written by two of his students, R. W. Oppenheim (with R. F. Foelix) and R. R. Provine, on synaptogenesis and electrophysiology of the developing chick spinal cord, respectively. Embryonic motility was rediscovered by Hamburger and his students only 10 years ago; they have since established that both the development and the elicitation of rhythmicity and movement patterns are independent of sensory stimulation. Provine describes the techniques he developed for recording neural activity in the embryonic spinal cord and his findings that indicate a close correlation between the rhythmicity and spread of motility and the bursts of neural activity at corresponding levels of the spinal cord. Foelix and Oppenheim describe their electron-microscopic search for the earliest appearance of synapses in the embryo's spinal cord. The search was successful and yielded results that, for the most part, closely correspond to predictions based upon developmental changes in motility. Their discovery of inhibitory synapses raises problems with respect to the relationship between observed behavior and underlying neurogenesis —the one appears to be the product of spreading excitation while studies of the other indicate that excitation even at the beginning of spinal cord functioning may be shaped by inhibition in ways that are not evident in overt motility. Hamburger poses the problem, in passages that attain esthetic beauty, as the "fundamental difficulty inherent in every reductionist effort to 'explain' phenomena at one level in terms of events occurring at lower levels."

Hatching is perhaps the most complex activity of the avian embryo. The available knowledge for the chick and other species is reviewed by Oppenheim, who himself has done some of the most analytical research on hatching. His chapter, through its excellent descriptions and illustrations, makes the subject unusually clear. The chapter by Corner, Bakhuis, and van Wingerden views the rhythmicity of embryonic motility as the expression of a basic neural rhythmicity which may be continuous in development with the rhythmic alternation of sleep and wakefulness during the early life of the chicken. These authors contribute additional evidence that hatching is controlled by cerebral mechanisms (already indicated in Oppenheim's studies) through their experimental analysis of EEG activity during hatching.

The remaining four articles do not simply tag along but make substantial contributions of their own. Two of these articles approach the study of behavioral embryology from a behavioral and functional point of view (and use different avian species, namely bobwhite and Japanese quail and laughing gull). Hatching and posthatching behavior observed in their natural setting are taken as starting points for the investigation of prenatal behavioral development. Key questions from this point of view are "the extent to which this [embryonic development and activity] is dependent on, or controlled by, the environment, either via sensory processes or by other means" (M. Vince) and "the possible role of the natural (species-typical) environment in structuring the embryo's behavior and perception" (M. Impekoven and P. S. Gold). These chapters present findings of interest to developmental ethologists: auditory stimuli accelerate and retard hatching among quail and other species, leading to synchronized hatching of the clutch (Vince), and specific parental calls have prenatal activating or inhibiting effects on gull embryos which persist in the hatchling (Impekoven and Gold). The study of embryonic behavior in Crustacea is presented in the chapter by M. Berrill. Research on this subject is at its beginning, but spontaneous motility is evident in several but not all species, reflex activity can be elicited somewhat later, and hatching, as in the chick and other animal classes reviewed by Oppenheim, requires special behavioral mechanisms.

Gottlieb's introductory chapter leads one to conclude that the old nature-nurture controversy is still present in behavioral embryology. It takes the form of a theoretical division between preformistic and probabilistic epigeneticists and often divides neuroembryologists and developmental ethologists or psychologists. There is hope, though, that this is not the case in the following statement made by Hamburger in concluding his chapter: "The notion that neurogenesis fully 'explains' or 'determines' embryonic behavior development is not valid as a generalization . . . even the most detailed knowledge of neural organization, including all significant synapses, in chick or rat embryos at a given stage would permit no prediction of the actual . . . movements performed at that stage. . . . All one can say is that the *state of differentiation of the nervous system at a given stage delimits the range of behavioral potentialities.*" This volume, then, admirably presents the state of the science, lacking only a fuller report of Gottlieb's research on the prenatal development of species-specific auditory preference among ducks.

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History of a Disease

A Plague of Corn. The Social History of Pellagra. DAPHNE A. ROE. Cornell University Press, Ithaca, N.Y., 1973. xvi, 218 pp., illus. $11.50.

