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Science, Technology and Society

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What we have discussed till now if we look at briefly that we started with the ontological questions concerning the ways in which technology, science and society have been conceived off. The way the two important forces of production namely science and technology have been conceptualized. The relation between technology and science and there we have already discussed how technology is prior to modern science, I mean technology always predates modern science okay.

And then we have discussed the relationship between technology and science on the one hand and society on the other hand. And we have used three models of HTS, three perspectives on HTS, the linear or hierarchical model, the inter actionist model, and the embedded model. On the one hand the linear model and the inter actionist model treat science, technology and society as distinct entities, treat science, technology and society as separate entities.

Whereas, the embedded model suggest that no science and technology are autonomous activities, are not isolated phenomena, are not independent activities rather both science and technology are very much a part of our social pharmacy. Then very much a part of our economical during policy, this is very, and from there on, I mean staying with the ontological questions, what we have discussed, how the idea of technological determination evolved.

And how, and in what ways we see some arguments against technological determination. And how technology is not neutral, anyway we will discuss these in the following lectures sometime later in the week. But what we found that the neutrality of technology is contingent of the way a specific technology is designed and controlled. And whether a technology is neutral or not, we

provided certain examples from the construction of the New York bridge from the design of the public roads in India, that technology is not neutral okay.

Whenever we talk about technology we must talk about technology, visa we the nature of the state and the kind of public policies that the state is going to have okay, this is very important. In this kind of circumstance, from these ontological questions we moved to the normative questions. Because, the reality suggests that these changes, these changes in the relationship between science, technology and society okay, have significant implications on agriculture, on health, on environment, on social security measures and so on.

And in this context we thought okay, now from these ontological, from the questions concerning reality okay, what it ought to be, what kind of HTS we want to, I mean what should be the form of HTS, what ought to be the practices of HTS. And from there onwards we had started a detailed discussion on mertonian institutional imperatives in the form of mertonian ethos of science, ethos of modern science.

Any ethos of modern science when I say effectively do not have complex of values and norms which is held to be binding on the man of science. And these norms are expressed in terms of prescriptions, proscriptions, preferences and permissions, we have already discussed this. Merton also dual it up in the bowl of science as the extension of certified knowledge, and the imperatives of science which are derived from the goal and the methods.

And then he moved to flank, four institutional imperatives, four ethos of modern science in the form of universalism, communalism, disinterestedness, and organized skepticism. If you look at this then what we find that universalism, communalism and disinterestedness they come under the rubric of the goal of science. Whereas organized skepticism comes under the methodological rezone.

And from this if the reality suggests something, and the normative questions, the normative structure of science suggest something, then what should be the methods of science. And the methods that we have tried to deal yet okay, within methods of science we have discussed inductivism, hypothesim okay, I mean positivism then the methodology provided by Karl popper. In the later we follow, what we are going to discuss, we are going to discuss the methodology profounded by Thomas Kuhn and Paul Feyerabend.

It does not imply that the methods of science, I mean the debate concerning the methods of science NC, that it did not tell you, the debate is still one okay. And the question, the method, what is the method of science is as old as science itself okay. The question which was addressed, I mean the question what is the method of science was addressed by Aristotle, Aristotle tried to provide the satisfactory answer to this question okay.

And I mean if you look at the history of science, I mean for three centuries from 17th to 20th centuries okay, two methodologies became standard for formers to the question which was posed, I mean the question what is the method of science. And then those two rival methodologies, those two rival responses to these questions what is the method of science consist of inductivism and hypothesim.

And as we have already discussed how inductivism is rooted in empiricism, empiricism is rooted in experience, whatever we cannot observe okay, cannot be considered knowledge in the inductivist scheme okay, knowledge is generated only through observations okay, which Bacon profound it okay, Francis Bacon, the father of empiricism inductivisim. On the other hand what we saw during these three centuries, I mean hypothesim which was profounded by Raleigh Bacon, Bacon is also known as the father of resoanlige.

Hypothesim is grounded in the principles of resonance in philosophy of resonance, resonaligion is based on reason according to which knowledge is generated only when we go beyond observation. Whereas, inductivist argue that knowledge starts with, I mean science starts with observation, begins with observation remains at the level of the observation and ends with observations hypothesis argue that no science starts only when we go beyond observations that is why that is how science trans observational in nature okay.

Whereas inductive loped up on certainty and breath as the hallmarks of scientific knowledge hypothesis lopped up on normality and depth as the hall marks of scientific knowledge okay we have already discussed I am just trying to recapitulate whatever as been discussed then the question emerged that how to mediate the two inductive region manners and the 2oth century saw the emergences of positivism as the most or one of the most dominant schools of philosophy of science.

If you look at the analysis of history of science then you will find the way they try to develop their perspectives on the development of society okay namely the theological stage the metaphysical stage the positivistic of scientific stage and positivism stood squarely against the schools of theology as well as metaphysics as we have already discussed theological stage was more concerned with the changes which occurred due super natural forces.

Whereas metaphysical stage attributes or metaphysical stage attributed changes mediated by natural forces and positive is suggested that no or positivist or the proponents of positivism or scientific stage suggested no changes occur not because of super natural forces or only natural forces but because of the human accent.

