Roosevelt Wild Life Bulletin

Charles E. Johnson

SUNY College of Environmental Science and Forestry

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Roosevelt Wild Life Bulletin

OF THE

Roosevelt Wild Life Forest Experiment Station

OF

The New York State College of Forestry

At Syracuse University

THE BEAVER IN THE ADIRONDACKS
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Roosevelt Wild Life Bulletin

VOLUME 4, NUMBER 4

OF THE

Roosevelt Wild Life Forest Experiment Station

OF

THE NEW YORK STATE COLLEGE OF FORESTRY

AT SYRACUSE UNIVERSITY
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** Resigned as Station Director May 1, 1926.
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# THE BEAVER IN THE ADIRONDACKS: ITS ECONOMICS AND NATURAL HISTORY

By Charles Eugene Johnson

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INTRODUCTION

In the summer of 1921 a survey was made to determine the beaver situation in northern Herkimer and Hamilton Counties of The Adirondacks. For some time previously repeated and insistent complaints had been coming to the State Conservation Commission, from various sources, to the effect that the beaver was a source of damage to various interests, notably timber and fishing, and in other instances it was claimed that private property on water fronts in this region was often subject to serious depredations by this animal.

The situation at that time had developed as a result of a number of years of uninterrupted protection, inaugurated for the purpose of bringing the beaver back to its former status in the Adirondack region, where it had long been all but extinct. The restocking began about 1905 with the liberation of a number of beaver which had been secured outside the State. At the time these animals were set free it was generally believed that the beaver had been completely extirpated in New York, but, as will appear later in this paper, there evidently were a few individuals left from the original stock, which had escaped notice. With the few pairs of introduced beaver as a nucleus, together with such others as might have survived from the native stock, and with legal protection from trappers, the species began a steady increase in numbers and a gradual dispersal along the water courses of the Adirondacks, which about fifteen or sixteen years later was destined to culminate in the alleged situation just mentioned. From an animal of highly illustrious ancestry, one might say, and deep in the esteem and affections of every New Yorker, from the Conservation Commission to the humblest and most optimistic Adirondack trapper, it had in this space of time become an outlaw in its own land. Its success as a species was its greatest liability, and its numbers were its undoing. So common had it become that now even many of its former friends, evidently touched with the desire for gain, at the mere sight of it began overhauling their traps and unleashing numerical estimates with reckless abandon.

Such was the state of affairs in 1921 when the opportunity came for the Roosevelt Wild Life Station to make a preliminary investigation in those localities in the Adirondacks in which, from all reports, the densest beaver population occurred, and from which, as above stated, the majority of complaints about the beaver had emanated. The need for such a survey was obvious. The beaver is generally recognized as one of the valuable fur-bearing animals of North
America, and there is hardly anyone who on mature thought will seriously question the material value that its presence in large numbers actually would have to the people of a region like that of our own Adirondacks. But its material value is not all, for the value of the beaver is not limited strictly to its skin alone. Throughout the whole country there is a vast and rapidly increasing number of our population which is interested in wild life for its own sake; people who enjoy the presence of wild animal life and have no desire to kill. The living rather than the dead beaver interests people of this sort, and it constitutes one of the attractions to this great group of men, women and children, thousands of whom come every summer to the Adirondacks to enjoy nature out of doors. Then there is that very considerable body of the resident population which takes a similar attitude, not only toward the beaver, but towards other forms of useful and interesting wild life. There are those whose yearly welfare—since their means of livelihood is closely tied up with summer visitors—directly or indirectly depends to a very considerable extent upon the maintenance of a generous supply of natural attractions. It is clear that some sort of survey or inventory is highly desirable of a resource of this kind. It is important to attempt to learn what the actual facts are, and to form some sort of estimate, however imperfect, of the possibilities in the situation.

In the previous reconnaissance (1921) the time available for the field work was limited to about six weeks. Though this period was devoted to only a relatively small part of the beaver-inhabited territory of the Adirondacks, it nevertheless was inadequate for anything like a complete investigation even of the limited area covered. To explore fully every pond, lake and stream on which beaver are known or are believed to occur is a time-consuming undertaking which would require many months for any one person to complete. Yet a personal inspection of as many such waters as possible is very necessary if the purpose is to obtain anything approaching an accurate picture of conditions as they actually exist. One cannot rely too much on the conditions found in one part of the Adirondacks in drawing conclusions in regard to another part; and information obtained at second-hand often is misleading, for with the beaver situation as with so many other things there is much that is merely relative. One informant considers the beaver numerous in his territory if he has seen half a dozen dams on a single stream; another will say that the animals are only fairly common where he has a seen a dozen dams on as many different streams. One man will speak of a dam fifteen inches high as large; another will call a three-foot dam small;
and on more than one occasion I have found a dam that I was told was "nine or ten feet high" to measure no more than three or four feet from the bottom of the creek. One man will speak of a flow as large if it covers one acre; another will say it is small if it covers three or four acres. Much depends upon what the individual happens to have seen and the kind of measuring stick he carries. This statement applies particularly to damage to trees and timber. A dozen four-inch trees and a fringe of alders killed in a beaver flow will constitute "a good deal of damage" in the eyes of one individual, while to another, two or three acres of six- or eight-inch trees will appear as "not much damage to timber."

In the summer of 1924 it was deemed advisable to continue the beaver survey and extend it to other sections of the Adirondacks, and field work was accordingly begun on June 24 and continued until September 1. That summer seemed a particularly opportune time to resume the survey for the reason that the State authorities had declared an open season on beaver during the preceding March, and it would be of importance to learn if possible what effect this trapping season had had on the beaver situation in the Adirondacks generally. In both the later and the earlier survey effort was made in the prosecution of the field work to visit and examine personally as many beaver-inhabited waters as possible, in as many sections of the Adirondacks as time and circumstances would permit. To visit all such waters would be an undertaking requiring many months for one person to accomplish, but it is felt that during the time actually spent in the field a fairly comprehensive view was obtained of the conditions as they actually exist in the Adirondack region as a whole. It was made a practice in every case to call upon the resident forest ranger and obtain from him information as to the present distribution of the beaver in his district. With all beaver-inhabited localities known to him marked on my map, the plan was then to visit as many of these localities as time permitted, paying particular attention to those places where the beaver were reported by the ranger to be most active or plentiful, or where damage of any kind was reported to be most extensive or serious. Game protectors, trappers, guides and permanent residents were interviewed whenever opportunity offered and their opinions obtained, together with whatever information they might be able to give with regard to the beaver situation in their respective localities.

At this point a word of explanation is necessary regarding the contents of the present paper. The edition of the *Wild Life Bulletin*
in which the results of the previous survey were published has now long been exhausted, and in view of the fact that numerous unfilled requests for that bulletin are on file with the Roosevelt Wild Life Station, it was deemed desirable to incorporate in the present account the principal facts and conclusions presented in the former paper. In the course of both surveys special attention was devoted to those phases of the beaver question which had been the chief sources of complaint. Those phases will here be taken up first, and the conditions in the various localities examined will be described as actually seen by me. The conditions in localities not visited will be stated as they were represented to me by the forest rangers in their respective districts, or by other inhabitants who were familiar with the facts.

SUMMARY OF THE PREVIOUS SURVEY OF 1921

The field work of the previous survey extended from July 27 to September 9, 1921. The territory then covered lies in northern Hamilton and Herkimer Counties. The principal areas investigated (see Maps 4, 5) may be roughly designated as the regions of Big Moose and Twitchell lakes, Beaver River Flow, Long Lake, Blue Mountain Lake, and Indian Lake. These areas together embrace what was at that time considered the most densely infested beaver territory of the Adirondacks. It constituted the center of beaver abundance. Within its boundaries or closely adjoining had been liberated a few of those original pairs with which the re-stocking of the Adirondacks began—an experiment which, not so many years later, appeared in the eyes of some people as what might be termed a regrettable success. The Adirondacks, of course, proved as attractive a habitat to these newcomers as they had been to the earlier native stock, and in addition there was now practically complete immunity from trappers as well as from natural enemies. The beaver consequently thrived and multiplied; it was not long before their dams and houses became conspicuous features on streams, lakes and ponds that had not known such structures in the memory even of many of the oldest inhabitants. The beaver in the Adirondacks generally had become little more than a legend and its return was hailed with interest by the residents of the region, whose attitude was wholly friendly. But matters were not permanently to remain thus. Years passed and fringes of dead trees and bushes appeared here and there along the shores of streams and ponds; a suspicious brown tinge became noticeable in waters
that heretofore had been crystal-clear; tenacious structures of sticks and mud arose with increasing frequency across wonted routes of boatman and canoeist. These and other annoyances, real or imaginary, began to formulate themselves in the minds of this one and that one; grumblings began to be heard in this quarter or that quarter—and then suddenly the beaver had changed from an object of universal interest, admiration and affection to a nuisance and a pest and even a menace that must be effectually curbed or completely destroyed. At least so it appeared to some minds.

Now, if one would look at all closely into questions of this sort, one must be prepared to encounter a certain amount of prejudice or self-interest, always ready to assert itself, and due allowance therefore must accordingly be made. Reasons for prejudice against the beaver are sometimes quite obscure if not entirely wanting. More often it is probably due largely to ignorance and a ready credulity born of that ignorance. Attitudes founded on selfish interests are more comprehensible. It is pretty generally the case that whenever a species of game or fur-bearing animal which has enjoyed protection to the extent that its numbers begin to excite the desires of the covetous, the means first seized upon by this gentry to bring about an open season on the animal is the dissemination of the idea that damage, great damage of one kind or another, and the more kinds the better, is being perpetrated by the species in question. The authorities are appealed to, and since a united minority, no matter how small, if sufficiently vociferous, in this field as in politics can sometimes gain its ends against the desires of an unorganized and silent majority, its appeal is sooner or later heard. The bear, for example, begins to increase. A farmer perhaps loses a hog. Bears have been known to kill hogs; a bear must have taken this particular hog. Bears, therefore, are destructive to the interests of the farmer and protection must be taken off the bear. Trout may diminish in numbers in certain streams. 'Coon tracks appear on the banks, and 'coons have been known to catch fish. 'Coons, therefore, must be responsible for the decrease of trout, and the open season on 'coon must be advanced, and—the desire of those who hunt 'coon for sport would of course then be gratified, but only incidentally, as it were. Too often the cry of "Wolf! Wolf!" is heard when there is no wolf; merely a yelping fox.

Then again with regard to such matters as the beaver there are certain special interests for which proper allowance must be made; interests to which the activities of the beaver may occasionally be
Fig. 87. Constable Creek. View above second beaver dam from mouth of creek; 1921.

Fig. 88. Constable Creek. View about a hundred yards above section shown in Fig. 87; 1921.
Fig. 89. Another view on Constable Creek. Mixed birch and spruce; 1921.

Fig. 90. Constable Pond, looking toward the outlet. Fringe of spruce timber under water; 1921.
a source of annoyance, and perhaps some damage. Such interests
at times are inclined to be impatient and intolerant of anything
that is not directly concerned with the promotion of their particu-
lar aims, and they give little thought or heed to the possi-
Bility that the object of their disfavor may be of importance and value to
someone else. These things are mentioned because unless due al-
lowance is made for these various viewpoints and the considera-
tions by which they are influenced, it is hardly possible to gain a fair
understanding of some phases of the beaver question. Not that
there may not frequently be justification for complaints against
activities of beaver, but for myself personally, in the light of my
own experience, it is difficult to escape the conviction that much
of the violent clamor that has been raised against the beaver in
recent years has been prompted more by prejudice and selfish in-
terest than by real cause or grievance. The extent to which blind
prejudice may get possession of an individual is sometimes amusing;
I say prejudice, but perhaps it might have constituted a species of
propaganda. A certain inn-keeper whom I interviewed, upon learn-
ing my errand launched forth in a violent tirade against the beaver,
liberally punctuated and bracketed with profanity. Taking advan-
tage of a brief lull I risked a question: "Now, Mr.—, will you
kindly tell me the exact extent of the damage you have suffered
from the beaver?" Pencil in hand I stood ready eagerly to record
what I fully expected to be a serious affair. Apparently taken
somewhat aback by his eager and sympathetic listener—did the
pencil and notebook have anything to do with it?—he hesitated a
moment and then—more profanity—replied with undiminished heat
but with evident truth that, "The —— —— things haven't done me
any harm, and I don't care what is done about them!"

Damage to Timber.—That phase of the situation which loomed
largest and formed the basis for the loudest complaints against the
beaver was the drowning of timber in the beaver ponds or flows.
As a consequence of this agitation the Division of Lands and Forests
(see Ninth Ann. Rept., N. Y. State Conservation Commission, for
1919, p. 48) in August, 1919, about 14 years after the introduc-
tion of the beaver, "In order to secure some accurate facts in
regard to the beaver damage in the Adirondacks," issued instruc-
tions to the rangers to "report in detail on all dams in their respec-
tive districts." When the data from these reports were summarized
it was found that 587 beaver dams had been reported. The com-
bined areas that had been flooded by these dams amounted, it was
estimated, to 8,681 acres, and the value of the timber damages to $51,425. "Two-thirds of the acreage flooded was State land, upon which stood seven-eighths of the total timber damaged." In some cases where the dams were of recent construction the trees were not yet dead, and (p. 49) it was "estimated that $5,530 worth of timber could be saved by immediate and permanent removal of some of the dams."

