revolutions per minute, $n = 5$ revolutions per minute (estimated), and $r = 2/3$ ft. (estimated). Then if $a = 1$ foot, we shall have $P =$ about 150 lbs.; or, if $a = 2$ ft., $P = 75$ lbs., etc.

It thus appears that under ordinary conditions of flight, the effect of these gyroscopic forces could hardly be serious.

In conclusion, we note the following simple rule for determining the *direction* in which the force P will be exerted. (This rule was first published by the writer in the *Engineering News* for June 21, 1910. See also *The Scientific American* for November 23, 1912.)

Imagine the deflecting force (that is, the force which compels the aeroplane to change its direction of flight) to be due to the pressure of a flat board against the spinning axle (say in front of the motor), and *note the direction in which the axle, if rough, would tend to roll along the board;* this will give the direction in which the (forward) end of the axle will tend to move as the result of gyroscopic action—that is, the direction in which the force P will act against the (forward) bearing.

For example, suppose the axle is spinning in the clockwise direction, as seen by an observer looking forward, and let the aeroplane make a sharp turn to the *left;* then the forward end of the axle will strive to *rise.* Similarly, if the aeroplane makes a sharp dive *downward,* the forward end of the axle will strive to turn to the *left.*

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FUR-BEARING MAMMALS: AN UNAPPRECIATED NATURAL RESOURCE

The manor of living nature is so ample, that all may be allowed to sport on it freely; the most jealous proprietor can not entertain any apprehension that the game will be exhausted, or even perceptibly thinned.

In such wise did Dr. Richard Harlam, writing in 1825, comment on the inexhaustibility of our natural game resources. As late as 1857 the following in substance appears in the report of an Ohio state senate committee:

The passenger pigeon needs no protection. Wonderfully prolific, having the vast forests of the north as its breeding grounds, traveling hundreds of miles in search of food, it is here to-day and elsewhere to-morrow, and no ordinary destruction can lessen its numbers, nor can those killed be missed from the myriads that are yearly produced!

The tragic story of the passenger pigeon is familiar to every one. Not so familiar, perhaps, are similar stories which may be told of other species. Fortunately, there is a growing realization that our national resources in wild life are rapidly dwindling, and attention is being directed toward checking the extermination.

This consideration comes not a moment too soon. Unless protective laws are enacted before a species is nearly extinct they can not ordinarily avail much. Nevertheless, vigorous efforts should be made continually not only to conserve species which are still plentiful, but to preserve species which, through our lack of foresight, are on the verge of extinction.

There is, however, one department of our fauna which, in the opinion of the writer, has hardly received its deserved quota of attention. I refer to the several species of fur-bearing mammals whose pelts have a commercial value. The species concerned include the bear, raccoon, skunk, badger, otter, sea otter, mink, marten, fisher, red fox and wolverine.

It is estimated on fair authority that there are within California alone trappers in the proportion of ten to the county, each of whom makes a possible average of five hundred dollars from his annual catch. There are fifty-seven counties, so that five hundred and seventy persons with a total income for the fur season of $285,000 a year would on this estimate be resident in the state. Two hundred and eighty-five thousand dollars is the interest at four per cent. on $7,125,000. This, or even a quarter of it, would seem to be enough of a commercial asset to be worth at least some legislative consideration.

On the basis of figures quoted by Ernest Thompson Seton[1] it appears that an extremely

[1] "Life Histories of Northern Animals," 1909.

conservative estimate would place the revenue to North America as a whole for the last seventy-five years from the furs of the raccoon, badger, wolverine, fisher, marten, mink, otter, red fox and large striped skunk at $222,735,000, and to the United States at $113,950,000. This is an average value per year of a little less than $3,000,000 to North America as a whole, and $1,500,000 to the United States. Three million dollars is the interest at four per cent, on $75,000,000 and $1,500,000 is the interest at four per cent. on $37,500,000.

Thus a conservative estimate shows that $37,500,000 is the "capital invested" by the United States in the fur-bearing mammals listed. These figures, while not especially large, do indicate that the fur value of these species has been appreciable! It should be remembered, too, that the furs of such damage-doing species as bear, coyote, wolf, mountain lion, lynx and wild cat are not listed in this estimate. That the fur trade total would be considerably swelled by the inclusion of the last-named mammals is indicated by the fact that Brass[2] has shown that the *annual* value of all North American furs during the years 1907–09 averaged one hundred million marks, or about $25,000,000. My estimates given above are probably below the actual figures even for the species included. Twenty-five million dollars is the interest at four per cent. on $625,000,000, which represents the approximate money-value of all North American fur-bearing mammals.

