

new, having been published, *in toto* or in part, elsewhere. Other papers are literature reviews. Although some of the topics have already received much attention in earlier published works, emphasis has been placed not only on additional new data but—what is perhaps even more important—on attempts to correlate structure and function through the use of a wide variety of experimental techniques. Among the methods employed by the various investigators were x-ray diffraction, electron microscopy, light microscopy, histochemistry, biochemistry, pharmacology, and electrophysiology. In most instances the investigators employed more than one experimental method. This approach has yielded a clearer understanding of the topics under consideration. Moreover, it presents the most recent morphological, biochemical, and physiological data in relation to current thought and research trends in certain areas of cellular neurobiology.

In addition to the papers dealing with nervous structure and function, four studies are included in the collected papers of the symposium which are of peripheral but, nonetheless, current interest. The high level of the papers is punctuated by an amusing addendum to one of the studies.

This book will be of value chiefly to those investigators whose interests lie in similar research areas. It should also be of value to cellular and comparative biologists with adequate backgrounds in the field of neurobiology, but it will not be easy going for the casual reader.

RONALD A. BERGMAN
Department of Anatomy,
Johns Hopkins University

The Biological Way of Thought. Morton Beckner. Columbia University Press, New York, 1959. 200 pp. \$6.

The biologist today is a curiously nervous fellow. He is beset by an ever-increasing need for physicochemical techniques and at the same time is alone in the task of reassembling the extracted parts into the living organism. Latter-day mechanists consider biology to be merely a complex extrapolation of physics and chemistry, while the modern heirs to vitalism, the "organismic biologists," vehemently reassert that the whole is greater than the sum of the parts. Reductionism versus emergence is still being argued.

Morton Beckner's book is a useful clarification of the position that biology is a unique and autonomous discipline which requires its own techniques of theory formation despite its use of physicochemical data. To this end, he restates the philosophic basis of organismic

biology and examines the qualities of organization, directiveness, and historicity which are attributed to living things alone. In effect, Beckner concludes that in our present state of ignorance the biologist has, perforce, to develop a methodology and a philosophic approach which is far removed from the physical and chemical mechanisms underlying the behavior of biologic material. This is best illustrated in such areas as taxonomy, evolution, and selection theory and genetics, where the New Systematics may be successful in resolving many problems of classification. Of more general interest is the closely reasoned case for the utility of model explanation and the teleological explanation in approximating biologic "truth."

Unfortunately, the working biologist is likely to be overwhelmed by the tortuous terminology used. Furthermore, a more immediate problem confronting the biologist is not the need to rise above the physical sciences but, rather, the need for enough training in physics and chemistry to put the enzymes back into the cells. One must agree in substance with Beckner that the traditional approach of the biochemist will not resolve the question of what is life, but neither will the New Systematics.

ESTELLE R. RAMEY
Department of Physiology,
Georgetown University Medical Center

Mineral Nutrition and the Balance of Life. Frank A. Gilbert. University of Oklahoma Press, Norman, 1957. xv + 350 pp. Illus. \$5.95.

The book is a critical review of 1177 books and articles on the mineral elements necessary to life on earth. The following essential elements are discussed: phosphorus, calcium, magnesium, iron, potassium, sulfur, copper, manganese, zinc, iodine, boron, molybdenum, aluminum, silicon, sodium, chlorine, fluorine, arsenic, lead, selenium, and vanadium. Each element is treated separately with respect to its relation to plants and animals, its essentiality, and its occurrence in water, soil, and living tissues. The deficiency areas and deficiency symptoms in plants and animals and the connection of some of these elements with enzymes, vitamins, and hormones are shown. The final chapter deals with the relation of soil and fertilizer to mineral metabolism in plants and animals, with human nutrition, and with national health. This chapter, which consists of only eight pages, is much too short to convey even a most elementary understanding of such complex and difficult subjects.

