book reviews

The New Heat Transfer

by Eugene F. Adiutori
The Venture Press, 1974
Pp. 230. Price: $22.95 ($19.95 within the USA)

"*The new heat transfer will transform convective heat transfer from a complex art to a simple science*". Mr Adiutori argues that since heat flux is often not proportional to temperature difference, as in natural convection or boiling for example, there is no point in converting heat fluxes into heat transfer coefficients. In this book, he is principally concerned with the establishment of his approach. He has produced neither an undergraduate text nor a designer's manual.

He suggests that heat transfer coefficients are so confusing that development of heat transfer itself is substantially impeded, both conceptually and arithmetically. He also considers that dimensional analysis and dimensionless groups undermine the subject, for misleading physical conclusions can be drawn and because the original raw physical data can be lost. A tenet of the new heat transfer is that experimental data should always be made available, if not in a journal then through a documentation service. He illustrates his arguments first with a re-evaluation of the literature on film cooling, the cooling of a surface in a stream of hot fluid by the injection of a thin film of cold fluid at the surface, and secondly with a discussion of the stability of boiling liquids.

His thesis is not without its virtues for there is no doubt that an unthinking reliance on heat transfer coefficients can lead to conceptual difficulties in those instances in which heat transfer rate is not proportional to temperature difference. However, at times the reader may feel like a person accosted at the railway station on his way to work and berated by a man who has just discovered the joy of coffee for breakfast and wishes to convert others to the habit. The author is surely mistaken in implying that engineers think exclusively in terms of heat transfer coefficients, not in terms of heat fluxes. For example, a significant point in the teaching and practice of chemical engineering is the behaviour of flow systems. The first law of thermodynamics is necessarily couched in terms of energy fluxes for steady or unsteady state continuous operation. Whilst loose talk of heat transfer coefficients for those systems in which heat flux is not proportional to temperature differences is common I do not believe that the difficulties are as severe as he would have us believe.

Mr Adiutori gives a number of very simple examples which if solved by slide rule, are more laborious in terms of heat transfer coefficients but these lack conviction for the operations are not difficult and would be trivial on a computer which

would be used in any event by most designers. He does not deal with those classes of equipment in which the convective heat transfer coefficient is effectively constant for which his methods would be unnecessarily laborious. Rather he feels that we should now go on and abandon also the concept of thermal conductivity.

The remarks about dimensionless groups seem to be ill-founded for he overlooks one of the key features of engineering design, namely, on the basis of sometimes wholly inadequate information, how to design equipment that will work with both a probability of success and a cost acceptable to the employer or to the community. With regard to dimensional analysis for non-linear heat transfer problems, rather the comment should be that if we need to introduce both heat flux and temperature difference into the treatment, then we necessarily gain another dimensionless group.

Certainly indiscriminate use of log-log plots may obsure the interpretation of data and give erroneous predictions if other groups have become significant that before were not. Authors do not always make their original data available and on occasion there is no doubt we can ascribe this to negligence. However, modern data acquisition systems can accommodate so much information that the most obliging documentation service might blanche. Gauges can be mis-read or be incorrectly calibrated. Certain measurements may not be obtainable or may be overlooked simply because the workers are ahead of their time and do not appreciate all the parameters. In biological work, experiments frequently vary for no obvious cause. If the consequences of dimensional analysis were the most glaring deficiency in the literature I would be very happy.

The most interesting part of the book is his discussion of thermal stability in pool boiling. Here he shows how the interaction of the boiling fluid with other components, for example the heater and the intervening metal, may influence stability. The discussion of film cooling is marred by an unfortunate error (total coolant flow is not equal to the coolant flow-rate per inch of slot length divided by slot length) which invalidates much of his discussion and takes the force out of his argument.

His writing can be discomforting. Much of the time the book reads like an extremely laborious set of undergraduate lecture notes issued by a fussy professor. Points are made not once but again and again. The line of argument sometimes proceeds by zig-zags and loops and on occasion disappears into personal reminiscences and comments on the development of the whole of scientific thought. Zeal pervades the text. In moderation, such stylistic points could be entertaining and help to secure an argument or maintain interest but here the intrusion seems too great and on occasion distressing. For example the repeated assurance, "... *that 'the old heat transfer' does not include my two published articles which were pages taken from the new heat transfer*" or the statement that, "... *those readers who wonder why I have waited almost ten years to publish the application of my theoretical and conceptual work will find the answer between the lines*" or the story of the difficult correspondence with the "Argonne Seven" who at one time thought some of Adiutori's previous work to be "a hoax" do not bolster confidence.

One forms the impression that the author has tried without much success to get his ideas into the research literature. Perhaps there is a message for those who like answers served up in a certain style with certain generally agreeable but not explicitly stated limitations. Complaints are to be heard about unreasonable examiners of Ph.D. theses or tiresome reviewers of papers who fail to accept a slightly new framework!

Whilst some of Mr Adiutori's points are fair ones, I do not think that he is presenting anything that is new. All engineers have cogent remarks to make about the printed word. Nor do I feel that the case has been well served by over-statement. What he has said should rather be the subject of an enjoyable anti-establishment lecture, not a whole book. Certainly I do not share his view that:

> "As the new heat transfer becomes generally accepted, the heat transfer coefficient will simply disappear, just as phlogiston and the caloric fluid disappeared in the nineteenth century".

or that:

> "*Engineering in the twenty-first century will bear little resemblance to present day* (1973) *Engineering. For instance:*
> *Hooke's Law will have passed away ...*
> *Ohm's Law will have passed away ...*
> *heat transfer coefficients will have passed away ...*
> *thermal conductivity will have passed away...*

to give a few from a list of more than twenty.

J. Bridgewater