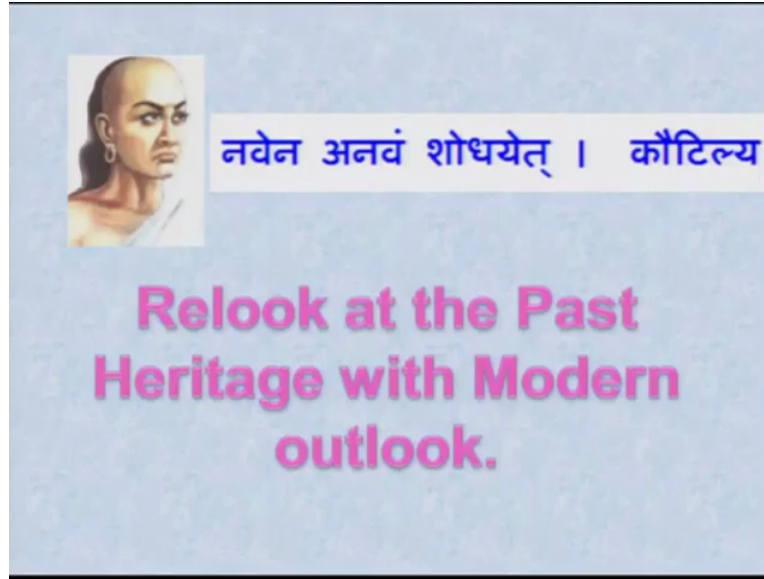


Introduction to Ancient Indian Technology
Professor D. P. Mishra
Department of Aerospace Engineering
Indian Institute of Technology
Module 1
Lecture No 04

Let us start this lecture with a thought process that is creativity is the alchemy of human life. As I told the creativity is a part and parcel of human life provided we are being educated in real properly. And also that depends on the social and political environment where we are living. So and that is the panacea rather I can say of all the problems what we are facing today. So let us (rec) recall that what we learnt in the last lecture.

We basically looked at the why our ancient science and technology relevant today. That question we are trying to answer. In the process, we looked at what are the problems we are facing in modern time due to the blatant misuse, abuse of modern science and technology. And we looked at also the how we are leading life, how it is connected with that. But now we know the problems, you know causes of the problems but what are the solution? We need to look at it.

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So for that, we will have look at a a very great person. His name is Kautilya whose name is....also known as Vishnugupta who was instrumental in installing the Chandragupta as a king, Mauryan empire. So he he has also written a very beautiful book known as Arthashastra which is the most (01:39) book on the statecraftship and then lot of science and technology in that and lot of things are there.

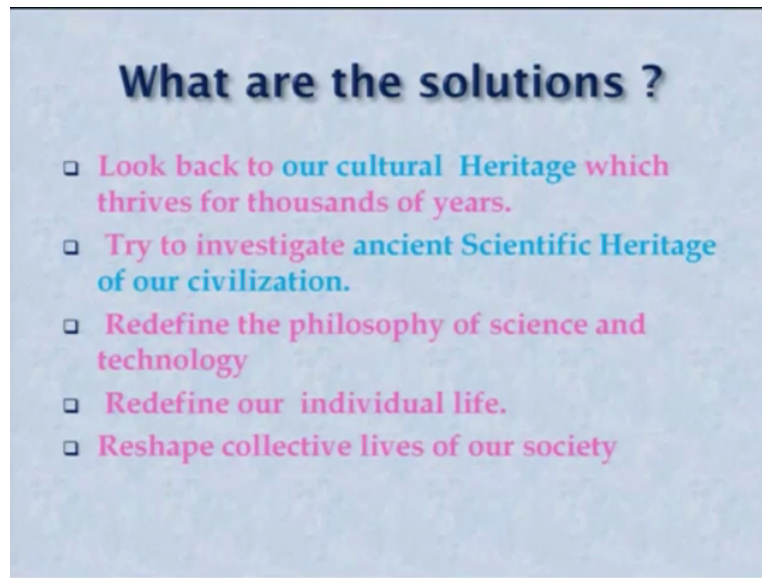
So I would urge upon you people to look at that book. It is a one of the rarest book and we lost a lot of book due to the invasion by the outside people and they destroyed lot of thing. But fortunately, we are having that book and we could see that that what science, technology, philosophy and other things we are having at that time, that book.

