Urbanization and Environment
Prof. Jenia Mukherjee
Department of Humanities and Social Sciences
Indian Institute of Technology, Kharagpur

Module - 01
The Urban and the Environment during the Era of the "Overlapping Cenes"
Lecture - 02
The "Anthropocene"

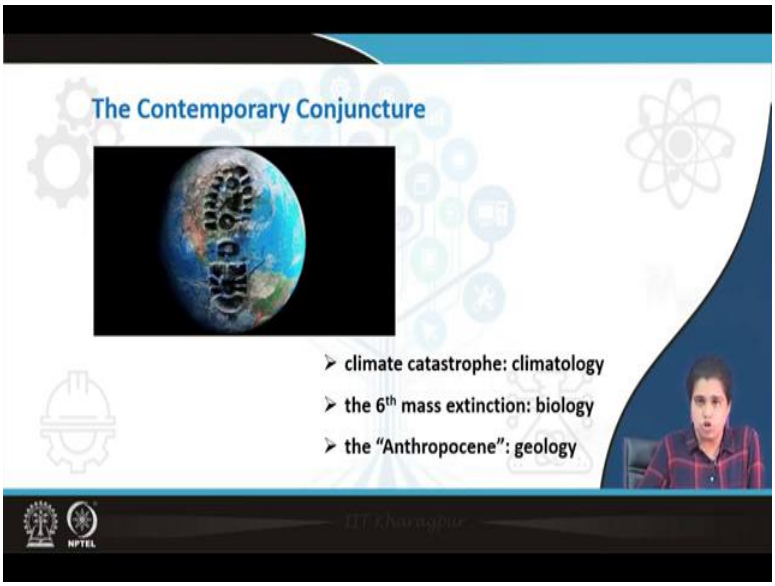
(Refer Slide Time: 00:22)

So, the focus of this lecture is on the "Anthropocene" and you know this is a crucial concept. I will explain why Anthropocene should be considered as the watershed in the contemporary conjuncture and definitely, you know "Anthropocene" is a geological epoch.

So, we are going to discuss the contributions of the geologists and you know why Anthropocene should be considered as a crucial critical contemporary juncture of our times. And then, I would also be discussing a bit that how you know this particular concept of Anthropocene has now traveled from Geology to Earth System Sciences.

So, I should also mention very quickly here that 'Anthropocene' now is not only restricted within the ambit of geology or even natural sciences, but 'Anthropocene' is also a cultural connotation or a cultural concept now. But however, I will remain I will keep this discussion restricted within the field of geology. And also, little bit within the you know contributions of Anthropocene as a earth systems concept.

(Refer Slide Time: 01:33).



Now, with this, let us discuss the contemporary conjuncture that I mentioned when I started this lecture. So, what is this contemporary conjuncture all about? All of us are extremely aware of the fact that you know we are going through a global environmental change. So, we are going through an impending climate crisis and these environmental constraints or environmental challenges are looming large on us.

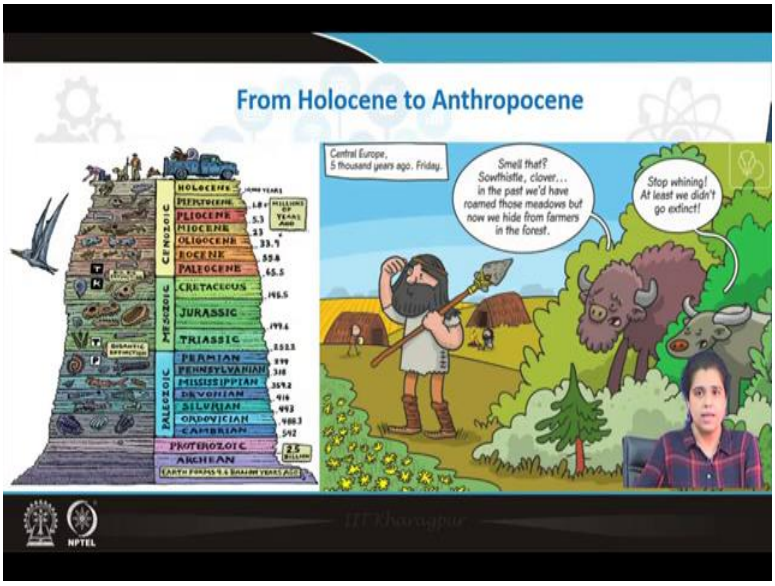
Our ecological footprint is also increasing and this environmental global environmental change you know it can be identified through several transformations that we are encountering during the present times including melting of ice, rise in the sea water level, lack of fresh water supply, changes in land use and so many other dimensions as well.

