

Introduction to Ancient Indian Technology
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Module 1
Lecture No 05

Let us start this lecture 5 with a thought process from (get) great scientist Albert Einstein. I like him very much because he talk something which touches my heart. The concern for man and his destiny must always be the chief interest of all technical effort. That we are not doing today. We are doing technology or the other thing for the market. Never forget it among your diagrams and equations.

We do that. We use lot of diagrams, equations but what for those things? Those are for the human welfare. That is a very important point I must tell you to you people. So let us recall that what we learnt. And we learnt a lot from the Kautilya, the what you call he is also known as Chanakya, the great person India has produced, a great teacher. That naven anvam shodhyet, that means we will have to do research and relook at the old stuff and use it modern time.

And then we look at chronological order, whatever this little amount of scriptures we could manage to keep in spite of number of invasions, right? And thousand years of being subjugation by the powers which were there in this country. And we find plethora of informations and knowledge our ancestors were having.

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Chronology of Major Periods		
Period	Scientific and Technological Developments	Remarks
900-1200 AD Ganitasarasamgraha of Mahavira Rasahrdaya of Govinda Bhatta Krishiparasara & Vrksayurveda	Summation of series, Sridhara's method of solving quadratic equations, Iron pillar at Dhar, Alchemical ideas, iron-casting, paper making, Sidhhanta-siromani of Bhaskar, Manasollasa of Somadeva, Paper making	Manuals on agriculture and botany, use of mineral medicines, Encyclopedic work
1300-1500AD (Sarangdhara Samhita)	Materia medica, urine and pulse examination New dimensions to astronomical and mathematical work, Rasasaratnakar, Rasasamuchaya, Pyrotechnics	Kerala school Mathematics, Complex chemical process
1600-1700AD	Use of mercurial and non-mercurial, extensive materia medica, treatment of syphilis, gun powder and guns, astronomical ideas, crafts, agriculture, perfumery, pyrotechnics	Chemistry introduced, Factories establishment
1800AD	Synchronization of foreign astronomical and mathematical knowledge with that of India	Huge masonry astronomical instrument
1800-2000	Advent of several modern technologies at the cost of indigenous technologies	Transfer of Indian knowledge and recycling of them to different form

But I will now just to complete that taking from what you call 900 to 1200 AD. If you look at, this is Ganitasarasamgraha of Mahavira and Rasahrdaya of Govinda Bhatta, Krishiparasara of....and also the Vrksayurveda. If you look at, these are the scriptures what we are having. These are the things whatever they.....you know like lot of things are not there. And this is the Rasahrdaya and of Govinda Bhatta. And the Krishiparasara, it is about agriculture.

This is Vrksayurveda about how to take care of plants and other things. And during this period, there is a manual people have done for agriculture like and botany. And of course like a use of mineral medicines and there is a (encyc) like encyclopedic work is there. And there is a lot of things have come into pictures what we are getting like a summation of series, and Sridhara method of solving quadratic equation.

I mean the quadratic equation we know the how to solve. We use it in schools and colleges, but there is various ways given by Sridhara. And you might be aware iron pillar at Dhar. And lot of alchemical ideas were being used at that time. And we are having iron-casting, paper making, and several other things like there is a book of Manasollasa of Somadeva, right? This book.

And in from 1300 to 1500, this is Sarangadhara Samhita, there is a one book which we are having. We talk about Materia medica and also the urine and pulse examination of the body, they were doing it. It is not that today we are only doing the examination, they do that earlier days.

And 'New dimension to astronomical and mathematical work', there is a book. Lot of chemistry books have...we we got it. I mean like Rasaratnakar, Rasasamuchaya, like these are the books what I am trying to tell.

And there is a pyrotechnic you know like method of doing that, it is....came up and we are having evidence. Beside this, we are having Kerala school of mathematics. And as I told like Kerala....from Kerala it went to the western countries, lot of mathematics tool and they started looking at seriously. And complex chemical processes as we are telling pyrotechnics and other things were also came up at that time what historian admitted, they are saying it.

So 1600 and 1700, like of course there is a lot of factories being established because if you look at there it is the Mogul and the Britishers' you know period kind of things. And industry and other thing dwelling. Basically cottage industry was in you know what you call were there earlier because we always have a cottage industries if you look at our history. But these are the big industries little medium level come up.

And then the our things also got this thing, destroyed in the process. And of course the gun and gun powders came into pictures like we are having lot of cannons. And astronomical ideas, of course, crafts, still we are doing that thing. Like agriculture, perfumery; you know perfumes were being used by the Mogul or the Muslim rulers and we are having it. Perfumes were also earlier there but they were using for that and therefore lot of you know this thing.

