Jurassic Park -- Jurassic Park by Michael Crichton
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Books, Journals, Software

Jurassic Park

Jurassic Park, by Michael Crichton, 400 pp, paper, $6.99, ISBN 0-345-37077-5, New York, NY, Ballantine Books, originally published in hardcover by Alfred A. Knopf, 1990.

Since Mary Shelley published her classic horror story *Frankenstein or The Modern Prometheus* in 1818, its motif has been unmercifully recycled—especially by Hollywood film makers who rarely hesitate to cash in on the public's fear of scientists and the unnatural things they do. The book *Jurassic Park*, by Michael Crichton, MD, and the movie of the same name by Steven Spielberg are the latest version of the horror story, albeit with much more interesting monsters. While Shelley's tale of horror involves a scientist who assembles pieces of human corpses to recreate a man, Crichton's scientist assembles pieces of 100-million-year-old dinosaur DNA to recreate extinct monsters, which also turn on their human creator.

If *Jurassic Park* were just another gory thriller, one might overlook the book's many blatant absurdities, self-contradictions, and falsehoods. But the novel is more than just scary entertainment. It is a morality play about the alleged evils of bioengineering and the doom that humankind faces if scientists are not diverted from their immoral and calamitous path.

The book's plot in brief: Backed by nearly a billion dollars from investors, entrepreneur John Hammond has set out to build a dinosaur theme park on an island 120 miles off the coast of Costa Rica. He has hired Henry Wu, a talented graduate student in genetics, and provided him with $10 million a year, supercomputers, 24 gene sequencers, and a supply of blood-sucking insects preserved in amber from the age of dinosaurs. In just 5 years, Wu has filled the amusement park with 238 dinosaurs representing 15 species, along with dragonflies with six-foot wingspans. However, before Hammond can open the park to rich tourists, he must convince his investors that the park is safe. To do so he flies in renowned paleontologist Alan Grant and his colleague, paleobotanist Ellie Sattler. Reluctantly, he also brings in Ian Malcolm, an eccentric, wisecracking mathematician who, Cassandra-like, prophesies doom for Jurassic Park as well as the demise of modern science.

Everything on the island is run by a single computer. Dennis Nedry, the computer scientist who designed the system, arrives to fix some remaining program bugs. Nedry is actually on a more nefarious mission: he has been hired by a bioengineering firm that specializes in industrial espionage (not too subtly named "Biosyn") to steal 15 dinosaur embryos. To accomplish the theft, he sabotages the computer system, jams all the phone lines, and shuts down all security systems, including the island's electric fences, the only barrier keeping the dinosaurs at bay.

The park staff desperately tries to restore the computer and security systems while the dinosaurs go on a bloody rampage and Malcolm continues harping on his apocalyptic message without once offering a hint of what might be done to avert the impending calamities that he claims are predicted by chaos theory.

A tyrannosaur catches up to Malcolm, but even the behemoth carnivore is not able to swallow the disagreeable mathematician. It spits him out, and Malcolm breaks his leg in the fall. High on morphine, Malcolm later succumbs to fatal infection, but not before he cheerfully tells why science is as doomed as he is.

Wu, the geneticist, suffers a ghastlier fate. Like Shelley's Prometheus, he too has "pursued nature to her hiding places" only to learn "how dangerous is the acquirement of knowledge." Crichton sends not a giant eagle but a dinosaur "raptor" to tear open the belly and eat the liver of his Prometheus.

In the end, only eight of the 24 people on the island escape. Jurassic Park is destroyed by the Costa Rican military, but not before some of the reptilian marauders escape to the mainland and disperse into the dense jungles, where they can reproduce without hindrance. Humankind has been cursed. The evil genie of bioengineering cannot be put back into the bottle.

While the movie has essentially the same message as the book, Spielberg has modified the plot, recast some of the characters, eliminated some of the glaring absurdities, and greatly reduced the gore. He also has toned down the moralizing and science bashing. As a result, the movie is less insulting to one's intelligence than the book.

