



# COSMOLOGY

## 认识宇宙学

Peter Coles 著 罗阿理 译

通识教育  
双语文库

A VERY SHORT  
INTRODUCTION



外语教学与研究出版社  
FOREIGN LANGUAGE TEACHING AND RESEARCH PRESS

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# Preface

This book is an introduction to the ideas, methods, and results of scientific cosmology.

The subject matter of cosmology is everything that exists. The entire system of things that is the Universe encompasses the very large and the very small, the astronomical scale of stars and galaxies and the microscopic world of elementary particles. Between these limits lies a complex hierarchy of structure and pattern that results from the interplay of forces and matter. And in the midst of all this we find ourselves.

The aim of cosmology is to place all known physical phenomena within a single coherent framework. This is an ambitious goal, and significant gaps in our knowledge still remain. Nevertheless, there has been such rapid progress that many cosmologists regard this as something of a 'Golden Age'. I have taken a roughly historical path through the subject to show how it has evolved, how it has drawn together many different conceptual strands along the way, and how new avenues for exploration have opened up with improvements in technology.

It is a good time to write this kind of book. An emerging consensus about the form and distribution of matter and energy in the Universe

suggests that a complete understanding of it all may be within reach. But interesting puzzles remain, and if history tells us anything it is that we should expect surprises!

# 前言

本书是一本有关科学宇宙学的概念、方法和成果的入门读物。

宇宙学研究的主题是宇宙中存在的万事万物。整个宇宙包含着极其巨大和十分微小的物质，大若体积巨大的恒星与星系，小若基本粒子的微观世界。在这种巨大和渺小之间存在着由力和物质相互作用的复杂的层次结构和模式。在此中间我们能找到我们自身。

宇宙学的目的是将所有已知的物理现象统一到一个单一的、一致的框架下。这是人类的雄心勃勃的目标，但我们的知识还存在着巨大的差距。不过，该学科的迅速发展使得宇宙学家们相信现在是宇宙学的“黄金时代”。作者通过贯穿全书的宇宙学简史来阐释宇宙学是怎样发展的、怎样将不同的思路综合到一起，以及怎样在技术发展的推动下对宇宙展开新的探索。

现在正是写这类书的时候，因为人们对宇宙中物质和能量的形式与分布的一致认识表明对宇宙的完整理解可能即将实现。虽然仍有一些有趣的难题尚未解决，但历史告诉我们，我们可以期待令人惊喜的新发现。



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# Chapter 1

## A brief history

Cosmology is a relatively new branch of physical science. This is quite a paradoxical state of affairs, because among the questions cosmology asks are some of the most ancient that humanity has ever posed. Is the Universe infinite? Has it been around for ever? If not, how did it come into being? Will it ever come to an end? Since prehistoric times, humans have sought to build some kind of conceptual framework for answering questions about the world and their relationship to it. The first such theories or models were myths that we nowadays regard as naive or meaningless. But these primitive speculations demonstrate the importance we as a species have always attached to thinking about the Universe. Today's cosmologists use very different language and symbolism, but their motivation is largely the same as our distant ancestors. What I want to do in this chapter is briefly chart the historical development of cosmology 'the subject' and explain how some of the key ideas have evolved. I hope this will also provide a useful springboard into the other chapters in which I explore these key ideas in more detail.

### The Universe in myth

Most early cosmologies are based on some form of anthropomorphism (the interpretation of something which is not human, in terms of human characteristics). Some involve the idea that the physical world is

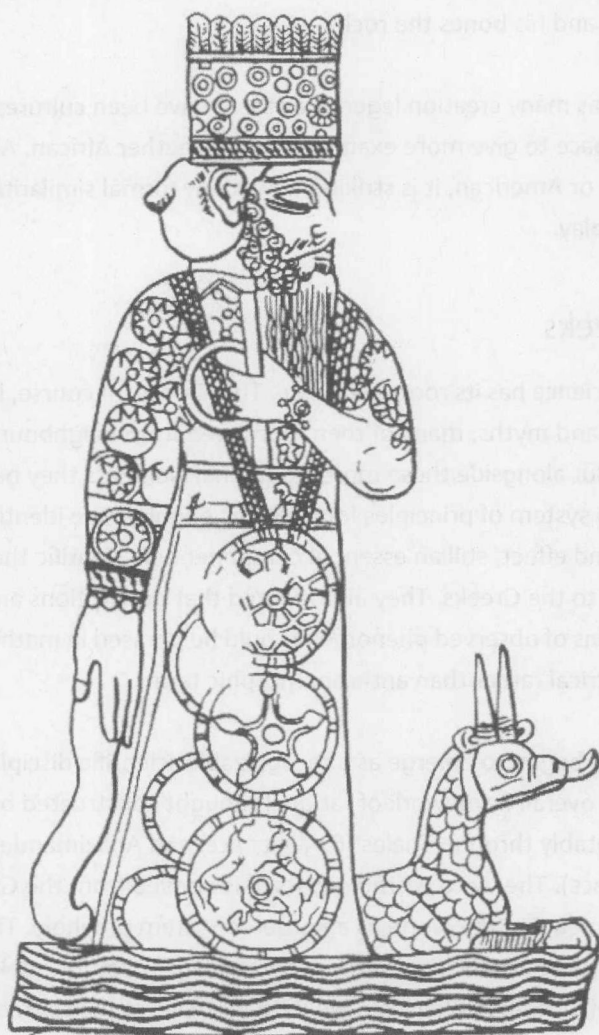
animated by wilful beings that can help or hinder mankind, others that the physical world itself is inanimate but can be manipulated by a god or gods. Either way, creation myths tend to explain the origin of the Universe in terms of entities whose motives can be understood, at least partly, by human beings.

There are many differences in creation myths around the world, but there are also some striking similarities. For one thing, their imagery often incorporates the idea of a supreme craftsman. The beauty of the natural world is thus represented as the handiwork of a skilled artisan, examples of which are found in all cultures. Another recurring image is the growth of order from chaos, mirroring the progressive organization of human society. Yet another parallel is the Universe as a biological process. The most striking examples of this occur in myths that depict the cosmos as forming from an egg or seed.

The Babylonian version of Genesis, the *Enuma Elish*, contains these elements. This myth dates from around 1450 BCE, but is probably based on much older Sumerian versions. In its account of the creation, the primordial state of disorder is identified with the sea. From the sea emerges a series of gods representing fundamental properties of the world, such as the sky, the horizon, and so on. Two of these deities, Marduk and Tiamat, fight and Tiamat the sea-goddess is killed. Marduk makes the Earth from her body.

China also furnishes interesting illustrations. One involves the giant *Pan Gu*. In this story, the cosmos began as a giant egg. The giant slept inside the egg for thousands of years before he awoke and broke free, shattering the egg in the process. Some parts of the egg (the lighter and purer bits) rose up to form the heavens while the heavier, impure parts formed the Earth. Pan Gu held up the heavens with his hands while his feet rested on the Earth. As the heavens drifted higher, the giant grew taller to keep them in contact with the Earth. Eventually Pan Gu died, but his body parts were put to good use. His left eye became the Sun,





1. The Babylonian God Marduk. Marduk is credited with the imposition of cosmic order after the destruction of Tiamat, the embodiment of primordial chaos, shown here at his feet in the form of a horned dragon. Many mythologies around the world incorporate the idea that order arose from chaos, and the theme survives in some aspects of modern scientific cosmology.