it even now is before overtaking the value of the lint, especially in long staple varieties. No compensating increase in the yield of seed is to be expected from a lintless cotton, the fiber being merely cellulose, like the woody tissues of the plant.

Picking a lintless cotton by hand would be out of the question because the seeds fall out as soon as the bolls open, but possibilities of avoiding this difficulty have been suggested by the fact that all varieties do not open the bolls to the same extent or with equal readiness. Certain foreign cottons have nearly indehiscent capsules, as have some of the relatives of cotton, including the okra plant, which could be grown as a seed crop. Other factors that affect the opening of cotton bolls are heat and dryness. Full-grown bolls of Kekchi cotton remained fresh and apparently unchanged for nearly six months in a greenhouse experiment, and yet opened normally when the plants were taken outside and allowed to dry. The failure of bolls to open in cool autumn weather, which now appears as a danger or limiting factor of cotton culture in some parts of California, might be an advantage if harvesting by machinery were practicable.

In considering the possibility of utilizing late-opening cotton in California it seemed that two kinds of machines would be needed. The first machine might be thought of as a modified corn-binder that would cut or pull the plants, and at the same time press and tie them into loose bundles or small bales, not too large to be handled easily nor too dense to dry without rotting. The bundles could be kept rather narrow, since the form of the plants can be controlled by methods of spacing and thinning that have been worked out. The stalks would be in the middle of the bundle, while most of the bolls would be on the outside, so that gradual drying and normal opening might be expected.

As the plants would be pressed flat in the bundles they should come out in convenient shape for running into another machine for picking the seed cotton from the bolls. Relatively slight adaptations of existing types of picking machinery might serve, the problem in this form being much simpler than that of picking cotton from live plants in the field, which many inventors have attempted to solve. Gumming of the machinery and staining of the fiber with the plant juices would be avoided, as well as the difficulties of operating and repairing very complicated machines in the field.

That machine picking could produce grades equal to those of cotton picked carefully by hand is hardly to be expected, although the quality might not be seriously impaired, if admixture with weak, immature fiber can be avoided. This might be possible in parts of California where the bolls are not likely to be frozen, though the leaves may be killed.

Cleaners and gins could be operated in connection with stationary picking machines, and utilization of the stalks for paper-making or other industrial purposes would become more feasible. Leaving the fields clear at the end of the season would facilitate the planting of other crops, and might have advantages in relation to pests or diseases. Even with cotton considered as a seed-crop, the possibilities of mechanical harvesting do not appear to depend upon the breeding of lintless varieties. Special characters, conditions, or appliances that might be expected to facilitate the harvesting of lintless cotton seem likely to be more useful in connection with lint-bearing varieties.

O. F. Cook

Bureau of Plant Industry,
U. S. Department of Agriculture

AN ASPECT OF THE RELATION BETWEEN ABUNDANCE, MIGRATION AND RANGE IN BIRDS

The steps by which a species of bird extends its range or acquires specialized migratory habits are not known. They present problems of interest in themselves and wide bearing in other fields. The aspect of the matter here set down is at least worthy of consideration.

The red-breasted nuthatch is a bird which breeds in the northern coniferous forests. Some years it sweeps south across the country in fall in considerable numbers, and it is ex-

ceptional when some are not to be found in fall and winter in favorable localities in our latitude. A comparatively small number are seen returning the following spring, often accompanying flocks of north-bound warblers. This past season is remarkable in that practically none came south. Two circumstances that have come to my attention have a significant bearing on this fact. In late winter at a locality on Long Island where the species can generally be found and it was absent, chickadees were observed feeding on pine seeds, one of the nuthatch's favorite foods, showing that it would have fared well had it been present. Also, in the preceding summer, observers who visited the southern edge of its breeding range found it unusually scarce.

We may place the movement of the red-breasted nuthatch with what I shall call centrifugal migrations. Species which possess such, of which there are a number of good examples, periodically attain a great abundance in their permanent range, and then sweep outward, as it were in waves. For purposes of discussion I will mention three other types of birds. The white-breasted nuthatch which occupies a broad area to the south of its red-breasted cousin, has, so far as is apparent, no migration. The song sparrow, although always present over a large part of its range, has a very definite intraspecific migration, and many species have what I shall call a centripetal migration, that is, they return from the distant south to breed each year in a definite northern area usually unsuitable to their permanent occupancy.

