

logical frequency curves, and their change with changing place and environment. The idea of correlation has received a precise definition. The results of experimentation have been quantitatively expressed. The rôle of natural selection, the method of evolution and the laws of inheritance are being discovered. Already we are able to predict greater results from the quantitative method in biology, especially where combined with experimentation, than any which have yet appeared.

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PLANT GEOGRAPHY OF NORTH AMERICA. COMPOSITION OF THE ROCKY MOUNTAIN FLORA.

IN Southern Wyoming the Great Plains extend across the continental divide, making a break in the Rocky Mountain chain, and dividing it into two groups, the Southern and the Northern Rockies. The former are for the greater part in the State of Colorado, but extend into northern New Mexico as well as southern Wyoming. The Wasatch and Uintah Mountains, although separated from the main chain by the Green River Basin, may also be noted here.*

The Northern Rockies begin in northern Wyoming, but have their best development in western Montana, northern Idaho, western Alberta and eastern British Columbia. The chain also extends into Alaska and Yukon Territory, but the flora of this region is partly very little known and so merged into the Pacific Coast flora that it deserves a separate treatment. Some isolated mountains, as for instance the Black Hills of South Dakota and the Little Rockies and Bear Paw Mountains of Montana, may also be mentioned here.

*The mountains of southern New Mexico and Arizona may also be accounted to the Rocky Mountain system, but their flora is so different and contains so many Mexican and Sonoran elements that it is better to exclude them from this discussion.

The flora of the two groups is essentially the same, but some differences are found. These are most evident in the coniferous vegetation. So are for instance *Pinus edulis*, *Pinus aristata*, *Picea Parryana* and *Abies concolor* confined to the Southern Rockies, while *Pinus Murrayana*, *Picea Columbiana* and *Abies grandis* take their place in the Northern. *Psudotsuga mucronata*, *Picea Engelmannii* and *Pinus flexilis* are equally common in both regions.

The flora of the mountain regions is made up of the following elements:

1. The ENDEMIC FLORA OF THE ROCKIES, which constitutes the largest element. In Montana it is represented by 33 per cent. of all the species and in the Southern Rockies the proportion is much larger.

2. The TRANSCONTINENTAL FLORA, made up mostly of hydrophilous plants.

3. The BOREAL FLORA OF NORTH AMERICA, which in British America is more or less transcontinental, but in the United States is found principally in the mountain regions. It is made up mostly of hylophilous plants, but also represented by some hydrophilous ones, as for instance members of *Cyperaceæ*, *Salicaceæ* and *Ericaceæ*.

4. The ARCTIC FLORA, found only on the tops of the highest peaks at an altitude of over 3,000 m. in Montana and over 4,000 m. in southern Colorado.

5. The CASCADE MOUNTAIN FLORA, which merges with that of the Rockies in British Columbia and partly extends south into Montana and Idaho.

But in discussing the flora of the Rockies, one must not only take in consideration that of the mountain regions, but also that of the intermingling plains, valleys and foothills. If this is done, several new elements must also be considered.

6. The FLORA OF THE GREAT PLAINS. The Great Plains consist of high dry tablelands and make up a large portion of Saskatchewan, Assiniboia, eastern Montana

and Colorado, eastern and central Wyoming, and western Dakotas, Nebraska and Kansas. They have a flora of their own, mostly consisting of xerophilous plants, but in the valleys along the water courses are brought in besides the transcontinental flora mentioned above, also a few of another element, viz :

7. The PRAIRIE FLORA OF THE MISSISSIPPI VALLEY. The species of the typical Alleghanian flora found in the Rockies are so few that they may practically be disregarded. In all cases they are also represented in the Prairie flora.

8. The FLORA OF THE STAKED PLAINS, which extends into southeastern Colorado and northeastern New Mexico. The Staked Plains, with their best development in northwestern Texas, are but a southern extension of the Great Plains, but contain numerous plants not found on the latter, so that its flora may well be treated separately.

9. The SONORAN FLORA, the general flora of the table-lands of northern Mexico, Arizona and southern and western New Mexico.

10. The GREAT BASIN FLORA of Nevada, Utah, southern Idaho and southeastern Oregon. This can almost be regarded as a desert flora. It is also met with outside of the Great Basin, especially in many places in the Green River valley of Wyoming, Utah and Colorado.

11. The COLUMBIA VALLEY FLORA. This

flora extends along the headwaters and tributaries of Columbia River into the Rockies of Idaho, Montana and British Columbia.

A flora made up of so many elements must naturally be very varied and exceedingly interesting. A comparison may well be made with that of the Alleghanies on one hand and that of the Cascade Mountains and Sierra Nevada on the other. If this is done we find that the flora of the Rockies resemble more the latter than the former.

