

Episode -9
Tracing India's Invisible Threads

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Characters

Prof. Akshay Roy: Male. Professor of Anthropology

Jigyasa: Student

(station. Appropriate sounds of confusion, train whistles etc.)

Prof. Roy: This way...Coolie... ..careful.... ..Coach...5....Chair no 37... ok. Here...keep the bag on the overhead rack...here is your money...thank you.

(Sounds of arranging suitcase.)

Prof. Roy: Hello, little girl do you mind letting me pass...I have the window seat...thank you.

(Sounds of settling down)

Prof. Roy: Are you travelling alone?

Jigyasa: No, I am not travelling alone...I am with my classmates on a school excursion...only my seat is in this Coach. I told my teacher it does not matter as we are only going up to the next station.

Prof. Roy: I see...well I will have the pleasure of your company till the next station at least. I am Professor Akshay Ray...what is your name?

Jigyasa: My name is Jigyasa...I am a student of Class Eight. You are a Professor. What do you teach?

Prof Roy: I teach Anthropology.

Jigyasa: Anthropology...what is that? I have not even heard about this subject let alone studied this in school.

Prof. Roy: Anthropology is the study of humanity. You will study it in college if you choose to take it up.

Cell phone rings...Jigyasa answers

Jigyasa: Yes Mummy. I am on the train. No the train has not started as yet...(a little irritatedly) Ok...I will not accept any food or drinks from strangers; I will not talk too much.....Mummy, you worry too much. I am Ok. Bye.

Prof. Roy: You must not be angry with your Mummy. She loves you and so she worries about you.

Jigyasa (laughs): She worries about everyone...about Daddy...about my brothers...about both my Grannies and my Grandpas...actually about all our blood relatives!!!

Prof.Roy: Jigyasa, you said that you know nothing about Anthropology? But I see that you know a lot about families. Anthropology is a study of the Human family...so you are already a student.

Jigyasa: Families? Of course I know about my family. I belong to the Kumar family, you know.

Prof. Roy: You know you belong not just to the Kumar family. You belong to another very big family too?

Jigyasa: What do you mean?

Prof. Roy: I am talking about the Family of humanity. All human beings belong to one big family, you know.

Jigyasa: You are talking like our moral science teacher. She always says that all human beings are brothers and sisters and belong to one family. I thought you teach...Anthro...Anthropology...not Moral Science.

Prof. Roy: Well Moral Science has the word Science in it doesn't it?. Laughs. You see in Anthropology we believe that all human beings

descended from common ancestors...so ...in a way...we are all brothers and sisters...and if you look closely enough and deeply enough you will see the invisible links that we share.

(The train whistles. Sounds of train moving...general sounds of the station moving away...train gathering speed. (All through the sound of a train moving has to be there ..muted back ground noise))

Jigyasa: We are Off!

Prof. Roy: Yes. Would you like the window seat?

Jigyasa: Not really but thanks. I'd rather chat with you; if you don't mind. It is interesting that you say we all belong to the same family...I don't see how we do. We don't even look similar. Look at me. I, like my parents, have curly hair and a snub nose. You have straight hair and a pointed nose. My brothers look like me...you don't. How can you say you and I belong to the same family?

Prof. Roy: Laughs. Dear Jigyasa. You are talking about your *immediate* family and so you can see the shared facial features and are linked by the ties of love and mutual concern...like your Mummy who worries so much. I am talking about a much-bigger extended family.

Jigyasa: Our school keeps details of the families of all the students...you will say details of the *immediate* family. (laughs) You know in case we are ill or something then they can contact the family. But I don't think anyone keeps records of family beyond that.

Prof. Roy: That is not correct, dear. Have you never attended any religious ceremony such as a wedding or a funeral? In Hindu ceremonies the names of ancestors going up to seven, even fourteen generations, are recited. Most families maintain records.

Interviewer (interrupting): Oh! You study lineages. You go back to grandparents; great grandparents and beyond. You look into who married whom and all that. My grandmother knows all that by heart...who married whom and where their children settled ...I did not think scientists did that too.

Dr. Sharma (amused voice): Yes, I study all that but I do it on larger scale. I also study the roots of entire communities. I study the roots of mankind. I document human roots...you know from where we came; where we settled and where we went again.

Jigyasa: Yes, So, there is this more- distant, larger family to which I belong but about which I know nothing.

