Research Methodology
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Lecture - 02
What is Science? Part 02

I said, science is mankind's attempt to find truth about nature and in that quest, along with correct ideas, many wrong ideas, illusions also arise. The task of conscious science is to find out which ideas are wrong and weed them out from our body of knowledge. Through that, we try to reach truth.

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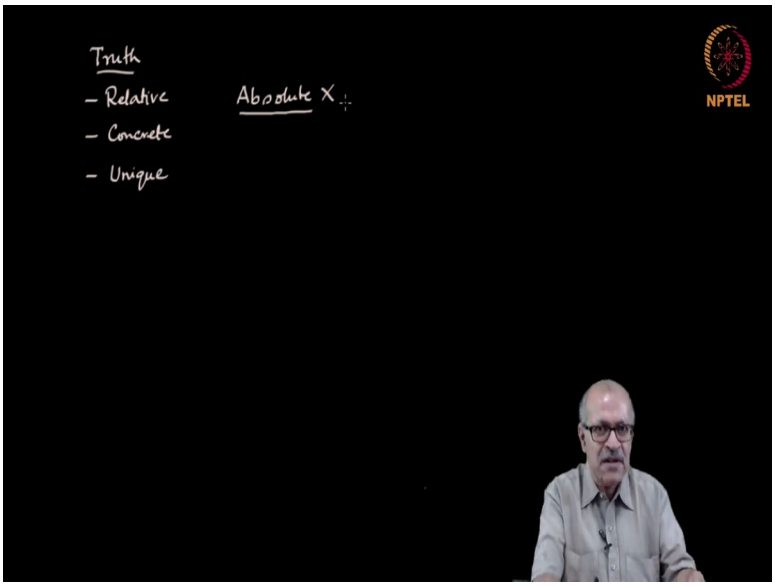

But, what is truth? Truth is actually the correspondence between an idea, a statement, and the objective reality. If an idea or a statement accurately represents the character of something in objective reality and it can predict outcomes of an experiment conducted on that piece of matter then we say that the idea is true.

Truth does not relate to something we cannot state. Is this table true? There is no point in asking that question. But we can ask the question: Is the length of the table 1.5 meters? That can be tested to be true or false. Therefore, the truth always relates to a statement.

The statement can be true or false, and whether it is true or false depends on how well it corresponds with physical reality. But such correspondence between a statement or idea

and physical reality is never attained in one shot, like a scientist thinks and immediately and without any error arrives at absolute truth. That never happens. Truth is always attained in small steps taken by many scientists. That is why science is a collective pursuit of scientist all over the world.

A scientist takes a small step and adds to the body of knowledge. On that basis the next scientist takes another small step and adds to the body of knowledge. That way we incrementally approach truth. Incrementally we are able to make our ideas, concepts, statements more and more closer to truth. That is why at any point of time if you look at our body of knowledge, then it cannot be said to be absolutely true, because we are incrementally approaching truth.

Had we reached truth then there would be nothing more to know. Science always has something more to know. That is because, we are trying to reach truth, but always there is a bit that is yet unknown, yet not done, yet not achieved. Therefore, at any point of time, our knowledge about the material world is partial.

Science never claims to have complete knowledge about anything. We try to find out the truth about nature and at any point in time we can only go to certain extent with always something more to be achieved. But you might ask: Can we not make a true statement?

Yes, we can. Like, ‘human beings cannot live long without eating’. It is true. Like, ‘the angle subtended by a triangle on a flat piece of paper is 180 degrees’. True. But these statements are rather simplistic statements. Science does not concern itself with such simplistic statements. It tries to find out what is yet unknown and in that pursuit, our knowledge is always incomplete.

Take for example, Newton’s theory. Newton’s theory means, I am putting together the three laws of mechanics plus the theory of gravitation. Put together, I am calling that Newton’s theory. That was tested on hundreds and thousands of different bodies: planets, cannonballs, etc., and always it has come out victorious. But when people started looking somewhat minutely at the motion of the planet closest to the sun, Mercury, then they found that there is an anomaly between what is predicted by Newton’s laws and what is actually observed.

As you know, the orbit of any planet is an ellipse with a major axis and the minor axis. For Mercury, the axis rotates and this phenomenon is not explained or predicted by Newton's theory. Then we knew that we need to look for more accurate better theories, and Einstein's theory of general relativity filled that gap.

The same is true, for example, for electromagnetic theory. Maxwell's theory of electromagnetism was extremely successful and it was tested on thousands of day to day events and it was always victorious. It turned out to be correct. But when people tried to apply the same laws in some atomic phenomena, they found that it simply does not work. In order to account for that situation, a new kind of mechanics, quantum mechanics, had to be developed. Which means that, even though a scientific theory may be proposed and may be tested on thousands of situations, still people should doubt that and people should keep on testing that.

