Ayurvedic Inheritance of India
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Module - 8
Ayurveda and Science

Lecture - 18
A Science Initiative in Ayurveda (ASIIA) to Ayurvedic Biology

In the long history of Ayurveda, it has had contact with Chinese medicine, it has had contact with Arab medicine, and we have evidence of those contracts and Ayurveda was never averse to accepting what was useful for patients, and adhered to Charaka's old adage that the whole world is teacher for the wise. For example, the examination of pulse - Nadi pariksha or the use of Mercury extensively in treating patients, that these were not mentioned in the Brihat trayi, but they came later from external sources and they have enriched Ayurveda.

Today, we will be talking about the interaction of Ayurveda with what we call modern science. Ayurveda was also a science, but it was pre modern science. When we talk about medical science, today, I want especially to refer to a two major events during the renaissance which made modern medicine according to my reading and that was one related to structure; the other related to function. It was Vesalius during renaissance in Italy who published the great work the structure of the human body; the fabric of the human body.

Now, prior to that also anatomy existed in Europe, but very often the descriptions were inaccurate; they were not verified to the extent they should have been. For example, Aristotle talking about women having more teeth than men; now, there are many such in all ancient descriptions of anatomy, but it was Vesalius who showed by painstaking dissection over many years; the accurate description of the human body; even going to small pisiform bone or lumbricals, tiny structures, nothing was left out and that description laid the basis for modern medical science in structure; that is accurate observation without which there can be no modern science.

A similar development by William Harvey; incidentally, he had his education in Padua in Italy and he did the famous experiments on circulation and showed that the human

heart is a pump and that is responsible for the circulation of blood, by painstaking experiments. So, if you have a hypothesis or an observation, if you have to prove that particular idea, then you have to have experiments done. In other words, your imagination or hypothesis if you want to test it, if you want to convert it into science, there is no escape from doing experiments. So, these two- accurate observations and experimental verification, these were the foundation stones of modern medical science. So, the interaction of modern medical science from the West Europe with Ayurveda - that is what will be interesting to us in this discussion.

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Now, we will be discussing the science Ayurveda encounter in India. One dealing with plant sciences, essentially Taxonomy; Garcia Da Orta from Portugal who came here in the 16th century to Goa; Van Rheede from Netherlands in the 17th century; Ainslie Roxburgh and many other British observers and scientists in the 19th century. These were the contacts with European science, Taxonomy at that time, a very modern science in those days with Ayurveda.

And then came Pharmacology; Sir Ram Nath Chopra in the 20th century, early 20th century, followed by Organic chemistry with great names like Asima Chatterjee, Govindachari, Sukhadev and many others who are living. So, that was mostly the dominating the 20th century. Now, Modern Biology, Immunology, that innovatively follows in the 21st century. These are the subjects we will be touching on in this lecture.

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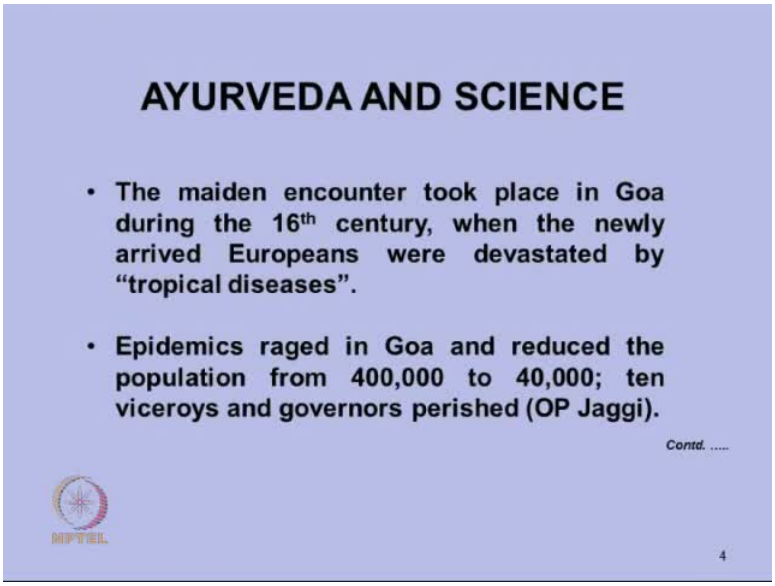

Now, the first encounter, Ayurveda and modern science, I mean whenever I say science I mean medical science or other sciences like Taxonomy applied to medical science. Incidentally, I must point out the Taxonomy plant sciences. These were not very considered very different from medical science because you will often find in the 20th, in those centuries, many professors of medicine in Europe, for example, they were also professors of plant science or Botany; this was not uncommon in England, in Europe, even in Calcutta. So, there were not far apart at that time.

Now, the first encounter was Garcia Da Orta who came to Goa in the 16th century, the first in a fleet coming from Portugal and that was the time they had just established themselves in Goa, and epidemics raged in the Goa. And according to one description in a matter of 10 years, the population of Goa reduced from 400,000 to 40,000; ten viceroys and governors perished because of tropical diseases like cholera, dysentery and so on, which were new to the Europeans and there no way of treating them.

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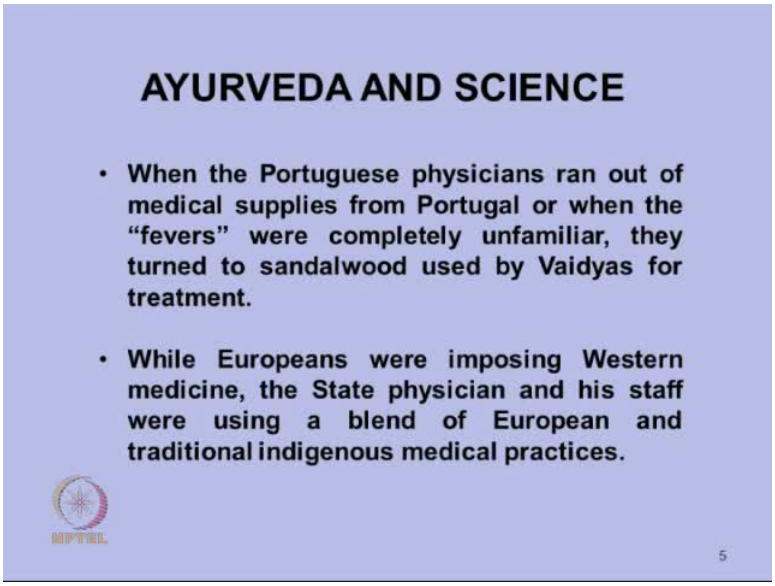

And when the Portuguese physicians ran out of medical supplies from Portugal or when the fevers were completely unfamiliar tropical diseases, then they had looked at what the native physicians were doing. They observed the use of sandalwood paste in treating fevers and that was one of the first that they adopted; external application for containing fever; so, it was a fragrant introduction to Ayurveda by the Europeans. Now, the, while the officials, the European officials in charge of colonial administration, they had strict rules about employing Indian remedies or Indian physicians. The state physicians and the staff from practical angle, they did not hesitate using their services.

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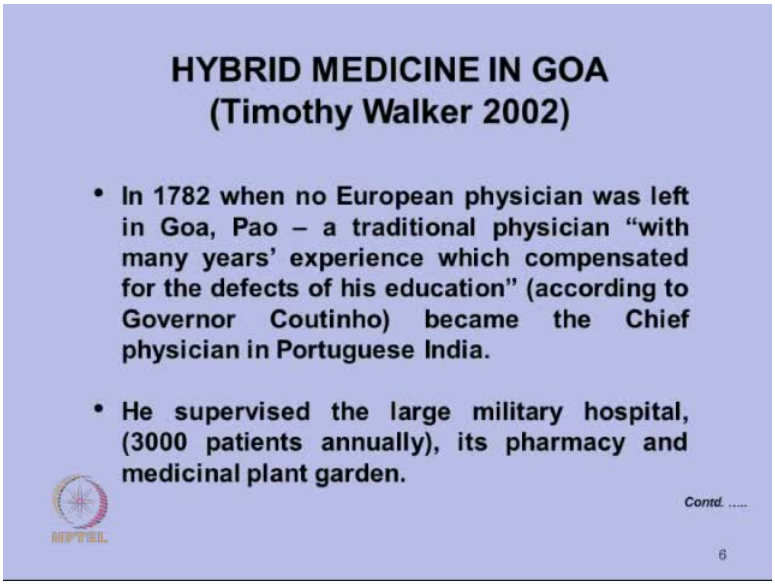

An American scientist Timothy Walker, he did an extensive study of the records available in Goa during this early colonial days; especially the use of native medical applications in Portuguese medicine. For much of what I say, I owe to these studies of Dr. Walker. In 1782, when there was no European physician left in Goa, Pao that was the name of a native Indian, a name which had been converted to Portuguese, a traditional physician with many years of experience; this is what the Governor Coutinho writes. This man who had no formal qualification in western medicine, he was a traditional practitioner, but he had many years of experience. So, he says, the Governor, with many years experience which compensated for the defects of his education became the chief physician in Portuguese, India in Goa because they had no choice; they had no Portuguese physician available and the problems were pressing. So, the Indian, they needed a physician and Pao was appointed, and he supervised a large military hospital, 3000 people being treated annually, its pharmacy and its medicinal plant garden; all these were under his charge.

He produced a booklet on descriptions and virtues of medicinal roots for use of not only in Goa, but also Portuguese colonies in Asia. Now, in this book, many of the plants which are mentioned they were actually taken from the Bruhat Trayi, the Ayurvedic classical text.

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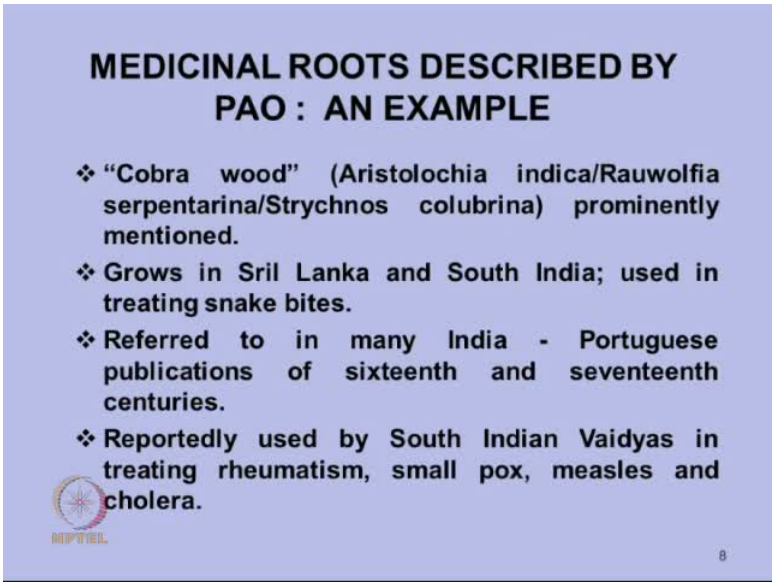

And one of the plants which he mentioned, not all the plants mentioned were taken from Bruhat Trayi, but Cobra wood was mentioned by him. And what is Cobra wood? It is not mentioned in the Ayurvedic text. It is grown in Sri Lanka and South India. It used in treating snake bites and it turns out that this was nothing but Rauwolfia serpentarina which became very famous later on. You will see the references to that later. This is one of the first mentions of that and it is referred to in many India Portuguese publications of the 16th and 17th centuries.

It was used extensively by Vaidyas in South India, and remember, the Bruhat Trayi, they were composed in the North of India. These were used in South India in treating rheumatism, small pox, measles and cholera; it was also used in Sri Lanka.

