Book Reviews

Die Evolution der Angiospermen. Armen L. Takhtajian. Translated from the Russian by W. Höppner. G. Fischer, Jena, 1959. viii + 344 pp. Illus.

Origins of Angiospermous Plants. Armen L. Takhtajian. Translated by Olga Hess Gankin. G. Ledyard Stebbins, Ed. American Institute of Biological Sciences, Washington, D.C., 1958. 68 pp. U.S., $3; foreign, $3.50.

Essays on the Evolutionary Morphology of Plants. Armen L. Takhtajian. Translated by Olga Hess Gankin. G. Ledyard Stebbins, Ed. American Institute of Biological Sciences, Washington, D.C., 1959. 139 pp. U.S., $5; foreign, $5.50.

From these three publications which have recently become available either in German or in English, it is apparent that Armen Takhtajian has been more successful than anyone else to date in putting together a connected and plausible account of the origin and morphological evolution of flowering plants. (Axelrod's recent admirable essay, "The evolution of flowering plants," is concerned primarily with paleontological, geological, geographical, climatic, and ecological considerations, rather than detailed structural considerations.)

In *Die Evolution*, another tribute to the Darwinian centennial year, Takhtajian has attempted to winnow from a very extensive array of modern morphological studies all available evidence bearing on the phylogeny of angiosperms. He concludes that the group was derived monophyletically from extinct gymnospermous stock arising between seed ferns and Bennettitales, probably in small montane populations during early Jurassic or even late Triassic time. Within angiosperms, the primitive forms were sympodially branched evergreen trees possessing unspecialized vascular tissues and bearing simple, more or less entire, stipulate, open pinnately veined leaves, with three or more traces and leaf gaps. He visualizes the flower as a bisporangiate strobilus, now best represented by a magnolian flower, which has undergone those evolutionary modifications familiar to students of the ideas of Arber and Parkin, Bessey, Hallier, and Hutchinson. The stamens and carpels are interpreted as the classical phyllome structures formed by reduction of the leafy sporophylls of their gymnospermous forebears. Insect pollination is held to be the principal motivating and guiding force in the development and modification of flowers, which he believes to be primitively cross-pollinated; "simple," unisporangiate, and "naked" flowers are regarded as invariably derived in response to a change to anemophily. He finds evolutionary trends also in spores and gametophytes. "Double fertilization" is a necessary concomitant of the extreme reduction of the megagametophyte, permitting the quick production of a compensatory food supply. In the seed he regards a nuclear endosperm as primitive and the loss of a sarcotesta and the development of arillar structures as derived. He devises his own evolutionary classification of fruits, dividing them into apocarpous versus coenocarpous types of different placentation, and stressing the nature of the floral gynoecium to the subordination of superficial adaptive features.

Major changes, such as the formation of a flower from a gymnospermous strobilus, a carpel from a compound megasporophyll, a truly monocotyledonous embryo from a dicotyledonous one, or the production of gametangium-less gametophytes, Takhtajian attributes to major changes in ontogenetic development, which may lead to the fixation of widely different adult conditions.

The last third of the book presents a descriptive "system" of angiosperm families arranged in 18 "super-orders" and 82 orders. This is illustrated by a rather shrubby phylogenetic tree, which begins with Magnoliales and has such prominent secondary key loci as Liliales for monocotyledons, Dilleniales, Hamamelidales, Theales, Cistales, and Cuno-niales. Takhtajian stresses that "Evolutionary morphology is accordingly the foundation pillar of the modern mega-taxonomy of plants" and emphasizes that correlating as wide a spectrum of characters as possible is the only feasible way to determine relationship. He also remarks of taxonomy: "among many biologists of experimental aim the notion is widespread that Systematics is a branch of knowledge that is absolutely outmoded. This conception of Systematics is profoundly false and the resule of a certain narrow-mindedness of thought associated with one-sided specialization. . . . The fundamental general-biological significance of Systematics consists in that millions of facts that have no sort of scientific value in themselves find their place in the constructions of Systematics. Systematics is consequently not only the basis of biology, but also its coronation."

While the great value of this book to Western workers is, of course, in the wealth of unfamiliar Russian literature Takhtajian brings to our attention in this and the following works, it is interesting to note that the extensive bibliography has more than 750 references to papers and books in English, many of them of quite recent date.

The *Origins* is pretty much a condensed and somewhat popularized version of the ideas and conclusions just enumerated, with stress on the role of flowering plants in the earth's past and present vegetation, their origin and rapid elaboration, the primitiveness of Magnolian (Ranalian) types, and the derived nature of "Amentiferae" and monocotyledons. An appendix contains a synopsis of the proposed taxonomic system. The familiar Western literature has been edited out of the bibliography in both this and the following translation.