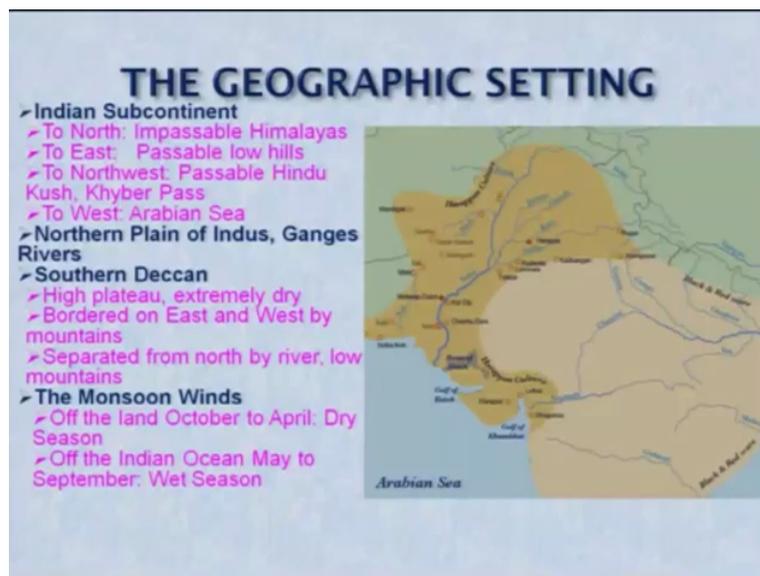
1800 AD onwards, we are having also....still this you know knowledge generation was continuing. In spite of invasion, it was going on. And unfortunately, this 1800 to 2000 that several you know technologies we have taken from the outside country at the cost of indigenous technologies. So our own people are become jobless. And even in spite of apathy for them, still you will go to the rural area, you go to even Kanpur city, you will find some you know kumbhar, jo kahate hai, potters.

You will be finding some blacksmiths and then they are doing a wonderful work in spite of all this thing. And according to me, India having a populous country, it should not go for the what you call mass producing and also the machines such that you know our people will be jobless. We should go for the what you call the cottage industry so that more employment can be generated and also the creativity can be developed.

Let me tell you what I think. I think is that this is the Patent Raj; patent is killing the creativity and also the market forces are taking. And then it should be people should have knowledge not the market forces. Earlier days, our country were always believe people should have knowledge, scientific knowledge, technological knowledge, they can involve in creativity and enjoy the life. So that we need to revive.

I must urge all of you do not go after the job, create the job for others and develop a eco-friendly technologies so that more people can be employed and more people can be creative and enjoy their life. So therefore we need to look at what we need and this ancient science and technology can give us way to do that.

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And let me now look to little...this is about chronological, right? What I am now trying to tell you like little more details about that. And we will go back to the Harrapan civilizations. And that geographical setting if you look at, it is the north side the Himalayan regions, right? If you look at, like these are....which is not shown here but these are the Himalayan region, here it will be.

And eastern basically passable low hill. And this is basically...in this region, this is the Harappan culture we are having. This is you call it Kabul and this is your Indus River. And this is Jhelum River and the Chenab, Ravi and Sutlej all are joining to this. And the nearby this, you know like

earlier days the Sarasvati river was there, people are saying. And this is your Mohenjo-daro which is the spot and as I told you that Mehrgarh is the place here where which is the one of the Harappan sites.

And Kalibangan region also is one of the Harappa's. And Lothal, let me look at it where it is. Lothal here, this is also Harappan sites. These are...if you look at, whole regions are basically Harappan region, this region what you call you know. This is the region what people have accepted. Okay. And so one side is....west side is your Arabian Sea. And this is your....in the northwest side, this side basically you will be having the passable Hindu Kush Parvat, you know like mountain will be there and Khyber Pass.

And of course, north side the Plain of Indus. This is Ganges Rivers; if you look at, this is your Yamuna, and this are the Ganga river here. Okay? And these are the Gangetic Plains regions. This region is the Gangetic Plain regions. And and this is of course, this this region is the your Deccan region, southern side and high plateau, extremely dry these regions and the border on the east and west by mountains.

As I told you there will be Eastern Ghats here in this region, Eastern Ghats and this is Western Ghats separated from the north by river, low mountains of course we are having. And if you look at, that is very important because this sea is you know controls your monsoon wind and so also the Himalayan. These are the things what govern. And we are destroying this Eastern Ghat and Western Ghats and other mountains as well, right? We are spoiling it.