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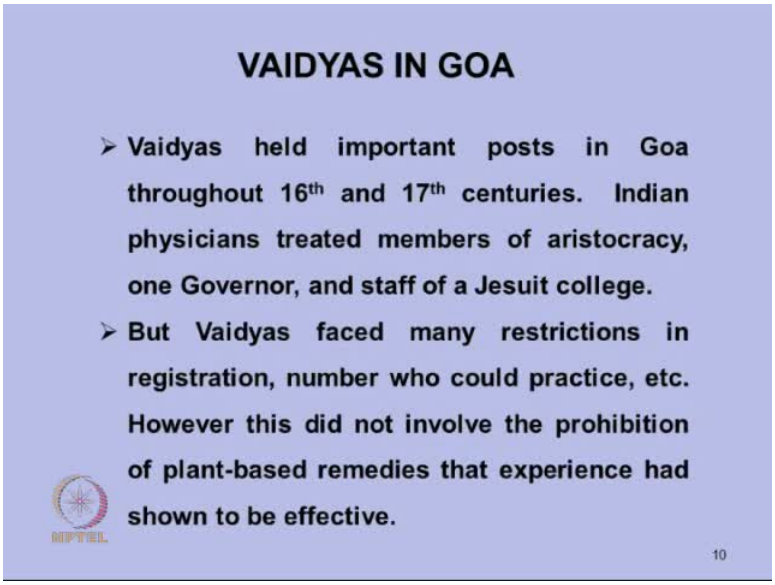

The Vaidyas in Goa: It is an interesting story because hospital facilities largely limited the use of Portuguese army personal. They built hospitals, the 3000 bed hospital or 3000 patients being treated annually that hospital.

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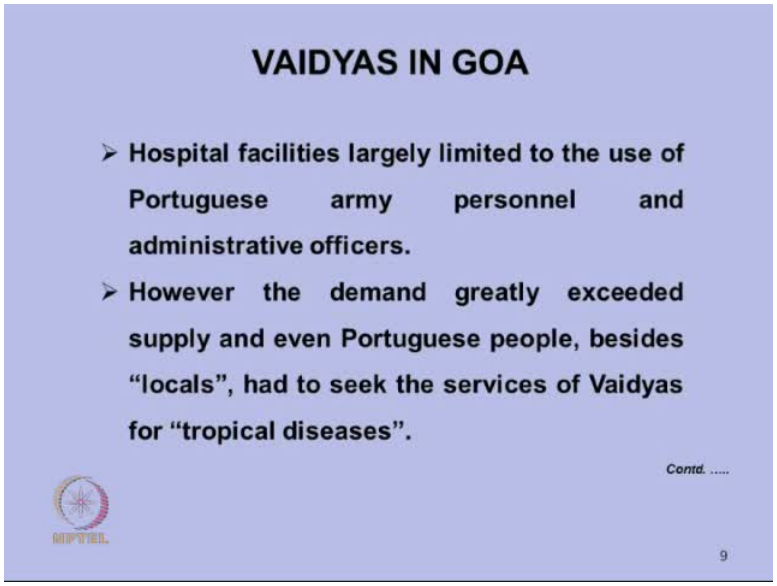

These were all mainly meant for Portuguese soldiers, their families and Portuguese officers, but the demand greatly exceeded supply. They did not have enough Portuguese physicians and the locals also sought local treatment and therefore, the Vaidyas were pressed in to medical service; so, treating essentially fevers and tropical diseases. So, both the Portuguese officials, soldiers and families, and also the locals, they did not shrink from using the help of Vaidyas.

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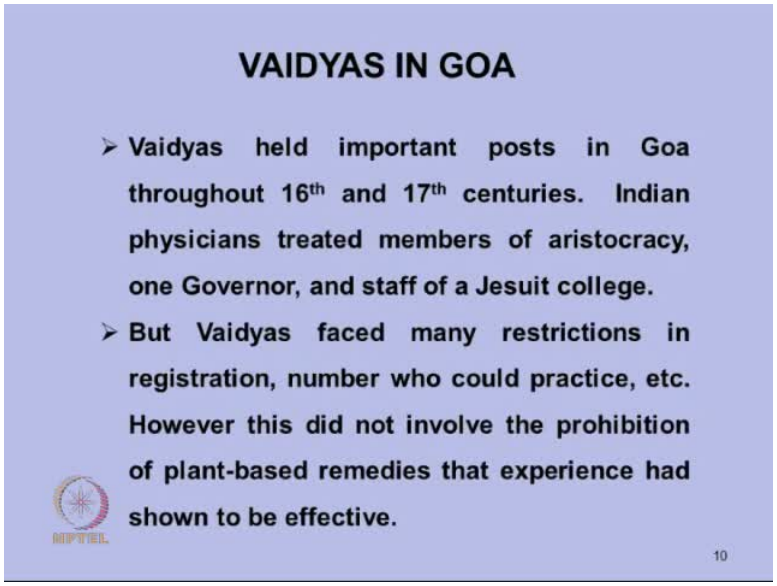

And Vaidyas held important posts in Goa throughout 16th and 17th centuries. And Indian physicians we have records to show that they treated aristocracy, one Governor, and staff of a Jesuit college. These are all Dr. Walkers research has shown; they treated them. These Vaidyas faced many restrictions in legal terms in registration, number who could practice etcetera, but this did not involve the prohibition of the use of plant based remedies which had been used traditionally.

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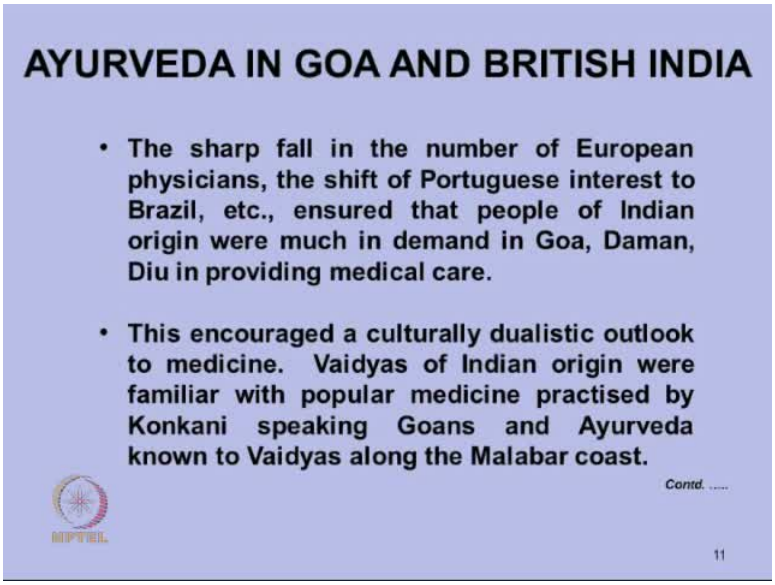

Now, the, a new development; the Portuguese had colonized Brazil, and their attention turned to Brazil for economic reasons and their interest in Goa started diminishing to that extent, and the people of Indian origin, the demand for medical services, they could not stop here. Not only the native population, but the remaining Portuguese officers and staff, they had to have medical help and the Portuguese physicians shifting their attention to Goa, their dependence on Indian physicians became even greater. So, we had a culturally dualistic type of situation in Goa at that time. Vaidyas of Indian origin who were similar with the great traditional practices of Konkani's in Goa and also the Vaidyas practicing in Malabar coast, that provided useful medical information for treatment.

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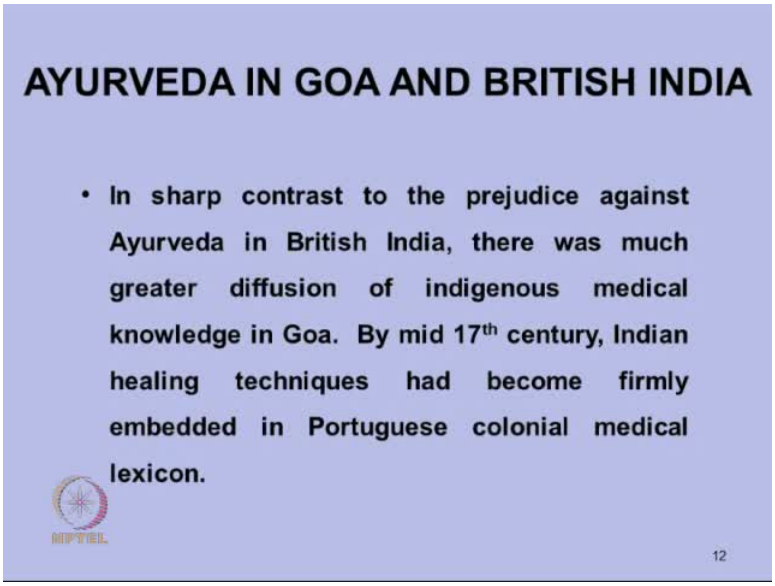

Now, in the, at that time, the British were colonizing the rest of India. There was a sharp prejudice against Ayurveda in British India, whereas in Portuguese India, there was a more friendly attitude towards Ayurveda. There was a greater diffusion of knowledge of Ayurveda in these Portuguese colonies.

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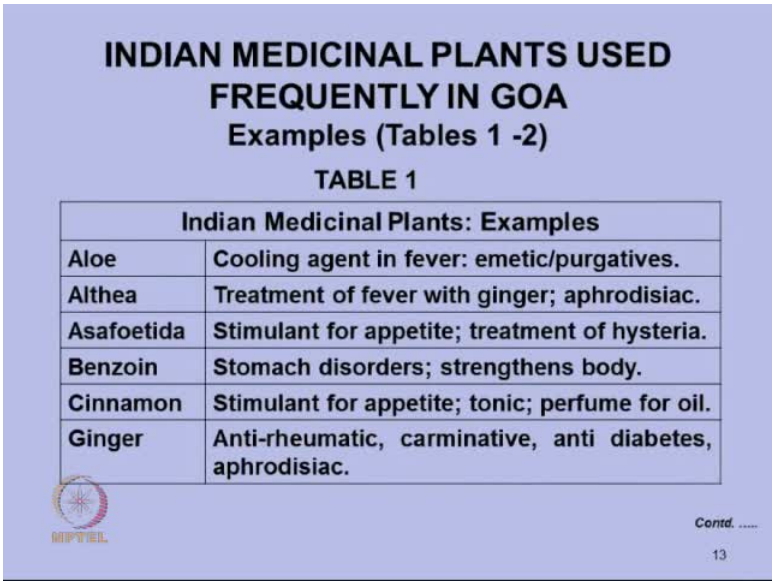

Now, these were the medicinal plans which were used frequently in Goa and also the applications are given here. Aloe for cooling agent in fever: emetic, purgatives. Althea Asafoetida, Benzoin, Cinnamon, Ginger, all these were used in traditional Indian

medicine. They had been used and for very similar indications, they were used in treating patients in Goa; treatment of fever with Ginger, stimulant for appetite - Asafoetida, Benzoin for stomach disorders as a tonic, Cinnamon stimulating appetite as a tonic, as a perfume, Ginger for anti-rheumatic, carminative etcetera. These indications are very similar what you find in Ayurveda also.

