

Research Methodology
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Lecture - 17

Historical Perspective: The Advent of Empiricism and the Idea of Evolution

In the last two classes, we have seen that, at the dawn of human civilization, the way of thinking was materialistic, primitive materialism as it is called. And after the advent of agriculture, the advent of slavery—that means class division—after various changes that happened in society, ultimately resulting in a stable form of slave owning society, only then idealism was born.

And so, in the Greek society, in the Indian society, in Chinese society and many others of the contemporary period, there was materialism as well as idealism. In India for example, the Materialistic school was represented by say Lokayata philosophy; the early form of Sankhya philosophy was also materialistic.

The Lokayata philosophy, the Sankhya philosophy—those were the representatives of the materialist school, while there were also the idealist school in India. Similarly the Pythagorean school, the Platonic school was essentially idealistic, while other people were carrying forward the torch of materialism.

But towards the end of the Greek period, slowly idealism was on its ascent and following the Greek period, the Roman period and the Dark Age, the medieval period in that time, materialism practically died out and idealism became mainstream, became the main plank of thought process in society. Again following that, there was the Renaissance and through the Renaissance, materialism was making a comeback and only after Newton, it made a forceful comeback.

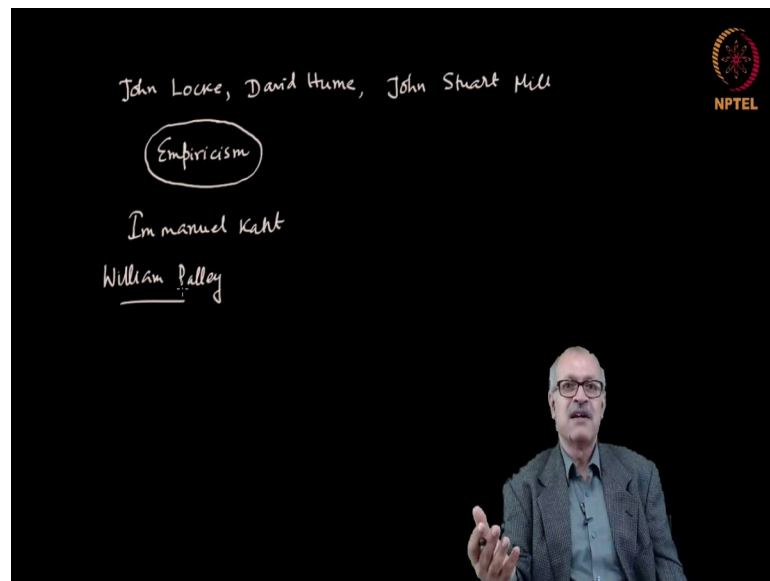
But we have seen that its second birth was with a defect: that it was a mechanical kind of materialistic thinking called mechanical materialism. That is what we have seen in last class.

We had ended when the industrial revolution started. In that period, as I have shown in the last class, various earlier unscientific beliefs, belief systems that had impact on

science, those were slowly being dispelled from the society by experimental investigation and tests.

The caloric theory, the phlogiston theory, the vital force theory and all those unfounded ideas were being eliminated through experimental work. And that success of experimental science was, in the next stage, theorized by a few philosophers. Foremost among them were John Locke, David Hume, and John Stuart Mill.

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Locke's position was that, after all, our knowledge, which can be dependable, comes for our experience. So, experience is the only source of dependable knowledge. He made the point that knowledge is not formed *a priori*, before experiencing something. Knowledge can form only *a posteriori*, only after experiencing that.

So, any phenomenon, any piece of matter, if you want to form a knowledge about that, that can be formed only after you experience it. Through your five senses, you come to know about it. Only then you can form some idea about it, form some knowledge about it. So, his point, then, was that, truth must be limited to what we experience or you can logically deduce from what we experience. So, experience should be the starting point.

This line of logic that places experience at the starting point, and any test should be conducted by either experience or observation, which is essentially bringing the natural world to our experience, this line of philosophy is called *empiricism*.

And these people were very dissatisfied with intuition, revelation, and that kind of mental phenomena as royal roads to truth. They said that these are essentially metaphysical speculations, no point in engaging in that, rather focus on experiencing, which means experimenting and observation, and that is the only reliable knowledge.

