

UP-HILL PLANTERS

By JOSEPH GRINNELL

The second week of October, a year ago, found me nature-watching on the western slope of the southern Sierra Nevada. I was walking along the road which leads up to Sequoia National Park, when, as the morning sunshine began to increase the warmth and dryness of the atmosphere, I began to note the sounds of falling and bouncing acorns. For, at the level where I was, about 5000 feet, the black oaks were just then yielding their annual crop of seeds. It would seem that these seeds are finally loosened from their cups, if not disturbed otherwise, when the air each day has reached a certain measure of dryness.

The mountain slope was steep, 25 to 45 degrees; and along about ten to eleven o'clock the sound and sight of descending acorns was impressive. They were even accumulating in appreciable windrows in places along the inside of the road next to the bank; now and then one, from source far up-slope, having gained extra momentum, bounced clear over the road and proceeded on its way toward the canyon bottom far below.

Acorns are smooth-shelled, heavy objects, and those of the black oak in particular, are of rotund shape. These qualities make for insecurity of placement on any slope upon which they fall, until in their movements they reach some arresting crevice, or some sufficiently wide strip of level, or nearly level, ground on which to find lodgment.

It was clear to me that the direction of seed scattering from any one oak tree was here well-nigh directly down-hill. In that place and on that day I saw *no* acorn moving *up*-hill. Gravity alone was acting as the agency of distribution. There appeared no possibility that *wind* could serve as an agent of elevation, as with seeds of such trees as maple, cottonwood and willow. In the case of the oaks, it might therefore seem, the only possible direction of general forest spreading through time would have to be through the action of gravity and streams of water, always down-hill. But how, then, could forests ever have spread, naturally, so as to gain altitude on our many mountain sides?

The next two days, October 12 and 13, my companion, Dr. Eric Hill, and I spent seeking pocket-gophers down near Three Rivers, about 1000 feet altitude, in the valley of the lower Kaweah River. Here another kind of oak, the blue oak, abounded, and we observed that there was a fairly good crop of its acorns, though not borne as uniformly as those of the black oak in the life-zone above. Very many of the blue oaks had produced no acorns that season. Especially was this true of the trees far up the hillsides above the valley bottom. Some of the trees had produced a few acorns. Those trees which were bearing most heavily were those of larger, thriftier-looking condition, down toward the river bottom. Of certain possible bearing on our problem, this season was a dry one; and furthermore it was the latest of a series of dry years.

As we tended our trap-lines, run in all the different types of soil within reach, we became aware of the presence and especially the activities of California Jays (*Aphelocoma californica*). These activities looked into, became of deep significance to us; for here, indeed, was the agency at this particular place, at this particular time, of transportation of acorns up-hill. The jays we saw to be centering their interest in those most abundantly fruiting trees down in the bottom of the canyon. There the birds were gathering the acorns and carrying them up the slopes, to be ensconced in various hidey-holes, some of them to be buried, after the well-known

blue-jay tradition, in the ground of open spaces on the hillsides. From morning to evening, individual birds were almost constantly in sight when we looked out of the auto cabin where we worked, 150 yards from the river.

Every bird going up-slope bore an acorn lengthwise in its bill; every bird in return course was empty-billed. If I had only thought of it, here was a chance for counting birds, and their loads, in sight, during, say, a three-hour period; and then computing the bushels of blue-oak acorns being elevated by the jays perhaps hundreds of feet each October day in that one valley.

In this same locality of observation, Dr. Hill and I saw "digger" ground squirrels busily gathering acorns that had fallen to the ground, carrying them in various directions (with these animals, however, irrespective of direction of slope) to their burrows or to their shelling stations. Twice we watched a ground squirrel climb up a blue oak to the larder of a group of California Woodpeckers, filling its cheek pouches with the acorns they had gathered and stored, even though being attacked by the resentful birds. Then the squirrel would go precipitately down the trunk and off to its own cache in the ground.

