wasting?—RKO's money on a new film (which he left incomplete) when the studio edited 40 minutes out of *Ambersons* to give it more box office appeal. It was not the last time Welles would let a project slip out of his control—and in so doing seem to disavow what he had created.

The cliché about Welles is that everything went downhill after these first two films. But as Thomson, an actor and the author of several books about film, makes clear, this was not so—except in the sense that Welles never surpassed *Kane*. (But then, who has?) To be sure, Welles was forever beginning projects, dropping them, and taking them up again years later in makeshift locales and even with different casts. Yet despite a professional life that often resembled a Ponzi scheme, Welles the charlatan was also a practicing magician, reaching into his shabby hat and pulling out movie treasures such as *Macbeth* (1948), *Touch of Evil* (1958), *The Trial* (1962), parts of his admittedly disjointed Falstaff saga, *Chimes at Midnight* (1966), *The Immortal Story* (1968), and *F Is for Fake* (1973).

Thomson's Welles is monumentally imperfect, full of passion, appetite, guile, lies, manipulation, misjudgment, arrogance, doubt, and, of course, a kind of genius. He is a manic-depressive egotist, "vividly disturbed and hysterically well, beyond treatment, so knowing that no doctor ever had a chance with him." This book traces the arc of his tumultuous life with surprising and admirable dispatch.

Too bad, then, that Thomson keeps intruding. His memory of seeing *Citizen Kane* for the first time, as a teenager alone in a revival house in London, is typical of the missteps: "I struggled with *Kane* because I knew that its show was more intense than anything I had seen, because I felt aroused by the need to run a little faster, because the shining young *Kane* was so entrancing."

Even more irksome are the imaginary dialogues between Thomson and—whom? his publisher? his alter ego?—that occur at irregular intervals without so much as a *caveat lector*. These are meant to dangle qualifications, questions, and alternative interpretations before our wondering eyes, and in their general fruitiness they are perhaps *echt*-Wellesian (the hokum Welles, that is). But mostly these dialogues recall the moments you faced as a child when a movie turned "icky" and you went to buy popcorn, hoping the actors would return to their senses by the time you returned to your seat. Too bad Thomson can't resist trying to upstage his subject. He of all people should have realized that no one ever upstaged Orson Welles.

—James Morris

Science & Technology

THE END OF SCIENCE:
Facing the Limits of Knowledge in the Twilight of the Scientific Age.
By John Horgan. Addison Wesley Longman. 320 pp. $24

Ours is a time of endings: not just of a century but of a millennium. Honoring custom, we daily announce finalities. Academics lecture on "late"—not "advanced"—capitalism. Optimists foresee the demise of talk shows, pessimists the death of the humanities. Can modern science, gray with 300 years, be far behind?

According to Horgan, many of the best and brightest scientists, mathematicians, and philosophers are resigned to defeat. What looms is a "postempirical" and "ironic" approach: the abandonment of the search for fundamental laws of nature, and the rise of a "science" that is . . . well, anxious, evocative, literary. In Horgan's words, "One must accept the possibility—even the probability—that the great era of scientific discovery is over. By *science* I mean not applied science, but science at its purest and grandest, the primordial human quest to understand the universe and our place in it. Further research may yield no more great revelations or revolutions, but only incremental, diminishing returns."

Horgan is the well-known author of profiles appearing in *Scientific American*, where he has explored the thinking and (more effectively) the personalities of a galaxy of stars, or at least scintillators, among those who have been doing science or metascience for the past few decades. His finely crafted interviews have been adapted for *The End of Science*, with new material added.

For anyone interested in the far frontiers of basic science and philosophy of science, not to mention the peculiar people who excel at such work, this book will prove absorbing.

Among the personas explored, all are cleverly and accurately depicted, although Horgan's likes and dislikes, his stylistic and even political sympathies, come through, whether by accident or design. His aversion to, for instance, Nobel laureate immunologist (and now neuroscientist) Gerald Edelman and the late Sir Karl Popper, philosopher of science, contrasts sharply with his deference to paleontologist Stephen Jay Gould and mathematician Roger Penrose.

But then, these are simply opinions. What of the author's claim of an ongoing abandonment of the great goal of science, which was to obtain not just answers but *the answer*? Horgan seems to have two main reasons for making this claim. First, he accepts the well-worn argument that we are in an era of diminishing returns from research, a view lately bolstered by the assertion that in seeking a "theory of everything" particle physics has finally overreached: neither "superstrings" nor any other mathematization of what is already mathematical, hence untestable, is likely to produce *the answer*.

Second, Horgan deduces from interviews with unquestionably powerful minds (and from meetings in which they assemble for metascience and bagels) that these good people are *troubled*. Asked whether they anticipate the end of science, many of them squirm but do not deny it.

Yet engaging as these glimpses of angst-ridden greatness may be, they are not fully persuasive. As Horgan properly notes, greatness has often announced that its work is done—only to be proved wrong. Granted, natural selection was a 19th-century idea, as were atoms made mostly of empty space. But genetics, apart from Mendel's pioneering insight, is a 20th-century story. So is the fusion of genetics with biochemistry, natural history, ecology, development, and earth history. The mystery of quantum gravity may or may not be solved, but whole territories of physics remain unexplored.

Finally, a certain gloom is bound to settle over any business that has grown exponentially and must now grow, if at all, linearly. Ask the brilliant, egotistical leaders in any field if their own achievements are likely to be trumped; most will stroke their chins and think not. Interview the youngest, most up-and-coming scientific geniuses, and you will get a different answer.

—*Paul R. Gross*

HISTORY OF THE HOUR: Clocks and Modern Temporal Orders. By Gerhard Dohrn-van Rossum. Trans. by Thomas Dunlap. Univ. of Chicago Press. 451 pp. $29.95.

There is nothing more distinctively modern than the ordering of all existence by days, hours, minutes, seconds, and, it sometimes seems, nanoseconds. How did time become the tyrant of modern life? The answer is not as obvious as it might appear. After all, time (or more accurately its measurement) is as old as the Babylonians, who invented the sundial and the 24-hour day. Yet the Babylonians didn't live by the clock.

Modern time began with the invention of the mechanical clock during the 13th century. Nowadays, scholars eager to find Eurocentrism lurking under every bed suggest that medieval Europeans borrowed the technology from the Chinese or Muslims. This hypothesis gets little more than a cold stare from Dohrn-van Rossum, a historian at Germany's University of Bielefeld. At great length, he shows that while much of the mechanical clock's history remains obscure, many different inventors in scattered European towns and cities had a hand in its development.

Dohrn-van Rossum observes that what really brought time to the public realm was the use—beginning in Orvieto and other northern Italian towns early in the 14th century—of *public* clocks capable of striking the hours. By the early 15th century, he notes, "life in [Europe's] cities was equated with