

*The Story of*  
**Genetics, Development**  
*and Evolution*

*A Historical Dialogue*

GÁSPÁR JÉKELY

# *The Story of Genetics, Development and Evolution*

## *A Historical Dialogue*

This unique story offers an introductory conversation to genetics, embryology and evolution, taking us on a historical journey of biology through the ages. Using a series of dialogues between the Greek philosopher Democritus and his disciple Alkimus, we travel through time visiting eminent scientists throughout the centuries, from Lazzaro Spallanzani and Theodor Boveri to Francis Crick, Max Perutz and Christiane Nüsslein-Volhard. We find ourselves at the intersection of competing theories in biology and witness the progression from the debunking the theory of spontaneous generation to the mapping of the genome. Attention is given not only to the great successes in the field but also to the equally important and exciting failures.

Originally published in Hungarian, *The Story of Genetics, Development and Evolution* provides a historical background to the life sciences, with complex scientific concepts stripped down and explained carefully for academics and anyone interested in going back to the roots and philosophies of scientific progress.

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GÁSPÁR JÉKELY

Max Planck Institute for Developmental Biology, Germany

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“Translated from Hungarian by Lara Strong”

# Prologue

## At the Harbour

ALKIMOS: Democritus, Democritus, I found you!

DEMOCRITUS: Is that you, Alkimos?

ALKIMOS: I roamed the entire market in search of you until I heard you were down at the harbour.

DEMOCRITUS: Ah, but you know it's here that I do my best thinking. The wind off the ocean inspires me to greater thoughts.

ALKIMOS: Master, have you read my poem?

DEMOCRITUS: I have, my friend.

ALKIMOS: I intend to submit it to the poetry contest. A poem in praise of Democritus is sure to gain distinction. Finally, thank Zeus, I've found the right profession for me. Poetry will be my lot. I'm prepared to write a heroic epic on the war between Titans and the Gods. I shall sing the War of the Centaurs and Prometheus.

DEMOCRITUS: Your commitment is admirable, and although I'm flattered you've written a poem about me, I should note that the oft-repeated phrase—"And the wise Democritus, in answer to his question, said," violates the rule of dactylic hexameter.

ALKIMOS: Master, that's not such a serious offence.



DEMOCRITUS: Yes, but if you remove the “rosy-fingered dawn” or “looking askance upwards” and the other tropes from your poem, not much remains. Show me the heart of your art. Show me the lines deserving of the name *true poetry*.

ALKIMOS: Master, listen! I swear to Zeus, Apollo himself could not have composed a better distich:

*In your spacious skull, intellect takes flight  
Your every thought eternal and bright*

DEMOCRITUS: I’m sorry to say, but it lacks spontaneity.

ALKIMOS: And this masterfully composed hexameter?

*With a murmur, the gentle wind of Aphrodite gained force.  
Scattering the magic, as Eos did the morning mist.*

DEMOCRITUS: Trust me, it’s rather insipid. Were those lines really in the poem? Interesting.

ALKIMOS: Oh, master, please listen to my favourite part:

*What sublimity pours from the pupils of the wise and clever Democritus  
The light of a new sunrise greets the ungracious world.*

DEMOCRITUS: The content isn’t bad, but the structure is a bit clumsy.

ALKIMOS: Clumsy? This beautiful verse? Oh, if only I could see it.

DEMOCRITUS: One of the greatest virtues a person can have is the ability to see his own mistakes.

ALKIMOS: Oh master, can’t you spare me a reassuring word? Your severity dampens my spirits; now all I see are my weaknesses. You force me to concede—poetry is nothing but a vain, childish fantasy—another pitfall of my youth. My poetic inspiration doesn’t soar. No, at the most it waltzes in the mud; the toxic air of my intellectual swamp deadens my non-existent genius.

DEMOCRITUS: Now, Alkimos, don’t be so hard on yourself.

ALKIMOS: Oh master, as you see, my undisciplined mind wanders nonstop, never arriving at shore. Tame it, restrain it. It’s not as useless as my body is

pitiable, as my legs are crooked, my belly soft, my chest withered. Lead me down the path of rigor; let me be lord of my tangled thoughts.

DEMOCRITUS: Your determination is impressive, Alkimos. You have quickly given up poetry, and now, if I understand, you'd like to be my apprentice and learn to be a philosopher?

ALKIMOS: Master, give me a chance!

DEMOCRITUS: How can I guide a three-wheeled cart down the right path? I'm suited for contemplation not teaching. But I must admit, I've become fond of you. Yes, I think perhaps I'd enjoy helping you exercise your intellect.

ALKIMOS: Master, thank you! I'm going to be a philosopher! Oh thank Zeus, I've found my path!

DEMOCRITUS: I hope so, son.

### **At the Market**

DEMOCRITUS: Come on, Alkimos, let's walk through the market and give ourselves over to the joy of thinking.

ALKIMOS: Yes, master. I'd also like to give myself over to the joy of a crispy, fried flounder and maybe some of that Thracian wine I've got in my leather flask.

DEMOCRITUS: Yes, yes, sometimes we have to lower ourselves and respond to our physical needs.

ALKIMOS: I swear to Zeus, lowering myself certainly feels good.

DEMOCRITUS: Son, if we pay too much attention to our stomachs, we have less time for our thoughts.

ALKIMOS: But Master, as an impassioned poet ... or rather philosopher, I can pay attention to two things at once. I'm anxious for my first lesson.

