sively in the biography. The book has merit not only as a chronicle of the life of a man but as an account of his science.

The second and more interesting half of the work describes many of Boveri's most famous experiments, demonstrating his extraordinary mastery of experimental design and objective scientific reasoning. Theodor Boveri was probably the greatest embryologist who ever lived and one of the most important geneticists as well. An embryologist viewing the current situation can feel that the period between Boveri and his contemporaries and the present has been a kind of scientific diapause from which we have not yet emerged. One reason may have been that their disciples turned to experimental embryology and lost contact with genetics. As Boveri pointed out, developmental problems will be understood only in a framework of genetics.

The remarkable feature about Boveri's experiments is that they, by themselves, suggest experiments which could be performed today with the use of modern methods. For example, molecular hybridization techniques could be applied to analyze the fragments lost during chromosome diminution in *Ascaris*. The concept of the germ plasm in eggs has been confirmed in many different embryos; study of its chemistry and effect on the nucleus is an exciting problem.

For these reasons the book should interest scientists concerned with developmental problems, as well as historians. We owe Rudnick a debt of gratitude for translating this book; perhaps she could be induced to translate some of Boveri's original articles.

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Appreciation of an Experimentalist and Philosopher

Les Concepts de Claude Bernard sur le Milieu Intérieur. An international symposium, Paris, June–July 1965. ROGER HEIM and others. Masson, Paris, 1967. vi + 423 pp., illus. 65 F.

Philosophie et Méthodologie Scientifiques de Claude Bernard. An international symposium, Paris, June–July 1965. ETIENNE WOLFF and others. Masson, Paris, 1967. vi + 170 pp. 30 F.

Catalogue des Manuscrits de Claude Bernard avec la Bibliographie de Ses Travaux Imprimés et des Etudes sur Son Oeuvre. Collège de France. MIRKO D. GRMEK. Masson, Paris, 1967. 419 pp. 40 F.

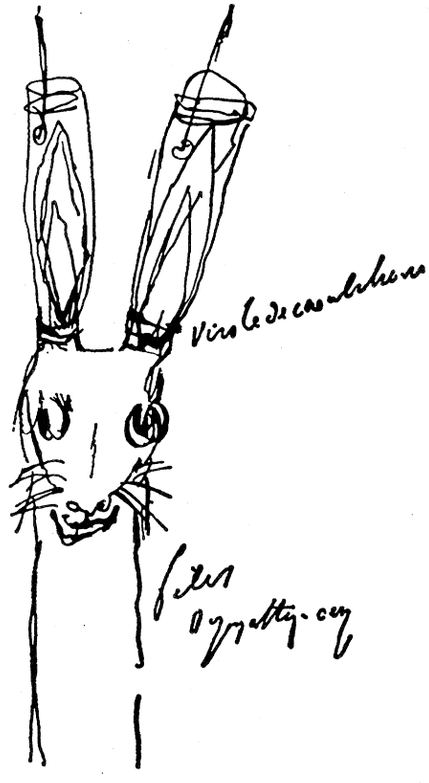
Claude Bernard and Experimental Medicine. Collected papers from a symposium, Minneapolis, April 1965, and an English translation of Bernard's *Cahier Rouge*. FRANCISCO GRANDE and MAURICE B. VISSCHER, Eds. Schenkman, Cambridge, Mass., 1967. Two volumes in one; vi + 210 + vi + 120 pp., illus. Cloth, $8.95; paper, $4.95.

Claude Bernard et les Problèmes Scientifiques de Son Temps. JOSEPH SCHILLER. Editions du Cèdre, Paris, 1967. Paper.

Claude Bernard is justly regarded as one of the great physiologists of all time. His work in any one of the several areas in which he was engaged—physiology of digestion and the role of the pancreas, vasomotor mechanisms and blood regulation, the glycogenic function of the liver, the recognition of the "internal environment"—would do credit to any life in science. But Bernard added to his mastery of experimental technique a self-consciousness about the nature of experimentation in physiology and medicine. His courses of lectures at the Collège de France and the Sorbonne were always prefaced by an explicit consideration of methodological and procedural questions, and through them the reader is able to trace the development of a philosophy of experimental biology. Finally, at midcareer in 1865, while recovering from a period of ill health, Bernard set out his *Introduction to the Study of Experimental Medicine*. In it he outlined a philosophy of scientific method, his rationale of scientific discovery, and his commitment to scientific determinism in biology. Perhaps the greatest strength of the volume was in Bernard's ability to illustrate his philosophical points by calling upon examples from his own laboratory. The book had a strong impact upon his contemporaries (for many years it served as an example of expository writing in the French schools), and has never been out of print since. The centenary of the publication of the *Introduction* has served as the occasion for several of the volumes under review.

Bernard has fared well at the hands of the symposiasts. An international colloquium called by the Collège de France gathered for several days in the early summer of 1965 to explore historical and philosophical aspects of Bernard's work and to examine the contemporary relevance of the concept of the *milieu intérieur*. The two resulting volumes, which have been published under the aegis of the Fondation Singer-Polignac, are really quite distinct. The larger of the two, *Les Concepts de Claude Bernard sur le Milieu Intérieur*, consists of a series of scientific papers organized about three regulatory functions: osmoregulation, thermal regulation, and regulation of blood pressure. A distinguished international group provides a combination of review and report on new research.