In 1920 the rangers were again required to report on beaver dams, this time reporting "only on new dams or dams which had been overlooked the previous year (Tenth Ann. Rept., for 1920, pp. 99-101)." The total number of dams reported for this year was 159, and the area flooded was estimated to be 1,070 acres. The value of the timber flooded was estimated at $3,410, of which it was believed $986 worth might be salvaged by immediate destruction of the dams. "It was evident," concluded the report (p. 101), "that the beaver are exceedingly active and that they are becoming more and more a nuisance in the Adirondacks. The damage done by them is increasing every year at an alarming rate, and something should be done to prevent such a wanton destruction of fine timber and beautiful shore lines."

The above paragraphs sum up the results of the official investigation of the beaver situation by the Conservation Commission up to the time that the preliminary survey was begun by the Roosevelt Wild Life Station. The results of this survey (in 1921 and 1924) as pertaining to timber damage will now be taken up and will be considered under the headings of the localities examined. At the conclusion there will be an analysis of the published reports on timber damage as appearing in the Conservation Commission's Annual Reports, and a general discussion of the entire subject of the relation of beaver to timber in the Adirondacks. Such analysis and discussion appears to be very important in the interest of a correct understanding of the beaver situation in this particular respect.

As stated in my earlier paper (122, p. 125) no attempt was made by me to estimate the total acreage of land or timber flooded by beaver. To have done so under conditions such as those existing in the Adirondacks, if any degree of accuracy was to be expected, would have involved months of time, an amount all out of proportion to the importance or value of any figures that might have been secured. It may, however, be stated as axiomatic that any discussion of acreage in this connection must have due regard for the fact that the number of acres of land flooded as result of beaver
Fig. 91. Constable Pond; flooded bay at inlet. Drowned timber mainly spruce; 1921.

Fig. 92. One of the dams on outlet creek of Lower Gull Lake; 146 feet long and 8 feet 8 inches high; 1921.
Fig. 93. Dam on outlet creek of Russian Pond; 1921.

Fig. 94. Twitchell Creek. View a half mile west of highway. Dead spruce, killed by flow; 1921.
Beaver in the Adirondacks

dams can in but few instances be taken as a measure of the number of acres of timber flooded or killed. The two are in no way equivalent. A beaver flow may cover perhaps fifty acres of land, but the timber affected may be limited to only a dozen or two trees scattered over the whole area, or confined to a portion of it less than an acre in extent. It must be recognized further that in many beaver flows, large or small, there are no trees to be damaged; merely alder thickets, willows and shrubbery—all without recognized commercial importance. Again, where valuable species of trees are affected, in calculating the monetary value, distinction must be made between young growth and larger marketable trees. For example, in estimating losses from forest fires a hundred acres of saplings destroyed would hardly be evaluated on the basis of their prospective future value as mature trees. The same principle must of course be applied to timber damaged by beaver. But there is a further distinction that also should be recognized, and that is, that in the beaver flows the trees are merely killed; they are not outright destroyed, and if so desired they can be utilized for practically the same purposes as those for which they are used when cut down by man. In the burn there is often little of value remaining. These and other considerations must be taken into account in estimating acreage and value of trees damaged by beaver ponds, if anything like a fair or reasonably correct valuation is to be reached. In view, therefore, of the futility of such an undertaking in the time available for the field observations, attempt was made merely to record the conditions as seen on the spot, with only occasional references to approximate acreage in individual cases.

In the following paragraphs I shall now describe first the beaver flows examined by me in 1921, in which, according to the rangers, the most extensive damage to timber had occurred. In addition a few examples will be given of beaver localities where no damage to timber had been caused, or where, due to prevailing conditions, none seemed likely to occur. To enter descriptions of all localities where beaver had established themselves would require more space than its importance justifies. It will suffice simply to list on a subsequent page the names of the localities where damage to trees or timber was found, and of those in which damage was negligible or entirely wanting.

Region of Big Moose and Twitchell Lakes.—The most extensive damage to timber in one continuous block in this region was found bordering Constable Creek and the pond of the same name (see
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Map 4). The length of the beaver flow there, including the pond, was about two miles. The width of the dead tree area varied from an estimated 10 rods at the lower end to about 18 or 20 rods at the pond. A much narrower fringe extended along the north and south shores of the pond to meet at the east end, at the entrance of Pigeon Creek. Five beaver dams were located on Constable Creek. The smallest one was about 25 feet long, and 15 inches high between water levels, and situated close to the mouth of the creek. This dam was on private land and had been torn open a number of times since it was started, and as a consequence no damage had resulted. The next dam was situated at the lower end of the long flow (Fig. 87) and was about 40 feet long, and 18 inches high between the water levels. The largest dam was the uppermost one, near the pond, and was about 300 feet long and 4 feet high. All the dams were in good repair. The conditions as seen at various points along this flow are shown in Figures 88 to 91. It will be noted that the trees affected are principally spruce, balsam fir, and birch. The largest trees were about 5 to 8 inches in diameter and represented a second growth in a previously cut-over district. The width of the flow here is due to the nature of the ground, the banks of Constable Creek being low and thus permitting comparatively extensive inundation with but slight increase in height of the water level.

In contrast to the conditions found on Constable Creek, may be mentioned those on the outlet stream of Lower Gull Lake. Of seven beaver dams occurring on this creek, two were among the four highest encountered in the Adirondacks, measuring respectively 119 feet along and 6 feet high, and 146 feet long and 8 feet high (Fig. 92). Because of the steepness and height of the banks here, the lateral extent of the ponds was limited, and damage to trees had been trivial. These two dams had been established several years and their continued existence offered no evident possibility of damage to timber.

On the outlet creek of Russian Pond, about 200 yards from the pond, was a dam 60 feet long and 2 feet 6 inches high (Fig. 93). The flow above this dam was about 65 feet wide and the brook just below it was 10 feet wide. A narrow fringe of dead spruce, the largest probably 6 or 7 inches in diameter, extends along each side of the creek from the dam to the pond. The banks of the creek would hardly permit flooding of any area of important size.

Bordering Twitchell Creek on the west side of the road is a belt of dead timber a mile or more in length. This belt contains some dead spruce of good size (Fig. 94), perhaps 8 or 10 inches in
Fig. 95. Dam at outlet of Oswego Pond, Twitchell Lake district. This flooded area extended half a mile above the dam; 1921.

Fig. 96. Lower Gull Lake. The raised water level had killed a narrow fringe of trees around the lake; 1921.
Fig. 97. The lower of the Two Sisters Lakes. A fringe of medium-sized spruce had been drowned; 1921.

Fig. 98. Beaver pond at junction of Sunshine and Jack Ponds, Twitchell Lake district; 1921.
diameter in some instances. This timber had all been killed several years ago, and at the time of my visit I saw no fresh or very recent signs of beaver along this part of the creek; merely the remains of three old dams which had been torn out, and of three old lodges.

The most extensive area of drowned trees, chiefly spruce, in the Twitchell Lake district, was on the borders of Oswego Pond (Fig. 95) and along the small creek entering this pond from the west. The trees here were generally of much smaller size than those along Twitchell Creek, but the stand was close and the flow extended to a distance of probably three-quarters of a mile along the creek from the pond. Bordering the little creek entering the pond from the northeast, was a similar but less extensive flow caused by a series of seven beaver dams, the largest one of which was about 100 feet long and 3 feet high.

Upper and Lower Gull Lakes each had a narrow fringe of small to medium sized dead trees. The dam at the outlet of Upper Gull was in disrepair, but at the outlet of Lower Gull was a dam about 90 feet long and 2 feet 6 inches high, in good repair (Fig. 96).

At the outlet of the lower of the Two Sisters Lakes was a recent dam 117 feet long and 2 feet 6 inches high. This had resulted in a narrow fringe of dead trees of small size along the north shore and in a bay to the east of the outlet, but more extensive damage was threatened on the low ground about the outlet where perhaps two or three acres of medium sized spruce were under water and the trees dying (Fig. 97).

A short distance northeast of Twitchell Lake lies a small pond known locally as Lily-pad Pond. Surrounding this pond is a belt of dead trees, chiefly medium sized spruce, about 40 to 60 feet wide. The beaver flow here had been caused by a dam built across the outlet of another small pond connected with Lily-pad on the southwest. The dam was 80 feet long and 3 feet 9 inches high, and had transformed these two ponds into one, which then connected with Twitchell Lake by way of Little Buck Pond. The last named had also been dammed at its outlet and was surrounded by a fringe of dead trees. Directly south of these three ponds lie Jack and South Ponds. At the outlet of South Pond was a dam 90 feet long and 3 feet high, but because of steeper banks no damage worth mentioning had resulted. At the junction of Jack Creek and Sunshine Creek in this vicinity was a dam which had resulted in another fringe of dead spruce (Fig. 98).

The flows above described contained, according to the ranger and local residents, the most extensive damage to timber found in the Big Moose and Twitchell Lakes region.
Region of Beaver River Flow.—At the outlet of Loon Lake in this region was a dam about 60 feet long and 2 feet 6 inches high. The raised water level resulting from this dam had killed, according to my estimate, about 10 or 12 acres of spruce and cedar. About two-thirds of the damage had occurred at the inlet on the southwest shore. A small creek along which considerable damage was being threatened was the one known as the North Branch, which enters Beaver River Flow from the northeast. There were three recently built dams on this creek near its mouth, and although these dams were only about a foot in height the ground bordering the creek is low and may be easily flooded; at the time, I estimated that if these dams were to be raised another foot perhaps 8 or 10 acres of land containing medium-sized spruce and a number of large pines would be flooded.

Along the railroad about four miles southwest of Beaver River Station, on the stream that has its source in Razorback Pond, there was a recently constructed dam which threatened a considerable stand of spruce of mixed sizes, part of it being already in water. This dam (Fig. 99) was only 55 feet long and 1 foot 10 inches high, but here, too, the ground was low and the dam favorably placed to flood a considerable area of ground.

The most extensive damage to timber in the Beaver River Flow region was found at Witchopple Lake. The flow here was caused by a dam about 175 feet long, and 2 feet 6 inches high between water levels, situated at the outlet (Fig. 100). While the greater part of the shoreline had not been affected, the low ground along the north and northeast sides of the lake had been overflowed and contained a belt of dead trees. The inlet stream entering at the northeast end of the lake had received the backwater so that its banks also were overflowed to its source in Beaverdam Pond, a distance of about half a mile. The belt of dead trees, chiefly spruce, was estimated to be about 20 to 25 rods wide over all (Fig. 101).

Sabattis Region.—In this territory, according to the local ranger, there has been no damage to timber, much of the district having previously been logged and fireswept.

Long Lake Region.—Despite the large number of beaver dams in this region, the amount of drowned timber was comparatively small. The localities in which the most extensive damage had been done were Round Pond, Pine Brook, Old Landing Creek and Clear (Eaton) Pond. Bordering the southeast inlet creek of Round Pond, probably 7 or 8 acres of ground containing spruce had been flooded.
On the northern tributary were two dams, one of which measured 125 paces in length, was 1 foot 6 inches high, and had caused a flow varying from about 12 to 18 rods in width, with a length of about half a mile (Fig. 102). The trees affected were chiefly spruce, of rather young and scant growth. On Pine Brook, just north of Round Pond, was an extensive series of dams, but along much of the course of this brook the land had been cut over and burned so that there was no timber that might be damaged. But about a mile from the mouth of the brook was a dam 100 feet long and 8 feet high (measured from the bottom), situated at a narrow part of the brook, which had created a large pond in some low ground adjoining (Figs. 103, 104). The length of this flow was about a mile, and the trees affected were mainly a rather sparse growth of spruce. On a small stream known as Old Landing Creek, which empties into Long Lake from the east, occurred three dams, the largest measuring 150 feet in length and 5 feet 3 inches in height. In the flow above were many large birches and spruces, besides four large white pines, the largest of which measured 7 feet 9 inches in circumference. On the southwest inlet stream of Clear Pond was a dam 110 feet long and 7 feet high, which had formed a pond covering about one and a half or two acres. The trees affected were principally birches, the largest of which measured from 9 inches to a foot or more in diameter. No important damage to timber had been caused by other dams on this stream, nor on the northern inlet of the pond where two abandoned dams were noted.

Forked Lake Region.—The most important beaver flows in this vicinity were found on what is known locally as the North Bay Stream, which enters North Bay at the eastern side of the lake. The course of this stream is through low swampy land, and extending for a distance of about half a mile from the mouth of the stream was a belt of spruce killed by beaver flows of some years past. The largest recent flooding was encountered about a mile from the mouth of the stream, where it was estimated that four or five acres of spruce were affected. The trees ranged from about 6 to 10 inches in diameter and the leaves had begun to turn yellow.

