Curie. The history of science is sometimes handled cavalierly and the political passages are no better: Bismarck's Polish policy is reduced to a misleading *boutade*, and Prussia is generously given five million instead of two-and-a-half million Poles. Yet there is a great deal of reliable information on science artfully woven into the biography.

Madame Giroud often goes to the heart of matters with rare skill. The cultural and especially the social contexts are also deftly sketched, with emphasis on the economic exploitation of women. Glimpses into the private lives of the austere Curies and their more sybaritic colleagues provide some relief from Marie's grim devotion to science. But Marie Curie is not famous because she knew Paderewski or visited Rodin's studio, or even for her love affair with Paul Langevin which is treated in exquisite detail by Madame Giroud. Langevin's wife made the scandal notoriously public, and Paul Appell, the desperate dean of the faculty of sciences, wanted to solve matters by encouraging Marie to return to Warsaw. The American physicist B.B. Boltwood, a collaborator of Rutherford's, was satisfied that he had been correct in classifying her as a detestable idiot, but generous American support for Marie's work indicates that his opinion was not widely held in the United States.

The work of the Curies gave French science an international attention it had not enjoyed since the national orchestration of Pasteur's genius. The glory was equally deserved, and dozens of foreign researchers came to work on radioactivity at the Radium Institute in the Latin Quarter's vast city of science. In 1925 Marie picked Fred Joliot as her laboratory assistant, and his subsequent marriage to her scientist daughter Irene produced

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In collaboration — Marie and Pierre Curie.

another great team in French physics. Joliot went on to become the main figure in the development of nuclear energy in France. Nearly up to her death in 1934 Marie was a tireless international ambassador for French science and an effective propagandist at home, where Jean Perrin and his friends were preparing the ground for the post Second World War structures and functions of French science.

Madame Giroud's book is heavily dependent on works such as Eve Curie's study of her mother. But its dramatic style and theme of *Une Femme Honorable* (the French title) make it a satisfying night's reading. □

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Optimal ideas

Brian Charlesworth

Physiological Ecology of Animals: An Evolutionary Approach. By R.M. Sibly and P. Calow. Blackwell Scientific: 1986. Pp.179. Hbk £26, \$49; pbk £11.95, \$24.50.

OVER the past decade, the quantitative application of the concept that the properties of living organisms represent optimal solutions to specific design problems has been a growth industry. Richard Sibly and Peter Calow have been prominent exponents of this approach, and the aim of this book is to set out some principles of optimization theory, and to apply them to a series of problems in physiological ecology and life-history evolution. The basic procedure is to assume a plausible set of constraints acting upon the properties of

interest in the particular study, for example that an increase in the amount of effort devoted to reproduction at a given stage of the life-cycle leads to a decrease in the chance of survival to the next stage. Given a criterion by which to measure darwinian fitness, one then calculates the set of values of the properties that yield a maximum in fitness according to the specified constraints. It is then assumed that natural selection will have caused populations of organisms to evolve close to this optimal set. Their observed properties are compared with the predictions of the model, in an effort to test the model's validity.

This procedure is often criticized on the grounds that failure of an optimization model to fit the real world does not provoke its originator to abandon belief in natural selection as the main force guiding the evolution of the characteristics of interest; rather, it usually leads him to tinker with the details of the model. This criticism

is somewhat misplaced, because the aim of workers using these methods is not to test the general validity of the theory of natural selection, but to uncover the biological factors which may be of significance in moulding the action of selection on the traits in question. Furthermore, given the complexity of biological systems one would have to be wildly optimistic to expect an accurate fit between predicted and observed properties. So emphasis has often been placed on theoretical predictions of the consequences of variation in ecologically determined factors which modulate the ways in which the system responds to selection, and on comparisons of populations with appropriate differences in ecology to see if they differ (at least qualitatively) in the expected fashion. Thus, it is a stock-in-trade of life-history theory that species living in environments with high adult survival relative to juvenile survival should invest less in reproductive effort per breeding season, compared with otherwise similar species with low adult survival.

Sibly and Calow bring out these principles in a number of case studies, ranging from an analysis of the factors affecting the efficiency of guts, to strategies of growth and reproduction. The emphasis is on the development of optimization models, rather than detailed testing against the data; indeed they state that their aim is to stimulate experimentalists to provide the necessary data. They succeed in convincing one of the diversity of topics to which their approach can be applied, and the book will be of considerable use to biologists in this area.

The authors can, however, be criticized on several points. One is that they give little indication of previous contributions to life-history theory, a relatively mature area of enquiry. Instead, they present their own reformulations of classic models as though they were wholly original, and provide only scanty citation of the literature. This will not help beginners find their way. More importantly, they fail to mention alternatives to optimization methods. Thus, there is no reference to Williams's and Medawar's theories of senescence, which have an important bearing on life-history evolution. Little mention is made of the possible role of competition in moulding selection on growth and size, and Maynard Smith's Evolutionarily Stable Strategy method for handling the complications that arise in competitive situations is not discussed. While the authors' approach has considerable value, and they have every right to advocate it, their book cannot be said to offer a comprehensive survey of the methods needed to solve problems in evolutionary ecology. □

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