



## Chapter IX - 5

*Human pups enjoy laying on the grass and staring at the clouds, in constant search for shapes, fun and adventures. Sometimes, their grown-up kin lays down with them, and tasks them with matching shapes with names. Notably, their whole species takes pleasure in assigning names to objects, emotions and to the other living beings. Whenever something new is discovered, it is given one of these weird attributes, which, somehow, tells them what something is and what is not. Interestingly, names have a real meaning only for them, and only until they want so. Often, they use the same name for something that has changed completely; often, instead, they do exactly the opposite, and they don't mind about it. Human beings have discovered the concept of patterns, and they have made it central in their entire existence. Sometimes, at night, humans stare at the sky and search the countless sparkling points for shining shapes in the dark. They assign friendly names to them, and unconditioned importance, letting their own creation influence their whole existence. They fail to see it, down there, at the self-proclaimed center of the tiny, little world within their range.*

“What is natural selection?” – asks Ujana – “Can you explain it before we meet them? Now I’m curious...”

“Sure, if you like! There’s a lot to say and it’s very interesting, you’ll see! I hope it won’t shock you...” – you add, smiling chuffed.

“No no, don’t worry!”

“Cool. So, first... how about we discuss how animals learn the best behavior, even if they cannot communicate?”

“This is impossible to me” – he replies, surprised and engaged – “I really want to see if you convince me!”

“Yes, it’s almost magical. I mean, many people know how it works because they read it at school, but it’s not easy to understand what it implies, and one...”

“But you do, right?” – he asks, full of admiration.

“Well, I’ve studied it too but not really in depth. Let’s say that I thought about it and read some books.”

“Books, books, so many books!”

“Hehe, maybe. Let me think about an example, just to start” – you make another long, emphatic pause – “OK, let’s start with something that doesn’t deal with animals... for the moment!”

“OK...”

“So, let’s assume” – you throw an entertained glance at the boy – “let’s assume we have a bag full of marbles, with different colors, materials and size.”

“I like marbles!”

“Great! Then, imagine that you close the bag and leave it on the table: what will happen to the marbles after, say, ten years?”

“What will happen... nothing?”

“Nothing, of course: all marbles will stay where they are. Now, imagine throwing them inside a big, big box, that we had prepared for this special occasion. You close this box and shake it, as much as you like: what will happen now?” – you ask, suggesting that the question was again rhetorical.

“What will happen? They will roll and hit each other, and...”

“Yep, that’s it. Nothing special but now comes the interesting part: what will happen if we make some little holes at the bottom of the box, all of the same diameter?”

“Hmm... can it break?”

“The box is wooden, it’s rigid... it won’t break.”

“OK... So, some marbles will fall, I guess... the smallest ones, while the others will...”

“Yes. Now, keep shaking our box for a few minutes or, better, a few hundreds of thousands of years. What will happen now?”

“That all the marbles that could fall have fallen, and the others are still... rolling?”

“Exactly! Now, if one day one of your friends came to visit you and asked you to open the box, what would she see?”

“She would see those marbles that didn’t fall, of course...”

“Yes: she would see all those marbles that are larger than the hole. So, overall, she would see many colors, materials and sizes, but not all sizes... because some of them *did not fit* the box.”

“Clear.”

“And even more: if you tidied your room, removing the other marbles that had fallen, she might even think that you never had any small ones at all... but you know that this is not true!”

“OK.”

“OK, cool. Do you see what I’m trying to say?”

“I see only a bunch of marbles in a wooden box.”

“Hmm... fine, but you got the big picture. Now, let’s switch to animals and see what happens with them. Have you ever read the example of the giraffe with long and short necks?”

“Nope...”

“Super cool. Imagine giraffes in the Savannah: a huge plain, with only few high trees and nothing more. Now, let’s assume that, long ago, there were giraffes with a long neck as well as with a short one. Unfortunately, since trees in the Savannah are very high, only those with long necks were able to find food while the others... well, you can imagine.”

“They died.”