Blue Mountain Lake Region.—The most extensive damage to timber in this district was on Salmon Pond (Salmon Lake) stream along its course west of the pond. About midway between the pond and the highway, at the beginning of a stretch of swampy ground, was a dam 75 feet long and 3 feet high (Fig. 105). The flow reached the full length of the low ground—about half a mile—and contained a belt of dead trees estimated to be about 12 rods
wide. The trees were chiefly small to medium sized spruce and balsam fir, with a scattering of birch (Fig. 106). On Mud Pond Stream where it parallels the highway was seen a beaver flow probably a quarter of a mile long, containing a rather close stand of dead spruce and balsam fir.

**Indian Lake Region.**—My stay in this district was short, and the only damage that I saw involving timber was on McCabe’s Creek (see legend, Fig. 107, p. 535; also list on p. 521, Lot 41, Twp. 17). This is a small stream (Fig. 107) on which beaver dams a few years previously had flooded some low ground containing a rather dense stand of spruce, the full extent of which I was unable to estimate in the time available, but which doubtless amounted to several acres. At the time of my visit, the dams had been torn out, and the larger trees cut off by the owner.

The above described localities represent, as previously stated, the most important beaver flows encountered during the period spent in the field, being moreover, with one exception to be mentioned later, the flows declared by the rangers to contain the most extensive damage to timber in their respective districts. Many other flows visited contained dead trees in varying amounts, but on no such extensive scale; and many were found to have resulted either in no damage to trees at all, or the amount was so small that speaking of it as damage would be putting that term to considerable strain. The reason for this was simply that in many beaver-inhabited localities there was no timber to be damaged. The original stand had long before been cut off, or the territory had been fire-swept, or both. In other places the banks and shores were sufficiently steep and high so that no area of any size could be flooded by ordinary beaver dams. And of course in the case of larger and deeper streams, on which the beaver usually does not attempt to construct dams, as well as in the case of the larger lakes, no harm had been done by flooding.

By way of summary there will now be listed, first, those waters the shores of which I personally examined and found them to contain more or less timber damaged by beaver flows; and secondly, the waters bordering which I found no dead timber, or an amount so small as to be wholly negligible.

Waters the shores of which contain more or less timber damaged by beaver flows:

- Constable Creek.
- Constable Pond.
- Chub Pond.
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Big Chief Pond.
Andes Creek.
North Branch, Big Moose Lake inlet stream.
Upper Gull Lake.
Twitchell Creek.
Lily-pad Pond.
Little Birch Pond.
Jack Pond.
Loon Lake.
North Branch (Beaver River region).
Witchopple Lake, and inlet creek arising in Beaver Dam Pond.
Razorback Pond and outlet stream.
South Branch (Beaver River region).
North Inlet stream of Lake Lila.
Peaked Mountain Pond.
A stream in Twp. 21, Lot 95, near Long Lake Village, and streams in lots 107 and 108.
Pine Brook (Forked Lake region).
Round Pond, and its southwest and north inlet creeks.
Pine Brook (Cold River region), lower course.
Old Landing Creek (Long Lake region).
Southwest inlet of Clear Pond (Lake Eaton).
North Bay Stream (Forked Lake region).
McCann's Brook (Blue Mountain Lake region).
Salmon Pond Stream (Blue Mountain Lake region).
McCabe's Creek (Indian Lake region).
Stream in Twp. 15, Lot 43 (Indian Lake region).

Waters the shores of which contain no timber damaged by beaver flows:

Queer Lake.
Lower of the Two Sisters Lakes.
Russian Pond.
Pigeon Creek.
Lower Gull Lake outlet stream.
Twitchell Creek, east of highway.
Outlet stream of South Pond.
Northeast inlet of Oswego Pond.
Salmon Lake (Witchopple Lake district).
Greater part of Witchopple Lake shoreline.
Upper sources of South Branch (Beaver River region).
Upper sources of Shingle Shanty Brook.
Mud Pond outlet stream.
Hitchcock Lake.
Long Pond (Sabbattis region) outlet stream.
Thayer's Brook (Long Lake region).
Grampus Lake stream (Grampus Brook).
Big Brook (Long Lake region); greater part of brook between Grampus Lake stream and Rock Pond.
Calkins Brook, lower part.
A small pond bordering Calkins Brook.
Cold River, lower part.
Latham Pond and outlet stream.
Boulder Brook and small tributary on the west.
Pine Brook, for greater part of its length (exceptions in its lower course, Lots 55, 56).
Mud Pond (Walker Preserve) and outlet stream.
Sargent's Ponds, the western and the middle one.
Cedar River, main stream.
Sprague's Pond, outlet stream (Indian Lake region).
Salmon Lake (Blue Mountain Lake region).

We may now turn to the survey of the season of 1924 and consider the situation as to timber damage at that time, in parts of the Adirondacks not covered by the earlier survey.

THE SURVEY OF 1924

Before describing the conditions as I found them it will be necessary to give some idea of the location and extent of territory covered. It has already been stated that the procedure during this survey was personally to examine as many of the beaver-inhabited localities as possible, in as many different sections of the Adirondacks as time and circumstances would permit. In this case letters had been addressed to fifteen rangers in various sections of the Adirondack Preserve, with inquiries as to the existence and relative numbers of beaver in their respective districts. With this information in hand an itinerary was thereupon planned so as to include as many sections as possible of that portion of the Adirondacks which had not been reached on the former occasion. As in the earlier survey, after having called upon the local ranger and obtained from him such information as he could give in regard to the location of the beaver-inhabited waters of his district, the general nature and extent of timber damage, etc., effort was then made to visit the most important of these waters and, with notebook and camera, record the facts as they were found. The stations herewith named indicate the general
Fig. 90. Dam at outlet of Razorback Pond, on property of Champlain Realty Co. The stand of spruce above dam was endangered; 1921.

Fig. 100. Witchopple Lake. View of part of northwest shore and dam at the outlet; 1921.
Fig. 101. View along inlet of Witchopple Lake; low banks inundated; 1921.

Fig. 102. Beaver flow on creek entering Round Pond, northern Long Lake region; 1921.
course of the itinerary, while on the accompanying maps are indicated the localities visited by me personally as well as those in which, according to the rangers, beaver were present, at least up to March 1, 1924: Piseco; Speculator; Indian Lake; North Creek; Olmstedville; Schroon Lake; Schroon River; North Elba; Newman; Tupper Lake; Long Lake; Blue Mountain Lake; Childwold; Cranberry Lake; Wanakena; Harrisville; Forestport; Atwell.

Piseco Region.—On what is known locally as Babcock Stream, a tributary entering Fall Stream from the west, was a dam about 270 ft. long and 2 1/2 ft. high. A few rods below this dam were two much smaller dams. It was evident that beaver had been established on this creek for a number of years. The two smaller dams had not resulted in any damage, but the long dam had produced a pond in which perhaps as much as 5 or 6 acres of medium-sized tamarack, spruce, and balsam fir had been killed. Near the entrance of this stream into Fall Stream was a group of softwood trees which had been killed in a former flow caused by a dam on the main stream, but this damage was trifling.

The Twin Lakes, about four miles west of Piseco, each had a narrow fringe of dead trees of small size, consisting of balsam fir, birch, maples, and a few spruce. The damage here also was done a few years ago. The shores are sufficiently high to make it improbable that any serious damage to timber can be done by the beaver.

On the outlet stream of Sand Lake, on that part of it which lies east of the main road, beaver dams had flooded some low ground containing chiefly alders, although among them were some dead spruce, balsam fir and birch trees. So far as could be determined without the aid of a boat the damage to timber was not extensive.

Speculator Region.—About seven miles directly northeast of Speculator is Miami River. Where this river turns from an eastward to a northeastward course it flows for about a mile or more through low, flat ground. At the time of my visit the water in the stream was at its normal level and the low ground contained a rank growth of grass and herbaceous vegetation. It was, however, evident that in recent years beaver dams had flooded this low ground, and many dead trees, chiefly hardwoods, were scattered throughout its extent.

At the extreme eastern end of Pillsbury Lake is a stretch of low, swampy ground bordering the inlet stream. A beaver dam, then in disrepair, situated at the outlet at the west end of the lake, had raised the water sufficiently to kill probably as much as four or five acres
of spruce growing on this low ground. At the extreme western end of the south bay, where a small stream enters, is a similar patch of dead timber, while a narrow strip occurs at another part of the south shore. The north shore is steeper and unlikely to be affected by beaver flows. All the dead trees about this lake were killed a number of years ago. The upper part of the Mud Lake Stream, or that part of it which lies about midway between Pillsbury Lake and the lower two of the Cedar lakes, also has in recent years been dammed, but at the time I saw it the water was low. A fringe of dead spruce and balsam fir flanks each side of this stream for at least a mile.

**Indian Lake Region.**—In this territory none of the beaver flows examined in 1924 had caused any important damage to timber. At the southern end of Wakely Pond the shore is low and here was a small patch of trees which had been dead for a number of years. A few dead trees may be seen also just above the culvert, where the road crosses a small outlet stream. The shores of the pond itself have no timber worthy of the name.

**Olmstedville Region.**—Ranger Barnes stated that to his knowledge no damage to timber by beaver agency had occurred in his district.

**Schroon Lake Region.**—According to Ranger Russell and Game Protector Wood, there are but few beaver in this district, and these men knew of no damage to timber from such agency. Neither did they think that any damage was likely to occur even if beaver should continue to inhabit this territory. The stream valleys here are narrow and steep so that, as one of these men expressed it, where any timber occurs beaver dams "would have to be awfully high in order to flood much ground."

**Schroon River Region.**—As in the neighboring Schroon Lake territory, beaver are rather few in this region and no damage of importance had been done to timber. I personally examined Hatch Pond, which lies about two miles northeast of Schroon River P. O., and found at its outlet a dam about 125 ft. long and 15 inches high. This dam had raised the water level sufficiently to flood the swampy ground bordering the northeast and east sides of the pond, where as a consequence there occurred a fringe of dead trees of medium size. The pond is a small one, about a quarter of a mile long, and half as wide, and the total amount of drowned timber, including a considerable proportion of birch, is not great.
Lake Placid Region.—According to Ranger Frank Hughes there were relatively few beaver in this territory, and he knew of no serious damage to timber resulting from beaver flows. I examined Long Pond, where I had been informed that damage had been done to timber, and found at the outlet a dam about 60 ft. long and 4 ft. high. It had been torn open and the animals had as yet made no attempt to repair it. It was evident that beaver had been at work here for a number of years. There was a narrow fringe of dead trees around the margin of the pond, and at the southeast end was a patch of about 3 acres of dead spruce and balsam fir, with a scattering of birch.

Tupper Lake Region.—In this region, according to Ranger Delbert McNeil, there had been no damage of importance to timber, and no complaints regarding the beaver had been made to him. The localities examined by me confirmed Mr. McNeil’s statement.

Newcomb Region.—Many beaver flows occurred in this territory, but in most of them little or no timber existed. The largest flow, according to Ranger Grover Lynch, occurred on a small tributary entering the Hudson River from the east a short distance south of Ord Falls. This flow was about a mile long and covered a large patch of swampy ground. “Considerable timber” had been killed. South of this flow, on Wolf Creek and on its main tributary, were several dams which had flooded swampy ground, resulting in more or less damage to timber. Among the localities which I was able to visit, I noted a considerable patch of dead spruce, perhaps 3 or 4 acres in all, on the low borders of the north inlet creek of Goodnow Pond; doubtless more flooded timber occurs along the swampy margins of the lower part of the pond and along the Goodnow River. In the region about the Tahawus Club, the caretaker, Mr. David Hunter, mentioned Jimmy Lake as a typical example of damage to trees in that district. The conditions I saw here are shown in part in Fig. 108. The dam at the outlet of the lake was about 65 ft. long and 4 ft. high. Similar conditions were found about the shores of the near-by Lake Sally. The number of small dead spruces and other trees found here is hardly such as to be classed as damage to timber. About two miles west of Newcomb is a little pond on the south side of the highway, which drains into Rich Lake. At the outlet of this pond there was an old dam about 3 ft. high which had been torn open by man, and evidently had been abandoned by the beaver. About the shores of the pond was a fringe of dead spruce, chiefly small trees, but some which probably measured 7 or 8 inches in diameter.
Blue Mountain Lake Region.—So far as timber damage is concerned the situation in this territory was practically the same as it was in 1921. According to Ranger Ralph Spring, the dam on Salmon Brook (Salmon Lake Stream of the former article; Fig. 105) had been abandoned by the beaver some time ago, so that no further damage had occurred. It was here that the chief damage to timber in this district was found four years before. The giant dam on McCann's Brook (Fig. 109) had also been abandoned.

