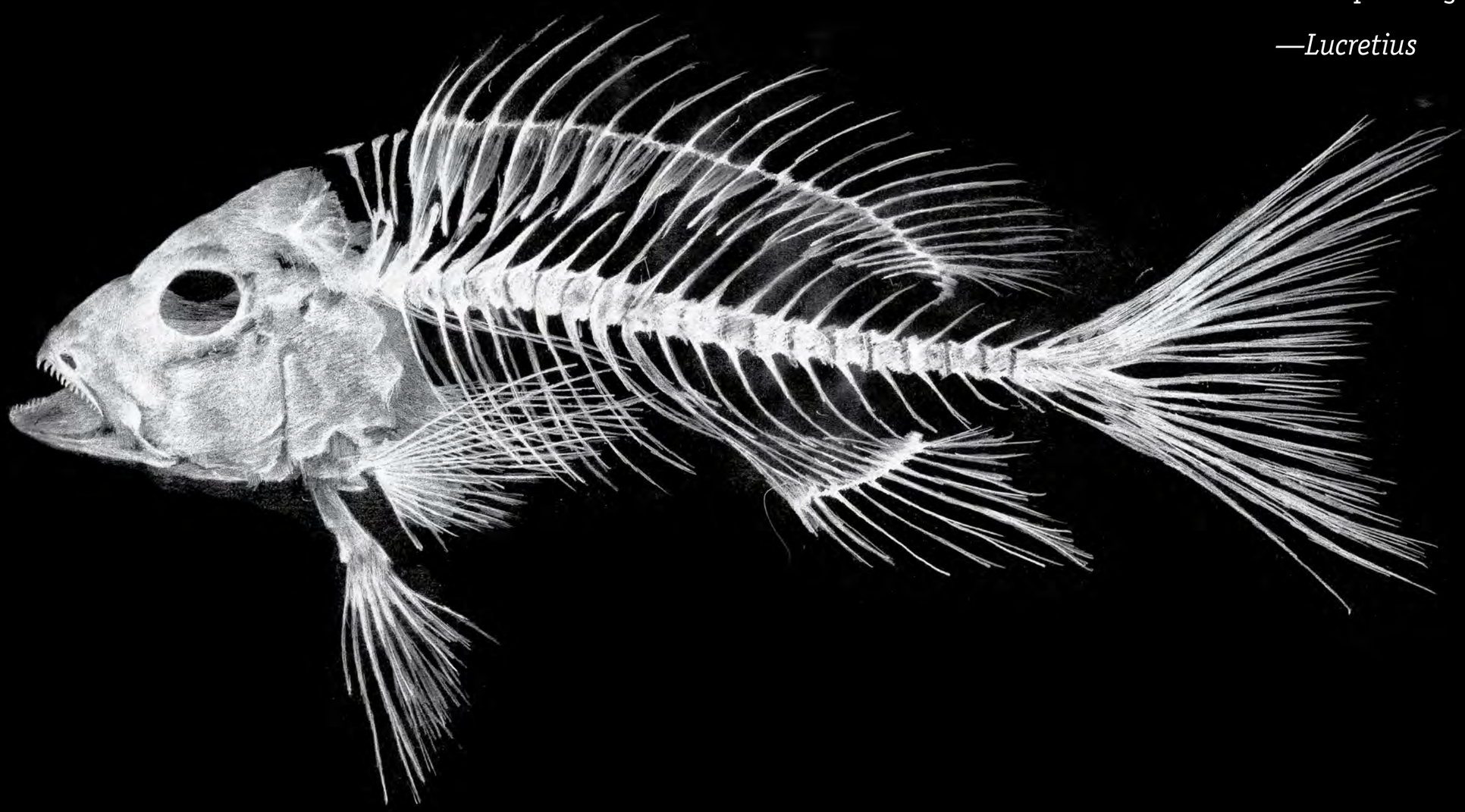
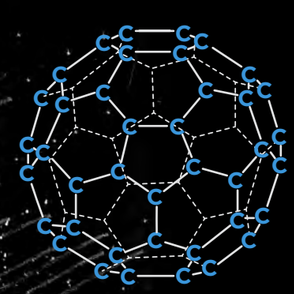
> Nothing can dwindle to nothing,
> as Nature restores one thing from the stuff of another,
> nor does she allow a birth,
> without a corresponding death.
>
> —*Lucretius*



# C

When telling a story, one is inclined to begin at the beginning. In this case, the life story of a single atom of carbon, that beginning is an unfathomable 13.8 billion years distant—when our universe announced its arrival with a Big Bang. To be more accurate, it is another 500 million years hence, when the intensely hot and dense early universe expanded and cooled enough to form its first elements—hydrogen and helium—great clouds of which coalesced into our first stars. One such massive star burned hot and bright and, as it neared its demise, got busy forming heavier elements. Here is where our hero enters the stage—a product of the fusion of three helium atoms. When this star finally explodes in a powerful and spectacular supernova, its elements are cast upon the solar winds to new places, full of purpose without intent.



On is the cosmic race. Quantum fluctuations and fundamental forces persuade the distribution of matter and energy throughout the universe. Our carbon atom is swept along in a colossal tug-of-war between expansion and gravity, matter and antimatter, weaving a tapestry of high and low densities. It is part of an aggregating protoplanet that is held within the attractive force of a midsize star, which itself is kept among billions of others like it. A galaxy. This galaxy, as well, maintains a fraternity of forces in the supercluster Laniakea. This will be the atom's neighborhood for some time.

C

Within one ordinary galaxy, the primordial nebula of one ordinary star provides building materials for its developing satellites. A nearby iron- and silicate-rich terrestrial mass, formed roughly 4.5 billion years ago, has now cooled enough to foster some heavy cargo violently delivered. During the chaos of the Bombardment Epoch, water from asteroids and volatile elements from the protoplanet fall to the gravitational attraction of a young planet Earth. This story's principal particle is one of many migrant seeds that have now been planted in a Goldilocks mantle.

Carbon's ease—eagerness really—in forming bonds and helping facilitate long molecular chains will prove crucial to building intricate and versatile structures. Our carbon atom forms just such an alliance with two oxygen atoms, and a molecule is made—one we will see often—carbon dioxide. It dissolves in an iron-rich, incipient ocean.

Around 3.8 billion years ago that molecule visits a Lost City at the bottom of the Hadean global brine. Here are the calcium carbonate towers of mid-Atlantic hydrothermal vents. Within their catalytic cathedrals is a serpentine structure providing suitable harbor for meetings of cold acidic sea with warm alkaline fluids released from Earth's mantle. $CO_2$ and hydrogen mingle in a matrix of temperature and pH gradients: a fortuitous confluence—a cellular template, if you will—for the development and replication of complex organic life.

O=C=O