“Yes. So, after tens of thousands of years there were no more giraffes with short neck and, for us humans, they exist only with

long necks. This is true, in fact, but it doesn't look at the process behind this evolution. We only see the result, what survived the challenges of the environment (the box or the Savannah). That's why it's called 'survival of the fittest'..."

"Because only the strongest animals survive, all the others die. I see, it's clear now!"

"No" – you reply sharp.

"What no?"

"It's not the strongest who survives. That's not the message!"

"But you just said...!"

"Look, the strongest animal in *that specific environment* survived: *this* is the survival of the fittest!"

"..."

"It may be that those who survive seem 'weaker': smaller, slower, heavier... all characteristics that we consider negative. Still, in some environment, these 'negative' traits can become positive, and the 'strongest' animals are no longer able to compete with them. This is the - harsh - beauty of this process: it doesn't matter how good you are on an absolute scale (which does not even make sense) but only with respect to the competition."

"Wow..." – murmurs Ujana in awe.

"Mind-blowing, isn't it?"

"It is... I thought I understood your examples but only now I realize it. It's shocking, especially when you think about..."

"... us, people?" – you add, calmly and with confidence.

"Yes. I can see that it happened around me, but I didn't realize how general this is. It's... how to say... wow..."

"Glad you appreciate. It's very important indeed! It helps explain almost everything, from animal species to humans and society, how things change in time."

"I see... Anyway, about animals," – he continues – "they don't change when they are alive, right? It's more like... it's the whole species that changes with time."

"Yes, with a lot of time actually: thousands, millions of years. Of course, things are much more complicated in reality than I'm describing now, but this is the intuition behind it."

“Why is it more complicated? To me it looks fairly simple now that you explained it.”

“Oh, so many things influence this process: what I described was so simplistic! To be precise, one should consider that animals are not alone but interact, and that the environment changes with time, or that animals can spontaneously mutate. But this is too complicated, we don’t need it to understand natural selection.”

“Animals can mutate? Serious?”

“Yes! Sounds weird but it’s true.”

“Seriously, animals can change without a reason?”

“Hehe, no, that’s not how it works, it happens before the animal is born. Let’s not think about it now, it was just an example of something random that makes things more complicated.”

“Wow! But... how do we know it if it’s all random? I mean, if everything is random there is nothing you can predict.”

“Are you sure?” – you ask with a sly smile.

“No? Random is random, there’s not much you can do.”

“I see what you mean but trust me, you can predict interesting things even if almost everything is random!”

“Hey! That’s impossible come on, you’re kidding me!”

“No, I’m not! I can make an example and you can check it out yourself tomorrow. Ready?”

“I am, but I don’t believe you now...”

“Super. So, this is the idea: take again your marbles and box, but this time we make a few changes. First, we insert a pin in each hole, to form a big triangle with many pins at the base and fewer and fewer the more we move to the top: ten, nine... one. OK?”

“OK.”

“Good. Then, let’s put the box in vertical position and, one by one, we make all our marbles fall in the box.”

“Can marbles hit those pins?”

“Yes, that’s the interesting part! Each marble will hit the first pin at the top and jump left or right, with equal probability. Is that clear so far?”

“Yes, seems easy but I don’t see what you want to tell me.”

“Oh, we’re almost there, follow me: the first marble will hit the first pin, then one of the two pins at the second level and so

on, until the end. If there are, let's say, one hundred pins at the bottom, where will this marble fall?"

"Where will it fall?" – he mumbles – "I don't know, it started from the center, but then each time it can fall to the right or to the left, so I have no idea... But" – he goes on – "since you ask, the answer must be at the center... is that correct?"

"No, it's not. You were right, the choice between left or right is every time random, so each marble can fall in any position at the base of the triangle. It's natural after all, since everything is random, isn't it?"

"Yes, of course... So why did you promise that we can predict it if every marble falls in any of the positions? If the final position is random" – concludes Ujana – "there's nothing we can do."

"There are no tricks! You can try yourself tomorrow: if you throw one marble the final position is random, if you throw two marbles their positions is random... but if you throw many, more or less the final arrangement is always the same!"

