PARADISE OF PLANTS

By H. WILPERT

ACCORDING to our present knowledge of the origin of the earth and the evolution of its inhabitants, there can never have been an earthly paradise. For the very word "paradise" implies perfection, which would make all striving and evolution superfluous, while it is just this striving and evolution which has produced all the varied forms of organic life we see about us today. Nevertheless, the idea of a lost paradise has always filled the dreams of mankind; and as it was to be found nowhere in the world, it was put at the beginning of Creation, although it might just as well have been placed at the end of the earth's history, had this not been at variance with human and earthly shortcomings.

IN SEARCH OF PARADISE

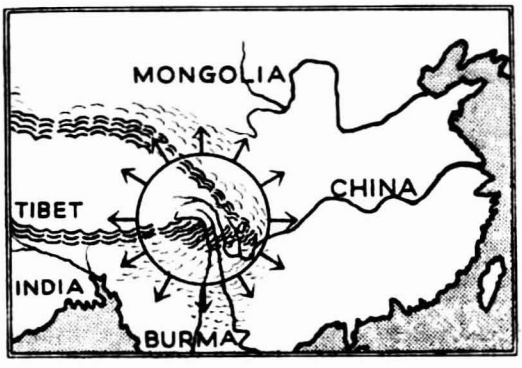
The former site of paradise has been sought for all over the world. Historical sources point to the original center of human culture, the region between the Euphrates and the Tigris Rivers. Instinctively we visualize paradise as a place abounding in flowers and fruit such as is only to be found in the tropics. As voyagers to the East first meet with such natural wealth in Ceylon, it is easy to understand that men have tended to regard this exquisite island paradise as the Garden of Eden of yore.

Meanwhile, however, the history of evolution, supported mainly by the proofs provided by paleontology, has shown that even man was subject to an evolution from a primitive to a complicated creature, a creature which was only able to gain its dominating position among all other creatures by the development of its brain. We know now that it is a waste of time to seek for the location of the Garden of Eden and to wonder what it may have looked like, for it is a pure figment of human imagination. On the other hand, the science of evolution and experiments in heredity have taught us that in the course of time new species of animals and plants have developed whose last descendants form the present fauna and flora of our earth. The process of mutation and transformation has covered periods of time inconceivably long to the human mind; but there are many indications that the present species originated in certain centers of origin and distribution whence they conquered the world.

PARADISE WITHOUT BEAUTY

According to Professor Ludwig Diels, Director of the Berlin Botanical Gardens, one of these centers, from which our present vegetation obtained many of its species, is to be sought in the high plateau of eastern Tibet, a rolling grassy plain bounded in the east by the Himalayas and in the north by the Kunlun range. It is a region of great geological age, if not the oldest part in that section of the earth's surface.

Although this botanical center of evolution, the original home of many different plants, may justifiably be called a paradise, we must not imagine it to be a flower garden abounding in tropical forms and colors; for some parts of this area are stark and monotonous, a true steppe with all the characteristics of such a region. But nature has chosen this place to provide the links between east and west and north and south, for four great floras join hands here: the central Chinese, the western Chinese, the Himalayan and, in the high, cold mountain regions, the arctic.



BOTANICAL "MISSING LINKS"

This region has gained its importance in the eyes of science by the fact that it possesses several connecting varieties or genera of plants which have given proof of various long-suspected connections as well as important details to enhance our knowledge of the history of evolution. In other words, that plateau has supplied the botanical missing links for a number of species and genera, as the following examples go to show.

The orchid genus *Cypripedium* (lady's-slipper) is to be found throughout the rest of the world in several separate subdivisions which are so clearly defined that there can hardly ever be any doubt as to which species an individual plant belongs to. But in eastern Tibet all these boundaries separating the species become untenable: here there are varieties whose characteristics penetrate such artificial boundaries.

