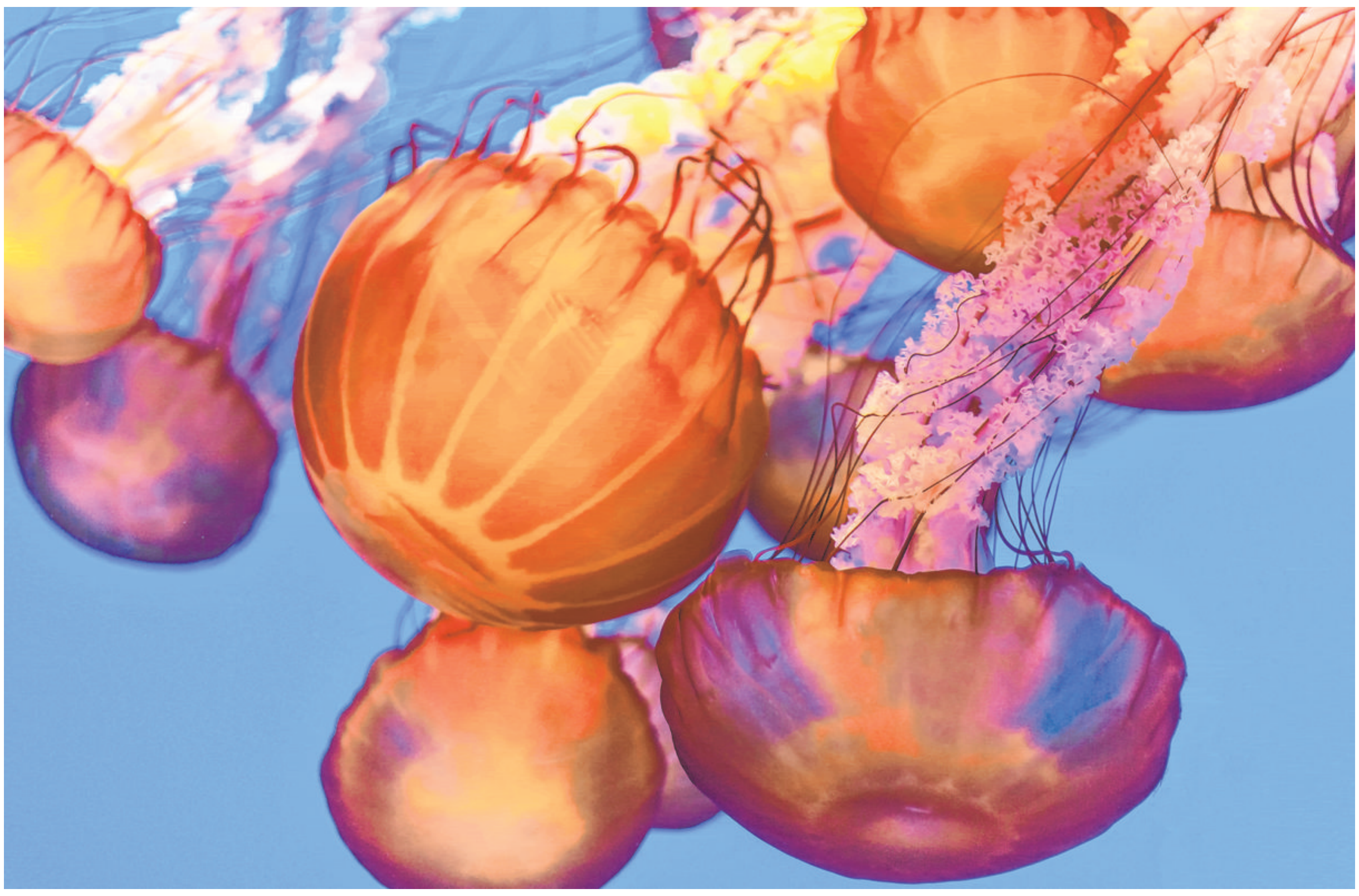
BOOKS

'Those crystal globes pulsating with life and gleaming with all the colours of the rainbow [are] the most delicately lovely creatures in the world.' —George J. Romanes