That is why positivism emerged in the context of the emergence of enlightenment industrial revaluation okay critical thinking rationality I mean rationalist philosophy of science maternity and so, if you look at this positivism also tried to question the dominants of church okay which both theological stage and metaphysical stage would not I mean they where they believed in the dominance of religion especially the dominos of church in Europe and positivism was the first stage in the analysis of the methods of science which try to question the dominance of religion okay.

That is why positivism provided several tenets and positivism perhaps was the fast organized method of science which try to look at science as a paradise of knowledge okay separated from or distingue from other areas of human activity or creativity okay that is why the fast tenet if you slightly recall the fast tenet suggest that the method of science I mean that science is disgusting from all areas of human activity or creativity because it purposes a method okay we have discussed many tenets that there is only one method comment to all sciences irrespective of that subject matter that is mythological monogyny that the method of science is the method of induction that method inductivism that the hallmark of scientific knowledge consists in a fact that all scientific statements must be systematically very viable systematic verifiability that there must be dichotomy between fact and value.

Facts do not have value facts are value neural where as values do not facts of contained there must be a unilateral relationship between observation and theory then we came into a citric of positivism that no observation is presupposition less no observation is theory independent as positivist circuit observations always theory lateral because the way we discussed I mean

observation does not provide with a language or EDM for expressing where as theory provides us with a language or EDM for expressing okay.

In the context of observation weather observations presuppose theory or not we discuss then if no observation is presupposition less if science does not start with observation as in depth as well as positives circuit such systematic rejection or systematic critic of positivistic control of science was brought about by Kuhn and there we have already discussed how popper started with posting these question what is the central question of philosophy that is the problem of cosmology what is the problem of cosmology.

That the problem of understanding the world including ourselves is part of the world if we get ours if we get isolated from the world then we get cannot examine we cannot understand doubt to understand the world we must be a part of the world we must involve ourselves with the real world phenomena then popper argued I mean popper immediately try to dealing it the method of science by making a reference to the context of justification.

And irr refuge to taught anything about a the context of discovery because for in for popper context of the I mean it is impossible it is not possible to provide the rational account of context of discovery okay and you only sided with the context or justification while providing, but popper science must science cannot start with observation as inductivists or positivists circuit or science also cannot start with the hypothesis as hypothesis circuit, for popper science must start with the problem, if there is no problem then what kind of observation that you are going to make.

Because whatever observations that you make it our observations must involved some element of selection some amount of selection, and that selection is very important why do we make how is knowledge generated in the domain of science, for popper precisely because if my observation and my expectation coincide then we are not going to get that science if our observation and expectation that do not coincide if our object if my expectation deviates from the kind of the kind of observation that I am making okay.

Then the real scope of knowledge is spread as in this context popper is popper's view is extremely important to note that science must start with the problem with the research question science must be able to identify a problem, from that problem we must try to formulate the

hypothesis which is a tentative solution to a problem or hunch from the formulation of hypothesis the way hypothesis is to circuit that it must be tested right or wrong and if a hypothesis is tested wrong then it must be rejected if hypothesis is tested right.

Then it must be accept it but for popper this hypothesis mean know be tested right or wrong but a hypothesis must be falsified to I am just giving you one more clue that as we have already discussed that you see a hypothesis need not be proved or disproved, if one is divert in improving or disproving these are our hypothesis then it hinders the tradition of cumulative knowledge means, one must remember this then hypothesis is must be tested right or wrong, in the hypothesis schema.

For popper it must be falsified it, it must move through the process of systematic falsification if it must go through if the hypothesis must go through the process of systematic falsification, then it may run the danger of a I mean it may be again falsified I mean it may be tested again right or wrong but if it is tested wrong then it runs the danger of reputesism okay, it must be subject to refutes we must refute that we must reject that hypothesis, on the other hand if our hypothesis is tested right.

Hypothesis could have argued that let accept the our hypothesis for popper no let us not accept our hypothesis, rather let us corroborate our hypothesis let us keep our hypothesis permanently tentative by doing that popper meant that under certain limiting conditions we are trying to corroborate or we are trying to keep our hypothesis permantently tentative because we haven it be able to explore or I mean we have not it, be able to explore all conditions as well as we haven it be able to test our hypothesis.

Under all other conditions okay that is why there is the question of universality okay was interrogated by popper that is why the question approach was interrogated by actual you truth that is why we used the term very similar to I mean very close to the truth or truth likeness or truth nearness okay that is why what is that very similar know that the distinction between an existing theory.

And a better theory and for Popper a better theory has the characteristics of, has the tenets of very similitude and it is a closer to the truth, but it is not the truth in itself okay, and such characterization such delamination of Popper methodology okay, well also questioned by many,

many, many authors in fact Popper head as many critics as many number of critics you will see and you will also find similarly he had many, many admires okay.

If Popper's method of systematic funkification provide us, provided us with a paradigm in the method of science in the second half of the 20th century then one of is perhaps the greatest arrivals which emerged who emerged in the form of the structure of scientific revolutions namely Thomas Samuel Kuhn and these two both Popper and Kuhn they perhaps if you look at the works of Steve fouler, if you look at the Eden Berger School I mean latitude, burtheu and so on okay, you will find that the controversies I mean the debates aroused in the context of the methods of science by both Popper and Kuhn is interesting I mean are interesting lot.

