pair breeding at Lake Forest. They seem, like the Cardinal, to be gradually extending their range to the north.

22. **Sitta canadensis.** RED-BREASTED NUTHATCH.—Very common during the falls of 1915, 1916 and 1921. Other years only a few have been seen.

23. **Polioptila c. caerula.** BLUE-GRAY GNATCATCHER.—Some years a very common migrant during May. A male was taken May 31, 1920 in the oak scrub and later the same day and throughout June a female was seen in the pines, generally in the same place and always uttering a plaintive call. I spent a great deal of time watching her on different occasions but if there was a nest it was never found. Dr. Eifrig reported seeing several May 30, 1921, and I intended making a search for a nest but my trip was delayed until July 24. On this date, I had just started through the oak scrub when I heard the call of the Gnatcatcher and found five in a small oak, two adults and three young. The young were almost fully grown and were catching insects for themselves but I saw the parents feed them a number of times. When the old birds approached the young opened their mouths and quivered their wings. This is a rare breeder in northeastern Illinois but is more common in the Sand Dunes in Indiana.

24. **Hylocichla g. guttata.** ALASKA HERMIT THRUSH. Mr. Coale took this bird November 5, 1916, and has already reported it in 'The Auk' (Vol. XXXIV, No. 1) being the first record east of the Rockies.

25. **Planesticus m. migratorius.**—ROBIN. Robins sometimes spend the winter in this region; seen December 31, 1914 and February 18, 1917.

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THE ROLE OF THE "ACCIDENTAL."*

BY JOSEPH GRINNELL.

The total number of species and subspecies of birds recorded upon definite basis from California amounts at the present moment to 576. Examination of the status of each species, and classification of the whole list according to frequency of observation, show that in 32 cases out of the 576 there is but one occurrence known. In 10 cases the presence of the species has been ascertained twice, in 6 cases three times, and for all the rest there are 4 or more

* Contribution from the Museum of Vertebrate Zoology of the University of California.

records of occurrence. Some 500 species can be called regularly migrant or resident.

Examination of the records for the past 35 years shows that the proportion of one-occurrence cases is continually increasing. In other words, the state is so well known ornithologically that regular migrants and residents have all or nearly all of them been discovered, and *their* number now remains practically constant, while more and more non-regulars are coming to notice. This might be explained on the ground that there are continually more and better-trained observers on the lookout for unusual birds. This is probably correct, partially. But also, I believe, there is indicated a continual appearance, within the confines of the state, through time, of additional species of extra-limital source.

In published bird lists generally, species which have been entered upon the basis of one occurrence only, are called "accidentals." This is true of county lists, of state lists, and, quite patently, of the American Ornithologists' Union's 'Check-list of North American Birds'. The idea in the adoption of the word "accidental" seems to have been that such an occurrence is wholly fortuitous, due to some unnatural agency (unnatural as regards the behavior of the bird itself) such as a storm of extraordinary violence, and that it is not likely to be repeated. This understanding of the word "accidental" is borne out by the explicit meaning given it in the 'Century Dictionary,' for instance, which is "taking place not according to the usual course of things," "happening by chance or accident, or unexpectedly." Now the way in which the word is used by ornithologists is really a misapplication of the term; for, as I propose to show, the occurrence of individual birds a greater or less distance beyond the bounds of the plentiful existence of the species to which they belong is the *regular thing, to be expected.* There is nothing really "accidental" about it; the process is part of the ordinary evolutionary program.

However, as I have intimated, the word is firmly fixed in distributional literature. We had better continue to use it; but let us do so with the understanding that it simply means that any species so designated has occurred in the locality specified on but one known occasion. No special significance need to be implied.

Accidentals are recruited mostly from those kinds of birds which are strong fliers. It is true that the majority belong to species of distinctly migratory habit. But some of our accidentals exemplify the most sedentary of species. Examples of one-instance occurrences, in other words "accidentals," are as follows: the Western Tanager in Wisconsin, the Louisiana Water-Thrush in southern California, Townsend's Solitaire in New York, the Catbird on the Farallon Islands, the Tennessee Warbler in southern California, and Wilson's Petrel on Monterey Bay. In the North American list some of the accidentals come from South America, some even from Asia and from Europe.

I would like to emphasize the point now that there is no species on the entire North American list, of some 1250 entries, that is not just as likely to appear in California sooner or later as some of those which are known to *have* occurred. Expressing it in another way, it is only a matter of time theoretically until the list of California birds will be identical with that for North America as a whole. On the basis of the rate for the last 35 years, $1\frac{3}{5}$ additions to the California list per year, this will happen in 410 years, namely in the year 2331, if the same intensity of observation now exercised be maintained. If observers become still more numerous and alert, the time will be shortened.