Now, this contemporary conjuncture is differently defined or differently conceptualized by different disciplines. For example, it is known as the period of climate catastrophe in climatology; it is known as the era of the 6th mass extinction in biology and in geology, it is the Anthropocene.

(Refer Slide Time: 02:56)

So, the major question I think that is before us today is that you know has the Anthropocene been thrust upon us. Again, if I can also ask an important, but a kind of a complementary question to this that does the Anthropocene craft similar sets of implications on different spatial scales or for that matter on different societies, communities and divergent sets of social actors. Now, before we get into these questions it will be important for us to first understand what this Anthropocene is all about.

(Refer Slide Time: 03:41)

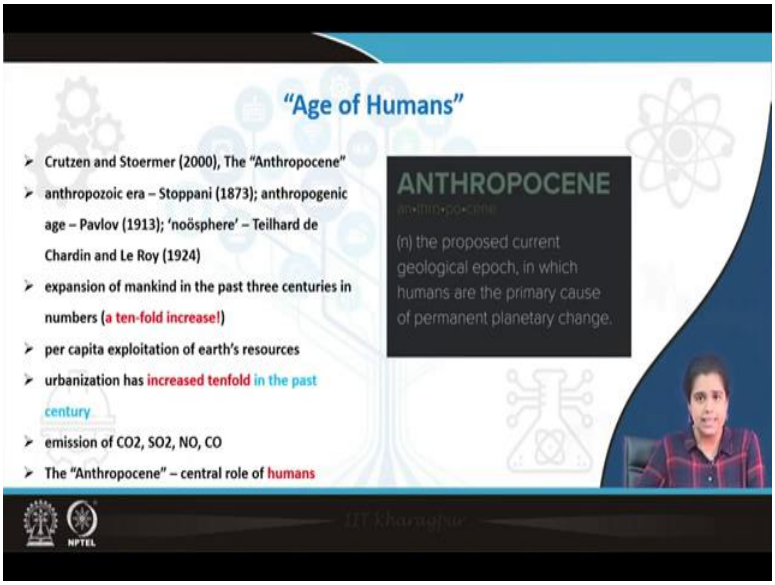


So, these are geological epochs. So, Holocene is kind of you know explained as a period of stability. So, this Holocene, I mean as per there are lot of controversies among scientists, among natural scientists, among geologists about the time period of Holocene. But you know more or less it is agreed upon that the Holocene period lasted for you know for around 10000 to 11000 years.

So, the last 10000 years, the Holocene, the Holocene period was there for the planet earth and this was a period of stability and this was also the period, when human beings also you know kind of they got of got lot of economic benefits and it was it can also be kind of understood as a period of period of economic growth, development.

So, it was a peaceful period of stability. There were some regional and local repercussions; but these repercussions did not translate to the planetary or the global scale. So, Holocene can be more or less kind of considered as an era of climate stability. But then, the natural scientists, again more specifically the geologists, they argued that now we have headed from the Holocene to the Anthropocene.

(Refer Slide Time: 05:09)



So, how this discussion on the Anthropocene actually started? I think here I must mention the very path breaking you know work which was published in the newsletter of International Geosphere Biosphere Program in 2000. So, Paul Crutzen and Eugene Stoermer, both of them they together wrote a piece, a small piece, two and a half page

piece called the ‘Anthropocene’ and there you know they kind of introduced this concept.

And in that article a small article, they mentioned that they were also very much influenced by works of the preceding periods, preceding centuries even. For example, they were quite influenced by the work by Stoppani. So, Stoppani talked about this anthropozoic era.

And Stoppani talked about you know how the power of mankind, the power of mankind and its activities had lot of implications on planet earth. So, he tried to he tried to categorize this power of mankind as a new telluric force. So, this was Stoppani’s contribution relating to this Anthropozoic era.