Precisely because they provide it two different methods which cannot refuted on their own at least today, both of them are no more but we still celebrate their works as quite novel works perhaps quite original works in their own act okay, haven do not happen Popper methodology and the kind of critical remarks that we made in through the works of in our hands in, in the last lecture let us briefly look at the views of Thomas Samuel Kuhn if you look at this okay.

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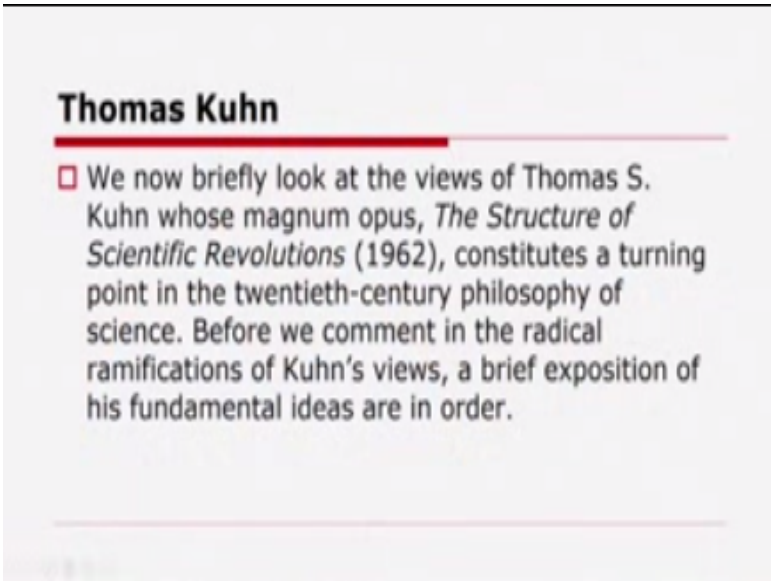

Kuhn I mean he is magnum opus work I mean the structure of scientific revolution in 1962 okay, constitutes a turning point in the 20th century philosophy of science. Before we comment on the radical ramifications of Kuhn's views a brief exposition of his fundamental ideas must be put in place, it is important to know under what circumstances Kuhn was writing, what kind of

transition that science always make or has already made okay, must be understood critically okay, and Kuhn provides with that kind of paradigm for Kuhn according to Kuhn okay.

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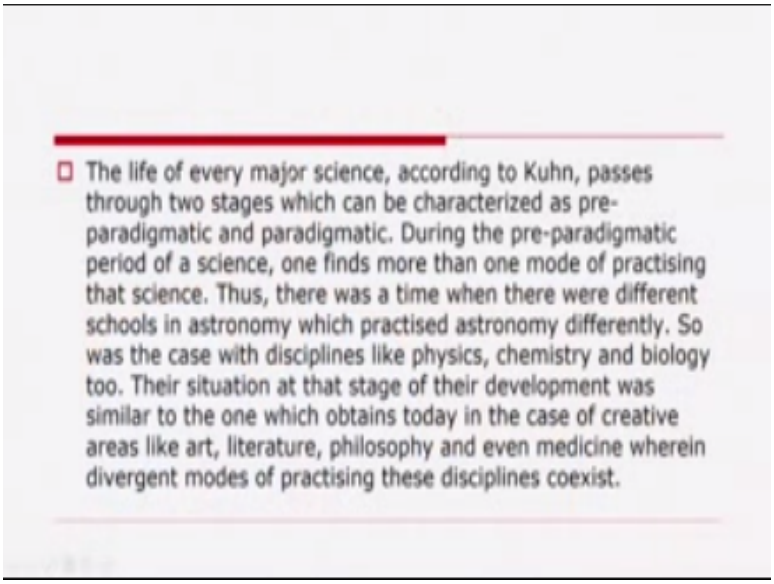

The life of every major science passes through two states, two successive stages which may be characterized as pre-paradigmatic stage as well as paradigmatic. During the pre-paradigmatic period of a science one finds more than one mode of practicing that particular science. Thus, there was a time when there were different schools in astronomy which practiced astronomy differently. So was the case with disciplines line physics, chemistry and biology too. Their situation at that stage of their development was similar to the one which obtains today in the case of creative areas like art, literature, philosophy, history even sociology and even medicine okay, where in different divergent modes of practicing these disciplines coexist, why it is so.

Earlier there was, there were various schools of astronomy there were various schools of physics, there were various schools of chemistry, there were various schools of biology but today if you look at this they are trying to build a congeners within this discipline okay, for Kuhn okay, which

creative areas like art, literature, philosophy and even medicine okay, they are not able to create that kind of conversers. Precisely because of the kind of because of the nature of the problems that we are endow with.

Then that is why what we find today that perhaps in the context of astronomy, physics, chemistry, biology okay, you find some kind of thinking or some kind of a convergent thinking. Whereas in the creative areas like art, literature, philosophy and even medicine. What we generally find that there are divergent modes of practice in this disciplines I mean in medicine you find allopathic you find ayurvedic or ayurveda you may find homeopathy you may find unanai you may find naturopathy okay, there is no one there is no consciences okay but in the case of astronomy there is a consciences I mean that today there is a consciences.

