(11) The region just outside the nuclear membrane shows greater oxidation activity and higher concentration of ribose nucleic acid.

(12) Cytogenetic evidence from translocations suggests that heterochromatin and centromere regions exert a gradient of effect along the chromosome, manifest both in nucleic acid disturbances and genetic effects.

(13) The heterochromatic regions are thought to contain nonspecific *polygenes,* more or less cumulative and indeterminate in their effects, as opposed to the specific, saltational *oligogenes* of euchromatin.

(14) The heterochromatic regions are thought to be regions of nucleic acid synthesis.

(15) The constituents of nucleic acid are also constituents of the O/R-phosphorylation mechanisms preeminently concerned with energy metabolism.

From a synthesis of these facts, the following hypothesis may be derived:

(1) Heterochromatin as substance and the centromeres, telomeres, and nucleogenic regions as loci, are in some way concerned with transfers of energy and/or substance across the nuclear and nucleolar membranes. Painter (1945) suggests a heterochromatin → nucleolus → cytoplasm cycle; I believe the circuit (a) may include other elements than the ribose ⇋ desoxyribose cycle and (b) may, in some cases, proceed in the reverse direction. Heterochromatin would thus be "liaison chromatin."

(2) From their behavior and topography chromosomes appear to be lines of transfer of energy and/or substance traversing the distances between the heterochromatic junctions.

(3) The metaphase period of maximum chromatin condensation with its minimum of surface area may also be specialized for energy transfer. In view of (11), (14), and (15) above, the transactions may be those concerned with energy metabolism. Such function may be the common denominator of all pycnotic chromosomes and chromosome regions.

(4) The nonspecific, quantitatively indeterminate polygenes of heterochromatin may be nothing more than effective concentrations of the constituents of nucleic acid participating in energy metabolism.

(5) The strategic location and direct participation of heterochromatin in energy metabolism would explain many of its properties and functions, especially its connections with cytoplasmic metabolism, and its apparent pacemaking role in neoplasia and variegation.

In short, *the various forms which chromatin assumes, and the changes which it undergoes in the mitotic cycle, may be a shifting series of pathways along which transfers of energy and substance are taking place between chromosomes and karyolymph and between nucleus and cytoplasm.*

The topography of the cell would thus be visible reflection of its function as an energy transformer.

The above thesis, expanded into a more detailed hypothesis, will appear elsewhere at a future date.

LEON VANDERLYN
Biological Abstracts, University of Pennsylvania

Book Reviews

Longleaf pine: its use, ecology, regeneration, protection, growth, and management. **W. G. Wahlenberg. Washington, D. C.: Charles Lathrop Pack Forestry Foundation, in cooperation with the Forest Service, U. S. Dept. of Agriculture, 1946. Pp. xxii+429. (Illustrated.) $5.00.**

This is a concise and clearly presented synthesis of the voluminous empirical and fundamental information that has accumulated through years of research on the silviculture and management of one of America's most valuable forest trees. It should be of great service to practicing foresters, scientists, students, and teachers. The Introduction clearly defines the longleaf pine problems.

Part I gives a well-illustrated summarization of technical data on resources, commercial uses, and wood and pulping properties of the species. Major economic uses are naval stores, piles, poles, posts, ties, mine timbers, lumber, and pulpwood. Less than half of the volume of wood was utilized until the pulp mills began converting the tops into paper. In second-growth forests, the species is being gradually replaced by slash pine in the coastal areas.

Part II covers the ecology of the species, including such items as site, climate, soil moisture, and soil fertility. An entire chapter is devoted to the much-discussed role of fire in regeneration. The author cautiously concludes that fire is advantageous in five of six conditions that prevent successful natural regeneration.

Part III is a very fine assemblage of information relating to the role of seed production, soil fertility, seedling development, and seedbeds in natural and artificial regeneration. Again the author recognizes the essentiality of fire for regeneration. The importance of leaving seed trees on cutover areas is stressed.

Part IV evaluates the damage and losses caused by fire, insects, animals, and climate. Damage from insects and disease can be minimized by improvement cuttings and thinnings. Chapter 8 is devoted to an analysis of the fire situation in the longleaf pine region, including behavior of fires, effects of fire on stands, mortality, fire control, and protective burning. The author concludes that periodic, controlled burning is advantageous. Uncontrolled burning may reduce diameter and height growth by approximately 20 per cent.

Part V discusses briefly the management of longleaf pine forests for naval stores and timber production. The chapter on naval stores is authoritative and up to date, and considers such items as chipping methods, effects of fire and weather on gum yields, and chemical stimulation. Treating freshly cut streaks with 60-per cent sulfuric acid should increase gum yields by 60 per cent or more. The management system recommended is clear cutting with seed trees scattered or in groups.