And then, we have Pavlov, a Russian Scholar in 1913 talking about the anthropogenic and then, there was another particular work by Chardin and Le Roy which also had a lot of influence on Crutzen and Stoermer. So, Chardin and Le Roy they talked about ‘noosphere’.

So, how did they define ‘noosphere’? So, according to them ‘noosphere’ was a world of thought, where the cognitive faculty of you human beings you know developed to such an extent that the technological talent could actually craft lot of changes on the society, on the environment and the interconnected relationship between society and environment.

So, this was how Chardin and Le Roy talked about noosphere. And so, from all these, you know conceptualizations, we can understand that there had been an expansion of mankind in terms of demographic size or demographic numbers in the past 3 centuries. And like if we try to be more specific about this expansion, so it is a tenfold increase. So, there has been a tenfold increase in the demographic size in the past 3 centuries; in the last 300 years.

And of course, it corroborates to the increase in per capita exploitation of planetary resources. And also in the past century that is in the last 100 years, urbanization has increased tenfold. So, we have to keep in mind these figures. For example, at least we have to keep in mind that there has been a tenfold increase of urbanization in the past century against the you know tenfold increase in demographic size in the last 300 years.

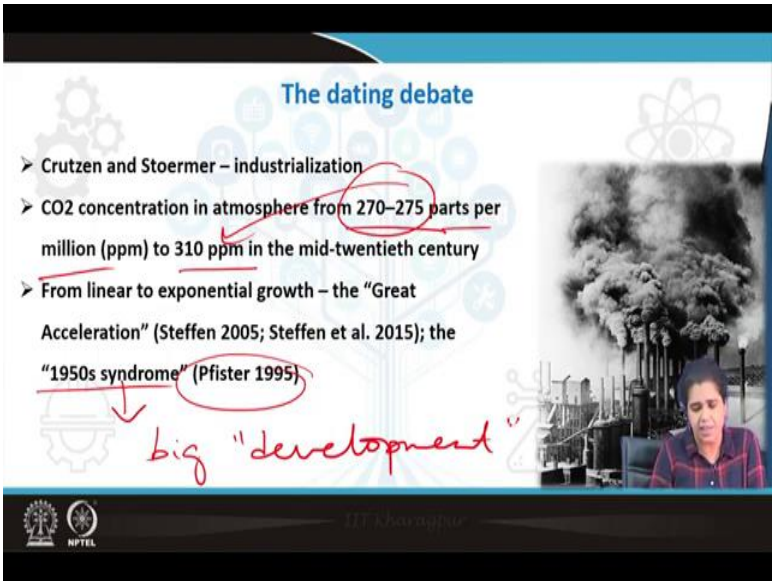
So, you can also understand that how urbanization has also been extremely rapid at an accelerated phase and of course, it means that the emission rates have increased like anything. There are lot of scientific works, lot of scientific researchers have been produced in the last few decades on I mean which has calculated which have calculated and estimated these emission rates and emission figures in terms of emission of CO2, SO2, NO, CO etcetera.

So, the final argument you know about this Anthropocene or the or this particular era is that human beings have actually played a crucial role you know in the assurance of this geological epoch.

So, it will not be wrong if we say that you know this Anthropocene is actually the age of humans and when I say "age of humans", you can see that I have put it in within quotes. So, I actually quote Crutzen and Stoermer here. And more specifically if you see this black box, so this is again from Crutzen and Stoermer, where this says then what is Anthropocene.

So, they say that it is the proposed current geological epoch in which humans and the key word is humans; so, humans are the primary cause of permanent. So, which means irreversible planetary change, but then the question is whether it is really absolutely irreversible. So, we can have some sort of discussion on that.

(Refer Slide Time: 09:46)



Now, again relating to the Anthropocene, there is also this dating debates. So, what does that mean? It means that controversy in terms of when did you know this Anthropocene begin. So, about the duration of the Anthropocene and also more importantly about the starting date or the starting decade so far I mean starting decade for this particular or this new geological epoch.