Suppose I will say that earlier knows as we have already discussed in the context of autonomy prior to Copernicus okay you will find that no the sun rotates okay and the earth remains constant that is autonomy version of astronomer autonomy also influenced by the powers that v a rector whereas copper Nikos and subsequently Galileo they try to convince they try to foreground the fact that know the sun remains constant okay rather the earth rotates moves around the sun.

In the context we have come to a point of a convergent thinking in the field of astrology but in the field of medicine today we do not have convergent thinking rather we have divergent thinking in the context of literature in the context of art in the context of music in the context of philosophy in the context of history we will have divergent more sub-practicing okay, that is why whereas even today we speak of schools of art.

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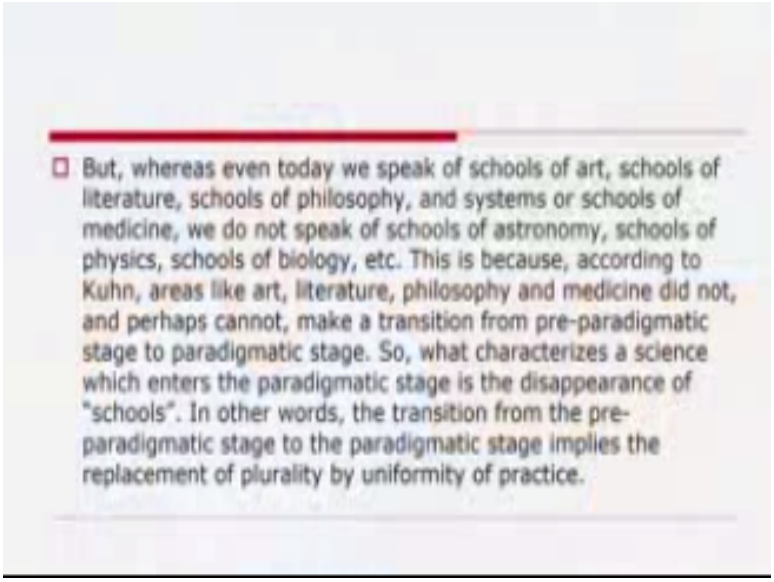

Schools of literature schools of philosophy and systems or schools of medicine we do not speak of schools of astronomy schools of physics schools of biology etc this is because according to Kuhn areas like art literature philosophy and medicine did not and perhaps get not come to a point of convergent thinking cannot make a transition from re-paradigmatic stage to a paradigmatic stage.

Then if I say re pre paraglide if I go ahead with Kuhn version of paradigmatic shifts then I much make a reference to the fact that in the pre paradigmatic stage we found convergent thinking sorry divergent thinking whereas in the paradigmatic stage we find convergent thinking okay that is why according to Kuhn create a various like art music literature philosophy and medicine did not en-perhaps cannot make a transition from pre- paradigmatic stage to paradigmatic stage.

So what characterization science which enters the paradigmatic stage is the disappearance of schools those divergent modes of thinking must disappear okay in the context of a parading okay that is why they try to built a conscience okay what is a conscience will come to this a little violent if what characterizes science which enters the paradigmatic stage is the disappearance of schools okay, in other words the transition from the pre paradigmatic stage to the paradigmatic stage implies the replacement of.

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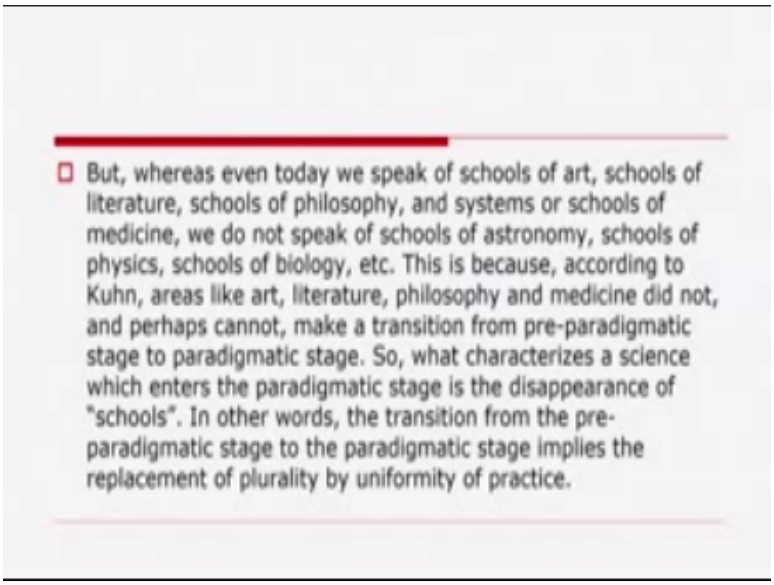

Fluorite by uniformity of practice, now in astronomy, no astronomer would tell you that remain constant and the sun moves around the earth. Now they have to come to a point of converging thinking that no their opinion is uniform now, that transition from pre paradigmatic stage to the paradigmatic stage implies the replacement of plurality by uniformity if practice, diversion thinking okay by the converging thinking okay. So that is why the replacement of plurality by infirmity of practice okay, whereas or when a science reaches.

