

Developing Scientific Temper

Dr S.S.Kalbag, Vidnyan Ashram, Pabal; Dist Pune. 412 403.
(Text for talk on AIR, Pune, 17.7.91 at 8.15p.m.)

From the time of our independence, beginning with Nehru, KC have been saying that "our people must develop scientific temper; then only we can progress". Scientists, political and social activists are all for this scientific temper. But what is this scientific temper? how can any one develop it? I feel this is not generally clear. This is what I shall talk about today.

Some consider scientific temper to be the same as rational thinking. Some consider it as not believing in superstitions. But I feel scientific temper is something more and somewhat different. Rational thinking is a subjective idea. Every thought is rational to the thinker at the time, in that state of mind. Later to himself or others it may appear irrational. Superstition is also based on an explanation put forward by somebody with incomplete knowledge and accepted by others as rational from their point of view. No body accepts any thing he considers irrational. Even among scientists, there are often debates as to which explanation is more rational. On the other hand we often do what suits us, and then try to rationalise what we have done; this is finding excuses. Intuition often leads to action and if it succeeds, we look for the rationale later. This shows what is rational to one can be irrational to another. Equally, what is considered irrational at one time, may appear rational when newer information is available.

The very process of learning by the human mind is based on rational thinking. He gets all our information through our senses. On this basis we make a "model" of the external world or reality. This model is a set of "rules" that we all accept on the basis of our own experience. Such as fire burns, all things fall down when thrown up; two and two always make four and so on. This leads to development of concepts such as the concept of groups having certain properties, the concept of numbers etc.

Whenever our model fails, we either change our model to accommodate the new experience or keep it aside as a "miracle"

What we call rational thinking is anything that fits 'our model.' This model changes with age and experience, therefore rational thinking is not constant. If we think more about this process of learning we can see the similarity with what we call scientific thinking. We collect experience through our senses, make a hypothesis or a model, then test it in real life situation, that is our experiment. Even the idea that when you consider the effect of something, you must have everything else the same or unchanged is a concept that every child develops at some stage. Piaget, who has studied for forty years, the process of learning in children, has enumerated a large number of such scientific concepts which come naturally to all children through life experiences.

Then why does not every one have the same kind of rational thinking? Making use of intuition is a skill that is not developed equally in all. This is where some people, who do not make use of all the information or draw wrong conclusions, appear irrational or unscientific to those who are better in these skills.

So in conclusion the rational thinking process is natural to all human beings. What goes wrong is the set of rules or the model one uses for this thinking. This in turn is based on inadequate experience of that individual.

Scientific temper or scientific approach as I prefer to call it, is a refinement of this same thinking process that comes naturally to every human being. Let us see what are the components of this and how they make a difference.

We get signals from the outside world all the time; sounds, pictures, smells, etc. We can't possibly take note of all these. We select from this what we want and also be alert to anything that is unusual. This is observation. It is a skill that needs to be developed. Observation is focussing our attention on selected stimuli, generally for a purpose. This has to be developed. Otherwise our information base is likely to be inadequate. Some people who have eyes open but mind somewhere else cannot get the same information as others who think about what they see.

Quantification of the information is an important part of the scientific temper or approach. Measurement and familiarity with the different units of measurements are important skills. Quantification increases the resolution of our observations. This means we can detect smaller differences that would otherwise be missed.

Having got the information, we need to learn to organise that information so that we make the best use of it. Organising must include recording of the more important intonation, classification and looking for patterns. If we see any patterns or lack of it, we then make a hypothesis; why? how? etc. This hypothesis is our model that explains why things happen the way we have observed.

The hypothesis is still tentative; until we find it dependable we may have reservations about its validity. After testing it in real life preferably, we put more trust in it. But all things are not easy to test in real life. Some times it is risky or expensive. So we make an experiment- that is, a situation artificially created to be as close to real life situation as necessary to get the desired information.

Just like us, everyone is collecting experience. Should we not learn from others experience as well? That will be faster learning. Comparison of our experience with others is important.

Out of all the above skills, the organising of information, recognising patterns and making a hypothesis are expressions of creativity. This is what intelligence is. The same information may be sometimes, tabulated in different ways to bring out startling conclusions.

Another quality, not a skill is often an important part of the scientific approach. This is the ability to bring out more than one hypothesis so that one chooses the best from the alternatives. The tendency is often to stick to the first thing that comes to the mind. Another skill that is not part of the scientific approach, but a valuable asset in scientific thinking, is the ability to express, precisely and concisely. There is a strong belief that we can only think in a language. To be able to put our ideas clearly, therefore helps in thinking.

Therefore, in conclusion, developing scientific temper involves refining the natural process of thinking by inculcating certain habits and skills. These are to sharpen our observations, acquire a habit of quantification of our information, practice recording of all relevant data in a systematic way, organise the information to recognise any patterns; think about why and how those patterns arise; make a hypothesis- that is think of a possible explanation for the observed phenomena; and finally verify whether the explanation holds good in other similar situations.

It is my experience that the above approach is not only useful in technical matters but in all every day activities. Such a scientific temper gives immediate economic returns by increasing the efficiency and productivity. I feel if we succeed in giving this scientific approach to all our students at the school leaving stage, they will learn by themselves the rest of their life. Unfortunately even many of the science and engineering

students do not have such a scientific temper and therefore make poor scientists or engineers.