"What? This is impossible..."

"No, it's not! All our marbles will form a huge bell in the box" – as you sketch waving a finger in the air – "and the final shape is always practically the same, every time you try."

"I don't understand, how can they know where to fall? If the first ones fell somewhere, maybe more on the right, how can the next ones fall more on the left to balance it? Also... why a bell? Are you sure they don't form a rectangle, a few marbles here, a few there? I think this makes much more sense."

"Maybe, maybe" – you smile – "but this is not what happens! The reason is actually simple, anyway it's not important now. All this story was only to say that yes, we can predict important information about things in nature, even if (almost) everything behaves randomly. Isn't it beautiful?"

"Let me guess: is this, again, what science does?"

"Hehe, exactly."

"Incredible... why didn't we see this at school?"

"Yep, I know, there's still a lot you have to study before. Even at university if you want to discover more... and it's really cool, one day you'll see it yourself!"

You kept walking in silence for a while, thinking about the chat and your reactions. The distant tower was still hidden beyond the bay, while a diffuse darkness had fallen over the seashore. You are eager to put an end to this adventure but, at the same time, you are growing fond of the boy and his stories. You also look forward to meeting his family, and you already picture that moment in your mind, when they hug you and thank you and invite you to their place to celebrate. Maybe they will give a present to show their gratitude, which you will kindly refuse with your greatest smile. Maybe this story will end up in some newspapers... maybe even in the national ones, who can say. This would certainly be an extraordinary conclusion for this long, wonderful outbound journey. Your friends would congratulate with you, and you will be pushed to tell this story over and over again, until they all know it by heart. And who knows, maybe you will stay in touch with his family and, one day, when he is older and wiser, you will meet him again and remember together the beauty of this moment. “Maybe we will walk through these lands again, to commemorate this night and appreciate the beauty of life. Or maybe not...” – you continue – “since, by then, we will both have our own families, and we might not have the chance to meet anymore.” A sudden breeze from the ocean makes you turn to the waves, where you find a beautiful moon glare floating light on the water. “How can I forget these moments, and this little boy, with his impossible story?”

Ujana was still walking silently, lost in his thoughts like many times before. He seems to be reflecting on your words, which makes you proud of your choice. “If I keep him focused, we will get there before he realizes it.” This was indeed a good strategy, you feel, to prevent awkward initiatives and a bad morale. All you needed was moving on as safe as possible and, at the same time, keeping him engaged on positive talks. Indeed, you also wonder if deep conversations were ideal for that moment. It worked well so far, but it started from the stories of his family: their challenges, his mother’s troubles, the book you are carrying. You had no idea

for how long you could keep that momentum, which had worked so well since you saw the flashlights. You had no idea until that moment, when he broke the silence and turned his eyes to you with a shy and engaging expression.

“There is one question I wanted to ask you” – says Ujana, all at once – “when you explained how evolution works, especially about animals. Can I?”

“Sure, go ahead! I hope I can answer.”

“Of course you can!”

“Ah, come on” – you reply, proud and embarrassed – “it’s all very simple! By the way, I haven’t told you yet why everything can be explained by natural selection: let’s not forget it if you like!”

“I didn’t!” – replies Ujana, throwing the wooden stick to the sky and catching it back with a fancy movement – “I was curious to know more about this point, before you tell me about that.”

“Great, good idea, then please go ahead!”

“Cool! So, my question is very simple: more or less, how long does it take to animals to mutate and evolve? I mean, a whole species, not a single animal.”

“Wow, this is interesting, glad you asked! There’s a lot we...”

“I mean” – he interrupts you – “is it something that happens slowly... or can it be also fast?”

“Well, for sure it’s slow, extremely slow I’d say, but I was...”

“Slower than life?”

“Than what? Life?”

“Life, yes.”

“Than our life, like... 80 years?” – you ask incredulous.

“Yes...?”

“Oh, well, how to...” – you stumble on a sincere laugh – “let’s say: yes, usually evolution is slower... *much slower* than our lifetime. It takes ages so see changes: you remember, we said thousands, millions of years” – you make a long pause – “but it never stops and happens everywhere, only limited by our limited perception.”