And we do not know what we are doing. So how to overcome because people want to have a what you call buildings or the rooms which is made out of concrete. Now from where they will get stone? From the mountains. If you look at 130 crore people, if everybody will having a house which is made of concrete, then where will be mountains? And that life of a concrete house is 50 years. Then after that, what will be? Again where...after the mountains you destroyed then where we will go?

So mountain has to be protected. How to go about it? Is there any technology we can have a good house, pakka house, right? Not out of mud and also do that. How to do that? Can you get any technology from the ancient time? I will show you that later on that we can do that.

So of the what you call October to April is the dry season generally. But nowadays, it is changing. It is...so also the of the Indian Ocean maybe in (11:39) wet wet seasons right? May to September. There is a lot of rain kind of things and this is helps. I I will tell you that we are....we should take care of ecology. And then that is the geographical kind of thing.

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Indus Valley Civilization

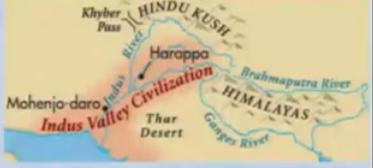
- ❖ The Indus River runs through north India, sources at Hindu Kush, Himalayas
- ❖ Rich deposits, but less predictable than the Nile
- ❖ Wheat and barley were cultivated in Indus valley
- ❖ Cultivated cotton before 3000 B.C.

Harappa and Mohenjo-daro

- Possibly served as twin capitals
- Each city had a fortified citadel and a large granary
- Broad streets, market places, temples, public buildings
- Standardized weights, measures, architecture, bricks

Specialized labor and trade

- Domestic trade, items: **pottery, tools, metals**
- Trading with Mesopotamians about 2300 to 1750 B.C.E



Period	Phase	Date
5	Late Harappa Phase	c.1800 BC to < 1300 BC
4	Harappa/Late Harappa Transitional	c.1900 BC to c.1800 BC
3C	Harappa Phase C	c.2200 BC to c.1900 BC
3B	Harappa Phase B	c.2450 BC to c.2200 BC
3A	Harappa Phase A	c.2600 BC to c.2450 BC
2	Kot Diji Phase (Early Harappa)	c.2800 BC to c.2600 BC
1	Ravi Phase (Early Harappa)	> 3300 BC to c.2800 BC



So if you look at, as I told that this is the Khyber or you call it Khyber Pass or this is a Hindu Kush you know mountain range. And this is your Harappan site, Indus what you call river it goes. And these are the sites I have told already, right? So this Indus Valley regions were having rich deposit but of course it was like a Nile, they always compare with the Nile river, right?

And and wheat and barley were cultivated in the Indus Valley what people are already found out and then cultivated cotton before 3000 BC, right? And if you look at this Harappa and Mohenjo-daro, like if you look at, your Harappa is here in this city one and Mohenjo-daro in this region, right? That is the place. And possibly they might have served as a twin capitals like the today we are having you know twin capitals.

So umm and each (chity) each city had a fortified citadel. That means where the administration, administrative people will be there, it will be also protected. And a large granary that means lot of food stuff they will be storing in that. And those streets, I will be showing something later on. I am just telling now the broad streets and market places, temples and public buildings were

there like whatever we are having in modern time and that is something 6000 BC according to the new data, otherwise 3000 BC. Okay.

So they were having standardized weights, measures and arch kind of things which I will not be talking but it is there. And they were having very good at architecture, they were using burned bricks as well. So domestic trades like they were having. Like, items like pottery, tools, metals like and also they were using lot of other items like cottons.

And they were trading with Mesopotamians, Greek and other things from something 2300 to 1750 BC. If you look at, these are the products what they were having like this is the thing what you do best, right? Even today also we are doing this flower vase. And these are basically weight, you can see this one, right? And and these are of course dolls and then kind of things and various motifs are being used like.

So of course, there is a various phases people have divided. They call it basically Ravi phase or Early Harappan phase, Kot Diji phase. Kot Diji is the...is not shown in this diagram, it will be somewhere unknown place. And Harappan Phase A, Harappa Phase B, Harappa Phase C depending upon this chronological you know years. And Harappa/Late Harappan Transitional and then Late Harappan is something 1800 BC to 1300 BC. Of course, these numbers also will be varying from different you know group of people.

