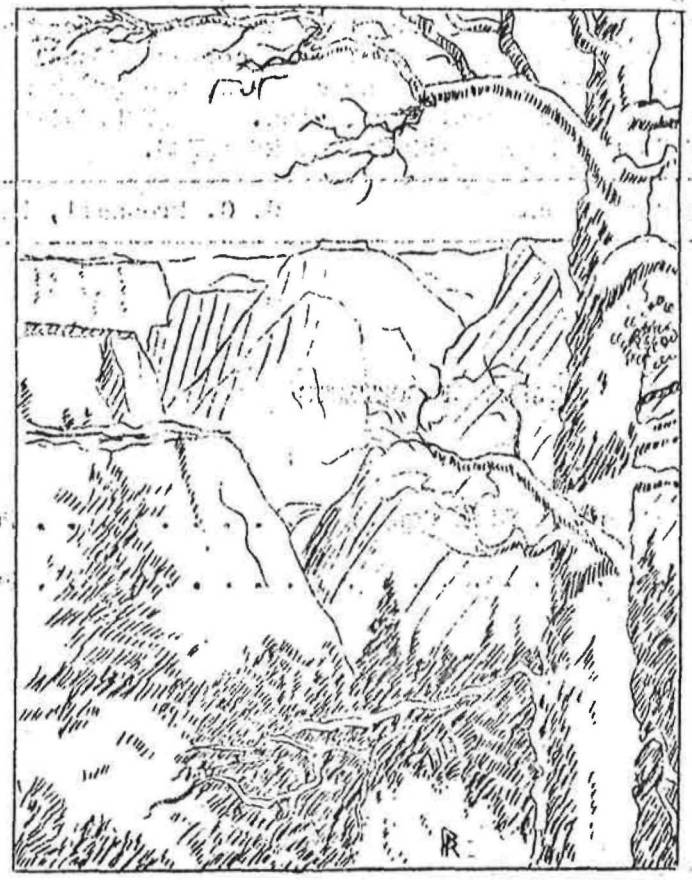
Zion and Bryce Nature Notes



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DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Zion and Bryce Canyon National Parks, Utah

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Zion-Bryce Nature Notes Sept.-Oct., 1934

This bullotin is issued monthly for the purpose of giving information to those interested in the natural history and scientific features of Zion and Bryce Canyon National Parks. Additional copies of these bulletins may be obtained free of charge by those who can make use of them by addressing the Superintendent, Zion National Park, Utah. PUBLICATIONS USING THESE NOTES SHOULD GIVE CREDIT TO ZION-BRYCE NATURE NOTES.

P. P. Patraw, Superintendent C. C. Presnall, Park Naturalist

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THE RIVER BOULDERS IN ZION CANYON

By J. C. Anderson

Conspicuous because of its total dissimilarity to the inclosing sandstone walls, the river-carried material in the bottom of Zion Canyon forms a mass of heterogeneous rocks gathered from the plateau drained by the Virgin River. Several thousand feet of rock layers on top of the inclosing cliffs of Zion Canyon have supplied the great variety and types of rock to be found along the river. These rock layers represent the sea and land deposits laid down through many millions of years, extending from the geologic past to the present day.

The trained eye of the geologist can, at a glance, name and place in their proper position in the rock layers the different types of rock on the valley floor. But the average visitor to Zion Park is only thrown into greater confusion by each succeeding new kind of rock because very few are composed of the same material that forms the cliffs of the canyon proper. It is the purpose of this short paper to describe, name, and locate as to origin the different rocks that are commonly seen in the Virgin River.

A cursory examination of the problem revealed that every major rock class is represented: namely, igneous, sedimentary, and metamorphic.

Igneous rocks having their origin from the interior of the earth have covered large areas in the form of lava flows and cinder cones. These rocks are represented by rounded boulders of basalt lava usually rich in small masses of greenish glass called Olivine. The much rounded shape of the lava rock is evidence of the long distance it has been carried.