Errors and Inconsistencies

Despite its far-fetched plot and careless writing, Crichton's novel has been hailed widely by critics as "astonishingly plausible," "remarkably realistic," and an "educational scientific seminar." Dropping the word "fiction," a *Wall Street Journal* review called it a "scientific thriller" and a story of "science run amok."

While on the surface, the author's knowledge of bioengineering and other scientific technologies seems impressive, the errors and inconsistencies that abound in his book suggest something else. For example, we're told that the Jurassic Park is not on an island but on a seamount. (It *is* on an island—seamounts are underwater mountains that do not rise above the surface of the sea.) The park's rides use electric cars with clutches, transmissions, and transmission humps. (Electric cars don't need these devices.) We're told that the Jurassic Park's computer is totally isolated for security and that it cannot be connected to any other system by modem, only to be told later that the computer purportedly had been hooked up to outside computers via its modems. The author also has trouble with numbers. Wu had cloned nine incredibly ferocious and highly intelligent, man-size dinosaurs called velociraptors. The eight adult "raptors" are secured in a special enclosure—they've already killed at least one worker. However, unbeknownst to everyone, at least six additional raptors have appeared out of nowhere and set up a secret underground nesting site on the island, where three of them have transformed themselves into males and started breeding. From their secret hideout, the raptors keep a vigil for ships on which they could "migrate" to the mainland.

The main premise of *Jurassic Park*, that dinosaurs can be cloned from DNA extracted from blood-sucking insects, is far-fetched. Amber from the dinosaur age is relatively scarce, and blood-sucking insects preserved in such ancient amber are rarer still. No dinosaur-age arthropod has yet been found with blood in its stomach. While theoretically it may be possible to recover dinosaur DNA from amber, the DNA will almost certainly be badly degraded, consisting of small, incomplete fragments, writes David Grimaldi, associate curator of entomology at the American Museum of Natural History, New York, NY, and a pioneer in the study of ancient insect DNA obtained from amber.[1] "Reconstructing the genome of a dinosaur from base pairs of DNA would be like trying to recon-

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struct Tolstoy's *War and Peace* from a gigantic vat of alphabet soup," he writes.

The book grossly misrepresents the current state of bioengineering. Leroy Hood, MD, PhD, professor of molecular biotechnology at the University of Washington School of Medicine, who developed the Hood automated gene sequencer described in *Jurassic Park*, writes, "Techniques do not exist for obtaining the complete DNA sequence of dinosaur DNA from just a few cells worth of DNA." Even if we knew the entire genome of a dinosaur, Hood writes, "the task of synthesizing the chromosomes with their billions of DNA letters is utterly beyond any current technology. And so is the task, once given the dinosaur chromosomes, of actually cloning a new dinosaur."[2]

Even if Wu had been able to do the unbelievable and clone sufficient amounts of DNA segments to have kept the 24 Hood automated gene sequencers working full-time (cranking out 12 000 base pairs per machine per day), he could have sequenced no more than 3.5% of the genome of a single dinosaur per year. Yet, the scientist not only sequenced the genomes of 15 dinosaur species (plus the genomes of frogs, birds, reptiles, and an extinct giant dragonfly), he also must have correctly figured out where every last strand goes in its proper chromosome. He then would have had to synthesize the billions of base pairs needed to clone each dinosaur without making a single significant base-pair error. In his spare time, he would have had to discover how to add the right methylation and other regulatory mechanisms needed to initiate and correctly orchestrate embryonic development. How long did it take Wu and his handful of helpers to accomplish all this? Less than 3 years and for only $30 million. By contrast, the Human Genome Project is expected to cost $3 billion and to take hundreds of researchers up to 15 years to sequence a single genome, with an unlimited supply of fresh DNA at their disposal.

