

# Scientific Outlook

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## Method of verifying the evidence

How does one verify evidence? The process of scientific thinking is the method that is used for doing this. The factors that constitute this method are:

*Observation, Logic, Inference and Verification (this is of three types, viz., direct, repeated and universal), followed by Experiment.* What comes out of this is the scientific outlook. Let me explain these factors. All the discoveries made so far are the result of some observation. We are taught in school about steam energy discovered by James Watt. The story goes thus. James Watt was engrossed in his thought. A kettle was boiling by his side. When enough steam gathered in the kettle its lid fell off. James put the lid back on the kettle. It fell off again after a little while. A few repetitions set him thinking about the reason for the lid coming off. He did not imagine a ghost in the kettle. He reasoned that since the lid comes off again and again, there must be something inside that pushes it out. This reasoning resulted in the discovery of energy contained in the steam, which led to the industrial revolution in Europe. Another example: we celebrate 28th February as National Science Day, because C.V. Raman's discovery of 'Raman effect' was published in world-renowned magazine 'Nature'. Later he won the Nobel Prize for it. How did he discover it? He was going to

England in a liner. Every day he used to go to the deck and see the deep blue sky above and the deep blue sea below. He was curious to know why. Now he could have praised God for creating the beautiful blue sky above and the beautiful sea below. But, he did not do that. He started reasoning and discovered a novel scientific truth. Thus, scientific outlook starts from observing phenomena and asking oneself the question 'why'.

Now one cannot expect to prove everything by observation. Suppose you have lost your way in a jungle in the evening. You need to reach some small settlement before night. Since you do not know where such a cluster of hutments can be found, you would not know which way to go. Then if you see some smoke going up at a dozen places by the side of a hill, you think this may be an indication of a settlement and you take the path towards it. What is the basis of your choice? You have not seen any men or a settlement or their fireplaces. But you know that wherever firewood is used for cooking, there is smoke and in the jungle, firewood is used for cooking. Evening is the time for cooking dinner and if food is being cooked in every hutment, there would be a dozen places from where the smoke can rise. So you deduce that there must be people living there and they are preparing their dinner. On the basis of this *logic* you proceed in that direction and your deduction turns out to be correct. Scientific outlook consists of firstly *observation*, secondly *reasoning (or logic)* where observation is not possible and thirdly *inference*. Let me explain the third constituent, *inference*. A friend of yours, who is a late riser, suggests that you accompany him for a walk at sunrise next morning. He promises to come to your house very early next day. Since you know he is incapable of doing this, would you argue with him, 'Oh, you want to go for a walk at sunrise, but how are you sure that the Sun will rise tomorrow?' No you won't. But how does one know that the Sun is going to rise tomorrow? When we give appointments several days in advance, how do we know that those days are going to break on this earth? We deduce this from our knowledge that the Sun has been rising regularly in the morning for the last 460 crore years. It has not taken any leave at all. If it does that even for a day, it can cause a permanent "leave" for all the living things on earth. Since the Sun has been rising regularly so far, you infer that it will do so even tomorrow and plan to go for a walk in the morning. This is *inference*.



The next factor is *verification*. We have already seen that it consists of three parts: verification, repeated verification and universal verification. What is verification? Adi Shankaracharya had said, even if hundred wise men tell you that fire is cool, will you believe it? No, you will not. If those hundred wise men say, 'not only do we say it, but it is also written in the book', you would reply, 'I do have a lot of respect for all of you but the direct evidence, my own experience, tells me that if I put my hand in fire it will burn.' Verification by direct experience is an important part of scientific outlook. Now we will see what is *repeated experience*. Someone tells you that using a certain enchanted ring will secure employment for the user within one month. You ask him to give you proof. He then says that he had used it and later his neighbor had used it and both got jobs within a month. What you should argue with him, is that if the same experience is repeated a large number of times, then we should make ten thousand such rings and distribute them among ten thousand unemployed youth. If they all get jobs within a month then we can accept that this ring does have some supernatural power of securing jobs for the unemployed. We cannot draw conclusions from just one or two examples. For drawing conclusions you need a very *large number of such examples*. This is the crux of the scientific outlook. Again this experience or verification has to be *universal*. It cannot be science without being universal. If you say that only the residents of that particular city will get jobs on using the ring, it will not be acceptable as scientific truth. If the ring really is capable of getting a job for the user, any body, anywhere should get a job within a month on using it. If a medicine is developed for a particular disease, it will cure any person suffering from that disease anywhere in the world. When the law of gravitation was proved, it could be applied anywhere in the world to verify it. Thus *scientific outlook is founded on direct verification that is repeated in very large number and is universally applicable*.