What he says? He says that Naven anvam shodhyet. What is the meaning of that? That means relook at the past heritage with modern outlook. He is not saying that you just copy the old thing and then you know new way. No, you should should not do the old wine in a new bottle. You will have to research, find it out, look at the essence and do whatever required at this moment. And this is the very important thing.

What we are doing today in the name of modernity, we are just copying the western people and pasting here, copy-paste you know. We do not understand that those things what they are doing that may be good for them but not for good for us. That does not mean we will not learn from

them. We should learn from them but with understanding, with its implication, with by integrating with our culture and heritage values that we have inherited from time immemorial. So therefore we need to look at it and that is the message what he has given.

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So what are the solution then? Solutions are whatever come to my mind I will tell but I just want to hear from you that what are the solution coming to your mind. He has given us pointers or the direction, Kautilya, he has said, “Look at the heritage. Do research on that, find it out what is the essence.” That means.....what is the meaning?

Meaning is that we need to look at our root, yes or no? Can anybody, can any of you tell me any other points? Because root is very important. And once you look at root, then we need to look at this back to our cultural heritage, right, which thrives for thousands of years. Even today you will find signature of our culture which was there even Harappa and before that. Can anybody tell me any signature you are aware?

Even the peacher the way we make, it was there in Harappan time technology-wise. Peacher you know like for getting you know...collecting the water, right, out of mud. That still it is going on. There are several things like for example in your auspicious occasion, you put a peacher full of water. Why? And that tradition is there from Vedic era, still we are following it.

But we should know why we are following it, right? So there are several signatures but those signatures although what you call markers are going out day-by-day from us due to the blatant what you call acceptance of modern principles from western people without understanding. So it is just you know...that is why we need to be...I call it as cultural invasion for us. We do not understand there is invasion.

So therefore we need to be careful and do that and try to investigate the ancient scientific heritage of our civilization. As I am emphasizing time and again, this civilization is still alive although it is about to die. But we can make it survive with our own effort by understanding its efficacy. So therefore we need to investigate, do research; do not be emotional that we are part. No, we will have to find out what is the truth.

As I told we are truth searcher. So therefore we should do that and redefine the philosophy of science and technology. If you look at the western way of doing the thing that they will have to win over them. Those science and technology as basically reductionist, reductionist they will find out small. They look at very myopic eyes, they do not do not look at the bigger pictures.

They will say, "Look, if I take a mountain, what will happen? If I destroy this thing...?" So for example, I will tell you, give one example. We are having Eastern Ghat, Western Ghat which is protecting us from the sea's onslaught because nature will work, lot of wind will come in the rainy seasons and summer, right? And that will be taken thwarted by the West. That will also water will come over there and then cloud will come, make the rain and then we will get water and this thing. But if we destroy, what will happen? What will happen to the ecology? It will get spoiled and we are doing that, right?

