fascinating old history of mathematics in the nineteenth century, had cited Cauchy's lectures as evidence of the "unusually high requirements on the purely mathematical side that were set as a basis" for the practical instruction in the École Polytechnique. But this turns out not to be true. In fact, there were complaints about Cauchy's teaching—and my, but they do sound familiar! *Five* lectures on the generalities of integration? "That might be all right in the Faculty of Sciences," said a physicist, "but it is not appropriate in the École Polytechnique, where the students are pressed for time." By 1825, when Cauchy repeated the course on differential equations, the Ministry of Education had been persuaded to decree officially that lecturers should stick to the syllabus officially established. Officially, Cauchy agreed: the minutes for November, 1825 say "M. Cauchy announces that, to conform to the wishes of the Council, he will no longer strive, as he has up to now, to give perfectly rigorous proofs." But in fact he did not change. The minutes a year later record that "M. Cauchy has presented only lecture notes that could not satisfy the commission, and thus far it has been impossible to make him...carry out the decision of the Minister." In other words, his notes that year were not considered fit to print.

Cauchy was always a man of prickly principles. Loyal to the old Bourbon regime, he abandoned his positions rather than swear an oath of allegiance to Louis Philippe after the 1830 revolution. (In 1838 he resumed activity in the Académie, which was exempt, but still refused all positions requiring the oath.) He had even less liking for the republican government set up in 1848, but he immediately resumed his position at the Sorbonne—because an oath was no longer required. Personal details like this are usually mere diversions in the history of mathematics, but in this particular case they seem to be important. As several authors (including Grabiner) have pointed out, Cauchy was not the only mathematician to lecture on calculus at the École Polytechnique. Ampère, Poisson, and others did so at about the same time. But Cauchy was stubborn. He would no more choose to give a false proof than to swear a false oath; he would deliver *his* lectures *his* way. And it seems that his stubbornness as well as his genius helped to give us the *Cours d'analyse*.

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Numerical methods for stiff equations and singular perturbation problems, by Willard L. Miranker, Mathematics and its Applications, vol. 5, D. Reidel Publishing Company, Dordrecht, Holland; Boston, U.S.A.; London, England, 1981, xiii + 202 pp., $29.95.

Numerical analysis and perturbation theory are two principal approaches to the problems of applied mathematics. It is a little surprising that there has not been more interaction between these approaches. In my opinion this is because the goals and the problem classes are rather different. At the risk of gross over-simplification, I would say that numerical analysis tries to provide quantitative information about a particular problem, whereas perturbation theory tries to gain insight about the qualitative behavior of a family of problems and only semiquantitative information about any particular member of the family. Numerical methods are intended for broad classes of problems and are intended to minimize demands upon the problem solver. Perturbation and asymptotic methods treat comparatively restricted classes of problems and require the problem solver to have some understanding of the behavior of the solutions expected. To the extent that the goals are different, the approaches do not overlap. When they do overlap, they tend to be complementary. Perturbation and asymptotic methods tend to be most effective numerically precisely in those limit situations when general purpose numerical methods perform badly or fail entirely. A simple example is the numerical solution of the initial value problem for a nonstiff set of ordinary differential equations. When the defining functions are smooth, this is a routine task for any of the better pieces of mathematical software, and the problem solver hardly needs to get involved. A singularity changes the situation dramatically. The problem solver really must sort out what is happening near the singularity and then approximate the solution there by special methods such as asymptotics.

The book is mainly devoted to the initial value problem for a system of ordinary differential equations. Some other topics are taken up, such as recurrences, boundary value problems, and initial value problems for partial differential equations. Although interesting, indeed I especially enjoyed the section on boundary value problems, they were distracting to me, and I would have preferred that they be omitted. More specifically, the book is devoted to "stiff" initial value problems. There is some controversy as to just what stiffness *is*, but the main point is that both the theory and practice of classical numerical methods are completely inadequate for some classes of problems of great economic value. These problems are often of kinds traditionally investigated in perturbation theory. For this reason there is currently great interest in the application of perturbation theory to the numerical solution of stiff problems and it is timely that the author should bring his expertise in perturbation theory to bear on them. As a numerical analyst, this reviewer found the possibilities raised in the monograph to be very interesting.

An important chapter is devoted to the numerical realization of inner and outer expansions for the solution of problems of boundary layer type. At present singularly perturbed initial value problems are being used by many researchers to gain insight about the characteristics of stiff problems and to discard plausible numerical methods that cannot be satisfactory in the generality desired. The problems and methods of singular perturbation theory are of unquestionable value in this area right now, and they hold great promise for the future. On the other hand, the straightforward realization of singular perturbation methods does not appear to compete with numerical methods now available for the stiff problems of boundary layer type treated in this chapter.

Another important chapter is devoted to the highly oscillatory problem, and here the perturbation theorists came to a deeper understanding of fundamental issues far earlier than the numerical analysts. For example, only recently have numerical analysts begun to appreciate that their customary pointwise error measures are inappropriate for problems with highly oscillatory solutions. In perturbation theory there are more natural definitions of a solution, and there are approaches with real promise for these extremely difficult problems. It is to be hoped that Miranker's seminal work can be generalized to less special problems, so that new software tools can be based on the ideas.

The author states that most of his material is drawn from the recent literature and that his treatment varies from formal to informal. This is accurate. The monograph might be described as a collection of papers by the author and his coworkers, supplemented with the necessary background material. More attention has been given to background material in numerical methods than in perturbation theory. Some mathematical sophistication is necessary for the more important sections of the book.

This is a stimulating book on the application of the methods of singular perturbation theory to the numerical solution of stiff ordinary differential equations. The numerical examples merely demonstrate feasibility, but numerical analysts should be reading this book for the possibilities of the approach, rather than for algorithms they can immediately implement. It is to be hoped that Miranker's success will encourage others to further develop the ideas to the point that they will provide new and powerful numerical algorithms.[1]

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The tragicomical history of thermodynamics 1822–1854, by C. Truesdell, Studies in the History of Mathematics and Physical Sciences, Volume 4, Springer-Verlag, New York, Heidelberg and Berlin, 1980, xiii + 372 pp., $48.00.

1. This volume carries the word 'history' in its title, and is published in a series of historical studies. The reader is thus doubly invited to expect an historical account, in which, therefore, past events and their contexts are described.

Truesdell's play is divided into five acts and an epilogue, with two named 'distracting interludes' (pp. 139–148, pp. 219–276) and an extra Act V to be played as an 'antiplot in a dark and empty theatre' (pp. 277–304). The action takes place mostly in the period between Fourier (1822) and Reech (1854), with major roles played also by Carnot, Kelvin, Clausius, Joule and Rankine, and minor parts and noises off coming from various other figures. Laplace, Biot, and Poisson perform a Prologue (pp. 29–46), without the help on p. 31 of Laplace [**1803**].