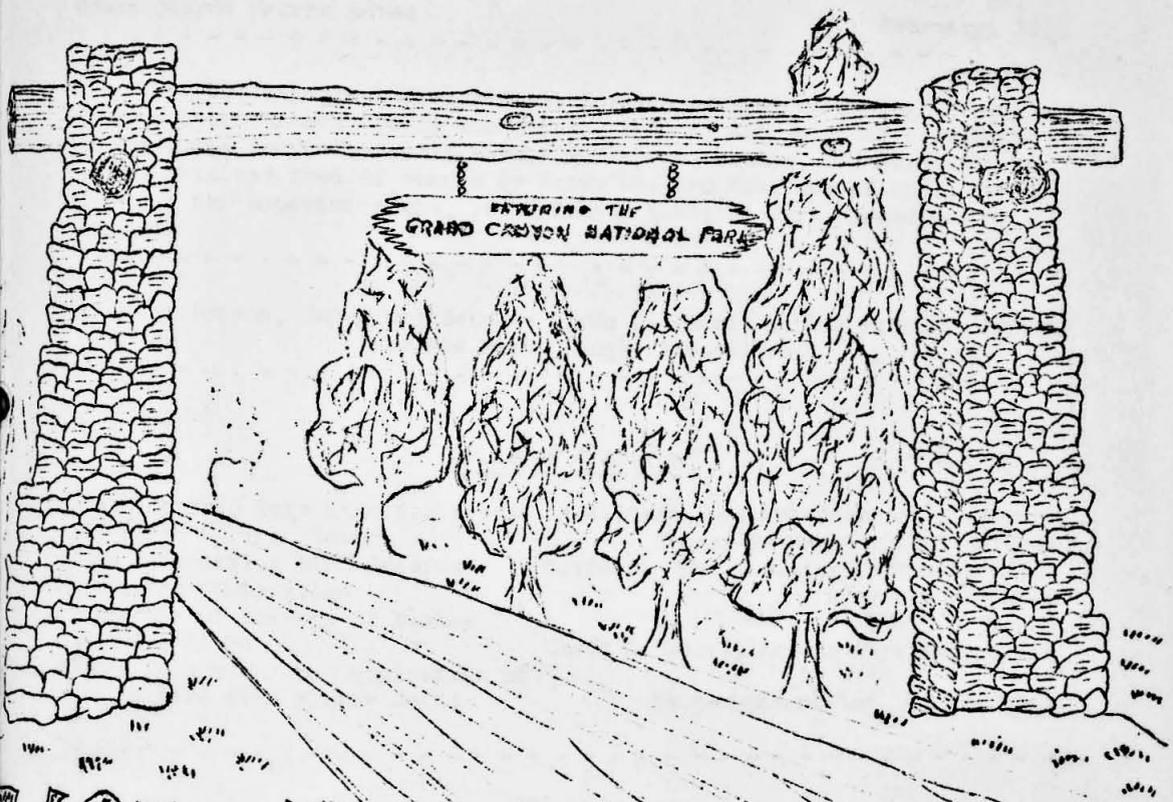


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This Bulletin is issued monthly for the purpose of giving information to those interested in the natural history and scientific features of the Grand Canyon National Park. Additional copies of these bulletins may be obtained free of charge by those who can make use of them, by addressing the Superintendent, Grand Canyon National Park, Grand Canyon, Arizona.

M. R. Tillotson, Superintendent -- Clyde C. Searl, Acting Park Naturalist
Pauline Mead, Ranger Naturalist.

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PLANTING FISH EGGS IN CLEAR CREEK

By Assistant Superintendent P. P. Patraw.

Clear Creek is the first permanent stream entering the Colorado River east of Bright Angel Creek. Its sources are springs issuing in most cases above the stratum of limestone known as the Redwall. Its most notable feature is Clear Creek Falls. When snows on the North Rim melt, Clear Creek Falls flow a considerable volume, clearly visible from Yavapai and Yaki Points on the South Rim, and affording a beautiful spectacle. At other times of the year the flow is relatively small. The height of the fall is 800 feet. The floor of the middle section of Clear Creek Canyon is covered with luxuriant vegetation - thick grass, juniper, cottonwood, Arizona redbud and box elder predominating, except for reeds growing on the stream's banks. At the bases of the lowest cliffs in the canyon are many ruins of prehistoric Indian dwellings; and in the faces of the cliffs can be seen the walled openings of many food caches. In the floor of the canyon itself are a few circular pits in which the Indians are supposed to have cooked the fruit of the mescal. It is apparent that at one time Clear Creek Canyon was well populated. Today the deer, and possibly an occasional bobcat or mountain lion, are the sole representatives of the higher order of animal life making use of this beautiful canyon. Here and there one may discover an antler or the disjointed skeleton of a deer. On our recent visit we observed many fresh deer tracks. The deer presumably enter the canyon only during the cooler months.