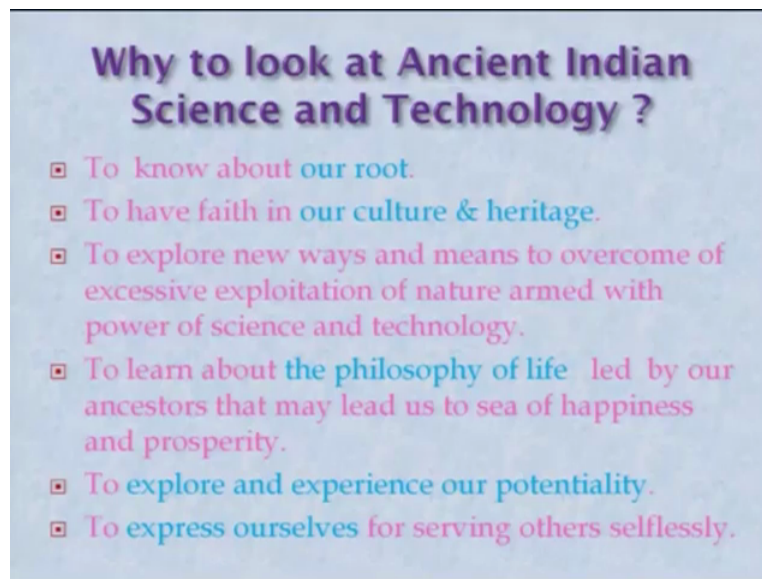
And therefore and we should say these are all divine. And our scripture says, "Those are all.....mountains, jungles and then (fore) like other things, all the limbs of the Mother Nature are divine." Therefore we should not destroy it. We should....so therefore we should be a part of it. And we look at whole picture, holistic approach.

So therefore the philosophy has to be defined and we should say that we are not living alone, we should live with others. Man is not only the animal should be here in this earth, all are connected, interconnected. So interconnectivity has to be accepted in total while designing, developing

technologies and also unraveling the (scien) science. So that philosophy has to be changed and which is not with the modern philosophy of science and technology.

Redefine our individual life. We are not here to blender, we are not here to only take food and sleep and then die. We are here to help and realize our potential. So therefore reshape the collective (law) life of our society, live together. Togetherness, joining, Vasudhaiva kutumbakam that means all are family. It is not only the human being but the animal, insect, even birds, even this any other living, non-living, all are part of Brahman what you call our scripture. So that is has to be looked at.

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So what I was telling, therefore we need to look at our root. Root is very important because without root we cannot really grow. And we want to grow as a human being. And so therefore to have a faith in our culture and heritage. It is not a blind faith that I am talking about. It is not that something is written in a Bible or Veda that I will have follow.

No, I will have to question the wisdom whatever it is there even in our scriptures, even in our our life because our scripture says, “Jugti Jugtam bacho grayam, bala tapi sukha tapi jugtihinam bachang tejyam buddhatapi sukha tapi.” The meaning is that even if a person or small baby, even a parrot is telling some logical thing, please follow that; if a person of wisdom, a old man or a knowledgeable person is saying something wrong which is illogical, please do not accept it.

That is the ethos what our scriptures has talked about it and we need to follow. But once that does not mean that I do not know, I will say it is no. I need to investigate, I need to find out, we need to look at it, check it and then say and then have a faith in that. So that is the cultural heritage we are having to explore the new ways and means to overcome the excessive exploitation of nature armed with power of science and technology.

So that means we need to (ove) overcome this problem, to live with the nature, use the minimum. The Western world consume more; it is other way around, consume less, distort less. Suppose for example, I can manage with two or three short pants, I can have. I can take less amount of food, I do not need it, right? I do not need you know like nowadays people are having – husband-wife, two person three cars. We do not need it.

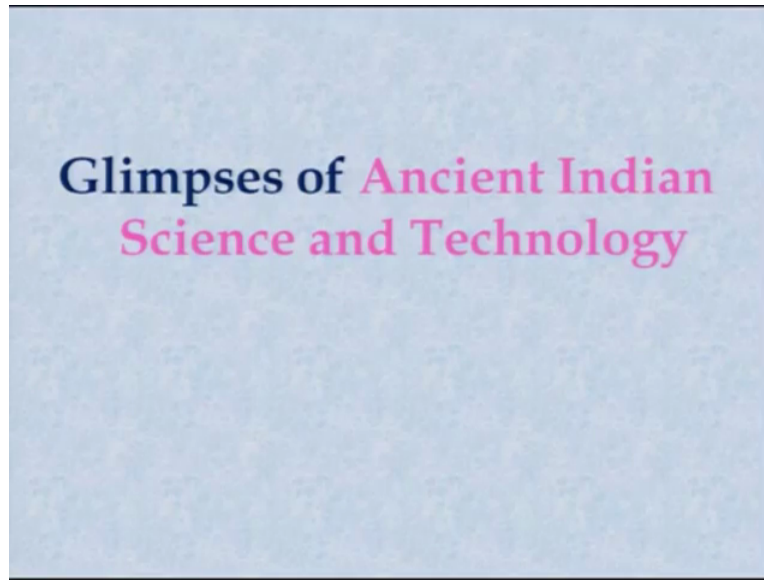
So therefore this is and when you are do a traveling, you can take people with you so that it will be good. Even if you are going car alone, why you will go alone? You take 3-4 people so that people will be benefited and the pollution can be reduced. So this is the way you need to redefine your life, an individual life and this thing and also find out how we will live with Mother Nature.

