***SOPHIE’S WORLD.* BY JOSTEIN GAARDER*.***

***“DARWIN”***

“We’ll talk about Darwin, Sophie. You may recall that the pre-Socratics looked for natural explanations of the processes of nature. In the same way that they had to distance themselves from ancient mythological explanations, Darwin had to distance himself from the church’s view of the creation of man and beast.”

“But was he a real philosopher?”

“Darwin was a biologist and a natural scientist. But he was also the scientist of recent times who has most openly challenged the Biblical view of man’s place in Creation.”

“So you’ll have to say something about Darwin’s theory of evolution.”

“Let’s begin with Darwin the man. He was born in the little town of Shrewsbury in 1809. His father, Dr. Robert Darwin, was a renowned local physician, and very strict about his son’s upbringing. When Charles was a pupil at the local grammar school, his headmaster described him as a boy who was always flying around, fooling about with stuff and nonsense, and never doing a stroke of anything that was the slightest bit useful. By ‘useful,’ the headmaster meant cramming Greek and Latin verbs. By ‘flying around,’ he was referring among other things to the fact that Charles clambered around collecting beetles of all kinds.”

“I’ll bet he came to regret those words.”

“When he subsequently studied theology, Charles was far more interested in bird-watching and collecting insects, so he did not get very good grades in theology. But while he was still at college, he gained himself a reputation as a natural scientist, not least due to his interest in geology, which was perhaps the most expansive science of the day. As soon as he had graduated in theology at Cambridge in April 1831, he went to North Wales to study rock formations and to search for fossils. In August of the same year, when he was barely twenty-two years old, he received a letter which was to determine the course of his whole life . . .”

“What was the letter about?

“It was from his friend and teacher, John Steven Hens-low. He wrote: I have been requested to ... recommend a naturalist to go as companion to Captain Fitzroy, who has been commissioned by the government to survey the southern coasts of South America. I have stated that I consider you to be the best qualified person I know of who is likely to undertake such a situation. “He wished ardently to grasp the chance, but in those days young mendid nothing without their parents’ consent. After much persuasion, his father finally agreed— and it was he who financed his son’s voyage. As far as the ‘financial side’ went, it was conspicuous by its absence.”

“Oh.”

“The ship was the naval vessel HMS Beagle. It sailed from Plymouth on December 27, 1831, bound for South America, and it did not return until October of 1836. The two years became five and the voyage to South America turned into a voyage round the world. And now we come to one of the most important voyages of discovery in recent times.”

“They sailed all the way round the world?”

“Yes, quite literally. From South America they sailed on across the Pacific to New Zealand, Australia, and South Africa. Then they sailed back to South America before setting sail for England. Darwin wrote that the voyage on board the Beagle was without doubt the most significant event in his life.”

“It couldn’t have been easy to be a naturalist at sea.”

“For the first years, the Beagle sailed up and down the coast of South America. This gave Darwin plenty of opportunity to familiarize himself with the continent, also inland. The expedition’s many forays into the Galapagos Islands in the Pacific west of South America were of decisive significance as well. He was able to collect and send to England vast amounts of material. However, he kept his reflections on nature and the evolution of life to himself.

When he returned home at the age of twenty-seven, he found himself renowned as a scientist. At that point he had an inwardly clear picture of what was to become his theory of evolution. But he did not publish his main work until many years after his return, for Darwin was a cautious man—as is fitting for a scientist.”

“What was his main work?”

“Well, there were several, actually. But the book-which gave rise to the most heated debate in England was The Origin of Species, published in 1859. Its full title was On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. The long title is actually a complete resume of Darwin’s theory.”

“He certainly packed a lot into one title.”

“But let’s take it piece by piece. In The Origin of Species, Darwin advanced two theories or main theses: first, he proposed that all existing vegetable and animal forms were descended from earlier, more primitive forms by way of a biological evolution. Secondly, that evolution was the result of natural selection.”

“The survival of the fittest, right?”

“That’s right, but let us first concentrate on the idea of evolution. This, in itself, was not all that original. The idea of biological evolution began to be widely accepted in some circles as early as 1800. The leading spokesman for this idea was the French zoologist Lamarck. Even before him, Darwin’s own grandfather, Erasmus Darwin, had suggested that plants and animals had evolved from some few primitive species. But none of them had come up with an acceptable explanation as to how this evolution happened. They were therefore not considered by churchmen to be any great threat.”

“But Darwin was?”

“Yes, indeed, and not without reason. Both in ecclesiastic and scientific circles, the Biblical doctrine of the immutability of all vegetable and animal species was strictly adhered to. Each and every form of animal life had been created separately once and for all. This Christian view was moreover in harmony with the teachings of Plato and Aristotle.”