“...”

“This was not too clear, it seems.”

“...”



“But why did you ask, anyway?”

“Because I wanted to see when the animals in my farm evolve. Do you want to say that I can’t see that, ever?”

“...”

“No?”

“No U, I’m sorry... it’s not possible to see it. But why did you want to see it? Is there a reason?”

“No no, no special reason: I only liked your explanation so much that I wanted to... I was curious to see how they would change... and how it works. I already imagined fancy shapes and colors for all our animals...”

“I’m sorry to see you disappointed, I didn’t...”

“...I’ll never see them, and I even don’t know why...”

“Hey, don’t do like this, please!” – you reply, trying your best to cheer him up – “If I didn’t tell you about it you would have discovered it only after a few years... Now, instead, you know something nice and interesting, you should only be happy!”

“Yes, it’s not a problem... I’m not sad, I’m only disappointed because I didn’t understand that it was so slow. I went too far with my imagination” – he adds, faking a smile.

“I saw that” – you pinpoint, laughing softly – “Let’s try not to think about it anymore, OK?”

“OK... but how can you be so sure about it?”

“About what? That evolution takes so much?”

“Yes, what you just told to me.”

“Ah, that’s easy, I studied and read a few books on the topic.”

“Ah... and how can someone know it, if no one has seen it?”

“Hey, wait, are you serious?”

“Of course I am, and you?”

“Me too, but I don’t understand the question. We know it because scientists studied it and it’s explained in the textbooks.”

“And that was enough for you, for this topic.”

“Well, I’d say it was enough for a general understanding, yes. I’m not an expert, but I think I know what I’m talking about.”

“So, you’ve never asked yourself why this is true, and you’ve not tried to check it yourself in some way?”

“No U, why should I? Many other scientists have worked on it in the last century, since the first works by Darwin and others.”

“Why? It’s you who said ‘The vast majority of people blindly believes in what science tells them, with no critical spirit’...”

“...”

“So, don’t you say anything now? Seriously?”

“Can you calm down please? What is all this insistence?”

“Sorry but, after that, I didn’t... I didn’t expect that you would tell me this stuff, that you don’t know it.”

“That I don’t know what? How can we know that evolution works this way?”

“Yes. Do you?”

“Yes, I do. Happy now?” – you reply sharply.

“...”

“Good. First, please calm down. Second, we know it because scientists have studied it. Third, they discovered it by observing the behavior of many, many animals, their colorful appearance, their ingenious strategies, now even their genome (whatever that is) and it all makes sense only if we assume that an evolutionary process is going on. We also found fossils that show intermediate stages of evolution... quite impressive, as you can imagine.”

“OK. But this doesn’t tell us that it takes so much time, it only says that it works.”

“Yes, somehow it’s true, but scientists have calculated that, in order to work, this process must be very slow. As slow as we said before, unfortunately. I cannot go into detail, it’s not easy, but there’s even more concrete evidence out there. Trust me!”

“OK, it’s complicated” – he replies disappointed – “but you say you believe it because a textbook says that scientist discovered it... but how did you check it yourself, if it’s so slow?”

“How can I check it myself? Well, easy: I cannot! At some point, we all should stop and trust each other’s expertise: scientists should trust the bakers, the tailors and so on.”

“And how can you be sure that the information is correct and that scientists have studied it, if you can’t check it?”

“Well, you can’t always prove that it’s correct, you simply trust the authors. Every now and then, you can even spot some typos

or errors but, overall, you can rely on the content. This comes without saying, though, don't you think?"

"I don't know, I don't understand anymore what you told me. How can you live your life with a critical attitude, as you said, and at the same time trust textbooks so unconditionally?"

"OK, fine. First, trusting the content of a textbook is not something you should do passively, just because there can be small errors, as I said. So, one should trust the author and, at the same time, read the content critically: it's unlikely to spot a mistake but absolutely not impossible."

"But this is not possible: how can I find a mistake if I am just learning from that book?"