So to learn about the philosophy of life laid by our ancestors that may lead us to the sea of happiness and prosperity. Because the balance is a very important key for the human life which was being propagated and professed by your ancestors, so therefore we need to look at it. And to explore and experience our potentiality.

Our scripture says, “We have infinite potential.” If we are having infinite potential and human being can experience that. And we need to do that, then only we can do a better science and technology, so that you will get intuitive power. And intuitive power is very important for doing better science and technology.

To express ourselves for serving others selflessly: Unless you serve other, unless your heart will bleat for the people around you, then you will not get the ideas of you know or intuitive knowledge you will not get. So therefore that is has to be done to revive our ancient science and technology and its ethos. So therefore you need to do that. So that is the way we need to go about it.

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And I will just tell you the glimpses of ancient Indian science and technology because it is a very vast and also we do not have a lot of you know scriptures at this moment and because most of are being destroyed. And also with the modernity, lot of scriptures which were lying maybe during my grandfather times and that were not taken care.

I will I will tell from my experience. My father left my village, grandfather's village. And then he was having lot of scriptures lying. I I remember you know that I had gone home and there in the pooja house, there is a lot of you know scriptures in the palm leaves and then my grandfather died. And then everything lost. I do not know what the those scriptures will be containing.

But today when I am thinking of looking at, those are not there. So therefore it is not true with my family alone, it is with the most of the things and we lost it. And so therefore we will not get all the things but I will tell you the very roughly what it is thinks.

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Chronology of Ancient Indian Scientific and Technological Developments		
Period	Scientific and Technological developments	Remarks
25000 BC-before Early Stone Age (Early Paleolithic period)	Chopper-chopping tool / Hand-axe culture	Punjab region, Peninsular India, extreme south India
25000-5000 BC Middle Stone Age (Middle Paleolithic period)	Predominance of flake tools, scrapers, borers, points, etc	do
5000-3000 BC Late Stone Age (Late Paleolithic period)	Predominance of microlith, flake, blades, lunates, scrapers, chisels, trapezoids, triangles, drills, borers, etc	do
3000-1500 BC Harappa Culture	Copper-bronze technology, Lost-wax casting process, wheel made decorated & glazed pottery, agricultural technology, domestication of animals, drainage, public bath, burnt brick, mortar construction, town planning, spinning, weaving, navigation and dockyard, etc	Sind, Punjab, Rajputana, Haryana, Saurashtra,

We can go by chronological order. And if you look at 25000 BC before, we call it basically Early Stone Age or people call it Paleolithic period, early Paleolithic periods where people are using copper and chopping tools, hand-axe, kind of things, right? And and this what people are telling. Whatever I am saying it is because whatever the historians they have accepted. But if you look at our other scriptures, they do not agree with that.

But I am saying whatever people have accepted, right? There might be much more than that and I do not want to invite you know controversy; otherwise I could have talked about it. But let us say, in that region Punjab region, Peninsular India and extreme south, they were having the what you call people were having you know habitats during in these areas.

And 25000 to 5000 BC, we are having basically Middle Stone Age what we call and Middle Paleolithic period. And predominance of flake tools like you know scrapers, like borers, points; they were using various metal, even some stones being used basically. I think metal came metal came later on according to the modern historians.

