Book Reviews

The Scientific Estate

The New Brahmins. Scientific Life in America. SPENCER KLAW. Morrow, New York, 1968. xiv + 315 pp. $6.50.

Spencer Klaw is a free-lance writer who has been a newspaperman and has served on the editorial staffs of the *New Yorker*, the New York *Herald Tribune*, and *Fortune*. He states in his preface that the aim of this book is "to portray the scientific community in the United States: to convey a sense of what it is like to be a [natural] scientist in America in a time when science has become a form of established religion, and scientists its priests and ministers." Thus are explained the title "The New Brahmins" and the subtitle "Scientific Life in America."

The novelty of this book is not the view suggested by its title—similar theses have been advanced by lay critics of the American scientific enterprise in recent years under other titles—but rather the method of inquiry. During a period of four years, the author interviewed at length some 125 scientists, including graduate students and postdoctoral fellows; members of the National Academy of Sciences at the large universities and professors of science at the small colleges; representatives of "big science" and of "little science"; scientists who work in industrial laboratories, in government laboratories, and in private research institutes; and finally scientists who are involved in the affairs of government and worldly problems. The persons interviewed by the author were asked to tell him about their careers: "about the choices they had made, and why, and how they felt about their work and its rewards." Epitomes of many of these interviews (usually under pseudonyms) are scattered throughout the book, either to introduce a new subject or to bolster an argument.

This "case history" approach possesses advantages and limitations. The advantages are, especially when the reporter is as judicious and perceptive as Klaw, that one obtains an impressionistic view of the range of satisfactions and frustrations of individual American scientists and some sense of the peaks and valleys of the American scientific effort. The limitations are that the extreme viewpoint receives equal play with the dominant state of affairs and that the statistics are necessarily small for each subgroup of interviewees, so that many conclusions must be treated with reservation. Moreover, the case history "net" is too coarse, unless one is willing to expend prodigious effort, to identify all the main themes and place a complicated phenomenon like present-day American science in broad perspective. If Klaw had interviewed another 125 representative foreign scientists, I am quite certain that a number of his conclusions would change. But more of this later.

Let us first examine Klaw's arguments in some detail. The first five chapters of the book deal with academic science. In the first chapter ("On becoming a scientist"), Klaw covers the training of graduate students in the U.S. After narrating several case histories, he makes such statements as "it is a fact of academic life that a scientist can seldom rise above his academic origins"; "perhaps the most serious thing wrong with graduate education in the sciences is that the student too often is treated as a peon"; and, finally, "one common criticism of the way government funds are dispensed is that professors are permitted to build research machines that turn out, along with streams of inconsequential research papers, streams of scientists who are poorly equipped even for jobs in which originality and imagination are not essential." These statements do not square with the statement in a later chapter that "as viewed by young Europeans, [the] most valuable elements [of the American approach] include early independence for young investigators, informal relations between students and professors, freedom to move from one institution to another, and absence of academic hierarchism."

The last statement is, in my opinion, much closer to the truth for the mainstream of American graduate education in the natural sciences, and it is not clear why Klaw gives so little weight to European opinion. Indeed, not only European but Soviet scientists recognize that the primacy of American basic research on the world scene is due in no small measure to the quality and organizational structure of our system of graduate education. By combining graduate teaching and research at a single institution, as we do in an American university, we expose our young people to exciting new ideas and the most modern research techniques. The fact is that many research programs at the university are planned so that graduate students will receive the maximum benefit from the available up-to-date equipment and contribute significantly to the research. (In contrast, in the Soviet Union, for example, the bulk of the scientific research is concentrated in the specialized institutes of the Soviet Academy of Sciences, not in the universities, which play a primarily pedagogical role. The results of this dichotomy between the instruction-oriented university and the research-oriented academy institute is that the university students receive inferior research training and the academy scientists miss the stimulation of bright young students.)

As regards the mobility of scientists from the "non-ivy league" to the "ivy league" universities, the same forces which Klaw considers in other connections—the elaborate review committee system in Washington for grants, the trend to team research in "big science," the sizable American delegations at international scientific conferences, and the like—all help to break down the barriers of "snobbery." The first chapter of *The New Brahmins* is not a total loss, since it ends with a succinct and intelligent appraisal of the role of postdoctoral fellows at American universities. Some mention might have been made of the important service rendered by the postdoctoral fellowship program in completing the training of substantial numbers of young scientists from abroad, with all the attendant benefits for the home countries and the American scientific position in the world.

The next four chapters are a considerable improvement over the first both

in the quality of the writing and in the balanced judgment. Klaw concludes his second chapter ("Science for the sake of science") with a moving account of an interview with one of America's leading young astronomers, "Aspinwall":

> Despite the wonder and ecstacy that he experiences in his work, and the respect that he commands among astronomers all over the world, Aspinwall is at times deeply apprehensive. He is haunted by the knowledge that one day his luck and his talent may simply run out . . . . Aspinwall can think of nothing more terrible, and it is plain that one reason he drives himself so hard is to assure himself over and over again, through tangible achievement, that the Calvinist God he does not believe in has not deserted him.