Long Lake Region.—In this territory I had opportunity to examine localities which I had not had time to visit on the former occasion. Among the waters now examined was Bog Stream, the outlet of Handsome Pond. This stream, situated on the Wm. C. Whitney tract, is bordered along much of its course by low swampy ground which is easily flooded. The shores of Handsome Pond itself are steep enough to prevent flooding by dams of ordinary height, so that no damage had been done except to a few trees bordering the outlet, where the ground was low and had been overflowed as the result of a dam situated a short distance downstream. For about half a mile below this point the stream is bordered by a fringe of dead trees, chiefly spruce, several rods in width. Where the stream then turns sharply from the northeast to the northwest it enters a large bog and here it breaks up into a series of channels, pools, and ponds, in which the main course of the stream is difficult to trace. The bog is approximately a mile and a half long and half a mile wide. Bordering this central treeless area is a dense stand of spruce. This timber has been dead for a number of years and no recent damage was noted so far as my observations extended. The dam which had been responsible for this long flow had evidently been abandoned, for the water was now at a low level. The damage to timber here was the greatest in one continuous block that I saw in the Adirondacks. It was this flow which Ranger Isaac Robinson mentioned to me in 1921, but which I was unable to visit at that time. Although the flow was on private land the distance to the dam apparently was the main reason why it had not been torn out, or the animals trapped in the early stages of their activity.

At the outlet of Moonshine Pond, on this same tract, is a dam about 100 ft. long and 4 ft. high. This has raised the water level sufficiently to drown a small patch of spruce at the upper and at the lower end of the pond. The remainder of the shore is high. On the outlet stream, about halfway from the pond to the entrance of the creek into Grampus Lake, are two dams, each about 75 ft. long
Fig. 103.—Beaver Pond on Pine Brook, northern Long Lake region. Chiefly cut-over and burned land, so that damage from flow was negligible; 1921.

Fig. 104.—The dam which caused the flow shown in Fig. 103. Pine Brook; 1921.
Fig. 105. Salmon Brook, Blue Mt. Lake region. Dam 75 feet long and 3 feet high; flow about a mile long; 1921.

Fig. 106. Salmon Brook. Dead spruce in the long flow on this creek; 1921.
and 3 ft. high. The upper one has caused no important amount of damage but the lower one has flooded an area of perhaps 15 acres of spruce and balsam fir.

Cranberry Lake Region.—According to Ranger Moses La Fountain, the only actual damage to timber in his territory had occurred at Otter Pond, a rather small pond about four miles southwest of Wanakena.

Among a series of small ponds visited south of Cranberry Lake, there was a fringe of dead trees bordering Clear Pond (Fig. 110), and some small dead spruce and balsam was found in the neighboring Tamarack Pond, but the total amount in these places was too small to be of any significance.

Atwell Region.—In this territory beaver were relatively few and I learned of no damage to timber, although doubtless some damage may have been done in a few places where beaver were known to have been working, such as South Branch of Black River, Little Woodhull Lake, Grindstone Creek, and North Branch of Black River.

SUMMARY OF LOCALITIES WITH REFERENCE TO TIMBER DAMAGES, FOR 1924

Below are listed, with brief comments, the localities visited in the summer of 1924, in which more or less damage to trees had occurred.

Piseco region:
Babcock Stream.—About 5 or 6 acres of spruce, tamarack and balsam fir.

Twin Lakes.—Narrow fringe of small balsam fir, birch, maple and spruce.

Miami River.—Many dead trees of mixed varieties occur along this stream for a distance of about a mile or more.

Sand Lake Outlet Stream.—Some dead spruce, balsam fir and birch; but amount too small to be of importance.

Speculator region:
Pillsbury Lake.—Perhaps 3 or 4 acres of dead spruce on the eastern shore, a narrow fringe of dead spruce and balsam fir on the shore of the southwest bay of the lake, and perhaps 5 or 6 acres on the low shore at the extreme southwest end of this bay.

Tributary of Pillsbury Lake Outlet Stream.—Narrow strip of dead spruce, with some balsam fir, bordering each side of this tributary for about a mile or so.

Outlet Creek of Puddle Hole.—A small flow, containing some dead birch, balsam fir and spruce. Amount unimportant.
Indian Lake region:
"Dish Cloth" Pond.—Fringes of dead trees bordering outlet stream, and a scattering of smaller trees about the shores of the pond. Damage unimportant.

Tributary to Brown's Brook.—Damage unimportant.

Wakely Pond.—Probably two or three acres of low ground with dead trees at the southern end of the pond, and a much smaller area at the outlet.

Schroon River region:
Hatch Pond.—A small pond with a border of dead trees of medium size on north and northeast shores.

Lake Placid region:
Long Pond.—Perhaps 3 acres of dead trees at the southwest end, and a narrow fringe around the margin.

Tupper Lake region:
Long Pond (Litchfield tract).—Amount unimportant.

Mt. Marcy region:
Avalanche Lake.—A few dead trees at east end.

Long Lake region:
Bog Stream.—The most extensive area of dead timber met with in one body.

Sheldon Brock.—Amount unimportant.

Moonshine Pond.—Estimated 3 or 4 acres of dead trees.

Moonshine Pond Stream.—An area of about 15 acres, containing spruce, balsam fir, and some birch.

Tahawus region:
Jimmy Lake and Sally Lake.—Narrow fringe of small dead trees. Unimportant.

Cranberry Lake region:
Clear Pond and Tammarack Pond.—Small ponds with fringes of small dead spruce. Unimportant.

Otter Pond.—Only locality of damage to timber in this district (Ranger LaFountain).

Piercefield region:
"There has been some damage done" (Ranger H. J. Carbary).

Oswegatchie region:
Damage "in some localities, but nothing very serious" (Ranger C. Ferris).

The following named waters are those about which no damage to timber had occurred through the agency of beaver.
Piseco region:
Fall Stream.
Vly Lake.
Fall Lake.
Brown's Flow Stream.
Scotch Pond.
T Lake.
T Lake Stream.
Sand Lake.
Sand Lake Outlet Stream.
Clockmill Pond.
Hatchery Brook (except possibly in its upper course which was not visited).

Speculator region:
Cedar Lakes, Upper and Middle.
Whitney Lake.

Indian Lake region:
Rock Lake.
Rock Lake Inlet Stream.

Olmstedville region:
No damage to timber in this region (Ranger Barnes).

Schroon Lake region:
No damage to timber (Ranger Russell).

Lake Placid region:
Connery Pond.
No important damage to timber in this territory (Ranger Hughes).

North Elba region:
South Meadow Brook (Fig. 111).
Heart Lake.

Tupper Lake region:
Follensby Pond.
Little Simon Pond.
Moose Creek (Litchfield tract).
Lake Madeline (Litchfield tract).
Duck Lake (Litchfield tract).
Ampersand Brook (Observations recorded by Mr. J. M. Johnson).
Stoney Creek Ponds and outlet creek.
No damage to timber in this district (Ranger McNeil).

Long Lake region:
Grampus Lake.
Mohegan Pond.
DISCUSSION OF DAMAGE TO TIMBER

Damage to timber was the gravest charge lodged against the beaver prior to the first open season on the animal declared March 1, 1924. The extent of this damage was officially represented to be very great, and although it quite certainly would have been found true that the majority of the people desired to have the beaver remain in the Adirondacks, with some agency for the control of its numbers, such as an open season, there was in certain quarters a violent prejudice against the animal, which advocated nothing short of its extermination from the entire Adirondack Preserve. While it is sufficiently obvious that a species like the beaver can not be allowed to continue indefinitely to increase its numbers in a region of limited size without adopting some means for its control, there nevertheless lurks a suspicion that a considerable part of the more extreme agitation for extermination of the beaver was backed by motives or interests not altogether unselfish. In other words, it is probable that much enlargement on the damages caused by beaver was made for purposes of propaganda in behalf of interests which for one reason or another were opposed to the presence of beaver, or of those who coveted its valuable fur. Now, since damage to timber has been such an outstanding charge on the criminal docket
Fig. 107.—McCabe’s Creek, Indian Lake region, showing spruce killed by flow; 1921.

Fig. 108.—Dam at outlet of Jimmy Lake, Tahawus region, 1924. Tree damage unimportant.
Fig. 109.—The high dam on McCann’s Brook, Blue Mt. Lake region; 11 feet 1 inch high at creek channel; 1921.

Fig. 110.—Outlet of Clear Pond, Cranberry Lake region, 1924. Damage to timber unimportant.
of the beaver in recent years, especially in certain quarters, it will be interesting to trace the development of this idea as reflected in the annual reports of the Conservation Commission.

It will be recalled that in 1903 steps were taken to restock the Adirondacks with beaver, the legislature in that year appropriating $500 for this purpose. Accordingly in 1905 three pairs of beaver were liberated in that region by the State; and about a dozen more were set free in another part of the Adirondacks by the owner of a private preserve. The same year "a small native colony of beaver, the last remnants of the original stock," was reported from the district northwest of Upper Saranac Lake. The Conservation Commission (see Fourth Ann. Rept., 1914, p. 251), in that year (1905) "placed a conservative estimate of the beaver in the Adirondacks' at 'about forty.'" In 1907 (l. c., p. 252) the state liberated in the preserve seventeen additional beaver, which had been obtained in Yellowstone Park, and the Commission in that year placed the beaver population at 100. In this same report (p. 197) I find the first allusion to damage to timber by beaver in the following statement: "Beaver continue to increase in the Adirondack region. Some complaints have come to the department relative to damage done by beaver by reason of cutting timber and flooding private lands. In some instances, after an investigation of the complaint of damage being done by beaver, we found it necessary to disturb their houses, which causes the colony to seek new quarters." Then, in the next annual report (Fifth Ann. Rept. Conserv. Com., 1915, p. 20) is found this statement: "The game census is yielding most interesting material in regard to the beaver in the Adirondacks. Every colony is being located and complete reports are being received covering the size of the colonies, the amount of land flooded by the dams, the effect of this flooding upon timber and the sentiment of the different localities regarding the beaver. The overwhelming feeling of every section is in favor of the beaver, and the State may accordingly view with satisfaction the very successful experiment of their re-introduction to their native haunts. While the subject is not without its complications, and some relief has of necessity been given to individuals whose property has been endangered, it is none the less true that the attraction and benefit that the animals afford is far in excess of the harm that they cause. Their dams and workings furnish points of interest which now annually attract thousands of vacationists, and their ponds have proved to be the natural breeding pools for trout, to the marked improvement of fishing on all of the streams where the beaver have located."
The foregoing statement is evidently made advisedly for in the report of the preceding year (Fourth Ann. Rept., 1914, pp. 252–255) the Commission published the reports of the game protectors on the beaver situation from fourteen different districts of the Adirondacks, showing "that the beaver are multiplying rapidly and are taking possession of their ancient heritage in many different sections of the Adirondacks." These reports are evidently what is referred to on another page of the Annual Report, in the statement already quoted, that "complete information" was being received covering the beaver situation. In some of the districts mentioned, the beaver were, according to these reports, already plentiful. Thus, for example, in the Fulton Chain District, there were reported "no less than 79 colonies, with 76 dams inhabited by 223 beaver." For the Glenfield District the game protector "reports the beaver numerous in his section." In the Keene District, "On Dec. 10 he [the game protector] reported discovering a new colony which has constructed a dam about 75 feet long, and flooding about 25 acres on Gates Brook." In the Lake Pleasant District, among several other localities, "One large dam on outlet of Spencer Lake, with back water of two miles, inhabited by at least 200 beaver." And a "Large colony and dams on north branch of Sacandaga river, with 30 to 40 inhabitants." In the Long Lake District the protector "reports at least 30 beaver in his section," while for the Raquette Lake District are reported "Numerous colonies in his territory, showing over 250 beaver inhabitants." The interesting fact is, that despite the numerous beaver and beaver flows that were in existence, now nine or ten years after the first animals had been set free in the project of restocking, and despite the fact that the Commission had been receiving and was continuing to receive "complete" reports "covering the amount of land flooded by the dams, the effect of this flooding upon timber . . . .", etc., no mention is made of any damages to timber; and no damage of serious nature seems to have been discovered by the game protectors, except in the case of those few individuals who had been given "some relief" because their property had been threatened. Furthermore the Sixth Annual Report, 1916, contains this positive statement (p. 17): "The success of stocking the Adirondacks with beaver has become increasingly apparent throughout the entire region. The universal testimony from hotel men and others in touch with the large number of summer tourists is that the beaver and their dams and houses constitute one of the most interesting phases of wild life of the woods. . . . In certain instances damage has been caused, either
from flooding, resulting in killing of timber, or from the felling of trees upon valuable camp sites. Permits to destroy dams and houses have been issued by the Commission where it has appeared upon investigation that such relief should be granted. In a few cases permission has been given to trap the beaver, but it has always been stipulated that the skins be turned in to this office. Up to the time of writing this report, however, no skins have been received."

The Seventh Annual Report, 1917, contains no reference to the beaver. It might be supposed that the World War was a sufficient reason for overlooking the matter this time, but we find remarks upon the urgency which the war had brought upon the importance of correct forestry practice, and attention is directed (p. 18) to the fact that the "coal shortage has brought forcibly home the great importance of wood for fuel." Neither could the failure to mention a situation which only in a year or two was to result in such destruction to timber—and on which data evidently had been accumulating in the office of the Commission—have been due to lack of space, for we find five pages (31–36) devoted to the game census, including a paragraph on song and insectivorous birds, and one on the woodcock, in regard to both of which no critical situation existed; and we even find two paragraphs (pp. 30–31) on the subject of "checking of predatory cats." The Annual Report for 1918 likewise is strangely silent on the beaver question. But all this silence seems to have been merely the ominous quiet that precedes the storm; and the storm in this case broke the next year.