And 5000 to 3000 BC, we call it Late Stone Age. Predominance of microliths, you know is a very tiny tools which will be...people will be using. Flakes and blades and lunates, lunates means you know crescent shape of lunar, that kind of tool they were using. And scrapers, you

know the we scrap the floor that way. And chisels, trapezoidal shape, triangular shapes you know like drills and borers they started using the metals. And these are the same region.

And 3000 to 1500 BC, Harappa Culture which was accepted worldwide. But if you look at recently as I told in the last lecture, IIT Kharagpur people have done research and published in Nature journal, they are claiming that it is 8,000 years back. That means basically (fo) 6000 BC, right? And we are cultured and always we feel that it is not 6,000 rather 10,000 or more than that. That is the our way of thinking.

But we need to do research to prove it. It is not that we will say it is, we need to do research. I hope and wish with this lecture you people will be motivated to carry out research and give some of your time to unravel and prove to the world that we are having a very old civilization and great culture.

So copper-bronze technology, we are having very good. And Lost-wax casting process, those people will be knowing and I will be talking about it that we use this ideal right making in modern time. We use this technique for making the turbine blades, compressors and other things; very intricate shapes we can fabricate.

And wheels made decorated and glazed pottery, pottery were very good at that time. Agriculture technology, I will be discussing about that what we are doing. Domestication of animal, drainage and public bath we will be discussing (showing), I will be showing some picture later on. We are using bricks since 3000 BC. And now it is being you know established that it is not 3000 BC, 6000 BC.

Mortar constructions, you know buildings like we do. Town planning, I will be discussing about later on. Spinning, weaving; basically this is about textiles, right? And navigations and dockyards, we are having proof to show that we are having you know sheep building technologies and dockyard to keep the sheeps there. And it is the Sind, Punjab, Rajputana, Haryana and Saurashtra regions, it is a very larger regions.

And of course, I always feel the southern side part; these are the northern part and then northern western side kind of thing. But I always believe the southern part also willing be having a great thing because the sea was there. So therefore I am having belief but this that has to be proved.

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Period	Scientific and Technological developments	Remarks
1500-1000BC Vedic knowledge	Concept of natural law ,monistic idea concerning water, Naksatra system, Calendar system, Knowledge of diseases and cure, Agriculture, Use of plough, Fermentation methods, Number names on the decimal scale up to 10^{12}	Panjab and Kashmir regions, Western U.P. , Gangetic plain
1000-700 BC The Yajurveda, Athravaveda, Brahmanas, Aranyakas	Medical knowledge, astronomical knowledge: list of plants and animals, cosmic cycle, Mathematical series, More physiological & anatomical, Doctrine of the Pancha-bhutas , Painted-grey wares, Iron production and their uses, soil fertility methods	Northern and north-western parts of India
600-550 BC	Northern Black-Polished wares, Making Iron & steel	Eastern parts central and other parts of India
500-to BC(Vedanga jyotisa, Sulba-sutra & Vaisesika)	Calendar making science, geometry, irrational numbers, Pythagorean theorem, permutations, combinations, binomial, physical concepts (atomism, space, time, motion and sound)	Eastern parts which spread to central and other parts of India

So if you look at 1500 to 1000 BC, the Vedic era what people already accepted but my belief is that it is much before that that. But I do not have a proof. If you people will get the proof, it will be nice. And concept of natural laws, people talk about laws you know physical laws, they were having that. And monistic idea concerning water, I will be quoting something from Upanishad what water is when I will be talking about water harvesting. And Nakshatra system that is what we use for our astrology, you know it was from Vedic era.

And there is a (Vedic) Vedanga Jyotisa also, calendar system. Calendar, of course we are using the other calendar, we are having our own calendars which is very old and very sophisticated. You can predict a lot of thing out of calendar unlike your what you call this modern calendar. What you call that?

Student: Gregorian.

