the relatively unresearched topic, Reconstruction was considered a tragic era during which white southerners suffered at the hands of rapacious Yankee carpetbaggers and their ignorant Negro minions. But by 1980, when Franklin published "Mirror for Americans," Reconstruction was understood as a serious attempt to establish some measure of racial equality.

Franklin's other major theme—the scholar's social responsibility—is dealt with in a selection titled plainly "The Historian and Public Policy." Much of Franklin's career coincided with the civil-rights upheaval, and he attempted to tread a course between both white and black extremists. Franklin believed that the black historian should remain calm and objective, refusing "the temptation to pollute his scholarship with polemics, diatribes, arguments." Dispassionate scholarship at times forced Franklin to repress his feelings in a way that "would not be satisfying to some, and . . . may even be lacking in courage. I do not commend it; I merely confess it." Yet Franklin's scholarship led him to his own variety of social activism. He provided expert witness in the courts and Congress; and he wrote the background studies for the NAACP's desegregation cases. Perhaps no scholar of his generation may more rightfully claim that "the historian is the conscience of his nation, if honesty and consistency are factors that nurture the conscience."

Science & Technology

MIND CHILDREN: The Future of Robot and Human Intelligence. *By Hans Moravec. Harvard. 214 pp. $18.95*
THE EMPEROR'S NEW MIND: Concerning Computers, Minds, and the Laws of Physics. *By Roger Penrose. Oxford. 466 pp. $24.95*

Last year a new computer program, playfully named Deep Thought, defeated several grand chessmasters at their own game. Such triumphs are seized upon by the people, especially popular-science writers, who argue that we are moving into a new reality, a 21st century shaped by computers that will take over almost all the tasks once done by people. Advocates of this argument for artificial intelligence—called, for short, "strong AI"—reason that all human thinking is the process of complicated calculations that computers theoretically can, and one day will, do. (According to strong AI, our brain is only, as Marvin Minsky put it, a "computer made of meat.")

Strong AI has one of its most forceful spokesmen in Hans Moravec, director of the Mobile Robot Laboratory of Carnegie Mellon University. Narrating the history of the AI community, Moravec provides some comparisons to show where we now stand: The computers of the 1950s he likens in intelligence to a bacteria, while today's computers, he says, are on the intellectual level of a spider. Moravec makes some calculations of his own. The computing action of the human retina can be performed today by computer simulations; by calculating what fraction the retina's function represents of the brain's operation as a whole, Moravec extrapolates how long it will be, given the phenomenal rate of advances in computer technology, before computers can simulate all of the brain's operations. In 40 years, Moravec estimates, computers will have "human equivalence." From there, Moravec goes on to imagine a "postbiological" world in which computerized robots not only perform, for example, brain surgery on humans but even improve and reproduce themselves. Moravec's technological future resembles Stanley Kubrick's film *2001*, in which the computers end up seeming more human than the people.

Proponents of strong AI like to label their opponents "mystics," but Roger Penrose has impeccable scientific credentials. The Rouse Ball Professor of Mathematics at Oxford, he has contributed to the physics of the "Big Bang" origins of the universe, and his research with Stephen Hawking helped establish the plausibility of black holes. Penrose's refutation of thinking as programmed computation is straightforward: Computers can deal only with computable numbers, but there exists an entire branch of advanced mathematics that works with noncomputable numbers. Indeed, he cites numerous mathematical laws underlying the operations of both the brain and the physical world which have this noncomputational character. As he differentiates thought from mere computation—in an argument that brings in complexity theory, quantum mechanics, Einstein's relativity, Gödel's undecidability, Mandelbrot's set, and physiology—Penrose proposes a new model of the mind that conjoins 20th-century biology, which is largely mechanistic, with contemporary physics, which is paradoxical (e.g., matter turning into energy or a particle passing simultaneously through two slits). Penrose's description of the mind's operation includes intuition, taste, and judgment, attributes which proponents of strong AI like to disregard.

Penrose has acknowledged that Moravec's *Mind Children* is stimulating and suggestive—as science fiction. However, when theoretical physicists and mathematicians speculate about a masterful set of equations that will unite subatomic quantum physics and large-scale relativity into a "theory of everything" (or T.O.E.), laymen are finding it increasingly difficult to tell the science fiction from the science. That may explain why the strong AI argument is enjoying such a vogue.

THE FIFTH ESSENCE: The Search for Dark Matter in the Universe. *By Lawrence M. Krauss. Basic. 342 pp. $21.95*

Sir Isaac Newton found that the amount of force that planets exert on one another depends on their mass and their distance from each other. This "pull," in turn, determines the speed and course of planets. The same principle applies to galaxies—or did. In 1933, the astronomer Fritz Zwicky established that galaxies move at speeds that should tear them apart, based on what we can observe.

Krauss, a professor of physics and astronomy at Yale University, demonstrates that for galaxies to hold together as they do, there must be a lot more mass to them than meets the eye. From the available evidence, he argues that "*more than 90 percent* of the entire mass within the visible universe is made of material that is invisible to telescopes." The new Hubble space telescope, by possibly determining at what rate the universe is expanding, may be able to suggest where and how much invisible or missing mass there is. But even without this evidence, Newton's universal theory of gravitation, Einstein's theory of relativity, and the "Big Bang" theory all support the idea of the existence of "dark matter." If dark matter doesn't exist, then these established theories will also have to be reconsidered.

What, then, is dark matter? And why not, Krauss asks, assume "that this dark matter is made of the same stuff we are"—that is, of familiar neutrons and protons? Because if it were composed only of these "normal" subatomic particles, galaxies would be much larger than they actually are. So the search is on for the other constituents. One candidate that meets theoretical muster is weakly interacting massive particles (WIMPs). But how do you test something like a WIMP, which is so elusive that it could pass through the molecules of a "solid" rock 100,000 times the size of the Earth and still not interact once with anything? Krauss proposes that one could build a 10-cm cube detector, and in one hour 10^{12} of them will have passed through, statistically enough for one to interact with the detector. He predicts that "there is a real possibility that this darkness will reveal its identity within our lifetimes."

Krauss cautions that the "discovery" of dark matter is "not necessarily as 'deep' as those associated with the development of relativity or quantum mechanics." Yet, he adds, it is "mind-boggling that within less than a quarter-century we have come within striking distance of the answer" to the question man has been asking for millennia: What is the universe made of?