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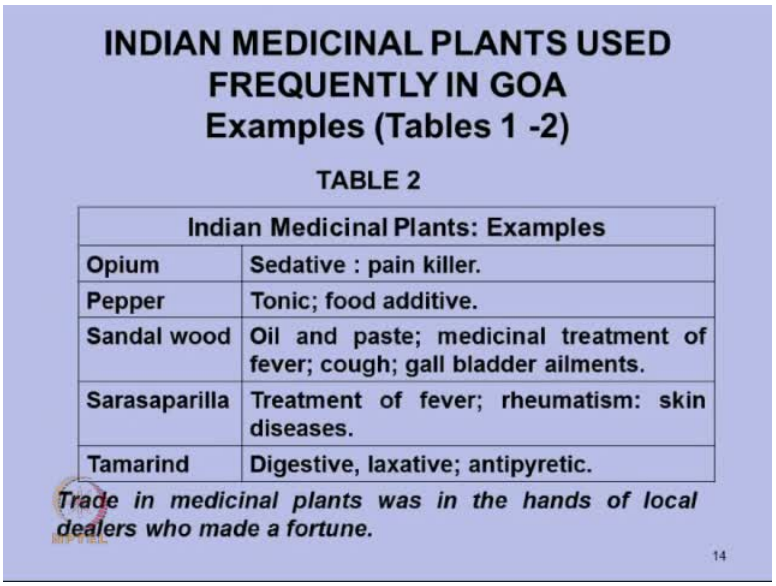

It goes on. Opium - this was not there in our traditional Indian medicine, but that was used in Goa as a sedative and pain killer. Pepper - tonic and food additive; Sandal wood extensively used; Sarasaparilla, Tamarind as a digestive, laxative, antipyretic, and so on. So, that use was increasing and the trade in these medicinal plants was in the hands of Goanese people and they made fortunes by exporting these to Europe; that is another story, we would not get into that.

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Now, that was the time, this was the background in Goa when Garcia Da Orta make made his entry into Goa. Now, he was an interesting person who as a Spaniard by birth became a physician and he reached Goa in a fleet commanded by Alfonso de Souza who was a friend of his. So, in 1534, Garcia Da Orta landed in Goa and started practicing medicine and he practiced medicine in Goa for 36 years; it is a long period indeed. And during this practice, he published this great book which is his claim to fame that is Colloquies on the Simples and Drugs of India in 1563; almost 30 years of experience in Goa. And it was first printed publication on Indian medicinal plants and practice of tropical medicine in in western literature; it was nothing earlier.

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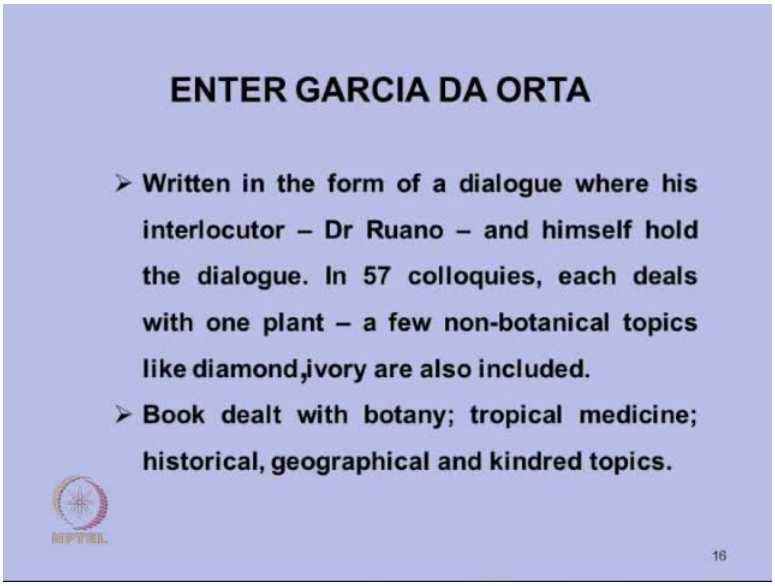

This was written in the form of a dialogue. That was a very fashionable type of presentation in those days; scientific themes being presented in the form of a dialogue, which makes it more easily readable. Here, Garcia is talking to a man called Ruano. Ruano is asking questions and Garcia is answering; that is the way it is written. There are 57 colloques or discussions and each one deals with the plant, and there are also some references to things like diamond; non not plants. That is also there, but basically it is dealing with India's medicinal plants, but it also contains something about medicine. The medicinal plant is applied for treating a particular disease; there will be a reference to that disease where very valuable information on the disease, historical, geographic correlates of these diseases.

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And this is the cover page of that Colloques.

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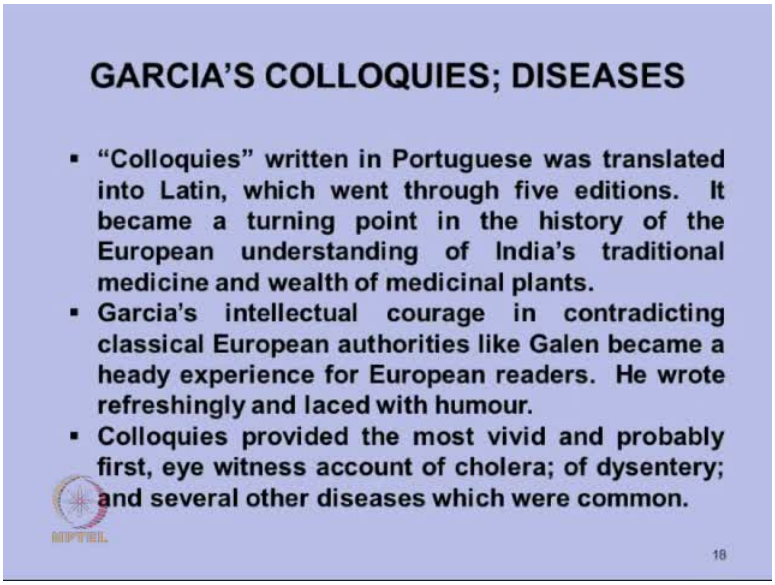

This was published in, written in Portuguese, but very quickly it was translated into Latin and all the European languages. This was the first authentic description of India's medicinal plants and it became something of a bestseller because it introduced India's medicinal plants and also the use in India's traditional medicine to Europe; that was the historical significance of this book. If you in this book since Garcia had been so long away from Europe, in Europe at that time Galen's medicine was the authentic medicine.

Nobody dared question any of the views of Galen, even if they had been unverified by science or anything. But in Garcia's colloquies, you will find he is raising questions about some of Galen's concepts and he also adds I could not have written this, if I had been living in Europe.

So, being away from Europe gave him a certain amount of independence intellectually and also the willingness to question. This was also appreciated in Europe; somebody sitting far way in Goa; he is raising these interesting questions about the Galen's heritage; that is another interesting aspect of this book. Apart from the great wealth of information on medicinal plants, this book contains very real descriptions, authentic descriptions of diseases like cholera.

In our Ayurvedic text, these are, the cholera is described; diarrhea's or various other diseases, but detailed portrait of a disease, that you have to read in books like Garcia. And also in British India, at that time there were administrators, collectors of various districts; there are excellent descriptions of diseases. They were seeing a disease like cholera for the first time or some other diseases and there are very nice descriptions of diseases; that is another thing which you find in Garcia's book.

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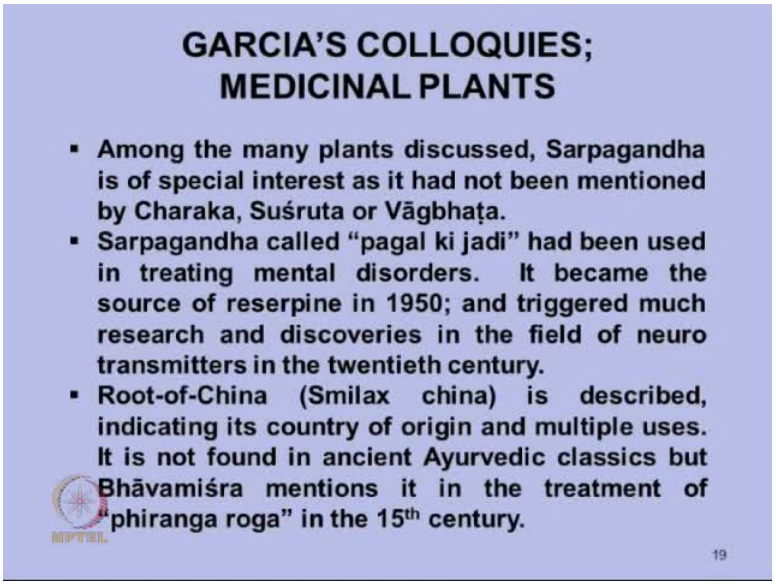

Among the many plants discussed, Sarpagandha is of special interest which we had already referred to that Pao had mentioned this and Garcia also mentions this because it was extensively used in South India, and this is not mentioned in Charaka, Susruta or

Vagbhata. Now, this was called long known in India as Pagal ki jadi. It was used for treating insanity. In the treatment of insanity, if you look at Charaka you do not find this plant mentioned, but the common they but, they characterized this as a drug for treating insanity.

Then it became the source of Reserpine in 1950 because long known as a tranquillizer of patients with insanity or other kinds of restlessness that was known. And in 1950s Rustom Vakil, very well-known cardiologist in Bombay trained in modern medicine, we had no good drugs in those days to treat high blood pressure. So, in desperation, Rustom Vakil, based on this information from native physicians that here is a drug which tranquilizes people and on a hunch he gave this Rauvolfia to patients with high blood pressure and found that blood pressure could be controlled. This he published in the Bombay hospital journal; he was a consultant in that hospital and that was picked up by Seba, and they did extensive research on this in Switzerland; that is how Reserpine came in to the market.

One of the first drugs for treating high blood pressure, it won a great deal of recognition; it triggered a whole lot of research. As anti hypertensive, it quickly lost its importance because much better drugs became available, but what followed was something interesting because this was known as for treating insanity. It was found to have some effect on neuro transmitters in the brain. And a great deal of research in neuro transmitters in the 1960s, they were triggered by the work original work on Reserpine and that has created a whole new branch of a research in neuro transmitters. So, it had some scientific significance apart from the treatment of high blood pressure.

Root of China was another drug which was mentioned by Garcia indicating its origin from china because they had colony in Macau in China. So, the Portuguese colonies they had a good deal of exchange of information. Now, in the ancient Indian Ayurvedic texts, this is not mentioned, but there was a text by Bhavamisra which was published in the 15th century, many centuries after Vagbhata, there you find this drug is mentioned in the treatment of Phiranga roga which is syphilis, which is not mentioned in the old Ayurvedic text.

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This is a picture of Garcia as he looked at that time and this was in the 16th century and the next century this board window of Taxonomy had been opened, but it was opened much further by this remarkable person Van Rheede.

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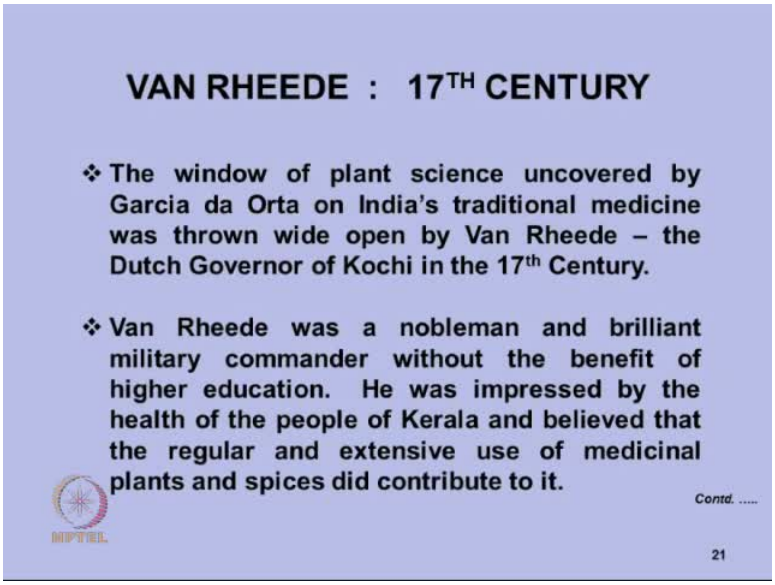

Van Rheede was the Dutch Governor of Kochi. That Kochi was not just a small state; it was a lot of Malabar Coast also was involved and he was the Dutch Governor in Kochi. He was a very daring commander, a noble man by birth, but he did not have much of higher education. But when he came and settled down in Kochi, became known as a

brilliant commander, one of the things he observed was the natives of Kerala, they looked healthy to him and he attributed their state of general health to the spices that they were consuming; like many of those like cardamom, ginger, cloves, all these if noted that they were consuming this in small quantities, turmeric, then all their daily consumptions they were taking small quantities and he thought their good state of health had something to do with this. That is how his interest was aroused and soon he started organizing a survey of the medicinal plants in the Malabar Coast.