The sedimentary class represents well over 95% of the rock in the region, but as the class is represented in the river carried rocks it falls far below that total. The reason is, of course, that the sedimentary rocks are less durable than the dense lava or igneous rock. Then again, the quartzite is classed as metamorphic though in this region it is of sedimentary origin. Sedimentary rocks vary in character and composition so greatly that a minor constituent of the rock layers may jump into predominance in the river gravel. Sandstone and shale are clastic or mechanical deposits that are hard or soft according to the state of con-

solidation, the amount and type of cementing material holding the individual grains together. Silica, the chief constituent cementing the so-called silicious sandstones makes a very hard rock while gypsum as a cementing material is extremely weak. Lime varies radically and makes a hard to very weak cement. Chemically deposited rock usually forms a very resistant dense material such as limestone, chert, and the various concretionary deposits found in sandstone and shale. Organic sediments are usually soft on weathered exposures. This is true of coal which burns and slacks without much chance of becoming mixed in the river rocks. Sometimes organic material makes a chemical change, as in the case of petrified wood.

Metamorphic rocks are not found in the Virgin River drainage as bedrock, but are derived from layers of gravel and conglomerate in the sedimentary series. The original source of the hard quartzites and black slate is still undetermined. These rocks are rather abundantly represented in the river gravel by a great variety of white to brightly colored quartzite boulders and pebbles. To give a conception of the relative abundance of the various rocks, small squares two to three feet in size were blocked out at various points along the river. The rock fragments were carefully sorted and given a percentage rating according to the amount represented in each case. Much more work needs to be done but the following rock counts may be taken as indicative of what a complete and thorough study would establish.

I - Rocks found in a two foot square about 200 yards below the suspension bridge in front of Zion Lodge:

20% red sandstone; soft.
28% buff and gray sandstone; rather hard and tightly cemented.
14% chert and small pebbles of quartzite.
20% lava; vesicular to dense.
14% gray and buff limestone (in part fossiliferous; about 30% is oolitic)
3% concretionary rocks; ironstone.
1% petrified wood

II - Rock count one-half mile above public campground:

50% gray to buff oolitic limestone; in part fossiliferous; often blue in color but buff on broken surface.
28% gray, buff; fine to medium grained sandstone; lime, silica and iron cemented; fossil oysters found like those in the Straight Cliffs Sandstone.
7% pink limestone; zigzag veins of pure calcite.
11% lava; vesicular to dense; black to blue-gray.
3% chert, quartzite; about 1% angular, the rest well rounded; some in conglomeritic.
One small rounded fragment of coal.

III - Rock count in three foot square one half mile below the Temple of Sinawava:

15% quartzite:
- 2% angular, conglomeritic
- 5% white; sub-argular to well rounded
- 8% red, gray, blue; angular to nearly rounded

35% blue to gray buff limestone:
- 18% dense buff
- 12% oolitic; fossilifferous
- 5% limestone conglomerate

21% sandstone:
- 12% buff, gray, and fossiliferous in part
- 4% peppery with black grains of chert
- 4% light red
- 1% dark red

4% pink limestone

6% chert; red and black

19% lava

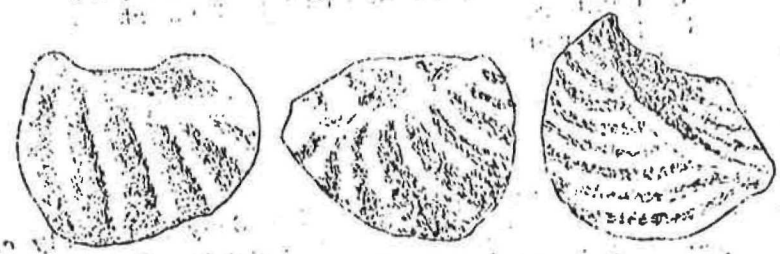
The Navajo Sandstone seen in the cliffs of Zion Canyon locally contributes large amounts of soft red sandstone to the canyon floor where it is seen in various stages of decay. In dry situations the red sandstone is hard and resistant, but where moisture is available the porous rock soon absorbs water which softens the lime and iron cement to such an extent that the touch of a finger reveals a soft crumbling mass easily washed away as sand. The white part of the Navajo Sandstone, comprising approximately the upper third of the formation, is much softer than the red part because it does not have the strengthening combination of iron oxides. Consequently it is very seldom seen on the canyon floor.

Triassic, Chinle formation supplies a very small amount of very red sand to the river where this formation is exposed at the base of the sandstone cliffs.

