erals of the region, he does mention the great abundance of jet. Like the Romans before him, St. Bede might have believed that all the coal deposits he saw were jet. This chronicler of his time makes no mention of anyone using this mineral as a fuel, but he notes that when the black stone was kindled, its smoke could be used to drive off serpents. So, by the 700s, if coal was burned at all in England, it was apparently not for its heat but for its protective smoke.

THE VAST SUPPLIES OF COAL that lay so undisturbed beneath St. Bede's feet had been waiting there since long before the time of the dinosaurs. Before the Jurassic, before the Triassic, before the Permian, there was the Carboniferous period, a long stage of ancient earth history named after the coal that was then forming. For most of earth's four and a half billion years, its land masses stood utterly barren while the story of life unfolded entirely within the sheltering seas. Only around 425 million years ago did plants begin clinging to the wet shores, and then slowly and tentatively they colonized the continents. By the Carboniferous period—from roughly 360 to 290 million years ago—there was no longer anything tentative about the presence of plants on land. Tangled jungles of remarkable lushness eventually swept across the landscape, hungrily drawing into their cells vast amounts of energy from the sun and carbon from the air.

During the late Carboniferous, the small bit of land that would become Newcastle was very close to the equator; suggested reconstructions of the era show Britain nuzzled up

against the then-tropical Greenland and Newfoundland, the ocean formerly between them having closed up. Because tectonic forces had not yet done much lifting, the continents were lower and swampier than today. The region's landscape, like that of most coal forests, would have been dominated by the bizarre *lepidodendron.* These huge trees could grow up to 175 feet tall, and they stood as a vivid demonstration of how far photosynthesis had taken those single-celled ocean dwellers that had accidentally discovered the process a few billion years earlier.

Most of the lepidodendron's length was made up of a straight trunk, up to six feet in diameter at the base, covered with a beautiful lizard-skin bark that gave the tree its name ("lepid" meaning "scale" in Greek). At the top, the lepidodendron branched out into a few short arms bearing narrow leaves up to a yard long. Modern drawings of these plants invariably show these grass-like leaves only at the very top; but some scientists think the leaves might have grown along the entire length of the trunk, which would have given it the look of a massive shaggy green pole. Unlike modern trees, the lepidodendron's interior was soft and pithy. As long as water was plentiful, the internal cells would stay expanded and keep the tree erect; without water, these proud giants of the paleoforest would have weakened, sagged, and finally collapsed under their own weight.

In Britain's primal jungles there also thrived a related tree, the *sigillaria,* which might have looked even stranger to the modern eye. Some types of sigillaria had a long trunk forking

once near the very top like a two-headed monster, each head crowned with a large spray of strap-like leaves. Other sigillaria were apparently short and stout, their unbranched trunks six feet in diameter at the base but only about eighteen feet tall. This tree was described in one old paleobotany text (a genre not known for colorful writing) as "grotesque," and more "like a huge barrel than a full-fledged tree." Ancient relatives of the modern horsetail also populated Britain's jungles, probably reaching over sixty feet. And then there were the ferns, primitive and highly successful plants, botanically related to the ones you may have growing in a pot in your home—except they had trunks and were thirty feet high.

This ancient jungle also teemed with bugs, and, lacking much competition on land, many grew to mammoth proportions. Some cockroaches reached a foot in length, the dragonflies had wing-spans of up to thirty inches, and the millipedes reached six feet in length—"as long as a cow," as David Attenborough has put it. Although these invertebrate specimens were certainly impressive, the real evolutionary headlines were being made by another line of creatures evolving on the forest floor: our back-boned ancestors, the amphibians. At the beginning of the Carboniferous, tiny newt-sized creatures not far evolved from fish slithered through the wet undergrowth; by the end of it, massive, fifteen-foot-long monsters were dragging their bellies through the primeval mud. We know this because they left both footprints and belly-prints. It was also during this lush time among the Carboniferous trees that some amphibians took the

momentous step of forming hard-shelled eggs, thereby evolving into reptiles, from which would later evolve dinosaurs, birds, and mammals.

Many of the plants of the Carboniferous ended up as coal because they failed to decay the way plants usually do. Normally, when a plant dies, oxygen penetrates its cells and decomposes it (mainly into carbon dioxide and water). As the dense mass of Carboniferous plants died, though, they often fell into oxygen-poor water or mud, or were covered by other dead plants or sediments. Sometimes this burial process was part of a very slow minuet between the coastal forests and the seas. During the Carboniferous, glaciers periodically grew and then shrank in the far Southern Hemisphere, making the oceans rise and fall. As the glaciers melted, the rising seas would step forward and engulf the tropical forests in water and sediment; as the glaciers reformed, the seas would fall back and let the forests step forward again.

Because oxygen could not reach the buried plants and do its disassembly work, the plants only partly decayed, leaving behind black carbon. The spongy mass of carbon-rich plant material first became peat. After being squeezed and slow-cooked by the tremendous pressure and heat of geological forces, the peat eventually hardened into coal. And, of course, it wasn't just the forest's carbon that ended up trapped in the coal, but the energy it had accumulated from the sun over millions of years. Instead of dissipating with the plants' decay, that energy was tucked away into the dark recesses of the earth, at least until

the amphibians crawling across the forest floor evolved into creatures capable of digging it up.

THE ENGLISH WOULD IGNORE their abundant coal reserves for four centuries after the time of St. Bede. In the late 1100s, historians finally find references to coal as a fuel. The English didn't call it "coal," though, since that was the name they used for charcoal, a fuel that had by then been used for many centuries. What we call "coal," the English knew as "sea coal," a surprising label for such a deeply terrestrial product, and one that stuck until the 1600s. Why they called it *sea coal* is disputed. Some think it's because the North Sea actually carved coal from exposed outcrops and yielded it up onto the beaches with the sand, where it was first gathered and used by the locals. The more common explanation, though, is that since most mined coal had to be shipped by sea to distant markets, it became inextricably linked to water in the minds of those who burned it.

It's hardly surprising that the coal trade began in earnest along the River Tyne. Its hilly banks exposed portions of coal seams from the North Sea to twenty miles inland. Coal was found and mined in many parts of England during the 1200s, but the coal fields around Newcastle were by far the most important. The seams there were good and thick and, importantly, above the water line. This meant that the mines would stay dry, or could be kept dry with simple drainage tunnels. It also meant that the heavy coal could fairly easily be moved downhill to the