp followers of the West.' To my mind, the agony of Raman can only be compared to that of Gandhi in Naokhali when he too found that all his life's work was at naught, the apostle of non-violence witnessing his countrymen beating each other to death." □