A Jurassic marine limestone, the Carmel formation, some 300 feet thick, directly above the Navajo Sandstone, is a great contributor to the river gravels as shown by the rock sections. It is fossiliferous and in places oolitic. Oolites are small lime concretions, round and smooth.

Oolitic Limestone

They can be found in great abundance on the shores of Great Salt Lake where they form the sandy beaches. Because of its dense crystalline nature the Carmel formation is particularly adapted for long distance transportation by water, resisting in turn the shocks and mechanical forces imposed by flood waters and the chemical attack so destructive to the durability of other rock formations. Fossils are very abundant in certain zones and it is not hard to locate the fossil bearing horizons when crossing an exposure of this limestone. Trigonia and Pentacrinus asteriscus are rather characteristic.



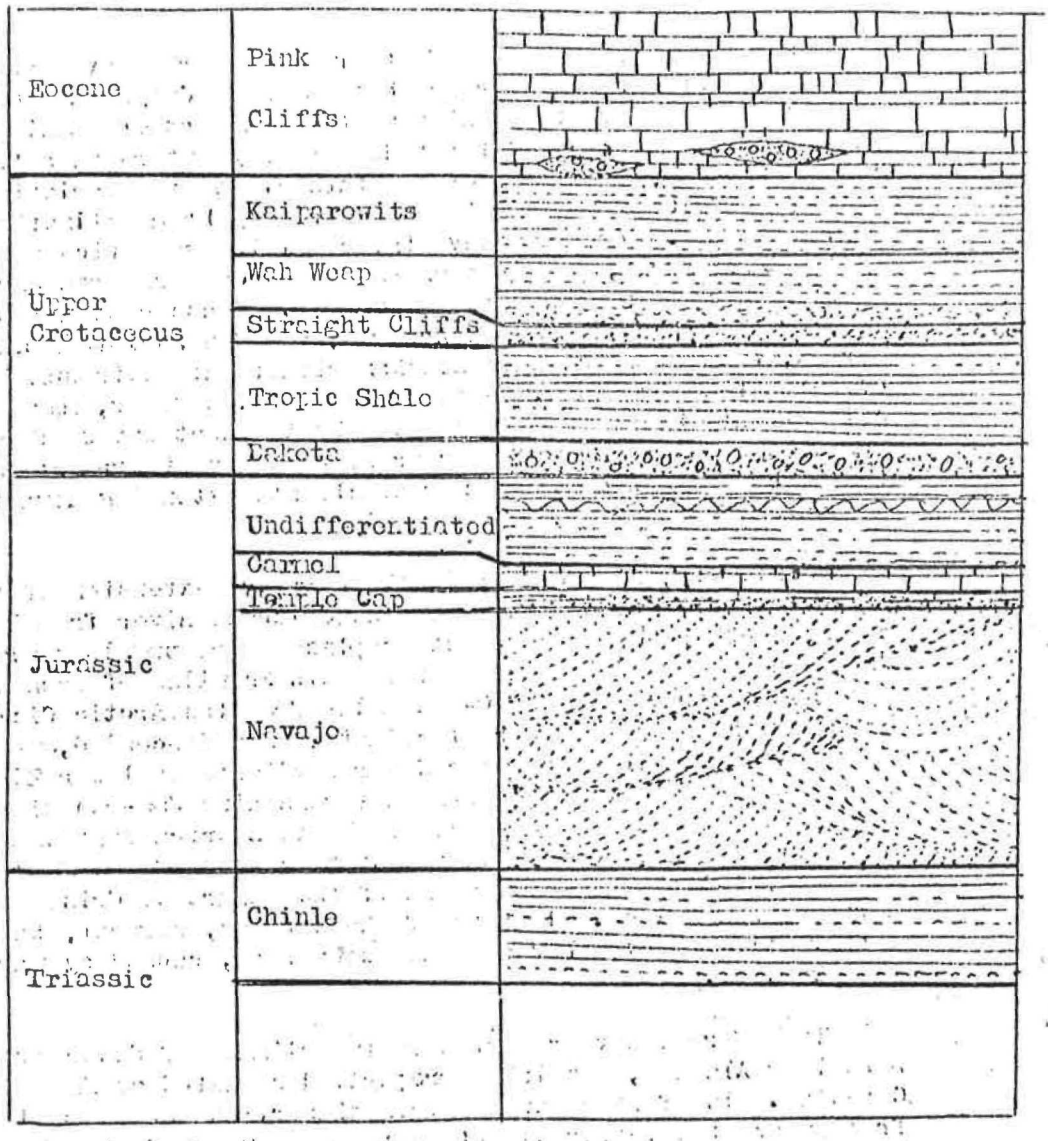
Trigonia

Overlying the Carmel formation are several hundred feet of sediments that are not represented to any measurable extent in the river gravels; but immediately overlying the uppermost of these is a layer of coarse gravel and sandstone (Dakota Formation) that contributes much of the small round chert and quartzite pebbles; black, red, and brown in color. This is the basal member of a series of more than 3,000 feet of cretaceous sandstones and shales ending under the Pink Cliffs. Prominent deposits of gravel occur in about two places in the series and a careful comparison of these gravels with fragments found in the Virgin River show them to be similar in color, texture, and size. All of the tuff and gray sandstone bounders found in the canyon have their origin in the ledges of Cretaceous sandstone. The black peppered sandstone comes from the Kaiparowits formation just below the base of the Pink