DEMOCRITUS: All right. If you recall, yesterday we talked about the creation of the world.

ALKIMOS: Yes.

DEMOCRITUS: I explained to you how atoms of all shapes and composition, as they collide, can form larger and larger bodies. These bodies — thanks to the variety of materials they're made of—can also take on countless forms and colours. The infinite assortment results in an infinite number of structures. Indeed, if we look around, we'll discover the unbounded richness of our world. Look at the abundance of sea creatures caught in the fisherman's nets, or the huge variety of birds in the sky. If we count the grass in a meadow and the game in the forest, the number will approach that of the stars.

ALKIMOS: Yes, there are millions of forms; the variations are endless. An inestimable wealth unfolds before me.

DEMOCRITUS: Son, don't let me fool you. Take a closer look at the fishmonger's display or the flowers in a field. What do you see? You've just eaten a flounder with the voracity of a child. But does the fishmonger have any more of the same to sell? If you pick a blade of grass, are there countless more of the same blades in the meadow?

ALKIMOS: Well ... not exactly the same.

DEMOCRITUS: That's right. So how do you know if a flounder is a flounder, or a blade of grass is a blade of grass if they're not exactly the same as the others?

ALKIMOS: Because they're similar.

DEMOCRITUS: Yes, indeed. Flounders more closely resemble each other than they do other fish. The same is true of grass and flowers. And of people, too, regardless of how dissimilar we seem. But of course, we have souls made of fire atoms, which distinguish us from all other things.

ALKIMOS: Ah, now I get it. Similar things are more similar to each other than to things that are different. It doesn't take wisdom to understand that.

DEMOCRITUS: No, but we have to travel a long road to understand why that's true. Why do baby birds resemble their parents? Why do only partridges emerge from partridge eggs? Why not larks? If the farmer plants wheat seeds, why does only wheat sprout from the ground and not rye? Why don't grapevines produce figs?

ALKIMOS: Excuse for saying so master, but that seems a bit crazy. I mean, who thinks a fig would grow on a grapevine? Everyone knows—even those of us who aren't very clever—that that's impossible.

DEMOCRITUS: Don't be fooled by what you're accustomed to. Just because we observe a phenomenon every day, and it's obvious to everyone, doesn't mean we don't need to explain it. It's always the easiest questions that are the most difficult to answer. That's because they touch upon the very essence of things—the secrets our minds can't grasp, but yet we believe we know them, because they're so familiar. Our never-ending task is to explore these questions.

ALKIMOS: I'm not objecting, but I don't understand why we have to examine questions of that sort. Why not be satisfied that things happen a certain way because they do. The gods know how to run the world. If Demeter sees a peasant sow wheat, she won't trick him by making rye sprout.

DEMOCRITUS: But I'm not satisfied, son. My goal is to understand things at the atomic level.

ALKIMOS: But how?

DEMOCRITUS: Let's take our thoughts a step further. How can the endless crashing of an endless number of atoms produce similar looking things? We must presume that something prompts some atoms to stick more closely together. Let's imagine that crooked atoms would rather join other crooked ones and not smooth ones. The smooth ones likewise prefer the company of smooth ones. This results in the large variety of things that resemble each other. This is how slithering worms, winged and four-legged creatures, the throngs of slippery fish, and the rank grasses that cover the earth came to exist. After birth, similar creatures mated and reproduced more creatures like themselves, so their great variety remained, the order of their atoms and the pulsating essence of their lives were established at the moment the atoms crashed.

ALKIMOS: That's exactly how I would have put it! I understand the point you're trying to make. Your thoughts are so beautiful I can't resist a sip from my wine flask. Ah, such a heavenly drink!

DEMOCRITUS: Give it here, son. I haven't had such fine wine in a long time. Ah, consuming wine in moderation helps the mind to generate ideas and put them into words. As the pure wine circulates in your veins, you'll be able to imagine the minuscule and the gargantuan. Your thoughts will propel you through the endless oceans. You'll reach the bottom of the bottomless, the limits of the limitless. But Alkimos, one day the moment will come when you'll realise you know nothing, even when you think you know everything. In every era, we think we've solved one or two mysteries, but the unknown is without end, a boundless territory. Still, our task is to conquer as much of this land as we can. I have travelled to Hellas, Thrace, and Persia, and met with many wise men, but the wisest were always those who acknowledged they knew nothing. Perhaps over the coming centuries, thousands of wise philosophers may turn this nothing into something. My most fervent desire is to be present at the time the great secrets are revealed, and we'll be able to say that our knowledge, as rudimentary as it is, is something rather than nothing. Now give me some wine. Let's drink up and sleep well.

ALKIMOS: My flask was full to the brim, but now only a few drops remain. Allow me to finish it, and then let's walk to the sandy shore and rest before nightfall.

DEMOCRITUS: Come, Alkimos, lead me there. My head has grown heavy. I wouldn't mind a short nap. I see my atoms clearly, the world I've created. They crash, they dissolve, they join, in an endless current. Oh, if I had the strength to watch them, to examine their special world, to understand the infinite secrets of their essence, their forms, their functions, and their roles. It's my only dream, my stubborn, burning desire.

ALKIMOS: We can rest here, master. The breeze is gentle, the sea calm.

DEMOCRITUS: Give me your hand. Help me to lie down. I can put my head on the soft sand. No, give me the flask. I'll put it under my head; there that's better.

ALKIMOS: Drat the sand. It's getting in my ears ...

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