“How so?”

“Plato’s theory of ideas presupposed that all animal species were immutable because they were made after patterns of eternal ideas or forms. The immutability of animal species was also one of the cornerstones of Aristotle’s philosophy. But in Darwin’s time there were a number of observations and finds which were putting traditional beliefs to the test.”

“What kind of observations and finds were they?”

“Well, to begin with an increasing number of fossils were being dug out. There were also finds of large fossil bones from extinct animals. Darwin himself was puzzled to find traces of sea creatures far inland. In South America he made similar discoveries high up in the mountains of the Andes.

What is a sea creature doing in the Andes, Sophie? Can you tell me that?”

“No.”

“Some believed that they had just been thrown away there by humans or animals. Others believed that God had created these fossils and traces of sea

creatures to lead the ungodly astray.”

“But what did scientists believe?”

“Most geologists swore to a ‘catastrophe theory/ according to which the earth had been subjected to gigantic floods, earthquakes, and other catastrophes that had destroyed all life. We read of one of these in the Bible—the Flood and Noah’s Ark. After each catastrophe, God renewed life on earthby creating new—and more perfect— plants and animals.”

“So the fossils were imprints of earlier life forms that had been wiped out after these gigantic catastrophes?”

“Precisely. For example, it was thought that fossils were imprints of animals that had failed to get into the Ark. But when Darwin set sail on the Beagle, he had with him the first volume of the English biologist Sir Charles Lyell’s Principles of Geology. Lyell held that the present geology of the earth, with its mountains and valleys, was the result of an interminably long and gradual evolution. His point was that even quite small changes could cause huge geological upheavals, considering the aeons of time that have elapsed.”

“What kind of changes was he thinking of?”

“He was thinking of the same forces that prevail today: wind and weather, melting ice, earthquakes, and elevations of the ground level. You’ve heard the saying about a drop of water wearing away a stone—not by brute force, but by continuous dripping. Lyell believed that similar tiny and gradual changes over the ages could alter the face of nature completely. However, this theory alone could not explain why Darwin found the remains of sea creatures high up in the Andes. But Darwin always remembered that tiny gradual changes could result in dramatic alterations if they were given sufficient time.”

“I suppose he thought the same explanation could be used for the evolution of animals.”

“Yes, that was his thought. But as I said before, Darwin was a cautious man. He posed questions long before he ventured to answer them. In that sense he used the same method as all true philosophers: it is important to ask but there is no haste to provide the answer.”

“Yes, I see.”

“A decisive factor in Lyell’s theory was the age of the earth. In Darwin’s time, it was widely believed that about 6,000 years had elapsed since God created the earth. That figure had been arrived at by counting the generations since Adam and Eve.”

“How naive!”

“Well, it’s easy to be wise after the event. Darwin figured the age of the earth to be 300 million years. Because one thing, at least, was clear: neither Lyell’s theory of gradual geological evolution nor Darwin’s own theory of evolution had any validity unless one reckoned with tremendously long periods of time.”

“How old is the earth?”

“Today we know that the earth is 4.6 billion years old.”

“Wow!”

“Up to now, we have looked at one of Darwin’s arguments for biological evolution, namely, the stratified deposits of fossils in various layers of rock. Another argument was the geographic distribution of living species. This was where Darwin’s scientific voyage could contribute new and extremely comprehensive data. He had seen with his own eyes that the individuals of a single species of animal within the same region could differ from each other in only the minutest detail. He made some very interesting observations on the Galapagos Islands, west of Ecuador, in particular.”

“Tell me about them.”

“The Galapagos Islands are a compact group of volcanic islands. There were therefore no great differences in the plant and animal life there. But Darwin was interested in the tiny differences. On all the islands, he came across giant tortoises that were slightly different from one island to another.

Had God really created a separate race of tortoises for each and every island?”

“It’s doubtful.”

“Darwin’s observations of bird life on the Galapagos were even more striking. The Galapagos finches were clearly varied from island to island, especially as regards the shape of the beak. Darwin demonstrated that these variations were closely linked to the way the finches found their food on the different islands. The ground finches with steeply profiled beaks lived on pine cone seeds, the little warbler finches lived on insects, and the tree finches lived on termites extracted from bark and branches ... Each and every one of the species had a beak that was perfectly adapted to its own food intake.

Could all these finches be descended from one and the same species? And had the finches adapted to their surroundings on the different islands over the ages in such a way that new species of finches evolved?”