Cliffs. Large bounders having abundant fossil remains are common, several being conveniently located near the end of the Narrows Trail. An abundance of soft gray shale in the Cretaceous is responsible for the unusual muddy color of the Virgin River. Prominent because of its thickness and the imbricated drainage pattern it produces, the 600 feet of Tropic Shale probably contribute more silt than the dozens of thin shale beds that lie in the sandstones above it. During the late summer when cloudbursts are common, a great amount of mud is supplied from the Cretaceous sediments and swept into the canyon, greatly increasing the Virgin River's power to move large rocks and small far from their previous positions. Occasional fragments of coal and petrified wood are found in some of the gravel bars and have their origin in the lower part of the Cretaceous embracing the Dakota and the lower part of the Tropic Shale.

With the discovery of small very round quartzite boulders, totally different from anything to be found in the Jurassic or Cretaceous for-

nations, came a perplexing problem which was solved when the source of these boulders was found in the lower part of the Pink Cliffs, where large masses of quartzite conglomerate form lenticular beds. This material has traveled the river bed more than 25 miles and with it came some of the pink impure limestone.

Many of the lava boulders have been carried farther than any of the other rocks, having come from on top of the Pink Cliffs. The road between Cedar Breaks and Navajo Lake crosses part of the great lava beds that supply boulders to the Virgin drainage. Some of the ignedus rocks, however, do not come from such remote regions, but from lava flows that fringe the west and northwest edge of the drainage area. These flows are supplying red and black vesicular lava to the canyon boulder display.