Beautiful, Brainless and Dangerous

Spineless
By Juli Berwald
Riverhead, 336 pages, $27

BY MARLENE ZUK



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JELLYFISH HOLD a peculiar position in the hierarchy of animal charisma. On the one hand, they have a hypnotic elegance as they pulsate through the sea, bringing to mind ballerinas with tentacle tutus, mesmerizing in their repetitive motion. Many species are beautiful, with colorful appendages that dangle in the water like deadly strings of beads. On the other hand, they are basically blobs of glup, as James Thurber characterized the villainous jellyfish Todal in his book "The 13 Clocks." Jellyfish lack the intelligent curiosity of octopuses and the graceful body integrity of snails. Also, they sting. In keeping with this gelatinous set of contradictions, they can be either food or pets. In Juli Berwald's fascinating "Spineless: The Science of Jellyfish and the Art of Growing a Backbone," jellyfish become a metaphor for what ails us, a kind of watery canary in the oceanic coal mine, and a guide to how little we know about the ocean's common inhabitants.

Biological details about virtually every aspect of jellyfish—their ability to luminesce, the inexplicable "blooms" that can render beaches uninhabitable and overwhelm other forms of marine life, the way their life cycle allows some species to be essentially immortal—are interwoven with the author's story of being a wife, mother and science writer. Ms. Berwald has a Ph.D. in ocean science and a talent for computer programming but eventually decided against a scientific career in either academics or industry. Her ambivalence about that choice, and the turning points that led her to an obsession with jellyfish, are elegantly juxtaposed against stories of the adventures of being a science journalist among some suspicious researchers and of the lives of the jellyfish themselves. This combination of insider and outsider perspective is uniquely suited to a book on creatures whose internal organs are visible through transparent outer layers. (When Ms. Berwald asks a researcher why jellyfish are transparent, he replies: "The question is, why isn't *everything* transparent?" Being invisible against the backdrop of open water has obvious advantages.)

The scientists who study jellyfish are as idiosyncratic and in some cases as enigmatic as their subjects, and Ms. Berwald provides often bemused profiles of them, from an Italian who was friends with Frank Zappa to an irascible American who grabs her notebook and calls her an "evil journalist." The book's subtitle refers to "the art of growing a backbone," but of course jellyfish are unrepentant invertebrates, with nary a spinal column among them. The backbone that emerges in "Spineless" is Ms. Berwald's own, as she speaks for the jellyfish and the people affected by them with increasing knowledge and authority.

Jellyfish, Ms. Berwald notes, are eaten by many Asians and an increasing number of people in other parts of the world, mainly as crunchy, largely flavorless additions to salads and the like, though one company makes jellyfish ice cream. Jellyfishing, the capture of large numbers of the creatures for sale to Asian markets, has become popular in places such as the state of Georgia, where a good fisherman can bring in more than 60,000 pounds in a day. Preparation for eating jellyfish is considerably more labor-intensive than the collection, involving many water changes, treatment with alum (the same substance used to make pickles crisp), and removal of the tougher parts. And home aquariums to house jellyfish (usually moon jellies, *Aurelia aurita*) are also becoming more common, though Ms. Berwald's own attempts to keep three jellyfish—endearingly named Peanut, Butter and Jelly by her daughter—ultimately ended in drain-clogging disaster.

Anyone who has seen jellyfish in the open ocean or in an aquarium has noticed that many species can produce light, sometimes in captivating rhythms along the sides of the bell. But the glow of jellyfish is more than an attractive happenstance. In the mid-20th century, a Japanese scientist named Osamu Shimomura figured out how the light was produced, and in the 1970s he described a protein called green fluorescent protein, GFP, partly responsible for making jellyfish glow. This protein has played a pivotal role in understanding how cells in many different kinds of organisms operate. It can be inserted into a worm, a cancer cell or a mouse to (literally) illuminate their inner workings. Mr. Shimomura, with two other scientists, was awarded the Nobel Prize in chemistry in 2008 for the discovery and development of GFP, a tribute to both science and the jellyfish.

