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"NOXIOUS" OR "BENEFICIAL"? FALSE PREMISES IN ECONOMIC ZOÖLOGY.

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So many thousands of American dollars have been spent in the last ten years upon the investigations of the United States Department of Agriculture into the economic relations of plants and animals to man, and so much of inestimable value has been accomplished in this direction, that any criticism of the work turned out may seem captious, so greatly does the good outweigh the bad in the gross account. Nevertheless, there is always a disaffected portion of the agricultural classes who sneer at the study of "bugs and bird stomachs" as a most unhappy and worthless waste of taxes. It is too true that the horse sense and field experience of some of these country folk often has a deeper and more practical wisdom in it than the professional zoölogist or botanist can gain in his laboratory work. Even the specialist in some of these studies would fain join in with the cry of the farmer that all our efforts to regulate the ravages of noxious animals and plants are as likely to increase or transform the evil as to correct it. Under former conditions of ignorance there was abundant cause to advocate such a happy-go-lucky theory, but now, thanks be to the persevering efforts of true science and wise legislation, we must all agree that it is our duty to spend and be spent in these researches.

It has been the writer's privilege to belong to both classes in this friendly controversy, and, with a fellow-feeling and sincere respect for each of these, he believes that the following remarks will be taken as evidence of his desire to reconcile and not antagonize the truth-seeking patrons and disciples of husbandry, whether in the field or the laboratory.

It will best subserve the object of this essay to use *Bulletin No. 3* of the United States Department of Agriculture on the "Hawks and Owls of the United States in their Relation to

Agriculture" as representing in one volume the standards by which the economic value of most of the mammals, birds, insects, and reptiles coming under the special notice of the Department have been estimated. It may be added that all subsequent publications of the Department indicate that there has been little change in these standards since the issue of the above-mentioned work of Dr. A. K. Fisher. Published in 1893, this well-prepared and finely illustrated little book represents the highest attainment in the development of economic ornithology yet reached in this country or abroad. Dr. C. Hart Merriam, under whose supervision the work was carried on, in his letter of transmittal to the Secretary of Agriculture, states that only two of the seventy-three species and races of rapacious birds found in the United States "need be taken into account as enemies to agriculture."

Before the investigations which resulted in this verdict were begun, it was the general belief, even among many observing and fair-minded people, that only two or three of the whole number were of any possible use to man. A study of the tabulated lists of stomach contents shows that this reversal of opinion rests solely on two factors. One of these is the relative amount of certain food-stuffs taken by the different species; the other is the character of the animal food preyed upon, whether formed of species noxious or beneficial to man from the agricultural standpoint.

Granting that the determinations of the first class were accurately made (and there is no reason whatever to doubt them), we may well inquire, By what standard do the zoölogists of the Department of Agriculture decide that certain species of mammals, birds, or insects, are considered to be noxious or otherwise? Nowhere in this work are the two classes defined, nor are any reasons given for the evident distinctions drawn between noxious and beneficial species enumerated in the food lists. The novice in such matters naturally seeks to know on what basis the doctors have decided for or against a hawk or an owl, but he is not informed, except as he can glean an item here and there among the biographies of the various species. This study reveals the following standards: (1) car-

nivorous mammals, mice, rats, gophers, and ground squirrels, as a class, are noxious; (2) birds, in their widest acceptation, which form the food of our hawks and owls are largely of species beneficial to agriculture; (3) reptiles and batrachians forming the prey of rapacious birds in the United States are, as a class, probably as noxious as otherwise; (4) insects preyed upon by these birds belong largely to noxious species; (5) of all the species of animals which are devoured by our rapacious birds in the eastern United States none is so largely and universally devoured or so harmful to agriculture as the common meadow mouse (*Microtus pennsylvanicus*).

I have striven to make these formulæ a conservative summary of the doctor's standards of good and bad as adopted in this valuable work. If it is a just summary, the author believes that the 1893 basis of judgment of our zoölogists in Washington is destined to undergo a radical change in some respects. It may already be doing so. Certain it is that the ideas conveyed in propositions 4, 5, and 6 are more or less erroneous, and in some features show a trace of the traditional prejudice which even scientific men often find it difficult to banish from their investigations.