It is with something of consternation, after all that has gone before, that one reads what havoc had actually been wrought by the beaver in the great Adirondack region of our state. The destruction had not been limited to timber, for we find (Ninth Annual Report, 1919, p. 48) that by their dams "They have frequently flooded public highways and even railroads"; and (p. 51) "Great damage has been done to improvements such as roads, docks, boat-houses, cottages, etc., that have been constructed on privately owned land." The conclusion reached is that, "Something must be done to prevent such large and widespread damage. Probably the removal of protection on beaver for a short open season will prove the most effective means of solving the problem." One is now in turn forced to marvel at the mildness of the cure proposed for a case so desperate as that which has been pictured in the alarming reports quoted.

Great as the damage appears to have been in other respects, it is the damage done to timber that foots up into the really large
and imposing item (l. c., p. 48): "Rapid increase in numbers of beaver in the Adirondacks within recent years has focused public attention on these interesting but destructive animals. It has been apparent for some time that considerable damage was being done by the beaver through the flooding and consequent killing of timber by their dams. . . . While trees actually felled by the beaver for food and dam building are many in number, their relative value is small, because they are usually of small size and inferior species. The substantial damage is accordingly in the flooded areas."

And now it seems necessary to draw the conclusion that the data which we had been told in earlier reports were being compiled in regard to the beaver and its relation to the timber, must have been consigned to the wastebasket as valueless, unreliable, or at least unsatisfactory for the purpose in view, for as the report continues we are informed that "In order to secure some accurate facts in regard to the beaver damage in the Adirondacks, instructions were sent by the Division of Land and Forests to the forest rangers in August to report in detail on all dams in their respective districts. There was not enough time to enable the men to cover their territory closely enough to examine every dam; therefore, the reports are incomplete, and probably not over 50 per cent of the total number of dams was covered." The results of the reports are embodied in a table (l. c., p. 50) in which are summarized by counties the number of dams, the areas flooded in acres, the value of the timber killed by flooding, the possible salvage by destroying the dams at once, and the average age of the dams in years. The data as tabulated distinguish between private and State lands. There are a number of important facts that appear upon perusal of the figures in this table, and because no mention of these points is made in the text of the Commission's report, the table is reproduced herewith. It will be seen that out of the total estimated damage of $51,425 done to timber by beaver flows on private and State lands, $5,947 is assigned to privately owned and $45,478 to State owned land. In each case the great bulk of the damage falls within the two counties of Hamilton and Herkimer: $4,707 in the former county, and $990 in the latter, on private land; $37,758 and $6,935, respectively, on State land. Only three other counties report timber damage on private land, namely, Essex, Lewis and St. Lawrence, whose estimates are, in order, $75, $50, and $125; and only two other counties report damage on State land, namely, Essex and St. Lawrence, with estimates of $700 and $85, respectively. The important fact to note is that of the 12 Adirondack counties listed, 7
## Summary of Rangers' Reports on Beaver Dams, November, 1919, [From Ninth Ann. Rept., Con. Com.]

<table>
<thead>
<tr>
<th>County</th>
<th>Private Land</th>
<th>State Land</th>
<th>Average age of dam (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of dams</td>
<td>Area flooded (acres)</td>
<td>Value of timber flooded</td>
</tr>
<tr>
<td>Clinton</td>
<td>22</td>
<td>170</td>
<td>$75.00</td>
</tr>
<tr>
<td>Essex</td>
<td>2</td>
<td>1</td>
<td>90.00</td>
</tr>
<tr>
<td>Franklin</td>
<td>2</td>
<td>1</td>
<td>90.00</td>
</tr>
<tr>
<td>Fulton</td>
<td>10</td>
<td>77</td>
<td>50.00</td>
</tr>
<tr>
<td>Clinton</td>
<td>94</td>
<td>1,879</td>
<td>4,707.00</td>
</tr>
<tr>
<td>Essex</td>
<td>24</td>
<td>199</td>
<td>900.00</td>
</tr>
<tr>
<td>Franklin</td>
<td>10</td>
<td>77</td>
<td>50.00</td>
</tr>
<tr>
<td>Fulton</td>
<td>3</td>
<td>175</td>
<td>125.00</td>
</tr>
<tr>
<td>Clinton</td>
<td>3</td>
<td>65</td>
<td>90.00</td>
</tr>
<tr>
<td>Essex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td>177</td>
<td>2,839</td>
<td>$5,947.00</td>
</tr>
</tbody>
</table>

Total number of dams reported: 587
Total area flooded: 8,681 acres on average
Total value of timber flooded: $51,425 of $90,000
Possible salvage of timber: $5.50 per dam

*Less than one year.
report no damage to timber by beaver, and 3 report damages amounting to an average of $83.33 each, on private land; and on state owned land, 8 of the 12 counties report no timber damage, one reports an estimated loss of $700, and one a loss of $85. In other words, in only 2 of the 12 Adirondack counties could the damage to timber by beaver flows really be considered serious, while in the other 10 there were evidently no damages or else they were not worth reporting. We may now turn to the report of the following year (Tenth Annual Report, 1920, pp. 99-100) and note the progress of the beaver problem:

"Beaver. In October, 1920, reports were received from forest rangers in the Adirondacks on the beaver. Instructions had been sent out to the rangers earlier in the season directing them to report on all beaver dams within their districts. Similar reports had been requested in 1919, and the men were directed to report this year only on new dams or dams which had been overlooked the previous year.

"The report for 1919 summarized the beaver damage for a period of years. The contrast in last year's and this year's report is notable, because the 1920 report includes almost entirely dams less than a year old. The total number of dams reported is only 159, as against 587 reported in 1919. The total area flooded in 1920 is 1,070 acres against 8,681 acres in 1919. The total value of timber flooded in 1920 is $3,410, an average of $22 per dam, as against $51,425, an average of $90 per dam in 1919. This is all new damage, in addition to that reported a year ago.

"It is notable also that the possible salvage of timber by immediately destroying the dams is $986, or 26 per cent of the total timber flooded, as against $5,530, or about 10 per cent of the total timber flooded in 1919. The new areas have been flooded for a few months only, and the timber may still be saved.

"It is evident from the above figures, that the beaver are exceedingly active and that they are becoming more and more of a nuisance in the Adirondacks. The damage done by them is increasing every year at an alarming rate, and something should be done to prevent such a wanton destruction of fine timber and beautiful shore lines."

This is the complete statement with reference to timber damage by beaver in the 1920 report. The annual report for 1921 contains no reference to timber damage by beaver, so that we are left in the dark as to the progressive destruction of that year. In the report for the next year, however, we are given further statements and figures. The first paragraph under the heading of beaver (Twelfth Annual Rept., 1922, pp. 6-8) declares that "The beaver, viewed solely from
The point of view of the person interested in the protection and production of forests and timber, has become a nuisance in the Adirondacks. . . . The figures of 1919 and 1920 showed considerable damage by beaver, but the figures for 1922, which are published in this report as a summary of the reports of the forest rangers for October, 1922, demonstrate that the beaver problem is one which must receive serious attention in connection with protecting our Adirondack forests.

"The rangers in 1922 reported 1,184 dams built since 1920, a total of 7,863 acres flooded, and timber to the value of $100,020 killed by flooding. Let us add these figures to those of 1919 and 1920, and we get a total of 1,930 dams flooding 17,500 acres, and doing damage to the extent of $154,855. Because of the large area of the ranger districts, and the brief time allotted the rangers for the study of beaver dams in connection with other work, it is probable that the figures quoted above can safely be multiplied by two and still be a conservative estimate of the damage done by beaver. When this damage in the course of a few years averages a quarter of a million dollars it is apparent that this question is of sufficient magnitude to demand our serious attention."

It is conceded that beaver dams do not always flood timber, for the next paragraph continues: "It is true that in some places beaver dams are built and land flooded which is of very little value. It may be burned-over land or cleared land where the damage is negligible. It so often happens, however, that dams are built in tracts of virgin timber and large quantities of pulpwood and timber are killed outright unless the dam can be immediately removed. Frequently the level of a pond or lake surrounded by virgin timber is raised sufficiently to kill timber, thus completely ruining the shore line of the lake and damaging the property to an extent far beyond that represented by the actual value for pulpwood or lumber purposes of the timber killed."

The report further states that the commission has been liberal in granting permits to private land owners to tear out dams and to take the animals themselves where they are doing damage, and that "Moreover, forest rangers and game protectors are constantly tearing out dams which flood timber on State land in the Forest Preserve. The progressive damage which the beaver are doing shows that such measures are not sufficient. The beaver build up a dam numerous times after it is destroyed, and for that reason, unless the animals can be taken, this problem cannot be solved."

The table of statistics on timber damage accompanying this report is reproduced herewith and furnishes an interesting comparison with
that for 1919. Perhaps the most remarkable thing appearing from the present (1922) report is the unprecedented dam-building activity displayed by the beaver since 1920, in contrast to that reported for the period between 1919 and 1920 when, as before quoted, the total number of new dams reported was only 150. It would indeed be interesting to know just how it was determined whether a dam had been built since 1920 or several years before that time. Since the compiler of the statistics evidently was devoted to the task of showing the "progressive damage which the beaver are doing" it would seem that the point must have occurred to him that it was important furthermore to state just how much time was allowed the rangers in which to count beaver dams and measure the acreage in the latter period as compared with the former, for the question would naturally arise as to the reason for the enormous increase in building activity in 1921, when the number of new dams reported amounted to nearly one and a half times as many as the total number of dams old and new that had been counted previously after a fourteen-year period of progressive beaver activity in the Adirondacks. Truly this is showing progressiveness with a vengeance. The results are tabulated by counties, as in the case of the previous table, but we are now informed in a footnote (see table) that "county" indicates the

**Summary of Rangers' Report on Beaver Dams in the Adirondacks.**

October, 1922. [From Twelfth Ann. Rept., Con. Com.]

<table>
<thead>
<tr>
<th>County</th>
<th>Number of dams built since 1920</th>
<th>Number of dams abandoned since 1920</th>
<th>Private Land</th>
<th>State Land</th>
<th>Possible salvage of timber by immediate destruction of dam</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres flooded</td>
<td>Value of timber killed by flooding</td>
<td>Acres flooded</td>
<td>Value of timber killed by flooding</td>
<td></td>
</tr>
<tr>
<td>Clinton</td>
<td>4</td>
<td>200</td>
<td>48</td>
<td>180</td>
<td>$850</td>
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<tr>
<td>Essex</td>
<td>91</td>
<td>161</td>
<td>55</td>
<td>104</td>
<td>150</td>
</tr>
<tr>
<td>Franklin</td>
<td>60</td>
<td>775</td>
<td>340</td>
<td>200</td>
<td>2,000</td>
</tr>
<tr>
<td>Fulton</td>
<td>55</td>
<td>189</td>
<td>104</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>Hamilton</td>
<td>476</td>
<td>702</td>
<td>2,000</td>
<td>92</td>
<td>1,000</td>
</tr>
<tr>
<td>Herkimer</td>
<td>217</td>
<td>555</td>
<td>506</td>
<td>9,415</td>
<td>4,000</td>
</tr>
<tr>
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<td>142</td>
<td>403</td>
<td>80</td>
<td>200</td>
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<tr>
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<td>34</td>
<td>136</td>
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<td></td>
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<tr>
<td>St. Lawrence</td>
<td>76</td>
<td>270</td>
<td>348</td>
<td>850</td>
<td>550</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>Warren</td>
<td>26</td>
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<td>10</td>
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<tr>
<td>Washington</td>
<td>496</td>
<td>3,484</td>
<td>4,379</td>
<td>$83,395</td>
<td>$10,100</td>
</tr>
</tbody>
</table>

Totals: 1,184 406 3,484 $16,025 4,379 $83,395 $10,100

*Counties* indicates location of ranger headquarters from which report came; and is not accurate as to location of dams.

Total area flooded 7,863 acres.

Total damage $100,020.

Average per dam, 6.6 acres and $85.00 damage.
location of the ranger headquarters from which report came; it is not accurate as to location of dams.” Here, too, it would seem exceedingly important to have furnished a list of the streams, ponds and lakes, on which the beaver dams were located, under their proper county headings, so that anyone so inclined would have met with no difficulty in finding the scenes of these many and great damaged areas. Mere lack of space could hardly have justified such omission in a matter so serious as the beaver situation in regard to timber damage was represented to be at that time. We see that Hamilton and Herkimer counties again are the heavy sufferers in timber damage, although the former has suffered more than seven times as much as the latter in value of the timber destroyed. Seven of the remaining “counties” list figures that are relatively unimportant, while three list no timber damages at all. As in the table for 1919, the present (1922) table shows that exceptional conditions must have prevailed in Hamilton county in order to account for the great sum of timber damages assigned to it. Let us focus our attention more closely on the figures for this county: Taking the damages on State land only, we find that 2,866 acres were flooded, causing a timber loss of $72,225; this gives an average damage per acre of $25.20. In the table for 1919, the figures for State land in this county are 4,637 acres flooded, and a damage amounting to $37,758, the average damage per acre being therefore $8.14. In the report for 1919 we are told that the damages there reported cover a number of years; in fact it was the first such report made since beaver first were introduced, and therefore numerous dams reported, if not the majority, must have been of several years’ standing. In the 1922 report we are told that the dams listed are new dams, “built since 1920”; yet the damage caused by these two-year-old dams far exceeds in value per acre the damage caused by the dams of several years duration. What is the reason for the great jump in value per acre of the land flooded in 1922—practically a tripled value—as compared with 1919? We are not enlightened in the report. We may be expected to draw the inference, presumably, that during 1921 the beaver organized an efficiency campaign and began building dams in strategic situations so as to flood successfully selected stands of timber, and such timber must perforce have been rather plentiful along all the beaver-inhabited streams.