After a study had been made of the rate of flow of the stream and of types and abundance of natural foods it was determined that Clear Creek is a stream suitable for trout. An order was placed on the Government fish hatchery at Leadville, Colorado, for 25,000 eyed eggs of eastern brook trout. The eggs arrived by express on Tuesday morning and were transferred from their shipping cases into tow-man-pack carrying cases. In each case are five 2-compartment trays fastened firmly by uprights to the center of the case with space between the trays and the walls of the case for ice. The eggs were apportioned into twenty equal parts, approximately 625 eggs, each division was carefully wrapped in muslin and placed in a tray compartment surrounded with moss. The cases, packed with ice, and an extra supply of ice, were taken by muleback down to the camp at the river. One box weighed 41 lbs. and the other 39½ lbs.

Two days previously rangers had gone to Clear Creek to prepare the beds for the plant. Locations for beds are selected where the stream flows in a normal swift current, having no eddies or pools, and the beds are prepared by raking so that the silt is disturbed for the stream to carry it away, leaving only clean gravel.

The following morning, after replenishing the ice in the cases, we set out for Clear Creek. Two of us carried the cases and the other two had much lighter napsacks containing provisions, camera, etc. We alternated carrying

light and heavy loads. Our route was up Bright Angel Creek a mile, then the steep climb up the granite wall and Tapeats sandstone, 1,200 feet higher in elevation, to the Tonto platform; over the Tonto heading four small canyons at the base of Zoroaster Temple, to Clear Creek Canyon, where we dropped down to the creek and went upstream to our camp under an overhanging cliff in the midst of numerous ruins of prehistoric dwellings. It was a relief to take off the packs which we had been carrying on our backs for six or seven hours, and which had seemed to grow heavier each hour. The sun had been hot and the only shade was such as a lizard might have found large enough to use. It would be excellent reducing exercise to carry a heavy pack up and down canyon walls and over the hot plateau if it weren't for the enormous quantity of food and water one demands at the end of the day.

But we could not rest long; there was not much of the day left and the eggs, which were just about ready to hatch, had to be placed in their beds with the least possible delay. The contents of the first case were planted in a couple of hours. Daylight waned rapidly as the second case was being planted, and the "nurses to little fishes" completed the last plant by the light of the moon.

In making a plant the previously-prepared bed is first raked to make sure that no silt has been redeposited since the original preparation. The planting board, a hinged affair having two metal wings about 12 inches square, is opened to a right angle and placed in the stream with the angle upstream. The board prevents the current from sweeping over the spot in which the eggs are to be deposited, so that the eggs will not be washed away. A small hole is scraped in the gravel, about 200 eggs are placed in it, and the gravel is replaced to cover the eggs.

The eggs that are "eyed" have reached the stage of incubation at which the embryo fry is ready to break thru the shell (it more resembles skin than shell) and shows through the covering as an eye. At the proper temperature, about 50 degrees Fahrenheit, the fry hatches out. The embryo has developed around the remainder of the egg contents which form a ball at its middle section. The fry remains under the gravel about ten days after hatching, and subsists on the contents of the ball. At the end of this period it has developed sufficiently to be able to move about and rustle food for itself. This is perhaps the most critical period of its existence; if sufficient silt has deposited over the gravel to form a seal, the fry is locked in as securely as in a vault and can not escape. Hence the care used in selecting bed locations where there is least likelihood of silt depositing and in preparing the beds to clean them of all silt.