Daphne A. Roe has written an informative and impassioned social history of the dietary deficiency disease pellagra. Her own research in basic and applied nutrition may well have compelled her to examine the complex circumstances which give rise to disease; her investigation has yielded a fascinating account of the ways in which scientific observation and explanation of disease are shaped by the social circumstances of the victims. Pellagrins have suffered combinations of hostility, abuse, and disregard from the time the dermatologic, metabolic, and behavioral symptoms associated with the disease were first observed in poor Spanish peasants during the 18th century. Even in 1937, after effective prophylaxis and therapy were known, ravages of pellagra among sharecroppers in the southern United States could be vividly documented, as in the pictorial commentaries of Margaret Bourke-White and Erskine Caldwell.

Ever since the earliest identification of pellagra contrasting assumptions have formed the idiom of investigation: there were "those who believed that pellagra was a man-made disease, the result of the inhuman practice of restricting the poor to a diet that cannot support health in a dog; and those who thought that it was the fault of the afflicted." Roe suggests, somewhat too simply, that those who have been responsible for successful research into the linkage between poverty and diet have been dedicated "to the credo that freedom from want is an integral human right."

The irony of this disease of malnutrition is that it first appeared at the time when agricultural technology made possible not only the growth of sufficient staple crops to prevent outright starvation but also the development of

commerce based on an agricultural economy. As Roe states, it was "political geography" that determined encouragement of those crops which produced good revenue. Pellagra appeared in 18th-century Spain and Italy, in 19th-century France, and in the 20th-century United States whenever nutritionally poor cereals became the main food for impoverished agricultural workers whose subsistence was harnessed to exportable crops and who were at the same time denied the means of growing or purchasing other nourishment.

Perhaps the most striking chapter of Roe's book is her account of the elimination of pellagra from mid-19th-century France, when, despite the prevalent view that pellagra was an infection transmitted by sheep to hereditarily susceptible peasants, the French government was persuaded by Théophile Roussel's investigation of pellagra to restrict the cultivation of corn and to force production of potatoes and other cereals and encourage animal husbandry. Roussel, convinced that scientific and medical knowledge was inadequate to the task of curing the disease, won the coveted prize in medicine of the French Academy of Sciences by his advocacy of social intervention where science failed.

Roe's indictment of ignorance and obduracy occasionally fails to take into account the context in which science and medicine were so gravely delinquent. The search for agents of contagion and the predisposition to account for susceptibility to pellagra in terms of heredity were, after all, attempts to apply scientific methods which appeared to be successful elsewhere. And surely apathy and remoteness from the poor-sick who were the victims played as great a part as malevolence in delaying the observation that led to the elimination of the disease.

Roe's book reflects the surprised hurt of the scientist discovering the conceptual constraints that restricted her predecessors. Another recent study, by the social historian Elizabeth W. Etheridge, provides a chronologically narrower yet historically more satisfying account of pellagra. In *The Butterfly Caste* (Greenwood, 1972) Etheridge describes the social and intellectual habits which resisted observation, experiment, and discovery and continued to impede implementation of prevention well after clear evidence concerning the cause of pellagra. Furthermore, Etheridge documents the manifold obstacles to care of the diseased that persist even when commitment to treatment is made. In 1930, 15 years after it was conclusively shown that pellagra could be prevented by simply providing cheap garden "greens" and minimal amounts of milk, there were still 200,000 pellagrins in the United States with a 33 percent fatality rate. In 1940 there were 2000 deaths reported, and only the enrichment of bread and other cereals with B vitamins during World War II and subsequently has permitted the poor to escape this devastating disease.

The poor in both urban and rural areas are still today disproportionately the victims of malnutrition and disease, and reports such as *Hunger USA: A Report by the Citizen's Board of Inquiry into Hunger and Malnutrition* have not moved substantial numbers of doctors, lawyers, or merchant chiefs to advocate measures to end poverty. Perhaps a widespread circulation of Roe's and Etheridge's historical studies among scientists could serve to suggest some largely overlooked connections between social intervention and basic research.

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