The second volume, *Philosophie et Méthodologie Scientifiques de Claude Bernard*, is devoted more directly to a discussion of Bernard, his work and influence. Mrs. J. M. D. Olmsted, who together with her late husband wrote one of the major biographical studies of Bernard, contributes a brief study of his influence on English and American



One of Bernard's sketches for experimental procedures. [From Bernard's *Cahier Rouge*. Reproduced in the English translation in *Claude Bernard and Experimental Medicine*]

physiology. We are reminded of the debt of Barcroft and Bayliss, of Henderson and Cannon, and of Sherrington, Haldane, and Starling to the integrative concepts developed by Bernard. Marcel Florkin has a brief but thoughtful article on Bernard and the beginnings of biochemistry, and Bernardo A. Houssay discusses the idea of integration and stability of functions in the organism as understood by Bernard. Other papers by Georges Canguilhem, Pierre Vendryès, Reino Virtanen, Raoul Kourilsky, Marc Klein, Otakar Poupa, and L. N. Karlik raise questions about theory and technique of experimentation, Bernard and the scientific milieu of his day, Bernard's negative attitude toward Darwinian evolution, and his relationship to clinical medicine. The most significant contribution to this symposium is made by Mirko Drazen Grmek in his paper on the development of Bernard's concept of the *milieu intérieur*; and this is as it should be. There is little doubt that Grmek has come to know Bernard's mind and work as few other men do. Ever since the Collège de France gave Grmek the task of assembling a catalog of the substantial archival collections of Bernard material in its possession, he has immersed himself in the writings of the French physiologist and provided us with significant new insights into the modes of thought and methods of work of Bernard. The published catalog with its extensive bibliography is an indispensable resource for anyone attempting a study of Claude Bernard.

The University of Minnesota was the sponsor of another commemorative symposium, and the resultant volume, *Claude Bernard and Experimental Medicine*, has been edited by Francisco Grande and Maurice B. Visscher. The papers are again of mixed quality, several serving as little more than "celebrations" of the French physiologist, others attempting serious historical analysis. Owen Wangensteen, surgeon and historian of medicine, sets Bernard's work on digestion in the context of experimentation that preceded and followed it. A review of the roots of Bernard's work on the vasomotor system is given by Hebbel H. Hoff and Roger Guillermin; and Frederic L. Holmes provides a brief report of his significant examination of the origins of the concept of the *milieu intérieur*.

Appended to the Minnesota symposium volume is a translation of Bernard's famous *Cahier Rouge*, an unpublished notebook containing entries covering the period 1850–1860, dealing with a wide variety of experimental and philosophical problems. Although a partial text of primarily philosophical comments had been published by Léon Delhoume in 1942, the advent of the centenary of the *Introduction* encouraged Hebbel H. Hoff and Lucienne and Roger Guillermin to prepare the translation of the full notebook. Almost simultaneously M. D. Grmek undertook publication, in French, of the full notebook, *Cahier de Notes, 1850–1860: Edition Intégrale du "Cahier Rouge"* (Gallimard, Paris, 1965). It is hard to claim that we will learn much from these notes that we could not have gained from published sources. True, the historian will be aided in his efforts to place things in their proper order—publication often serves to falsify the actual sequence of ideas and procedures—but Bernard was always remarkably candid in print. For today's scientist, however, there must be a certain excitement in being able to look over the shoulder of some giant of the past and observe just what it was that filled his intimate thoughts, see his sketches, read his experimental designs, and ponder his queries. We can observe Bernard grappling with one of the pressing problems of biological explanation, physical reductionism:

> The physicochemical phenomena do not produce the physiological properties, and it can be admitted that the physiological property changes into physicochemical phenomena but not the reverse. The chemical phenomena show the results of the destruction of matter which has fulfilled its physiological phenomenon, but it is not they which produce the physiological properties [p. 79].

The final book under review, Joseph Schiller's *Claude Bernard et les Problèmes Scientifiques de Son Temps*, constructs Bernard's scientific biography within the context of the work that other scientists were doing on similar problems. The interplay of Bernard the scientist and Bernard the philosopher comes through well, and one leaves this study with renewed appreciation for a careful yet daring experimenter, ever conscious of the relationship of experiment to explanation.

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Tracing the Expression of Heredity in Behavior

Behavior-Genetic Analysis. JERRY HIRSCH, Ed. McGraw-Hill, New York, 1967. xviii + 552 pp., illus. $12.50.

Genetic Diversity and Human Behavior. J. N. SPUHLER, Ed. Aldine, Chicago, 1967. xii + 291 pp., illus. $7.50.

The effect of heredity on behavior is one of the fundamental problems of biology and psychology. In biology, behavior is directly related to the theory of evolution, since natural selection depends upon the process of adaptation, and behavioral responses are major forms of adaptation in all animals that are capable of behavior. In psychology, genetic differences are a major source of variation between individuals and must be taken into account in any effort to make human behavior predictable.

For workers in the field of behavior genetics, a major problem is that of determining the next logical step in the development of this science. The question "Does genetics affect behavior?" has by now been answered with an emphatic "yes," but there are still many important kinds of behavior that have not been explored in this fashion. The question of whether or not genetic effects are important is no longer a burning issue and needs to be raised only in certain practical situations. Nature and nurture are interdependent. Neither can exist without the other, and there is no general answer as to their relative importance. Where should behavior genetics go next? The question of *how* heredity affects behavior still remains largely unanswered, and this is the theme of much of the work that is reported in these two volumes.

To present this question of *how* in a different sort of perspective: We know that the primary action of the genes is that of catalysts or enzymes affecting ongoing chemical processes within cells. Between this intracellular activity and behavior, which involves activity of the whole body, there is usually a long chain of intervening processes, any one of which can be independently affected by hereditary factors. An extra dimension of variability is added by the fact that behavior is an adaptive process and hence variable. Hence there