Observations of the type just cited, gathered into notebook and memory from many parts of California, have led me to generalize concerning the paramount agency of vertebrate animals in the dispersal of trees, especially of oaks. My recollections bring into this credit column, not only California Jays, woodpeckers, and ground squirrels, but also gray squirrels, chickarees, chipmunks and wood rats, and Steller Jays and Band-tailed Pigeons. In reflecting upon this matter, we can see readily that the relationship is of reciprocal benefit; all of these animal agents of seed dispersal are supplied, at least in part, by the oaks with food, or shelter, and (or) nursery sites. The trees produce crops of nutritious seeds—each seed nutritious either to the prospective oaklet or to the animal that eats it—in vast excess of immediate seeding needs. There is enormous seeming extravagance on the part of the trees, far and away greater production than would be needed to provide for persistence of the species, *if* the species were of fixed geographic position through time. Granting an individual longevity of 75 to 300 years for more or less mature oaks of one kind and another (I cite Jepson, *The Silva of California*, 1910, p. 57), perhaps one successful germination to only a million acorns would provide for mere forest replacement. Even this ratio is probably far too high. The point I wish to make is that in the long-time interests of the tree species, involving locomotion of the whole *forest*, there is value received upon this huge rate of production. It is not extravagance, but good investment, for the oaks to provide subsistence for a continuing population of animal associates.

Even in any relatively brief period of years, catastrophe may overtake the fortunes of the oak forest. Fire of great intensity may destroy all of the growths on a given slope clear to the top of the ridge. Then quick recovery—early repopulation by the oaks—will likely be dependent upon the survival and germination of acorns buried previously by animals, in open places, where the heat was least effective, as also upon the year-by-year marginal replanting process just described. I think especially of California's great erosion-guarding and water-conserving chaparral belt, of which the live oaks and scrub oaks of several kinds are prominent constituents—and their constant animal attendants, the California Jays, the chipmunks, and the dusky-footed wood rats.

Giving again to our scientific imagination fair rein, let us think of the oak belts of California in longest time vista—back through not only centuries, but millenniums. Also let us think of the, to us invisible, climatic boundaries which at any one time-

level hem in those belts, each belt characterized by a different species of oak. And let us further think how these boundaries have shifted in past time spatially, as borne upon by changes in physical conditions affecting climate—those involved in repeated elevation and depression of the land surface, and in shiftings of prevailing air currents. We can then think of the oak belts, as slowly marching, through time, up hill and down dale, southward and northward, as their species have been driven by the gradually shifting exigencies of physical requirement which determine where new trees can not only sprout, but mature. Again, we must think, not of the individual tree up to 300 years old, but of the aggregate of trees involving long series of generations of their kind. Such time-space aggregation has been *forced* to move from place to place. It has literally *had* to keep up with the procession. It has *had* to provide ways and means of insuring transportation, or else be wiped out through complete failure at any one level, of those favoring factors which have to do with the existence of each kind of oak in its own life-zone. Tree species have had to move their location from one period to the next or die in a struggle against oncoming adverse conditions.

Here, then, is where a certain portion of the associated animal life has come into the service of the oak species. In the present era, with life-zones probably advancing northward, and up-slope, we can think of the successive belts of valley oaks, blue oaks, golden oaks, black oaks, and huckleberry oaks, on our western mountain-sides, as relying, most especially for that part of their dispersal comprised in elevation, entirely upon their bird and mammal associates. And there obtains that vital exchange of benefits to which I alluded. Plant-animal communities, eventually closely knit in their specific interrelationships, have been subject to evolutionary processes quite as definitely as discrete species.

Note.—An adapted version of this account was included in a radio talk published in *The Scientific Monthly* (XLI, December, 1935, pp. 553-556). Permission to reprint the matter duplicated here has been received from the Associate Editor of the journal cited, Mr. Ware Cattell.

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SUMMER NOTES FROM PLUMAS COUNTY, CALIFORNIA

By JOSEPH EWAN

Two papers published, by A. P. Smith (*Condor*, 20, 1918, p. 45) and by Joseph Mailliard (*Proc. Calif. Acad. Sci.*, ser. 4, 13, 1923, p. 29), deal briefly with the notable birds of the region about Quincy, to the north of the area here under consideration. In addition, Margaret W. Wythe has written upon "Some birds of the Gold Lake District" (*Condor*, 29, 1927, pp. 61-66), a region some two thousand feet above the present locality, in the Canadian and Hudsonian zones. Mohawk Valley, with which I deal, is, on the other hand, a locality of Transition Zone complexion, freckled with Great Basin species.

In the course of work as nature counselor at Y.M.C.A. Camp Caldwell, near Blairsden ("Dentens" on Downieville U.S.G.S. Quad.), Plumas County, the author enjoyed intermittent opportunities to note the bird population of the region. My attention was divided among several duties, but observations were made from June 24 to July 18, 1934, chiefly upon early morning trips with small groups of boys.

The area covered by these notes extends from the town of Blairsden east to Portola (approximately "Kerby" on the Sierraville U.S.G.S. Quad.), roughly ten miles