It will be observed that there are now many more one-occurrence, "accidental," cases than there are two-occurrence cases, and that there are more of the two-occurrence group than there are three-occurrence, and so forth, there being a regular reduction in the intervals so that, if we just had enough observations, a smooth curve would probably result. If the one-instance occurrences should continue to accumulate without any modification of the process, in the course of about 300 years there would be more of these "accidentals" in California than of regularly resident species, and the other groups would grade down in a steeper curve. I attempted to carry out the figures, which seem to behave according to some mathematical formula; but when I came to deal with $\frac{3}{5}$ of an occurrence I decided it was profitless to go on!

It is evident, however, that another process takes place, of quite opposite effect. With the lapse of time second-occurrence

cases replace one-occurrence cases, to be followed by a third order of accretion, and this by a fourth; and the process might continue on ad infinitum, until theoretically, sometime after the full number of the North American list had been reached, our state list would no longer contain any accidentals at all. To cite an example, the eastern White-throated Sparrow was recorded first from California, and then as an accidental, on December 23, 1888; in 1889 a second specimen was taken; in 1891, a third was taken; and so on until in 1921, 19 occurrences have been recorded. This species is considered now simply as rare, certainly not accidental, casual, or even specially noteworthy save from a very local standpoint.

It comes to the mind here that if observations could be carried on so comprehensively as to bring scrutiny each year of every one of the 200,000,000 birds in California, this being the estimated minimum population maintained within the state from year to year, a great many more accidentals would be detected than are now known, and in addition some birds now known from but a few records, or even as accidentals, would come to be considered of frequent, though not necessarily regular, occurrence. With the White-throated Sparrow it is not impossible that a thousand of the birds have wintered in California in certain years.

Some of the considerations in the preceding paragraphs, while of interest in themselves perhaps, have confessedly been rather beside the issue. For the definite question which I wished to ask and which I will now briefly discuss is as to the function or role played by accidentals. Are they a mere by-product of species activity or do they in themselves constitute part of a mechanism of distinct use to the species?

The rate of reproduction in all birds, as with other animals, is so great that the population rapidly tends toward serious congestion except as relieved by death of individuals from various causes or else by expansion of the area occupied. The individuals making up a given bird species and occupying a restricted habitat may be likened to the molecules of a gas in a container which are continually beating against one another and against the confining walls, with resulting pressure outwards. But there is an essential difference in the case of the bird in that the number of individual

units is being augmented 50 per cent, 100 per cent, in some cases even 500 per cent, at each annual period of reproduction, with correspondingly reinforced outward pressure.

The force of impingement of the species against the barriers which operate to hem it in geographically, results in the more than normally rapid death of those individuals which find themselves under frontier conditions. There follows, through time and space both, a continual flow of the units of population from the center or centers toward the frontiers.

The common barriers which delimit bird distribution are as follows: Land to aquatic species and bodies or streams of water to terrestrial species, the climatic barriers of temperature, up or down beyond the limits to which the species may be accustomed, and of atmospheric humidity beyond critical limits of percentage; the limits of occurrence of food as regards amount and kind with respect to the inherent food-getting and food-using equipment of the species concerned; and the limits of occurrence of breeding places and safety refuges of a kind prescribed by the structural characters of the species requiring them.

An enormous death rate results from the process of trial and error where individuals are exposed wholesale to adverse conditions. This can be no less, on an average, than the annual rate of increase, if we grant that populations are, on an average, maintaining their numbers from year to year in statu quo. But before the individuals within the metropolis of a species succumb directly or indirectly to the results of severe competition, or those at the periphery succumb to the extreme vicissitudes of unfavorable conditions of climate, food or whatnot obtaining there, the latter have served the species invaluably in *testing out* the adjoining areas for possibly new territory to occupy. These *pioneers* are of exceeding importance to the species in that they are continually being centrifuged off on scouting expeditions (to mix the metaphor), to seek new country which may prove fit for occupancy. The vast majority of such individuals, 99 out of every hundred perhaps, are foredoomed to early destruction without any opportunity of breeding. Some few individuals may get back to the metropolis of the species. In the relatively rare case two birds comprising a pair, of greater

hardihood, possibly, than the average, will find themselves a little beyond the confines of the metropolis of the species, where they will rear a brood successfully and thus establish a new outpost. Or, having gone farther yet, such a pair may even stumble upon a combination of conditions in a new locality the same as in its parent metropolis, and there start a new detached colony of the species.