"Well, in that case it's more difficult, and maybe you can't do it in the first read. But, if we are where we are, it means that maybe we can rely on books, don't you agree? Seems fairly simple to me, aren't you making things unnecessarily complicated?"

"..."

"Being critical is good, being always skeptical is not a good idea: it might help you in some situations, but society is built upon a common trust that we..."

"No, I'm not making things more complicated. Don't take it bad, but I think it's you who's confused in the first place."

"Me? Why would I be confused?"

"Because you told me to be always critical, and to beware the words of unreasonable people, and now you tell me that you trust the words of scientists whom you've never met, through the content of books written by other people, on something that you cannot check yourself in any way?"

"..."

"Does it make sense to you, seriously?"

"I don't know what..."

"You know what?" – insists the boy – "Now I'm even more confused than before."

"Why?"

"Because I've always trusted my textbooks, and you've done the same apparently. But then you come and say that I should not trust unreasonable people and be critical, as much as possible."

“I got it, you told me already, so what?”

“So, now I should trust also the content of other books like fairy tales or the Bible, with all the wonderful miracles that are described in detail, and the anecdotes about Christ and all the saints who followed him.”

“Hey, wait...”

“It’s the same story. Plus, the source of the Bible is as reliable as the ancient essays on geometry of the Greek philosophers.”

“U, please, wait...”

“No, it’s even more reliable in a sense: how likely is it that some ancient scholars developed all those impressive theories without good schools, books, warm houses, nothing? Maybe that is all fake, and religion is the only thing we should count on.”

“...”

“After all, I remember your story about vaccines, where people ‘choose to go against the experts and not to vaccinate their children’, which, in your opinion, is crazy and dangerous, right?”

“Right...”

“Then, why should believers be discriminated, or mocked, if they can count on so many experts in their community, and they take inspiration from one of the most ancient and important books ever written?”

“...”

“And we can even test its teachings in our everyday life, to behave well with people, be humble, help each other... not like science, with its unverifiable theories like evolution.”

### 3

Everything was still and silent, down there on the seashore: the landscape unaltered for a few long minutes, the bushes static since the wind had dimmed, the sky as painted on the vault of a cathedral. Nothing more to draw your attention away from his thorny observations. Honestly, deep inside you feel you know how to answer, but you didn’t expect a child to excavate so much in depth. Moreover, since the only purpose was to distract him

and consolidate his confidence, you wouldn't expect him to undermine yours.

Nevertheless, there you are, walking in the young night on a desolate land, with a delicate situation to handle. Seemingly simple, and yet so wearying to make sure everything goes smoothly. Earning his trust and confidence was the uppermost priority at this stage, something you couldn't allow yourself to lose, especially in view of the upcoming fork at the bridge. In the end, though, as you realized you had no second-hand experience to guide your decisions, let alone personal. Hence, after a short time to digest it, you dress your best smile and face the boy with unprecedented self-confidence.

"Can I say something?" – you ask rhetorically after a long and embarrassing pause, to mark the start of your reply.

"Of course, I'm curious now."

"Good. So, you made a very good point" – you try to have him better-disposed – "but that's not the end of the story. There's a lot we can say about it, especially on the role of religion."

"Can you please summarize it first, and then you tell me more? I'll get lost otherwise, since it sounds already very complicated" – he confesses, challenging you to go straight to the point.

"Sure..." – you pause again, theatrically – "So, I'd say you are both right and wrong, at the same time. I would agree with what you said, but there's a point that, somehow, invalidates it all."

"..."

"Was it short enough?"

"Yes... but it didn't mean much. I don't know what you don't agree on, so I cannot reply. I only see that, again, you have two opinions, like with my teacher. Is it normal to do like this, do you like it? I've never seen anyone do it before..."

"They're not discordant, not at all: I would agree with you if it was not for my objection, which invalidates the discussion."

"But this is not what you said. This, at least, sounds clearer."

"Fine, if you prefer it, I'm happy with this one. You asked me to be concise and I did my best to summarize it, it was not that easy! If you like, we can talk about it."