There are a number of other points in the table which also would seem to require elucidation in this connection. In 1921, it will be recalled, the Commission’s report was silent on the beaver question. For the preceding year (1920) a total of 159 new dams was re-
ported. Add these to the 587 dams that had been counted in 1919, and we have a total of 746 dams. Now, in the 1922 report we learn from the table that a total of 406 dams had been abandoned since 1920. Are we to infer that these abandoned dams are dams that were included in the count of 587, or are they additional dams not included in that count? If they are dams “abandoned since 1920” it is implied that they were in existence in that year, for surely they were not built and abandoned that same season. But we are told that only 159 new dams were reported in 1920! In Herkimer county alone, we see from the table that while 217 dams were built since 1920, 286 dams were abandoned since that year; yet the 1919 report gave only a total of 127 dams for Herkimer county. When, are we to assume, were those 286 dams built? The only reason why any attention at all is directed here to these figures—which appear to prove altogether too much—is to point out the utter uselessness of such statistics so far as they are intended to show what the real situation is as to the “progressive” damage to timber by beaver in the Adirondacks.

The Annual Reports for 1923 and 1924 contain no reference to the beaver despite the alleged seriousness of the situation.

The Fifteenth Annual Report, 1925, of the Conservation Commission has come to hand, and since another official reference to the beaver situation appears there, it will be important to mention it in the present connection. The reference to the beaver is brief and in part at least is essentially a repetition of statements made in previous Annual Reports. A “Summary of Rangers’ Reports on Beaver Dams in the Adirondacks, October, 1925”, gives a table of the usual kind of “Number of dams built since 1922,” in which in separate columns for private and State lands are listed the number of acres flooded and the value of “timber killed by flooding.” The total area flooded since 1922, according to this table, amounts to 5,573 acres the total damage to $34,908. The average area flooded per dam is 5.3 acres, and the average damage amounts to $33. The “number of dams built since 1922” is 1,052.

There are a few statements and figures in the report which require notice. For example (p. 20): “Letters have been received by the Commission from owners of the largest tracts of privately owned land in the Adirondacks, aggregating three-quarters of a million acres. These owners have unanimously recommended the continuation of the open season on beaver.” In connection with this statement it is interesting to glance again at the tabulated figures on beaver damages contained in the Commission’s report for 1919
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(1920), already referred to in the present paper, and compare the situation at that time with the situation as set forth in the table for 1925. Taking the three counties of Hamilton, Herkimer, and Lewis, where the bulk of the damage to private timber had occurred, we see that in 1919, 2,155 acres of private land had been flooded, with an estimated value of $5,747. From October, 1922, to October, 1925, the number of acres of private land flooded is 2,075, and the value of the timber flooded thereon amounts to $11,763. In other words, despite the two consecutive open seasons on the beaver, in 1924 and in 1925, leaving practically the year 1923 alone as the period during which this great damage is likely to have been done, the amount of timber damage advanced to more than twice the sum of the damages which had accumulated up to 1919! When one takes these figures in connection with the above quoted statement regarding the desire of private land owners to reduce the beaver, one is almost compelled to believe that private land owners in this beaver-infested territory did not, after all, avail themselves of the opportunity to get rid of the beaver. In the absence of explanations the figures as they stand point to the conclusion that opening the season on the beaver has had the effect of vastly increasing rather than substantially decreasing the damages to timber. Surely an anomalous situation! The figures are the more puzzling since on State land for the same period, in these same counties, the number of acres flooded fell from 5,521 to 1,210; and the value of the timber flooded fell from $44,693 to $14,953. Merely to throw further light on the attitude of private owners toward the beaver I may mention here that of four private owners in the most densely beaver-inhabited region of the Adirondacks, whose combined tracts aggregate nearly 140,000 acres, three informed me personally that they saw no serious harm as the result of the presence of beaver on their lands, and the fourth, whom I did not have an opportunity to see personally, may possibly be listed as maintaining a rather calm disposition toward the beaver, since although he permitted his caretakers to trap during the first open season on the beaver, after the second season opened he ordered all trapping stopped within the first ten days. And on one of these tracts was found one of the largest beaver flows which I saw in the entire Adirondack region.

Another statement in the 1925 Report which must be considered surprising in view of the seriousness of the beaver problem pictured in previous Annual Reports, occurs on page 18: "No figures are available to show the total number of beaver taken during the two open seasons, but it is known that at least several hundred were trapped,
and it was the desire of the Commission to ascertain what effect the open seasons had on the beaver problem in the Adirondacks." Then in order to obtain "accurate information", the report continues, the forest rangers were instructed to go over their districts carefully and count the number of new dams that had been built since 1922—as on the previous occasions. Now, the surprising thing is, that although the decision to open the season on beaver furnished a splendid opportunity to secure some very important and reasonably accurate figures bearing on the beaver problem, namely, the number of beaver actually taken during the two seasons, no advantage seems to have been taken of that fact. Such figures could have been obtained by the application of a tagging system, for example, or other effective requirement, and the importance of having figures of that kind in the circumstances, was so great as to have justified any extra labor and expense that might have been incurred in the operation of the system. A knowledge of the number of beaver taken the first season was of the utmost importance, if for no other reason than to be able to judge whether the one month of open season was sufficient to relieve the situation. If the situation was as serious as the Annual Reports had intimated it to be, and the number of beaver as great as some estimates therein had previously hinted, then the taking of an estimated "several hundred" beaver in the two seasons must have seemed woefully inadequate to ameliorate the conditions. The knowledge whether fifteen thousand or fifteen hundred were taken in the first season, or in the second, or in both, would have established a presumption, at the very least, on the basis of which further measures could have been intelligently formulated.

But perhaps more significant as reflecting the true situation in regard to the beaver, as viewed by the people of the Adirondacks, is the following notice which a little later (February, 1926) appeared in the Bulletin of the New York State Fish, Game and Forest League, page 5, under the heading "No open season on beaver": "Conservation Commissioner Macdonald has decided that there shall be no open season on beaver in this state this year, believing that the result of two years' trapping is sufficient for the present to hold the beaver in check. Petitions from all parts of the state and from the Board of Supervisors of St. Lawrence County, who went on record, fearing that a third season's trapping would have a tendency to exterminate them were the real reasons for his issuing this order."

**Personal Observations.**—When I first entered the field on June 27, 1921, to begin a survey of the beaver situation in the Adiron-
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I was entirely ignorant of the conditions in that region. Beyond having been told that numerous complaints had been made in regard to damage done by beaver, and having kindly been supplied with a map by Mr. W. G. Howard, of the Department of Lands and Forests at Albany, on which had been plotted the dams reported in 1919, I had no previous knowledge of what I might expect to find. My immediate objective was the districts in northern Hamilton and Herkimer counties where, according to my map, the great majority of beaver dams were located. From there also the chief complaints regarding beaver damage had come. In each locality visited I was dependent upon the local ranger and other inhabitants for directions as to where the most important beaver flows were to be found. In many instances the ranger personally accompanied me to the flows and gave me valuable information in regard to other flooded areas, situation of dams, damages, etc., in places time did not permit me to examine. Without exception the rangers rendered all the assistance possible without interfering with their regular duties, and because of this assistance I believe that no important beaver flows escaped notice or mention. I have previously in this report described the location of the largest beaver flows personally examined by me, and the character of the timber damage found in them. The location of all the dams seen by me or reported to me by others in 1921 are shown on the maps accompanying my former paper, and these maps are for convenience reproduced herewith (Maps 4, 5).

In the light of my own observations on damage to timber by beaver in the Adirondacks I find it somewhat difficult to reconcile the gloomy picture depicted in the annual reports of the Conservation Commission with the actual conditions as I saw them. In fact as I read the accounts there given and attempt to harmonize them with what I have seen, it is difficult to avoid the impression that the compiler of the statistics on timber damage has been somewhat extravagant in the use of figures. So far as the "quarter of a million dollars" value which the compiler places upon the timber killed in the beaver flows is concerned, there would in the first place seem to have been very little besides poor guesswork upon which to base such an estimate, and in the second place it seems to be straining the point rather severely to place such astonishing monetary value upon a commodity which, even if it had not been damaged or destroyed by beaver flows, could not have been taken off or sold or otherwise realized upon because of Constitutional prohibition. For the State Constitution in regard to the Adirondack Preserve pro-
vides (Art. VII—Ann. Rept., 1914, p. 160): "Forest Preserve,—Section 7. The lands of the State now owned or hereafter acquired, constituting the forest preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed."

It is evident that the estimates covering damages by beaver have not been made with such regard for accuracy as have for instance the estimates of forest fire losses (see Ann. Rept., 1920, p. 188). In tabulating the statistics on fire damage to timber, pains have been taken to classify the areas burned into acreage of virgin timber destroyed, acreage of second growth, and acreage of brush and waste land. In the case of beaver damage we are given no such classified description of the timber killed or of the character of the land flooded; only summaries of acreages and estimated values. Yet it is obvious that if one is to judge of values, then the character of the land and the kind, size, and quantity of the tree growth involved constitutes the first and foremost items that need to be known. It is therefore difficult to avoid the conclusion that the compiler has proceeded on the unwarranted assumption that every acre flooded was covered with a close stand of the more valuable species of trees. Let us take for example a few figures from the table of the "Summary of forest fire losses, for 1920, by counties" and compare them with some of the published figures on beaver damages (1919, 1920): The total acreage burned in the Adirondacks in 1920 is given as 14,102 acres; the "value of standing timber destroyed" on this area is $11,175. The average damage per acre is therefore $.792. In Warren county alone 1190 acres were burned, including 75 acres of "virgin timber" and 837 acres of "second growth." The "value of standing timber destroyed" here is given as $905, and if we count only the 75 acres of virgin timber we have an average of only $12 an acre as the value of this timber. Accordingly, in estimating the damage to timber by beaver it would seem no more than fair to draw the same distinctions as to the character of the lands and of the trees or timber affected as is done in the case of damage by fire; and this of necessity must be done if the figures sought are to have a semblance of meaning and are not to be actually misleading.

Let us now turn our attention to some of the largest and most damaging beaver flows which I saw in the Adirondacks and examine them a little more in detail. In 1921 the flow on Constable Creek was considered the largest and most destructive beaver flow in the Big Moose district. According to my own estimates made on the spot, the flow, including the belt of drowned trees bordering the
creek, varied in width from 10 rods at the lower end to about 18 or 20 rods where it reaches the pond; thereupon it continued as a narrower, interrupted fringe of dead trees about Constable Pond, which is of less importance and for our purpose here need not be considered. Assuming that the width of the flow with its dead-tree belt averages 15 rods, and that its length is 2 miles (approximate distance as shown on U. S. Geological Survey topographic sheet), the area of this flow will be 60 acres. But in this flow the fact is to be noted that the middle portion is a stretch of open water representing the original channel of the creek, which is without trees, that large patches occur in many parts of the flow which contain nothing but brush, and that the timber, or what may be so designated, is of a rather sparse stand, of medium to small size and much interrupted in its distribution. Inspection of figures 87 to 91 inclusive will make clearer the conditions here found. The actual timber loss in this flow appears therefore to be relatively small. It is my opinion that of the 60 acres estimated to be flooded here, not more than one-third of the area can be considered as containing timber in the proper sense of the word.

Two or three miles west of Constable Creek was the flow on Twitchell Creek (Fig. 94). As to size, the dead trees here were about the largest that I met with in the flows of this region, and the stand was close in many places, so that, according to my own view, the actual timber loss was fully as great as that in the Constable Creek flow. The length of the Twitchell Creek flow was probably a mile or more, and the average width probably not over 20 rods. The distance of a mile would therefore represent about 40 acres. But here, too, it is necessary to subtract the open patches of considerable size in which there are no trees; and the variation of the trees themselves both in size and distribution—here a cluster of large trees, there a cluster of slender poles—is also to be considered. Obviously it would be straining the facts somewhat to say that forty acres of timber have been destroyed.