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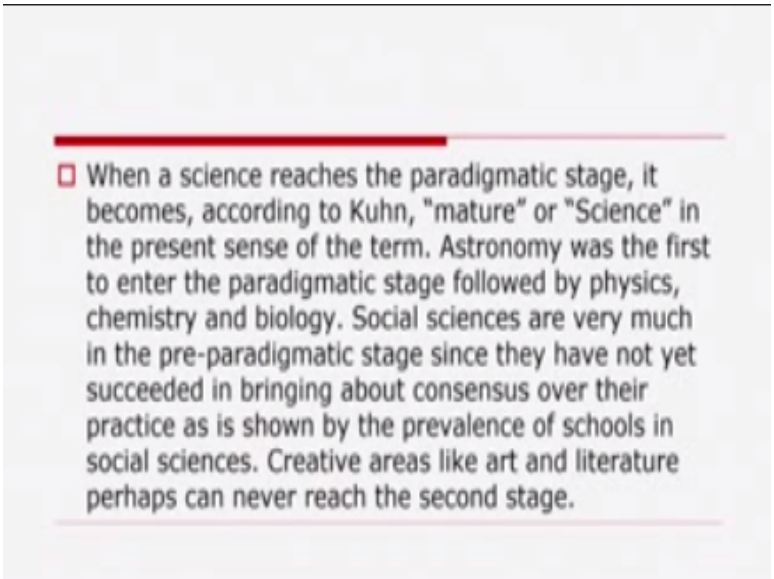

Reaches the paradigmatic stage it becomes according to match you or science in the present sense of the term, it becomes mature okay and if I say that a science would make a transition from pre paradigmatic stage to paradigmatic stage or which discipline was the fast to make a transition from pre paradigmatic stage to paradigmatic stage, now astronomy was fast to enter the paradigmatic stage

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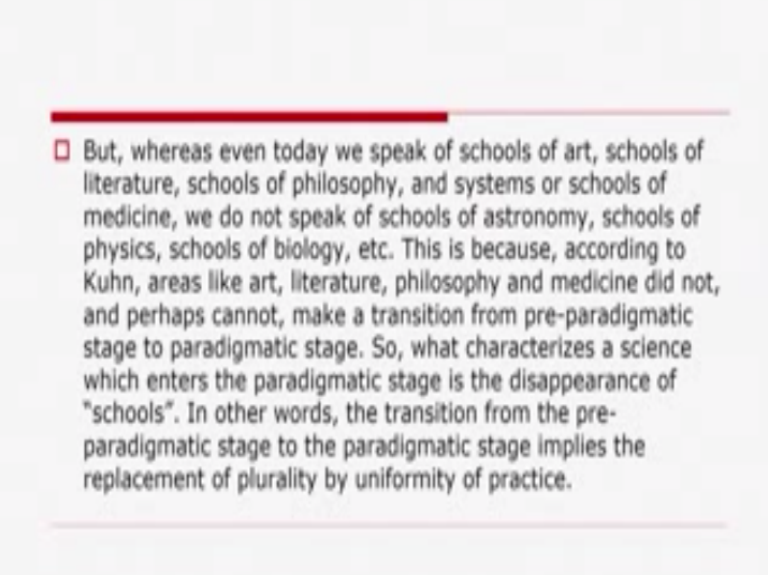

Now astronomy was the fast who enter the paradigmatic stage followed by physics then chemistry and then biology social sciences I mean including sociology which I held from okay I just student of sociology okay I would always say even, even may Kuhn also suggested that social sciences are very much in the pre-paradigmatic stage since they have not yet succeeded bringing about consensus over their practice.

As is shown by the prevalence of schools in social sciences creative areas like art and literature music philosophy and so on perhaps can never reach the second stage precisely because of the nature of the problems that we have conferment with today in social sciences in human manner okay perhaps but that is a different question whether we should have a conserve or not.

You can ethical question or not that is different story altogether okay in today's text okay perhaps divergent thinking in social sciences is prefer okay but that is not there in the Kuhn schema as such will come to this point okay then what kind of mature science that we have talked about is science.

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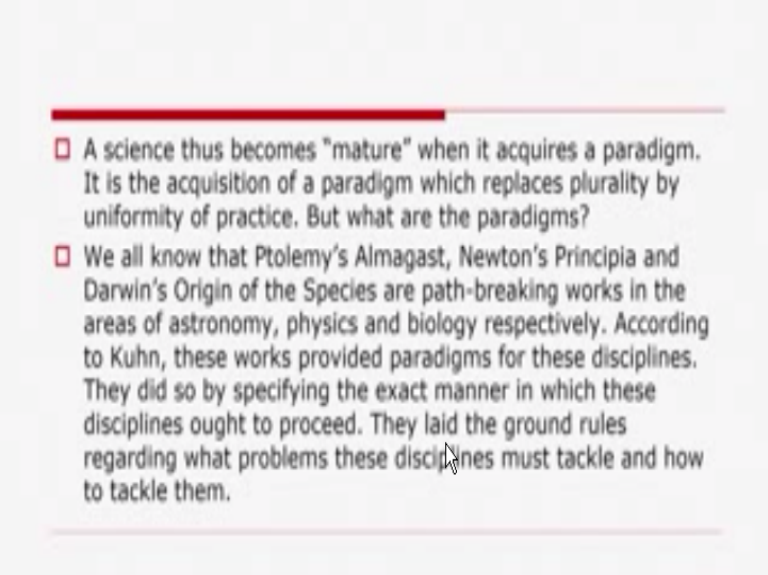

Thus becomes mature when it acquires a paradigm I mean science becomes mature when it makes a transition for pre-paradigmatic stage to the paradigmatic stage it is the acquisition of the paradigm which replaces plurality by uniformity of practice it is the acquisition of the paradigm which replaces divergent thinking by convergent thinking.