THE FIRST SPRING FLOWER

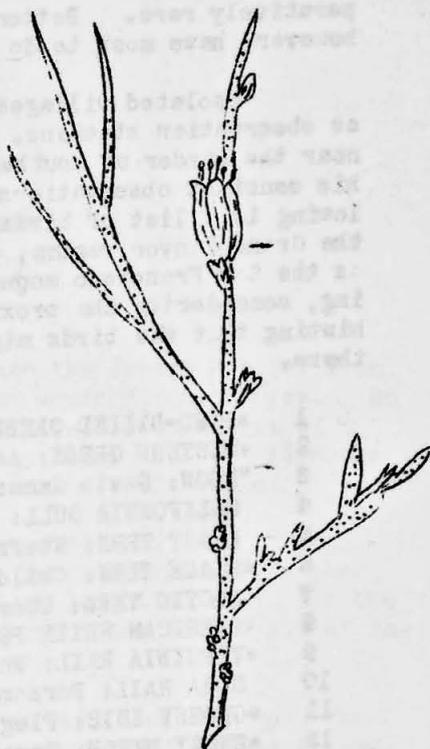
By Ranger-naturalist Pauline Mead

There is a small yellow-green bush, that grows in the lower altitudes at Grand Canyon, called "turpentine broom" (*Thamnosma montana*), a member of the rue family and closely related to the hop tree (*Ptelea*). It is usually destitute of leaves and the short stems are pointed, giving the plant a thorny appearance.

Turpentine broom bore the first spring flower that was seen this season. It was found in Hermit Basin on the eighth of February when snows were still falling on the Canyon rims. The urn-shaped blossom is a deep purple color and has yellow stamens that extend beyond the petals. The older flowers lose their rich purple coloring and become lavender, then turn greenish-white before they fade.

The leaves drop from the old stems but they can be seen in the early spring gathered into rosettes in the nodes along the main stem. When new branches grow from these nodes they elongate between the leaves separating them until the original rosette gradually disappears.

The plant receives its name from its strong odor resembling that of turpentine. The odor is caused by secretions from the many small glands that cover the stems.



Flowers are beginning to bloom in the bottom of Grand Canyon although it is still winter on the rims. On February 22, anemones (*Anemone tuberosa*), wild sweet peas (*Lotus Nummularius* ?), and fleabane (*Erigeron* Sp.) were found blooming along Bright Angel and Phantom Creeks. Flowers of a little purple-red spurge (*Euphorbia versicolor*) and a lavender-pink rockcress (*Arabidopsis thaliana*) were seen on cliff ledges in Box Canyon. There were many purple flowered wild carrots (*Phellopterus utahensis*) in bud on Mormon Flats.

SOME INTERESTING BIRD RECORDS

By Clyde C. Searl, Acting Park Naturalist.

Bird enthusiasts are often surprised by observing some bird in the arid regions of western North America that had hitherto been unrecorded from a given locality. Year after year, the bird lists of various localities are gradually growing larger, due perhaps to recent publications on western birds by recognized authorities. Such publications, acting as a basis and a guide, always create an interest. At times the question is brought up as to whether various groups of birds are widening their range, and in some instances that such is the case can not be denied although comparatively rare. Better observations by an increasing number of bird lovers, however, have most to do with the widening of the recorded range.

Isolated villages in the arid regions of the west have proved ideal as observation stations. Clifton Greenhalgh, a high school student at Kanab, near the border of southern Utah, is a lover of birds, and for several years his constant observations have added a number of interesting records. Following is a list of birds recorded at Kanab that have not been reported in the Grand Canyon region, nor in that country southeast of Grand Canyon as far as the San Francisco mountain region and Mormon Lake. The list is interesting, considering the proximity of Kanab to the Grand Canyon country, therefore hinting that the birds might range in that region, although as yet unrecorded there.