The *Essays* deals with more basic and theoretical considerations of evolution in all groups of plants, although emphasis is placed on vascular ones. The first 30 pages are devoted to a historical synopsis of plant morphology, ranging from Theophrastus and Goethe, whom the author greatly admires, to Zimmermann and the telome theory, and including a number of less familiar Russian authors. The second chapter (which also forms the introduction to *Die Evolution*) treats the interconnected forms of adaptive evolution: *progressive*—major advances in structural-functional organization; *specialization*—adaptive radiation; and *regressive*—secondary simplification. The confusing heterochrony of

evolutionary change in different organs, which is stated to be most pronounced in less specialized forms, is treated next. The bulk of the volume, however, is devoted to the major role in plant evolution attributed by Takhtajian to ontogeny and its modification, and to the related topics of recapitulation and "evolutionary teratology." "In evolution, new characteristics arise as hereditary alterations of organs at the most diverse stages of their morphogenesis, beginning with the formation of primordia and ending with the last developmental phases." This fact, according to the author, refutes Haeckel's famed biogenetic law, which postulates a recapitulation of ancestral *adult* forms. The principle of alteration of ontogenies is applied by Takhtajian to bridge a wide range of apparently profound gaps between major groups of plants and to explain the rise of new developmental lines differing sharply in adult form from their ancestors. At the same time, he cautions that the ontogenetic method must be used cautiously and in conjunction with comparative morphology, lest its potentialities be exaggerated as, for example, he believes they have been by Gregoire, Thompson, and others in denying the foliar nature of carpels. He concludes: "The evolutionary botany of the future will be erected on the basis of a synthesis of morphology and physiology."

If in all this there is very little that is startlingly new to Western students of plant evolution, it is interesting to discover that the climate of opinion is not radically different between East and West.

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Metropolis and Region. Otis Dudley Duncan, W. Richard Scott, Stanley Liberson, Beverly Duncan, Hal H. Winsborough. Published for Resources for the Future, Inc., by Johns Hopkins Press, Baltimore, Md., 1960. xviii + 587 pp. $8.50.

The program which resulted, among other things, in this hefty volume was initiated by the Social Science Research Committee of the University of Chicago. It was largely carried on at the Population Research and Training Center of that institution, with support from the Ford Foundation and from Resources for the Future, Inc. (which also sponsored this volume). It is, according to the senior author, virtually a companion to the Resources for the Future study *Regional Economic Growth in the United States* by Harvey S. Perloff and others. Perloff is credited with being "in large measure responsible" for "the ideas which ultimately crystallized in this study."

The authors attempt an integrated treatment of the orientation of metropolitan structure in the United States, a study frankly cross-sectional, one providing a bench mark for dynamic analysis of future change. Its aim is threefold: (i) to review ideas on the nature of the metropolis, (ii) to test these ideas against an outline of the structural characteristics of the metropolitan economy of the United States about 1950, and (iii) to survey the industrial composition and regional relationships of the larger U.S. cities.

In analyzing metropolis structure the authors emphasize location and function. Influenced by Gras, they think of "the metropolis as an industrially developed city, strategically located at a focus of a transportation network." Such concepts are tested with statistical data on the 56 SMA's (SMA: Standard Metropolitan Area) with a population of 300,000 or more in the 1950 census.

Data on manufacturing industries are broken down into categories (i) according to the extent that raw materials are processed or materials already processed are fabricated, (ii) according to whether their output is for final or nonfinal markets.

With the aid of an ingenious diagram (Fig. 15, page 264) that plots commercial against manufacturing activity, the 56 cities are divided into seven categories: national metropolis, regional metropolis, regional capital, submetropolitan (diversified manufacturing with metropolitan functions), diversified manufacturing with few metropolitan functions, specialized manufacturing, and special cases. The authors are less interested in getting each city into a proper pigeonhole than in establishing a typological classification demonstrating how U.S. cities are differentiated in metropolitan functions and regional relationships.

The remaining half of the book is given over to data, discussions, and summaries for 51 of the cities. (The five national metropolises are omitted because their analysis would have overtaxed the available resources.) A detailed "industrial profile" is presented for each. The extent to which each industrial category has inputs and outputs that are local, regional, or national is discussed in considerable detail and summarized in tabular form. The salient facts for each city are presented in brief summaries. The Denver summary, for example, reads as follows: "Denver appears to be chiefly a commercial and financial SMA performing metropolitan functions for a large portion of the Mountain States. Some processing of resources is carried on—notably meat packing and sugar refining—and inputs appear to arrive from the immediate hinterland (Area B) in the case of sugar beets and from both hinterland and regional areas (B and C) for livestock. Transportation, wholesaling, irrigation, administrative, and educational services appear to be performed for a large but sparsely populated area (Area B) consisting chiefly of Colorado and parts of New Mexico and Wyoming, while financial, military and tourist functions are performed for a regional or national area" (page 380).

Stylistically the book tends toward a dull, polysyllabic, professional mumble. The following sentence is characteristic: "If we are right in thinking that times are ripening for the appearance of such a signal contribution to the theory of metropolitan structure, then our rather eclectic adaptation of a number of perspectives and analytical techniques may be excused as an effort to temporize with competing claims that we cannot adjudicate satisfactorily" (page 19). Resources for the Future should somehow induce a more straightforward expository prose in its reports.

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Birds of Anaktuvuk Pass, Kobuk, and Old Crow. A study in arctic adaptation. United States National Museum, Bulletin 217. Laurence Irving. Smithsonian Institution, Washington, D.C., 1960 (order from Supt. of Documents, GPO, Washington 25). viii + 409 pp. Paper, $2.

Anaktuvuk Pass, an area of mountain tundra at an elevation of about 2400 feet, is important ornithologically because many species of birds use it in migrating through the formidable Brooks Range to and from the Arctic slope of Alaska. Kobuk, a village in the northwestern interior of Alaska, is on the Kobuk River about 120 miles from