While in this case it is only a matter of doing away with separating lines drawn within a genus, other examples show that even the characteristics defining various genera may be wiped out here. This is the case, for instance, with two genera of the primulaceous plants, the primrose (*Primula*) and the sea-navelwort (*Androsace*). In Europe they appear as two sharply defined genera. But in the mountains of eastern Tibet there is a genus *Pseudoprimula*, which is closely related to the primrose and may at the same time be regarded as the ancestor of the sea-navelwort.

There are also connecting forms between the saxifrage (*Saxifraga*) and the golden saxifrage (*Chrysosplenium*) which had never been expected, for elsewhere these two genera differ to such an extent that so close a relation had no longer been deemed possible.

Of the columbine (*Aquilegia*), whose blossoms in Europe are always spurred, a primitive form still exists here whose petals have not yet developed a spur and which must hence be regarded as the older one, as simplicity is the primary in nature, complexity being the product of later evolution. The generic characteristics of the foxglove (*Digitalis*) and larkspur (*Delphinium*), whose difference is obvious even to the superficial observer, become so similar in species to be found in eastern Tibet that one seems to be faced by the very plant in which both genera have their common origin.

In Central Europe there is only a single species of the herb Paris (*Paris quadrifolia*) to be found, and its area of distribution reaches as far as Central Asia. In the high mountains of Yünnan, *Paris* appears in vast numbers of species and varieties, all of which, characteristically enough, are distributed over small areas only. The same applies to edelweiss (*Leontopodium alpinum*), of which the inhabitants of the Alps are so proud because of its rarity. In Europe it represents the only species of its kind, while in Central Asia edelweiss is to be found in many species and varieties as well as in vast quantities, so that "edelweiss steppe" has become the term for one of the natural formations of that region.

What is typical, however, is that most of the varieties represent primitive forms limited to a few species which, on the other hand, cover whole tracts of land.

FROM DESOLATION TO BEAUTY

The entire aspect changes in the bordering area to the south, where the four mightiest rivers of eastern Asia, the Yangtze, Mekong, Salween, and Irrawaddy, flow down from their sources in the marshy, upland plateau 4,500 meters above sea level. After a lei-

1. Lady's-slipper *(Cypripedium)* 2. Primrose *(Primula)* 3. Sea-navelwort *(Androsace)* 4. Saxifrage *(Saxifraga)* 5. Golden saxifrage *(Chrysosplenium)* 6. Columbine *(Aquilegia)* 7. Foxglove *(Digitalis)*

surely course through the broad valleys of the rolling plateau, they turn into foaming torrents cutting through the rugged mountains of western Yünnan and Szechwan. The effect of their erosion has given this part of the world a peculiar appearance. Peaks 7,000 meters high and vertical canyons 3,000 meters deep are still undergoing changes as a result of the continuing plutonic activity of this tectonically speaking still young region.

The regional changes in vegetation and the immense variety in species in this majestic mountain country with its romantic wildness provide scenes of singular beauty.

This region is marked by its great number of endemic species, i.e., such species as have originated on the spot and whose special characteristics have caused them to remain at the center of their origin. The explanation for the origin of such forms and the fact that they have not left their original location is to be found in the secluded nature of those valleys, in the equable climatic conditions over a long period of time, and in the lack of a struggle for existence. Thus these remote valleys developed a wealth of species such as is hardly found anywhere else in the world, with the possible exception of the Chimborazo region in South America. However, we must not confuse the above-mentioned wealth of species with a mass vegetation; on the contrary, the individuals of any one species are comparatively rare in the Yünnan-Szechwan region and are limited to small areas.

GOAL OF MANY EXPEDITIONS

For more than fifty years, phytogeographical and phylogenetic research has devoted great attention to this region. When toward the end of the last century the French Jesuit father Delavay sent the first botanical collection to Europe from what was then the almost inaccessible province of Yünnan, more than half of the 3,000 species he had collected proved to be new to science. Thus a new flora was introduced of whose existence nothing had been suspected and which appeared to be the richest anywhere in the world. From then on, this corner of the world became the goal of expeditions led by a number of prominent scientists.