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Indus Valley Civilization

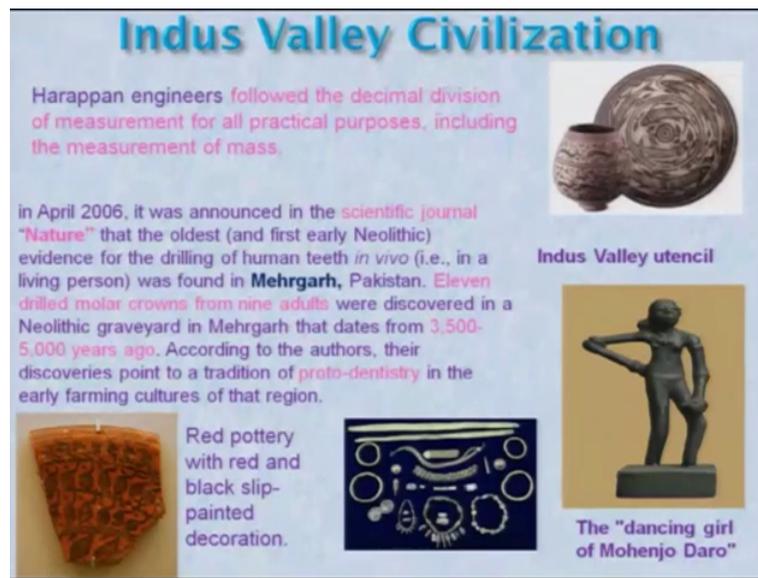
Harappan engineers followed the decimal division of measurement for all practical purposes, including the measurement of mass.

in April 2006, it was announced in the scientific journal "Nature" that the oldest (and first early Neolithic) evidence for the drilling of human teeth *in vivo* (i.e., in a living person) was found in Mehrgarh, Pakistan. Eleven drilled molar crowns from nine adults were discovered in a Neolithic graveyard in Mehrgarh that dates from 3,500-5,000 years ago. According to the authors, their discoveries point to a tradition of proto-dentistry in the early farming cultures of that region.

Indus Valley utencil

Red pottery with red and black slip-painted decoration.

The "dancing girl of Mohenjo Daro"



So if you look at... Let us look at Indus Valley Civilizations. And as I told, there were having a lot of you know engineering components. And they were following the decimal divisions of measurements for all practical purposes that what we use. And including the measurement of mass, they were also knowing how to measure the mass that like we use Kg, Gram and other things.

And if you look at, they were having the Indus Valley utensils. You can see it is so nice looking and then they could have and so also the dancing girl of Mohenjo-daro. If you look at, this kind of things are being used by the Gujarati people even today, these are bangles, okay? These bangles are still today. That means from that onwards we are having the tradition. That means our culture is living. So this is... there are several signature you will get, you will have to look at it. Look at with that eye.

So these are also the what you call they were using lot of ornaments for their to the you know... these are the very fine, minute ornaments. How they were making? What are the technology they were having? Today if I want to make, I will have to use sophisticated machine. Do they had sophisticated machines? How they were making those things? Right? They may be having we do not know. But if you think of, you know it is very difficult.

And this if I ask all of you engineering people like if I will ask how to make this thing, very few people will tell me, “Look! You can make this way.” Okay? So these are the thing we need to say, “How they were making? What are the precision? How they are doing?”

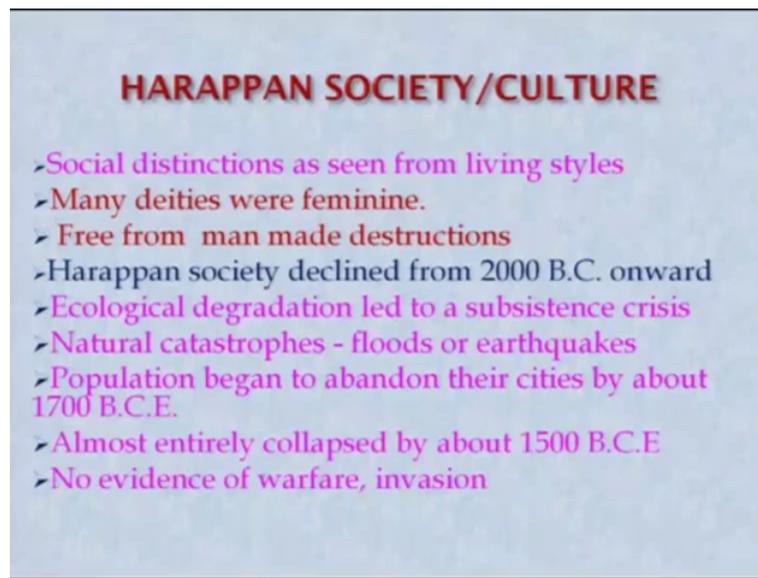
Like, red pottery you know like if you have very good motif, it is having design. How they are doing? And still existing after so many....these are all evidence from that excavation. It is not that some picture has been made later on. So very interestingly, if you look at a paper published in ‘Nature’ which is a very prestigious journal, right...? And a best or the most prestigious journal is Nature. They published in 2006 and about the how people were doing this in vivo. In a living person they were doing the drilling the human teeth.