I have known many deeply creative young American scientists for whom this statement rings true.

In the next chapter, on "The good professorial life," Klaw gives an eminently fair recital of the rewards and pressures the present-day American academic scientist is subject to. Quite good salaries for the academic scientist now prevail at the better universities, although these are shared, in great degree, by his colleagues in the humanities and social sciences. The academic scientist enjoys the benefits (again in common with his humanistic colleagues) of reduced teaching loads, but everyone pays back in the increased time spent on the management of academic affairs. But, as Klaw shrewdly observes, "the new value that has been placed on the services of academic scientists has affected their laboratories even more than their living standards." Most of the support for basic academic science, in the form of sophisticated equipment, research assistants, and major facilities, comes from the federal government; this contribution approximates $2 billion a year. Owing to a slight confusion between basic and applied research in an academic environment, Klaw seems to accept the view that "it is probably true to say that the 'best scientists' can generally get support for the work they want to do; the 'average scientists,' for the work government wants done." This statement does not hold for the basic science departments but may hold for the engineering departments, where applied science is chiefly carried out. This chapter concludes with a very amusing portrayal of the transformation of an academic researcher into an administrator. His "downfall" commences with the realization that "it is only at long intervals that the researcher enjoys the feeling (or illusion) of solid accomplishment that the administrator can enjoy merely by emptying his in-box." He graduates to a temporary assignment in Washington, where "he also discovers that he likes sitting around a table with sub-cabinet officers . . . talking about the politics of scientific patronage—a form of gossip whose pleasure is enhanced by the virtuous conviction that it is gossip in a good cause." And so on.

In chapters 4 and 5 ("The price of affluence" and "The styles of big science"), Klaw comes to grips with the potentially "corrupting" influences on American basic science. In view of the large numbers of investigators involved and the sizable funds expended, it can be argued that "success in academic science may depend on the number of papers a man writes more than on their quality" and that the present system of government support "tends to breed entrepreneurs, to discourage imaginative research by young scientists, to intensify competition among scientists, and to take up too much of its beneficiaries' time." The grain of truth in each of these statements is supported by an appropriate quotation (for example, "Charlie spent three years working on a really hard problem that didn't pan out; the poor bastard had to go to work for Du Pont"). But the countervailing arguments are not neglected (for example, with respect to the all-too-human disputes about scientific priority, Klaw reminds us that Leibnitz and Newton fought bitterly over the invention of the calculus in the days of "little science"). It is an exceedingly difficult task, and will become increasingly so in the immediate years ahead, to insure that strong federal support for university research does not seriously infringe on the independence and freedom of the individual scientist. That this objective has been achieved so far is supported by Klaw's summary statement: "The most striking thing about basic science in America since World War II is not how much it has been corrupted by money, but how little."

As regards the controversy concerning "big science" versus "little science," I can only express my deep conviction that no pure scientist worth his salt would prefer the time, expense, and rigors of team research associated with big science to the joys of little science. Only an intense desire to acquire a deeper understanding of certain classes of natural phenomena which cannot be probed in any other way would justify the construction of the large facilities which characterize "big science." Unfortunately, some of the most exciting frontiers in basic science fall in this category (for example, high energy physics and cosmological astronomy). The costliness of big science does raise the question of national priorities and requires a separate discussion. (I do not buy Alvin Weinberg's criterion for establishing priorities according to the number of adjacent sciences which a "big science" involves, since obviously neither the science of the subnuclear dimension [high energy physics] nor the science of the cosmological dimension [astronomy] will satisfy this criterion as well as will the sciences of atomic or nuclear dimensions.) One impressive piece of evidence that "little science" has not been neglected in the U.S. is the outstanding performance of mathematics. A recent report of the National Academy of Sciences has come up with the flat statement that "there are more first-rate mathematical centers in the United States than in the rest of the world."

Chapter 6 ("Scientists without students") deals with the private research institute and basic research in government laboratories. The private research institute, such as the Carnegie Institution, certainly has its place on the American scene. However, for reasons I mentioned earlier in discussing the basic research milieu in the American university as compared to the Soviet academy institute, it is unlikely that the private research institutes will draw away an appreciable number of academic scientists. This situation may change if government frugality and student unrest become permanent features of academe. Only one government laboratory, Oak Ridge, is considered in this chapter, and while it is a reasonably representative one, the subject deserves much more attention.