Experiment is the last important constituent of scientific outlook. Anybody should be able to verify scientific truths by conducting required experiments. Water boils at 100 degrees centigrade. It means that water will boil at this temperature anywhere in the world, be it Mumbai, Calcutta, London or Madras. If it boils at a lower or higher temperature at any place, you have to have another universal law that explains why and to what extent the boiling point of water rises or

drops. It is not that water will boil at 90 degree centigrade in Mumbai and save fuel because the residents of Mumbai are very religious, while the residents of Moscow being atheist water boils there at 110 degrees centigrade. One can verify it by experiment. So observation, the question 'why so' based on the observation, then reasoning or logic where observation is not possible, followed by inference and verification and lastly experiment are the steps that build the scientific outlook.

There is a lot of value content too in the scientific outlook. It tells how a human being should look at life in general. The value content dwells in the method of scientific thinking. Right manner, autonomy, questioning (or inquisitiveness), courage (or fearlessness) and modesty (or humility) are the five main elements of value content.

### Right attitude

When you adopt a scientific way of thinking, you have to consider every problem from all sides. There was a drought in Maharashtra in 1993. It did not rain till the month of July. The governor of the state, therefore, invited people to pray to their respective gods for rain. It is true that there was a grave scarcity of water in Maharashtra. It is human nature to turn to God whenever in great difficulty and to implore him to help overcome that difficulty. God may or may not help us. That is a separate issue. But it gives us some support and there is nothing wrong in finding such support. This is what most people think. Our Constitution too, gives us full freedom of worship. So when the governor called on all of us to pray for rain, we issued a leaflet, saying that this is an insult to the great social reformers of Maharashtra. People were angry with us for not believing in God. We do agree that one has a right to believe in God and pray to him. But if you try to understand our argument as to why prayer was improper in this case, with an open mind, you will understand what is meant by *right attitude* in the scientific outlook.

What is the reason for the scarcity of drinking water that Maharashtra had to face? It wasn't that there had been no rain in Maharashtra, in the previous year. The average rainfall of the state is 1000 to 1200 mm. In some hilly regions it is 2000 to 2500 mm. While in some other regions it is 450 to 700 mm. Out of the 300 Talukas of Maharashtra, approximately 100 are in the rain shadow region, where the average rainfall is between 500 and 700 mm. The statistics of the



average rainfall in Maharashtra in all these regions, for the last 100 years are available and do not show any shortfall in rainfall anywhere, barring an exceptional year or two. This means that our state receives a minimum of 500 to 700 mm of rain in some regions and much more in many others. But in both these regions every summer, we experience large-scale scarcity even of drinking water leave alone water for crops. It has been proved that everywhere, if the small rainfall of 450 to 500 mm is properly dammed, collected and soaked in the soil and used wisely, it provides enough drinking water throughout the year, in addition to irrigating one crop. It's not that this cannot be done in Maharashtra. That it can be done is proved by many like Vijay Borde in Adgaon near Aurangabad, Anna Hazare in Ralegansiddhi, Dwarkadas Lohia in Beed and Vasant Gangavane in Ratnagiri district. However this solution applied in a few pockets of Maharashtra, is not yet applied in the rest of the state.

Let us consider the outstanding example of Israel, where rainfall is a meager 5 to 6 inches (12.5 to 15 mm) per year. This country can export vegetables to the rest of the world and our farmers go to study their irrigation methods. This shows that even with a scanty rainfall as in Israel, scarcity of water can be overcome with proper planning. In Maharashtra, we get much more rainfall, and yet we experience scarcity of water increasingly, every year. This is a manmade rather than a natural adversity; manmade because of the impotence of our politicians. To pray to God for rain is like the prayer of a student, appealing God to let him through the exams successfully without making any effort himself. To look at the problem from all angles, as in this case, in order to understand it thoroughly is the *right* attitude of looking at a problem.