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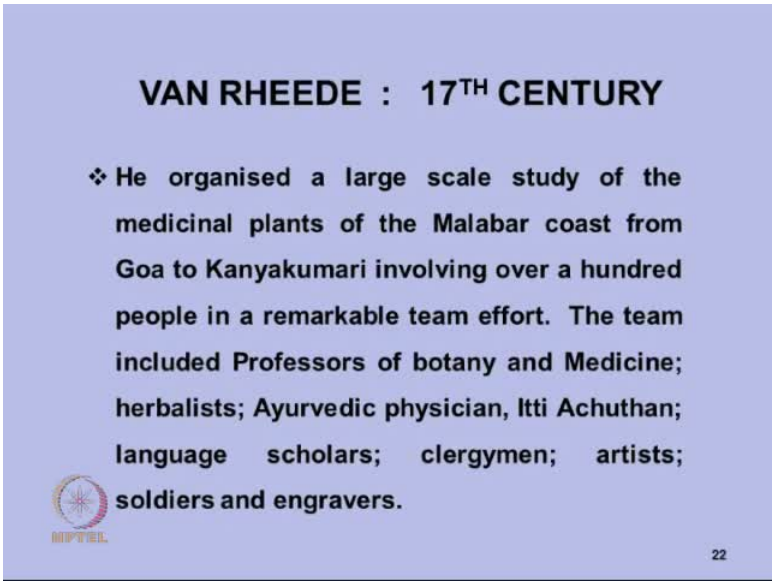

By Malabar Coast he meant all the way from Goa to Kanyakumari, and soon this interest became, so he became so passionate about this. He organized a very big group almost a hundred people. As a Governor he had the resources; the Dutch East India Company supported his effort and this team included professors of Botany and medicine, herbalists, Ayurvedic physician Itti Achuthan, language scholars, clergymen, artists, soldiers, engravers, almost hundred people and lot of field workers.

There were three herbalists from South Kerala where I live. There was a Itti Achutan an Ayurvedic physician; he was the one providing the medical information or the use of these medicinal plants. There were many other herbalists; there was a Father Mathew who was involved in this. So, a large number of highly educated expert people were part of this team, and he found among his soldiers people who could draw extremely good

botanical drawings. He took them also and you will see some of the remarkable drawings which they made at that time.

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Now, they worked on this for 30 years and this is Van Rheede.

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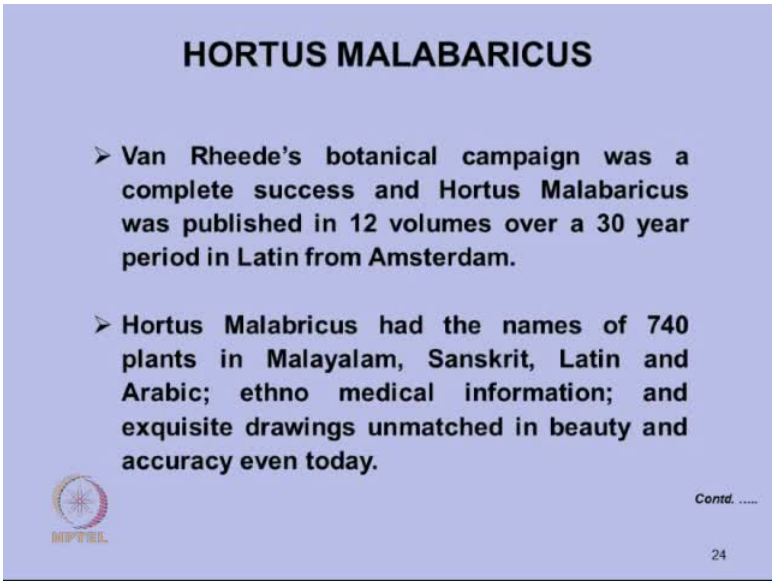

And his campaign was a total success and he published Hortus Malabaricus, the garden of Malabar. It was published in 12 volumes over a 30 year period in Latin from Amsterdam. And they said, gave the names of 740 plants in Malayalam, Sanskrit, Latin

and Arabic, ethno botanical information and exquisite drawings unmatched in beauty and accuracy even today.

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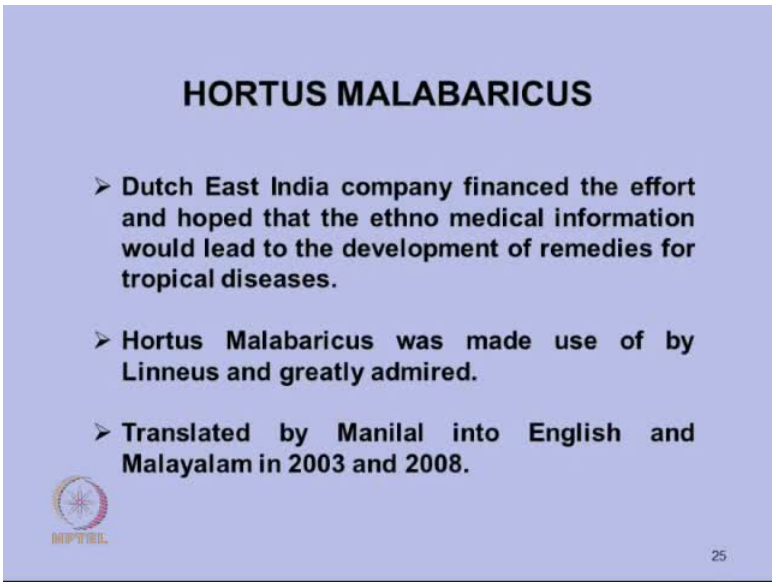

There is a lot of medical information about the use of this in a particular disease; that was supplied by Itti Achutan. And Dutch East India Company, they financed this effort over this long period in the hope that this could lead to the treatment of tropical diseases. Perhaps, it might even have a good commercial angle. And this was made use of by Linneus in developing his system and it was translated only recently in 2008 into English and Malayalam by professor Manilal of Kozhikode.

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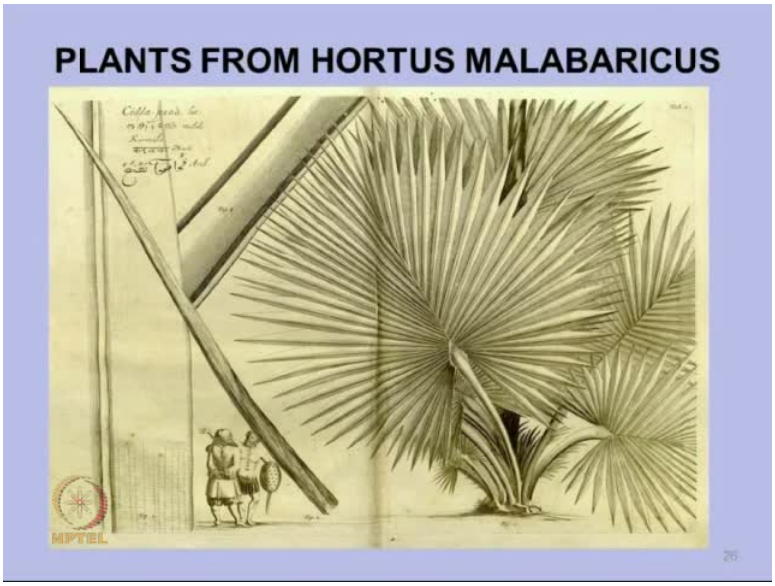

Now, these are some of the drawings from Hortus Malabaricus; so extremely impressive.

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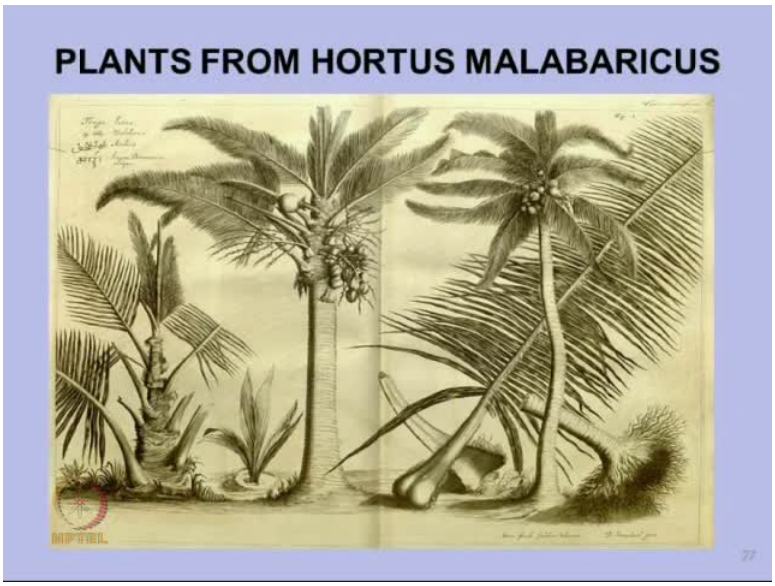

Now, here is a coconut tree. You can see on the left hand side, a coconut tree, as soon as it is planted. It is grown a little bit, a little more and in on the right hand side, you can see a tree in its adult hood; it leaves with such authentic detail.

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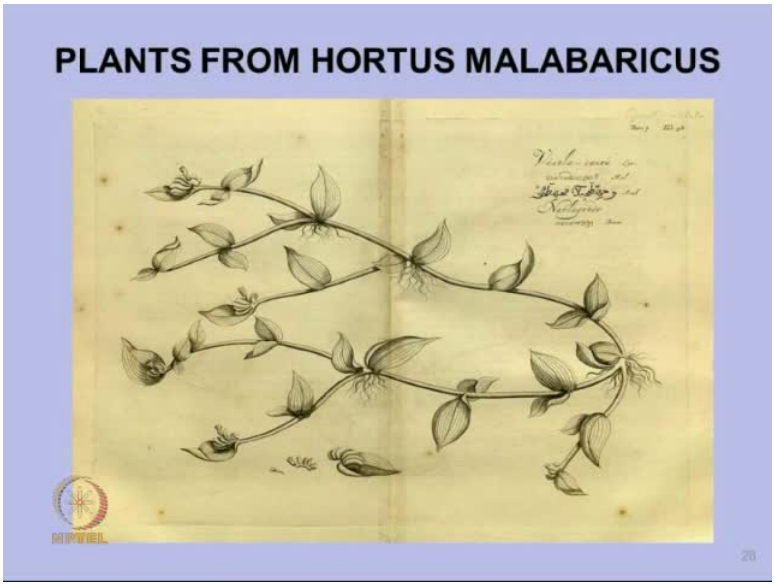

Now, here is a creeper.

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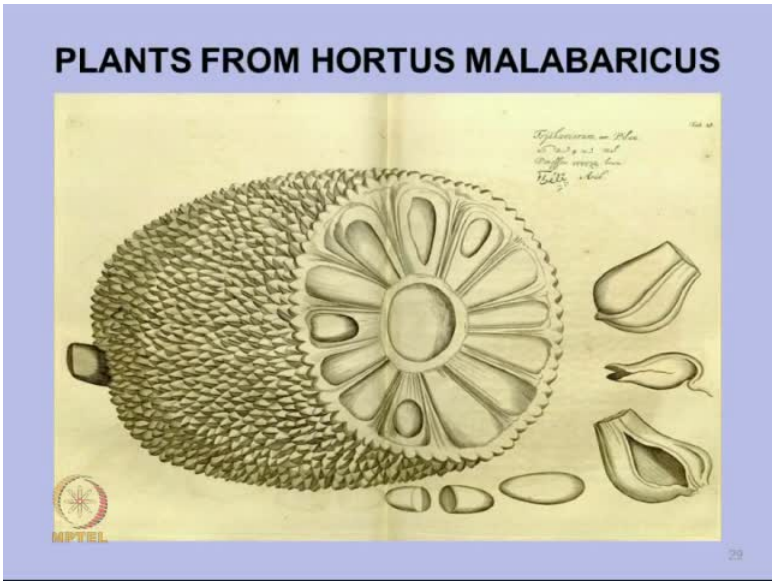

Here is a Jackfruit; you can see how beautifully it is drawn.

