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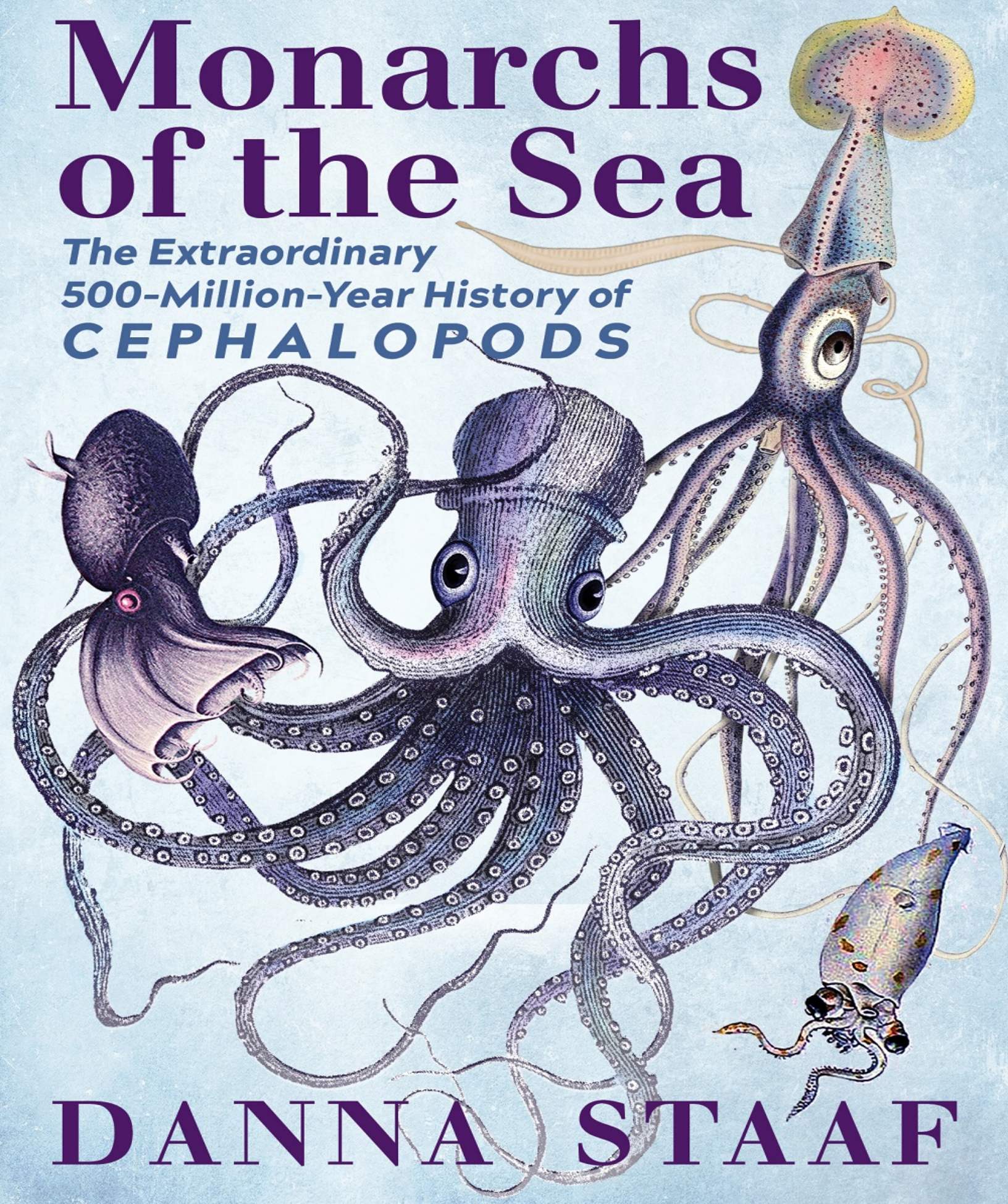
Monarchs of the Sea