As still another example may be mentioned the flow on Bog Stream in the Long Lake region. This is the largest flow in that district and the largest flow that I saw or heard of in the Adirondacks. Unfortunately, on the two occasions when I made a trip to this flow I was overtaken each time by a severe rainstorm so that I was unable to secure photographs or to examine conditions throughout its full length. However, here too the area of the flow is not equivalent to area of timber-covered ground, for the great central part is a treeless or practically treeless bog, while the dead timber, chiefly spruce, forms a belt around the margin. To gain an idea of the
size of this flow I consulted the topographic sheet of the U. S. Geological Survey for this quadrangle and found that Bog Stream, for about 2 miles from its source in Handsome Pond, is bordered by swampy ground averaging approximately half a mile or less in width. This swampy ground then narrows down and continues, but the large flow is included in about the first two miles. If we now assume that this whole area of swampy ground constitutes a beaver flow, we have a total of about 640 acres. So far as timber is concerned we are obliged to exclude the great central bog area, but if we assume that the belt of dead timber on each side has an average width of 15 rods, we shall have, for the two miles of flow, 120 acres containing dead trees. But we might still have to make proper allowance for the actual distribution of the trees in this area, which would result in some modification of the figures.

The foregoing examples are cited merely to show the necessity for distinguishing between the area of flow and the area actually containing dead trees, and the necessity for taking into account also the character and distribution of the timber affected. Only by so doing can we hope to obtain a fair estimate of actual damages caused by the agency of beaver flows. Every beaver flow presents conditions more or less different from those of the next, so that one can not safely examine only a few and therefrom draw dependable conclusions as to all the rest. And, as before remarked, the timber damages or losses resulting from beaver flows must be measured by the same yardstick as that used in measuring losses from fire.

In addition to the points just mentioned there is another fact which apparently has not been given proper recognition in the published data on beaver damages, and that is, that in a large percentage of our Adirondack ponds, lakes, and streams inhabited by beaver, no damage to timber by flooding has occurred. In 1921, at the close of the field work I found, upon listing the locality data, that 50 per cent of all the beaver-inhabited waters which I visited showed no damage of this sort. In checking up the results of the survey of 1924 for the Adirondack region as a whole I find that more than 60 per cent of the beaver-inhabited waters visited showed no damage to timber. The reason for this high degree of immunity is evident to anyone at all familiar with conditions in the Adirondacks; it lies largely in the factor of topography and in the fact that in numerous places there is no timber that might be affected. Since the height of the banks determines the possibilities for overflow, and since the shores or banks of numerous Adirondack ponds, lakes and streams have an incline and a height such as to render any extensive overflow
unlikely, it is clear that timber damage as a result of beaver flows is to that extent self-regulating.

It will now be well to set down in summary form a few elementary facts in regard to the relation of beaver to timber damage:

1. Possibility of damage to timber which may border beaver-dammed waters depends upon the character of the shores or banks and of the ground adjacent. Many Adirondack waters are unsuited for the building of dams by beaver and therefore are immune to flooding by beaver agency.

2. In estimating the value of timber killed by beaver flows, the size, quantity, and the species of trees affected must be considered as a basis for the valuation.

3. The area actually bearing timber in a beaver flow is usually not equivalent to the area of the flow and the distinction between the two must accordingly be recognized. The only part of the flow that can justly be charged to the beaver is the area or level over and beyond that of the original pond, lake, or stream before it was dammed.

4. The number of dams is no measure of the area of flow or of the amount of damage to timber—any more than it is a measure of the quantity of beaver. One beaver dam if in the proper situation may flood a dozen acres; a dozen dams in another situation may flood less than one acre.

5. When the facts show that a situation may be critical in only one or two of the twelve counties of the Adirondacks, it is not a foregone conclusion that similar critical conditions are due to develop in every one of the remaining ten. Where real damage to timber is being done or is threatened, effective measures should be taken to prevent it, but when such necessity arises in one part of a beaver-inhabited territory it is hardly in the best interests of the people of other parts that the same sweeping remedial measures be applied blanket fashion over the entire area. The beaver constitutes one of the most important natural resources of the Adirondacks and is one of far-reaching possibilities from the viewpoint of revenue to the people of that region of the State. For this reason no drastic, ill-considered action to reduce the capital stock of such a resource should be undertaken or advocated unless the need for it is clearly justified by carefully considered facts.

**METHOD OF CONTROLLING BEAVER FLOWS**

The usual methods of checking or preventing beaver flows in the Adirondacks have been to tear open the dams by hand or to blow them out with dynamite. These methods entail more or less labor and
expense and in neither case are the results more than temporary, since the beaver is able to repair or rebuild a dam in a relatively short time. While the difficulty can always be solved by killing the beaver, yet at the seasons when the animals are most active in dam building, their skins are practically without value in the market. Unless the need is sufficiently great, it obviously is bad economics to kill out of season animals whose skins a few months later will be worth anywhere from $10 to $20 or more each. Recently a method of water level control for beaver ponds has been suggested by Bailey ('22, pp. 11-12), which is well worth trying. The expense is relatively small, the method is relatively simple, and, according to Bailey, “has proved, so far as tested, entirely successful.” The method in brief consists of siphoning off the water to the desired level by means of iron pipes or other devices. To quote the author:

“One or several pipes of sufficient size to carry the normal water flow should be laid through the dam with the outlet at the level at which the water is to be held, the other end terminating in a wire strainer, reaching down into deep water and covered with stones or logs. When the water has been lowered to the desired level, the intake end of the pipe must still be well under water so that no marked current or water draft is perceptible at the surface. The pipes must also be securely held in place, so that they cannot be pulled up, and the outlet must project a few feet beyond the lower face of the dam, in order that they may not be covered with mud.

“In some cases it will be necessary to pipe the water some distance below the dam to prevent the beavers from building a second dam for retaining the water from the first. If the water is to be lowered to its original level a more elaborate system of drainage may be necessary, but in many cases lowering it 1 or 2 feet will save the timber around the shores and still leave ample depth for the use of the beavers.

“A very simple drain made of three or more straight hardwood logs laid on a board or a piece of sheet iron through the dam would serve in many cases as well as a pipe. The logs should be laid in the same manner as the pipe, two of them being slightly apart at the bottom, and a third laid on top of them, their upper ends extending down into deep water.

“To discourage beavers from damming a stream a blind drain of stones, logs, or tiling could be used, so that when a dam is started the water will still flow underneath.”

For controlling beaver on small streams or in lakes having small
tributaries, Bailey suggests fencing, but he admits that this method has not been sufficiently tested. His idea is that a proper kind of fence with wire netting stretched across the stream and extending out 15 to 20 rods on each side will prevent beaver from passing this barrier, the reason being that beaver as a rule do not readily leave the water to walk such a distance overland as would be necessary to get around the barrier. To prevent the animals from burrowing under the fence, it is necessary to lay wire netting also on the bottom, and along the sides of the banks for a distance of several feet at least, on each side, if beaver are to be kept from passing either way. A fence capable of holding adult beaver and young alike, should consist of a 2-inch mesh, and wire not smaller than No. 16. The fence should be 4 feet high, the bottom sunk at least 2 inches below the surface of the ground, and there should be an inside overhang of 6 inches at the top. A fence 5 feet high would probably require no overhang. During flood stage it will of course be necessary to prevent damage or clogging by driftwood, and the author therefore suggests that a guard fence may be built above the first one.

In regard to another device for checking beaver in their dam-building, Mr. John H. Hatton, Assistant District Forester at Denver, Colo., has permitted me to quote from an unpublished report by him on the Rocky Mountain beaver:

“A forest ranger in the southwestern part of Colorado suggested that when beaver had started the construction of a dam at a place where it is not desired they may be caused to leave the vicinity by first tearing out a portion of the dam and inserting a few heavy branches in the brook, with cow-bells hung on flexible branches near-by, which are attached to the branches placed in the brook by cords. This was on the theory that when the beaver returned to rebuild the dam, they would disturb the branches which had been placed there and in so doing would ring the cow-bells. This method was reported to have been quite successful.”

In regard to all of these devices it is probably unnecessary to add that only by a sufficient number of tests in various situations can their efficacy be determined.

**BEAVER VERSUS TROUT**

Next to the damage to timber the loudest complaint against the beaver arises from its harmful relations, fancied or real, to trout. As was pointed out in my previous paper on the Adirondack Beaver ('22, p. 149) the effect of the presence of beaver upon trout waters is a subject about which we have very little actual knowledge. No
thorough-going scientific investigation of the question has ever been undertaken. Much of what has been written and spoken on the subject is based upon more or less unwarranted assumption, theory, and positive but often quite conflicting opinion. On the other hand there are certain views which apparently rest on a basis of fact; at any rate the arguments advanced in their support are reasonable and actually may contain a large measure of truth.

In the period between the introduction of the beaver in the Adirondacks in 1905, and the year 1914, the Conservation Commission itself and its game protectors evidently had discovered no harm to trout from that source. In the Annual Report for the latter year, in which reports of numerous beaver colonies in various parts of the Adirondacks are summarized, we find (p. 254) the following statement with reference to the report of the game protector at Long Lake: "He makes this observation of special interest to the trout anglers: 'The people living in this section think that the beaver are doing fine and are glad to see them back. They tell me the beaver are a protection to our small streams containing trout because the beaver builds dams and floods the marshes back of the dams. This makes it hard for the fisherman to fish all the pools and gives the trout a chance to grow.'" Furthermore, no less an authority than Tarlton Bean, the State Fish Culturist, two years later ('16, p. 13) makes this positive statement: "The beaver dams in the Adirondacks make stream pools on a large scale, and have greatly improved trout fishing on the streams where they are located."

In connection with the previous beaver study ('22, p. 149-157), I personally encountered, as there stated, two opposing views with regard to the relation of beaver to trout. One held that the activities of the beaver are harmful; the other, that they are beneficial. The champions of these opposing theories were equally emphatic. Each side could cite concrete examples of waters where beaver had produced the diametrically opposite results claimed for them by the other. However, while there may be no question as to the actual conditions so far as trout were concerned, it is by no means settled that the cause or causes in either case can with finality be attributed to the beaver or their activities. It will be worth while to take up these two phases of the beaver question in order and consider some of the testimony on which the opposed views are founded.

Supposed harmful influence of beaver on trout.—The possible harmful effects of the activities of beaver upon trout have previously (1. c., p. 149) been mentioned as arising from three sources: (1) The barrier effect of their dams to the movements of the fish; (2)
the higher temperature of the water in beaver ponds in summer; (3) harmful gases or other toxic properties in more or less stagnant water of beaver ponds.

1. In regard to the first of these, the view that beaver dams which are more than a few inches high effectually prevent trout from passing over them in their upstream movements, is doubtless correct, although I know of no actual observations to bear this out. Going downstream is of course a somewhat different matter, provided the face of the dam is sufficiently abrupt and there is a full head of water in the pond above. But even in such cases a dam that is more than a foot or so high between water levels, constitutes an obstruction of greater or less difficulty. Where dams occur at close intervals on a stream it is therefore undeniably true that any trout which may be present are restricted in their movements, and, what is more important, are prevented from passing upstream to their spawning grounds. Where dams are few and far between, these obstructions are correspondingly less harmful, and if tributary streams have their entrances into the main stream in the intervals between the dams, there may be no harmful effects whatever so far as movement of trout to their spawning grounds is concerned.

2. The trout is a cold-water fish. During the summer months the water in shallow beaver ponds is exposed to the full effect of the rays of the sun and gradually becomes warmer as the season advances, until its temperature passes the limit for the well-being and possibly the very existence of trout. Where these ponds cover considerable area, and all the trees and bushes in them are dead, the effect of the sun is of course much greater in the shelter of surrounding woods than on the open water of more exposed ponds and smaller lakes. The current of the stream having been arrested by the dam, the effect often approaches that of a stagnant pool. In regard to the question of high temperature, a writer in the Annual Report of the Conservation Commission for 1920 (p. 118) evidently believes that the effect is not restricted to the water in the pond alone, for he says: "If a sufficient area has been flowed to cause an abnormally high temperature, this high temperature is transmitted to the stream below the dam and renders the latter unfit for trout for its entire length, or to some point below where accessions of colder water restore the natural conditions to a partial degree. There are many streams thus rendered uninhabitable, and when portions of streams are still unaffected, the natural spawning places at the headwaters are rendered inaccessible by the beaver dams." Now the foregoing statement may, from a theoretical viewpoint, be correct enough, but
to what extent the conditions described actually occur in any Adirondack stream, is quite another question; and the author does not indicate that any temperature records have been made on any beaver pond or stream to support his assertion. Other factors besides mere areal extent will determine whether or not the water in a beaver pond reaches a temperature too high for the favorable existence of fish, and it may well be doubted whether "many" Adirondack streams have been rendered uninhabitable to trout in this way "for their entire length". Much depends, for example, on the weather conditions during the warmest part of the summer, on the depth of the pond and of the stream, etc. Before such a statement can be made as a fact, it must of course be based on actual temperature readings of the stream before it was dammed by the beaver, of the beaver pond, and of the stream above as well as of the stream below. There is nothing to indicate that this has been done.