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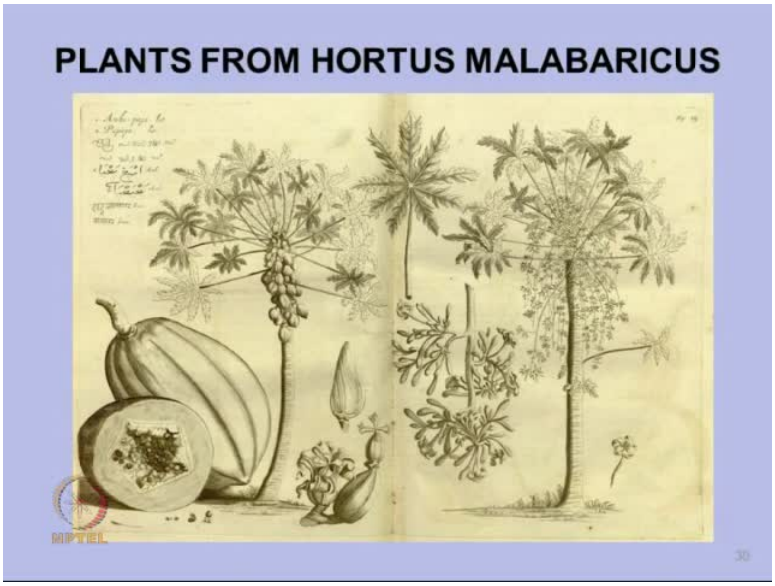

Now, here is a papaya which was not (( )), it was introduced by Protuguese in India, but you can see the Portuguese papaya.

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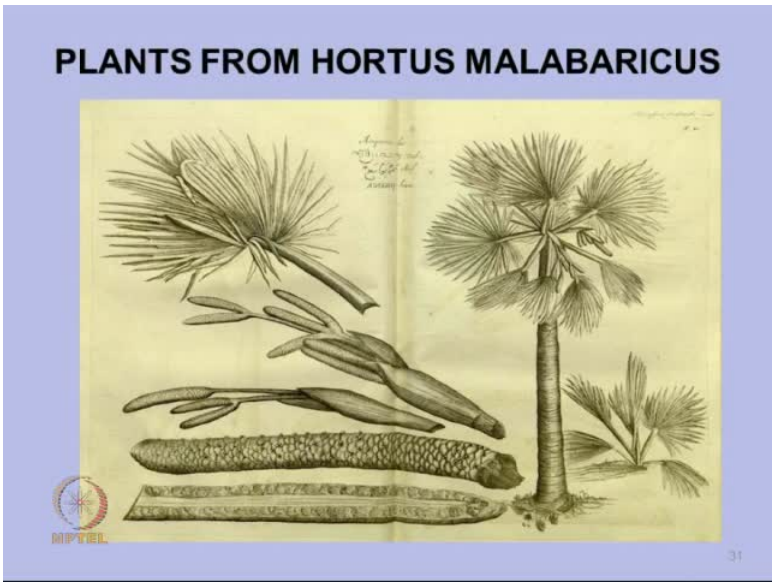

Now, here is a palm tree. These are some of the examples and each one of them is a masterpiece of botanical drawings.

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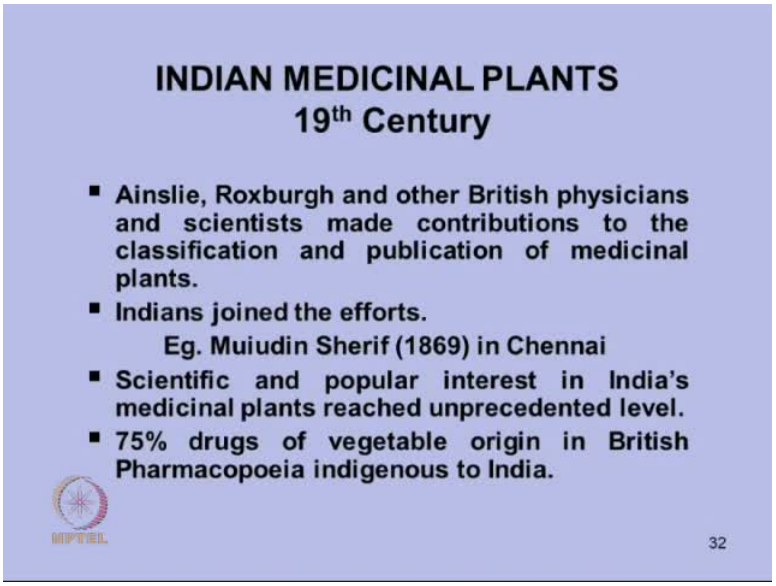

Now, the 19th century, after Van Rheede the interest in the Indian medicinal plants heightened and number of British, Ainslie's one and Roxburgh in Bengal, these they did extraordinarily fine work on the lines of what Van Rheede had done. In fact, Roxburgh produced a book Hortus Bengalensis; it did not get kind of recognition which Hortus Malabaricus got, but that trail which was opened by Van Rheede was followed by many others including an Indian Muiudin Sherif in Chennai in 1869. So, number of publications came on medicinal plants of India, and the the interest in the medicinal plants of India reached such high level in 75, the 19th century British Pharmacopoeia said 75 percent of the drugs of vegetable origin, they had their origin from India.

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Now the 19th, late 19th and early 20th centuries, the British administration, they set up a series of research institutions in India. Everybody knows that the British introduced western hospitals system in India. They started nursing, midwifery, medical education, medical schools, all these are known. What is not so well known? They also set up research institutions; one of them was Indian Research Fund Association, the forerunner of ICMR.

They started this even before the MRC of Britain. Haffkine Institute, Mumbai, Nutrition Research Laboratory in Coonoor, King Institute, Guindy, Central Research Institute in Kasauli and School of Tropical Medicine, Kolkata; these were all started by the British towards the end of the 19th century or early 20th century, but there was not one which was focused on Ayurveda or the traditional medicine in India because they did not consider because it was, it was worth investing in research in this medicine.

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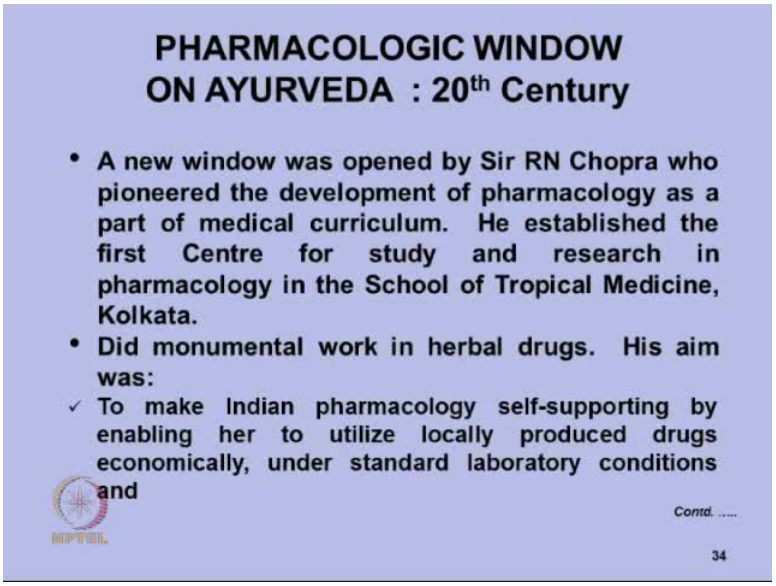

However, so Ram Nath Chopra was appointed in the School of Tropical Medicine, Calcutta, and he started the first department of Pharmacology. So, we had so far the window of Taxonomy; that is how modern science looked at Ayurveda through a window of Taxonomy. Then, it was Sir Ram Nath Chopra who opened a new window that is the window of Pharmacology. This was the first such centre in Pharmacology established in India and he did monumental work on drugs, and his aims were, I have quoted this, to make Indian Pharmacology self supporting by enabling her to utilize locally produced drugs, economically. And he had this vision of natively produced drugs would plays play a very important role in health services.

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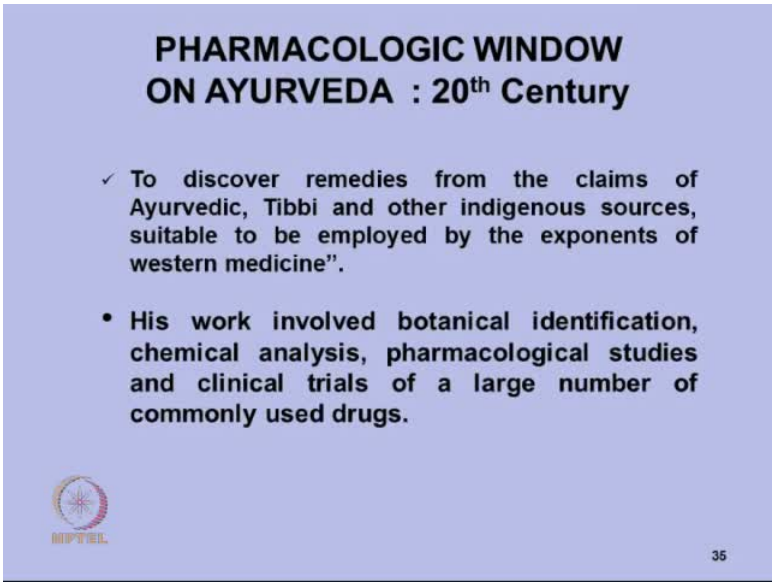

And secondly, he wanted to discover remedies from the claims of Ayurvedic, Tibbi and other indigenous sources suitable to be employed by exponents of modern medicine. These were the two objectives of Ram Nath Chopra. And apart from the botanical identification which had been done earlier, his work involved chemical analysis, pharmacologic studies and clinical trials of a large number of these drugs.

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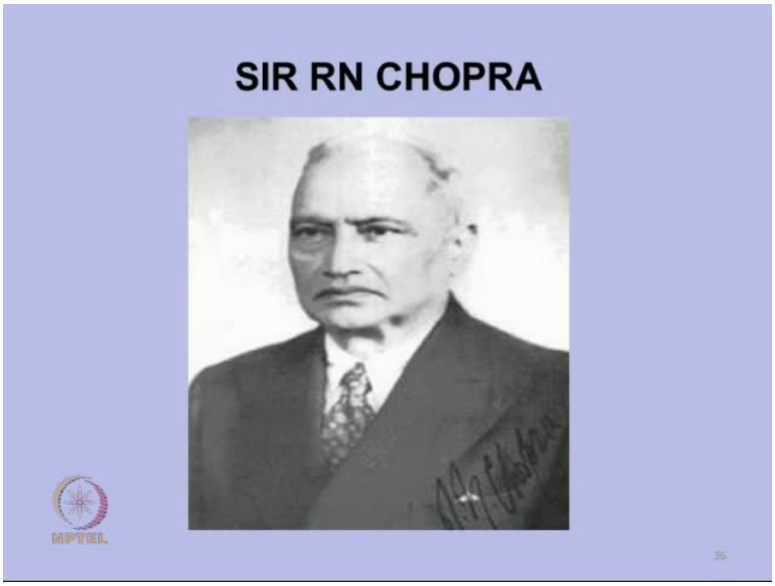

Those were introduced by Sir Ram Nath Chopra. He was a Kashmiri who did this great work in Culcatta.