Are jellyfish simple creatures? Yes and no. They lack a brain and the associated nervous system, of course, and they have a single opening in their body cavities; what goes in comes out the same way, so to speak, an unsettling thought for those of us who are used to more of a directional passageway. But their reproduction is oddly byzantine, with life stages that all have poetic names: planula, polyp, strobila, ephyra, medusa. Some of those stages are spent fixed to a rock or other stationary object, others are free-floating,

> The author's attempt to keep three pet jellyfish—named Peanut, Butter and Jelly—ended in disaster.

and the rules for exactly how and when each develops into another are still poorly understood. "Complexity isn't such a simple thing," Ms. Berwald quips. This complexity, or lack thereof, matters because the jellyfish (or more accurately, a jellyfish relative called the comb jelly) was recently hypothesized as the creature most similar to the ancestor of all animal life, supplanting sponges. This conclusion was challenged, and the sponges are back at the base of the evolutionary tree, at least for the moment, but the debate underscores how difficult it is to understand how simple components gave rise to the tissues and organs in modern animals, including ourselves. Maybe jellyfish are complex in ways that do not seem obvious to us.

Readers interested in biological superlatives can find them here: the largest jellyfish, the deadliest, the one that occurs in the highest numbers. Ms. Berwald goes to Japan in search of the largest but finds only a 250-pounder perhaps 3 to 4 feet in diameter; they can grow to nearly twice that size, a feat enabled by prodigious growth during their juvenile stage, when they can increase their weight by 11% a day. But the physical size of jellyfish is dwarfed by their importance. Jellyfish may well be what biologists call a keystone species, one that plays such an essential role in an ecosystem that its absence would cause the system to collapse. Yet their world is being destroyed by humans. Juli Berwald calls on us to rescue the jellyfish and, in so doing, perhaps rescue ourselves.

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What Darwin Learned From Dorset

Reading the Rocks
By Brenda Maddox
Bloomsbury, 254 pages, $28

BY SANDRA HERBERT

'WHY WRITE about Victorian geologists?" asks Brenda Maddox. "For me, the simple answer was 'George Eliot.' Having accepted an invitation to write a biography of the Victorian novelist, I was intrigued to learn that Mary Ann Evans (her real name) had been an ardent geologist. She was introduced to the young science by her life partner, George Henry Lewes. Their enthusiasm for hammering the rocks on holidays at Tenby and the Isle of Wight brought alive to me the excitement of the mid-nineteenth century, when geology was new, as in many ways was investigative science itself."

> The 'curiosities' Anning collected in her bonnet turned out to be fossils from prehistoric animals.

Another of the many delightful characters that populate Ms. Maddox's "Reading the Rocks: How Victorian Geologists Discovered the Secret of Life" is Mary Anning of Lyme Regis in Dorset, England. "Born in 1799," Ms. Maddox writes, "from youth to middle age Anning was a familiar figure on the Lyme shoreline in her long skirt, shawl, bonnet and basket, endlessly toiling to find the treasures she knew were buried in the unstable rocks and in the sands uncovered at low tide." The fossils Anning discovered she sold for profit to geologists, including Henry De la Beche, who would become the first head of the Geological Survey of Great Britain. Purchasers of Anning's "curiosities" gave the fossils she unearthed such now-familiar names as ichthyosaur and plesiosaur. In 1830 De la Beche created a large watercolor painting—"Duria Antiquior," meaning "a more ancient Dorset," now at the National Museum of Wales—depicting the creatures swimming in the region's ancient waters.