It is this rare instance of success that goes to justify the prodigal expenditure of individuals by the species. Such instances, repeated, result in the gradual extension of habitat limits on the part especially of species in which the frontier populations are in some degree adaptable—in which they can acquire modifications which make them fit for still farther peripheral invasion against forbidding conditions.

Incidentally, the great majority of these pioneers are, I believe, birds-of-the-year, in the first full vigor of maturity; such birds are innately prone to wander; and furthermore it is the autumnal season when the movement is most in evidence, a period of food-lessening when competitive pressure is being brought to bear upon the congested populations within their normal habitats. The impetus to go forth is derived from several sources.

The "accidentals" are the exceptional individuals that go farthest away from the metropolis of the species; they do not belong to the ordinary mob that surges against the barrier, but are among those individuals that cross through or over the barrier, by reason of extraordinary complement of energy, in part by reason of hardihood with respect to the particular factors comprising the barrier, and in part of course, sometimes, through merely fortuitous circumstances of a favoring sort.

Geologists tell us that barriers of climate are continually moving about over the earth's surface, due to uplift and depression, changes in atmospheric currents, and a variety of other causes. Animal populations are by them being herded about, as it were, though that is too weak a word. The encroaching barrier on the one side impinges against the population on that side; the strain may be relieved on the opposite side, *if* the barrier on that side undergoes parallel shifting, with the result that the species

as a whole may, through time, flow in a set direction. If anything should happen that a barrier on one side impinged on a species without corresponding retreat of the barrier on the other side, the habitat of the species would be reduced like the space between the jaws of a pair of pliers, and finally disappear: the species would be extinct.

But, in the case of persistence, it is the rule for the population, by means of those individuals and descent lines on the periphery of the metropolis of the species, to keep up with the receding barrier and not only that but to press the advance. I might picture the behavior of the population of a given bird as like the behavior of an active amoeba. This classic animal advances by means of outpushings here and there in reaction to the environment or along lines of least resistance. The whole mass advances as well. The particles of protoplasm comprising the amoeba may be likened to the individuals comprising the entire population of the animal in question, the mass of the amoeba to the aggregate of the population.

It is obvious that the interests of the individual are sacrificed in the interests of the species. The species will not succeed in maintaining itself except by virtue of the continual activity of pioneers, the function of which is to seek out new places for establishment. Only by the service of the scouts is the army as a whole able to advance or to prevent itself being engulfed: in the vernacular, crowded off the map—its career ended.

The same general ideas that I have set forth with regard to birds, who happen to be endowed with means of easy locomotion, hold, I believe, also for mammals, and probably in greater or less degree for most other animals. I can conceive of a snail in the role of an "accidental," an individual which has wandered a few feet or a few rods beyond the usual confines of the habitat of its species. Given the element of time (and geologists are granting this element in greater and greater measure of late), the same processes will hold for the slower moving creatures as they seem to do for those gifted with extreme mobility.

Migration, by the way, looks to me to be just a phase of distribution, wherein more or less regular seasonal shifting of popula-

tions takes place in response to precisely the same factors as hem in the ranges of sedentary species.

The continual wide dissemination of so-called accidentals, has, then, provided the mechanism by which each species as a whole spreads, or by which it travels from place to place when this is necessitated by shifting barriers. They constitute sort of sensitive tentacles, by which the species keeps aware of the possibilities of areal expansion. In a world of changing conditions it is necessary that close touch be maintained between a species and its geographical limits, else it will be cut off directly from persistence, or a rival species, an associational analogue, will get there first, and the same fate overtake it through unsuccessful competition—supplantation.

Museum Vert. Zool., Univ. of California, Berkeley, Calif.
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NOTES ON FOOD HABITS OF THE SHOVELLER OR SPOONBILL DUCK (SPATULA CLYPEATA).

BY W. L. MCATEE.

Reports have been made by the Biological Survey upon the food habits of all of the shoal-water ducks of the United States except the Shoveller. McAtee wrote the accounts[1] of the Mallard, Black Duck and Southern Black Duck, and Mabbott those[2] of the Gadwall, Baldpate, European Widgeon, Green-winged, Blue-winged and Cinnamon Teals, Pintail and Wood Duck. The Shoveller would have been included in the latter report had the author returned from war. However, design as well as fate had to do with the omission; truth is that the food habits of the Spoonbill duck are more difficult to study than those of any other anatine species yet investigated and the work, therefore, was postponed to the last. Even so the pioneer analyses by McAtee have not yet been supplemented and these are here reported upon so that some data on the food habits of the Shoveller will be available, and the

[1] U. S. Dept. Agr. Bull. 720, 35 pp., 1 Pl. Dec. 1918.
[2] U. S. Dept. Agr. Bul. 862, 67 pp., 7 pls. Dec. 1920.