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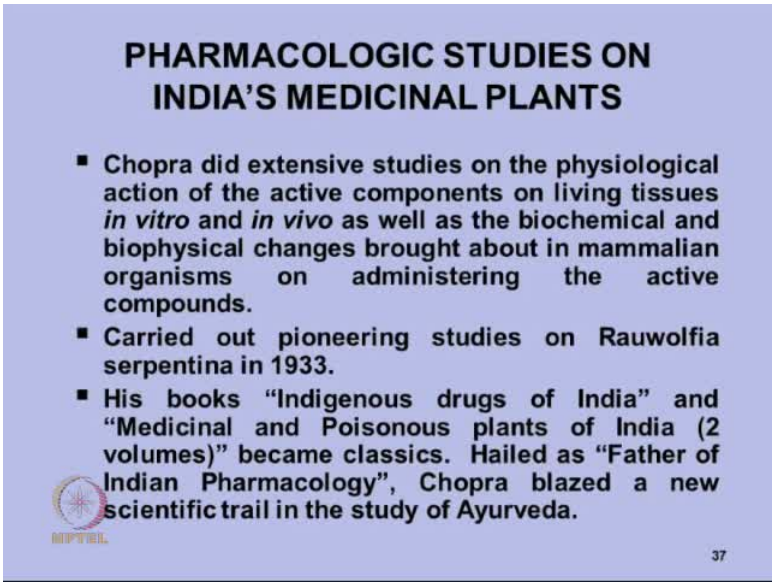

And the physiologic action of the active components of living tissue, on living tissues in vitro and in vivo and animal preparations he did. These were all pioneering efforts that time. And mammalian organisms, how do they respond to the administration of these compounds, and these Rauwolfia Serpentina, he did extensive studies in 1933. And his two books the Indigenous Drugs of India and Medicinal and Poisonous plants of India, thus they became classics because there was no other publication of that kind.

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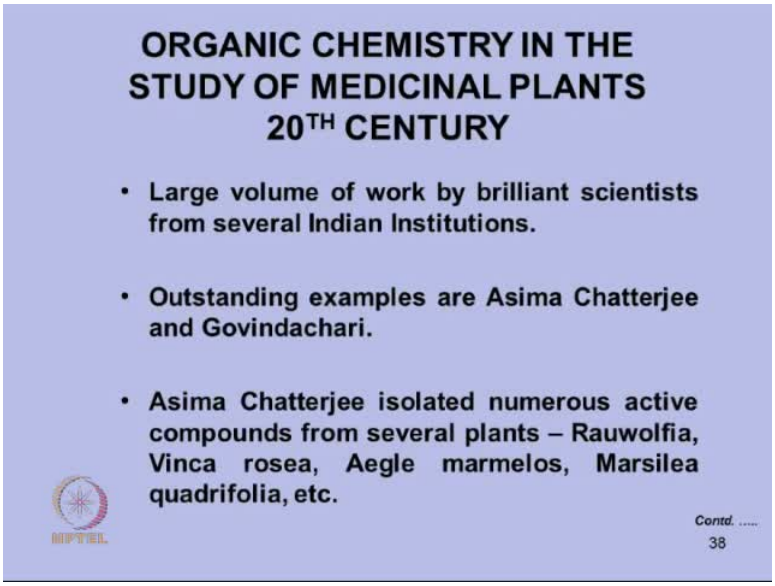

And this new window pharmacology, it was a question of a few decades. It went on to a new window opening; that was Organic chemistry. It was a natural step from isolation of compounds etcetera, which Sir Ram Nath Chopra started in Calcutta. It was natural that natural products chemistry should follow, and this large volume of work was done in the throughout 20th century. It still goes on and the outstanding pioneers were people like Asima Chatterjee in Calcutta, Govindachari who worked in Bombay and in Chennai and professor Sukhdev. So, there are number of other people living also who had contributed extensively to natural products chemistry.

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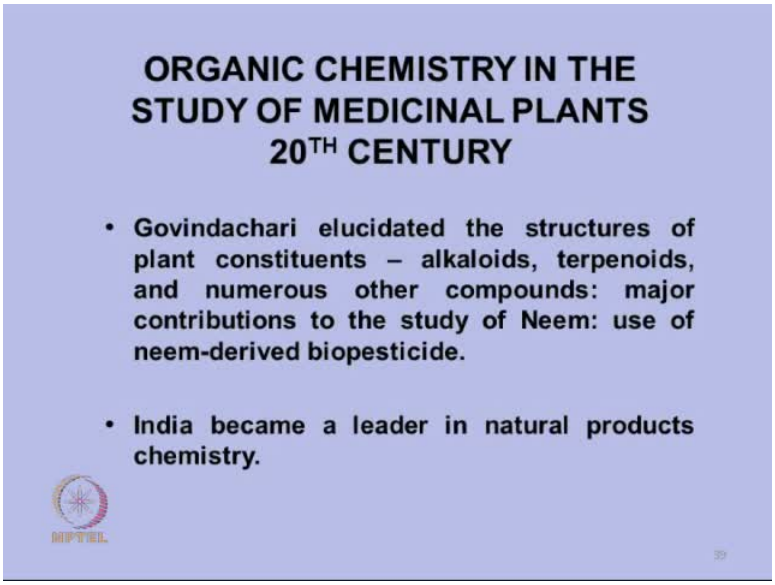

And hundreds and hundreds of papers have been published and there is a mine of information on this. This database on Organic chemistry related to medicinal plants, that is a valuable source of information to everybody working on medicinal plants and drugs from medicinal plants, including multinational companies. So, India became a leader in natural products chemistry in the 20th century.

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Now, the current state of research, if you look at this, this is the background starting with Taxonomy, then pharmacology, natural products chemistry, all these interaction of modern science with Ayurveda, this this had been happening from 16th century to the 20th century. But today, if you look at Ayurvedic research, there are three types: one is the medicinal plants, continuation of what had been going on, then there are clinical studies and Basic science. Now, these three, I would like to consider them.

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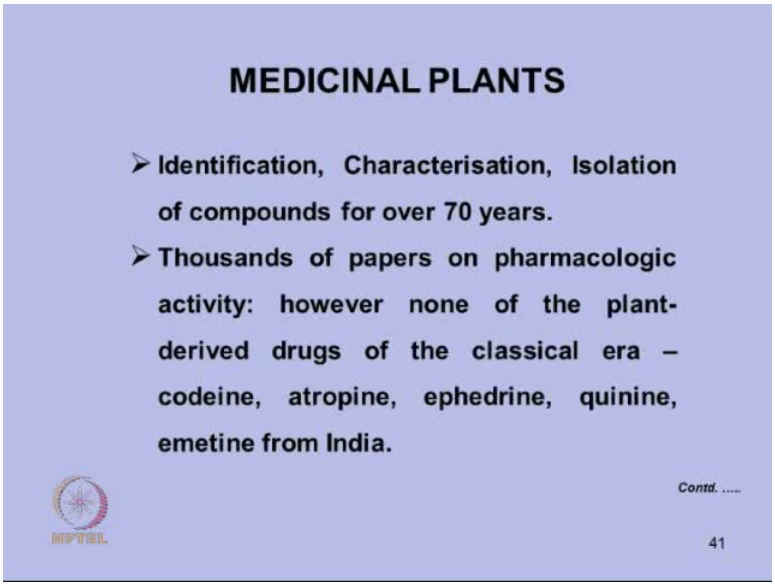

Now, medicinal plants going on for 70 or 80 years, thousands of papers but none of the medicinal plant derived drugs in common use, like codeine, atropine, ephedrine, quinine, emetine, they emerged from India, they all came from outside. None of these arose within India.

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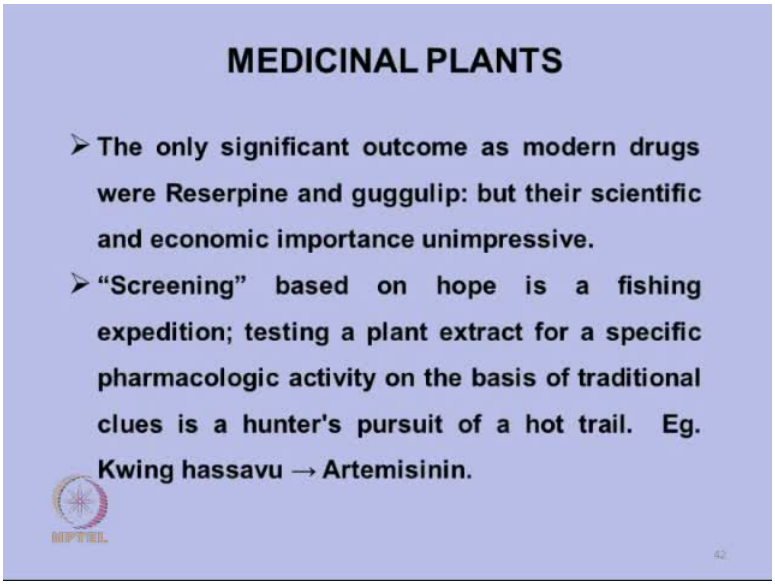

The only significant outcome, modern drugs Reserpine and guggulip; both are derived from our Indian medicinal plants, but neither of them could claim to have made a great impact in terms of medical treatment or in terms of economics. What is happening is, there is a great deal of screening of medicinal plants going on and we have not been able to come up with any major drug, a blockbuster drug, as they say. That has not happened; unlike the Chinese in a short period of 10 or 12 years, they could come up with this artemisinin from a Chinese traditional plant which is a effective treatment for Falciparum malaria. We have not been able to come up with a drug of that kind.

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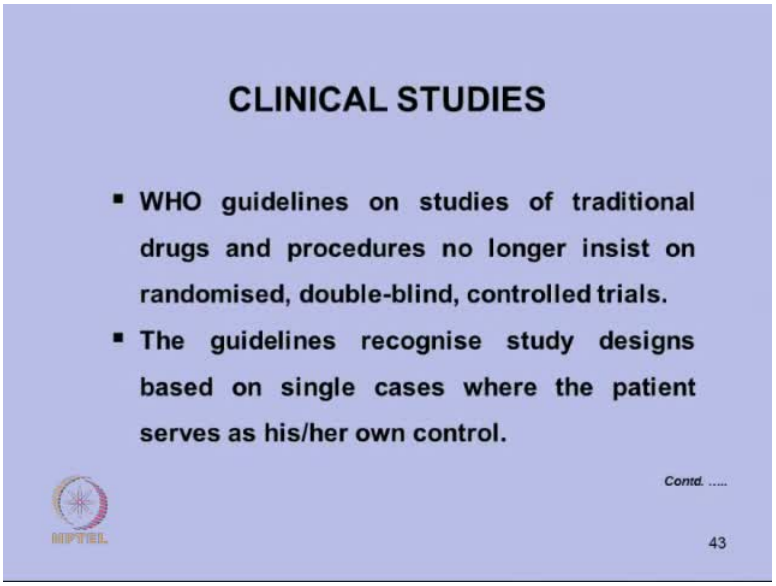

If you look at the clinical studies, these are studies done in patients. A particular type of Ayurvedic treatment, how effective is it? There is, there has always been a debate; this randomized, double blind, controlled trails which is the standard test in all drug development programs; you have to go through this before a drug can be marketed. Now, this may not be applicable to traditional drugs like Chinese medicine or Ayurvedic medicine, because conceptually itself, if you have a controlled and a study group comparable or identical in every respect, except the study group you are doing an intervention; that is the concept behind randomized, double blind, control trial. But in Ayurveda, this is simply not possible because you cannot say that one group of hundred people, another group of hundred people, they they are the same. They cannot be the same because Ayurveda each individual is different; their prakriti is different; it is like finger printing. So, you cannot say that these two are comparable or identical groups. So, conceptually there is a difficulty in this controlled trails.