David Hume said that whatever so far people have believed, be sceptical to that, do not believe all those things blindly. Test. Of course Galileo said that, but Hume said emphatically that you have to test all that, and the test should come from our experience. So, all knowledge comes from some kind of sense experience.

John Stuart Mill even made the point that, the things that we often feel that these are not really experiential, for example mathematics, for example, logic—these are abstract and in that sense many people feel that they do not really stem from experience—but Mill made the point that, even that has the starting point in some form of experience. The numbers are something that we experience: we experience the number of cows, the number of sheep, bananas, apples. So, from that the numbers come, and the our logical faculty allows us to abstract that to various things.

But the starting point were things that we experience. Geometry also starts from what we experience and then our mind abstracts it. We might not have encountered a perfect triangle, but our mind can abstract it into the geometrical shape of a triangle. But the starting point was that we have seen things that resemble a triangle, resemble a circle.

All human knowledge, therefore, including even mathematics and logic, are derived from generalization from some kind of sense experience, according to them. So, that was the philosophical position of empiricism. And much development happened following the prescription of empiricism.

All these developments were happening mainly in the areas of physics, chemistry, and mathematics, but very little was actually achieved in this period in biology. The reason was that, in that period materialism and idealism were both existing in society, fighting for intellectual space. But the last bastion of idealism was in biology, because it was believed, following religious beliefs, that the biological world was created at one shot by the great creator. And therefore, all the biological world is fixed.

It is not that people did not study. They did, they observed the biological world, they observed the organisms, the animals and plants, but with a view to understanding the mind of God. They tried to understand why did god create this animal, that animal, that organism. And through that, a line of knowledge developed that is called *natural theology*, where people were studying biological world, but with a view to understanding the mind of God.

For example, John Ray, he was the first to classify the plant kingdom; but his paper was titled “The wisdom of God manifested in the work of creation”. So, he was studying the plant kingdom, but the whole thing he was seeing as ‘why was this plant created’, ‘what was the final cause of creation of this plant’ and things like that.

Even Linnaeus thought like that. Linnaeus was the person who actually categorized the whole of the biological world into various stages like kingdom, phylum, class, order, family, genus, species. This kind of classification of the whole biological world was done by Linnaeus. The way we today name different species, the genus followed by the species, that nomenclature was also introduced by Linnaeus. He did great work. But through that, he was actually seeking to understand why did God create these organisms. And he did not believe in evolution, even though the classification that he created contained hundreds of clues as to the fact of evolution.

But at that time evidence was accumulating, because people were working on mines and as they worked on mines, they were finding fossils. Larger and larger number of fossils were being found, fossils of organisms found at odd places like at the top of a mountain finding the fossil of a fish, which is very unlikely to happen. The believers said that these are unsuccessful creations of God. But evidence was accumulating, and people were still trying to accommodate that evidence with their existing belief.

For example, there was a biologist called Cuvier in France. He was the person who did comparative anatomy of different kinds of species, for example, elephants. There is the African elephant, the Indian elephant, the mammoths and the kind of elephant-like creatures found in the American subcontinent called mastodons. He did a comparative anatomy of all those. These were work of great importance as was revealed later. But he did not believe in evolution. Rather he believed in, not one creation event, but repeated creation events; every time there is creation and after some time the whole creation is

washed away by the Biblical flood and then again there is creation, again it is washed away by floods and what we are finding today in the fossils are essentially those organism that lived during those epochs.

So, you see in biology, people were somehow trying to cling onto their old belief and refusing to accept the fact of evolution. But some philosophers, most importantly Kant, Immanuel Kant—a German philosopher, he stressed that everything is undergoing changes, everything, in his language, is in a flux.

If everything is undergoing changes, then, if I want to address the question ‘how did the solar system come into being?’ then also we will have to imagine some kind of a evolutionary process that ultimately led to the shape of the solar system that we see today. He proposed such a theory of evolution.