Ms. Maddox traces the emergence of geology in Britain during the 19th century with an emphasis on the institutional side of the science's development. With the creation of the Geological Society of London in 1807, she tells us, the nascent discipline gained a parliamentary-style forum that would help trigger its astonishingly rapid progress. Ms. Maddox highlights here—and she is not alone in this interpretation—the value of strenuous debate: Disagreements were raised, fiercely argued, then resolved. One of the keenest such debates was between "uniformitarians" and "catastrophists," terms coined in 1832 by the philosopher of science William Whewell. According to Whewell, the catastrophists, of which William Buckland was a key figure, believed that "epochs of paroxysmal and catastrophic action" have been "interposed between periods of comparative tranquility." Uniformitarians, among them most prominently Charles Lyell, believed that "the changes which lead us from one geological state to another have been, on long average, uniform in their intensity." Both sides had their victories. When Louis Agassiz introduced the concept of Ice Ages to Britain, he and Buckland formed a successful alliance to identify glacial remains in the British Isles. Meanwhile Lyell thoroughly rejected any pairing of a catastrophic flood, as described in Genesis, with any actual geological event. His argument carried the day, and by 1840 there was no place for Noah's flood in British geology.

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TIME & TIDE Ammonite fossil embedded into a rock face.

Lyell is also the Geological Society member Ms. Maddox admires most. His three-volume "Principles of Geology," published from 1830 to 1833, made the convincing case that the earth was much older than traditional dating, and that presently active forces on the planet are sufficient to explain geological phenomena. "Principles" greatly influenced a young Charles Darwin, even though its second volume argued against evolution. Eventually Lyell came around to Darwin's view, for which Ms. Maddox gives him great and proper credit. She also considers Darwin's "On the Origin of Species" (1859) the key document of the 19th century, with Lyell's "Principles" its primary forerunner.

The geology-Lyell-Darwin link is the golden thread that runs through "Reading the Rocks." My own interest also lies in this area, but in truth the question of the origin of species was not the primary concern of most practicing geologists at the time. The dominant research program in mid-19th-century British geology was the effort to determine the planet's geological strata, based on the signal achievements of Adam Sedgwick (identifier of the Cambrian) and Roderick Murchison (identifier of the Silurian). These two men, along with other stratigraphers, initiated a new era in the fledgling science. This did not occur without controversy, and led their contemporary Joseph Henry, the first secretary of the Smithsonian Institution, to complain that stratigraphers "look apparently upon different strata of rocks with as much feeling of personal property as an Englishman does on the broad acres which have descended to him through a long line of ancestors." Whatever their personal faults, stratigraphers had by the mid-19th century established the outlines of what today is called the geological column. This in turn allowed for a description of the history of life on our planet as summarized by John Phillips in "Life on the Earth: Its Origin and Succession" (1860). Ms. Maddox discusses both Sedgwick and Murchison, though not with the emphasis that I believe their work deserves. She does not mention Phillips.

Instead, Ms. Maddox places too much emphasis on Lyell's relationship to Darwin. She is correct that the latter owed an enormous intellectual debt to the former, and to geology generally. Darwin realized as early as 1837, however, that geology alone, with its many gaps in the fossil record, could not do the job. To understand the process of the formation of new species, Darwin had to compare the distribution of species over time (geology) with the distribution of species over space (botany and zoology).

Using a series of engagingly written biographical sketches, Ms. Maddox has produced a short but absorbing book for the general reader that presupposes no prior knowledge of geology. She is scholarly in her method and, as a former journalist, keenly inquisitive. She has given us a fine introduction to the subject, drawing on the writings of current historians of science as well as the work of current geologists, and deserves applause for showing how the science of geology animated the intellectual life of many Victorian men and women, including George Eliot and George Henry Lewes who, as Ms. Maddox notes, read their way through Darwin's "Origin" just two days after its publication.

Ms. Herbert is the author of "Charles Darwin, Geologist" and a past president of the History of Earth Sciences Society.