While science fiction writers usually avoid having to explain the technology that does not yet (and may never) exist by placing their stories in the future, Crichton places his story in the immediate past, perhaps to make the danger of bioengineering appear even more looming. The author then stacks the deck against science with a plot riddled with absurdities to convince the reader that defying nature by cloning extinct life forms can only lead to disaster.

Just a few of the absurdities: Everything in this billion-dollar state-of-the-art theme park and resort is run by one computer, including the electrified fences and other security systems. Although it is common knowledge that computers are prone to hardware and software problems, there is no backup computer nor is there a computer expert on the staff. Indeed, no one even knows for sure how to turn off and reboot the computer. The telephones can't be used to call for help because they are all controlled by the computer. There's not a single radio on the island by which the staff can summon help. The island has no boat or helicopter by which they can escape. Despite the great size and complexity of the park, there are only two automobiles on the island. The *18-foot-tall* tyrannosaur is secured in an enclosure only by a *12-foot-high* electrified chain-link fence and, of course, there is no backup power to the fence if the main generator goes down. (Zoos throughout the world use moats and solid barriers to protect visitors from carnivores a hundredth the size of tyrannosaurs.)

The destruction of the Jurassic Park comes about because of these and other implausible blunders in its design. Yet, the reader is expected to believe that such projects are doomed from the start because complex systems cannot be controlled and because it's not nice to fool Mother Nature.

Nevertheless, humans routinely control complex systems, from flying high-tech aircraft to making $65 million movies like *Jurassic Park*. And humans have been fooling Mother Nature ever since the dawn of agriculture. The book presents a distorted picture of chaos theory to prove that scientists can never be trusted to control complex systems or the "monsters" they create. In reality, mathematicians are finding ways to use chaos to control complex systems with a high degree of speed and flexibility.[3,4]

Readers are also falsely informed that "universities are no longer the intellectual centers of the country" and that all the really important discoveries since World War II, such as the polio vaccine and magnetic resonance imaging, have come out of private laboratories, which are driven primarily by greed. This misinformation is very surprising coming from an author who received his medical degree from Harvard Medical School and was a postdoctoral fellow at the Salk Institute, La Jolla, Calif. The polio vaccine was developed by Jonas Salk, MD, then at the University of Pittsburgh. Paul Lauterbur, PhD, invented MRI while at SUNY, Stony Brook, NY.

Pandering to Luddites

Against the backdrop of rampaging dinosaurs, the science bashing continues throughout the book. "Discovery is always a rape of the natural world," Malcolm says. Scientists are not content unless they "stick their instruments in" and violate "the natural order. . . . Scientists want it this way. They want byproducts and trash and scars and side effects. It's a way of reassuring themselves. It's built into the fabric of science, and it's increasingly a disaster."

According to Malcolm, scientists have no humility. "There is only a get-rich-quick, make-a-name-for-yourself-fast philosophy," he tells the paleobotanist. "Cheat, lie, falsify—it doesn't matter. Not to you, or to your colleagues. No one will criticize you. No one has any standards." He gets no argument from the paleobotanist.

What about the advances of science? There haven't been any, not really, he insists. "We've had 400 years of modern science . . . it's time for a change . . . ," Malcolm argues. "We are witnessing the end of the scientific era. Science is destroying itself."

The author appears to be pandering to today's Luddites and anti-intellectuals, who view science as either a benighted force or a rusty belief system that, "like the medieval system before it . . . no longer fits the world any more." A new paradigm is coming, Malcolm predicts. What this paradigm is, the dying mathematician-prophet does not reveal.

Science indeed may be in danger of extinction, but not because it no longer fits the world. Science is under increasing attack from the left and from the right, from "New Agers," promoters of quackery, creationists, flat-earthers, animal rights terrorists, and many others whose religious, philosophical, or political views do not hold up under the light of science. Crichton's monster tale should appeal to these enemies of science better than any Frankenstein incarnation ever did.

