How a good teacher operates...

I recall that when I was in Class II, one of my maternal uncles came to live with us in order to help with my studies for his M.Sc. in mathematics. Morumama, as he was commonly known in our house, noticed that our house had two blackboards adorning the walls of the back verandah; one small and the other full size. What is their purpose, he asked. My younger brother and I explained that our father had got those installed so that we may indulge in writing school matters or in recreational work of any kind. In short, we had complete freedom of usage.

Hearing this, Morumama ventured further: could he use the smaller board for something to write on? I graciously permitted the "guest user", little knowing for what purpose he wanted it. I was to discover the answer shortly. Half an hour later, I happened to pass by in the verandah and I found something written on the small board. I was in for a surprise! I saw the title, which read clear enough: A challenge problem for JVN. And underneath was the problem itself written out in the neat handwriting of Morumama. What was it all about?

"I knew you would come to ask me that question," smiled Morumama as I accosted him. He explained that the question was for me to solve all on my own. "No asking a third party. If you succeed, you win. If you fail to solve it, come to ask me and I will explain. But then I win. Let us see who wins..."

Of course, there was no explicit time limit "but if the problem remained unsolved for a week, perhaps you agree that I may claim victory?"

I agreed to the stipulations and there began a series of challenges that lasted nearly three years. During those three years, I advanced to Class II, but knowledge, common understanding wise, I had acquired a wide horizon of mathematics; a horizon that far extended beyond the textbook version at school. It was also fortunate for me that my class teacher in maths was supportive of this whole exercise. Indeed, there were occasions when I would walk in and write a challenge problem on the classroom blackboard and the teacher would invite the whole class to join him in solving the problem. That is indeed a way that a good teacher can bring out the best in his or her pupil.

By the notion of a "challenge" the teacher appeals to the pupil's ego. And, the ego can drive the pupil to higher levels of achievement. Morumama's approach was illustrative of how a good teacher operates.

Another example of a good teacher I encountered was when as a post-doc I was visiting CalTech. I was lucky to be there when a lecture course was announced in the physics department with the lecturer being no less a person than Richard Feynman. The lecture course announced was on the notion of path integrals, a topic to which Feynman had made very valuable contributions. In a sense this was the proverbial straight from the horse's mouth! Indeed it was refreshing to have the subject from a person who had contributed so much to it. Additionally the lecturer's histronics added to the enjoyment of listening to the lectures. The lecture notes for the course subsequently found their way in print in the form of a textbook, Quantum Mechanics and Path Integrals. How the same topic can be made to appear difficult by one teacher and simple by another was demonstrated in this lecture course. For one week Feynman went out to Cornell University to deliver some special lectures and during his absence he asked a colleague to deliver the lectures. The colleague was another distinguished physicist, Murray Gell-Mann. However, his style was very different. He used a very formal approach and got lost in complicated expressions. At the end of the week, he completed his lectures and Feynman, who was by then, proposed to resume from that point.

To check on what had been taught by Mr Gell-Mann, I asked the class a few searching questions, all basically amounting to "What does his specified por-


tion covered. All he could see were blank faces. Obviously, although we had taken down Mr Gell-Mann's notes we had not really followed the physics behind them. "I see that you have not understood what Gell-Mann was talking about. Let me do that portion my way," he said. And in two lectures to follow he did the same calculation his way. It was not rigorous nor was it formally correct, but it explained the physical principles neatly. We could see what we were doing.

This example contrasts a teacher who is formally correct but hard for students to understand from a student-friendly teacher. The latter may not be taking liberties with rigour, but his teaching method is much more lucid. Not every teacher can successfully copy the Feynman style of jumping up and down, moving back and forth, raising and lowering the voice, etc. These are helpful in lifting the student's morale. But the main contribution from the teacher has to be a clear enunciation of what he is talking about.

The writer, a renowned astrophysicist, is professor emeritus at Inter-University Centre for Astronomy and Astrophysics, Pune University campus. He was Cambridge University's Senior Wrangler in Maths in 1969.