Research Methodology
Prof. Soumitro Banerjee
Department of Physical Sciences
Indian Institute of Science Education and Research, Kolkata

Lecture - 21
Historical Perspective: The Rise and Fall of Positivism Part 01

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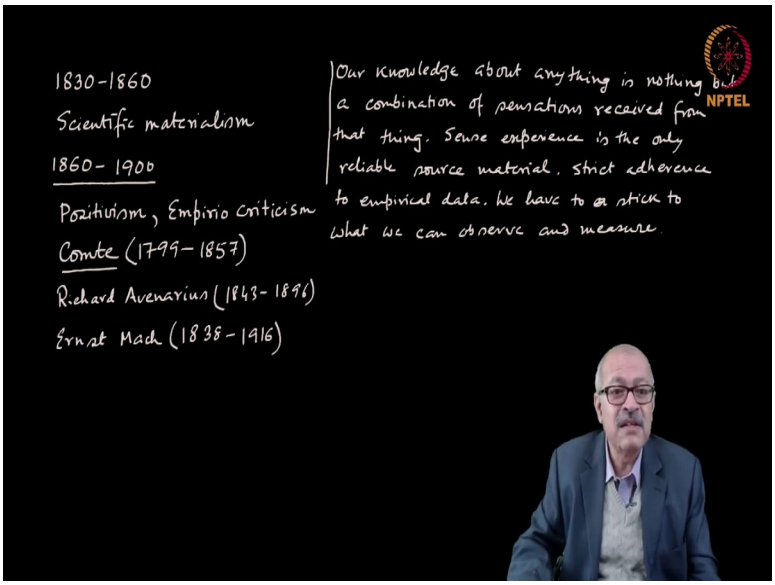

We have seen that, over the period from 1830 to 1860, a lot of developments happened in sciences. For example, the cell theory was developed, the theory of evolution was developed, the theory of thermodynamics was developed, which establish that the forms of energy are interconvertible.

But the second law said that, if you are trying to convert energy from a low quality energy to high quality energy—low quality means dispersed form of an energy like heat, to high quality energy like, say, the motion of a shaft or the motion of electricity through a wire—then you cannot do that with 100 percent efficiency. All these developments happened. Electromagnetism also developed at that time.

So, through that, we came to the understanding that things in the world, matter, is not something given, with fixed properties. Things are continuously undergoing changes, evolving. Coming into being, evolving, and going out of being. Therefore, the earlier mode of thinking, which attributed certain fixed properties to things, and tried to study

things *as they are*, that mode of thinking was proving to be insufficient to face the challenges of that particular time.

So, in that view, a new form of materialism developed, which is called scientific materialism. Scientific materialism said that we should not focus on studying things, rather we should focus on studying processes. The world is, therefore, a complex of processes in which things are coming into being and going out of being and evolving.

Therefore, the emphasis shifted to the study of the processes. In studying the processes people realized that, whenever we are talking about change, for example, the biological evolution, in that case there are both quantitative small changes and also qualitative large-scale fundamental changes. For example, speciation event is such a qualitative change. Transformation from one form of energy to another is a qualitative change.

The change of the form of matter, a state of matter, for example, from water (liquid state) to vapor (gaseous state) is a change of state, which is a qualitative change, so on and so forth. It was found that there are different types of changes, quantitative as well as qualitative.

And in studying the changes, people realized that in anything there are two opposing tendencies and in order to understand the reason for the change, the causal connection, you have to understand those opposing tendencies. If something is stable for some time, more or less static, then the fact that it is stable needs to be understood by the balance of the two opposing tendencies. So, you can write an equation.

When the balance is disturbed and you have a change, evolution, then that has to be studied, if it is a physical system, in terms of a differential equation. And in the right hand side still you have the balance of forces. So, studying the two opposing tendencies, the contradiction between the two opposing tendencies became the center point of study in the sciences. ***

Through that, science was progressing. But in the period, now we are talking about a period around 1860 to about 1900, if we consider that period, then we will find that there was scientific materialism that was providing the basis of scientific investigations. But at the same time another tendency developed, another philosophical current developed, which is called positivism.

The early onset of positivism happened as a continuation of the earlier empiricist tendency. If you recall, the empiricists said that our knowledge can only stem from our experience. Our experience is the basis, and therefore, the foundation of all knowledge should be experience, empirical knowledge.

And in this period when there was a beginning of the idea of positivism, it came from somebody called Comte. He was a French social scientist. His time was 1799 to 1857. Comte was making the point that, in the social sciences, so far we have mostly focused on what we think should be, ought to be, that kind rather than what actually is. Therefore, he suggested that, in order to study society, social sciences, we have to base ourselves on hard data on actual observation of the social phenomena. So, his point was that, we have to base ourselves on what we know to be positive knowledge.

From that 'positive knowledge' this idea of positivism came. His idea, definitely, for that time, was a progressive idea, because that helped us to free our studies in social sciences from various unscientific and subjective notions. 'I believe it should be so', 'I believe that should be so' – that kind of notions. It helped us free ourselves from that.