Prof. Roy: Actually to which we all belong. Think of it this way. Think of a huge tree with many branches that keep growing and dividing into more branches as they grow. However, they share the root, don't they?

Jigyasa's phone rings

Jigyasa: Yes Ma'am. I am comfortable. No Ma'am ...my co-passenger is Prof. Roy...an Anthropologist... OK. Ma'am

Jigyasa: My teacher wants to speak with you. Her name is Suparna Banerjee and she is Science Teacher at St. Mary's Convent.

Prof. Roy: Ms Banerjee? I am Prof. Akshay Roy of Calcutta University. Please do not worry about Jigyasa. We are having a great conversation about our shared roots. Please don't mention it...no trouble at all.

Handing the phone back to Jigyasa...Here Jigyasa keep the phone safely.

Sounds of the phone being put back in bag.

Jigyasa: You were saying that our roots are the same...but after thousands and thousands of years and even after people moved from caves to faraway places in search of food and shelter how you can trace the roots? How can you even be sure that they are still there?

Prof. Roy: Oh we have retained our roots all right. Only we need sophisticated tools to see them.

Jigyasa: You study roots of populations...that can't be seen with our eyes? To study the roots you have to get to the base of a family tree—you have to get the great-great-many times great-grandparents. They are dead and buried! All you will get are names...and what information of relevance can you deduce from mere names?

Prof Roy: Laughing loudly....No. no wait a minute. Don't jump to conclusions that the dead have left nothing behind except names. Let me explain.

Jigyasa: Ok.

Prof Roy: You know what cells are: The cell structural as well as the functional unit that makes up our bodies. Within the cell, its headquarters or nucleus contains tightly coiled thread-like structures..."

Jigyasa (finishing the sentence): ...called chromosomes which bear the units of heredity or genes. I know this. We learnt this in school. Human body cells have 23 pairs of chromosomes and roughly, 30,000 genes.

Prof. Roy: Good. We get our chromosomes from our parents...23 from each because the male reproductive cell and the female reproductive cell each carry only 23 chromosomes each. These haploid numbers fuse to give the 23 pairs or diploid set that we have in our body or somatic cells. Of course, different plant and animal species have different but specific numbers of chromosome pairs.

Jigyasa: Most Genes have their own addresses on a chromosome and they are actually bits of DNA, right? I am sorry but I can never remember the full form of DNA...

Prof. Roy: (helpfully and slowly): De- Oxy- Ribo- Nucleic Acid. You see, already you have a clue to what I study...the chromosomes

and genes that we got from our parents...and which govern everything that goes into making you...YOU. The genes carry the blue print of all the traits and characteristics that we inherited from our parents

Jigyasa: Oh! OH!! And the parents got their chromosome and genes from their own parents who got it from theirs.....My God, this stretches forever into the past....but how do you actually lay your hands on the cells, chromosomes or even genes from people who are dead and gone?

Prof. Roy: Have you ever thrown a pebble into a pond? The pebble disappears from sight but the ripples remain. To scientists, the ripple pattern it has left behind is enough. Nothing perishes totally. People leave clues behind.

Jigyasa: Oh...you study the traits that the children may have inherited and that tells you about the traits the parents had. Genes govern traits...so that is how you study the genes.

Prof Roy: (happily) Yes. Geneticists investigate the structure, function and transmission of genes. So, there are three major areas of study: Molecular genetics. Transmission genetics. Population genetics.

Jigyasa: Molecular genetics is the study of the structure of DNA and all that but what is Transmission genetics?

Prof. Roy: Transmission genetics is the traditional approach to the study of genetics. In a very rudimentary way...you were actually talking Transmission genetics when you said that your brothers and you have curly hair because both your parents have curly hair.

Jigyasa: Wow! Then what do you do?

Prof. Roy: We make gene maps, that is, we study of where and how genes are arranged on chromosomes.

Jigyasa: I thought so, the word map was a clue. From the name I think, population genetics the study of a large group of people who live in geographical area. Am I right?

Prof. Roy: Yes. Population genetics focuses on how the relative frequency of genes changes, in a population, over time. See some genes occur more frequently and remain common while other genes increase or die out in certain populations.

Jigyasa: It is fascinating that genes can survive and genes can die too.

Prof. Roy: If people carry the genes then those genes persist in populations; if no one in the population carries that particular gene then that gene has died out in that population—

Jigyasa: Yes I understand...but can the same gene persist in another population in another area?