LIFE ZONES

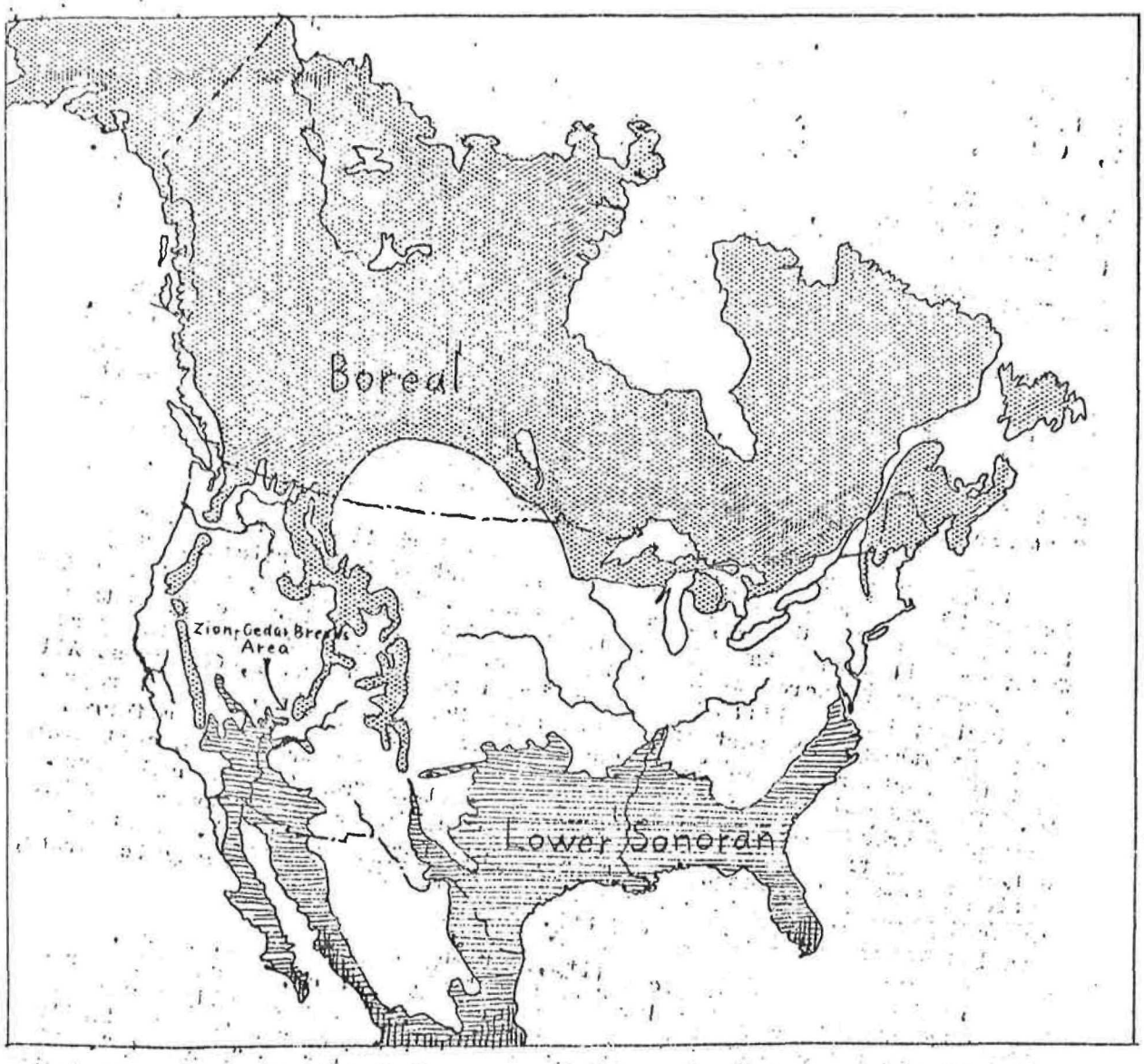
By C. C. Presnall

During the coming winter we plan to publish a series of articles on birds and animals, dealing chiefly with their distribution in Zion, Bryce, and Cedar Breaks. Since the distribution of all forms of life is determined to a great extent by temperature, we will present in this article a brief summary of the temperature conditions, or Life Zones, in the three areas.

Travelers visiting the Southern Utah Parks invariably notice the pronounced climatic difference between Zion Canyon and Cedar Breaks, a difference equal to that existing between northern Mexico and central Alaska. Many degrees of latitude normally intervene between such diverse climates, but on steep mountain slopes the variation in altitude has the effect of telescoping the normally broad climatic belts into narrow zones. Hence we have the condition so noticeable to visitors in the Utah parks, a condition that is much more pronounced on many mountains than it is on Cedar Mountain. Classic examples of this are the San Francisco Peaks, in Arizona, and San Jacinto Mountain, in California, both of which have Alaskan climate at their summits and Mexican climate at their bases. Both of them are, however, mere islands of cold climate besieged on all sides by the heat waves of extensive warm areas, whereas Cedar Breaks represents the southernmost extension of a long unbroken peninsula of boreal climate extending down the Rocky Mountains from Canada.

Similarly, Zion Canyon is the northern extension of a great area of Austral climate extending up the Colorado River from Mexico. In other words, southern Utah is a meeting place where two long arms of climate from Alaska and Mexico extend to within 29 miles of each other. It is possible to travel the 2000-odd miles from the Arctic Circle to Cedar Breaks without leaving Boreal climate, then descend 6,500 feet in 29 miles to the Mexican or Lower Sonoran climate of lower Zion Canyon, and continue in that climate during the remaining 350-odd miles to Mexico. There are only two other places in North America that exhibit this Life Zone arrangement. One is at the southern end of the Sierra Nevada, and the other is at the southern end of the Sangre de Cristo Range, in northern New Mexico. In both of these cases, however, there are minor interruptions in the boreal zone extensions, caused by narrow Transition Zone valleys.

