relations, into consideration. It is evident to any zoologist who has studied large series of specimens of a wide-ranging and plastic species that it is, of course, easy to mistake false for true intergradation, as, for instance, if adults in comparable age and condition are not used in comparison. It is likewise easy to overlook evidence of intergradation, since the latter is sometimes obscured by other circumstances. For example, two forms may meet on the edges of their ranges and intermingle on common ground, remaining perfectly separate and be apparently distinct species, yet elsewhere directly or indirectly through other forms completely intergrade. This is exemplified in our case of *Aphelocoma* by *Aphelocoma californica woodhouseii,* which remains an apparently distinct species where its range meets that of *Aphelocoma californica immanis* at the foot of the Sierra Nevada, but which eastward passes directly by continuous geographic intergradation into *Aphelocoma californica texana,* and thence through forms in eastern Mexico into *Aphelocoma californica sumichrasti,* which in turn intergrades individually with *Aphelocoma californica hypoleuca* and *Aphelocoma californica immanis.* A parallel case is found in the mice of the genus *Peromyscus,* as shown by Mr. W. H. Osgood,[5] in *Peromyscus maniculatus austerus* (Baird) and *Peromyscus maniculatus oreas* Bangs; and also in *Peromyscus maniculatus gambelii* (Baird) and *Peromyscus maniculatus rubidus* Osgood. To consider them species, because at some point where their ranges meet they remain distinct while at another similar place they intergrade, would clearly not best represent the facts.

The use, therefore, of individual variation as one of the chief criterions of intergradation seems not only not illogical but necessary.

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COTTON AS A SEED CROP

UTILIZATION of cotton seed as a source of oil and other valuable products has brought forward two questions for cotton breeders; first, the possibility of increasing the oil-content in the seeds of lint-bearing varieties; and second, the breeding of a lintless cotton, to be grown strictly as a seed-crop. In asking the first question it is assumed that the oil might be increased without reducing the lint, while the second is prompted by the idea that lintless varieties could be harvested by machinery, thus avoiding the chief difficulty and expense in the production of fiber, the labor of picking the cotton by hand.

Increasing the oil in cotton seed was undertaken several years ago in connection with the breeding of the Trice variety. A large amount of careful work was done by Professor S. M. Bain, of the University of Tennessee, assisted by the late Mr. Albert T. Anders, formerly of the Bureau of Plant Industry, but without finding the definite differences that were sought as the basis of selection for oil-content. The fluctuations induced by conditions of growth or associated with various degrees of maturity attained by the seeds were so large as to conceal inherent differences of individual plants or progenies. As might be expected from the greater proportion of kernel to shell, the oil-content seems to be higher in varieties with large seeds, more than 24 per cent. of oil, or 64 gallons per ton of seed, being reported for the Meade cotton in Georgia, but large-seeded varieties are unpopular because they do not have the highest percentages of lint.

The breeding of lintless varieties might not prove difficult, since individual plants with entirely naked seeds have been found as chance variations in lint-bearing stocks. Degenerate "slick-seeded" plants with little or no fuzz on the seeds and only a sparse covering of lint are of rather common occurrence in the Southeastern States in ordinary short staple fields raised from "gin-run" seed. Some of the inferior "Hindi" variations of the Egyptian type of cotton have nearly naked seeds. Failure to eliminate the Hindi admixture in Egypt damages the crop to the extent of several million dollars every year. A lintless cotton would need to be excluded rigorously from any region where other varieties are grown. The seed must become much more valuable than

[5] *North Amer. Fauna,* No. 28, April 17, 1909, pp. 52, 53, 66, 69 and 70.

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.

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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-