FRANCIS JOSEPH WEISS
Arlington, Virginia

Die Haustiere Afrikas. Ihre Herkunft, Bedeutung und Aussichten bei der weiteren wirtschaftlichen Erschliessung des Kontinents. Caesar R. Boettger. Fischer, Jena, Germany, 1958. x + 314 pp. DM 31.20.

This remarkable book is probably the most complete, the most up-to-date, and the most critical account in existence of our knowledge of the origin, evolution, and distribution of domestic animals, of their value to man, and their influence on the development of cultural patterns. Although relatively few of the animals under domestication have their origin in Africa, most of the others have been introduced into this continent since prehistoric times, and, therefore, this book deals with almost all of them, even with bees, silk moths, and cochineal insects. The only domestic species not introduced, and therefore not discussed, are the reindeer, the three South and High Asiatic species of cattle—that is, the gayal, banting, and yak—and the South American llama and alpaca.

In contrast to widely prevailing views, it is pointed out that nomadic life is not the precursor of sedentary agricultural culture but that random food gathering, including hunting and fishing, preceded planting, that regular agriculture became possible only after suitable domestic animals had become available, and that the modern nomadic life is a secondary development brought on by the necessity of feeding too many livestock.

It is shown that the dog is the oldest domestic animal, that the pig is next in line, and that it was replaced in the Near East by cattle, sheep and goats. The origin of all these domestic animals is in the fertile crescent of anterior Asia, although later on related subspecies of the same forms were tamed, and frequently crossed, with the original stock in other parts of Asia, as in India, Malaysia, and China.

Whereas most species were domesticated for reasons of utility, cattle and the cat originally were taken on for cultic reasons. The same applies to the jackal in Egypt, which is no longer associated with man.

African origin is accepted for the donkey, cat, ferret, rabbit, pigeon, dove, guinea hen, and some breeds of bees. However, other species were temporarily kept in Egypt, such as the jungle cat (*Felis chaus*) (for cultic reasons), the striped hyena, three species of antelope, the Nile goose (*Alopochen aegyptiaca*), and the African elephant (in North Africa). Some of the introductions from Asia, the distribution of which is more restricted, are the horse, the water buffalo, and the dromedary. The latter is considered to be derived from a wild species different from the wild ancestor of the Asiatic two-humped camel.

The economic value of the introduced species is discussed in detail, and the question is raised whether the development of new domestic stock from the native wild African fauna is possible, and under what conditions.

This book is an indispensable reference book and a standard work for the zoologist, the ethnologist, the prehistorian, and the economist. Its style is condensed and does not make for easy reading. The literature is given in footnotes. There are no illustrations.

ERNST SCHWARZ

Armed Forces Institute of Pathology,
Washington, D.C.

Economics and the Social Sciences

Population Growth and Economic Development in Low-Income Countries.

A case study of India's prospects. Ansley J. Coale and Edgar M. Hoover. Princeton University Press, Princeton, N.J., 1958. 389 pp. \$8.50.

This is the third major study in Asian demography sponsored by the Office of Population Research at Princeton University; the other two are Kingsley Davis' volume, *The Population of India and Pakistan* (1951), which is an indispensable tool for anybody interested in Indian population problems, and Irene Taeuber's study, *The Population of Japan*, which has just appeared.

Contrary to what the title suggests, Coale and Hoover's book is almost exclusively devoted to an examination of the prospects for Indian population growth and the economic implications of different rates of growth over the period 1956 to 1986. Towards the end of the book the results for India are compared and contrasted with prospects in Mexico.

In the absence of reasonably reliable vital statistics, forecasts of population growth in India had hitherto been limited mainly to simple projections of the decennial growth rate shown by recent censuses. The 1951 census commissioner based his discussion of future prospects for population growth and food supply, and his eloquent plea for an active population policy, upon the broad assumption that the Indian population would continue to grow at the annual rate of 1.2 percent at which it grew in the decade 1941 to 1951. The same rate of growth was assumed in the long-term projections given in the second Indian Five-Year Plan. It is one of the great merits of Coale and Hoover's book that it shows the dangerous irrelevance of such mechanical projections.