Professor: Gregorian calendar, right. That is not that good according to me but of course we are using it. So knowledge of diseases and cure like healthwise, so they are identifying. Agriculture, use of plough, fermentation methods you know this also was there. And number names on decimal scale up to 10^{12} , I cannot think what will be the size of number they were thinking, you know. Today it is very difficult to think.

So that is again there are talking about Punjab, Kashmir regions, Western U.P., Gangetic Plains; they were not concerned about the southern part, I always believe that will be there. And because for this people have excavated and they got the evidence, right? And their excavation need to be done in the southern side but where to do that is another question. You know like where I will go? I cannot excavate all the places. So that is the thing.

And this something 1000 to 700 BC, Yajurveda, Atharvaveda, you know Brahmanas and Aranyakas, all those things being you know written, people are talking about. There is a several things. I will not go through it. I will only tell that that these are the things which people are having. Like, mathematical series, right? And they were talking about cosmic cycles. And you know like we are....have used some Teller series.

There are several binomial series we will do, lot of things are there in our you know from the time. And more physiological, anatomical and about the health. And doctrine of Pancha-bhutas we talk about, sometimes we do know, maybe you people may not be aware, at least I was aware about Pancha-bhutas. Painted-grey wares and then the people started using iron during this Vedic era, right? And their uses and even soil fertility, how to enhance the fertility of the land. For agriculture, they have started doing like your compost what we use you know.

And 600 to 500 BC, this is basically using of iron and steel and then and then they are claiming, the modern historians, they are saying eastern part of...eastern part and central and other parts of India, this already spread this civilization what they are claiming. But I do not believe. I believe that is the total place the civilization was there. Maybe small pockets where the what you call jungles and other thing there but it is the whole country according to me.

But do not go by me, go by the historians because those are provable, okay. Toh, 500 to something around AD till this thing, Vedanga Jyotisa and Sulba-sutra and Vaisesika if you look at is very great things because they will be talking about structure of the atom. You must not have studied this in atomic theory because we do not teach that thing; we teach the outside country what they are talking. We are having a very beautiful system, atomism and time and motion and the sound whatever the physics you look up; of course, they look at in a very different way.

Their main objective is spirituality but in that they look at. So and beside this, if you look at you know this Pythagoras theorem and other thing, these are there during this Sulba-sutra, is much

before the Pythagoras. And binomial series and then several others like geometry, rational numbers and lot of things you know were there but we need to look at. And again it has spread to the other part, eastern and central part of the India.

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Period	Scientific and Technological developments	Remarks
0-500AD Ayurvedic treatise : Charak and Susruta samhita Nyayabhasya, Arthashastra of Kautiliya Jain and Budha Scriptures	Surgery, mining, Metalworking, Agriculture, Irrigation, Glass making, vision and propagation of sound, animals and plants classification, rotation theory of earth, epicyclical theory, pie and sine values, Extraction of square, cube roots, first order equation, jewelry art, Iron Pillar, Copper statue of Buddha, Ceramic ware	Medical, rhinoplasty, lapa rotomy, lithotomy, extracting, forging, decimal place-value system, 99.72% wrought iron made and cast in two layer, Indo-Gangetic Plains
600AD Panchasiddhantika: Saura, Paulisa, Romakar, Brahma and Paitamaha,	Concept of Mahajuga (4, 320, 000 years) Brhat Samhita of Varahamihira: chemical processes, plant and animal classifications Amarakosa: Classification and synonyms of plants and animals, minerals and metals;	Encyclopaedic work, Lexicon: Suryasiddhanta provides best and most accurate <i>Tithis</i> .
700-800AD Brahmashphuta-siddhanta & Khandakhadyaka by Brahmagupta	Astronomer & mathematician, indeterminate equation second order arithmetic progression for nth terms, area of cyclic quadrilateral, volume rules, diagnostic methods, etc Naya-vartika of Udyotakar: Elucidation of atomism, space, time Asthangahrdaya of Vagbhata: Ayurvedic text	Translation of Indian text into Brahmashphuta-siddhanta (Sindhiml) Khandakhadyaka (Arkand) , Mullansandam (Baden) and Asthangahrdaya (Ashmakar) into Arabic