- 1 *PIED-BILLED GREBE: *Podilymbus podiceps podiceps* (Linnaeus)
- 2 *WESTERN GREBE: *Aechmophorus occidentalis* (Lawrence)
- 3 *LOON: *Gavia immer* (Brunnich)
- 4 *CALIFORNIA GULL: *Larus californicus* Lawrence.
- 5 *LEAST TERN: *Sterna antillarum* (Less.)
- 6 *BLACK TERN: *Chlidonias nigra surinamensis* (Gmelin)
- 7 *ARCTIC TERN: *Sterna paradisaea* (Brunnich)
- 8 *AMERICAN WHITE PELICAN: *Pelecanus erythrorhynchos* Gmelin
- 9 *VIRGINIA RAIL: *Rallus virginianus* Linnaeus
- 10 *SORA RAIL: *Porzana carolina* (Linnaeus)
- 11 *GLOSSY IBIS: *Plegadis guarauna* (Linnaeus)
- 12 *SNOWY HERON: *Egretta thula thula* (Molina)
- 13 *BLACK-NECKED STILT: *Himantopus mexicanus* (Müller)
- 14 *BLACK TURNSTONE: *Arenaria melanocephala* (Vig.)
- 15 *MARBLED GODWIT: *Limosa fedoa* (Linnaeus)
- 16 *BLACK-BELLIED PLOVER: *Squatarola squatarola* (Linnaeus)
- 17 *RED-BREASTED MERGANSER: *Mergus serrator* Linnaeus
- 18 *WHISTLING SWAN: *Cygnus columbianus* (Ord)
- 19 *WESTERN GRASSHOPPER SPARROW: *Ammodramus savannarum bimaculatus* Swainson
- 20 *WESTERN SAVANNAH SPARROW: *Ammodramus sandwichensis alaudinus* (Bonap.)

- 21 *NORTHERN SHRIKE: *Lanius borealis* Vieillot
 22 SLENDER-BILLED NUTHATCH: *Sitta carolinensis aculeata* (Cass.)
 23 OREGON JUNCO: *Junco hyemalis oregonus* (Townsend)
 24 TRAILI FLYCATCHER: *Empidonax traillii* (Aud.)
 25 *VERMILION FLYCATCHER: *Pyrocephalus rubinus mexicanus* Sclater
 26 *BARN OWL: *Tyto alba pratincola* (Bonaparte)
 27 *ROCKY MOUNTAIN HAIRY WOODPECKER: *Dryobates villosus monticola* Anthony
 28 GAIRDNER WOODPECKER: *Dryobates pubescens gairdnerii* (Aud.)
 29 YELLOW-BELLIED SAPSUCKER: *Sphyrapicus varius* (Linnaeus)
 30 WILLIAMSON SAPSUCKER: " *thyroideus* (Cass.)
 31 RED-BREASTED SAPSUCKER: " *ruber* (Gmelin)

* Recorded in Bailey's "Birds of New Mexico"

A STRANGE COMBINATION

By Ranger Burt Luzon

One day in November as I was riding through the forest not far from the Canyon rim, I came upon three deer bedded down under a pinon tree. On the back of one of the deer sat a medium sized, sandy-colored rabbit of a domestic breed. The rabbit had been released by a local youth. Although the day was rather cold the rabbit appeared to be quite comfortable.

When the deer saw me they jumped up and started away on a gallop. The rabbit tried to stay on the back of the deer, but was evidently a poor rider, although good at getting off for at the first jump the rabbit hit the ground running and followed the deer into the timber. The last I saw of the rabbit it was in fourth position following the deer.

This same rabbit has been on friendly terms with the deer herd for more than a year which would show that a rabbit is consistent in its friendship and also knows how to keep its feet warm.

Catkins have fallen from most of the cottonwood trees (*Populus fremontii*) at Phantom Ranch. Many of the trees are in bud and some of the leaves have appeared.

A REMNANT OF THE AGE OF FISHES

By Edwin D. McKee

During that great period in history known as the Devonian, fish became the dominating creatures on this earth. They were masters of the sea and they showed distinctly higher development over the shelled animals and crab-like creatures that had been in power before them.

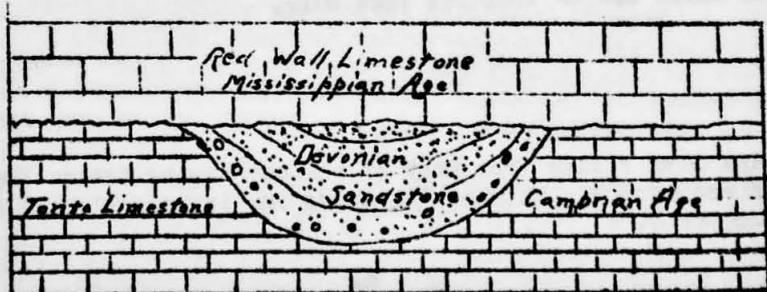
The Grand Canyon region was a low, flat country with streams and rivers meandering over its surface during the latter part of the Devonian time. Sands and limes gradually accumulated in the water courses and stream-cuts, and probably over much of the surrounding region. River-rounded pebbles were also deposited and in some places the remains of fresh-water fish were buried and preserved.