As a starting point for their projections, the authors had to make independent estimates of the age distribution and the vital rates in 1951. Their

method is designed to avoid the distortion arising from the unreliability of age reporting in Indian censuses. Briefly, the method is based on the hypothesis that the level of fertility and over-all growth rates have changed little over the 30 years from 1921 to 1951 and that the structure of the population must therefore approximate closely that of a "stable" population in which the life table is directly given by the age distribution. On this basis, the most likely age distribution, the birth rate, and the age-specific mortality rates for 1951 are determined, and projections (by the component method) are made by 5-year age groups and for 5-year intervals until 1986.

It is assumed that mortality will decline sharply until 1971, at a rate somewhat similar to that at which it has declined in Ceylon. According to detailed estimates by the authors, life expectancy at birth had already increased from around 32 years in 1951 to slightly less than 38 years in 1956. It is assumed that it will increase further, to 50 years by 1976, largely as a result of the eradication of malaria. This assumed trend in mortality is combined with three different assumptions on the course of fertility.

With unchanged fertility, the Indian population would by 1986 be slightly more than double its size in 1956. This projection, based as it is on rather extreme assumptions for both mortality and fertility, may be regarded as the upper limit of the range of conceivable population growth.

At the other extreme, a projection is made on the assumption that fertility rates will decline linearly by 50 percent over the 25 years from 1956 to 1981. This is a tall order, but even so the 1986 population would be 53 percent above that of 1956. Thus, even if there should be a very successful drive to reduce fertility, population would grow at a higher rate than has been observed for any previous period of 30 years.

It is particularly interesting to compare this with the result of the third and last projection, which assumes that the same end result, a 50 percent decline in fertility by 1981, is brought about in the much shorter span of 15 years, beginning in 1966. In this case of a delayed but much sharper decline in fertility, the increase in population from 1956 to 1986 would be 65 percent. In other words, if the beginning of the decline in fertility is delayed, a *more than proportionate* increase in the effectiveness of population control will be necessary in order to keep population down to a given target figure at any future point of time. This is obvious, upon reflection, but it is the kind of obvious truth that needs to be repeated and worked out in dry figures so as to make it clear that

postponement in matters of population policy means that far more drastic, painful, and costly measures will have to be taken at a later stage.

The bulk of the volume is devoted to answering the question: "What is the difference in the levels of income per head which would be associated with the high and low fertility trends, respectively?" The reasoning is essentially in terms of the familiar growth model, in which output per head results from assumed values of the savings ratio, the marginal return to investment, and the increase in population. But the authors have refined this simple model in several important and interesting ways.

1) The amount of resources available for purposes other than personal consumption is made to depend upon income per consuming unit rather than upon aggregate income. Hence, under lower fertility a larger share of total output is available for raising output per head.

2) Instead of postulating a marginal rate of investment (or saving), as usually understood, the authors postulate a given share of increments in income to be available for addition to the combined category of public outlays (whether on current or capital account) and private investment. This enables them to make explicit allowance for the fact that the resources that have to be devoted to education and other welfare expenditure depend upon the age composition, which in turn is a function of fertility. With a smaller number of dependents (such as would result from declining fertility), a smaller share of available resources would have to be devoted to welfare expenditure; this would have "a diluted, indirect or delayed effect on output," and more would be available for outlays which "raise aggregate output in a relatively direct and immediate way."

3) Within the category of welfare outlays a further distinction is made between those which are required for the current needs of the existing population and those needed to provide facilities for additional people. For the first category a productive effect of half that of "direct growth" outlays is predicted, and it is assumed that even this reduced effect would be somewhat delayed, by 15 years. The second category of outlays, which becomes the more important as the fertility rate rises, is assumed to have zero growth effect within the horizon of the projections.

4) Finally, it is assumed that the capital-output ratio would increase gradually during the period, from 3.0 to 3.6.

The projections rendered by this model show that on the basis of the low-fertility assumption, income per consumer in 1986 would be around 40 percent higher than the figure based on the