

THE MAGIC OF REALITY



HOW WE KNOW
WHAT'S REALLY TRUE

RICHARD
DAWKINS

Bestselling author of *THE SELFISH GENE*

ILLUSTRATED BY
DAVE MCKEAN



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DAWKINS

The Magic of Reality

How We Know What's Really True

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FREE PRESS

New York London Toronto Sydney New Delhi



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Praise for THE MAGIC OF REALITY

"I am often asked to recommend good books on science for young people. From now on, I will not have to hesitate. *The Magic of Reality* provides a beautiful, accessible and wide ranging volume that addresses the questions that all of us have about the universe, separating often too-little-known facts from too-frequently-believed fictions. For this reason, it should be a powerful resource for people of all ages, written with the masterful and eloquently literate style of perhaps the best popular expositor of science, Richard Dawkins, and delightfully illustrated by Dave McKean. What more could anyone ask for?"

—LAWRENCE KRAUSS, Foundation Professor and
Director of the Origins Project at Arizona State University and
author of *Quantum Man* and *A Universe from Nothing*

"I want to show you that the real world, as understood scientifically, has magic of its own—the kind I call poetic magic: an inspiring beauty which is all the more magical because it is real and because we can understand how it works . . . The magic of reality is—quite simply—wonderful. Wonderful and real. Wonderful because real."

SCIENCE

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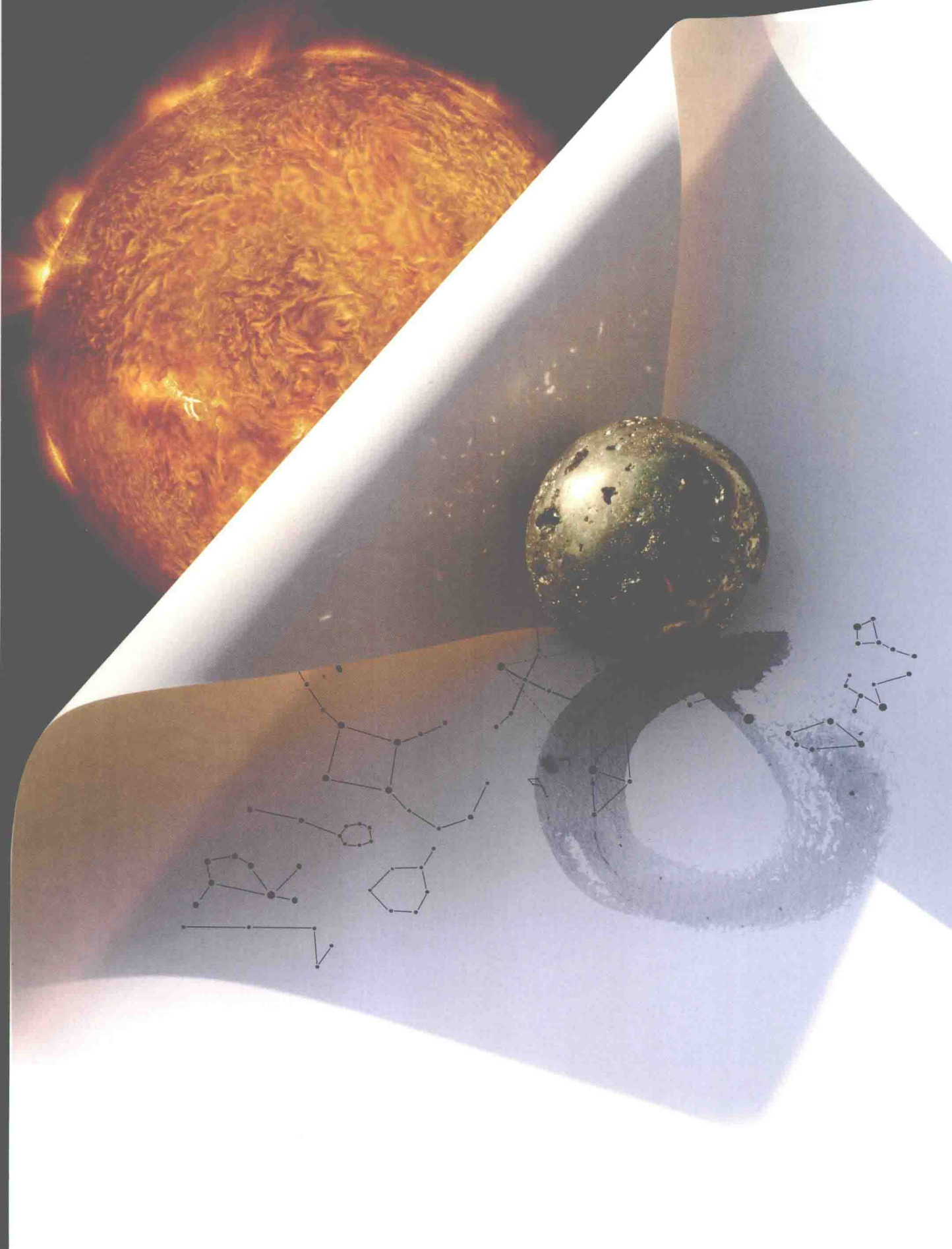


