

"No one can be like Newton, Einstein was a unique person. I do not claim to be unique in any sense. I work within my limitations; others work within their limitations. Each person tries to do his best."

Prof. S. Chandrasekhar talks to S. Kumar

"I am not a glamorous mathematician. I do not work on things which are glamorous. Consequently, I am not competent to answer questions on things which people speculate and talk about". Humble, modest and unassuming, the learned astrophysicist and Nobel Prize winner, Prof. Subrahmanyan Chandrasekhar speaks sparingly.

Always cautious in making remarks, he rarely discusses any subject other than his own, in public. Stars, their evolution, stellar structure and dynamics and Black holes are among the topics he discusses unhesitatingly. His achievements can be aptly summed up in the words of Virginia Woolf — placing perfectly and accurately a square over an oblong. This is as challenging a task as placing a square peg in a round hole.

Prof. Chandrasekhar remained aloof from the city of Bombay



Prof. S. Chandrasekhar : Science will be poorer if everybody did science.

one name, Raghunathan—he is considered by everyone outside as one of the best mathematical intellects. He is right here. If one can build such an institute — this is from independence — which has had such a splendid record in mathematics, why should not it be possible to build universities like that. I am not a person who runs universities. I have never been a dean. It seems to me that if the emphasis and if the same care and foresight had been into the universities as had been in the case of institutes, we would have scientific environment in India which is enormously better than what it is today. Clearly, we have to start somewhere. If you start this year, the effects will be clear next year. I think it is rather sad the universities have been impoverished.

What is your view on student disturbances?

Yes, students go on strike. The blame can be distributed. But the one group on which I won't throw any blame is the young people because they are manipulated. Young people, given the right opportunity and the right atmosphere, will always do well. You have to believe that. If you don't believe that, there is no future for any society, not to say Indian society. Every society depends on the youth, providing the stamina for the future generation. The older people have the responsibility to provide the environment. If they provide the wrong environment, students go the wrong way.

Let us now turn to some specific scientific issues. How big is the universe? How many galaxies and stars are there?

These are things which I find difficult to answer. I do not have the figures readily. Why don't you ask Prof. Narlikar? He has written a book on it. His book

technical and whose implications are in the long range. I do not have any view on these glamorous things people write about.

What is your view on the theory that the objects called "Quasars" contain the Black holes?

These radio galaxies have jets which go very long distances. The question is what harbours there. It seems to be the view that in the centre of these jets are Black holes, with million or even 100 million solar mass. They are rotating rapidly and because of their rotation, they are able to focus the beams sufficiently and they go that long. I have read the theory with some care though I have not worked on it. It seems to be quite reasonable. Because the energy output is so large that nuclear sources cannot provide that much energy. It looks as though gravitational sources must be present. Gravitational energy becomes important only when you have objects of the size of Black hole, it has some very remarkable property of focussing beams. I think that these radio galaxies like quasars are powered by central Black holes of enormous mass.

Has the sun another companion?

I don't think there is a binary for the sun. But, there are speculations that there may be. There is no astronomical reason why there should not be any but on the whole it does not seem likely. But, it is conceivable that there are other planets beyond what we know.

In the life of a star, white dwarf is supposed to be a final phase. Can a star be born as a white dwarf?

It is unlikely. If a star forms, it starts off with big dimensions. But there are instances in which

# 'I'm not a glamorous mathematician'

and spent the time in a secluded guest house near Thane when he arrived from the USA to be in India for Diwali. During a day of hectic schedule at the Tata Institute of Fundamental Research (TIFR), he met the press for a short while, recorded an interview for the AIR and spent more than an hour with the mathematicians.

However, he acceded to my request for an exclusive interview in his hotel suite, after receiving the third R. D. Birla memorial award. Following are the excerpts from the interview:

Astronomy flourished in ancient India. But, later Indian contribution to this field slowly declined. What are the reasons for this?

In Kerala, two centuries before Newton, there were some mathematicians with enormous power and they invented the series which were now seem to have been discovered by Newton. The name of the mathematician is Madhava. The works of those mathematicians have been studied and understood very recently. It shows the remarkable ingenuity and power of the group of mathematicians. It throws an entirely new light on the level of sophistication Indians have reached. I have not read astronomy proper.

About the rest, I do not know. Why was this fact not known before? What is the significance of the work done?

The books were not known before. They were discovered only recently. Their significance is that there were mathematicians of great intellect before in India.

From your own experience, would you suggest some principles or codes which would define the way to do science?

Who am I to make principles for others? Why should I think that I am a person given the authority and judgement to tell what other people should do? Each person should do what he is capable of. I do not see that any person can dictate principles to others. I think the main aspect of science is with people with different interests, temperaments, tastes and abilities to work. Science will be poorer if everybody did science, quote — by the same principle — unquote. The fascination of science is a structure built by scientists working in different disciplines for centuries. No one can be like Newton. Einstein was a unique person. I do not claim to be unique in any sense. I work within my limitations; others work within their limitations. Each

person tries to do his best. You have gone on record saying that Indian universities neglected research and at the same time, individual institutions flourished. This distorted system has stifled the growth of science. How can we remedy this unhappy situation?

I think they (the government) ought to support the universities and provide the faculty sufficient time and leisure to do research. They should not be overburdened. In other words, research must be one of the prime qualifications for a university faculty. They cannot be simply the teaching bodies.

The university of Bombay, I understand, is one of the couple of universities in the country where the admission is by merit. In other places it is not. Clearly, that is detrimental. University should not operate except on the principle of merit. This is one of the methods very obvious to everybody.

It seems to me, if it has been possible, since independence, to build in this country an institute like the TIFR where the mathematicians for two decades have been first rate, absolutely first rate. For example, on the faculty of TIFR now, just to mention

contains all the numbers like the size and radius of the stars, galaxies and the universe. I really cannot answer questions connected with the universe because I have not worked on it. It is not something on which I can make any comment.

There is a strong view that the protons, which were hitherto believed to be stable, were really not so and they decayed. What is the implication of this discovery to the universe?

These are matters about which my remarks are not specially appropriate. If the protons decay, of course, in  $10^{32}$  years, the universe will disintegrate in  $10^{34}$  years. On the other hand, it has not been measured yet. One has not found it yet. Why should I make any comment? The biggest expert, Prof. Narlikar is here. He can discriminate between his personal ideas and facts. I may say some foolish things and Narlikar will read the paper and say what a stupid thing. I do not want to make a fool of myself. Till about 1972, I was the editor of the "Astrophysical Journal". I used to know all the astronomical facts in great detail. Since I gave it up, I have been working on some special problems connected with Black holes which are highly

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the star has a binary and the core has white dwarf dimensions with a big envelope. The envelope can be dissipated with the mass going to the other object, and then, of course, you are left with the white dwarf in a time scale very short compared to the normal time. Occasionally, white dwarfs can be formed sidestepping evolution.

Can a white dwarf collide with another white dwarf?

Yes, it is possible. For example, if two white dwarfs of 1.2 solar mass collide, they become a Black hole. If a white dwarf of 1.2 solar mass collides with another of 0.4 solar mass, the total becomes 1.6 solar mass. So it must collapse either into a neutron star or a Black hole.