So, Crutzen and Stoermer again they according to them Anthropocene you know Anthropocene started since the 18th century. And why 18th century? Because 18th century is crucial in terms of industrialization, in terms of industrial revolution and you know the three major changes that occurred during this 18th century. These are the mechanization of labor number one. So, this is one particular change that occurred, then there was mechanical production and also, transformation of energy using steam engine. So, that was another major development. So, definitely, we can relate to the discovery of the steam engine by James Watt. And also, the major development during this time was the production, exploitation and use of coal and iron.

So, what happened is that you know these Western European cities most importantly and more specifically the British cities like Manchester or Glasgow or Leeds and even London acquired dubious honorific smoke, big smoke and I am not going into that discussion; but we also know that you know how this industrial revolution and pollution also gave birth to a romantic British writing.

So, that is a different topic and we do not have scope to enter into that. But the major argument is that yes, industrialization occurred and industrialization, it definitely you know it had a lot of impact on the emission rate. So, what is happening is that again there is another argument which says that the Anthropocene the date should actually or that the era should be considered to be the 1950s.

Because 1950s again is the crucial time period from when lot of new developments, lot of new activities, economic activities actually started and what we find you know in the mid 20th century was that this CO2 concentration in atmosphere, it increased from 270 sorry; so, from 270 to 275 parts per million which is ppm to 310 ppm.

So, we can see that you know how there has been a steady increase in the CO2 concentration in the atmosphere and this is directly related to global warming. And this is also very important like Pfister, he wrote a piece called where he talked about this 1950

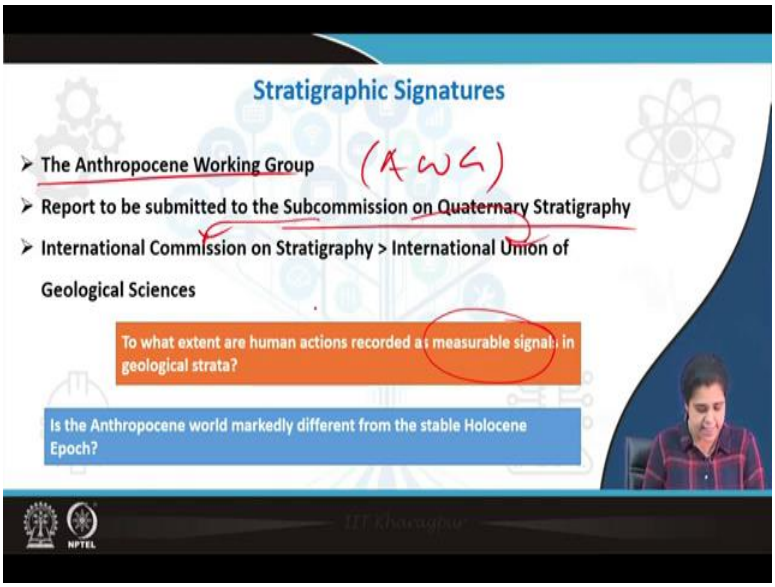
syndrome and why this 1950s is so very important? Because we also have another art system scientist who is Will Steffen.

And Will Steffen also talked about the period of the great acceleration during this 1950s and we know that you know this 1950s is importance important in terms of; in terms of you know new economic activities at accelerated phase. Like for example, there has been McDonaldization. This is also the era of I think big, this is very important development. So, this is a period of big development.

So, development in the form of construction of large dams, development in the form of you know the implementation several big developmentalist projects triggered by the development of this vision of the state or the stagecraft and as I mentioned like McDonaldization and also economic indicators in the form of increased or increasing international tourism, foreign investments and also gross national product.

So, the debate continues that whether it will be right to argue that Anthropocene actually started from the 18th century that is a period of industrial revolution or whether you know it started since 1950s. But whatever it might be I mean there is no doubt about the fact that this CO2 concentration and the in atmosphere and emission rate since then and lot of pressure on the biophysical components of planet earth have increased.

(Refer Slide Time: 14:47)



So, now, we will go into the little bit more technical part of the discussion, where I would like to again draw you to the history of you know of this debate relating to the formulation or the coinage of this term called Anthropocene as a watershed geological epoch.