To avoid misunderstanding, let us take the most flagrant case of a so-called noxious mammal, one which forms the bulk of the food of several of our hawks and owls which are nowadays rightly classed as the farmer's friends. The common vole, or meadow mouse (*Microtus pennsylvanicus*), belonging to the same subfamily of rodents as the northern lemming, is rated by nearly all who know him as the incarnation of agricultural pests. On this standard, and this alone, have Drs. Warren, Fisher, and Merriam based their verdict of the economic value of nearly two-thirds of the eastern species of hawks and owls which appear on their rolls of honor. The rough-leg hawk is accorded first place on this list because he eats almost nothing else but meadow mice of this species. But it is a stubborn fact that the case of the meadow mouse has never been proved against him. Not a tithe of the study devoted to his devourers has been given to him, and no scientific analysis of his stomach contents or food habits has yet been put on

record. His plea of not guilty stands good so far as the records of economic zoölogy are concerned. This may sound preposterous to every reader of the statement, but it is undeniable, and not more difficult to believe, after we have inquired into the facts of the case, than the conclusions of the modern zoölogist regarding some of our hawks and owls. "Of course, meadow mice live almost wholly on vegetable food, the grasses and grains of the farm, and that settles it." So retort the great majority, and until a very recent period the writer had thoughtlessly been one of that number. As a farmer, I have had ten years' acquaintance with the habits of the meadow mouse in Pennsylvania and New Jersey, and as a zoölogist, have made about six years' study of the same animal in ten eastern states. In that time about a thousand specimens have been secured and examined, and four hundred preserved for study. Without going into details, the following is a summary of my conclusions as to the economic status of this species, the common meadow mouse, *Microtus pennsylvanicus* of Ord :

1. From 90 to 100 per cent. of the food of this mouse throughout the year is vegetable, of which 60 to 80 per cent. consists of endogenous plants, chiefly grasses; 15 to 30 per cent. consists of exogenous plants, chiefly weeds; 5 to 10 per cent. consists of tubers and roots; and 1 to 5 per cent. consists of grain and seeds.

2. From 1 to 5 per cent. of its diet consists of animal matter such as other meadow mice, and the remains of dead animals.

3. Its vegetable food the year round is largely made up of "grasses," popularly so called, and during the summer season several species of native and introduced weeds form a considerable share of its diet.

4. Its destruction of grasses at all seasons is confined largely, and in the majority of cases almost exclusively, to the rushes (*Juncus*), sedges (*Carex*), salt grass (*Spartina*), Indian grass (*Andropogon*), and other coarse forms which have little or no agricultural value and are rejected by stock either as hay or pasturage.

5. 70 to 80 per cent. of the whole number of meadow mice in any given area restrict their habitat to low, moist soils,

bogs, and clearings, which are classed by the farmer as waste land or untillable meadow, and in these situations they consume almost nothing which would be utilized by the husbandman.

6. 20 to 30 per cent. are found on upland soils. Of these, nearly all confine their foraging to neglected fence rows, abandoned fields, weed patches, brush piles, rubbish, and litter, caused by that clog to American civilization, the shiftless farmer. In these situations the meadow mouse destroys nothing, but utilizes a great deal which otherwise would cumber the ground.

7. The arable land of every well-kept and cultivated farm or nursery, whether in pasture, grass, grain, orchard, truck, or young trees, is practically deserted by this mouse. In short, it can only exist where a food supply is found in conjunction with proper shelter, a shelter in almost every instance synonymous with neglect and waste on the part of the farmer and of utility on the part of the mouse.

8. The meadow mouse rarely eats grain except when the rigors of exceptional winters deprive it of green food. It then confines its appetite to what is found on or in the ground, and which has been exposed by the farmer's improvidence. It very rarely disturbs seeds, fruits, tubers, roots, or vegetables during the growing season and does little damage in winter to those buried in the ground, most of the ravages in these cases being the work of the short-tailed meadow mouse (*Microtus pinetorum*) and the white-footed mouse (*Peromyscus leucopus*).

9. On upland soils the meadow mouse is a surface feeder, forming its runways almost entirely above ground in the shelter of surrounding vegetation and débris. The burrowing of this species is confined chiefly to easily worked, moist lowlands, where it conduces largely to better drainage and an increase of vegetable growth.

To summarize the case briefly, it may be truly said that as a converter of waste vegetable matter into flesh-food for bird and beast the common meadow mouse has no rival in the regions it inhabits. Besides the numerous species of hawks and owls depending almost entirely on this mouse, other carnivorous birds, as the crow, jay, shrike, and heron, devour a

great many. It forms a large part of the menu of several of our mammals, as the wild cat, house cat, fox, marten, weasel, mink, raccoon, skunk, and opossum. The larger species of snakes, the bullfrog, and some of the turtles also devour them. Strike the meadow mouse from the food list of the tens of thousands of animals which devour him in the eastern United States, and the problems of the economic zoölogist would multiply an hundred fold.