Many botanical novelties were brought back by the well-known sinologue Faber. A tragic fate overtook another German expedition led by Dr. R. Brunhuber and Karl Schmitz, who were both murdered in 1909 on the upper Salween. Such names as Filchner and Tafel are also intimately connected with the exploration of Tibet, and some Shanghai readers may remember the expedition of Walther Stoetzner, who was accompanied by several Shanghai Germans, among them Fritz Secker. One of the most productive collections was that of the Viennese botanical geographer Handel-Mazzetti, who thoroughly covered the whole district in the years 1913 to 1920.

The southwestern region was opened up chiefly by French and English explorers. In addition to the "Mission Lyonnaise," there was George Forrest who collected specimens in the mountains of the upper reaches of the four great rivers. No less was the tribute due to E. A. Wilson, author of the well-known *Naturalist in China*. Among more recent expeditions, those of Kingdom Ward and Lord Cranebrook deserve special mention. The two first German Schäfer expeditions also made this area their objective and returned with valuable information.

8. Larkspur *(Delphinium)* 9. Herb Paris *(Paris quadrifolia)* 10. Edelweiss *(Leontopodium alpinum)* 11. Magnolia 12. Catalpa 13. Wisteria

CENTER OF ORIGIN OR REFUGE?

The region has been called the "cradle of the plant world," while Wilson, looking at it merely from the viewpoint of its abundance in flowers, calls it the "garden of the world." E. Schäfer, who developed his theories of evolutional history principally from his study of fauna which, it must be admitted, does not provide as convincing proofs as botany, is more reserved in his judgment and feels equally justified in regarding the region as an area of refuge. In his opinion, plants, animals, and man, when experiencing a deterioration of climate such as occurred, for instance, during the glacial period, retreated into secluded, inaccessible valleys and preserved their primitive forms till today.

INCUBATORS OF NEW SPECIES

However that may be, the geographical conditions make the beneficial effect on the evolution of species clear. In the unfavorable conditions for existence on the northern upland plateau the primitive forms of the plants eke out a meager life in vast quantities but in few numbers of species. The more highly developed species are to be found in the craggy border area whose narrow valleys with their comparatively unvarying conditions of existence act like an incubator upon the organisms, subjecting them to mutation until they are entirely adapted to the specific local conditions. In this area there are a great number of different species. On the other hand, the number of their individual plants is limited, and they cover only very small areas, i.e., only those in which their organism is in complete harmony with its environment.

An example of how the mountain ranges, with their narrow valleys and ridges too high for life to cross, are able to isolate the species is provided by any geographical profile chosen at random, as, for instance, the sector between Batang and Yachow, following the thirtieth degree of northern latitude for a distance of four hundred kilometers.

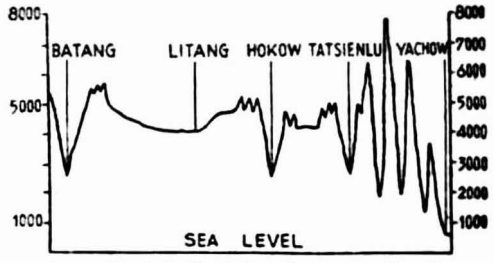
MIGRATING PLANTS

If the existence of primitive forms speaks for the assumption of a center of origin, this simultaneously emphasizes the second great significance of this area as a center of distribution from which individual elements radiated over China and beyond to find on their wanderings suitable conditions of existence thousands of miles from their original home.

The mechanisms for dissemination provided by nature are as varied as they are ingenious, no matter whether they rely on their own power, on human or animal agents, or on water or wind. Migrations of plants have been going on since time immemorial. If we only go back as far as the glacial period—expressed in figures, for 30,000 years—this means, in view of the preponderant annual character of plants, i.e., those which sprout, blossom, and bear fruit within the course of a year, a series of 30,000 generations with all its possibilities of territorial expansion and individual mutation, while man has covered the same period with no more than a thousand generations.