In chapters 7 and 8 ("The vineyards of utility" and "The industrial labyrinth") and, to some extent, in chapter 10, Klaw scrutinizes the problems of the applied scientist in university, government, and industrial laboratories. On the whole, he supplies a reasonable sampling of attitudes and develops some of the important distinctions between basic and applied research—for example, the fact that a practical goal necessarily imposes constraints and controls on the applied scientist which would hamper productive and original

work in pure science. This does not prevent Klaw from making the plea that "if science is to be used more efficiently, ways must be found of preserving in large-scale applied research some of the autonomy and free cooperation that characterize basic research." There is some tendency to exaggerate the weaknesses and pitfalls of American industrial laboratories and to underestimate the successful performances of a goodly number of them. In this connection, interviews with European industrial scientists would be illuminating and would help to explain why western Europe is so agitated about the "technology gap" vis-à-vis the United States.

Finally, mention should be made of chapter 9 ("Movers and shakers"), in which the role of the natural scientist as government administrator, government adviser, and commentator on public issues is discussed. The treatment is exceedingly sketchy, and the reader learns too little about the contributions of American science to political decisions and the continuing international dialogue which is taking place (by means of the Pugwash conferences, for example) in the attempt to find solutions for some of our global problems. It is clear from Klaw's brief treatment that he would sympathize with these efforts, but he owes it to the readers of the next edition of an otherwise stimulating and level-headed book to reveal more completely the full measure of social responsibility which the bulk of American scientists are prepared to assume for the good of mankind.

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Glycerides

Fatty Acids and Their Industrial Applications. E. SCOTT PATTISON, Ed. Dekker, New York, 1968. xii + 390 pp., illus. $8.

Fatty acids or derivatives thereof are used in either the formulation or the manufacture of many, if not most, of today's products. They range in use from food emulsifiers to corrosion inhibitors. This book, which updates (to 1966) a volume published in 1957, consists of chapters pertaining to the manufacture and uses of fatty acids and other fatty chemicals. The chapters were written by experts. For the most part the presentations emphasize technology rather than science.

Many of the uses for fatty chemicals derive from the mixed polarity of this class of substances, and it is conceivable that applications which seem remote from each other are actually manifestations of the same property. Thus the present volume, which brings together discussions of widely varied uses, may provide the "ideas" which the application technologist is always seeking. And even the theoretical scientist with an interest in surface chemistry might profit from knowledge of practical applications. However, the reader must bear in mind the generalization made on page 248, in the chapter on the textile industry, that "much of the information on composition and uses is proprietary knowledge that has not been revealed in the scientific or patent literature, and . . . many of the compositions revealed in the patent literature are of doubtful utility or validity." This reservation is frequently applicable to discussions of industrial technology. Unfortunately, authors are not usually in a position to distinguish fact from fancy.

Specifically, *Fatty Acids and Their Industrial Applications* covers fatty acid sources, their production, and physical and chemical properties. Most major uses are discussed in chapters devoted to specific areas of application. Other important but perhaps not major uses, for example, mineral beneficiation and crude-petroleum production, are mentioned only in connection with specific chemicals. The last chapter presents a timely treatment of synthetic fatty acids, which may ultimately offer serious competition to those produced from natural sources.

As with any collection of the writing of more than one author, this book exhibits wide variation in writing skill and in style. Some chapters are well written, others are poorly written; little if any editing appears to have been done, and in some chapters proofreading was inadequate as judged by the number of typographical errors. Some chapters are excessively detailed, others are perhaps too general. There is some repetition, although it is probably not excessive. Most chapters include an adequate number of references; three, excluding the introductory chapter, have no references. The index is short; it may be unrealistic to suggest a more comprehensive index in a book of this sort.

In spite of the defects mentioned, and others, this book offers the only broad discussion available today of fatty chemical uses. It will certainly provide useful reading for those working in this or related fields. For the student planning a career in industrial technology, it offers a fairly extensive introduction to areas of opportunity.

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Calorimetry

Thermometric Titrimetry. H. J. V. TYRRELL and A. E. BEEZER. Chapman and Hall, London, 1968 (U.S. distributor, Barnes and Noble, New York). viii + 207 pp., illus. $7.75.

Tyrrell and Beezer have provided the first text devoted exclusively to thermometric titrimetry. The book, which lists and discusses 332 references dating from 1913 to 1966, is well written and organized. Adequate mathematical treatment is given, and thermodynamic principles involved in the two uses of calorimetry, for acquiring precise values of enthalpy and as a technique of analysis, are discussed. Thus the needs of the scientist, who is concerned with getting precise data, and the analyst, who demands speed with sufficient experimental accuracy, are taken into account.

A chapter with 43 references is devoted to construction of titration calorimeters and their uses. Applications in aqueous and nonaqueous systems and in special cases such as that of molten salts are discussed. Thermometric titrimetry and potentiometric methods are compared as necessary for technical clarity.

The text presents a challenge in suggesting that nonselectivity of thermometric titrimetry is grounds for the use of ingenuity rather than for rejection of the technique. An example of such a use of ingenuity is the development of a "thermometric indicator," a technique in which a component is added which begins to react with a large reaction enthalpy at the endpoint of the reaction. Further industrial applications can be forthcoming from scientists and analysts who will apply similar ingenuity to thermometric titrimetry.

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