Therefore, the WHO organized a meeting in 2000, how to, you have to have some kind of evidence; that was the subject of discussion; there was representative from India also and they came with a, with a number of liberalized guidelines. One of them was a subject or a group serves as its own control. This is not acceptable in modern medicine, but here a group of subjects or a subject, individual with a known disease; that is now confirmed, inclusion criteria, then they are subjected to this intervention and the outcome you touch the same subject. So, the subject or as subjects serve as their own

controls; that was accepted; Similarly, the intervention that you make. in modern medicine, you are only giving one particular drug. So, here in Ayurveda, often it is not possible to have just one drug; there may be some procedure attached to it or something else. There may be two or three items in that treatment; so that is called a black box.

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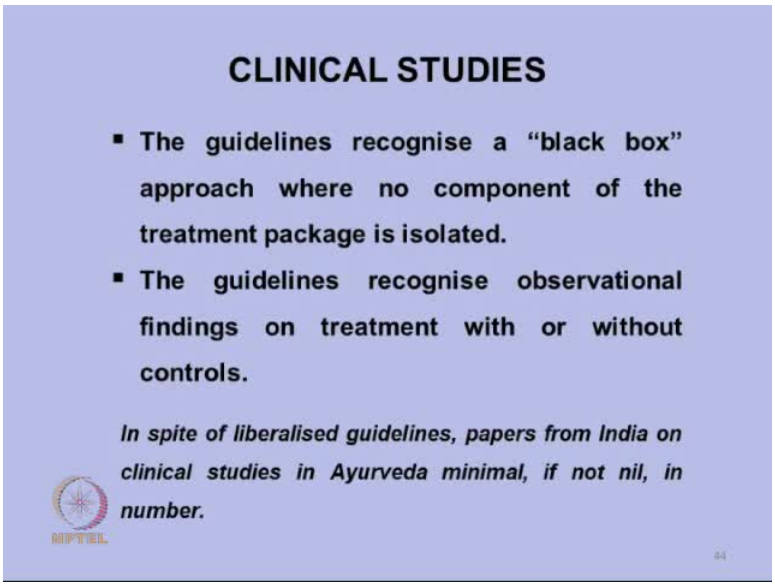

So, that was accepted. We will not dissect each of them and try to find individual effects. So, that was accepted black box approach, and observational findings also were accepted. So, these were some of the liberalized guidelines of the WHO where even though these guidelines are available, we have very few papers coming from India on clinical research.

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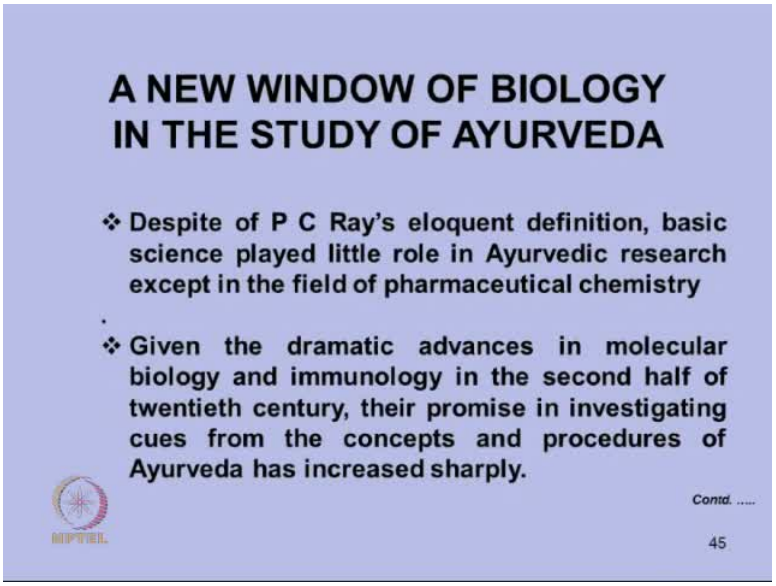

And when it comes to basic science being applied, modern biology, immunology and so on, the situation is worse because that has received the least attention. And P C Ray, the great pioneer of chemistry in India, he called Ayurveda from 600 BC for almost 800 years as the Ayurvedic period in the history of Indian science; not only because Ayurveda is the mother of medicine, but he also regarded it as the mother of chemistry because all the rasa shastra, the mercury, studies on mercury, its properties, its biological effects, all these were done in the under the umbrella of Ayurveda and also a great deal of plant science.

So, P C Ray in his History of Hindu Chemistry, he calls this period Ayurvedic period in India's history of science. But inspite of that, there has been very little interaction between modern science and Ayurveda in the 20th century or subsequently, there is no forum where scientists and Ayurvedic physicians interact.

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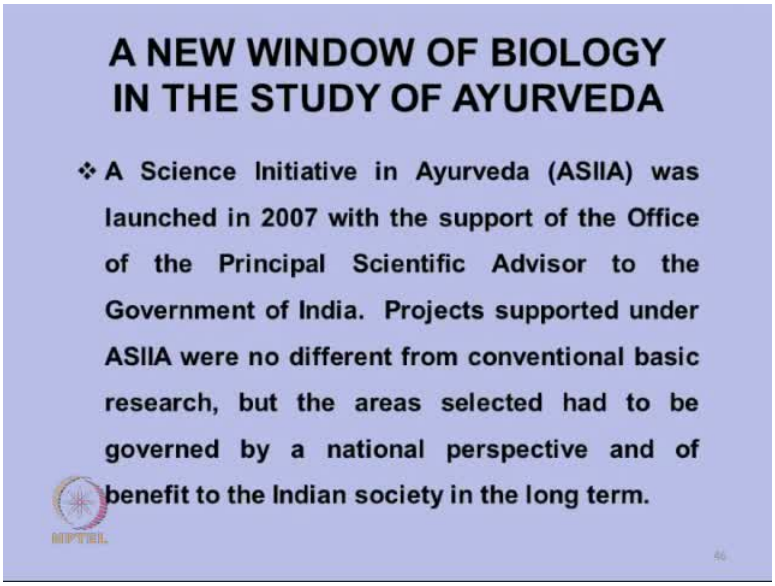

So, in the present century or the end of 20th century, the most dramatic development is the molecular biology, immunology, and there is a great scope for having using the techniques of these two disciplines in investigating Ayurvedic concepts and procedures. This has not happened. So, in 2007, a science initiative was started under the or with the support of the Office of the Principal Scientific Advisor to the Government of India, and these projects were no different from other science projects, but there is a national perspective in these projects, and also they could have some stage potential utility for India's population. So, that was clearly mentioned in starting the science initiative.

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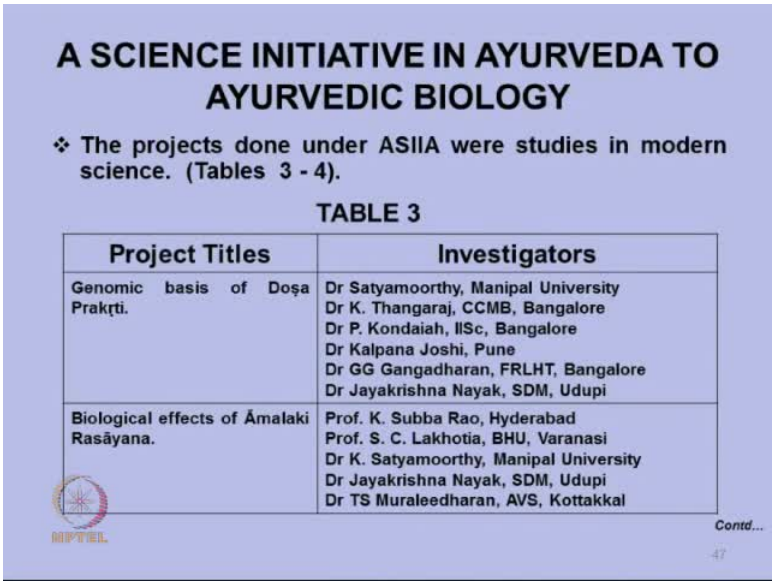

Now, we had a series of projects identified at that time. I have simply listed them here. The Genomic basis of dosa prakrti; we have talked about it at great length the vata, pitta, kapha, prakrtis; four mixed prakrtis. So, these three main prakrtis, we have seen the how important they are in Ayurveda because they determine the predisposition of subjects to various diseases; they determine the course of the disease; they determine the response of the subject to drugs because the same treatment will not produce the same result in these three prakrtis.

Therefore, it is a subject of great importance in Ayurveda, but there has been no evidence. In 2007, there was no clear evidence, biological evidence for this because the prakrti determination was done on the basis of a series of traits: physical traits, mental traits, behavioral traits put together; this is vata, this is pitta, this is how they had been identified traditionally; that method was being followed, but is there any biological evidence for this? That question remained.

So therefore, by 2007, we had already techniques in Molecular Biology. We could do DNA sequencing, gene expression studies, number of new techniques had become available, which did not exist 30 years ago. Therefore in 2007, this project was started and I have listed all the investigations, investigators. Three locations for the study, subjects being selected in Manipal, subjects in Bangalore and in Pune, and they were selected by traditional Ayurvedic physicians based on uniform criteria and the blood samples taken from these subjects, they were tested for three different molecular markers.

That is, one is the single SNP's; that is changes in the DNA, gene expression studies and methylation studies. These were the three markers which were selected mainly to see if there were patterns in these three molecular markers which would correspond to these three prakrtis. That subject is going on. Since they are all writing papers etcetera, I will not be giving the results and so on. The second was the biological effects of amalaki rasayana, we had a lecture on the subject. If you give this rasayanas, what effect does it have on the body?

When we say that rasayana giving the regenerative powers are increased; that is one of the claim made; their cognitive functions improve; their digestive functions improve; these are all claims made by Ayurvedic physicians. So, can we really have some

markers to check or test these claims? Now, this has been completed and published of subject of great interest. So, this is producing biological evidence internationally acceptable to a very ancient treatment with rasayana.

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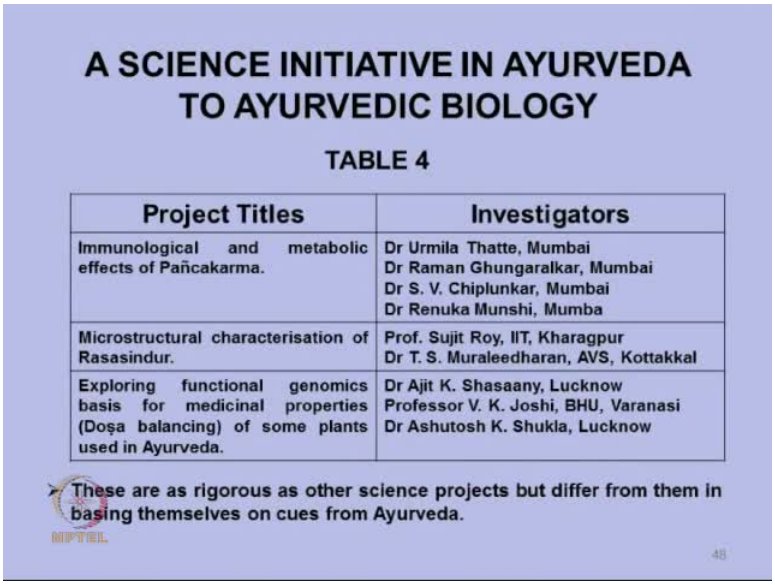

Then we have immunologic and metabolic effects of panchakarma. Panchakarma is a very crucial Ayurvedic procedure. When the doshas are perturbed, they are plentiful; you want to eliminate them, evacuative measures, and when you do that what happens to the immunologic system in the body, the immune functions, what happens to metabolic functions? This study was done in Bombay in the Podar hospital which is an Ayurvedic hospital and the metabolic functions were studied by Professor. Thatte in Nair hospital and Immunologic studies were done by doctor Chiplunkar in the ACTREC.