Today also we do if you are old or something, your teeth has gone bad; they were doing at that time. And that has been proved. And 11 drilled molar crowns from the nine adults were discovered in the Neolithic graveyard in Mehrgarh, I talked about Mehrgarh where it is, is a city place that dates from some 3,500 to 5,000 years ago.

Again they are saying this what they have dated. Of course, IIT Kharagpur is saying 1,000 years again more than this. But according to author, their discoveries point to the tradition of proto-dentistry in the early farming culture of that region. Because our culture if you look at, it is farming, agriculture. I remember when Gyani Zail Singh, he was a president he told in foreign country: What is your culture? He told spontaneously agriculture. I used to laugh at him but today I realize he was true.

Agriculture is the culture of our country. The village is the soul of our country. We should keep the village culture intact and so also the urban. It is not that only village will be there. We always live in a urban and village kind of thing, both are important. So therefore we need to learn these things: how they were manufacturing? And I am sure that they were not using that machine of what we are using. They were using the cottage industry – by using the mind and you know hand – this balance between mind and hand. So that we are having, it is there in our blood. We need to revive.

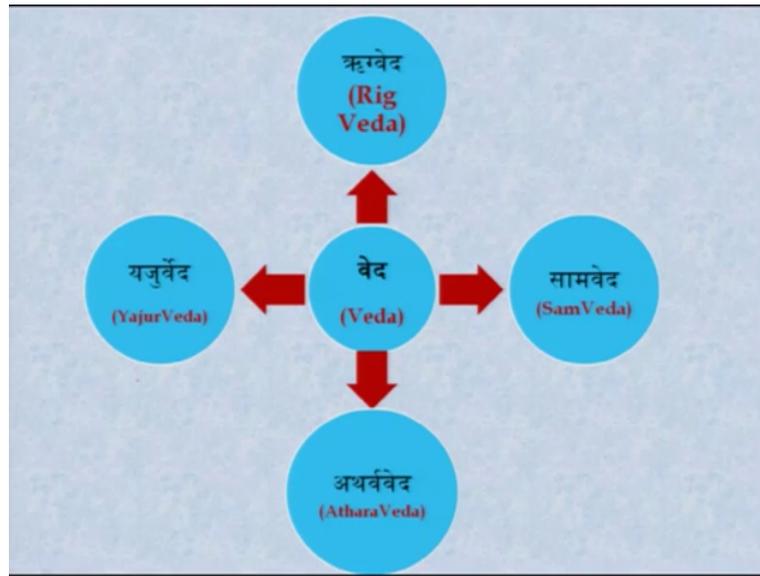
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So if you look at, there is a lot of this thing which I have already talked. I will not talk about that. But I will tell you that one thing – The Harappan society was free from manmade destructions. Today we do that. If you look at newspaper, lot of destruction we are doing. We are not at peace. The society is not at peace because of blatant misuse, abuse of the technologies.

So and no evidence of warfare, invasions and of course why it was collapsed is a one question that might be arising in your mind. Maybe it is due to some kind of climatic change or maybe they had used the technology at that time blatantly and spoiled their world, therefore it got extinct. There are several questions looming around and you people may do research to find out why that civilization got extinct at that time till you know and then again new phase started later on around 500 BC.

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Now I will come to the Vedic era. So you must be knowing that Veda Veda is divided into four types. You know, one is Rig Veda, Yajur Veda, Sama Veda, Atharva Veda. So it is text are available today, it is very difficult to read.

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Basic Texts	4 Vedas (Rig, Yajur, Sama & Atharva) Samhita, Brahmanas, Aryanaka, & Upanishads
Supplementary Texts	6 Vedangas
Complimentary Texts	4 Upangas

Main Ancient Indian Knowledge System : 14 Disciplines

Supplementary Texts

- Shiksha : (Education & Phonetics)
- Vyakaran : Grammer
- Chandas : Prosody
- Nirukta : Etymology
- Yotisha : Astrology
- Kalp : Rules for rituals

You want to read, you will have to learn Ashtadhyayi, that grammar. I am afraid very few people are (agr) are there in this country who can teach you you know properly. And we need to revive that; otherwise you cannot understand the Vedas.