He saw the starting point in the evolution of the solar system as a nebula, a dispersed mass of gas and dust, which, at some point of time, started to collapse onto itself because of its own gravity. If it has a slight bit of angular momentum, then as it contracted, the angular momentum would be conserved and naturally it will spin faster. As it spins faster, it will take the shape, not of a globule of gas, but like a disk. And according to Kant, the sun was formed at the center of the disk and the planets were formed in the outer side of the disk. So, Kant was essentially making the point that everything is in a state of flux.

So the idea that evolution happens was, so to say, in the air. And then, at the turn of the 19th century, Lamarck first emphatically said that evolution happens. These fossils are essentially signatures that evolution happened. Even though his mechanism of evolution, the mechanism of evolution that he proposed, turned out to be wrong, but still his main contribution is that, he made emphatically the point that evolution happened.

In that situation, again there was a backlash from idealism, a very forceful backlash from idealism in the form of the points made by Reverend William Palley. Let me point out that at the time, fossils were being found, so naturally there was evidence that evolution happens, but people were trying to cling on to their ideas, creationist ideas. But they idea that evolution happens was, so to say, in the air.

And in that situation Lamarck had said that, evolution really happens; though he proposed a mechanism of evolution, which later turned out to be wrong, but nevertheless he had proposed that evolution happens. In that situation William Paley made a forceful attack on the idea of evolution.

His line of logic was as follows. He said, suppose you are walking on a forest path and suppose you see a stone lying on the forest path. It will not raise any question in you. You will not be surprised to see a piece of stone there. Why? Because it is natural to be there.

But suppose you are walking on a forest path and you see a wrist watch lying on the forest floor. Naturally it will raise a question in you: 'How did it come there?' because it is not supposed to be where it is.

So, you would pick it up, examine it and then upon examination you realize that this is a very complex piece of machinery. And upon examining it further, you will realize that it has a design and therefore, it is not likely to be, just like that, lying on the forest floor, because it is a product of a design. And he said that, if there is a design, there must be a designer.

Then he said, look at any organism, any biological organism's body. You will find that it is an enormously complicated piece of machinery. And upon examining it, you will find that it is a product of design.

He specifically gave the example of the eye. Look at the eye: it has a retina, it has a mass of transparent material, it has a lens in front, the lens is such that the focal length can be changed and all that. It has been created, it is a product of a design. And if there is a design, there must be a designer.

So, he said that, the existence of all the biological entities and the fact that their bodies are so complex, they function because they have been deliberately designed to be like that. And if there is a design, there is a designer. So, the whole biological world, according to Paley, was the product of a conscious design.

In the meantime, geologists were also working. Geologists tried to find out how or whether the things that we see on the surface of this planet—the rivers, the mountains, the lakes—have they remain like that all the time?

They found that no, rivers change course; they found that the process of erosion changes mountains, the landscapes. And so, people were starting to realize that the surface of Earth did not look like this all the time, and then people were trying to piece together how long might it have taken for the Earth to take the shape that we see today. And they realized that it is much older than believed so far.

In that situation Darwin, who was also initially influenced by the argument of Palley, undertook his voyage on the ship Beagle. At that time he was just a naturalist. His job as a naturalist was to look at different flora and fauna in the places that the ship visited and to chronicle that, to record that.

But he had read the book by Lyell on geology; in which Lyell had pointed out that the age of the Earth must be much more than what was at that time believed. And then he went to various places and saw with his own eyes evidence of evolution. He came back to England with a lot of samples. Then he slowly developed his idea of natural selection.

And when it was published 1859, it caused a furore, because he was making the point that the whole evolution happens following a material process, the process of natural selection. There is no place for a designer, because nothing is a result of a design. Things happened, more complex structures have evolved in the biological world, because of the fact of natural selection, in natural process, a material process.

So, that created a furore, some scientists stood in favor of Darwin, some people where in the opposite side. There were debates. And finally, as we understand today, Darwin's theory won the day. That was the starting point of biology proper. An eminent biologist Dobzhansky has commented that “nothing in biology makes sense, except in the light of evolution”.

So long as evolution theory was not there, biology could not really take off. But following the emergence of evolution theory, biology took off. And after that it has been very fast growth of knowledge in biology.