The bulk of the forest of the Rockies is made up of Conifers. Most of these are common to the region and mountains of the Pacific Coast, but none of the trees are found in the Alleghanies or around the Great Lakes. The White Spruce, *Picea Canadensis*, has been reported from northern Montana and Alberta, but I think erroneously so. Probably *P. Columbiana*, which resembles it in habit and the glabrous branches, has been mistaken for it. *P. Columbiana* is otherwise much more closely related to *P. Engelmannii*. Two prostrate shrubby species of *Juniperus*, *J. Sibirica* Burgsd. and *J. postrata* Pers. range across the continent. Both are subarctic and sub-alpine. Besides these none of the Rocky Mountain conifers are found in the East, although they are often represented there by closely related species.*

* List of the Rocky Mountain Conifers and their representatives in the East and on the Pacific Coast

Rocky Mountains.	East.	Pacific Coast.
<i>Pinus flexilis</i> }	{ <i>Pinus flexilis</i>
<i>Pinus albicaulis</i> }		{ <i>Pinus albicaulis</i>
<i>Pinus monticola</i>	<i>Pinus Strobus</i>	{ <i>Pinus monticola</i>
<i>Pinus edulis</i>	{ <i>Pinus Lambertina</i>
<i>Pinus aristata</i>	<i>Pinus monophylla</i>
<i>Pinus ponderosa</i> }		{ <i>Pinus aristata</i>
<i>Pinus scopulorum</i> }		{ <i>Pinus Balfouriana</i>
<i>Pinus Murrayana</i>	<i>Pinus resinosa</i>	<i>Pinus ponderosa</i>
	{ <i>Pinus Virginiana</i>	{ <i>Pinus Murrayana</i>
	{ <i>Pinus divaricata</i>	{ <i>Pinus contorta</i>
	{ <i>Pinus echinata</i>	

Among the deciduous trees and shrubs, the number of species common to the Rockies and the East is much larger. Many of these common species are boreal, but some are truly transcontinental or nearly so.

Of the SALICACEÆ about three-fifths of the Rocky Mountain species are endemic or western. The rest are nearly all boreal. The only ones that cannot come under these categories, as far as I can remember, are *Salix Bebbiana*, *S. candida* and *S. cordata*. The eastern *Populus deltoides* is represented in the Rockies by a western variety.

Of BETULACEÆ, *Betula papyrifera*, *B. glandulosa*, *Alnus Alnobetula* and perhaps *A. incana* are found both in the Rockies and in the East. The other four Rocky Mountain species are western.

Of FAGACEÆ, *Corylus rostrata* is common to the Rockies and the East. Besides by this species, the family is represented in the region by a few endemic low species of *Quercus* of the White Oak group.

ULMACEÆ is represented by three or four species of *Celtis*, of which *C. occidentalis* is found in the East. *Ulmus Americana* is found here and there in the valleys of the Great Plains, but scarcely reaches the Rockies.

All woody species of HYDRANGIACEÆ, GROSULARIACEÆ, ROSACEÆ, POMACEÆ, DRUPACEÆ, PAPILIONACEÆ, RUTACEÆ, RHAMNACEÆ, ACERACEÆ, CELASTRACEÆ and ANACHARDIACEÆ are endemic or western, except four species of *Ribes*, four of *Rosa*, *Rubus strigosus*, *Dasifora fruticosa*, *Sorbus sambucifolia*, *Prunus Americana*, *P. Pennsylvanica*, *Amorpha fruticosa*, *Rhamnus alnifolia*, *Acer Negundo* and *Rhus glabra*, which are also found in the East.

The two species of VITACEÆ found in the Rockies, viz., *Vitis vulpina* and *Parthenocissus quinquefolia* extend to the Atlantic coast, and so also the three species of ELÆGANACEÆ.

Taken as a whole, scarcely 20 per cent. of the woody plants of the Rockies are found in the Alleghanies or around the Great Lakes. Nearly all those common to both regions are transcontinental or boreal species. If on the contrary, the woody flora of the Rocky Mountains were compared with that of the mountains of the Pacific Coast, one would find that at least 50 per cent. of the former would be represented in the northern Cascade Mountains, which in British Columbia are more or less contiguous to the Rockies.

It has been impossible for me to make a detailed comparison of the general flora of the Rockies with that of the East on one hand and with that of the Pacific States on the other. In my catalogue of the flora of Montana and the Yellowstone Park, I made such a comparison, and I think that the conclusion reached there with some modification may serve for the whole Rocky Mountain region. The catalogue contains 1,976 species and varieties. Of these 487 are found both east and west of the mountains and 268 only east thereof, or in other