“That was the conclusion he came to, wasn’t it?”

“Yes. Maybe that was where Darwin became a ‘Darwinist’—on the Galapagos Islands. He also observed that the fauna there bore a strong resemblance to many of the species he had seen in South America. Had God once and for all really created all these animals slightly different from each other—or had an evolution taken place? Increasingly, he began to doubt that all species were immutable. But he still had no viable explanation as to how such an evolution had occurred. But there was one more factor to indicate that all the animals on earth might be related.”

“And what was that?”

“The development of the embryo in mammals. If you compare the embryos of dogs, bats, rabbits, and humans at an early stage, they look so alike that it is hard to tell the difference. You cannot distinguish a human embryo from a rabbit embryo until a very late stage. Shouldn’t this indicate that we are distant relatives?”

“But he had still no explanation of how evolution happened?”

“He pondered constantly on [yell’s theory of the minute changes that could have great effect over a long period of time. But he could find no explanation that would apply as a general principle. He was familiar with the theory of the French zoologist Lamarck, who had shown that the different species had developed the characteristics they needed. Giraffes, for example, had developed long necks because for generations they had reached up for leaves in the trees. Lamarck believed that the characteristics each individual acquires through his own efforts are passed on to the next generation. But this theory of the heredity of ‘acquired characteristics’ was rejected by Darwin because Lamarck had no proof of his bold claims. However, Darwin was beginning to pursue another, much more obvious line of thought. You could almost say that the actual mechanism behind the evolution of species was right in front of his very nose.”

“So what was it?”

“I would rather you worked the mechanism out for yourself. So I ask: If you had three cows, but only enough fodder to keep two of them alive, what would you do?”

“I suppose I’d have to slaughter one of them.”

“All right... which one would you slaughter?”

“I suppose I’d slaughter the one that gave the least milk.”

“Would you?”

“Yes, that’s logical, isn’t it?”

“That is exactly what mankind had done for thousands of years. But we haven’t finished with your two cows yet. Suppose you wanted one of them to calve. Which one would you choose?”

“The one that was the best milker. Then its calf would probably be a good milker too.”

“You prefer good milkers to bad, then. Now there’s one more question. If you were a hunter and you had two gundogs, but had to give up one of them, which one would you keep?”

“The one that’s best at finding the kind of game I shoot, obviously.”

“Quite so, you would favor the better gundog. That’s exactly how people have bred domestic animals for more than ten thousand years, Sophie. Hens did not always lay five eggs a week, sheep did not always yield as much wool, and horses were not always as strong and swift as they are now. Breeders have made an artificial selection. The same applies to the vegetable kingdom. You don’t plant bad potatoes if there are good seed potatoes available, and you don’t waste time cutting wheat that yields no grain. Darwin pointed out that no cows, no stalks of wheat, no dogs, and no finches are completely alike. Nature produces an enormous breadth of variation. Even within the same species, no two individuals are exactly alike. You probably experienced that for yourself when you drank the blue liquid.”

“I’ll say.”

“So now Darwin had to ask himself: could a similar mechanism be at

work in nature too? Is it possible that nature makes a ‘natural selection’ as to

which individuals are to survive? And could such a selection over a very long

period of time create new species of flora and fauna?”

“I would guess the answer is yes.”

“Darwin could still not quite imagine how such a natural selection could

take place. But in October 1838, exactly two years after his return on the

Beagle, he chanced to come across a little book by the specialist in population

studies, Thomas Malthus. The book was called An Essay on the Principle of

Population. Malthus got the idea for this essay from Benjamin Franklin, the

American who invented the lightning conductor among other things. Franklin

had made the point that if there were no limiting factors in nature, one single

species of plant or animal would spread over the entire globe. But because

there are many species, they keep each other in balance.”

“I can see that.”

“Malthus developed this idea and applied it to the world’s population. He

believed that mankind’s ability to procreate is so great that there are always

more children born than can survive. Since the production of food can never

keep pace with the increase in population, he believed that huge numbers

were destined to succumb in the struggle for existence. Those who survived

to grow up— and perpetuate the race—would therefore be those who came

out best in the struggle for survival.”

“That sounds logical.”

“But this was actually the universal mechanism that Darwin had been

searching for. Here was the explanation of how evolution happens. It was due

to natural selection in the struggle for life, in which those that were best

adapted to their surroundings would survive and perpetuate the race. This

was the second theory which he proposed in The Origin of Species. He wrote:

The elephant is reckoned the slowest breeder of all known animals,’ but if it

had six young and survived to a hundred, ‘after a period of from 740 to 750

years there would be nearly nineteen million elephants alive, descended from

the first pair.’ “

“Not to mention all the thousands of cods’ eggs from a single cod.”

