lus of food as they do in a wild state. Hence the fact that a given animal is indifferent to, or even rejects, a certain species of insect when in captivity, by no means indicates that it would be indifferent to or reject the same species under natural conditions. Indeed, it has been definitely shown that many "disregarded" and "rejected" species are actually taken by wild animals of the same species as those experimented upon.

The whole doctrine of warning colors and mimicry is built upon the presumption that the species mimicked is disagreeable or dangerous, and hence under the law of natural selection the mimicking species has come to assume the same colors as the one mimicked; this presumption is in many cases unsupported by any evidence, and in many other cases is quite contrary to the known facts. Dr. McAtee's conclusion is that since acceptance or rejection of food in captivity bears no close relation to food preferences under natural conditions, the value of experiments upon captive animals to determine the efficiency of warning colors and other protective adaptations in their insect food is very questionable. It should be checked up with such definite knowledge of the natural food as is obtained by the examination of contents of stomachs or other portions of the alimentary canals. He clearly shows that many species which have been considered to be protected by noxious secretions or other adaptations are not really so protected, a conclusion supported not only by the definite evidence produced by Dr. McAtee, but also by the fact that if such species were not preyed upon by various enemies they would soon people the whole earth. Whether the reader finally agrees with Dr. McAtee or not, he will find in this timely paper much information and food for thought, and by having read it will be better prepared for intelligent consideration of the subject. By no means the least valuable feature of it is the series of bibliographies occurring at intervals under the proper sub-headings.—JUNIUS HENDERSON.

CONTRIBUTIONS TO AVIAN PALAEONTOLOGY FROM THE PACIFIC COAST OF NORTH AMERICA. By LOYE HOLMES MILLER (Univ. Calif. Publ. Geol., vol. 7, no. 5, October 12, 1912, pp. 61-115).

The present paper is a detailed summary of our knowledge to date of the fossil birds of the Pacific coast. The accompanying bibliography shows that there have been published eleven separate papers relating to this field of ornithology. By far the most important of these are obviously those of Miller himself who has been fortunate in having full access to the rich material accumulated under the direction of Dr. J. C. Merriam in the department of palaeontology of the University of California.

Of the eight localities on the Pacific slope, in which fossil birds have been found, six are in California. The most notable of these localities, the now famous Rancho la Brea, near Los Angeles, has produced no less than forty-nine species of birds, with promise of further discoveries as excavations there are continued in the future.

Miller's present contribution includes an account of each of the fossil faunas, with lists of the species known from each. Past distribution as thus shown in the regions concerned is compared with present day conditions. Various lines of evidence point towards a Pleistocene climate of higher temperature and greater humidity than now.

The Pleistocene avifauna contained several types of birds not now found north of South America. There appears to have been a retraction in the ranges of these types to the southward. There were many more species of eagles and vultures in California in Pleistocene times than now.

Among causes of the extinction of raptorial species Miller considers as of probable importance, the disappearance of forests and luxuriant meadow vegetation, and the great reduction in the population of herbivorous mammals. J. C. Merriam's studies indicate the disappearance of many species of carnivorous mammals at about the same time with the raptorial birds now extinct. Dr. Miller believes the coincidence significant of dependence of the scavenging birds upon the beasts of prey, in that the former fed largely upon the discarded kills of the latter.—J. GRINNELL.

AN INVESTIGATION CONCERNING THE FOOD OF CERTAIN BIRDS. By JOHN HAMMOND, B. A. (Journal of Agricultural Science [Cambridge], June, 1912, 4, pp. 380-409).

As a further contribution to a knowledge of the food of the birds of England has come a paper entitled "An investigation concerning the food of certain birds" by John Hammond. This paper gives some of the results of an investigation instituted by Professor Wood and Mr. Warburton of the School of Agriculture, Cambridge, "to determine whether or not certain birds were harmful to agriculture." The method adopted in the investigation was "the examination of stomach contents, together with a collection of field notes concerning each bird."