<i>Larix occidentalis</i> }	<i>Larix laricina</i>	{ <i>Larix occidentalis</i>
<i>Larix Lyallii</i> }		{ <i>Larix Lyallii</i>
<i>Picea Parryana</i> }	{ <i>Picea Canadensis</i>	{ <i>Picea Sitchensis</i>
<i>Picea Engelmannii</i> }	{ <i>Picea rubra</i>	{ <i>Picea Engelmannii</i>
<i>Picea Columbiana</i> }	{ <i>Picea Mariana</i>	{ <i>Picea Columbiana</i>
<i>Pseudotsuga mucronata</i>	(<i>Tsuga Canadensis</i>)	<i>Pseudotsuga mucronata</i>
<i>Abies grandis</i> }		{ <i>Abies grandis</i>
<i>Abies amabilis</i> }	<i>Abies balsamea</i>	{ <i>Abies amabilis</i>
<i>Abies concolor</i> }		{ <i>Abies concolor</i>
<i>Abies lasiocarpa</i> }		{ <i>Abies lasiocarpa</i> , etc.
<i>Thuja plicata</i>	<i>Thuja occidentalis</i>	<i>Thuja plicata</i>
<i>Juniperus scopulorum</i> }	<i>Juniperus Virginiana</i>	<i>Juniperus California</i>
<i>Juniperus Knighti</i> }		
<i>Juniperus occidentalis</i> }	{ <i>Juniperus occidentalis</i>
<i>Juniperus monosperma</i> }		{ <i>Juniperus monosperma</i> , etc.
<i>Juniperus prostrata</i>	<i>Juniperus prostrata</i>	<i>Juniperus prostrata</i>
<i>Juniperus Sibirica</i>	<i>Juniperus Sibirica</i>	<i>Juniperus Sibirica</i>
<i>Taxus brevifolia</i>	<i>Taxus Canadensis</i>	<i>Taxus brevifolia</i>

words 755 of the Montana and Yellowstone Park species are extending eastward. This includes transcontinental and boreal plants, as well as plain and prairie species. Of these not more than half or not fully 20 per cent. of the whole number reach as far east as the Alleghanies or the Great Lakes. If the flora of Colorado should be compared in a similar way with that of the east, one would find that a much smaller number of species was common to the two. It is therefore safe to say that not 20 per cent. of the plants of the Rockies are found in the Alleghanian region and that these consist almost exclusively of transcontinental and boreal plants.

In comparing Montana with the Pacific Coast, I found that 487 (mostly transcontinental and boreal plants), plus 520 (mostly Columbian and Cascade Mountain plants) or 1,007 species or nearly 51 per cent. of the plants of that State are also found west thereof. These figures can not be taken as a fair average, for in Colorado we find fewer plants that are common to that State and the Pacific Coast. I should judge that even 20 per cent. would there be a high number. I think, however, that it is safe to say that between 30 and 40 per cent. of the plants of the Rockies are also found in some part of the Pacific Coast region.

The families best represented in the Rock Mountain flora are the following in the order here given: COMPOSITÆ, GRAMINEÆ, PAPILIONACEÆ, CYPERACEÆ, SCROPHULARIACEÆ, ROSACEÆ, CRUCIFERÆ, RANUNCULACEÆ, CICHORIACEÆ, POLYGONACEÆ, ONAGRACEÆ, UMBELLIFERÆ.

In Montana the composites (with CICHORIACEÆ and AMBROSIACEÆ excluded), constituted about 15½ per cent. of the species of flowering plants, the grasses about 10 per cent., the pea family 6 per cent., the sedges and rushes 5 per cent., etc. Of COMPOSITÆ over 45 per cent., of GRAMINEÆ over 41 per cent., and of PAPILIONACEÆ

nearly 50 per cent., but of CYPERACEÆ only 25 per cent. are endemic species.

In Montana the following genera are represented by the largest number of species: *Carex*, *Senecio*, *Erigeron*, *Potentilla*, *Pentstemon*, *Astragalus*, *Poa*, *Aster*, *Ranunculus*, *Salix*, *Artemisia*, *Polygonum*, *Castilleja* and *Eriogonum*. In the whole Rocky Mountain region these genera will have nearly the same order, except that *Pentstemon* and *Polygonum* have to be moved slightly further down and *Eriogonum* a little higher in the scale.

P. A. RYDBERG.

A TERTIARY CORAL REEF NEAR BAINBRIDGE, GEORGIA.*

THIS fossil coral reef is located near Russell or Blue Spring, about four miles below Bainbridge, Decatur County, Georgia, along the Flint River. My attention was first called to the presence of reef corals in this vicinity by finding two species, collected by Professor Raphael Pumpelly, in the United States National Museum. These species were described by me in Monograph XXXIX. of the United States Geological Survey, under the names *Stylophora minutissima* and *Astrocenia pumpellyi*, both species being compared with species from the Antiguan Oligocene. Subsequently, in February, 1900, Mr. Alfred H. Brooks, of the United States Geological Survey, brought me from the same locality a species of *Orbicella*, which I identified with an Antiguan species and specimens of *Astrocenia pumpellyi*. Because specimens of *Pecten* (*Pseudamusium*) *ocalensis* Dall and *Orbitoides* were brought with the corals, I referred the latter to Dall's Ocala horizon of the Vicksburgian Oligocene. It will be shown later that I was mistaken as to the stratigraphic position of the corals.

Because of the interesting character of the corals from Russell Spring, I requested

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