Thus far we have referred to the climate of Cedar Breaks as Boreal or Alaskan, but it is properly designated as Hudsonian and Canadian. The former extends from timberline down usually to 10,000 feet from whence the latter usually extends to 8,500 feet. Practically all



ZONE MAP OF NORTH AMERICA
Simplified to show only the principal areas of the Boreal Region and the Lower Sonoran Zone.

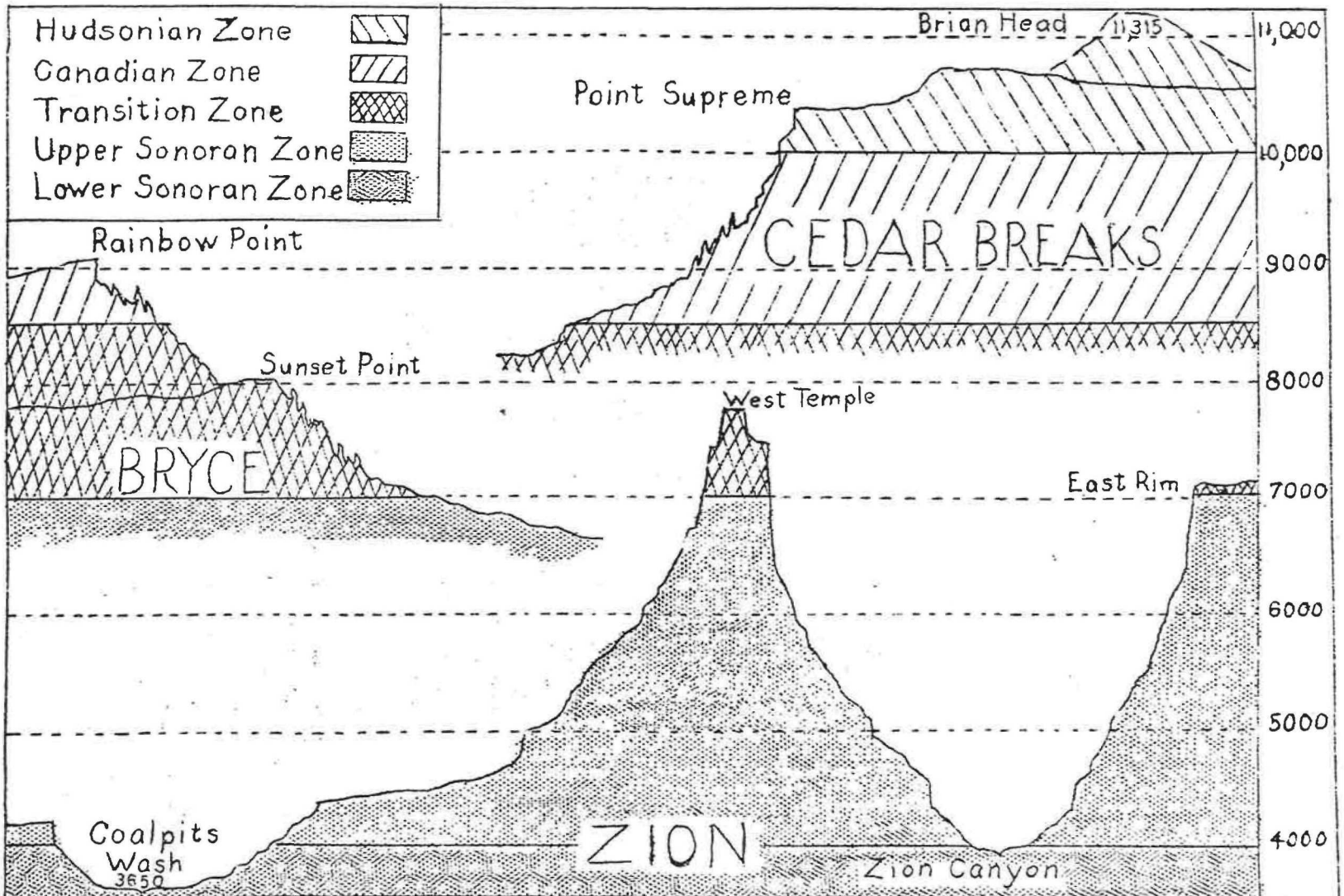
of Cedar Breaks National Monument lies within these two zones, only a very small area beneath the Pink Cliffs being below 8,500 feet, while the highest point (10,700 feet) lacks several hundred feet of reaching timberline. All of the monument now accessible by roads and trails is in the Hudsonian Zone, which is here characterized by Engelmann Spruce (Picea engelmanni) and Alpine Fir (Abies lasiocarpa). The relatively barren Pink Cliffs of Cedar Breaks are chiefly within the Canadian Zone, but this zone is much better represented in the higher portions of Bryce Canyon National Park, where there are typically Canadian forests composed of White Fir (Abies concolor), Limber Pine (Pinus flexilis), and Quaking Aspen (Populus tremuloides aurea).