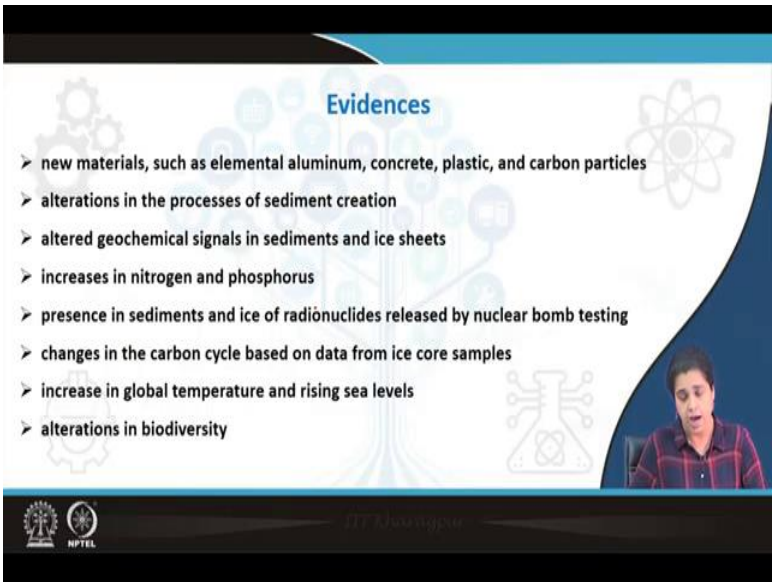
So, when these discussions were going on, finally you know this AWG which is this Anthropocene Working Group, so this Anthropocene working group was formed and this Anthropocene working group consisting of scholars from various natural sciences discipline more importantly, geologists. They were supposed through to write a report and to submit this report to the sub commission on quaternary stratigraphy.

So, and they were asked to kind of investigate to carry on investigations on stratigraphic signatures. So, they were supposed to investigate the signatures or the imprints on rock strata to find out whether you know this Anthropocene can really be stratigraphically considered to be a distinct period, distinct from the Holocene or not and like if this sub commission on quaternary stratigraphy was convinced with their report, then this report that the route was like it would be submitted to the Sub commission on Quaternary Stratigraphy.

From there, it will go to the International Commission on Stratigraphy for further approval and finally, it can only be approved by the International Union of Geological Sciences. And so the task that this AWG was assigned to was to map or to measure to what extended human actions recorded as measurable signals in geological strata.

So, will we will very quickly also discuss about the evidences through which they could actually kind of quantify and investigate and measure you know this so called measurable signals in the rock strata or the geological strata. And this was a burning question which they had to answer that is the Anthropocene world markedly different from the stable Holocene period alright? So, now, we will see like their conclusions Yeah.

(Refer Slide Time: 17:19)



So, I told you the I told you that you know some evidences, they definitely they had to depend on a set of evidences through which they could actually investigate these stratigraphic signatures. So, what are these evidences? So, here is a list of few evidences. So, number one, new materials such as elemental aluminum, concrete plastic and carbon particles. Then, they also kind of you know measured alterations in the process of sediment creation and I think this is very important.

So, how can someone or how can this how could this group you know measure the alterations in the process of sediment creation? Say they do they did this for example, you know say, so they try to find out or figure out you know the sediment capture behind dams for example.

And also, they try to estimate or calculate erosion from mining or you know erosion from deforestation even, they try to also calculate you know sedimentation from eutrophication processes, you know eutrophication from fertilizers. So, through this, they tried to kind of calculate or a measure alterations or transformations in the processes of sediment creation.