And the basic text is four Vedas as I told. And each Vedas will be having Samhita, Brahmanas, Aranyaka and Upanishads. These are all various parts which need to be look at it. Of course, I do not know ...I could not understand. I was trying to read Vedas but I will tell you I like Upanishads which is very easier and simpler and very profound in that. And one should study that; of course with the help of somebody one can look at Vedas.

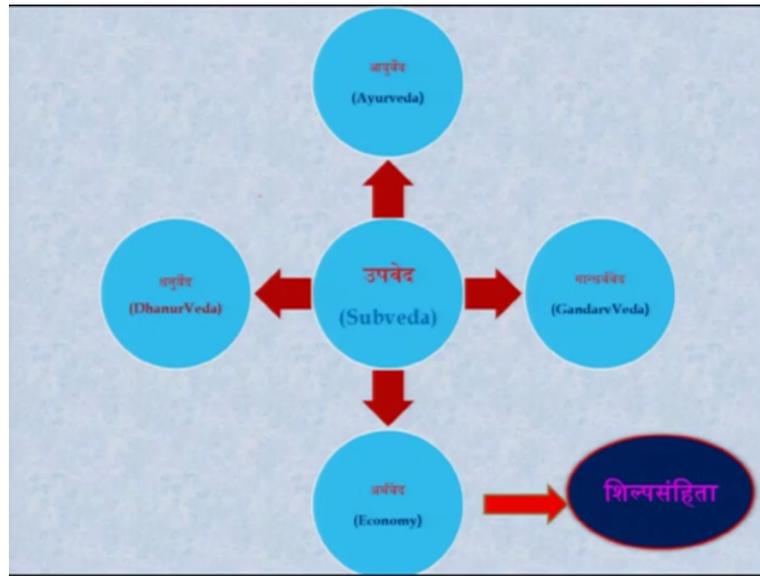
And there are supplemental text, 6 Vedangas and complimentary text, 4 Upavedas, Upangas which are still existing. There might be several other things. Main ancient knowledge system is basically 14 disciplines. So if you look at, this is basically 6 and 4, 10 and then this 4, total is 14 as of now. So supplementary text if you look at, it will be Shiksha, Shiksha means education and also the phonetics. Phonetics very plays important, today we do not know phonetics.

We do not know the science because ours is a phonetics based language but we do not know how it is and that is being emphasized earlier days. And of course, education what was given I will not talk here, it will take at least 2-3 hours to talk about that. What is a kind of education? I have understood little bit about it. And Vyakaran is very profound, very great and people have accepted it. We do not read that way. And prosody that is the Chandas basically. How to do that? It is an art. It also require a lot of mind. We do not do that today.

Nirukta, etymologies like how these words have formed, we do not know. If I ask somebody, how this word has come...? Let us say 'manav', manav kisko kahoge? Man what you call? "Oh, no, no. Manav is man." It is not. You are having some definition, certain things, properly it is being spelled out, science is there. It is a very beautiful, we do not do that. Jyotisha is being looked down upon today because of business, because of misuse of it.

And Kalp, rules of rituals – whatever the rituals, there should be some rules and it is having certain reason. Those are we do not know. It has to be looked at, research has to be done.

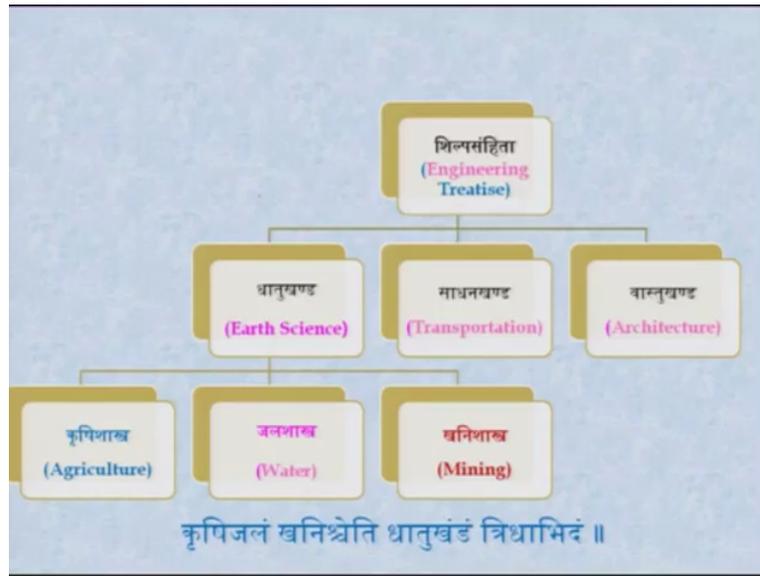
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So if you look at those Upavedas, of course they are divided into four parts. One is Ayurveda, most of you will be aware because it is coming up again. And unfortunately, Ayurveda is being practiced in the form of allopathy. People have not understood. They should use through the tenets of that and then practice that way.

