Tired trio: Carreras, Pavarotti and Domingo

chance to record their best roles, are Richard Leech, an excellent Rodolfo in "La Bohème," and Jerry Hadley, one of the best interpreters of Stravinsky's "Rake's Progress". Another young tenor, Roberto Alagna of France, has had better luck with the hazards of recording contracts and has brought out a much-praised version of Donizetti's "Elixir of Love" (Warner/Erato 4509-91701-2). Mr Alagna, who wowed the audience at a recent recital in London's Barbican, is preparing a new version of "La Bohème" for EMI with a brilliant young American maestro, Antonio Pappano.

Spiteful tongues claim that one at least of the Big Three must struggle to read a score. To most younger singers this lack of professionalism would be unimaginable. Josef Protschka, a German tenor, tackles challenging works such as Hugo Wolf's opera "Manuel Venegas" (Capriccio CD 10 362). Perhaps the finest musicians among current tenors are three Englishmen. All are past 50 and still sound fine. Anthony Rolfe Johnson, after decades of singing oratorios, has broken into works such as "Peter Grimes" (EMI CDS 754832 2). Philip Langridge, also a strong actor, shines in technically punishing works like Schoenberg's "Moses and Aaron" (Decca CD 414 264-2). And Ian Partridge, who is at home with both oratorio and classical song, also sings opera: for example, Berlioz's "Les Troyens" (Philips CD 416 432-2) and Vaughan Williams's "The Pilgrim's Progress" (EMI CMS 764212 2).

There is, in sum, no excuse to whinge about a shortage of tenors now that the Big Three are past their prime. Nor are the only good tenors young tenors. Spain's Alfredo Kraus is 68 (some say he is older) and he has just recorded a new CD (Philips 442 785-2) where he sings one aria with nine high Cs and another with a high D.

Louis Pasteur

Pity a science that needs heroes

THE PRIVATE SCIENCE OF LOUIS PASTEUR. By Gerald Geison. *Princeton University Press; 411 pages; $29.95. Distributed in Britain by John Wiley; £24.95*

PASS ten Paris summers or so in the half-light of the Bibliothèque Nationale's manuscript room; pore over some ten thousand pages of minute scrawl in previously unexamined laboratory notebooks; apply this microscopic scrutiny of a great biologist's daily work to subtle and challenging questions about scientific method. Spend, in short, 17 years on a meticulous biography of one of the grandest figures in the history of science–and wake up to headlines such as "How Louis Pasteur perfected science of cheating", or "Lies in the Lab".

Gerald Geison, the author of this splendid biography, published in French and English on the 100th anniversary of Pasteur's death, is no muck-raker trying to denigrate a scientific hero, who was a propounder of the modern germ theory of disease and one of the founders of modern immunology. At times Mr Geison seems almost abashed by what he has found in more than 100 lab books of this giant, tightly held within the family at Pasteur's request until 1971, when his last male heir passed them to the French national library.

Pasteur spotted a place for himself in posterity early on and delivered creditably on a promise to his young and neglected wife to lead her there with him. But he also had, it turns out, good reasons to keep posterity out of his papers. From evidence in the daily record of his experiments Mr Geison makes a convincing case that at moments critical to his most dramatic scientific achievements Pasteur misrepresented his work so as to marginalise opponents and to gain public confidence, private sponsorship and scientific prestige.

The most damning revelations are these. Pasteur's public demonstration in 1881 of a vaccine against anthrax made him a national hero in France. But he neglected to point out that the technique for making the vaccine had, in fact, been "borrowed" from a competitor. Four years later, at work on the most terrifying human disease of his time, rabies, Pasteur not only began human trials of vaccines despite objections from his collaborating physician (at a time when the results of his animal experiments were not at all conclusive) but actually treated two patients "privately" and apparently without success. He courted publicity for his vaccine only later, when in a position to announce the successful treatment of young Joseph Meister and Jean-Baptiste Jupille, a triumph that placed Pasteur in the ranks of scientific immortals.

Mr Geison disdains the tendency in much popular writing about scientist's careers "to telescope the usually extended and sometimes tedious process of scientific discovery into a single dramatic moment of illumination." But by rejecting the easy storyline of heroic effort rewarded by sudden triumph the author obliges himself and his readers to tread a more demanding and frequently more tedious path.

The abundant detail Mr Geison provides on Pasteur's early work in crystallography will be best appreciated by readers who have toyed with optical isomerism in the tartrates and paratartrates. But perseverance is rewarded. By 1848 Pasteur could show that distinct substances with identical chemical formulae were mirror-images of each other, distinguishable by asymmetries of their crystal structure. Though that breakthrough led Pasteur himself to formulate a spectacularly ambitious and mistaken theory of living organisms, it had far-reaching consequences for the science of the time.

Pasteur's efforts to understand living nature drew him into experiments, in effect, to create life in the laboratory. Whether non-living matter could spontaneously arrange itself into living matter was in Pasteur's day furiously disputed. The view that non-living matter could—the doctrine of "spontaneous generation"—was to Pasteur false. He was, it turns out, right about this, but not for the right reasons.

Though Pasteur claimed to have no preconceptions about spontaneous generation and insisted in public that fact should decide the issue, Mr Geison shows that Pasteur himself was against the doctrine from the

Pasteur and human guinea pig

start, lent his scientific authority to religious conservatives who opposed it on theological grounds and even threw out about 90% of certain experimental results, defining as "unsuccessful" any experiment indicating that spontaneous generation had occurred. Though he gathered evidence that spontaneous generation did not take place, he never succeeded in disproving the findings of his opponents.