“Yes please. Maybe, let’s do it before that quay over there?” – he adds, pointing to a shady corner of vegetation with his stick – “There are more things I’d like to ask and so little time.”

It was so nice to see Ujana motivated, energetic and positive, even if it was for debating such an unexpected argument. He looked free of the tension and fear for his relatives, and it felt like he gave it for granted that everything would end in the best way. Somehow it was childish, for sure, but it was so much better than having a child prey of anxiety or concerns. The best strategy, then, seems to engage him with his questions, fast enough to keep him enthralled and slow enough to talk until the lighthouse.

“Cool” – you start – “so... first things first: I agree with almost everything you said. As a matter of fact, we (students, people, researchers, everyone) trust the content of textbooks in the same way as believers trust the word of the Lord in the Bible and in the other works. You’re right – you stress – there’s no substantial difference, the only exceptions being the cases where something can be easily verified by the reader. But since we’re not talking about those cases, yes: often we believe in new findings without a rigorous check. To make an example” – you continue – “when a new result is found, we trust the work of reviewers, experts who assess the validity of a result when it’s presented.”

“How did you say... reviewers?”

“Yes. They are a small group of scientists who are asked to check the content of a work.”

“And how many are these reviewers? I mean, for something big like... a powerful theorem?”

“They can be up to five, and they review works within their expertise. They are not only theorems; it can be anything from experimental biology to theoretical economy.”

“And these experts... they never make mistakes?”

“Of course they do, even quite often I’d say. Anyway, just to make it clear, don’t expect them to redo all the calculations or experiments that they see in the manuscript! They don’t have time

for that, they have their own work to carry out... they are even not paid for their service, so you can imagine...”

“Wait, you’re telling me that a scientist presents a discovery, sends it to them and they make only a quick check? And then, if they accept it, it’s printed for everyone to read in a textbook?”

“Well, things don’t go exactly as you described, it’s a bit more complicated but yes, this is what happens every day in science.”

“Then, how can we be sure that it’s correct, if no one checked it very carefully?”

“It’s unlikely that results are completely wrong. Sometimes, they spot some flaws in the work and, in that case, they send it back for improvement. Other times they may overlook the error and the work is accepted anyway... but, eventually, the community realizes it and the results are corrected or discarded.”

“...” – he looks at you with skeptical eyes.

“Look, this system has worked well for decades, even though it’s far from perfect.”

“But you can’t know it for sure, can you?”

“No, you can’t, but look at what we achieved only in the last century: don’t you agree that this process must work well?”

“I only see that we trust books that can contain things that no one has ever checked carefully, about theorems or experiments that no one can do at home. Do you know how I call this?”

“No, how...”

“You know it, don’t pretend” – he replies with a sly smile.

“Would you call it religion?”

“Yes. To me now it’s clear that science is only religion.”

“Are you serious, again? I can...”

“Come on” – he interjects – “it’s you who ‘can’t tolerate all the people who make fun of conspirators, when they are the first who have no clue about why things work as they do’. I didn’t know science worked this way, I thought it was more...”

“... reliable?” – you try to guess, to show that you are following and that you are not scared by his arguments.

“Reliable, yes... but that’s not all. You also said that we should be wise and respect superstitious people: fine, I agree, I’m happy you told me. Then, you explained that science is never certain but,

rather, it can be proven wrong (and this should be the ‘essence of its power’): fine again, I see what you mean and I agree. Plus many other things like evolution, and now you even say that there’s no difference between science and religion!” – he adds – “I don’t know any more what to think... I was very enthusiastic about what I learnt at school, and everything I believed in was wrong.”

“Wait!” – you reply on instinct – “We already talked about it: science is still the awesome thing you love, no one touched it! We only talked about some aspects that are not discussed at school. Also, let’s not forget that it all started from your teacher, trying to understand her advice together. It was cool talking about it, I hope you found it interesting too!”

“Yes, of course it was interesting” – answers the boy, hidden behind his sad look – “but it’s not what I wanted to hear. Now I feel like I have no dreams anymore.”