The worst charges proved against him are: (*a*) the undermining and tunneling of artificial water barriers; (*b*) the destruction of a small amount of grain and vegetables not seasonably harvested or housed; (*c*) the consumption of a very small percentage of grasses which would have been utilized by the farmer; (*d*) the gnawing of the bark of fruit trees in severe winter weather.[1] The insignificance of these items compared with the value of the mouse as a tiller of the soil, a destroyer of weeds, utilizer of otherwise useless grasses, and a food supply for two-thirds of our carnivorous birds, mammals, and reptiles, is apparent. Exterminate the mouse, and the changed food relations resulting therefrom would cause the extermination of many most beneficial animals and the conversion of others into pests, to the greatest detriment of agriculture. Let us not forget, on the other hand, that any marked decrease of the animals which prey on the meadow mouse is equally to be deprecated, attended as it might be with similar consequences to the "vole plagues" of the old world. To maintain the balance of power between these neutralizing agencies, in the changed conditions imposed by advancing civilization, is the real province of economic natural science.

In 1894, the year following his publication of the volume on "Hawks and Owls," Dr. A. K. Fisher contributed an essay on "Hawks and Owls from the Standpoint of the Farmer," to the *Yearbook of the United States Department of Agriculture.*

[1] Dr. A. K. Fisher, in a recent answer to my inquiries regarding the possible economic value of the meadow mouse, denies that it is anything but a pest, and states that its destruction of trees in nurseries is alone sufficient to condemn it. I have since corresponded with two prominent Pennsylvania nurserymen, Mr. Thomas Meehan and the Wm. H. Moon Co., both of whom deny that they have suffered by this mouse to any extent.

On page 219 I find his first specific arraignment of the meadow mouse, a bit of information wholly lacking in the work of which the doctor's later article was a summary. After mentioning that America is free of the devastating hordes of lemmings which sometimes overrun northern Europe, Dr. Fisher says: "The vole or meadow mouse is common in many parts of this country, and is, east of the Mississippi River, without doubt the most destructive mammal to agriculture. It destroys meadows by tunneling under them, and eating the roots of grass. . . . This mouse also destroys grain and various kinds of vegetables, especially tubers, but probably does even more damage by girdling young fruit trees." There can be no doubt that Dr. Fisher refers primarily to the same species that I have been defending. The injustice of these accusations, as stated, is the more to be deplored, coming as they do from a scientist whose authority is taken as final by a large class of people. This fact, however, should never be construed as a point against the value of hawks and owls and other animals in preventing a vole plague in America. It only indicates that economic zoölogy is in its infancy, and shows the danger of allowing a greater truth to distort the lesser. Four years have elapsed since Dr. Fisher made his statement, — ample time for the officers of his bureau to have discovered that the greater part of the real damage done to vegetation by cutting of grass roots, eating of vegetables, seeds, and grain, and the girdling of young trees, is the work of another member of the vole family, the mole-like, short-tailed, rusty-backed pine mouse (*Microtus pinetorum*). The name mole mouse would better fit this energetic little burrower on whose shoulders rests the onus of most of the sins which we have unwittingly charged to the meadow mouse and the mole.

An hereditary prejudice may become an instinct stronger than our desire for scientific truth. One of the most popular and tenacious fallacies is the human hatred of reptiles and the desire for their wholesale extermination as noxious animals. The same remark will apply in large measure to skunks, minks, and weasels. Without being precise, it may be safely asserted that one-half of the food of our east American snakes consists of

mice (chiefly meadow mice) and insects. The remainder of their diet is made up largely of other snakes and reptiles, birds, batrachia, and fish. Undoubtedly Dr. Fisher recognizes the economic importance of the majority of our reptilia and batrachia, yet one cannot escape the suspicion that he has practically classed these as noxious because he has not taken the pains to declare them beneficial. He includes the swallow-tailed kite in the small list of those hawks "wholly beneficial" to the farmer. The tabulated lists and reports show that the food of this species is largely made up of insects, also of snakes, lizards, and other reptiles whose diet is quite as beneficial to agriculture, perhaps, as that of the kite. Nevertheless, the doctor says: "The snakes, lizards, and frogs it destroys, though by no means injurious to agriculture, probably will be regretted by few." We cannot but deprecate such a statement from such a source, for, though it does not condemn these animals, it implies that they are inferior or insignificant in the economic scale, — an imputation utterly without warrant, and serving to perpetuate the popular idea of their worthlessness.

The case of the swallowtail may serve as a striking illustration of nature's mysterious balance of good and evil:

> That not a worm is cloven in vain,
> That not a moth with vain desire
> Is shrivelled in a fruitless fire,
> Or but subserves another's gain.