The centrifugal type of migration is notable for two things, its futility and its wastefulness. By futility I mean that species do not seem to increase their permanent range by that method; rather, periods of abundance and migration are followed by periods of scarcity even in that range. Data enough has been gathered to at least partially explain this. Individuals swept south by the wave seem not to have the definite migration instinct which causes centripetal migrants to return to their identical nesting localities over zones of latitude. One or more instances are at hand of the red-breasted nuthatch remaining to breed in southeastern Massachusetts where (in the Cape Cod region) it becomes especially numerous during its incursions, perhaps from the abundance of its favorite pine seeds. Yet it is probably too much of a wanderer ever to establish a permanent colony there, even if the environment were satisfactory. Probably the majority of any wave of centrifugal migrants is utterly dissipated and lost, and a small minority find their way back to their permanent range. In fact there is little to be said in favor of centrifugal migration except that it is expedient, in fact the exigencies of the case may demand it.

I will now enter a little further into the realms of hypothesis and present the most plausible view of the sequence of migrations. The centrifugal condition is the original one, with the species in a state of unstable abundance, followed by the elimination of centrifugal migrants and the permanent resident condition typified by the white-breasted nuthatch, where the species is sufficiently adjusted to conditions to maintain itself in unvarying though comparatively small numbers. The migratory tendency now begins to express itself in a definite way among the individuals, many of which have definite breeding and winter localities, the former perhaps (in the case of the song sparrow) in some garden, the latter in some swamp. The tendency is for these two localities to become separated by greater and greater distances of latitude until we have a well-marked intraspecific migration.

As this process goes forward the range of a species may well break in the middle, leaving a centripetal migration in which highly developed homing instincts in the individual bird take the place of the futile centrifugal "wanderlust" of the race in its initial condition. The maximum ability to colonize and expand would come with the stage in which the individual had a definite migratory instinct to adjust to the season and yet was sufficiently a permanent resident to "hang on" in a good locality against adverse circumstances, a condition to my mind approximated among familiar species by the song sparrow, which has at

this time considerable abundance over an unusually extensive range. Also birds with the greatest development of centripetal migration, though often exceedingly abundant, are perhaps less resistant than others. Of the shore birds which formerly thronged our coast, the greater yellowlegs, whose summer and winter ranges were not so widely separated, has held out best against the inroads of gunners, while the Eskimo curlew and golden plover with the longest migration routes, have suffered most severely.

The above aspect of the situation may be of interest to the student of fluctuating population and political complications arising therefrom as well as to the student of bird migration. The fact seems to be that in nature a species adjusted to maintain its numbers constant even though comparatively small, is in a more advantageous position than one in which there is a rapid increase of numbers necessitating migrations beyond the capabilities of the individuals.

J. T. Nichols

New York City

QUOTATIONS

THE ROCKEFELLER FOUNDATION

The Rockefeller Foundation in New York is a conspicuous example of modern philanthropic effort. Owing its existence and its maintenance to the enlightened liberality of Mr. John D. Rockefeller, it is conducted on business lines without the appeals to public benevolence which, in the absence of state endowment, are generally necessary to procure the funds required for the successful prosecution of charitable enterprises. A review of the work done by the foundation in 1917 for various purposes connected with the war, and in regard to public health and medical education, recently issued by the president, Mr. George E. Vincent (New York, 1918) states that at the end of 1917 the principal fund had a market value of about £21,000,000; the income of that fund for the year was £1,430,770. To this were added a balance carried over from 1916, a gift by Mr. Rockefeller of £1,100,000, and the sum of £1,000,000 voted by the trustees from the principal fund. The cash balance carried forward into the year 1918 was £23,325,809, but all except £254,267 of this amount will be needed to meet appropriations and pledges for the next fiscal year. The foundation is at present devoting by far the greater part of its available resources to the support of war work. When the United States joined in the great struggle the foundation placed a large sum at the disposal of the American Red Cross, which has undertaken comprehensive schemes of relief for the allied armies and the civilian population of the invaded countries. The only work which it is now directly administering in Europe is an antituberculosis campaign in France. The American government from the first insisted that the training camps were to be regarded as educational institutions. Official commissions and national and local societies worked together in providing within and outside camps comfort, recreation, social entertainment, educational opportunities, and moral safeguards for the troops. To nearly all the units that make up this vast cooperation the foundation has given sums amounting in the aggregate to £900,000. In 1917 a portable military base hospital was erected in the grounds of the Rockefeller Institute for Medical Research, embodying the features which British and French experience has proved to be essential. In this hospital the Carrel-Dakin method of sterilizing wounds is being demonstrated. To the hospital and the laboratories medical officers of the army and navy are being sent for study and experience. The foundation has undertaken the making of serums and their distribution to government hospitals. Funds are being provided to help the Surgeon-General in engaging specialists for the treatment and hospital care of nervous and mental diseases due to the war. Contributions were also made for the after-care of the victims of infantile paralysis in the epidemic in New York in 1916. In 1915 the foundation offered to bear the cost of establishing and maintaining as a part of Johns Hopkins Hospital a school of hygiene and public health. During 1917–18 a staff was recruited and lines of work laid down. Dr. William H. Welch resigned