“Darwin further proposed that the struggle for survival is frequently

hardest among species that resemble each other the most. They have to fight

for the same food. There, the slightest advantage—that is to say, the

infinitesimal variation—truly comes into its own. The more bitter the struggle

for survival, the quicker will be the evolution of new species, so that only the

very best adapted will survive and the others will die out.”

“The less food there is and the bigger the brood, the quicker evolution

happens?”

“Yes, but it’s not only a question of food. It can be just as vital to avoid

being eaten by other animals. For example, it can be a matter of survival to

have a protective camouflage, the ability to run swiftly, to recognize hostile

animals, or, if the worst comes to the worst, to have a repellent taste. A

poison that can kill predators is quite useful too. That’s why so many cacti are

poisonous, Sophie. Practically nothing else can grow in the desert, so this

plant is especially vulnerable to plant-eating animals.”

“Most cacti are prickly as well.”

“The ability to reproduce is also of fundamental importance, obviously.

Darwin studied the ingenuity of plant pollination in great detail. Flowers glow

in glorious hues and exude delirious scents to attract the insects which are

instrumental in pollination. To perpetuate their kind, birds trill their melodious

tones. A placid or melancholy bull with no interest in cows will have no interest

for genealogy either, since with characteristics like these, its line will die out at

once. The bull’s sole purpose in life is to grow to sexual maturity and

reproduce in order to propagate the race. It is rather like a relay race. Those

that for one reason or another are unable to pass on their genes are continually

discarded, and in that way the race is continually refined. Resistance

to disease is one of the most important characteristics progressively

accumulated and preserved in the variants that survive.”

“So everything gets better and better?”

“The result of this continual selection is that the ones best adapted to a

particular environment—or a particular ecological niche—will in the long term

perpetuate the race in that environment. But what is an advantage in one

environment is not necessarily an advantage in another. For some of the

Galapagos finches, the ability to fly was vital. But being good at flying is not so

necessary if food is dug from the ground and there are no predators. The

reason why so many different animal species have arisen over the ages is

precisely because of these many niches in the natural environment.”

“But even so, there is only one human race.”

“That’s because man has a unique ability to adapt to different conditions

of life. One of the things that amazed Darwin most was the way the Indians in

Tierra del Fuego managed to live under such terrible climatic conditions. But

that doesn’t mean that all human beings are alike. Those who live near the

equator have darker skins than people in the more northerly climes because

their dark skin protects them from the sun. White people who expose

themselves to the sun for long periods are more prone to skin cancer.”

“Is it a similar advantage to have white skin if you live in northern

countries?”

“Yes, otherwise everyone on earth would be dark-skinned. But white

skin more easily forms sun vitamins, and that can be vital in areas with very

little sun. Nowadays that is not so important because we can make sure we

have enough sun vitamins in our diet. But nothing in nature is random.

Everything is due to infinitesimal changes that have taken effect over

countless generations.”

“Actually, it’s quite fantastic to imagine.”

“It is indeed. So far, then, we can sum up Darwin’s theory of evolution in

a few sentences.”

“Go ahead!”

“We can say that the ‘raw material’ behind the evolution of life on earth

was the continual variation of individuals within the same species, plus the

large number of progeny, which meant that only a fraction of them survived,

the actual ‘mechanism,’ or driving force, behind evolution was thus the natural

selection in the struggle for survival. This selection ensured that the strongest,

or the ‘fittest,’ survived.”

“It seems as logical as a math sum. How was The Origin of Species

received?”

“It was the cause of bitter controversies. The Church protested

vehemently and the scientific world was sharply divided. That was not really

so surprising. Darwin had, after all, distanced God a good way from the act of

creation, although there were admittedly some who claimed it was surely

greater to have created something with its own innate evolutionary potential

than simply to create a fixed entity.”

**QUESTIONS RELATED TO THE CHAPTER DEDICATED TO DARWIN IN “THE WORLD OF SOPHIA"**

1. What is understood by current naturalist? Who were their main exponents and what were their most important contributions?
2. Explain the theory of the origin of species prevailing before Darwin’s theory of evolution.
3. Explain Lyell’s geological theory.
4. List and explain the different arguments that brought Darwin to the conclusion of the biological evolution.
5. What does the artifical selecton consist of?
6. Explain the influence of Malthus in the Darwinian Theory. By the way, who is Malthus?
7. In which fields do natural selection operate?
8. Why does only one human race exist?
9. What were the reactions to *Origin*?