bers of the Curie circle, however, took from the war only a heightened appreciation of the efficacy of science and bent themselves to a successful attempt to increase research budgets. One outcome of the funding they secured was a job for Frederic Joliot, talented protégé of Marie Curie and Langevin.

The scant 60 pages Weart devotes to this background is somewhat strained by the richness of the events and the large number of personae. The story occasionally becomes thin or fragmented, and as a result these chapters are less successful than those that follow.

Scientists in Power hits its stride in chapter 4, at the point when Joliot, in January 1939, received the article by Otto Hahn and Fritz Strassmann suggesting that the uranium atom could be split. By then, Nobel Laureate Joliot was a professor at the Collège de France and, with an eye toward practical applications as well as pure research, had built up impressive laboratory facilities. Joliot enlisted two young colleagues to work on fission. One was Lew Kowarski, who, after a childhood disordered by the Russian revolution, was struggling to attain the security of a scientific career. The other was Hans von Halban, Jr., the urbane and well-to-do scion of an Austrian academic family. Weart's narrative proceeds as a group biography of the scientific and political fortunes of this team.

At first, Weart's story is chiefly of traditional, small-scale laboratory investigations. As the scientists gained the confidence to work toward a reactor, however, they needed additional resources. They approached industry and government, offering the uranium mining firms the possibility of new markets and France the hope of energy and armaments in return for money, personnel, and materials for their experiments. But "Joliot and his team, unlike most scientists in other countries, determined to take over the development of the practical applications of fission themselves" (p. 103). The stage was thus set for struggle over the control of nuclear technology and hence also over end use; the scientists aimed principally at providing a new source of power, the government emphasized bombs.

In the spring of 1940, Paris fell and the paths of the protagonists diverged. Joliot ceased fission research and remained in Paris to sustain French science in the harsh environment of the Occupation. He soon added to his role of seeming collaborator a second as a Resistance fighter. In 1942, he joined the most active of the French anti-Nazi groups, the Com-

Paul Langevin (left), Paul Rivet, and Pierre Cot giving the Communist salute atop a taxicab during a demonstration, 14 July 1935. [From *Scientists in Power*]

munist Party. Halban and Kowarski went to England. Ultimately, although by this time separated by a growing animosity, both went to Montreal, where Halban had recruited French scientists-in-exile to build a heavy-water reactor.

When the war ended, Joliot and some of the scientists who had returned from Canada joined to become the backbone for the new French Commissariat à l'Energie Atomique (CEA). Here the first French reactors were built, under the control of the Scientific Committee of the CEA and against formidable political obstacles. Joliot, High Commissioner and dominant force in the Scientific Committee, took a position of vigorous opposition to research on nuclear bombs, a position deriving from both humanitarian considerations and the exigencies of Communist political strategy. In 1950, however, first Joliot and gradually other leftists were forced out of the CEA. Simultaneously, power passed from the Commissariat's Scientific Committee to an administrative division whose sympathies lay with industry and government. The scientists, in effect, ceased to set their own goals. By mid-1951, research at the CEA had drifted onto the path leading to weapons.

Weart generalizes from this history in his Afterword. His discussion here lacks the lucidity of the preceding narrative; nevertheless its main points are easily seen and the model he gives can fruitfully be extended to other cases. Technical inventions are not simply dictated by the laws of nature or of existing hardware, in the author's view. Neither are they completely determined by societal structures. Rather, they are born from an interaction between nature and society that is mediated by a community—the professional scientists—with its own characteristic psychology and special interests. Scientists want knowledge, prestige, and pecuniary rewards. On the one hand they must study nature to achieve these goals, and on the other they must apply to society for the resources with which to prosecute their researches. Society, in supporting science, buys itself knowledge, national prestige, medical and industrial applications, and instruments of war. This process of negotiation operates to select out of all the innovations compatible with natural laws those that are realized.

How can we improve the selection mechanism and obtain more beneficent technologies? Weart directs our attention to the scientist-mediator. Scientists and engineers are often guilty of ignoring the social dimensions of their work. Weart suggests that, along with others, they "step outside the boundaries of [their] jobs in order to act publicly." Perhaps we now uncover an unexpressed reason for the author's choice of the French case; Joliot exemplifies just this kind of broad social and moral vision. "If we also work to escape the constrained thinking and activities of narrowly defined roles," Weart concludes, "we might look with more confidence to the future" (p. 276).

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Rutherford and His Times

Rutherford and Physics at the Turn of the Century. Papers from a symposium, Montreal, Oct. 1977. MARIO BUNGE and WILLIAM R. SHEA, Eds. Dawson, Folkestone, Kent, England, and Science History Publications (Neale Watson), New York, 1979. viii, 184 pp. $20.

Forty years after the death of Ernest Rutherford a symposium was held at McGill University to discuss his work as Macdonald Professor of Physics there within the context of fin de siècle physics. The present volume constitutes the proceedings of this symposium, though two or three papers in it were added subsequently (including Norman Feather's Rutherford Memorial Lecture, delivered a day or two earlier at McGill during independent celebrations at the dedication of the new Rutherford Physical Laboratory) and at least one paper and all the comments or discussions have been omitted.