In his acknowledgments, Crichton says his Malcolm character was inspired by Heinz R. Pagels, PhD, the late physicist and former president of the New York Academy of Science. Similarities between Pagels and Crichton's anti-science doomsayer should escape anyone who knew Pagels or who read his wonderful books on modern physics. Malcolm seems more like a clone of the anti–genetic engineering obstructionist Jeremy Rifkin than he does the late physicist. Pagels was an optimist who argued that human survival depends on protecting the light of science from being extinguished.

"Science is not the enemy of humanity but one of the deepest expressions of the human desire to realize that vision of infinite knowledge," Pagels wrote.[5] "Our capacity for fulfillment can come only through faith and feelings. But our capacity for survival must come from reason and knowledge."

Because science has no "fixed and solid place on the constellation of human life as

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do politics, religion, or commerce," it needs careful nurturing, he wrote elsewhere. "Science is a wondrous but fragile enterprise. Unlike commerce, religion, and politics, which are as old as human culture, science is a recent activity—practiced well for a few centuries, no more."[6] Science is not "as resilient as commerce, religion, or politics. It needs careful nurturing." Like the physicist Max Born before him, Pagels wondered if science might ultimately be abandoned. "If that should happen," he warned, it would be "an error that might cost us our existence."

It would seem that Crichton has taken pieces of the dead humanitarian physicist and created the monster Malcolm to scare readers more than he ever could with bioengineered monsters alone.

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JAMA

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Vascular Medicine

Vascular Medicine: A Textbook of Vascular Biology and Diseases, edited by Joseph Loscalzo, Mark A. Creager, and Victor J. Dzau, 1211 pp, with illus, $135, ISBN 0-316-53317-3, Boston, Mass, Little, Brown & Co, 1992.

This ambitious text addresses all types of vascular disease as well as hypertension. The first third (about 400 pages) is devoted to basic concepts of biology of the vasculature and to pathophysiologic mechanisms, material most useful to clinical investigators and academicians. The next 150 pages cover diagnostic methods for evaluation of persons with vascular disease. Here the clinician will find much useful information.

The remaining 650 pages covers a great deal of clinical material so that in some areas details of management that some readers would appreciate are not included. Specific deficiencies, in my opinion, are the incomplete discussions of acute peripheral arterial occlusion (less than one page) and of thoracic outlet compression, no mention of the international normalized ratio (INR) in the anticoagulant section, and omission of transcutaneous oxygen tension as a noninvasive test of ischemia and of transesophageal echocardiography in the evaluation of unexplained embolic peripheral arterial occlusion. Also, I thought it a bit unusual to find the clinical description of thromboangiitis obliterans in the vasculitis chapter rather than in the section on nonatherosclerotic occlusive peripheral arterial disease, its major clinical feature.

Particularly excellent chapters, in my opinion, are "Pathophysiology of Thrombosis," "The Pathogenesis of Atherosclerosis," "Examination of the Patient With Vascular Disease," "Hypertension," "Percutaneous Transluminal Angioplasty," "Aortic Dissection," "Clinical Spectrum of Vasculitis," "Pulmonary Thromboembolic Disease," and "Chronic Venous Disorders."

Extensive references concluding each chapter are a strong point of this volume. The many diagrams and tables are excellent. Having more than 1200 pages in a single volume makes this book a bit unwieldy; perhaps subsequent editions should be in a two-volume set.

Overall, this text can be recommended as a good reference for the basic aspects of vascular disease and particularly for new concepts, but it is somewhat less useful for the busy clinician or surgeon.

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Booknote

Incorrect Publisher

The correct publisher of *The History of Surgery in the United States 1775-1900,* vol 2, *Periodicals and Pamphlets,* by Ira M. Rutkow (reviewed in *JAMA,* July 7, 1993), is Norman Publishing, San Francisco, Calif.