Prof Roy: well done!! Indeed it can and often, it does. Understanding how genes are transferred from one population to another is called Gene Flow.

Jigyasa: I like the term Gene Flow...it gives the impression of a river that twists, turns and meanders over a huge distance taking its cargo of water wherever it goes. People also go here and there but always carry their cargo of genes with them.

Prof. Roy: Very good! You see, when separate populations come into contact there are inter-marriages. This results in introduction of new genes into the existing pool of genes. Think of it like two rivers meeting and then sharing the waters, which later on can divide into many channels and go different ways. Marriage is a way new genes come into the family and the community.

Jigyasa: You say marriage brings in new genes....do you mean the bride brings in the new genes when she goes to her in-laws house in another place? I mean in society we see a preference for male children because it is felt that girls marry and go "out" of the family while male children carry on the family surname and thereby ensure continuity. Is this really so?

Prof. Roy: When a girl marries and takes on another family name does she give up her DNA?

Jigyasa: No!!! That's not possible.

Prof. Roy: She received her DNA from BOTH her father and her MOTHER and she carries it with her. Her children...sons and daughters both receive it as a legacy from her. Her DNA legacy never dies irrespective of the fact that she left her maiden name to take the surname of another family.

Jigyasa: The DNA legacy never dies. So do I still have something in my DNA that links me to my mother's mother and her mother...right up to my Cave-dwelling maternal ancestor?

Prof. Roy: That is a very perceptive question! You do indeed. You are still carrying in every cell something you received from only your mother who got it from her who in turn got it from her mother. I mean this is a gift specifically from the matriarchal side of your family.

Jigyasa: I can understand my mother giving me her DNA...after all I did receive a haploid set of chromosomes from her, so half of all my genes are her gift. But what could my Great- great- great-grandmother on my mother's side have given me? I don't even know her name!!

Prof Roy: We focus so much on a girl leaving home after her marriage that we forget that all women give something special to all their children, above and beyond the haploid chromosome set. This gift comes only from the mother's side and is given equally to sons and daughter. So my mother gave this gift to both me and my brother ...but she herself got this gift only from her mother, my Nani...not my grandfather or Nana.

Jigyasa: What is this mysterious gift?

Prof. Roy: It is a bit of DNA...some special genes. You see, during fertilization only the DNA in the sperm's nucleus penetrates the egg's nucleus. The sperm is so small that it really doesn't contribute anything to the next generation other than the haploid DNA. The egg provides the energy needed for the biochemical reactions that follow. It does so by using cell organelles called Mitochondria: you can think of these as the cell's power house.

Jigyasa: I know...Cellular batteries.

Dr. Roy: Although most DNA is packaged in chromosomes within the nucleus, mitochondria also have a small amount of their own DNA. This genetic material is known as mitochondrial DNA. In humans, mitochondrial DNA spans about 16,500 DNA base pairs, representing a small fraction of the total DNA in cells.

Jigyasa: Ah! I see. Mitochondrial DNA is passed to offspring solely from the mother's side. It can be studied to observe DNA changes over time from the mother's side because it is female-specific DNA. Is there no similar male-specific DNA?

Prof. Roy: Indeed there is. Normally, Y chromosomes are passed from father to son.

Genes on the Y chromosome are male-specific.

Jigyasa: So, Mitochondrial DNA and genes on the Y chromosomes make it easier to study gender-specific linkages.

Prof. Roy: The best part is that any change or mutation in both Y chromosomes and mitochondrial DNA remain fixed in place on the DNA. We can then use DNA as a clock.

Jigyasa: As a clock....How?

Prof. Roy: I will give you an example. Say we are studying ten Y chromosomes taken from ten different men. Say all of these samples contain a mutation named A. Suppose only five of these

chromosomes also contain a second mutation, B. Then we say that mutation A occurred first; mutation B came later.

Jigyasa: Yes. That is logical.

Prof Roy: Plus we can say that all ten men who carry the chromosome with mutation A are the direct male line descendants of the same man who was the first person to carry mutation A.

Jigyasa: By the same logic...the first man to carry mutation B was also a direct male line descendant of this man, but he was **also** in the direct male line ancestor of all men carrying mutation B.

Prof. Roy: absolutely. Series of mutations such as this, forms molecular lineages which we study.

Jigyasa: So after studying a person, you study families; then you study groups of families or populations. Do you study communities or populations across parts of nations or even across nations? Have you studied India?

