This Week's Citation Classic

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Van Dyke M. *Perturbation methods in fluid mechanics.*
New York: Academic Press, 1964. 229 p.
[Dept. Aeronautics and Astronautics, Stanford Univ., Stanford, CA]

The techniques of perturbation theory are described using examples from various branches of fluid mechanics. Although regular perturbations are discussed first, the emphasis is on singular perturbations, and in particular on what has come to be known as the method of matched asymptotic expansions. [The *SCI®* indicates that this book has been cited over 955 times since 1964.]

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"No doubt one reason this book has been often used and cited is that it is cheap. Technical books have become so expensive that, aside from essential textbooks, the average graduate student cannot start a library. If you want him to own your book, make it cheaper to buy than to photocopy! I induced the publishers of the original edition to add to our contract a limit of three cents a page. Although I have never regretted that arrangement, they soon did, and after five printings they insisted that they could not fill existing orders unless I let them double or treble the price. Instead, I recovered the copyright, modernized the text with 40 pages of notes and references (and an Escher frontispiece), and embarked on the exhilarating experiment of being my own publisher of the 'Annotated Edition.'"[1] I've shipped 4,000 copies at the original $7 price, and only now has the latest postage increase forced me regretfully to raise it to $10.

"Another reason is that the book appeared at a propitious time, just as students of fluid mechanics the world-round were discovering the method of matched asymptotic expansions. We all knew from Prandtl's boundary-layer theory how a thin region of rapid variation can be accommodated next to another region of normal variation. But only after Kaplun[2] and Lagerstrom and Cole[3] explained creeping flows did we realize that the idea of using different scalings in different regions applies to almost every field of fluid mechanics. In fact, it goes much further; and if from time to time I look up my own name in the *Science Citation Index®*, it is not so much from egotism as to marvel at the unexpected branches of technology to which matched expansions are being applied.

"Many citations are concerned with just one page of the book, where I formulated an 'asymptotic matching principle' for joining expansions in two neighboring regions. In doing this, I had supposed that I was merely codifying an 'intermediate matching principle' promulgated by Kaplun; but L.E. Fraenkel[4] showed that my rule is essentially different: simpler to use in most cases, but to be applied only with certain restrictions to expansions that involve logarithms.

"One disadvantage of having a book cited frequently is that you begin to receive many more manuscripts from editors who thumb through the references looking for referees. The only cure for this would be to emulate Mark Twain and George Orwell, and publish under a pseudonym.

"Of subsequent books on perturbation methods in applied mathematics and mechanics, that of Cole is closest in spirit. Long out of print, it has happily just reappeared in considerably amplified form, thanks to the coauthor-ship of J. Kevorkian."[5]

1. **Van Dyke M.** *Perturbation methods in fluid mechanics.* Stanford, CA: Parabolic Press, 1975. 271 p.
2. **Kaplan S**. Low Reynolds number flow past a circular cylinder. *J. Math. Mech.* **6**:595-603, 1957.
3. **Lagerstrom P A & Cole J D.** Examples illustrating expansion procedures for the Navier-Stokes equations. *J. Rat. Mech. Anal.* **4**:817-82, 1955.
4. **Fraenkel L E.** On the method of matched asymptotic expansions. *Proc. Camb Phil. Soc.* **65**:209-84, 1969.
5. **Kevorkian J & Cole J D.** *Perturbation methods in applied mathematics.* New York: Springer-Verlag, 1981. 540 p.