Journals

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Inflammopharmacology

Inflammopharmacology, K. D. Rainsford, editor-in-chief, quarterly, $177, Dordrecht, the Netherlands, Kluwer Academic Publishers, 1991- .

Students of the literature of inflammation and its pharmacological control now have a new international, interdisciplinary journal. Blending several disciplines, *Inflammopharmacology* reports clinical and experimental research on drugs, their actions, therapeutic efficacy, and safety when used in the treatment of various inflammatory diseases. According to Kluwer's 1992 *Journals in Medicine* catalogue, the journal covers experimental development of in vitro systems and in vivo animal models; assay methodologies; biochemical, immunological, and pharmacological studies; clinical pharmacology and therapeutics; drug-induced side effects; comparative drug studies and trials; and novel approaches toward the therapy of inflammatory conditions. The journal should appeal to both investigators and practitioners.

Spearheaded by Rainsford, editorial responsibility lies with 31 experts worldwide. Authors will appreciate the short turnaround time for manuscript review, a month or less from the date of submission. Its refereeing policy is explicitly outlined in the instructions for authors, which speak in defense of anonymous review while providing procedures to ensure due process and proper consideration. On the average, seven articles, each five to ten pages in length, fill approximately 93 pages per issue. Advertisements for other publications are occasionally inserted between articles; conference reports and announcements are also included. However, neither the proposed book reviews nor the editorially encouraged critical commentary have materialized by the second volume.

In targeted content, *Inflammopharmacology* competes with only a few specialized journals for manuscripts, although there are large numbers of journals across broad disciplines that presently absorb the pool. Its primary competitors are *Agents and Actions, Inflammation, European Journal of Rheumatology and Inflammation,* and *Arthritis and Rheumatism.* In addition to these well-established journals, other prestigious rheumatology and pharmacology journals with wider topical venues will continue to divert studies from this newcomer. When compared with its competitors in terms of article output of equal quality, its price is a bargain and has remained stable, a commendable action by Kluwer. From the library perspective, praise is due also for printing the SISAC (Serials Industry Systems Advisory Committee) bar code symbol on the back covers of issues to provide a means for speedy incorporation into library collections.

As with other new journals, readers will find interesting designs and models

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but experience difficulty in finding significant results. Of particular note, one article explores the use of nitroglycerin in experimental lung fibrosis induced by intratracheal bleomycin in the hamster. Whereas inflammation was reduced, fibrosis, the critical feature of the bleomycin model as measured by hydroxyproline, was not affected. Another clinical study showed no differences in the reactions of rheumatoid arthritis subjects injected with radioactive yttrium or triamcinolone. Since yttrium is not frequently used, the study is of interest but not clinically useful. Most of these considerations relate to the growing pains of new journals and not to any specific editorial decisions.

True to new journal ventures during times of fiscal constraint, this one will have difficulty moving up the tiers in the health sciences literature, despite its respectable quality. With indexing and abstracting coverage provided selectively by *Chemical Abstracts*, greater exposure from other indexing services is essential to its future.

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Ethics

Kennedy Institute of Ethics Journal, Renie Schapiro, editor, quarterly, $48 (personal), $68 (institutional), Baltimore, Md, The Johns Hopkins University Press, March 1991-.

CQ: Cambridge Quarterly of Healthcare Ethics: The International Journal for Healthcare Ethics Committees, David C. Thomasma, Thomasine Kushner, and Steve Heilig, editors, quarterly, $42 (personal), $84 (institutional), New York, NY, Cambridge University Press, winter 1992-.

