

expected to accept a constant diet of abstract definitions and meticulous propositions without knowing how he—or anybody—is to be regarded as fitter for the experience. The author's claim that applications are consigned to a series of annexes, in order not to overburden the text unduly, bespeaks a pedagogical style which does not elicit my sympathy. Applications, in my view, should form an integral part of any text and can only, when appropriately chosen, serve to lighten the reader's task (if not, perhaps, the writer's). Moreover, the applications are themselves only marginally more concrete than the basic material of the text; and the manifold topics introduced in the annexes are discussed in so perfunctory a manner that the reader will be even more bewildered by this plethora of unmotivated "applications" than he was by the main body of the text. For example, differential modules and the associated notions of homology and homotopy occupy half a page, and the topic of simplicial complexes receives one page of discussion.

Certain idiosyncrasies of style contribute to the difficulty which may be experienced by a reader brought up on a less austere mathematical diet. Principal among these is a system of notation which, while being entirely logical and consistent, is somewhat private and unwieldy; and a massive priority to the concept of "relation" over that of "function". This last is to be explained by the author's own research interests; but it is a depressing experience to read that a function from  $E$  to  $E'$  is a binary relation which is left-bijective.

A final criticism concerns the extraordinary omission of the excellent book, *Universal Algebra*, by Paul Cohn, from the bibliography. A more commendatory remark is also in order, however; an experienced algebraist, trained in the classical tradition and wishing to familiarize himself with certain parts of abstract mathematics (category theory excluded) might well benefit from consulting this text.

PETER HILTON

## EXPENSIVE ENGINEERING

### Concorde

The Story, the Facts and the Figures. By T. E. Blackall. Pp. xiv + 108 + 47 plates. (Foulis: Henley-on-Thames, May 1969.) 56s.

THERE will be many stories about Concorde, for this tremendous venture has been surrounded by controversy since its inception. It has been described as too early and too late, a social necessity and an unjustified nuisance, an international money spinner and a political white elephant. Only now as we approach the moment of truth has a respectful hush descended. Meanwhile, men who have dedicated a third of their professional lives to the project get on with their job, well aware of the risks and of the rewards.

Mr Blackall with his feet firmly on the ground has restricted himself to facts and figures. These are clearly presented and supported by excellent photographs. The greater part of the book is concerned with detailed specifications of the structure, the propulsion, the auxiliary machinery, and the complex equipment needed for control, flight management and navigation during the various phases of flight. The book will commend itself primarily to engineers and as a source of information to the growing body of people who will become involved in the operation and maintenance of Concorde.

But even a layman cannot fail to be impressed by the vision of its designers and by the sophistication of its engineering. A minor miracle is the use of air drawn from the engine compressors at 600° C to maintain a cabin temperature of 25° C, with the skin of the aircraft itself well above the boiling point of water. The Concorde will be the most thoroughly tested aircraft ever produced. For years after its introduction into service, full scale

fatigue tests will continue hour after hour accumulating data two years ahead of any operational aircraft—a vital guarantee for safety in flight.

The book does less than justice to the fundamentally new aerodynamic concept which alone has made supersonic flight commercially feasible. During the post-war years many abortive attempts were made to solve the problem with highly swept wings. But although sweep back provides an elegant escape from wave drag up to transonic speeds, beyond 45° the flow tends to break away at large angles of incidence and handling characteristics are unacceptable at landing and take-off.

The breakthrough came in 1956 when the Royal Aircraft Establishment proposed an entirely new approach—the slender wing—in which the flow is deliberately induced to break away from a sharp leading edge. The powerful vortices induced make a major contribution to the lift, and moreover both lift and drag can be smoothly controlled over the entire speed range. In 1961 the HP115 completely verified experimental results in the tunnel, and the slender wing is now the basis not only of the Anglo-French Concorde but also of the Russian Tu 144 and the Boeing supersonic transport.

Mr Blackall has been understandably cautious about the financial return to be expected from this huge investment. So much depends on imponderables such as passenger appeal, load factor, utilization, and above all on the number produced. The VC 10 although of more conservative design, and produced in very much smaller numbers than the Boeing 707, has nevertheless competed well on the transatlantic routes because of a consistently higher load factor. Concorde is at least 5 years ahead of any possible competitor and even if confined to transoceanic and transpolar routes there is a potential demand for several hundreds. We must wait until the cruise performance of Concorde 001 and 002 is established before any reliable market forecast can be made, but so far the omens are good.

ROBERT COCKBURN

## Correspondence

### Preknowledge Survey for University Science Entrants

SIR,—The preknowledge survey for university science entrants by O'Connell, Wilson and Elton (*Nature*, 222, 526; 1969) is welcome. I must, however, dissent from the authors' views in one respect: a lecturer requires that his students should have a rational understanding of elementary concepts, not just a vague acquaintance with terminology. In this sense it does not appear that the "comprehensive course in basic mechanics" which the students are supposed to have received is generally "adequate to build a university course on".

It is shocking that less than half of the science students tested recognized force and acceleration as vectors, but we must not assume that those who are acquainted with these ideas understand them. It is very usual for students (and their teachers) to find vector sums of forces acting on different bodies. Of the 135 students tested by O'Connell *et al.*, 122 associated force with mass times acceleration. Most students whom I have questioned make the same identification. But this does not prevent almost all of them accepting without question the commonly taught idea that a molecule under the action of a resultant force remains at rest in a state of tension. Reasoned criticism over many years has failed to prevent qualified physicists from continuing to teach and publish (and presumably to believe) this absurdity.

The uncritical acceptance of contradictory beliefs has been shown to be a commonplace in several topics of