The Extraordinary 500-Million-Year History of CEPHALOPODS



DANNA STAAF

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THE EXPERIMENT
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"Cephs rule! *Monarchs of the Sea*, like its protagonists, is nimble, fast, surprising, smart, and weird in the very coolest sense of the word. What could be more fun than jetting back in time to primordial seas with the monsters who really ruled our planet? In these pages, Danna Staaf makes every dino lover and every undersea adventurer's dream come true. It's a fabulous read, with squishy, slimy delight on every page."
—Sy Montgomery, *New York Times*–bestselling author of *The Soul of an Octopus*

"This crystal-clear book will open your world to wider horizons and much deeper times. . . . Long before vertebrates evolved anything like higher intelligence, squids and octopuses were on a separate track to versatility, problem-solving, individual recognition, and deceit. Before we can know who we are, we must know who we are here with—and who has come before us."
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"This engaging book may do for early cephalopods what paleontologists did for dinosaurs in the 1960s: spark a public renaissance of appreciation for these magnificent creatures who

once ruled the seas."
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Nursery Earth: The Wondrous Lives of Baby Animals and the Extraordinary Ways They Shape Our World

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For Anton,
the microconch
to my macroconch

Cephalopods, with the unusual means at their disposal, could have become the monarchs of the sea. And they were so, in fact.

—Jacques-Yves Cousteau & Philippe Diolé, *Octopus and Squid: The Soft Intelligence*

INTRODUCTION

Why Squid?

Long before humanity was even a twinkle in the eye of the first mammal, our planet was ruled by strange and fearsome creatures. Some grew to monstrous size, the largest animals the earth had ever seen. During their 400 million years of glory they diversified to fill every niche, from voracious predator to placid grazer—and then a global cataclysm almost completely wiped them out. Only a humble few of their descendants survive to keep us company today.

Of course, I'm talking about cephalopods.

I could just as easily have been describing dinosaurs, except for one small hint: the stupendous length of the animals' tenure. Dinosaurs weren't around for nearly as long as cephalopods. Nevertheless, most people know a bit about dinosaurs, while they've never heard of cephalopods. (The accent is on the first syllable: SEF-ah-lo-pod. Some folks in the UK and Europe honor the word's ancient Greek heritage with a hard "C": KEF-ah-lo-pod.) Even those who are familiar with these curious creatures usually know only the living ones—squid and octopuses—not their long-extinct ancestors. I myself was in that camp for quite some time.

I met my first cephalopod on a family road trip when I was ten years old. At the Monterey Bay Aquarium in California, I stood mesmerized by the rippling skin, the undulating arms, and the intimate eyes of a giant Pacific octopus. Shortly after returning home, with my father's patient support, I procured a secondhand saltwater aquarium and became known at school as "the girl with the pet octopus."

I devoured all the information I could find about these amazing animals. In the 1990s, that meant checking out books from the library on sea life and poring over the one or two pages that mentioned cephalopods. I discovered only one exclusively cephalopodic book—*Octopus and Squid: The Soft Intelligence*, by Jacques-Yves Cousteau and Philippe Diole.[1] It was in this book that I first encountered mention of cephalopods as long-ago "monarchs of the sea."

Questions hurried on the heels of this new information. When did octopuses and squid rule the seas? What did their kingdom look like? And why wasn't it around anymore? Cousteau, however, left such pursuit aside and returned to the ever-entrancing study of living cephalopods. So I did the same.

I learned to scuba dive (thanks again to my father, who learned alongside me so I'd have a buddy) and took every available marine biology class. Eleven years after my first visit, I returned to Monterey, this time as a graduate student at the Hopkins Marine Station of Stanford University. Though few people other than marine biologists have heard of this marine laboratory—the second-oldest in the United States—it shares a fence and a friendly professional relationship with the famous Monterey Bay Aquarium.

At Hopkins I spent six years studying the reproductive habits of Humboldt squid. I learned how to drive a boat and cast a net, how to fish with rod and reel in California and with 300 feet (100 m) of hand line in Mexico. I learned how to slice up a piece of squid skin thinner than paper with a glass knife and how to write a computer program that eats up decades of data and spits out a map. I also learned that while I never got tired of explaining the latest squid science to anyone who asked and many who didn't, I often got tired of producing the science myself. After six years, I left Monterey with a doctoral degree and a conviction that I was better suited to science communication than science generation.