Then what are these paradigms all about what do we know or what do we mean by paradigms okay we all suppose if you look at different disciplines suppose we have discussed let a no in Kuhn schema that we have made a we have made a statement that astronomy was the first make a transition from pare-paradigmatic stage to paradigmatic stage followed by physics then chemistry and then biology.

Then what kind of paradigm that have created if you look at this we all know that Ptolemy's Almagast was the paradigm in astronomy later on we say revolution is a paradigm astronomy okay when Ptolemy was reject Newton's principia was the paradigm infusive now we say no it is relativity is a paradigm stage but today perhaps still now we have not yet able to come up with any alternative.

But Darwin in the field of biological sciences still role the rots Darwin the origin of species then we all know that Ptolemy's Almagast initially Newton's principia and Darwin's the origin of species are path-breaking works in the areas of astronomy according to Kuhn these works provided paradigms for these disciplines.

And they did so by specifying the exact manner in which theses disciplines ought to proceed they laid the ground rules oaky laid the foundations regarding what problems these disciplines must tackle and how to tackle them. Then a paradigm a paradigmatic discipline a paradigmatic work must not only rise to attempts to identify problems for the respective disciplines.

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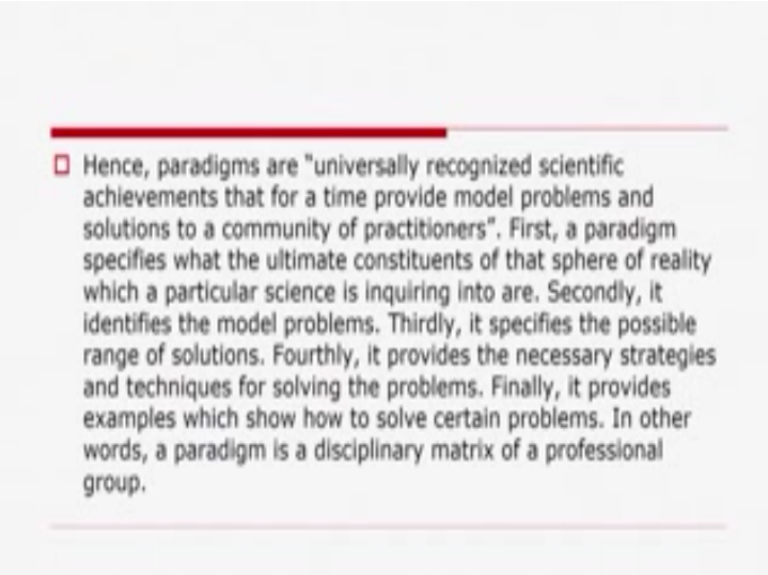

But also must be able to show how to address those problems how to answer those problems okay how to tackle hence then what a paradigms theoretically then for Kuhn let me court Kuhn here paradigm but universally recognized scientific achievements that for a time provide model problems and solutions to those model problems to community of practitioners it not only provides model problems.

But also provides solutions to those model solutions to those model problems for community of practitioners in the case of in this case but though community of scientist okay let me break these statements of who definition of the way he dealing it okay. First a paradigm specifies what the ultimate constituents of that sphere of reality which a particular science is inquiring into are.

Secondly, it identifies the model problems model questions thirdly it specifies the possible range of solutions to those model questions or model problems fourthly, it provides a necessary strategies and techniques to solve those problems I mean methodologies okay finally it provides examples which how to solve those certain problems in other words paradigm is a disciplinary matrix of a professional group.

Then we must start with I mean we must discuss one by one Number 1 a paradigms specifies what the ultimate constitutes of that science of reality which is particular science is inquiring into; I mean the entire subject matter of that science known. The scope and ambit of that particular science must be known through that paradigm. And for a long time Toly fact provided us with that cooper nicus later on provided us. Then neutron also okay, then that particular paradigm perhaps, there is the origin of the species, evolution of species, principle of natural selects okay.

That paradigm tries to identify the model problems, what are the model problems? Suppose if I say let me give you an example that, let say dinosaur, anaconda they are far more powerful compare to human species like us. So if you look at their energy, if you look at their stamina with their killer instinct okay. I mean they could have survived, why they could not survive but human species survived. Gwen provided a satisfactory answer, later on marks provided satisfactory answer and other biologist they also have provided satisfactory answer to such question.

Number 1 is adaptability, a species also may be huge or small okay that is species must be able to adapt to the existing environment, nature number 1. And number 2 is that power to reproduce further, your generation okay. In those two cases okay, the principle of natural selection if you look at this I mean this is how we have survived. Human species have survived okay. These are the model problems that they will provided and the kinds of module solution to those model problem within that specific discipline of biology.