I will not elaborate on that. And I will just inform you that these are the things one can look at: Dhanurvedas, Gandharva Vedas, and Artha Vedas that is about economy. And all those things together if you look at Artha Veda, economy, you can think of Shilpa Samhita. I have already talked about lately, what do you mean by shilpa in the first lecture.

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So what I will do, basically you can say Shilpa Samhita is basically engineering or technology treatise kind of things. It will be about Dhatukhand, about Earth science, about what are the things are there. Sadhankhand is basically about transportations like sea transportation and then what you call road transportation. Of course, people are claiming that there is air transportation but I do not know that. But at least, sea and the naval ship and then other thing we can accept. Okay? Architecture, the Vastukhand, there is a...we are having Vastushastra, it is now a very big business. People are making a lot of you know....they are fooling the people also, one has to be careful.

Umm, and then when you talk about this Earth science is basically agriculture because agriculture was very part and part of our civilization even today – till today, although we lost the way to western people. Now again the agriculture is coming up with a new name of organic farming but that is our way of doing it. And we must relearn it not from the western people, from our scriptures and improvise it if it is required at this moment. Jalshastra, water is very important. And mining, the khanishastra is also is one can look at it.

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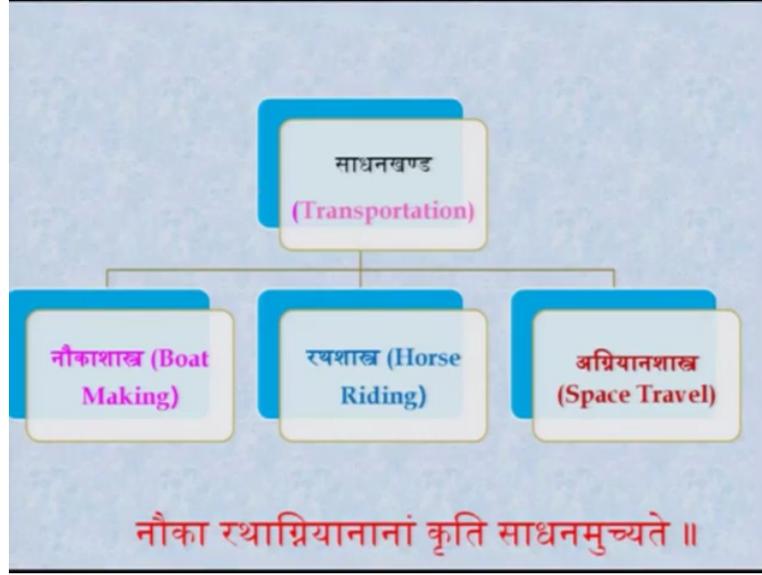


And if you look at krishishastra is basically vrukshavidya like plantations, pashuvidya about animal science, manushyavidya like human resources, you know like is a part of krishi, you know like it is a part of krishi. So how to make them this thing? Jalshastra will be about scriptures of water. Sansechanvidya they basically irrigation and sangranvidya, drainage of water like how to transport and other things.

And stambhanvidya, storage of water because water storing is very important and is a natural way people have done. I will be talking about that when I will talk about water harvesting, how natural it was to us. And if you look at the khanishastra is pruthakaran, separation of metal that we do in modern time and bhasmikaran vidya, calcination I will be talking about that later on.

And sankarvidya, making of alloys, we are having. You might be knowing most of the temples we are having any metal, it will be panchdhatu, ashtadhatu, navdhatu, you know these are all nothing but alloys. And dhrutividya, gemology like you know gems. Like we are....very good people are using lot of things, earlier they were knowing how to do that.

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And transportation if you look at, naukashastra like boats making; rathashastra, horse riding; agniyanshastra, people call it space travel. I do not know about that but at least I can say that naukashastra we are having evidence. Rathashastra anyway we are there. So these are the things has to be looked at it.