In the intervening time, several wonderful cephalopod books had been published,[2] but none about the creatures' heyday as monarchs of the sea. Whenever I sought answers to the questions I'd carried since childhood about their ancient kingdom, I found myself once again limited to one or two pages, this time in books about prehistoric life. And that generally meant books about dinosaurs. The classic dinosaur book hurries through an account of how life evolved in the ocean, diversified into some interesting forms, then finally made its way onto land, where the story *really* gets started.

This bias is quite understandable. Everyone loves dinosaurs, from toddlers playing with plastic *Triceratops* to adults enjoying the *Jurassic Park* franchise, and I am no exception. In one of my first school memories, my second-grade classmates and I read a book of poems called *Tyrannosaurus Was a Beast*, then received the thrilling assignment of choosing a poem to memorize.[3] I picked *Diplodocus*, and one less than thrilling stanza remains indelibly etched: "Diplodocus plodded along long ago, Diplodocus plodded along."

Dinosaur love is so entrenched in our culture (especially our childhood culture) that it's hard to believe it wasn't always this way. But in fact, all through the first half of the twentieth century, dinosaurs were seen as slow, stupid, and boring—not just by the public, but by the very scientists who studied them. Then, in the late 1960s, the legendary Yale paleontologist John Ostrom discovered *Deinonychus* and described it as quick, active, and energetic, in blatant contradiction to established wisdom.[4] Ostrom's student Bob Bakker, who was equally quick, active, and energetic, and furthermore gifted as both a speaker and an artist, became the champion of what he dubbed the "dinosaur renaissance."[5] The new view of dinosaurs gathered momentum through the 1970s and '80s, though the old "plodding" perspective still showed through from time to time, as in the *Diplodocus* rhyme.

It was Ostrom who taught us that modern birds are surviving dinosaurs, obliging us to refer to ancient forms like *Tyrannosaurus* and *Triceratops* most accurately as "non-avian dinosaurs." It was Bakker who showed us warm-blooded non-avian dinosaurs with complex social behaviors, which were then portrayed in *Jurassic Park* films. That dinosaurs are legitimately enthralling is not a perspective I would dream of quarreling with.

However.

The fossil record of cephalopods goes much further back—500 million years to the dinosaurs' paltry 230 million. The fossil record of cephalopods illuminates the single most dramatic extinction in Earth's history (yes, more dramatic than the meteor impact that ended the Cretaceous). The fossil record of cephalopods gives Earth some of its most bizarre and beautiful rocks, which humans have interpreted as everything from snakes to pagodas to buffalo. And because of the remarkable way a single cephalopod fossil encapsulates the living animal's history, from embryo to adult, their fossil record may help to explain some of evolution's most recalcitrant puzzles.

What's more, ancient cephalopods share many appealing features with dinosaurs. Massive size is one: the longest fossil cephalopod shells reach 20 feet (6 m), comparable to the height (though not the gobsmacking length) of the biggest dinosaurs. In life, these cephalopods could have borne tentacles that extended their length by several meters. And though cephalopods ruled the seas long before the dinosaurs' ancestors even crawled onto land, the final extinctions of these two great groups were strangely synchronous.

Here is my wonderful secret: although library bookshelves may not be packed with accessible information about ancient cephalopods, the esoteric journals of academia are. Every year—every month, it seems!—cephalopod paleontologists publish new discoveries and new interpretations in the arcane pages of *Acta Palaeontologica* and

Lethaia. Some of these scientists I met during my years as a student, and they've kindly guided me to other leading lights in the field. I'll be quoting from my interviews with these luminaries throughout the book. From Japan to Germany, from the Falkland Islands to Salt Lake City, researchers are pouring their passion backward in time, striving to understand an ancient watery world. There's never been a better time for cephalopods to enjoy their own renaissance.

Unfortunately, the very name "cephalopod" is a major hindrance. It's not as catchy as "dinosaur," which can be translated as "terrible lizard" even by children with no formal Latin education. What does "cephalopod" even mean? Let's use squid as our entrée (if you'll pardon the gastronomic pun) to the weird and wonderful world of the "head-footed."