He also provided principles of natural, so let us okay, fourthly a paradigm must provi8de the necessary strategy and techniques for solving those problems. I mean that particular paradigm must be able to provide the necessary methods, methodological must provide, frame work to solve those module problems and finally a paradigm must provide examples, which so how to solve certain problems.

Perhaps Kuhn mentioned that paradigm is the disciplinary matrix of professional context. In this group context professional group I mean the scientific community okay. I mean there is no individual scientist here but the collective.

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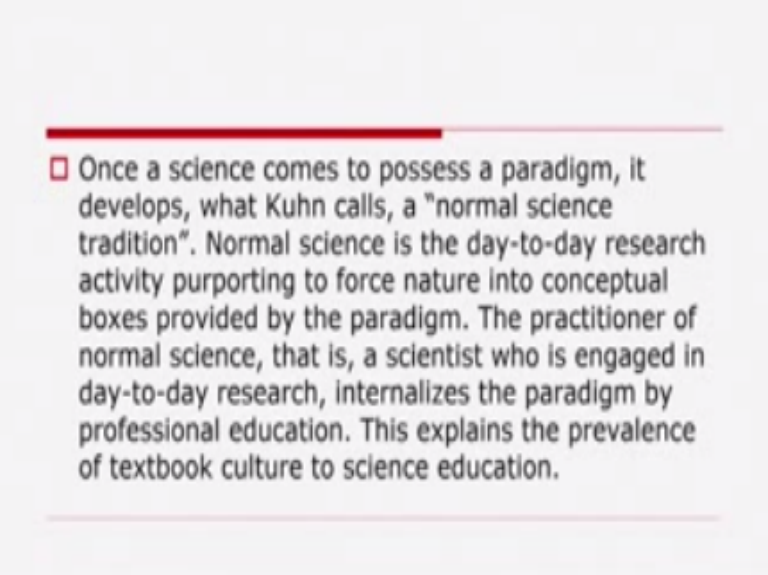

Once a science comes to possess a paradigm it develops what Kuhn calls normal science tradition. Normal science does not means, normal or abnormal science I mean nor bound science, which are bound by rules, regulation, values, nomadic frame work okay. What is that normal science? Normal science is the day to day research activity purporting to force nature into conceptual boxes provided by a particular paradigm. And the practitioners of normal science that is scientist themselves who are engaged in day t o day research internalize the paradigm by professional education.

Such professional, I mean this internalization of the paradigm by professional education explains prevails of text book culture to science education okay. That is norm bound science, value based science, you cannot deviate from the rules and the regulations of the science okay. That is the normal science you cannot deviate from the normal, you cannot go beyond the normal, and you have to operate your practices. You have carried out your experiment within such a rules, regulation, frame works, institutions, structures, organization, and mandates and so on.
From here onwards what we see okay what kind of normal science.

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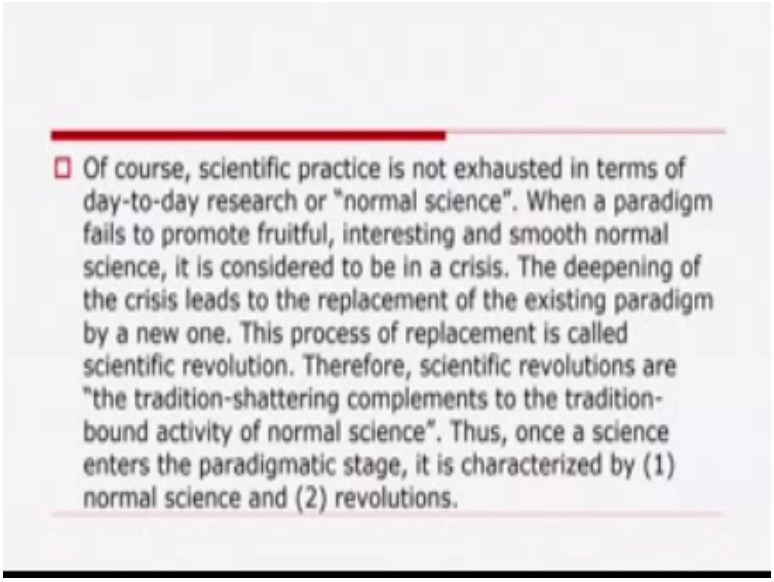

In deed scientific practices are not exhausted in terms day to day research or normal science, when a paradigm fails to promote fruitful and interesting and smooth normal science it is considered to be in a crisis and the deepening of the crisis leads to the replacement of the existing paradigm by a new paradigm if the paradigm is not steady the existing paradigm will become a pre paradigmatic stage for a new paradigm okay.

They are not activity and paradigm means model models are not static models change in the changes in the questions the globes the circumstances conditions and some okay let say when a paradigm fells to promote fruitful interesting and hence move normal science tradition it is considered to be in crises the depending of the crises leads to the replacement of the exiting paradigm by a new paradigm.