All this raises a simple-minded question. Was Pasteur a bad scientist? Clearly not. He was a great one. How then are we to explain his apparent lapses? Part of the answer, Mr Geison suggests, is to avoid an over-narrow understanding of what scientists do. Any account of the scientific enterprise according to which a scientific theory lives or dies by the evidence alone, unaffected by the prejudices and persuasiveness of its author, will fail to grasp Pasteur's remarkable success.

Shown in this light, Mr Geison makes Pasteur in many ways worthier of our admiration than the saintly figure of legend was. Instead of a dogged experimenter who stumbled repeatedly on the truth either by accident or by the routine application of some mechanical procedure, Pasteur emerges as an artist of the microscope inside the laboratory and a talented, at times unscrupulous, advocate outside.

This approach does not exonerate Pasteur entirely. Mr Geison scrutinises the rights and wrongs of Pasteur's work on rabies. In the end he concludes that conquering the scourge of rabies outweighed the moral injury done by Pasteur's risky experiments on humans. Even when it comes to the unsavoury appropriation of his rival's vaccines and his subsequent cover-up, Mr Geison stops short of charging fraud, pointing out that, whether or not the technique itself belonged to a rival, only Pasteur could get it to work consistently.

"Pity a country without heroes," a character says in Bertolt Brecht's play, "Galileo". "No," answers the great scientist, "Pity a country that needs them." Though the old picture of Pasteur as hero will not survive this book, Mr Geison voices some poignancy about the demolition job he has done, knowing that heroes are not unmade lightly. But he recognises, too, that every generation or so makes its own sense of old myths and heroes. "Each age," he writes, "will get the Pasteur it deserves." To suggest that his readers merit this one is to pay them a heady compliment.

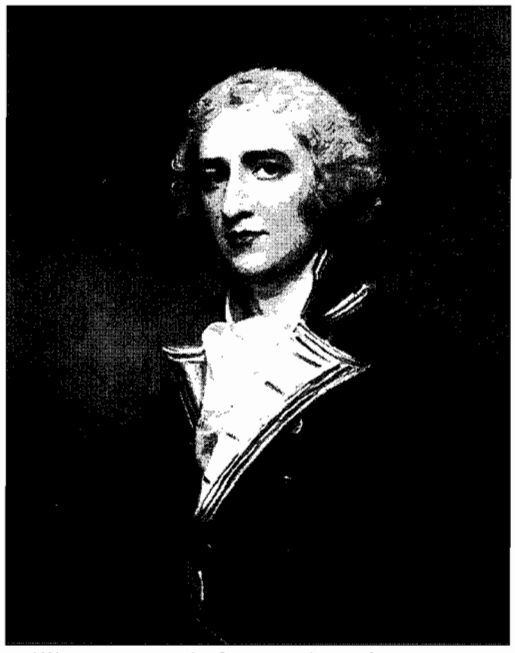
Nautical novels

Taut timenoguys

A SEA OF WORDS: A LEXICON AND COMPANION FOR PATRICK O'BRIAN'S SEAFARING TALES. By Dean King. *Henry Holt; 411 pages; $27.50*

THE double portrait hung above the back staircase is a long way from being the most striking of the exhibits in the National Maritime Museum at Greenwich. Yet now and then visitors stop and look at the man and boy in the picture, read the accompanying description, and return their gaze to the canvas with a curiosity that far exceeds anything such a humdrum piece of 18th-century art would seem to merit on its own account.

When you see this double-take, you can bet a turnip against a gold napoleon that you have found a fan of the sea-faring novels of Patrick O'Brian. For the visitor is studying the likenesses of Captain John Bentinck and his son William, later to be vice-admiral of the Blue, and is wondering which of them invented Bentinck shrouds, a type of sail in which Mr O'Brian's hero, Jack Aubrey, places much faith.



William Bentinck, future admiral

In 17 novels written over the past quarter century, Jack Aubrey and his particular friend, the half Catalan, half Irish naturalist, surgeon and spy, Stephen Maturin, have delighted ever-growing legions of fans like those who pause thoughtfully in front of the Bentincks. The books provide all the excitement and drama expected in stories of the sea, but they also offer much more.

Walter Jon Williams, a writer who served his years on the seas of nautical fiction before finding greater success and acclaim in science fiction, put it well when he said the novels are "what might have resulted had Jane Austen's brother Frank taken up the literary life".

Mr O'Brian's novels are a many-faceted comedy of manners; a protracted study of companionship, friendship and love; and psychological portraits of a perception rare in any but the best genre fiction. Aubrey himself is a masterpiece of characterisation, at the same time fundamentally simple and endlessly interesting.

Two constant threads run through all of this, entwined around each other: Mr O'Brian's love of language and his love of knowledge, principally but not exclusively maritime, historical and scientific. These are the aspects of his fiction addressed by Dean King's useful, though rather misleadingly named, reader's companion.

If you have ever wondered where a Blue Nose comes from, what a prodromus foretells, who served on the Board of Green Cloth, or why a timenoguy needs to be taut, this book will certainly help. To any disoriented lubber who needs to take a quick bearing in Aubrey's world of staysails and sternposts, it will be a useful compass.

The book is a better lexicon than companion. A companion would look at the world of the novels and the world of history through each other; it would compare characters to the historical figures that they are modelled on; it would discuss the minor characters and events in the books in appropriate contexts. "A Sea of Words" offers the reader none of this; it is devoted to an analysis of the crucial threads of language and learning, rather than to providing a commentary on the rich patterns that O'Brian weaves with them. It is a sea of words that carries no trade of ideas, or vessels of incident. It does, however, after a fashion, tell you which Bentinck is which.