The Carbon Caper

Real World Ecosystems
Article

Once upon a time, long ago (approximately five thousand million years ago), a carbon atom floated about in the Earth's early atmosphere. This carbon atom, like billions of others around it, was bonded with two atoms of oxygen to form the molecule we now know as carbon dioxide. A humid wind wafted the carbon atom down and carried it along near the surface of the prehistoric ocean. A wave crested and broke, pulling bubbles of air down below the surface. Our carbon atom now found itself dissolved in the soupy water of a shallow prehistoric sea.

This young ocean was warm and slimy, and probably quite foul, if you could have been there to smell it. The water was murky with green and blue coloured algae, the beginnings of life. With energy supplied by the bright sun, the algae disassembled the carbon dioxide molecules, stripping off their oxygen atoms, and reassembled them into complex compounds, such as sugar and starch. In this manner, our carbon atom now became part of the crusty mass of starch, inside a floating blob or prehistoric algae.

But this state would not last for long. Within days of becoming part of the algal colony, the carbon atom found itself back in the atmosphere. This happened one night in the water when a large amoeba-like creature ate the blob and sued the alga's starch as food. The resulting messy digestion reunited the carbon atom with two oxygen atoms and sent it bubbling back to the surface and up into the atmosphere.

For many millions of years, the atom repeated this story, being absorbed by plants, and released to the atmosphere when fungi, bacteria, or brainless slug-like animals ate the plants. In fact, the carbon atom would probably still be repeating this endlessly boring cycle if it hadn't been for an unusual twist of gat. It happened one day when the Earth was perhaps four billion years old, a time when the land was covered with green, steamy swamps inhabited by ponderous dinosaurs. The carbon atom, with its pair of oxygen sidekicks, was drawn up into the tissue of a giant tree fern. There, just like un the algae. The oxygens were stripped off, and the carbon atom was neatly fitted into a long starch molecule, part pf a succulent shoot of new leaves being spouted by the giant fern.

Ordinarily, the tree fern would have simply died and released all its carbon atoms as the moulds and bacterium decomposed its tissues, Today, however something bigger than a bacteria had other plans/ This something turned out to be a hadrosaur, a plant-eating reptile with a nut-sized brain controlling a bus-sized body.

The hadrosaur was eating a swath through a patch of succulent shoots. The fern shoot with our carbon atom was smashed to a pulp between the hadrosaur's back teeth and sent down to its stomach, along with tonnes of other pulverized vegetation. There, inside the warm, wet. And airless stomach, the fern's starch was digested, some of it becoming energy for the dinosaur. One product of dinosaur

digestion was a carbon-based gas called methane, which the hadrosaur vented back to the atmosphere from both ends in vast, putrid quantities!

The carbon atom, it its latest reincarnation as a methane molecule, spent several centuries drifting about in the atmosphere, circling the planet several hundred times. Finally, energy from the sun broke up the methane molecule, and the carbon atom found itself once again saddled with two oxygen atoms. This was to be its last trip to the atmosphere for a very long time.

Our carbon atoms final flight ended the day it was absorbed by some algae near the edge of a swamp, not far from what would one day become Sheffield, in England. Instead of going back to the atmosphere, or even into a dinosaur, the carbon atom, along with thousands of tonnes of vegetation, was simply buried. Deep under a growing pile of sediments and mud, the black **peaty** (A dark, fibrous material created when 'decomposition fails to keep pace with the production of organic matter'. It is the first stage of transformation of dead plant matter into coal) material was squeezed and heated, and slowly transformed into coal, while the layers of mud above and below became soft sedimentary rocks

There the carbon lay, entombed in the dark, hot coal seam with billions and trillions of other carbon, oxygen and hydrogen atoms, 140 metres below the surface. Ages and millennia passed, silent except for the occasional earth tremor, or glacier grinding by overhead. Eventually, the glaciers, volcanic movements, and water brought the carbon atom, along with its neighbours in the coal seam, close to the surface.

The year was 1790, near the beginning of the Industrial Revolution. By this time, a new species known as humans had largely taken over from the dinosaurs as the planet's self- declared movers and shakers. The humans were interested in the coal because of its usefulness as a fuel and source of chemicals.

The British miners who worked the coal seams risked their lives to harvest the black, rock-like material. Once on the surface, the coal was carried to furnaces and used to heat molten steel, the most important material of the fledgling Industrial Revolution. It was also the fuel of choice (wood and peat being the only alternatives) for firing the newly invented steam engine, which was all the rage in the factories and mills that were springing up throughout Britain and Europe.

Our much-traveled carbon atom lay inside a lump of coal that got shovelled into the boiler of a British textile mill. There, in the fiery heat of the boiler, the carbon atom was once again reunited with two companion oxygen atoms, companions which had seen it through so many adventures many long centuries before. Bursting into the atmosphere from the smoke-belching stack, the atom was swiftly carried high into the atmosphere, to begin another globe-circling ride.

Not a year later, now somewhere over eastern North America, the carbon atom was taken in by one of the needles of a young white pine and locked into the tree's trunk in the form of wood. The atom was joined by many others as, year after year, the tree added more and more wood to its trunk. Over the next 150 years, the young sapling would grow to be a stately, towering giant in the eastern forests of the young nation of Canada. At about the time Canada's railways were being built to the western coast, this pine tree was cut down and sawn into railway ties. The wooden rail ties, destined for the western end of the rail line, were loaded onto flatcars and pulled behind a steam locomotive.

Upon arrival in what would eventually be called the Province of Alberta, workers unloaded the ties and laid them onto the gravelly rail bed. Steel rails were laid upon them and anchored with heavy metal rail spikes. The rail ties, with their trillions of carbon atoms, would carry the load of hundreds of trains bringing settlers and trade goods to the West, and returning with grain, beef, and raw materials for the hungry eastern Canadian markets.

The carbon atom remained a part of the rail tie until just very recently. That section of rail line, now long abandoned, had to be torn up so a bike path could be built in the thriving community of Red Deer,

Alberta. All the ties, including the one containing our favourite carbon atom, were sent to a municipal incinerator to be burned.

Once more, the carbon atom would undergo the combustion process. However, the heat given up by the burning fuel in the incinerator was not all wasted. Part of it was diverted to drive a small electrical generator, which fed power to the municipal electrical system. Our carbon atom, along with much of the other wood fuel, left the incinerator in the form of a tiny particle of ash, part of the smoke that hung near the ground air on cold days.

One recent January morning, a student at the local high school arrived early for classes. As she got out her car, she caught the faint but familiar scent in the frosty air. The smell triggered a string of pleasant memories: her summer of camping at a provincial park with her family and the parties at the lake in May and June with her school friends. She smiled at the thought of seeing some of those same friends this morning in her science class. As she walked to the door, she didn't notice the tiny particle of ash that settled on the sleeve of her coat.