predators and prey more appropriate
than spiders as a baseline for inter-
preting dinosaurs — why do the prey
have to be cold-blooded? Low preda-
tor/prey ratios for the Serengeti can-
yield appropriate information. Study
of Morrison brontosaurs says nothing
about punctuated speciation since
there is no reason to tell how much time,
if any, separates study sites in Wyo-
moming and Colorado. There are out-
right mistakes too, as where Bakker
characterizes the mammalian cerebral
lobes as parts of the midbrain that
expand forward to cover the underly-
ing forebrain (they are forebrain ex-
panded backward to cover the midbrain).

There is a lot here that is interest-
ing, but there is a lot of exaggeration
too. I assume the title Dinosaur Her-
esties is plural because the book is
about both old orthodox dinosaur heresy and new radical dinosaur heresy. Neither extreme seems reason-
able, and the truth must lie between.
Bakker deserves credit for elegantly
expanding the range of all that might be possible in interpreting Mesozoic dinosaurs. The challenge now is
to narrow the range and replace the
dragons of persistent mythology with
more carefully constructed creatures.

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OF WHITE WATER AND
BROAD SCIENCE

The River That Flows Uphill: A Jour-
ney from the Big Bang to the Big
Brain. William H. Calvin. Macmillan
Publ., New York, 1986. 528 pp., illus.
$23.00 (cloth).

As science has advanced technically
and conceptually, it is increasingly
difficult to present it to the public in
comprehensible form. Fortunately
film-makers, broadcasters, and writ-
ers have risen to the challenge and
effectively continued providing the in-
terested lay person with access to its
progress. In biology such people as

David Attenborough, Stephen J.
Gould, and Richard Dawkins have
combined erudition and eloquence
to make the new developments accessi-
ble and entertaining. The book we
have here takes a novel approach to
this demanding objective.

William Calvin is a neurobiologist
who has been down the Colorado
River in a rubber boat four times and
has marveled at the wonders of the
Grand Canyon. He also likes to hold
forth about evolution. Calvin has
drawn on his multiple experiences of
the Grand Canyon to compose a fic-
tional journal of a single expedition in
which he intersperses daily notes on
the events and scenery of the trip,
reports of discussion among the mem-
bers of the party (most of whom are
also neurobiologists), and disquisi-
tion about evolution and a host of
other topics. The result is a fat book,
which is part travelogue and part
popular science.

The travelogue part of the book
includes a great deal about the geolo-
y of the Grand Canyon, both its
stratigraphy and geomorphology.
Remains of Indian habitations are occa-
sion for accounts and speculations
about the Anasazi people who made a
living in the canyon a thousand years
ago. Comments on the effects of con-
struction of the Glen Canyon Dam
upriver link to discussions of conser-
vation efforts designed to prevent fur-
ther damaging incursions to the ecol-
y of this unique part of the world.
The thrills of shooting rapids give
way to observations on how the dis-
position of rocks and gradients gov-
erns the behavior of the river. It is
from such observation that the para-
doxical title of the book derives: in
places the force of the main current
pushes eddying water into reverse so
that at its margins the river does
actually flow back uphill.

But the river is also a metaphor for
evolution, which has been thought of
as a reversal of the flow dictated by
the second law of thermodynamics. In
the scientific parts of the book Calvin
conducts us from the origin of the
universe to the emergence of human
intelligence via the current relevant ideas
in cosmology, chemistry, geology, bi-
ology, and anthropology. He does so
in easy stages, which take up more
and more of the space as the journey
proceeds. The story thus builds to a
kind of climax, which is Calvin's own
tory for the relatively rapid increase
in brain size that marks the separa-
tion of Homo sapiens from its ances-
tral primate stock. In this "throwing
hypothesis," the survival value of in-
creased speed and accuracy in hurling
stones for hunting led to selection of
the bigger and bigger brains making
possible the timing and muscular co-
ordination necessary for such im-
provement in technique. With the
brain thus enlarged, the way was
opened for the evolution of intelli-
genence, self-awareness, and language
as emergent consequences, similar to
the way in which adaptation of feath-
ers for flight was made possible by
the prior evolution of feathers for
insulation.

The book is thoroughly well in-
formed, yet presented with a breezi-
teness that carries the reader along at
an almost effortless pace, like the
current of the river. Along the way
the text and margins are liberally
decorated with quotations from a
wide variety of sources—poets, phi-
losophers, scientists, and others—dis-
playing the author's erudition. There
is a map for each of the 14 days of the
journey and other useful illustrations.
Much of the time the enterprise seems
like a giant spree, for the language is
hearty, rather in the manner of under-
graduate pub talk. Calvin says that he
spent "a lot of time to get a sentence
just right." However, I frequently
found the jokey jauntyness growing
tiresome and contrasting unfavorably
with the more measured levity of
Gould or Dawkins. This, of course, is
a matter of taste, and does not dis-
tract from the positive qualities of the
book, especially its wide range of
difficulty, as the journey

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