It is clearly apparent that there are good economic reasons for the protection of some of our mammals at least. The need of conservation is beginning to be keenly felt in California, where trappers in the Sacramento Valley recently testified to the writer that practically all fur-bearing species are rapidly decreasing. There is much wanton destruction of these animals during the summer season when their fur is worthless. The grizzly bear, the noblest member of our California fauna, is now practically extinct. The sea-otter, possessing the highest fur value of all our mammals, formerly existed in great numbers off the coast of western America, and is also a vanishing species. The dismal story of dwindling numbers and final extinction seems about to be repeated in the cases of certain animals with which we are now dealing as though the "manor of living nature" was inexhaustible.

We are confronted with two facts: first, America's crop of fur is economically profitable, and second, the mammals on which this harvest depends are in most cases decreasing in numbers. We may dispose of these mammals in one of two ways: (*a*) They may be appropriated to man's use as rapidly as possible, with no thought of future supply. Their money-value thus becomes a perfectly definite sum, which can not be added to when the species become extinct. (*b*) They may be wisely conserved, heed being paid to the future. Their economic value under this method would either remain at about the figure at which it now stands, or would increase, and the fur-bearing mammals would be of permanent instead of transitory worth in dollars and cents. For instance, in California we could count on a quarter of a millon dollars coming into the state annually which would not otherwise find its way here.

Upon proposing legislation it becomes immediately apparent that there are difficulties. Several of the animals mentioned are charged with various offences against the farmer. Others are to some extent predatory on game fishes and game birds. There is strong suspicion in the minds of some that their depredations are in many cases not so serious as certain of the indictments against them would indicate. But the lack of information does pointedly emphasize the need for more data as to their numbers and habits.

Nature-history museums may be relied upon for some of these desiderata, but at best there is no doubt that our knowledge is yet fragmentary and inconclusive. A state trapper's license, be it ever so small, would give data as to numbers of trappers and amount of trapping done which would be invaluable to legislators desiring to adopt a wise conservation policy. Perhaps more important

[2] "Aus dem Reiche der Pelze," 1911, p. 356.

even than this would be a thorough investigation by the various state and provincial game or conservation commissions of the habits of the species concerned, with special reference to food preferences and commercial values.

Protection of those species whose numbers are not yet reduced below a critical point would doubtless be possible and adequate. Conservation of beavers has been successful in such cases. Nature distinctly favors some of the species through their practically inaccessible habitats, or their self-protective instincts. It is evident that protective legislation would consequently vary with the species and with the conditions of its existence in particular localities. Where one mammal may require a five-year closed season, another may need protection during the breeding season only, and for still another, protection may be altogether unnecessary at present.

There is further reason for paying heed to these elements of our fauna. The fact that man is the dominant species does not justify his wanton extermination of any members of the living world around him. It has taken nature geologic ages to evolve these animals, and it is our duty to be considerate in our dealings with subordinate forms of life.

There is no resurrection or recovery of an extinct species, and it is not merely that here and there one species out of many is threatened, but that whole genera, families and orders are in danger.

Dr. Mitchell in a recent number of SCIENCE[5] has forcibly called attention to a number of facts, full of sinister warning to those who dislike to stand by and see the careless destruction of our native fauna. Allow me to quote again for the sake of emphasis:

Each generation is the guardian of the existing resources of the world; it has come into a great inheritance, but only as a trustee.

In the opinion of the writer the intrinsic interest and the humanitarian arguments, as well as the economic one, emphasize strongly the desirability for wise attention to this lesser problem of the fur-bearing mammals, none the less than to the careful conservation of all the rest of the wild life yet remaining at our disposal.

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[5] 1912, p. 353 and following.

THE WRITINGS OF WILLIAM G. SUMNER

TO THE EDITOR OF SCIENCE: A little over a year ago the Yale University Press published a collection of essays by the late Professor William Graham Sumner. It is now proposed to publish another volume to be called "Earth Hunger and Other Essays," during the fall of 1913 or a little later. In connection with this enterprise, I wish, as editor, to bespeak your assistance.

It is desired, in this proposed volume, to collect (aside from more extended matter) all of Professor Sumner's shorter publications. Many of his best and most characteristic utterances were brief articles, struck off on occasion, and widely scattered in newspapers and magazines. We have little trouble in finding his longer articles, but it is difficult to locate many a short and vivid fragment. Since the other volume was issued, not a few suggestions have come to our ears to the effect that another time we should not overlook this or that pregnant utterance—some striking thing which has riveted the attention of our courteous censor, and which he would like to have at hand. Sometimes such a constructive critic can not remember just where or when he has seen such an article, and suggests vaguely that it was "in the papers," or "in one of the weeklies."

Now we want all these scattered materials, and it has occurred to me that suggestions might be forthcoming as to their whereabouts, if our present effort to make a final and exhaustive collection of Sumneriana were announced to your readers. We should be glad to examine any materials that might come within the scope of the proposed volume, and to receive any suggestions, however vague, as to utterances, brief or extended, from the pen of Professor Sumner. Materials sent me in care of the Yale University Press will be acknowledged and promptly returned after examination.