Prof. Roy: Just look at the people in this coach...most of us are Indians but see how different we are. We have fair skin, brown skin and dark skinned Indians. We have Indians with straight hair, wavy hair and curly hair...

Jigyasa: We also have bald people...See there!

Prof Roy: Yes, we have all sorts of physical characteristics in our populations.

Jigyasa: Why is there so much diversity in India?

Prof. Roy: This is because many waves upon waves of people have migrated into India ever since the first ancestral population entered from Africa. There is general agreement that early man dispersed from Africa across Asia between 1 and 2 million years ago but there are different theories about the route they took. Of course, this did not happen in one day. Nor was there just one journey out of Africa.

Jigyasa: Can we use DNA to understand the evolution of modern humans?

Prof. Roy: Yes. We can also use it to trace migrations of people, identify individuals, and determine the origins of domestic plants and animals. Actually, DNA analysis has traced human ancestry back to an African "Eve."

Jigyasa: Yes. But what about India? Have there been any studies to find out who we are and what invisible threads link us all?

Prof. Roy: Yes indeed. But I have to hurry...we should be reaching your station in another ten minutes or so. Lalji Singh who was a Scientist at the Centre of Cellular and Molecular Biology, David Reich and their colleagues have shown that, today's Indian population is the model of mixture between two ancestral populations, named as ANI and ASI.

Jigyasa: ANI?? ASI??

Prof. Roy: ANI means 'Ancestral North Indians.' ANI is genetically close to Middle Easterners, Central Asians and Europeans. ASI stands for 'Ancestral South Indians.'

Jigyasa: This is so interesting.

Prof. Roy: That is not all. We now know that Indian populations bear the genetic imprint of European, Asian and even African genomes. This is only to be expected as India has seen wave upon wave of human migrations. Each new wave brought in new genetic diversity. The passage of time saw admixtures with the existing populations. The result is that contemporary India is a huge melting pot of human diversity.

Jigyasa: Oh! There was inter-breeding between different populations and all the "ripples" can be read in the genes of the present-day Indians! We are all carrying the invisible threads that tie us together as a big family.

Prof. Roy: Scientists think that many Indian populations were founded by small numbers of individuals who later undertook limited migrations...not going very far. These events can be dated by genomic data between 750 years to 2,500 years ago.

Jigyasa: Have there been any other studies on Indian populations?

Prof Roy: Many. For example, Scientists such as Deepa Edwin, Susanta Roychoudhary and Partha Majumder of the Indian Statistical Institute, studied DNA samples from 160 unrelated individuals belonging to five tribal populations of Southern India. Their studies indicated that the Indian populations were founded by a small number of females because there is fundamental unity of mitochondrial DNA lineages in India, in spite of extensive cultural and linguistic diversity.

Jigyasa: Fundamental unity of mitochondrial DNA lineages means that there is little diversity in mitochondrial DNA, which means that only a limited number of female great –great... many times great... grand mothers were there. So we are really quite closely related on our mother's side at least...the invisible mitochondrial DNA tells us that.

Prof. Roy: Jigyasa, I am impressed. You have understood the logic.

Jigyasa: What about the gene-related diseases? I read in the newspapers recently that people in South-east Asia have more heart-related problems. Has there been any study on the genetic diseases that Indians may be prone to...more invisible threads that link us?

Prof. Roy: Following a disease-causing gene allows scientists to track backwards to a healthy population from which the broken gene may have originated. The recently-concluded Indian Genome Variation project studied many medically important genes in populations representing the genetic spectrum of India.

Jigyasa: How will this study help Indians?

Prof. Roy: Apart from giving us an idea about the threats that we are vulnerable to because of our genes, we hope that the results of this study will help us to predict diseases better. Later, we may even manipulate the effectiveness of specific drugs by monitoring the way the body reacts to them.

The train whistles loudly and sounds of brake applied and slowing down.

Prof. Roy: I think this is where you have to get down. I think your teacher is signaling to you to get down. Let me help you with your luggage.

(Appropriate sounds of the luggage being taken down.)

Jigyasa: Thank you for telling me how, even though we migrate to distant lands, we still carry our genes with us. Our genetic roots go with us irrespective of where we settle. Thank you for showing me that although populations are genetically distinct our roots are shared and we are all linked by invisible threads. Bye.

Prof. Roy: Good bye.

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