So this is from 0 like your this thing to the 500 AD. And there is a several treatise have come up during that time. One is Charaka and Sushruta Samhita, you might be aware because today Ayurveda being again coming back, so also yoga. So therefore some of you might be aware. And Nyayabhasya, Nyayabhasya is another things. And as I told Arthashastra of Kautilya, by the Vishnugupta. And the Jain and Buddha scriptures, there is lot of things and lot of you know science and you can see in those scriptures also.

So if you look at, there is a lot of things are there. I will not go through all of them. Only I will tell you few of them like for example, glass making started doing that. And for example, propagation of sounds and the classification of animal and plants, they have done in a very systematic way. I am like we need to look at it. We are not being....we are not teaching those thing in the school and college, it should be taught.

And like pie, sine values, extraction, so if you look at square and cube roots was a difficult one you know, we always use quadratic equation, right? But cube roots and then again first order equations and then other things are being talked about in this here. And there is a engineering-

wise lot of things like forgings, you know like what you call lithographies and laparotomy and then you know rhinoplasty nowadays it is also being used. So something 19 decimal points you know where they started and wrought iron made of cast in two layers, particularly in (Indo) Indo-Gangetic Plains.

And if you look at in 600 AD onwards, there is a several thing like Panchasiddhantikas like Saura, Paulisa, Romakar, Brahma and Paitamaha. These are the things. The lot of concept they put together. During that a concept Mahajuga, what they calling that is a very big years, they are saying various jugas like Tetrajuga, Dwaparajuga, all those things. And the Brihat Samhita of Varahamihira is being written at that time and where the chemical processes, plant and animal classifications.

And there was a another book which is very good and then it is still there. Of course, lot of...as I told lot of scriptures, lot of textbooks were being burnt out because of you might be aware this Nalanda and other things got destroyed. And we are the first people, you know we are having several university in ancient times, so those university were being destroyed. So we lost a lot of thing.

And classification, synonyms of plants, animals, and minerals and metals they have done in Amarakosa. And these are of course the encyclopedia today you are seeing, thinking but at that time it was there like Surya Siddhanta provide the best and most accurate tithis. Like, this (Suddya) Surya Siddhanta is a book you know which will provide about the tithis.

And 700 to 800, this is Brahmashphutasiddhanta like if you look at it is having a lot of treatise about mathematics, astronomy and other things where the equation of second or arithmetic progression for any terms you know like lot of complex mathematics are being.....area of cyclic (quadri) quadrilaterals, volume rules, diagnostic methods are being talked about.

If you look at that, book was translated into the like Sindhind, that book is translated. Brahmashphutasiddhanta which was by the Brahmagupta, it is being translated to Arabic you know. And then there is another book, Khandakhadyaka, by by the again Brahmagupta is (()) (27:05) to Arkand, his name is in Arabic.

And like (Madhav) Madhavanidhana which is also translated into Badon and then Asthangahridaya is a Ayurvedic text by Vagbhata is also translated into Arabic like Astankar. So there are...these are the things we know it is being translated. There might be several things which might be translated and gone to the western countries we do not know, right? Or nor we are doing research on that at this moment.

So therefore there are lot of things are there. And I would like to stop over here and we look at this chronological in the next lecture. We can...now at least you can having the idea about. Whatever the little text we are having today, it is showing a lot. Now if we imagine that all that scriptures we could have kept, even some of the scriptures are people are trying and to get them back. And lot of people are having, they do not want to give because of possessiveness.

And there was a what you call attempt by I think maybe 20 years back by the government of India but it was not very successful. But still they are claiming they are having something around 10,000 scriptures they are having. But where (tho) are those things? And I will be also telling you little later on that where you can get some of the informations. I will be telling in theafter few lectures where you can go and do research, get those information. Thank you very much listening and I will continue in the next lecture.