Also by Richard Dawkins

The Selfish Gene
The Extended Phenotype
The Blind Watchmaker
River Out of Eden
Climbing Mount Improbable
Unweaving the Rainbow
A Devil's Chaplain
The Ancestor's Tale
The God Delusion
The Greatest Show on Earth

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Cages
Crazy Hair (*with Neil Gaiman*)
MirrorMask (*with Neil Gaiman*)
The Wolves in the Walls (*with Neil Gaiman*)
The Day I Swapped My Dad for Two Goldfish
(*with Neil Gaiman*)
Slog's Dad (*with David Almond*)
The Savage (*with David Almond*)
The Homecoming (*with Ray Bradbury*)





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Clinton John Dawkins

1915–2010

O, my beloved father

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Skalarwertige Tensorable Körper
wird in Lorentz'scher Form angelegt.
wird für räumliche Körper

$$\text{rot}(f \cdot u) = \frac{\partial u + \frac{1}{2} \omega}{\partial t} \quad \text{rot} u + \frac{\partial f}{\partial t} = 0$$
$$\text{div}(u + \gamma) = \frac{\partial f}{\partial t} \quad \text{div} f = 0$$

$$\text{Feldstärke} = u_1 = u_2 = u_3 = i g_1 = -i g_2 = -i g_3$$
$$p_{12} \quad p_{21} \quad p_{13} \quad p_{31} \quad p_{14} \quad p_{41} \quad p_{24} \quad p_{42}$$

$$\frac{\partial f_{\mu\nu} + p_{\mu\nu}}{\partial x_\mu} = \partial_\mu \quad (\text{Kontinuitätsbedingung})$$

$$\frac{\partial f_{\mu\nu}}{\partial x_\mu} + \frac{\partial f_{\nu\mu}}{\partial x_\nu} = 0$$

$$V = V_0 + (1 - \frac{1}{2} \alpha) \gamma$$

... wegen Rotationen.
Lorentz-Transformation

II. Raum und Zeit
XII. Additionstheorem
des Geschwindigkeits
Lorentz'sche Substitution
des Lorentz-Transformations.

14. III. Relativitätstheorie und
Lorentz-Transformation
Feldtheorie Tensor als Hilfsmittel der Theorie
Theorie der Tensorrechnung.

$$\begin{array}{c|c} p_{\mu\nu} \frac{\partial}{\partial x_\mu} & p_{\mu\nu} \frac{\partial}{\partial x_\nu} + p_{\nu\mu} \frac{\partial}{\partial x_\mu} + p_{\mu\mu} \frac{\partial}{\partial x_\nu} \\ \hline f_{\mu\nu} \frac{\partial}{\partial x_\mu} & f_{\mu\nu} \frac{\partial}{\partial x_\nu} + f_{\nu\mu} \frac{\partial}{\partial x_\mu} + f_{\mu\mu} \frac{\partial}{\partial x_\nu} \end{array} \quad \begin{array}{c} - \frac{1}{2} \frac{\partial}{\partial x_\mu} \\ - \frac{1}{2} \frac{\partial}{\partial x_\nu} \end{array}$$
$$\frac{\partial}{\partial x_\mu} \left(\frac{1}{2} f_{\mu\nu} u_\nu \right) = p_{\mu\nu} u_\nu$$
$$\frac{\partial}{\partial x_\mu} \left(\frac{1}{2} f_{\mu\nu} u_\nu \right) = p_{\mu\nu} u_\nu$$
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1

What is REALITY? What is magic?



REALITY IS EVERYTHING that exists. That sounds straightforward, doesn't it? Actually, it isn't. There are various problems. What about dinosaurs, which once existed but exist no longer? What about stars, which are so far away that, by the time their light reaches us and we can see them, they may have fizzled out?

We'll come to dinosaurs and stars in a moment. But in any case, how do we know things exist, even in the present? Well, our five senses – sight, smell, touch, hearing and taste – do a pretty good job of convincing us that many things are real: rocks and camels, newly mown grass and freshly ground coffee, sandpaper and