So, that studies, again they have, their paper has already been sent for publication. Micro structural characterization of Rasasindur; this is another interesting subject because Rasasindur is a mercury derived powder and this is used in Ayurveda, but mercury, as you know, is a highly toxic substance and its use is forbidden in the modern medicine. It is considered highly toxic, whereas if you talk to traditional Ayurvedic physician, they would tell you that Rasasindur, we have been using for centuries. We do not find these complications you are talking about.

Now, here is something which needs to be tested; it is a riddle. How do you find this non toxicity which they affirm? Instead of dismissing it, we should test it. So, this study was done by Professor. Sujit Roy in IIT, Kharagpur, currently he is Bhubaneshwar, to look at the micro structure of this (( )) whether that could give an give an explanation to this non toxicity of the drug; that is a change in the structure; that paper has already gone.

And then again looking at the functional Geonomics in these three types of plants, anti vata, anti-pitta and anti--kapha plants, is there something in their functional Geonomics which could explain their different type of responses, different types of therapeutic effects? That is a project done by Shasaany and others in Lucknow SEBA. Now, these are the projects which have been going on for the last few years; some of them published, some of them under publication.

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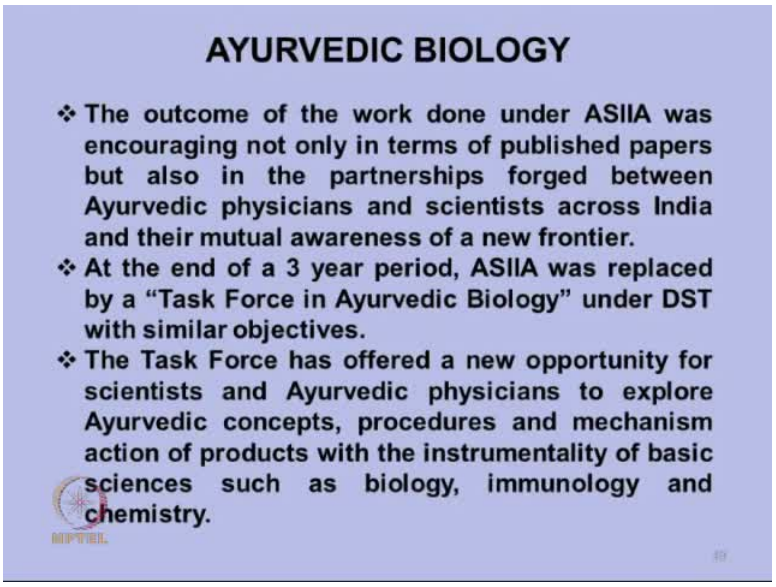

They have given on the whole encouraging results and because of this encouraging results on Ayurvedic science, initiative in Ayurveda, it has been possible to take it to the next stage because Department of Science and Technology, they were encouraged by the results seen so far. So, they have set up a task force in Ayurvedic Biology with similar objectives; that is to apply basic science to test the concepts and procedures in Ayurveda. It does not get into herbal drug development; it does not get into clinical

trials or safety and efficacy; it confines itself to these; Apply basic science to study the concepts and procedures in Ayurveda; that is where it stands today.

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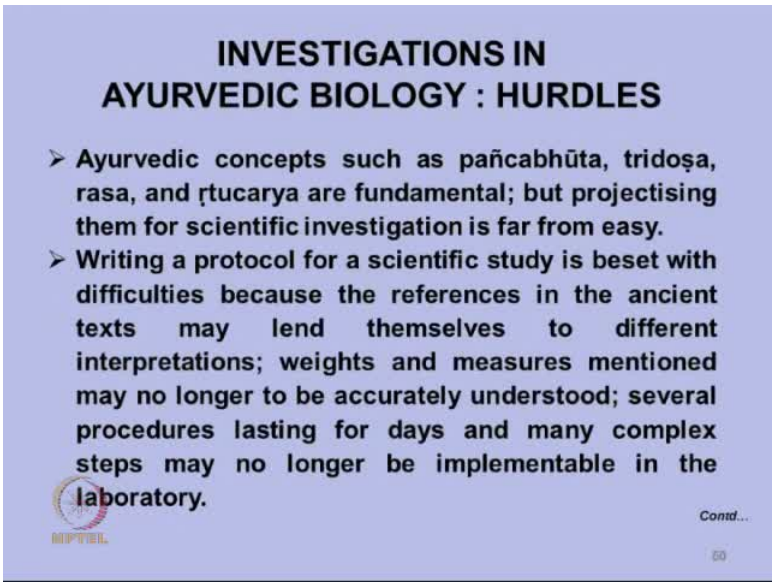

Now, the there are certain hurdles in doing this kind of research. The first problem is like panchabhuta, tridosha, rasa, rhutucharya, these are all fundamental basic Ayurvedic concepts. But to make them, projectizing them for experimental work is exceedingly difficult. How do you make it testable in the laboratory? That is the first problem that we face in this kind of research. When you want to do, apply basic science to study an Ayurvedic concept, immediately, you have this problem panchabhuta or tridosa, how do you do that?

Second, when you write a protocol for a scientific study, we have a number of practical difficulties because the ancient texts, they may not lend themselves to writing so easily because they are interpreted differently by different authorities. Weights and measures mentioned may no longer be accurately understood today and several procedures lasting for days and so many other complexities would make it very difficult to reproduce today. These are practical difficulties.

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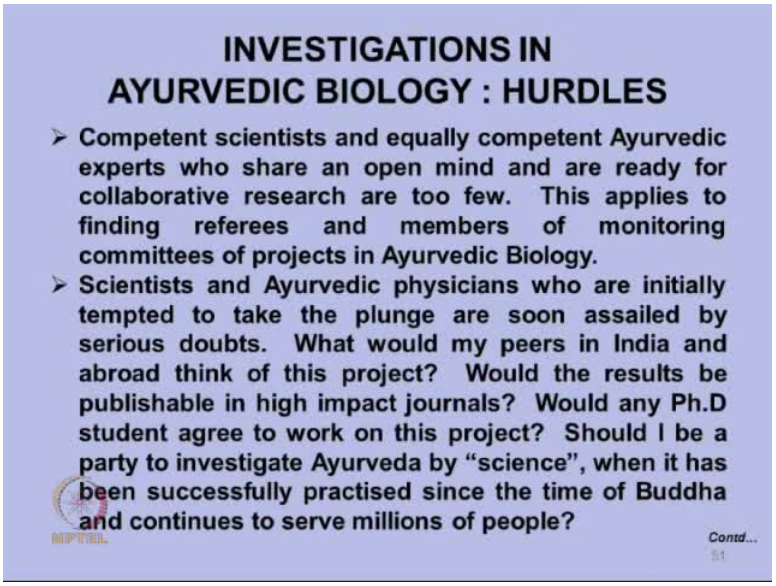

Then we have competent scientist and equally competent Ayurvedic experts who share an open mind, and share the interests to study this. There are too few like that in this country, and this applies to finding referees or members of monitoring committees and so on. It is quite difficult to find enough people; that is another great limitation.

And then having found these scientist or Ayurvedic physicians, after they take the plunge and sooner or later, you may find their interest may not be sustained. They begin to have all kinds of doubts: what would my peers think about this work? How would scientist abroad think about it? Would my PhD students be willing to work on this project and so on, the scientists are worried. Whereas, Ayurvedic physicians some of them would start wondering, should I be a party to investigate Ayurveda by science when it has been successfully practiced since the time of Buddha, why should I be a party to this? So, they also begin to have hesitation in this. And these can easily affect the morale of the whole group and that can be a hurdle.

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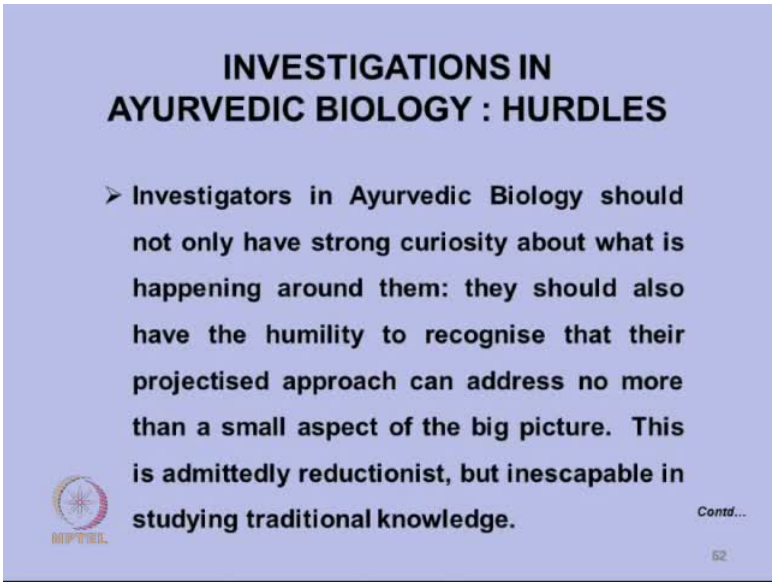

Therefore, they should have a strong curiosity, tenacity in pursuing this objective, and they should also have the humility to recognize that when you do this reductionism, reductionist approach to an Ayurvedic concept, we are limited by that. In other words, if you find there is no evidence by that particular approach, your reductionism, that may be a reason for that because there is a whole lot more which you have not analyzed. That humility one should have. In other words, based on one particular test, you cannot come to a final conclusion.

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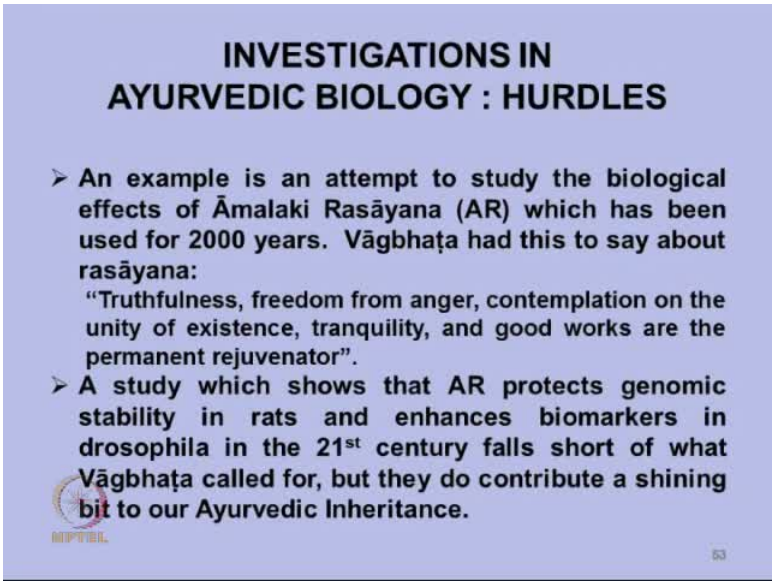

An example is the Amalaki Rasayana and this 2000 years, it has been used and Vagbhata, I have quoted this many times, truthfulness, freedom from anger, contemplation on the unity of existence etcetera; this is what really constitutes a permanent rejuvenator, but these are not testable in the laboratory.

However, the laboratory studies show that the genomic stability in rats and they enhance biomarkers in the drosophila. These are enhanced by this rasayana. Now, that is a very limited approach to studying rasayana using modern techniques, but it is a very important finding. So, here, even though we have not looked at the rasayana holistically, but what little we have analyzed have come out with a brilliant finding which is something to be to be cheered, and that is one important lesson we have learnt from the work done so far.