But in the following period in the physical sciences, the same idea was adopted and further developed into full fledged positivism, which is also called empirio-criticism. This was developed by Richard Avenarius (his time was 1843 to 1896) and most importantly, Ernst Mach.

Avenarius was the Swiss scientist and Mach (1838 to 1916) was Austrian. You may have heard various contributions of Mach, Mach number, Mach principle and things like that. He was basically a working in classical mechanics. He made many contributions in physics, but at the same time he was very active in propagating this positivist philosophy.

What did they see? Their point mainly was that, our knowledge about anything should be based on our experience. That was the empericist position. But the point of the empirio criticists or positivists was that knowledge cannot transcend the boundaries of our experience. Our knowledge about anything is what we experience about that thing.

Our knowledge about anything is limited to our experience about that thing. An experience means whatever we get by way of sensation. Sensation means we have 5

sense organs and we sense things through those 5 sense organs. Therefore, if we are trying to study anything, whatever we get through our five sense organs that is the basis of our knowledge, and knowledge can never transcend the limits of that kind of observation. So, our knowledge about anything is nothing but combination of sensations, sensations received from that thing.

So, if you are studying something, say, studying the properties of a particular thing, then whatever you are getting as a combination of sensations from that object, that is the source of our knowledge. Therefore, they said that sense experience is the only reliable source material. On the face of it, that is scientific, because that is what your positive knowledge about that thing comprises. And they stressed on the importance of that. They stressed on the strict adherence to empirical data. That means, whatever is not observable are not real.

That is what their main point was: we have to stick to what we can observe and measure. We have to do what we can observe and measure. As a result, they made the point that what is not observable are not real. Their point was that, unless you stick to this diktat, you might commit the error of going into unfounded imagination, and therefore, you might be led into a wrong way of doing science.

So, their main point was, what is not observable is not real. Since they stuck to the point of observability, therefore, their point was that whatever we can observe we should limit to that. Our task in science is essentially to chronicle, to record, whatever is observed, and then relate these observations. Limit your knowledge to whatever we can observe. Do not go beyond whatever you can observe, because that is where metaphysical abstraction will come, and it is not going to lead to proper science. That was their point.

And in fact, if somebody asks you: “do you believe in ghosts?”, one can easily say, has any ghost ever been observed? Has anybody experienced a ghost? Has any ghost given rise to a sensation to our 5 organs? No. If not, do not believe in ghosts. So, that was the kind of logic. For many unfounded beliefs this is the way to abandon the unfounded beliefs, because these are the things that we observe.

And as a result, because of the positivist philosophy, various unfounded ideas at that time were being tested, and being, in many cases, abandoned, new ideas coming. All this

happened, because they stressed on empirical data. Evidence must come in form of empirical data.

But there was a problem. The problem came from the position. Let me summarize first. Your sensations from a particular thing comes to our 5 senses. That need not be confined to raw sensation by using the 5 senses; the ability of the 5 senses can be enhanced by the use of a microscope or a telescope, so that we can observe the minute microorganisms or distance galaxies. All that is fine, but ultimately it has come to your senses and only then you believe that is there. And what is our idea about that particular thing? That is limited to whatever we are getting as the sense perception.

Therefore, they did not even believe in the existence of a piece of matter independent of our sense perception from that matter. They said that, ultimately what is coming to us, are the sense perceptions: we are touching, we are feeling, we are seeing, and through that we are making some idea about that particular thing. Therefore, what ultimately is true for us? What is positive knowledge? The sense perceptions. And we really do not have any positive knowledge about the thing itself.

And therefore, they did not believe that matter exists independent of our consciousness. For them, matter is what comes to us through our sense perceptions. What consist of our sense perceptions in science? Arthur Eddington, another famous physicist, he said that it ultimately boils down to the pointer readings. We are physicists and what do we really measure, what we really observe, are the pointer readings.

So, what we can really record is that the pointer moved from this point to this point, and that is what we can ultimately record. We cannot really talk about what is the physical thing, which is giving rise to that movement of the pointer, because that is what we do not observe directly. What you observe is that the pointer moved from this point to this point.

This philosophical viewpoint, positivism, actually held sway among scientists for a long time. For about 50 years, it was the main plank of philosophy.

The major problem happened in the area of statistical mechanics. In order to explain what problem it caused, let us start from a little back, from the time of John Dalton, around the first decade of the 19th century, probably it was around 1810 or so.

What John Dalton proposed, it was not a fundamentally new proposal because the ancients like Leucippus, Democritus, an in our country Kanada, also conjectured a similar thing: that if you keep on breaking a piece of matter, ultimately you will get further unbreakable indivisible particles and they called it ‘atoms’.

Additionally Dalton said that, there are only a few species of atoms, and whenever some chemical reaction happens, basically the atoms are handholding with each other, reacting with each other, and that helped chemists to understand the ratios in which various substances take part in chemical reactions.