On the basis of Dr. Fisher's statistics we will suppose a swallow-tailed kite to eat 100 insects, 2 chameleons (*Anolis*), 1 lizard (*Sceloporus*), and 3 grass snakes (*Cyclopis*) in one day. At first thought this should gladden our hearts. But an entomologist will say that 50 of those insects are tiger beetles, dragon flies, and wasps, the two former destroying hundreds of other insects, while the latter captures numerous flies and spiders daily. Avoiding the query as to what kind of insects the other insects eat, the herpetologist declares that the chameleons and the lizard and the green snakes daily devour among themselves about a thousand insects great and small. On the insect basis alone the problems of good and bad in this case are infinitely multiplied. From that point of view it looks, at best, like a

bad case for the kite. From another standpoint the evidence bears hard on the snake. As a variation to insect diet perhaps it has swallowed another snake. Is this an argument in its favor? Or it swallows a toad or frog, both of which live almost wholly on insect life. All this reminds us of Dean Swift's rhyme:

> So, naturalists observe, a flea
> Has smaller fleas that on him prey;
> And these have smaller still to bite 'em;
> And so proceed, *ad infinitum*.

So the plot thickens until we are tempted to despair of the utility of these investigations. A weed is a useful plant misplaced; so also is the hawk, the mouse, the snake, or the insect a noxious animal when we unwisely alter the conditions of its struggle for existence. In nature's order all have their place in the economy of creation.

Two notable groups of injurious mammals in this country are the jack rabbits and the spermophiles, or ground squirrels, of the West. Their combined ravages amount to agricultural losses of tens of thousands of dollars annually and cover a vast extent of country. This condition of affairs has become a national question in the last decade, and was a state question long before that. The vast increase of these rodents is directly due to man's destruction of rapacious mammals, birds, and reptiles, especially of the coyote, or prairie wolf, in these regions; also to the increased amount and improved quality of food supply attending the settlement of the country. This is a matter in which no restoration of primitive conditions is either feasible or desirable, except so far as rapacious animals, wrongly considered harmful, can be encouraged to increase. The effectual devices recommended in the Bulletins of the Department of Agriculture,[1] and adopted by our western brethren for the destruction of jack rabbits and spermophiles, as well as the noxious pocket rat, or gopher, are strong proof of the practical value of economic study along these lines.

[1] *Bulletin No. 4*, "The Prairie Ground Squirrels of the Mississippi Valley," 1893. *Bulletin No. 5*, "The Pocket Gophers of the United States," 1895. *Bulletin No. 8*, "The Jack Rabbits of the United States," 1896.

The following propositions may be considered as a synopsis of the conclusions arrived at in the preparation of this paper:

Firstly, the province of economic zoölogy should embrace (*a*) the study of the functions and habits of living creatures in their relations to nature and to each other, with special reference to the uses and welfare of mankind; (*b*) the publication of the results of this study in a form most easily accessible to and understood by the public, with a view to correct popular errors and enlist the sympathy and coöperation of the people in the necessary reforms; (*c*) the perfecting of legislation for the control of injurious, and the protection and encouragement of beneficial, species; (*d*) the prevention of an unequal administration of economic laws, having in view the peculiar needs and industries of the region involved, and the varying circumstances of environment, the aim always being to secure the greatest good for the greatest number; (*e*) giving the benefit of doubt as to the economic value of a species to the species in question; (*f*) the recognition of the fact that true economy cannot ignore the æsthetic and the altruistic in its enforcement of utilitarian laws.

Secondly, concerning the subject of economic zoölogy as specially affecting the United States it may be said: (*a*) that, in general, experience has shown that the *extermination* of any native species on economic grounds is undesirable, but its *restriction*, temporary or continuous, may be a subject for wise legislation; (*b*) that the damage done by many so-called noxious species is offset in a degree beyond calculation by the fact that they form a large share of the food of beneficial or harmless species, which, if deprived of this source of supply, would be exterminated or become harmful by recourse to an unnatural diet; (*c*) that in the United States we have large areas so nearly in their virgin state that the balance of nature there existing may be taken as a criterion by which to restore the most natural order compatible with the changed conditions of populated districts; (*d*) that the unwise destruction of so-called noxious species in this country has not gone so far toward extermination that present-day reforms will fail to be a remedy, as is the case in Europe; (*e*) that the unity of our

country in the direction of interstate and national legislation has developed early enough for us to conserve the natural productions of the United States in a manner now impossible among older nations; (*f*) that the unparalleled deforestation and agricultural settlement of the lands of the United States and the importation of foreign species of animals and plants to her shores has so suddenly and materially affected our climatic and zoölogical conditions that nowhere else in the world has there been presented such a variety of important economic problems; (*g*) that owing to our exceptional facilities for the study of these problems by a corps of trained students and scientists so competent to solve them, and a people so alive to the necessity of education and reform, the civilized world is looking to us for results in economic research commensurate with the money, time, and brains invested, and the demands of a progressive century.