LIVING

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The essential Darwin

200th birthday of the man who made biology make sense

Last Thursday, the British naturalist Charles Darwin, the father of the theory of evolution, had a birthday – his 200th to be exact. People around the world with a love of nature and a love for the power of rational thinking are celebrating. The theory of evolution is the glue that holds the biological sciences together. Without it, nothing in biology would make sense.

OUR CHANGING SEASONS
Drew Monkman

As a starting point, it's important to understand what we mean by "theory." In science, the word theory is used for a unifying principle that explains a body of facts or a given phenomenon. For example, we call upon the theory of gravity to explain why all objects fall towards the surface of the earth when dropped. No one questions this. In other words, a theory is simply an explanation to a set of observations. Confusion sometimes arises because a second meaning of theory is an unproved assumption or conjecture. That is not the meaning we're referring to here.

At its simplest, the theory of evolution explains how organisms change in appearance and behaviour with time. The theory goes like this: Through reproduction, organisms have young that are generally like themselves. However, only a fraction of the young survive. Luckily, not all of the offspring are exactly the same. In every generation, there are slight differences in size, colour, strength, behaviour, or other features. These variations are due to small, naturally occurring genetic mutations.

Now, as we all know, life is a struggle to find food, a mate, shelter, and other essentials. The struggle is especially difficult if there have been changes in the environment. However, some features might help in this struggle, a larger, stronger beak, for example. Any offspring lucky enough to have this feature will be better adapted to their surroundings. Their chances of surviving and going on to breed will therefore be improved. We call this natural selection. Nature is choosing or "selecting" those individuals that will survive. By contrast, the term artificial selection is employed when humans do the selecting, such as in breeding dogs or cattle.

If a useful feature can be inherited, the next generation of offspring will have it too. It will make survival for them easier and lead to even more offspring with this feature. As this process continues over long periods of time and many generations, features that improve the chances of survival become more common and a species "evolves" or changes. Those individuals that lack the necessary feature or features eventually die out because they cannot adapt or compete. The "new" species is eventually only able to breed with individuals of this same, new group. For example, a population of birds that somehow becomes isolated from the ancestral population and evolves in a different environment will eventually be unable to breed with individuals of the ancestral group. In this way, it has become a new species, namely a group of organisms capable of interbreeding and producing fertile offspring. Two different species, however, are not able to interbreed and to produce fertile offspring.

Karl Egressy photo

The monarch butterfly (below), is the only Canadian butterfly that migrates. The red crossbill (right) has developed as a number of subspecies, all with slightly different bills adapted to the type of seeds they eat. Both are examples of Darwin's theory of evolution at work.

Drew Monkman photo

Darwin's theory was inspired to a large extent by his observations of finches that inhabit the Galapagos Islands off the coast of Ecuador. The 13 different finch species living there all evolved from a common ancestor. This ancestor was similar to the blue-black grassquit finch, a species of the west coast of South America. It is believed that a few of the original grassquit finches from the mainland ended up on the Galapagos, probably blown over by a storm. Then, over the next million years or more, this original ancestral species evolved into 13 new species, each taking advantage of a different food source and habitat type. Each species evolved to have a particular type of beak, which is suited to a certain kind of food. For example, the vegetarian finch has a crushing bill, the tree finch has a grasping bill and the cactus finch has a probing bill. Today, these finches are seen as a textbook example of evolution.

Darwin found manifestations of evolution everywhere, even in the gardens and hedgerows of his country home in England. And we, of course, can see them everywhere around us here in the Kawarthas. I was thinking of this the other day while cross-country skiing at Haultain, north of Burleigh Falls. A small flock of red crossbills was feeding noisily in the top of a white pine. Crossbills are specialist feeders of conifer cones, and the unusual "crossed" bill shape is an adaptation to assist the extraction of the seeds from the cone.

Red crossbills are to North America what finches are to the Galapagos Islands. They represent a clear example of evolution by natural selection. In the same manner as Darwin's famous finches, red crossbills have evolved unique bill sizes, bill shapes, body sizes, and flight calls. The differences in these features depend on the kind of conifer seeds they eat, since they have essentially co-evolved with their conifer food source.

There's a red crossbill, for example, that specializes on red and white pine seeds. Another one is equipped to tackle lodgepole pine seeds, and yet another feeds on black spruce. While the birds may all look generally alike to the casual human observer, each variety of crossbill seems to recognize its own kind and appears to refrain from breeding with other red crossbill types. Biologists have proposed as many as nine red crossbill subspecies, some of which are probably distinct species.

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Darwin was the first person to make the asking of "why" questions about organisms and the natural world both sensible and acceptable. Why does a given animal live here and not there? Why does it look like this and behave like that? Darwin gave us a tool – the theory of evolution – to consider these sorts of questions. He also made us realize that we should expect a reasonable answer to these questions. Before Darwin, we simply accepted that God had created a given species in its present form, and this was how it had always looked and behaved. No further explanation or questioning was necessary. End of story.

Darwin showed us for the first time that species evolve and have a history. In other words, there is a logical explanation as to why they are the way they are. Every living organism that exists today stands at the end of an incomprehensibly long corridor of history that explains why it is the way it is. At the same time, every organism is at the starting line of a corridor of change projecting into the future.

To better illustrate the idea of "history," a helpful example is the monarch butterfly. What is there in the monarch's history that explains why it's the only Canadian butterfly that truly migrates? Although many questions still remain, the explanation goes something like this. Like hummingbirds, monarchs are essentially tropical organisms. They evolved in the tropics in close relationship with milkweeds, the only plant species that monarch larvae will eat. The distribution of milkweed species in Mexico, the U.S. and Canada has changed repeatedly over millions of years as a result of changes in the North American land mass because of phenomena such as ice ages. The migrational pattern we see now therefore originated in the distant past when monarchs were following the milkweed species as they spread northward. Each year when winter arrived, the butterflies retreated southward to avoid the cold and lack of food. In the spring, they would once again follow the re-emerging milkweeds northward. This northeast-southwest movement was eventually incorporated into the monarch's genetic code to produce a cyclical migration.

Why is it then that other butterfly species don't migrate? Let's take the example of the West Virginia white butterfly. They evolved in the temperate zones and lay their eggs on a temperate zone plant, the toothwort. There is no reason for them to migrate to the tropics because toothworts are not to be found there. Therefore, West Virginia whites have evolved to overwinter in the temperate zone in the chrysalis stage of the life cycle.

Having a basic understanding of the theory of evolution confers a deep spiritual and intellectual satisfaction to the experience of observing nature. It allows us to always ask why. And the answer to a why question is deeply satisfying. Evolution also shows us that our universe is ripe with diversity. Millions upon millions of different species exist on this planet, even today. And we, as humans, are but one of these species. We are made of the same matter and many of the same chemical compounds as all other life on this planet. Like monarchs and crossbills, we are the fruits of the planet and the evolutionary process.

As Stuart Kaufman states in his recent book, Reinventing the Sacred, "If one image can suffice, think that all that has happened for 3.8 billion years on our planet, to the best of our knowledge, is that the sun has shed light upon the Earth. . . and all that lives around you has come into existence, all on its own. I find it impossible to realize this and not be stunned by reverence. We can only have profound gratitude to participate in this ongoing evolution.

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