The volume as a whole succeeds in

conveying a picture of Rutherford and his times. Erwin N. Hiebert finds that physicists themselves around 1900 experienced a growing sense of unity and progress and spearheaded an expansion of physical principles into the world of the very small and very large and that such tendencies to speculate and collaborate had emerged more than a decade or so earlier; that they held firm to such anchor points as the first law of thermodynamics, the periodic table, and Maxwell's theory; and that their principal puzzles centered on the ether, electron theory, radioactivity, and the second law of thermodynamics. Neil Cameron provides another perspective by discussing the general intellectual and educational setting in England, at one point (p. 136) encapsulating the relative status of physics at Cambridge and Oxford in a telling comparison:

> In the 1870's at Cambridge you could find Maxwell, at Oxford, Clifton; in the 1880's at Cambridge, Rayleigh, at Oxford, Clifton; and from then on until the end of the First World War, at Cambridge, J. J. Thomson, at Oxford, Clifton.

Stephen G. Brush, in his essay, suggests that to understand the concept of a scientific revolution one should look at the broader canvas, which at the turn of the century reveals a veritable age of scientific genius and a general sense of crisis, in many disciplines—physics, mathematics, astronomy (the subject of Guglielmo Righini's essay here as well), geophysics, chemistry, biology, psychology, anthropology, technology. He selects for more detailed comment the revolutionary achievements of Einstein, Rutherford, T. C. Chamberlin, E. B. Wilson, Nettie M. Stevens, Alfred Binet, and Freud, finding that the single common element linking them was a deep change they wrought in our perception of time, from an essentially evolutionary world view to a stochastic one.

Focusing more particularly on Rutherford and McGill, Lawrence Badash somewhat iconoclastically finds the seeds of the transition from little science to big science in Rutherford's research at McGill—in his role as the leader of a vigorous and productive research group specializing in a restricted number of problems, in the generous financial support received from Macdonald, and in Rutherford's capacity to attract public attention and personal honors. John L. Heilbron provides a bird's-eye view of the full range of physics at McGill, displaying its institutional setting and showing how Rutherford's approach to physics, research, and influence on students and assistants contrasted with that of his predecessor, H. L. Callendar, and Callendar's student (subsequently Rutherford's colleague) H. T. Barnes. Thaddeus J. Trenn analyzes in detail how Rutherford, through brilliant experiments and compensating calculational errors, concluded in 1902 that alpha particles are corpuscular in nature. The story of the alpha particle is extended further in time by Feather in his Rutherford Memorial Lecture, which is reprinted from the *Proceedings of the Royal Society of London*. Finally, Stanley L. Jaki illustrates and discusses Rutherford's realistic world view.

The quality of the papers collected in this volume, in general, is high; the editorial work less so. The absence of a subject index, which greatly increases the utility of a volume of this type, is regrettable; the absence of a name index is inexcusable.

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A Successful Career

Gay-Lussac. Scientist and Bourgeois. MAURICE CROSLAND. Cambridge University Press, New York, 1978. xvi, 334 pp. $36.

What one misses in Gay-Lussac and in the French physical scientists of his generation is *passion*, the unwavering demand to *know*. Naturally there are few in any age who are passionate to a vivid purpose. Those who are, however, or who are fortunate enough to live in a time when it looks like passion might get somewhere, are the ones we remember—Michael Faraday the Sandemanian, the indefatigable Darwin, Einstein sure that Jehovah does not gamble, Rutherford willing to go on tinkering his whole life because at bottom things must be *simple*.

Perhaps this is a romantic view and utterly out of consonance with Gay-Lussac, who was at the opposite pole from romanticism, as is his biographer. Gay-Lussac emerges from these pages puritanical, utilitarian, ambitious, diligent, hardworking, henpecked, conservative, positivistic, cautious, colorless, and humorless. He may have sowed a few wild oats when he first arrived in Paris (from St. Léonard, near Limoges) in 1795, and he may, just after that, have been a draft-dodger, but for the rest of his life he was a virtual Boy Scout. This does not make his biographer's job easier, for there are no amusing anecdotes to tell, no surprises throughout Gay-Lussac's long life, no obvious tensions, and, therefore, no drama. The man had no dash and, apparently, no vision. If this is the case with most of us, it is also the reason most of us would not make interesting biographies.

Despite the author's intention "to place the man in his intellectual, social and national context" (p. x) and his assertion that Gay-Lussac "did not divide his life into two separate compartments: science and private life" (p. 226), his book treats the life and the work separately, in terms of distinct principles. The life is dedicated to the principle of the "career," and the work to that of the "contribution" to science. These two words recur throughout the text to tell us on the one hand how Gay-Lussac shaped the course of his life and on the other hand how he saw his place within science.

Gay-Lussac's "career" went largely from success to success. His and his father's plan for him to study law in Paris went awry as he got caught up in the excitement that infused the founding and early years of the Ecole Polytechnique. He decided to devote himself to science and came under the tutelage of Claude-Louis Berthollet. After working for several years as Berthollet's assistant he entered (1806) the Institut National (the successor to the Académie de Sciences), became professor at the Faculty of Science (1809) and at the Ecole Polytechnique (1810), then assumed the editorship (with Arago) of the *Annales de chimie et de physique* (1816). In middle and later life he held a high position at the Paris Mint and sat in the Chamber of Deputies (1831) and in the Chamber of Peers (1839). Along the way he invested wisely, capitalized on his knowledge of chemical processes with several inventions that he patented, and bought land. Honors, respect, and prestige followed. Gay-Lussac died well-off and established; his rise from provincial petit bourgeois to national figure took place without serious setback through the storms and uncertainties of Napoleonic, 1830-revolutionary, and bourgeois-monarchy France.

About all of this in Crosland's treatment I have no quarrel. It is a story told with firm command of detail and with imaginative documentation. I find his account of the other aspect of Gay-Lussac's life deficient, however. Now there is no doubt that this great chemist made "contributions" to our knowledge of both chemistry and physics, and also to