The field of bioethics and health care ethics, like most other biomedical disciplines, has grown rapidly over the past 15 to 20 years. This is clearly evidenced by the rapid growth of the literature. The most recent Kennedy Institute Scope Note on "Basic Resources in Bioethics" (published in the first issue of the *Kennedy Institute of Ethics Journal*) lists 14 core bioethics journals, not including the two reviewed here. These titles include well-established and highly respected journals like the *Hastings Center Report*, *American Journal of Law and Medicine*, *Journal of Clinical Ethics*, and *Linacre Quarterly*. Reviews of two other excellent new journals in this field appeared in *JAMA* during the past year.[1,2]

Thus, with so many excellent, established, and new bioethics and health care ethics journals already available, potential individual or institutional subscribers must ask, are two more needed? Our examination of the issues published to date for these two journals suggests that both have the strong potential to be valuable additions to the array.

The *Kennedy Institute of Ethics Journal* draws upon the Institute's prestigious faculty, superb library resources in bioethics, and position inside the beltway to make three salient contributions. First, its articles provide a broad and well-grounded scholarly perspective, offering readers an excellent education in moral theory as applied to problems in bioethics. Second, its regular "Bioethics Inside the Beltway" feature offers unique insights into the connections between policy and theory that underlie governmental concerns with bioethical issues, projects, and programs. Finally, the ongoing "Scope Notes" series (prepared by the Institute's National Reference Center for Bioethics Literature and previously distributed as a free-standing publication) is worth its weight in gold as a bibliographical resource. This regular feature provides short essays on a variety of important topics followed by extensive annotated bibliographies, organized subtopically.

The Kennedy Institute is largely responsible for the development and flourishing of bioethics as a discipline, and, thus, it seems natural and appropriate for it to publish this journal. This is the journal to have if you wish to pursue or to promote the development of broad and deep thinking about bioethics. Many articles, as well as the "Scope Notes," are keepers, likely to be consulted repeatedly.

In contrast, *Cambridge Quarterly of Healthcare Ethics* is an easier read, livelier and more practically oriented. It is well designed to appeal to its primary audience, the members of health care ethics committees, and to others who prefer a more user-friendly, case-focused format. *CQ* does not attempt to separate the practical from the theoretical, however; instead it publishes articles that combine various perspectives and that introduce law, feminism, psychological and emotional considerations, and the other concerns of the "new" bioethics, which the editors prefer to label "healthcare ethics."

Both of these journals also incorporate, but are not dominated by, an international perspective. One quarter of the Kennedy Institute journal's 16 editorial board members work outside the United States, as do about one third of *CQ*'s 48 board members, and *CQ* explicitly seeks to engage "a world community of ethics committees" in comparative moral analysis. This international focus is particularly useful, both theoretically, as American bioethics continues to struggle with basic questions of universality, and practically, as health centers learn to deal with cross-cultural ethical concerns among their own staff and patient populations.

Like the Kennedy Institute journal, *CQ* draws on both established and well-known scholars and some with less immediately recognizable names. *CQ* publishes a somewhat wider variety of authors and articles (case discussions, historical and procedural analyses of health care ethics committees' work, and the like, in addition to purely scholarly pieces), reflecting the breadth of ethics committee membership. Both journals also publish article series and responses to articles, thus providing continuity of moral discourse. *CQ* is more likely to gather together several articles on a special topic in a single issue—a feature that is very valuable for readers interested in the topic but which can render the issue disappointing to others.

Both journals are printed on high-quality paper with evidence of careful copyediting. Advertising is minimal and located at the end of the issues so as not to interrupt the articles. *CQ* provides clear and comprehensive guidelines for contributors in the first issue of each volume; the Kennedy Institute journal's brief instructions to authors appear on the inside back cover of each issue. From its first issue, the Kennedy Institute journal has been indexed in Index Medicus and MEDLINE, and both journals are included in BIOETHICSLINE.

Key to the lasting value of any journal is how well it wears over the years. Both of these journals are mining rich lodes for their articles, but *CQ*'s may have the potential to run thin more quickly. Provided they can keep up the quality, choosing between these two new journals, whose goals are more complementary than competing, will be difficult. Subscribing to both (the individual and institutional subscription rates are quite modest by today's standards in biomedicine) would afford anyone a reasonably good coverage of the field.

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