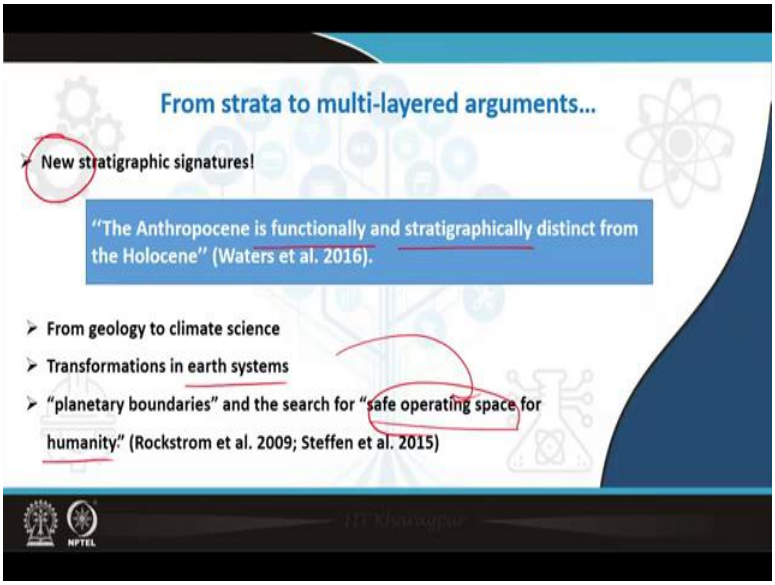
Then, they also they had to they had to quantify altered geochemical signals in sediments and ice sheets by for example, calculating increases in polycyclic aromatic hydrocarbons, then increases in nitrogen and phosphorus, presence in sediments and ice of

radionuclides released by nuclear bomb testing, changes in the carbon cycle based on data from ice core samples.

So, it was a robust task I am sure and increase in global temperature and rising sea levels and finally, they also mapped alterations in biodiversity right. So, maybe you know through agricultural homogenization or you know supplanting the way through which like human beings kind of they supplanted, established species by invasive species and these invasive species.

And the whole process being human induced to a great extent. So, these were the evidences through which they had to kind of investigate the stratigraphic signatures on planet earth and we will see their findings.

(Refer Slide Time: 20:01)



So, the findings were definitely this they found out completely new, either completely new stratigraphic signatures or stratigraphic signatures which were substantially you know which were substantially different or substantially at a completely different level in the variation in the Anthropocene.

So, with this, their conclusion was yes, "the Anthropocene is functionally and stratigraphically distinct from the Holocene". So, you know if this particular geological epoch is categorized or is conceptualized as the Anthropocene which is different from

the preceding period this is not an erroneous conception or conceptualization sorry this is not an erroneous formulation.

So, this is what they finally, concluded. So, now, I think like and through this discussion that I mean in the research, this there has been a meteoric rise in the concept of the Anthropocene and because it has traveled now from geology to climate science and it has also traveled to social sciences and the humanities.

So, and there are so many research works which have been produced you know if you just if you do a Google search, you will find out that how many articles have been written, even if even you know in the title if it you do a search to find out that in the titles of papers or the in the titles of articles, how many titles can you find out with Anthropocene as a word in these titles.

So, you will be you will be mesmerized to see these numbers and so, just the you can do this exercise. It can be you can do it out of fun and just so the exercise is to find out how many journal articles or how many book chapters or how many books for that matter have this Anthropocene in their titles from 2000 till the present times that is in this period of 2 decades or 20 years after Paul Crutzen and Eugene Stoermer actually published their Anthropocene article in the IGBP newsletter.

So, you can understand that you know how this concept has actually seen a meteoric rise in its carrier and many scientists, many researchers, they have plunged into you know this Anthropocene research. But what is most important is that from geology, it made a direct you know this concept directly traveled.

So, earth system sciences because like here the earth system scientists, they try to find out the quote unquote again abrupt and irreversible changes that planet earth is facing since the last 2-3 decades or little more than that and this earth system scientists their role really has been crucial in this context because our next lecture will be on the “planetary boundaries”. So, the earth system scientists, they have come out with come up with a framework or a tool to measure and assess the SOS that is the “Safe Operating Space for humanity”.

So, this earth system sciences, they have you know formulated the concepts like thresholds and boundaries and they have formulated these concepts to because the final

agenda or the objective is to identify safe operating space for humanity where because so that we are aware, we remain aware about the risks and uncertainties you know of our content on temporary conjunction when this transition is taking place and maybe you know the transition is complete.

But because we have transcended from the Holocene to the Anthropocene. So, from the stable period of Holocene to the uncertain period of Anthropocene. So, in this phase of transition, what kind of risks do we have; what kind of uncertainties and vulnerabilities you know the planet earth is facing which can be; which can be quite severe for human well-being and for that matter for the well-being of planet earth and all other species, you know cohabiting this planet.