And these versus of replacement of the existing paradigm by the new paradigm is called scientific revolutions I mean you may say revolutionary science as against normal science normal science is not bound institutional bound rule bound regulation bound but this content of revolutionary science it goes beyond through science had there been no revolutionary science there would not have been opening had there been no revolutionary science there would not had been any Einstein then had there been no revolutionary science.

Then there would not have been any otherwise everybody used to now everybody thinks I mean I prior to thinking that I mean prior to marks thing that know how have we there was a theoretical explanation gods says have created us such questions that raised I mean such

questions were challenged such propositions were challenged okay by doing it subsequently marks okay.

That is why marks want road in the contest of in the origin of species and the context of principle of natural science okay that's why this process of replacement of the existing paradise by a new paradise is also called scientific revolution or revolutionary science therefore scientific revolutionary if I say.

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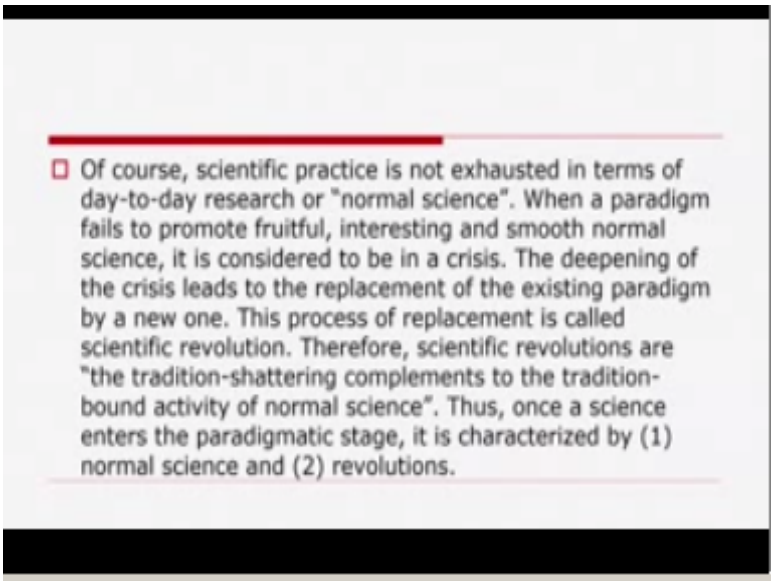

Normal science is which is the perusal activity which is day to day which refers to a day to day research activity okay if normal science is a tradition bound activity then revolutionary science is the tradition is a activity therefore scientific revolution are the tradition complements to the tradition bound activity of the normal science thus once the science inters the paradigmatic stage it is characterized by fast normal science.

And second revolutionary science I repeat if I mean normal size the way it is known as a pulse selling activity the way we know that a normal science is a day to day research activity non bound activity if normal science is refers to a tradition bound activity then revolutionary science

is the traditions activity it does not fall studies and it goes beyond the either go existing traditional normal institutional frameworks structures organized in a mental okay that's our science next progress.

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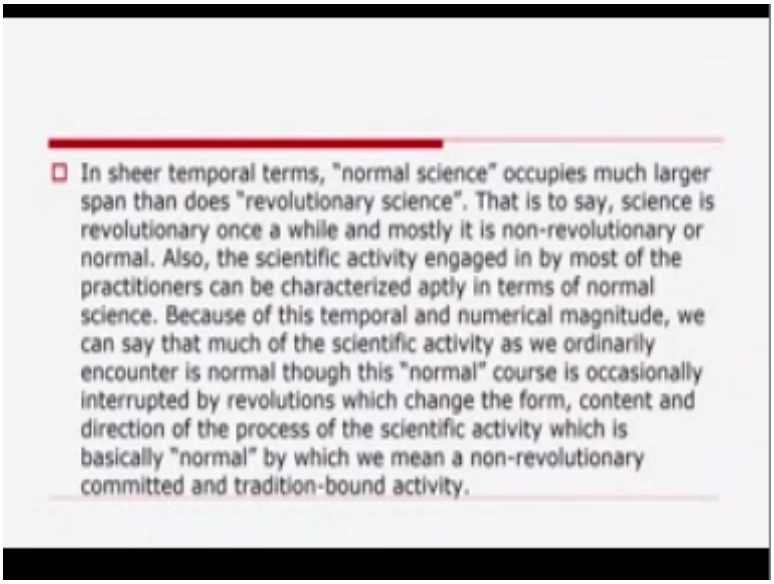

In sheer temporal terms the normal science occupies much larger span than does revolutionary science that is to say science is revolutionary once a while and mostly it is non revolutionary or normal okay also the scientific activity engaged by most of the practitioners can be characterized aptly in terms of normal science because of this temporal and numerical magnitude we can say that much of the scientific activity.

As we ordinarily encounter is normal though this normal course is occasionally interrupted by revolutions which change the form contained and direction of the process of the scientific activity which is basically be normal by which we mean non revolutionary committed and tradition on normal science is always tradition bound activity whereas revolutionary science is always tradition certain case.

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Officer- in- Charge, CET
Dr. Subhajit Choudhury

CET Production Team
Bikash Jyoti Nath
CS Bhaskar Bora
Dibyajyoti Lahkar
Kallal Barua
Kaushik Kr. Sarma
Queen Barman
Rekha Hazarika

CET Administrative staff
Arabinda Dewry
Swapan Debnath