In beginning the investigation the following points were taken into consideration:

"(1) That the examination of the stomach contents ought to be continued throughout the

year, as the conditions (harvest, seed-time ploughing, etc.) would vary considerably.

"(2) That the district from which the birds to be investigated come should be extensive but not too wide. If all were taken from a small area, local conditions would be too prominent; whereas, if birds were obtained from the whole of Great Britain, the variations in climate (and consequently in dates of seeding and harvest) would prevent a clear idea being obtained of the changes in the food materials that occurred from month to month.

"(3) That field notes ought to be taken when the birds were killed, the following facts being mentioned: (a) name and address of sender, (b) date and time of day, (c) exact locality in which the bird was killed, (d) weather, on account of its influence on insect life, (e) special notes, if the bird was doing any particular injury."

A distinct advance in method over previous work can be seen in the attempt to determine the food for the whole year by making collections of birds in the same general locality each month of the year. Although birds were collected where found feeding, attention is given the character of the place where the bird was collected, thus emphasizing the availability of certain kinds of food.

The food of the starling (*Sturnus vulgaris*) and of the lark (*Alauda arvensis*) is given in detail. The final verdict as to the economic value of the starling is as follows:

"(1) The starling is very beneficial during the late spring, summer and early autumn months, eating many harmful insects although a number of beneficial ones are also destroyed.

"(2) During the autumn, and to a less extent in the spring, much harm is done by the consumption of seed corn (particularly wheat); many harmful insects, however, are also destroyed during this period.

"(3) Owing to the fact of the bird's autumn and spring migrations, the remedies suggested are, either (i) to dress the seed corn with something that renders it distasteful to birds; or (ii), if suggestion (i) cannot be carried out successfully, to kill off the autumn migrants in large numbers."

The following conclusion is reached in regard to the lark: "On the whole the lark is beneficial; but, owing to the injuries done at certain times of the year, there is no reason why it should be specially protected, although its wholesale slaughter is to be deprecated."

A table showing the results of the stomach examination of various other birds, which were obtained in insufficient number "for an opinion to be expressed as to their utility," is added. A "List of References" gives a number of the important European publications on the food of birds.

In this paper there appear several original ways of tabulating results. One table gives the number of birds collected each month and the exact locality in which they were collected. A second table gives the date, time, place, locality, weather and sex, and tabulates the different kinds of food under the headings injuries, benefits, and neutral. A third tabulation groups seeds, vegetation, etc., insects, etc., and miscellaneous food under these same headings giving the "times occurred" and "number occurred." The material grouped in this way has been mounted on cardboard. To the student, but perhaps to a less extent to the farmer, this method presents vividly the economic aspect of each meal. As a method of preserving the material permanently, it has disadvantages as compared with the "vial" method.

A fourth table presents data from the standpoint of the food articles. It gives the percentage of times each article of food has been taken by the birds examined. A description of the food taken each month brings out clearly the change in food-habits from one part of the year to another and so emphasizes the necessity of a study of the bird's food the year through.

Perhaps the greatest criticism that can be offered is that against the use of the numerical method. To say that five out of twenty birds, or 25 per cent, ate carabid beetles hardly gives us a clear knowledge of the relation of this particular diet to the whole food or the bird's relative taste for carabid beetles. The percentage-by-bulk method used by the U. S. Biological Survey comes nearer showing the relative importance of the food elements. The value of the numerical method as a guide to the actual destruction acomplished, however, is self evident. A combination of both methods doubtless comes nearest the common aim —"interpretation of economic values."—H. C. BRYANT.

BIRDS IN RELATION TO A GRASSHOPPER OUTBREAK IN CALIFORNIA. By HAROLD C. BRYANT (Univ. Calif. Publ. Zool., XI, November 1, 1912, pp. 1-20).

In July, 1912, a plague of grasshoppers was reported from the vicinity of Los Banos, Merced County, California. The author visited the locality and spent a week there in studying the possible bearing of the native bird-life upon the insects. The present paper is occupied with an account of the observed facts, together with some general remarks upon the relation of birds to insect outbreaks.

It was found that at least fourteen species