So, it is very important to have a reality check about those risks and uncertainties. And from that point of view, I think that the contribution of earth system science in terms of you know detailed and rigorous understanding about the geological epoch of the Anthropocene has been great, has been like huge and enormous as well.

So, yes, so we will move on to the next topic, where well be focusing on planetary boundaries and the nine planetary boundaries and the thresholds and boundaries which are important for our understanding to explore Anthropocene in a more scientific and systematic manner.

(Refer Slide Time: 25:46)

So, these are the references which you need to go through; but if I mean if you find the list to be quite too much, I think you at least the 2 articles which I would like you to go through are of course, the small article; but the most significant one by Crutzen and Stoermer, it is a brief, it is a small article, but then you can understand the context and this is very very important, I am telling you and this also because like when Stoermer talked about Anthropocene before Crutzen.

So, he was already you know discussing the concept informally maybe in some seminars or conferences since 1980s. But then Crutzen, you know he collaborated with Stoermer and conceptualized this in 2000 and this conceptualization also fetched him the Nobel Prize. So, this is really significant. So, please go through this two and half page article.

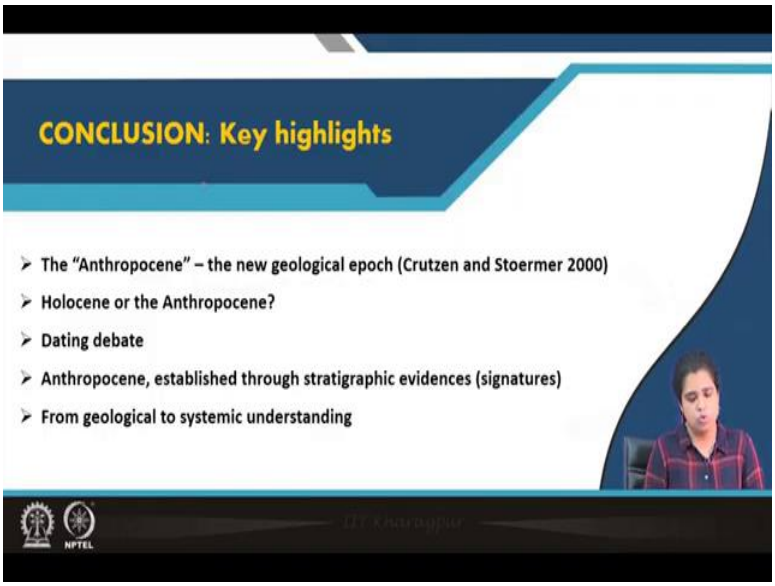
(Refer Slide Time: 26:55)

(Refer Slide Time: 27:02)

And also, this will be an important read; this one by Steffen. Will Steffen and the final suggestion so far as reading is concerned, my final suggestion would be please go through the article by Helmuth Trischler. So, it is a kind of a historiography article; it is a it covers I mean it is a, it is a literature review kind of an article.

So, he provides, Trischler provides us with the state of the art literature about this Anthropocene and the why I think the article is too important because like he talks about the developments that had occurred you know in the in Anthropocene or in the journey of the Anthropocene in both natural and social sciences. So, he discusses Anthropocene both as a geological natural science concept and also, as a cultural concept and connotation.

(Refer Slide Time: 28:10)



Yes. So, to conclude this lecture very quickly, I think I can cover the key highlights. So, the concepts or the ideas which we could cover through this Anthropocene lecture, where number one we discussed that why we should talk about the Anthropocene as the new geological epoch of our times and we talked about you know this transition from the Holocene to the Anthropocene.

And then, we discussed a bit on the dating debate. So, like with few scholars wanting to you know push the frontier or push back the date to the 18 century and some scholars I mean talking about the great acceleration period that is 1950s as the time frame from when this Anthropocene started and we talked about like how this Anthropocene working group could investigate the stratigraphic signatures of earth through a number of evidences.

And then they finally, concluded that yes, this particular geological epoch is functionally and stratigraphically distinct from the stable period of the Holocene and finally, we had concluded with this with a fact that how the concept has traveled from geological to more systemic understanding with major contributions from earth system science and earth system scientists.

Thank you.