The northern half of the plateau at Bryce, between 7,600 and 8,400 feet, represents typical Transition Zone, which normally extends from 7,000 to 8,500 feet in this region. All of the high plateau country in Zion is also in the Transition Zone, but because of its lower elevation, (6,500 to 7,800 feet) it has some characteristics that are not so evident at Bryce; for example, a greater amount of oak brush (Quercus utahensis). The Transition Zone forests in both parks are nearly pure Yellow Pine (Pinus ponderosa) but at Bryce the oak undercover is largely replaced by Manzanita (Arctostaphylos platyphylla).

Below the rims of Bryce and Zion is the Pinon Pine-Juniper scrub forest, which indicates Upper Sonoran Zone. It is a comparatively broad zone, usually extending from 6,500 feet down to 4,000, with occasionally wider limits as great as 7,000 to 3,700 feet. The characteristic scrub forest, with many open expanses of chaparral, covers the entire zone except where infrequent streams or springs furnish moisture enough for Cottonwoods (Populus fremonti) and various other deciduous species.

Only a very small area of Zion National Park lies in the Lower Sonoran Zone (termed Mexican in the first part of this article). The lower ends of Zion Canyon, Parunuweap Canyon, Shones Creek, and Coal Pitts Wash, are all within this zone. In each of the first three canyons there are less than 60 acres of Lower Sonoran climate included within the park boundaries; in Coal Pitts Wash there are between 900 and 1,000 acres. All of these streams are part of the Colorado drainage system, and all represent the northern end of the Mexican climate extension already referred to. The Lower Sonoran Zone is in this region almost treeless except where deciduous trees extend down well watered valleys from the Upper Sonoran. Only one new tree species makes it appearance in the Lower Sonoran of Zion National Park - the Mesquite (Prosopis juliflora glandulosa). Most of Lower Sonoran in Zion is covered with a sparse stand of xerophytic shrubs, mingled with eight species of cacti.

In forming a mental picture of the life zones in Zion, Bryce, and Cedar Breaks (or any other locality, for that matter), it should be remembered that the zonal boundaries do not extend horizontally around the mountains like ancient shore lines; hence all references to zone limits have been qualified by such adjectives as "usually" or "normally". The limits of any given zone shift up or down from the normal to a surprising degree. At one point on Horse Pasture Plateau, in Zion National Park, the Upper Sonoran Zone extends up a warm sunny slope to 7,300 feet, yet an observer standing there among the Pinons and Junipers can look down to a shady protected valley 1,100 feet below where Yellow Pines and Quaking Aspens proclaim Transition Zone - complete reversal of zones caused chiefly by differences in exposure. On the far side of this Transition Zone Valley is a narrow canyon where the sun shines but a few hours a day. There, at an elevation of 6,400 feet, is a dense stand of Transition Zone trees (Pseudotsuga and Abies) beneath which grow herbaceous plants usually found in high Transition or low Canadian Zones. Such examples are very numerous in Zion, and are found to a lesser degree in Bryce and Cedar Breaks.



Ideal Diagram of Life Zones in Zion, Bryce, and Cedar Breaks