But when I say I do not know, that does not mean we will not look at it. We will look at with a pinch of salt, with a you know mind to unravel, prove that it is right, not go by emotion, go by the something.

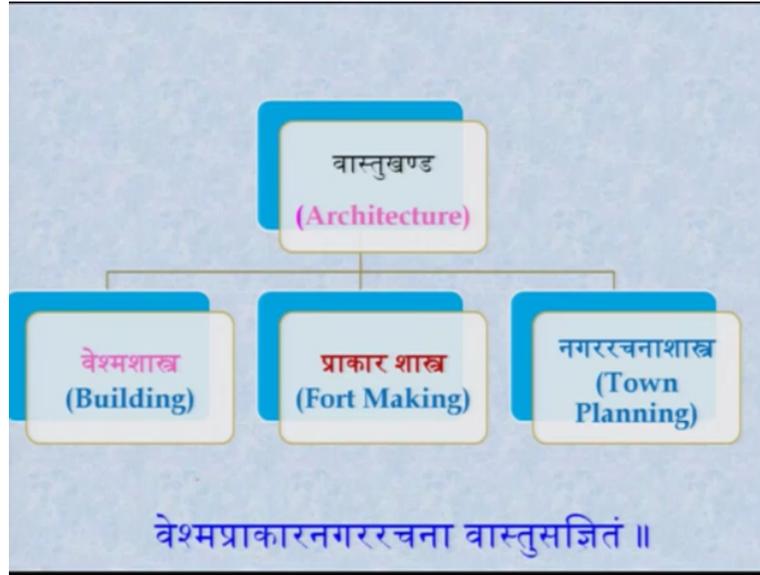
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नौकाशास्त्र (Boat Making)	रथशास्त्र (Land transport)
मुक्तिकल्पतरु, अर्थशास्त्र,.....	रथलक्षणम्, शुकनीति, अर्थशास्त्र,.....
➤ तरीविद्या (Raft Making)	❖ अश्वविद्या (Horse Riding)
➤ नौविद्या (Construction of Boats)	❖ पथविद्या (Road Construction)
➤ नौकाविद्या (Construction of Ships)	❖ घंटापथविद्या (Hill Roads)
	❖ सेतुविद्या (Bridge Construction)
अग्नियानशास्त्र (Space Travel)	
यन्त्रसर्वस्व, अगस्त्य संहिता, समरांगण सूत्रधार,.....	
❑ शकुन्तविद्या (Birds Training)	

Toh, tarividya, raft makings; nauvidya, construction of boats; naukavidya, construction of ships, right? All were having. And rathashastra of course, so these are the....uktikalpataru, Arthashastra these are the (skip) scriptures available and Rathalakshanam, Shukraniti, Arthashastra, right? These are the things from where you will get some information about this.

Ashvavidya, horse riding; pathavidya, road construction; ghantapathavidya, hill roads like roads will be hill side one; Setuvidya, bridge construction. , so if you look at agniyanshastra what people are giving, Yantra Sarvasva, Agastya Samhita, Samarangana Sutradhara these are the books whatever people have collected. And shakuntavidya, birds training they were doing earlier days to train the bird to give the information. Vimanavidya, air and spacecraft.

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So about the what you call architecture, about building, fort making and town planning: I will be talking about town planning and also about the rural areas how we can make buildings kind of things. I will be talking about the....of course, I will not be touching upon fort making because from these two we can learn a lot how we can do.

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And I think this veshmashastra if you look at, how to look at vasovidya, tents. People were making tents and huts, kutividya. Mandirvidya, I will be talking about how to make the huts

what people are using; Mandirvidya, I may not. Prasadvidya like palaces. And nagar-rachna shastra, town planning I will be talking about. Aapanvidya, market; rajgruh vidya; sarvajanvaas vidya, public places; vanopavan vidya, garden I will do and devalaya vidya, temples.

So I will be talking about in town planning only the buildings. I will not be touching upon temples, is a very vast subject you know. So and this fort making, I will not talking about the durgavidya, forts; castle like kutvidya; aakarvidya like moats you people might be knowing is basically drench which will be having this thing; yuddhavidya, warfare.

So what I will be... now I will be stopping over here. And then we have seen what is the plethora of knowledge our ancestors were having but we will be discussing some of them only, okay? So you have seen the whole gamut like of the things whatever they required for leading a very nice life and also a very productive and balanced life. Some of the technology are required. And we will be looking as we go along with that.

And in the next lecture, I will be talking about how our people were doing science, what are the basic principles they were following. That, we will be looking at in the next lecture. Thank you very much.