Isolated patches of lavender rock represent the only remaining traces of the "Age of Fishes" in the walls of Grand Canyon. These have been located in eighteen different places, all very limited in area. They probably represent only a small part of once extensive deposits which were later largely eroded away.

Because of the scarcity of Devonian rocks in the Grand Canyon, it is of especial interest that a small remnant was located recently below Yavapai Observation Station on the South Rim. Even from the distance of several thousand feet, the characteristic lavender color of these rocks affords a conspicuous landmark.

A closer examination of the Devonian rocks below Yavapai Point is extremely illustrative. A bowl-shaped cut in the thinly bedded limestone which forms the top of the Tonto formations can be readily seen. It is about 150 feet wide and forty feet deep and probably represents a stream channel. Filling it is the more massive but softer rocks deposited as sand during Devonian time. This is seen to be steeply sloping near its outer margins, thus indicating the angle of the bank on which it was laid down. Its reality becomes even more apparent when one notices that near its bottom are included many fragments and pebbles left on the surface from the partial erosion of the Tonto rocks below.

As yet no fossils have been found in this particular pocket of rocks but it is hoped that with further search some indications of life in the Devonian, including the remains of fish, will be brought to light there.



BUILDING ROCKS

By Clyde C. Searl, Acting Park Naturalist

Lectures of any type on the formation of Grand Canyon, or on the rocks forming the walls of the Canyon, usually bring forth some comment. Such comment is usually commendable and expressive of appreciation of a clearer and better conception of the origin of the Canyon, but occasionally it is otherwise.

It is not difficult to cause an open-minded person to change his mind, given time enough, concerning any erroneous conception he may have as to the formation of the canyon, and common knowledge of the erosive forces of Nature makes the story of the cutting of the canyon a comparatively simple and easily understood matter.

However, it is not so easy to explain the formation of the rocks themselves to people who have never had any geological training. To speak of organic and sedimentary rocks without explanation as to their formation and structure leaves a vague conception. To them a rock is a rock and it has always been so. But when explanation is called for it is much easier to inform people about the rocks with which they are familiar, especially the formation of sedimentary rocks in which they may have seen unmistakable fossils. Arguments on this subject can always be strengthened by referring to phenomena going on every where about them. The building up of layers of silt at the mouths of rivers is an example most easily understood by most people.

Difficulty is reached when one speaks of organic rocks specifically, especially the limestones. Pointing to a layer of rocks hundreds of feet thick and remarking that it is literally built up of the secretions of corals and shells and the skeletons of animals, calls forth doubt in the minds that can not take all for granted. At first thought there does not seem much chance of animal remains accumulating to such a depth as to form any well marked deposit. Though the air may be filled with insects, though birds may be seen in great numbers, and though animals are known to abound everywhere on the surface of the earth, yet nowhere can their remains be found as forming a deposit. Much as one may travel about, dead animals are seldom seen; they creep into holes and die there and gradually their bones crumble and disappear.

But it is possible to look in the right places and see remains of animals and plants forming accumulations. Newspaper accounts and popular articles telling of animal skeletons found in strange places have been helpful in opening up the minds of credulous believers. Tar pits into which prehistoric animals have fallen and have been preserved have made the story clearer to those who will read. But even with such knowledge it is often hard to cause people to conceive of thick layers being formed in the same manner.

It is on the floors of great seas that occur the most wonderful examples of the way in which rocks are gradually built up of the remains of animals to a depth of many hundreds of feet, and over distances covering great areas, and in this light it is not difficult to convince people that the top layer of the formations at Grand Canyon was once the floor of a sea. The proof is there when clearly marked sea shells can be shown embedded in the heavy rock. Yet when it is told that the body of the rock is built up of many minute and invisible shells a snag is struck. There would be little argument could proper pains be taken to place portions of the rock under powerful glasses so that the minute organisms which helped to form the rock could be seen. It is the smallest life that has built the bulk of the rock.

