What about consciousness itself? Why Check for

some states associated with felt experience (the pain of a headache, the sight of a sunset) and others not? Musser's focus is inte-

grated information theory, or IIT, IIT begins with five allegedly self-evident "axioms" of

awareness: consciousness exists, and it is structured, specific, unified, and definite.

It then derives "postulates" concerning the causal structure of conscious systems, identifving consciousness with integrated infor-

mation-information that cannot be reduced to that in a system's parts. Finally, IIT offers a mathematical measure of this quantity, Φ:

However, despite its enthusiasts, IIT has

profound problems. Its axiomatic basis is

specious (those that are not trivial are not

ential critique—that IIT implausibly assigns

vast amounts of consciousness to DVD play-

ers and inactive logic gates-but seems un-

do more than distinguish humans from DVD

players; it must detail when, why, and to

what degree we are conscious. Here, psychol-

ogy's absence is most glaring. Over the last

century, psychological research has revealed

innumerable phenomena of consciousness,

from paradigms that alter awareness (at-

tentional blink, inattentional blindness) to

methods that render stimuli unconscious

(masking, flash suppression); from extraor-

dinary disorders of consciousness, such as

blindsight or neglect, to rigorous studies of

ena are the data that any scientific theory

of consciousness must account for. That is

why all serious theories say something about

them, including global neuronal workspace

theory, higher-order theories, and recurrent

theories. Yet these phenomena and ideas are

almost nowhere in the book. Of course, psy-

chology has not solved consciousness; but one cannot hope to unravel awareness with-

Consciousness is genuinely mysterious.

So is fundamental physics. But hoping that

physics can solve consciousness while ex-

cluding other approaches is only a recipe for

Although controversial, such phenom-

metacognition ("awareness of awareness").

Of course, a theory of consciousness must

concerned by this (devastating) result.

an equation for awareness.

BOOKS et al.

CONSCIOUSNESS

Chasing an equation for awareness

A writer seeks connections between consciousness and fundamental physics



By Chaz Firestone and Ian Phillips

cience begins with mystery. What causes lightning? How did this mold stop bacterial growth? Why do we age? Arguably, the two greatest mysteries are the cosmos and consciousness-the vast world out there and the vibrant world within. Scientists captivated by one

can be called to study the other, seduced by the thought that these mysteries are connected. Science writer George Musser's book Putting Ourselves Back in the Equation reviews their progress: Can physics unlock the mystery of consciousness? Does consciousness underlie fundamental physics?

The result is an ambitious but ultimately disappointing tour, peppered with breathless encounters with well-known scientists. Representative of the cast is MIT's

Max Tegmark, who tells Musser: "If you look at the problems that we're still stumped on in foundational physics, pretty much all of them trace back to consciousness."

One puzzle is the quantum measurement problem. The basic formalism of quantum mechanics describes a world of superpositions: combinations of states represented by a wave function. Consider Schrödinger's celebrated cat. The relevant equations pronounce it both dead and alive; but when we open its box, it looks either dead or alive, never both. Multiplicity collapses into singularity-how? A radical solution is that consciousness is

the culprit. "The mind reaches out," writes Musser, "grabs particles that are poised between possibilities, and tells them, Choose!"

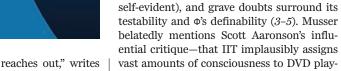
Other solutions avoid such mental magic. "Many-worlds" interpretations-favored by many contemporary physicists, including Tegmark himself—eschew collapse entirely. eliminating the mind's putative role. Musser charges these views with incoherence (even

> theories) but does too little to substantiate his case.

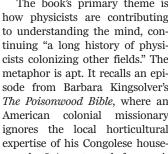
> The book's primary theme is how physicists are contributing to understanding the mind, continuing "a long history of physicists colonizing other fields." The metaphor is apt. It recalls an episode from Barbara Kingsolver's The Poisonwood Bible, where an American colonial missionary ignores the local horticultural expertise of his Congolese house-

keeper. The upshot? A nasty rash from poisonwood sap and a flooded garden.

Yet a key source of local expertise is notably absent-psychology, the science of the mind. An early example: Musser rightly applauds physicists' contributions to artificial neural networks but is overly credulous of their implications, declaring that "ChatGPT and DALL-E are already able to do things that seem to be coming from deeply felt experience" and "are starting to demonstrate a generalized intelligence like that of humans." Interviewing more psychologistsexperts in both feelings and intelligence could have exposed the considerable gulf remaining (1, 2).



comparing them to conspiracy



Musser integrates physics with neuroscience, economics, botany, chemistry, philosophy, mathematics, ornithology, and more.

> more mystery, not less. ■ REFERENCES AND NOTES

out confronting these data.

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