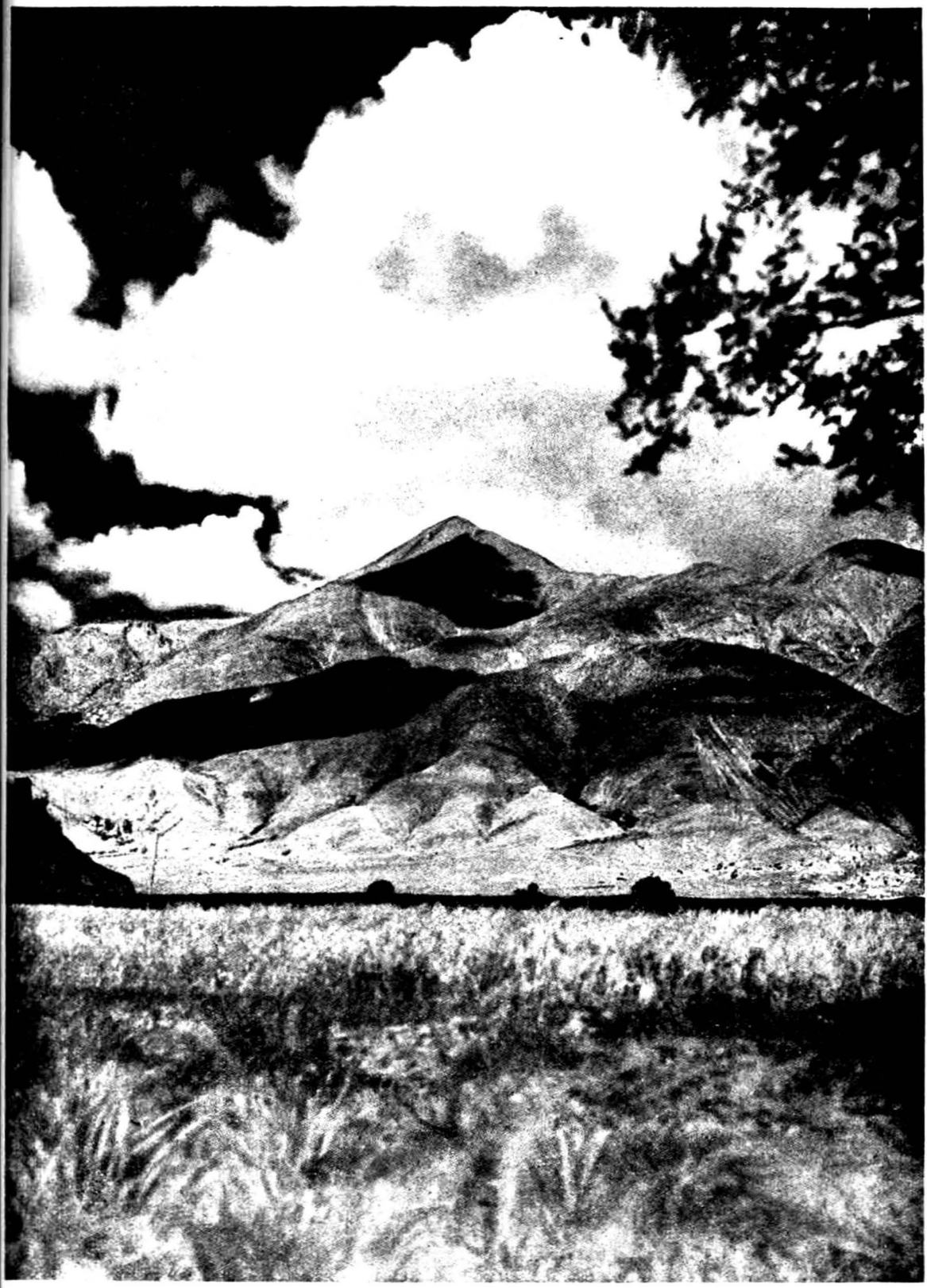
The effects of plant migration play an important or even a determining role in the composition of a flora. China obtained the great majority of her species from the Tibetan center, and her adjacency to the Himalayas has also provided the flora of western and central China with many Himalayan species, among which, strangely enough, the Sikkim element predominates.