The minute life is delicately sculptured and the similar patterns throughout are helpful in proving beyond a doubt that they are the remains of living things. Crowded as they were in the seas, these small creatures formed a sea deposit as they died and fell to the bottom. As fresh generations sprang up and died the deposit grew deeper and deeper. After a lapse of centuries, if the deposit were allowed to remain undisturbed, and if some sort of measure could have been set up to determine the rate of growth, it would have been found to have gradually built up and to have enclosed the larger skeletons of shells and sea lillies and corals and many other forms of sea life. Even the softer sponges, by the action of the water and its contents became hardened and their structure clearly preserved.

If one could advance step by step, reading what there is to be read in the rocks, and proving it all to his satisfaction as he goes along and before he takes the next step, there would be encountered little trouble in believing that the story of the rocks as told in Grand Canyon gives a clear understanding of events of ages past.

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THIRD REPORT ON THE GERMINATION OF NATIVE WILD FLOWER SEEDS

By Ranger-naturalist Pauline Mead

In the December and January issues of Nature Notes preliminary reports on an experiment on the germination of native wild flower seeds was published. Reports on this experiment will continue to appear monthly. It is hoped that this study by shedding light on the behavior of wild flower seeds will assist in the eventual replacement of exotic plants by native wild plants in landscaping within the National Parks.

Nineteen species of seeds, in most cases 100 seeds each were planted on December 11 under greenhouse conditions. The last observation was taken February 25. All but four species of seeds had germinated. Those four were sulphur flower, crane's bill, pink pentstemon and vine figwort. There was only one seedling each of cat's-claw and red pentstemon, New Mexican locust trefoil, blue bonnet, creeping pentstemon and scarlet bugler, showed a low percentage of germination. Seeds of western virgin's bower, cliff rose,

apache plume and prickly aster gave the highest percentage of germination. Seeds of blue pentstemon and Indian paint brush germinate fairly well. It will be noted that the number of western virgin's bower, cliff rose and Indian paint brush seeds that germinated has approximately doubled in the last month.

Some of the seedlings are two and three inches tall and are ready to transplant into the hot bed. A hot bed was constructed for this purpose on a south facing slope. One foot of fresh manure was placed on the bottom and was covered with 14 inches of soil. The bed is covered with greenhouse sashes. It will be interesting to note how these wild plants, started in the greenhouse, will transplant.

With the additional room afforded by the hot bed, many more species of seeds will be planted.

The results observed February 25 are as follows:

Name of Plant:	No. of seeds planted.	No. of seedlings above ground.	Percent of germination.
Western Virgin's bower (<i>Clematis ligusticifolia</i>)	100	64	64
Sulphur Flower (<i>Eriogonum stillatum</i>)	30	0	0
Mountain Mohogany (<i>Cercocarpus montanus</i>)	20	8	40
Cliff Rose (<i>Cowania stansburiana</i>)	100	38	38
Apache Plume (<i>Fallugia paridoxa</i>)	100	28	28
Cat's Claw (<i>Acacia greggii</i>)	5	1	20
Crane's Bill (<i>Goranium incisum</i>)	3	0	0
New Mexican Locust (<i>Robinia neomexicana</i>)	50	4	8
Trefoil (<i>Lotus Wrightii</i>)	10	2	20
Blue Bonnet (<i>Lupinus barbiger</i>)	4	3	75
Globe Mallow (<i>Sphaeralcea marginata</i>)	100	9	9
Creeping Pentstemon (<i>Pentstemon linarioides</i>)	100	2	2
Tall Blue Pentstemon (<i>Pentstemon glaber</i>)	100	16	16
Pink Pentstemon (<i>Pentstemon palmeri</i>)	100	0	0
Scarlet Bugler (<i>Pentstemon torroyi</i>)	100	6	6
Red Pentstemon (<i>Pentstemon bridgesii</i>)	100	1	1
Indian Paint Brush (<i>Castilleja linariaefolia</i>)	100	18	18
Vine Figwort (<i>Maurandia antirrhiniflora</i>)	100	0	0
Prickly Aster (<i>Macharenthera angustifolia</i>)	100	25	25

Although the presence of birds does not always denote the coming of spring, the arrival of migratory birds is always interesting. Robins are usually the first comers, and so it has been at Grand Canyon this winter. Robins were reported at the feeding tables as early as the 18th of February this year, and by now they can be seen frequently.

Dr. Carson has also reported a house finch which arrived here about the 20th of February.