Scientists do that all the time. That means, in science there is no guru. We never say that, because Newton was such a great scientist, as Newton said this therefore it has to be correct. We never say that. We test whatever he said. We never say that this theory is proposed by Einstein—such a great scientist—he cannot be wrong; he must be correct. We never say that. We always test that.

So, we doubt. This is a hallmark of science. We are skeptical about our own theories and this is a hallmark of science. That is why, often science is called a organized skepticism. You have heard of organized belief systems—some belief that is shared by many people and that becomes sort of an organization; that organization demands everybody to believe in something. While exactly the opposite happens in science. It is an organization. It is an organization of scientists involved in some pursuit, but they share one common thing: they are skeptical about everything. Organized skepticism.

And since we are skeptical, we test all the theories from different angles, different situations, different conditions. We test our theories and whenever we find that some theory that was established is not able to account for some fact in a particular condition, then that creates the condition for a new science to develop.

We always look for such situations where the known laws fail or prove to be inadequate. Through that we incrementally improve our knowledge. We incrementally go closer and closer to truth. That is why, whatever statement we make, whatever knowledge we have,

whatever truth we talk about, these are all relative: relative to the condition in which they had been proposed and they had been tested.

Newton's theory was proposed and tested under terrestrial conditions under the condition of relatively weak gravity like what pertains in most part parts of the solar system. It has been proposed and tested under that condition and it is true relative to that condition. It might not work in a different situation.

The same is true for Maxwell's laws of electromagnetism. For any law of science, everything that we know are relative. That is why, in general we say, *truth is relative*. Relative to the condition in which they had been had been stated and tested.

But, because Newton's theory was ultimately proved to be inadequate under the condition of very strong gravity, because of that reason, do we say Newton's theory is wrong? False? No, because in the condition in which it was proposed and tested, in that condition it continues to a work. Because it was tested under that condition and the test is not wrong, therefore it still continues to be valid under that condition.

And because of that, whenever an engineer builds a bridge or an engineer designs a rocket to go to the Mars, we always use Newton's theory. Because we do not need to use Einstein's theory in that condition. Why? Because in the condition in which it is being done, in that condition, the Newton's theory is *concrete*.

So, I talked about two attributes of truth; one is truth is relative. Every statement that we make is relative to the condition in which it has been obtained as truth: the condition in space and time. And truth is concrete, because in the condition in which it has been proposed and tested, in that condition it continues to be valid and can be used for productive purposes. So, in that condition it is concrete.

The third attribute I will talk about is that truth is *unique*. For every question there is a unique correct answer. Science, as I said, starts with asking questions. To answer one question, initially there can be many people trying to answer and there can be many different answers given.

Say, how was this solar system created? If that is the question, there can be initially different answers given by different people; different hypotheses proposed by different

people, but science knows that most of these will be ultimately proved wrong. Maybe one of them will be proved; the one that is not proved wrong will be taken as correct. Or it may be so that the correct one has not yet been proposed. Still further research is necessary.

But whenever there are competing theories, you always know that both cannot be correct. All of them cannot be correct. And that is why we always try to formulate tests by which we can figure out what is wrong, what is false, and eliminate them from our consideration. This pursuit of science, this method of science, rests on the assertion of philosophy that truth is unique.

For every question there is a one correct answer. Not many. Moreover, everything in this material world is changing, evolving and therefore, the truth about anything cannot be static, fixed, absolute. It is always changing and that is why we have no interest in absolute truth. Truth is not absolute.

Truth is relative. Truth is concrete to the situation in which it has been proposed and tested. Truth is unique. But there is nothing like absolute truth. The moment you reach an absolute truth, there will be nothing more to know. Science never reaches that condition. And science has abandoned all attempts to reach the absolute truth, because it knows that its not possible.

It has no interest in absolute truths. It always tries to focus on a particular issue, particular situation, particular material, particular phenomenon under certain conditions and tries to figure out what is the law of nature governing that. And there is nothing like an absolute truth which is independent of space, time, condition, always applicable. There is nothing like that. There is no absolute truth in nature.

The whole field of chemistry, the entire chemistry, makes no sense in the condition prevailing in the sun, because chemistry concerns formation of molecules and no molecules can form in the sun at that temperature. So, the whole science is invalid there. The whole science of chemistry is true relative to the condition that pertains at a particular temperature.

Similarly, the whole science of biology makes no sense in, say, Neptune, where there is no life. The whole science of biology, therefore, is true relative to the condition that prevails on an Earth-like planet with certain physical conditions.

Similarly, you will find that every law is applicable to a specific condition. In other situations it makes no sense. So, with that, we have understood the nature of truth and science. The pursuit of science is to find truth about nature. So, in the future classes when we talk about the actual method of science, how we actually do it, we have to keep these issues in mind.

What we are looking for are the truths about specific things, specific phenomena under specific conditions. And then, truth will be relative to that condition, it will be concrete in that condition and for that situation truth will be unique, but it will not be absolute. You have to remember that.