However, the mutual influences exerted upon each other by the various regional floras in the way of exchange of species represent a very complicated chapter of botanical geography, since they are affected by a great many circumstances. Thus one



Geographical Profile Batang-Yachow. Elevations in meters

might feel inclined to assume that, as a result of the existing territorial links, the flora of Europe or at least that of the western part of the Asiatic continent would be the one to be most thoroughly penetrated by Chinese elements. It is true that many European plants are of Central Asiatic origin, but their number is much smaller than one would tend to believe on the basis of given conditions.



Southern Tibetan scene. It is from this region that many of the present day plants of Asia, North America, and Europe have originated

BOTANICAL GARDEN OF EDEN?

Grazing yaks on the high plateau of Tibet. Many primitive forms of the kingdom of plants are still to be found here

Whole bushes of edelweiss cover the slopes of Tibetan mountains

The hot, damp atmosphere in the deeply eroded valleys of Southwestern China acts as an "incubator" of new plant species

NORTH AMERICA A BOTANICAL COLONY OF CHINA

The opposite is true of the Atlantic part of North America. By means of various comparisons, Asa Gray has demonstrated to us the striking similarity and correlation of the two floras. A notable number of families, genera, and species is common to both regions, but in most cases China possesses by far the greater number of species, a fact which points to an earlier botanical colonization; in North America we sometimes find only one or two species of a genus, while in China there are many. Thus, for instance, the genus *Magnolia*, which does not occur at all in Europe and in the western part of North America, is represented by nineteen species in China and Japan, while there are seven species to be found in the Atlantic part of North America. Of the catalpa tree, which is native to China, there are also five species to be found in China and two in North America. The genus *Wistaria* exists in only four species throughout the world, all of which are to be found in China while two of them also occur in America.

The reason for this curious phenomenon of floral relationship between China and the Atlantic part of North America is to be sought as far back as the Tertiary. Before the glacial period, Asia and North America had a much closer territorial connection than is the case today, and on account of the more favorable climatic conditions of those times the vegetation of the northern areas was also far more extensive and luxuriant. Thus the main essentials for a plant migration or an exchange of plants were present. During the glacial period, however, the polar ice cap advanced southward and separated the two continents for ever, as it did not recede to its former limits during the subsequent warm period, remaining instead quite a bit further south.

It seems strange that it is the Atlantic part of North America which shows so striking a resemblance to the Chinese flora; one would, after all, expect the Pacific coast to be more likely to provide such parallels. But this is where geographical conditions on the American continent interfere. The plants flowing in from Asia over the old northern land bridge were blocked in their migration to the south by the inhospitable Rockies and arid prairies. In the east of the American continent, however, the Asiatic species could spread without hindrance. Moreover, they found a suitable climatic environment here. Although the Pacific coast offers a similar environment, the sole strip of land by which the plants could get there was so narrow that this stream of plants advancing along it from the north got suffocated.

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So China shelters in eastern Tibet and western Yünnan and Szechwan a botanical center of evolution and distribution which has benefited the vegetation of the entire Eurasian continent as well as the rest of the world. There, far off from the bustle of the world and undisturbed by political events, nature has been going on for thousands of years evolving new forms of plant life to offer the earth.

Not Only in Canada

The Member for North Battleford, Saskatchewan, Mrs. Dorise Neilsen, declared in the Canadian House of Commons:

"On October 1, 1943, no fewer than 1,075,000 women were gainfully employed in Canada . . . . They are filling places . . . in our gun factories, shipyards, steel mills . . . . Wherever it is a question of dexterity or accuracy or patience or pride in work, women are not second to men . . . . [These women] are wondering what their position will be when the war is over. Are the governments and employers going to say: 'Well, girls, you have done a nice job; you looked very cute in your overalls and we appreciate what you have done for us; but run along now; go home; we can get along without you'?"