And so, chemists started using Dalton’s idea, Dalton’s Atomic Theory. But physicists said that, have you ever seen an atom? Have you ever seen a molecule for that matter? And if you have not, then actually there is no reason to believe that they exist. It is only a part of our imagination. It might help chemists to imagine things. But that is not real. It is imaginary. What is not observed is not real.

Therefore, the physicist community, in totality, refused to believe in the existence of atoms and molecules. But at the same time, these two currents, the current of positivism and the current of scientific materialism were going side by side, and there were some scientists who believed in that. There were some scientists who believed in the existence of molecules and they started building theories on the basis of that.

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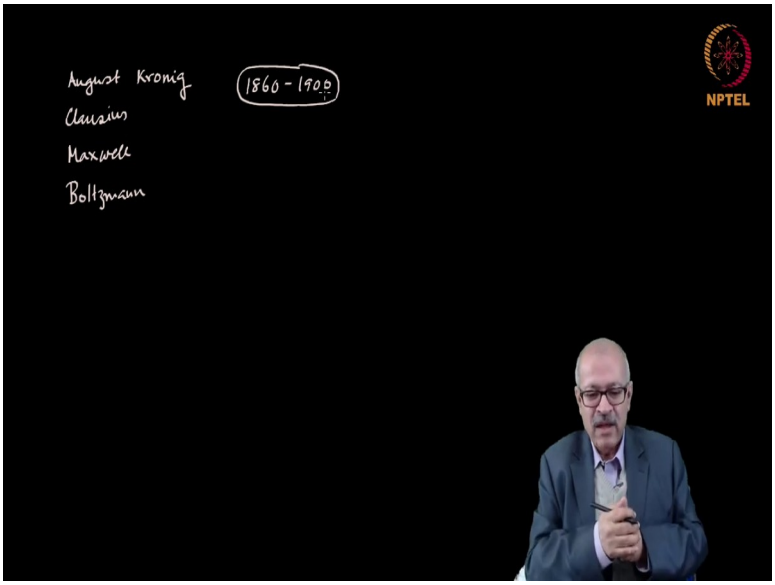

Among them, I will take the name of August Kronig, who first tried to imagine that, when we talk about air or a gaseous substance, it is basically comprising a huge number of molecules jostling around. And then he tried to develop a theory of pressure and other gross properties based on the velocity distribution or the energy of each particle.

He had pictured each particle as having only linear kinetic energy. After Clausius read his paper, he further developed it assuming rotational motion and other kinds of motion of those molecules. And when Maxwell read Clausius's paper, he developed it further and developed what is the famous Maxwell distribution of molecular velocities. Again Boltzmann developed that idea further, and developed what is now known as the Maxwell-Boltzmann distribution of molecular velocities.

Notice that all these people were basing their theories on the assumption that molecules exist. But the physicists were telling that molecules do not exist, because you have never seen a molecule. And therefore, there was a contradiction between these two groups and even though Clausius's theory on Thermodynamics, Maxwell's theory on Electromagnetism were accepted, but when they are talking in terms of statistical mechanics, these were not accepted. Boltzmann was in particularly targeted, criticized. His papers were not accepted in journals, he was not allowed to speak in conferences. So, it was a very bad situation especially for Boltzmann, because Boltzmann was focusing on developing statistical mechanics.

Clausius had other planks for him. Maxwell had developed other theories for which he was well known. But Boltzmann’s focus was on statistical mechanics and he did enormous contribution in statistical mechanics, but none of them were accepted. The physicists said that you are basing your assumption on something that actually does not exist. It is only a figment of imagination.

Boltzmann was so crestfallen, so dejected by the refusal of the physicist community to accept the work of his lifetime, that in the end he committed suicide. So, that was the situation when we come to the turn of the century.

Between 1860 and 1900, a lot of developments happened. For example, earlier there was a belief in something called ether, and Michelson and Morely did an experiment that disproved the idea of existence of ether. Earlier it was believed that whenever there is an infectious disease, it happens because of something called miasma, a noxious form of

bad air that emanates from rotting matter. Louis Pasteur, through his experiments, showed that idea is not correct. In fact, what is responsible are germs and thus he developed the germ theory of diseases.

All these were happening because of experimental work done by various people. In this period the experimental work on photo-electricity was done. In the area of engineering, the whole of electrical engineering: the DC and AC power supply system, generation, power distribution, lighting, all that was developed. Internal combustion engines were developed. So, a lot of developments were happening.

But you will find that most were of the type of some dispelling earlier beliefs, or some experimental work. But important theoretical works of the standard of what Maxwell did for electromagnetism, what Clausius did for thermodynamics, for what Darwin did in biology, that kind of theoretical development practically did not happen in his period.

And historians are rather surprised to see that, this period is somewhat barren of major theoretical developments. Later we understood that was because the dominance of positivism. Because their point was essentially that ‘limit yourself to what you can observe, experiment, and limit yourself to what you can see, and do not develop it any further beyond what you can observe’.