### **Self-dependence (or self control)**

What do we mean by self-dependence? The scientific outlook maintains that this universe exists of its own and is bound by cause-effect relation. One can find or establish cause-effect relation of every thing that takes place in this world. Nothing can happen ignoring this relation. Of course mankind has not been able to establish the cause-effect relationship of each and every phenomenon, say for example the exact cause of cancer. But we know the method of investigating cause-effect relation of phenomena and can say with certainty that there does not

exist any good or evil supreme power that can control all that happens in the world. Once you accept the existence of such a power, it follows that you also believe that praying to the good power is beneficial and appeasing the evil one helps avert calamities or turn the calamities onto someone else through some rituals or rites. This however, is impossible in this self-controlled world by ignoring the cause-effect relation. This is an important aspect of the scientific outlook. *Thus the meaning of self-dependence of the universe is: all that happens has cause-effect relation, this relation can be discovered, the discovery can be incomplete for a while but the direction of the investigation is right and the relation is eventually found.* We can also remove the shortcomings in the discoveries, on the basis of which life is made happier.

### Inquisitiveness

The third aspect, inquisitiveness means to search keenly. I shall ask you two questions that are not mine and have been asked earlier. In the summer, some people store water in a black earthen pot while others use a red pot. Now the question is, does the water in the black pot become cooler than that in the red pot? The second question is the one that was addressed by the king of Sicily to his courtiers. He asked, "If a live fish is put in a vessel filled to the brim with water, the water does not overflow, whereas it spills out on putting a dead fish into it. What is the reason? I give one minute to think and answer." Would any of you like to answer these questions? The answers in general that we get are: since black color absorbs more heat than the red, water in the black pot remains less cool than that in the red one; a live fish floats in the water and also absorbs oxygen from the water, while the dead fish sinks to the bottom and displaces it which then spills out. The wise courtiers of Sicily too, gave the same answers. But nobody ever thought as to who observed these phenomena, and on what basis were such conclusions drawn. *We are given to believe whatever we are told.* Water filled in a vessel to the brim ought to spill whether you put a dead fish in it or a live one. Similarly how cool the water will be, depends on how porous the pot is, and how much water from the outer surface of the pot evaporates and not on the color of the pot. We instantly start reacting to whatever is presented before us instead of keenly verifying the facts, which is not appropriate for any field of life.



### Fearlessness

The fourth criterion of scientific outlook is fearlessness. When one tells a scientific truth of which he is convinced, he becomes the victim of the anger of the upholders of the prevailing system. In such a situation whether you can tell the truth, of which you are convinced, fearlessly or not, is put to test. When Socrates tried to tell such a truth, he was sentenced to death. He was told to go to the adjacent room and the drink poison kept there in a cup. He drank it calmly. When you are out in search of truth, you ought to be unafraid of the consequences; you should be ready to pay the price of your search, whatever it be. This path of search of truth is the path demanded by the scientific outlook, where fearlessness is utterly necessary. The Scientific Truth need not necessarily belong to the field of physical science. It may be from the social field. 60 years back, there was a man in Pune who earnestly tried to tell people that our nation is in danger as the population is growing without any control. We have got to adopt family planning in order to curb this runaway growth. No body listened to him then. In fact he was called a lunatic. The words – family planning and birth control – are found in our every day vocabulary now. But in those days they were considered dirty. Who was this courageous man who used these so called dirty words in those days? He was the son of Bharat Ratna Dhondo Keshav Karve. He was hauled into the court of law for using the words family planning and population control, writing articles on them and propagating them. He however never stopped propagating family planning in order to control population, come what may. He boldly told the truth and had we paid heed to what he said, our nation would not have been coping with this enormous problem. We would have overcome this difficulty long back.

### Modesty

The fifth characteristic of the scientific outlook is humbleness or modesty. Science is always humble. Religion boasts that it gives the correct answer and the answer that it gives is the final one. Religion does not need to go beyond what it knows. Every one should accept the explanations given by religious authority as it tells *the final truth*. Science on the contrary, always admits that its knowledge at any given time is limited. The conclusions science draws are on the basis of the evidence available up to that date. In case something different becomes

known, science is ready to change its opinions. Science being humble, its very characteristic is to *change its opinion in the light of new research and new evidence*. Religion is not and was never so humble. Religion has a prophet and the word of the prophet is the final truth!