In addition to the text, the volume contains 11 appendices, a 12-page glossary, a bibliography of 637 citations, 48 plates, and 74 figures.

L. W. R. JACKSON

School of Forestry, University of Georgia

Insect microbiology: an account of the microbes associated with insects and ticks with special reference to the biologic relationships involved. **Edward A. Steinhaus. Ithaca, N. Y.: Comstock Publishing Co., 1946. Pp. x + 763. (Illustrated.) $7.75.**

For a long time there has been need for a real evaluation and synthesis of the literature dealing with the microbes of insects and Acarina. Various groups of specialists have concerned themselves with one or another of the groups of these microbes, but the literature was so widely scattered that few of the specialists could become familiar with it. Systematic bacteriologists and protozoologists have studied microorganisms from insects but have usually been interested primarily in the microorganisms themselves. Economic entomologists have been interested in microbes which produce disease in insects because of the economic importance of agents that reduce the numbers of either beneficial or harmful insects. Again the medical entomologists, plant and animal pathologists, and medical and veterinary scientists have been concerned with that large group of microbes producing disease in plants and animals for which arthropods (insects, ticks, and mites) act as transmitting agents. These latter groups usually become concerned entirely with either the microbe or the arthropod, but few individuals develop a strong interest in the relationships between them.

Dr. Steinhaus' book represents an attempt to evaluate this widely scattered and heterogeneous literature (of over 1,600 references). The book may properly be called an introduction to a new science—the science treating of the interrelationships of arthropods and their associated microorganisms, including the extracellular bacteria, the intracellular bacterium-like and rickettsia-like symbiotes, rickettsiae, yeasts, fungi, viruses, spirochetes, and protozoa (but not the nematodes). Considerable attention is given to the associations known as mutualisms, thus bringing to the attention of students of parasitism those interrelations which probably are vastly older than the parasitic relationships and an understanding of which will undoubtedly throw light on the latter. The bacterium-like and rickettsia-like symbiotes which have established such very close relations with their hosts' tissues and life cycles that they have often been mistaken for organelles and organs of the host are described at some length. They grade imperceptibly into forms similar in appearance, which apparently do little or no harm to their arthropod hosts but which may produce deadly disease in the vertebrate hosts. A chapter is devoted to the protozoa in termites, which have much interest from the standpoint of the evolutionary and physiologic aspects of the mutualisms existing between them. The natural and acquired immunity of insects to microbes is discussed in a separate chapter, and the principles illustrated are related to vertebrate immunology.

The book should do much toward stimulating investigators to enter this new and interesting field of study.

CLAY G. HUFF

University of Chicago

Apes, giants and man. **Franz Weidenreich. Chicago: Univ. Chicago Press, 1946. Pp. vii + 122. (Illustrated.) $2.50.**

Since the discovery of the first *Pithecanthropus* skull in 1891–92 and the first *Sinanthropus* skull in 1929 much additional material has come to hand—so much, in fact, that apparently Weidenreich feels that we must be prepared to reorient our thinking about man's early evolutionary history.

Perhaps the most startling conclusion offered by Weidenreich is that "giants may be directly ancestral to man." As the bases for this assertion there are (1) three giant molars found by Von Koenigswald in a Hong Kong apothecary shop and termed by him *Gigantopithecus blacki* (although Weidenreich says they are hominid); (2) a mandibular fragment found by Von Koenigswald at Sangiran, Java, and called by him *Meganthropus paleojavanicus*; and (3) a skull found by Von Koenigswald, also at Sangiran, called by Weidenreich *Pithecanthropus robustus*. It is Weidenreich's feeling that these three are, more or less in order as given, in linear relationship to the *Pithecanthropus erectus*—*Sinanthropus pekinensis* group, who, in turn, are ancestral to *Homo sapiens*.

Weidenreich affirms vigorously that the nomenclatural plethora is not to be construed in terms of the Linnaean binomial taxonomic system. The names are, for the most part, merely "Latinizations" of descriptive and/or place names. Indeed, the author is prepared to admit that *Pithecanthropus erectus* and *Sinanthropus pekinensis* are true hominids, referable to the genus *Homo*.

The book also contains chapters on the classification of modern races and on the phylogeny of brachycrany.

Weidenreich has done human paleontology a yeoman service in thus presenting his views. It is no evaluation of him, but rather of the material, when we suggest that the lineal arrangement of *all* the above-named fossils (so that they are in a direct line to *Homo sapiens*) is an assumption that rests upon certain dentocranial characters known to be quite variable. The possibility of relationship is one thing, the probability another. We would wish for a better knowledge of the range of variation before we write Q.E.D.

W. M. KROGMAN

University of Chicago