As a rather indirect detrimental effect of the high temperature of beaver ponds upon trout, the same writer (I. c., pp. 117-18) advances the following: "It is now a well recognized fact that the work of beaver is destroying the fish productivity of many streams. Occasionally the beaver obstructions create a pond out of a portion of a trout stream, as a result of which, for two to five following years there is a yield of numerous trout much larger than ordinarily is caught before the stream was dammed. The result is similar to that which follows the reservoiring of natural lakes and ponds. For a few years the fish inhabitants find an abnormal amount of food and grow rapidly. Whether the reservoiring is the work of beaver or man, a large area of the pond may be too warm in summer to be congenial for cold water fishes, and the latter are at such times confined to the spring holes and inlets. The angler soon learn where the fish are compelled by water temperature to resort and have good fishing until the fish are reduced to a minimum. After a few years it often happens that such pools produce very few trout, but if they contain numerous chubs or other warm water fishes, the latter become very numerous, consuming the food of the young trout as well as the trout eggs and fry"! The curious line of reasoning displayed in the statement quoted would seem indeed to render it difficult for the average person to understand the devious ways by which "the work of beaver is destroying the fish productivity of many streams," even though it may be "a well recognized fact". The statement actually asserts that beaver ponds are really very beneficial to the trout productivity of our streams so long as the trout fishermen do not over-exercise their art! If they do, the chub and other warm water fishes
found in the pond are likely to get the upperhand of the few trout
the angler has overlooked! The truth of this will probably not be
questioned. But the statement quoted furnishes a good illustration
of the contradictory and conflicting ideas encountered in connection
with the question of beaver in relation to trout. Comparing this
statement with a previous quotation credited to a game protector, it
is evident that preconceived notions are largely responsible for the
way in which some things that may be seen in a beaver pond are
interpreted. To one, a beaver pond enables the trout to escape the
angler; to another, it places the speckled beauty completely at the
mercy of the angler. To an observer on the sidelines, so far as the
productivity of our trout streams is concerned, it would almost seem
as though the angler might after all be the proper individual to
watch.

The question of temperature of the water as it affects trout is
after all a rather indefinite one, and much remains to be learned on
this score before the topic can be discussed with assurance, and
about the temperature of our own Adirondack streams we seem to
know practically nothing. In a general way it is known that certain
species of fish have a preference for or actually require for their
well-being and continued life "cold" water; other kinds may thrive
in "warm" water. But as Embody (122, p. 7) has pointed out, cold
and warm as applied to water are relative terms which need to be
defined more clearly. "It is desirable to know first," says that author,
"how warm a stream may become in summer and still be suitable
for trout. There is some lack of agreement among fish culturists
upon this very point." He then goes on to present some data from
early authorities, one of whom found that 68° F. was the highest
temperature favorable to trout; that at 70° they stopped eating; at
75° they began to die; at 80° the death rate increased; at 90° all the
tROUT died. The author points out that these temperatures probably
had reference to the water in hatching ponds where conditions "were
quite different from those in wild waters." From Green's (170)
"Trout Culture" he takes the statement that trout would die at a
temperature of 68° F. and quotes Stone's (177) comment on this
statement that, "This may be the case in New York, but it is not the
case in New England. Trout in our vigorous, swift-running water
will sometimes live through 75° F. Still I consider 75° very dan-
gerous and anything over 70° unsafe." But these statements, as
Embody remarks, were made before 1880 and he suggests that our
tROUT brooks at that time possibly were colder than they are at
present. He continues: "There is a possibility that through natural
selection our speckled brook trout is gradually adapting itself to warmer waters. According to present-day evidences either this must be true or certain statements of Ainsworth and Green were not based upon complete observation. For upon an examination of the temperature data from certain trout brooks in this county, we find a number of instances where speckled trout apparently thrive and take the hook in waters whose highest temperature ranges from 74° to 79° F. The highest temperature in which speckled trout were found was 81° F. This was in the Upper VanPelt Brook, where three specimens were clearly observed apparently not inconvenienced by the high temperature.

"In other parts of this stream brook trout were observed in temperatures of 76°, 78° and 79° F. In the Dusenbury stream they were seen in temperatures of 79° and 80°; in Upper Fall Creek 77°, and in the Enfield 79° and 80° F.

"It must be kept in mind that the temperatures referred to were taken in the hottest days of the summer of 1918 when the maximum air temperature in the open ranged from 95° to 100° F. Thus they probably represent the extreme conditions occurring in these streams."

In order to determine the temperature fluctuations "a series of readings were taken in a warm unshaded part of the Dusenbury stream where brook trout occur," and it was found that the extremes were 67° and 80° F., or a daily range of 13°. The minimum air temperature as recorded by the local weather bureau was 79°. "From these readings," says Embody, "it is evident that the highwater temperatures are not of long duration, probably not longer than 5 hours. It is, therefore, clear that some speckled trout experience no ill effects from temperatures of 79° and 80° when only of short duration. While it may be true that a temperature of 70° F. would be unsafe in a crowded hatchery pond, the writer feels that for wild, rapid unpolluted streams, the unsafe temperature is higher; how much so, he is not prepared to say. The temperatures of 79° and 81° as stated above, however, are very significant, even though they may not obtain in many trout streams. Notwithstanding these extreme cases, the writer prefers to err on the safe side, and therefore recommends as a basis for future stocking with brook trout that 75° F. be taken as the dividing point between 'cold' and 'warm' water."

The results of Embody's studies have recently been discussed by Kendall (1924, pp. 289-290), who is more cautious in accepting the higher temperatures mentioned as tolerable to trout. The idea that trout, through the process of natural selection, may have become
adapted to somewhat higher temperatures than those formerly obtaining, he thinks, is "dangerously near 'deep water'" if seriously intended. It would appear to him, he says, "that in planting trout the slogan 'safety first' should be regarded, until it is established that everywhere and under all conditions 75° F. is well within the natural temperature range. If it is proved to be so, it will not signify that a new adaptation is taking place, but that it is one condition which is comprised in the consummation of thousands of years of adaptations to changing environment and other conditions through a complex of natural forces and 'factors,' which has been indefinitely referred to as 'natural selection.'" Regarding his own observations on brook trout and water temperatures in the Allegany State Park, Kendall concludes (p. 293) that, "If the limited temperature observations of the Allegany Park trout streams could be regarded as significant of anything concerning brook trout, they would indicate that the optimum conditions are in waters not warmer than 60 degrees, and 75 degrees represents the limit of even temporary endurance. However, the present writer makes no claim that they are sufficient for such a deduction. But given a stream, the temperature of which does not exceed 60 degrees in the hot season, other things being favorable, no one need hesitate to plant 'brook' trout in them. If higher degrees are observed, other conditions such as possible hotter and dryer seasons must be considered also."

Consideration of the statements quoted above makes it sufficiently clear that the question of beaver pond temperatures in their relation to trout is not one that can be answered offhand by argument and discussion. There are beaver ponds and beaver ponds, and among them there quite certainly will be found very considerable variations as to temperature, but in the Adirondack region as a whole, I am inclined to believe on the basis of personal observation on the conditions presented by the great majority of beaver ponds visited, that the temperature probably not often reaches and maintains for a sufficient length of time a degree high enough to be, to any great extent, fatal to trout.

3. In regard to the question whether the character of the water itself in many beaver ponds may be such as to be injurious to trout, the answer is no more certain. In recently established ponds especially, but also in older ones, where much activity on the part of the beaver occurs, the water may be more or less discolored, due, presumably, to various dissolved substances from trees, bark, humus, decaying vegetable matter, etc. In some beaver ponds where circulation is slight, there may probably be a deficiency in oxygen; and
other gases may possibly accumulate to such a degree as to become harmful and even fatal to trout or other fishes. Especially there may be a tendency to accumulation of excessive quantities of carbon dioxide and nitrogen. According to Shelford (13, pp. 59–60) "several workers have shown that carbon dioxide is very toxic to fishes. . . . Fishes, for example, turn away when they encounter as small an increase as 5 c. c. per liter of carbon dioxide. Since a large amount of dissolved carbon dioxide is commonly accompanied by a low oxygen content as well as other important factors, the carbon dioxide content of water (strongly alkaline water excepted) is probably the best single index of the suitability of the water for fishes.

"Nitrogen and carbon dioxide are produced especially near the bottom and if the water did not circulate they would be too abundant in some places and deficient in others for animals to live."

On another page (1 c., p. 113) the same author states that "Analysis of the bottom water from ponds with humus-covered bottoms showed that it contained no oxygen. The open water of the lakes with the incomplete circulation in summer is without sufficient oxygen to support life, below the level of circulation." In regard to dissolved substances in the ponds and their effect on fishes, Marsh (10, p. 896) states that "The water soluble substances in bark and in the wood of some trees are capable of killing fishes, but while such products are undesirable in streams, the amounts of bark and wood necessary to affect fish in flowing streams are so large that it is not likely that they do much direct damage to fishes by the substances which dissolve from them."

In the light of these facts it is quite possible that in some Adirondack beaver ponds conditions may become intolerable to fish life, particularly trout, but conclusive evidence is lacking. In the two seasons spent in the Adirondacks in an effort to see and examine as many beaver-inhabited waters as possible, I failed to find any significant number of beaver ponds or trout streams, in which, judging from surface evidences only, it was sufficiently obvious that the character of the water was such that it might be injurious to trout. It is true that the water of many streams on which beaver are working presents a more or less coffee-colored appearance, but I am not aware of any actual proof that this feature in itself is any positive indication of the injuriousness of the water to trout, although it is a general belief among many people. Taking the Adirondack region as a whole, however, it is quite probable that there occurs certain trout streams on which beaver operations have created adverse water
conditions in one or another of the ways suggested. In some shallow ponds, high temperature may be a factor; in others there may be toxicity resulting from certain dissolved substances; in still others there may be at times a lack of sufficient oxygen, or an excess of carbon dioxide, nitrogen, or both. Since the oxygen content of the water varies inversely with the temperature (Embody, ’22, p. 8) low oxygen content is of course more likely to be found in summer in the shallow ponds which lack spring feeders. But a fact which is not to be entirely disregarded is that the beaver dams themselves offer some means of aeration of the water passing over them, in the same way as do artificial dams. The degree to which aeration takes place by this means depends of course upon the character of the individual dams. In the case of low dams where the water falls but a few inches the aeration would not be as great as in the case of higher dams. But it may well be argued that the average beaver dam, in which the passing water is abundantly broken up as it trickles and drops through the network of sticks and boughs, is fully as effective an aerating device as is the usual type of man-made dam employed in the construction of artificial trout ponds. Natural falls and rapids are recognized as very important agencies in stream aeration (I.c., p. 8). On the same principle the gently flowing streams which are without natural falls or rapids, may, so far as aeration is concerned, safely be said to be much better off because of the presence of a few beaver dams along their course than they would be without them.

**Fluctuation of water level.**—In connection with the supposedly unfavorable aspects of beaver activity outlined above, there may be mentioned at this point the possible effect of the lowering of the water level in certain beaver-dammed trout streams, brought about by man when he tears out the dams. Kendall (’22, pp. 263–264) has pointed out that fluctuations in level of fish-inhabited waters are more or less harmful to fish life. His reference is to man-built dams, but the same objections would apply to beaver-built dams. He says: “High stages of water may afford new feeding areas for some kinds of fish, but this signifies only change of locality. Fish are enabled to ascend farther up some brooks and even onto overflowed areas, but since in many instances the stored waters are sooner or later drawn upon, the possible effects are manifestly serious.”

“If, by chance, fish have become accustomed to temporarily prevailing conditions, sudden changes can only be to their general dis-
advantage, and must necessarily react unfavorably upon the perpetuation of the fish supply." As applied to beaver ponds, this means that where dams have been established on trout streams for a considerable time, it is possible that tearing out the dams will result in more harm to trout than would leaving them intact.

Supposed beneficial influences.—The beneficial results of beaver dams to trout are considered to be the increased volume of water in the streams that are dammed, and with this, an increased food supply. The idea underlying the first of these points is that a deep cool pool is better than a shallow cool pool. Of course this applies only to streams the banks of which are high or steep enough to permit the formation of deeper pools and not merely broad shallow expanses of water such as result from the damming of streams with low, flat banks. That the deep cool pools formed by beaver dams on some Adirondack streams are actually beneficial to trout has been admitted even by some who are hostile to the beaver. It is maintained by many that the largest trout in a locality are found in the beaver ponds, if such occur, and the large size is attributed to increased amount of food coming with the increased volume of water. It is a recognized fact among fish culturists that the artificial pools produced by building dams across little headwater streams and springs (Bean, quoted by Kendall, '22, p. 314) are beneficial to fish. The pools thus formed maintain a good supply of water for young fish in dry seasons, and "prevent them from being swept away by spring freshets. They also largely increase the area in which the natural food supply may grow, and over which the fish may seek this food." But this is not all, for the same author continues: "By remaining in these pools near the headwaters, the fry gain security from the larger predaceous fish that lurk downstream." Now the same functions are doubtless served in some degree by beaver dams on streams of similar character. The chief difficulty with the beaver dam is, however, the matter of control. As has previously been remarked, a beaver dam more than a few inches or a foot high is likely to prove an insurmountable obstacle to trout that are seeking passage upstream in the spawning season. The man-made dams have the advantage of being of fixed suitable height, and narrow, so that the ascending fish may easily leap over them. Nevertheless many beaver dams quite certainly do, in proper places, and so long as they remain of proper height, actually serve a useful purpose to the cause of trout culture in the manner described. On many other streams beaver dams are probably anything but harmful, for the statement made by some Adirondack residents that certain streams had never pre-
viously contained such quantities and large size of trout as they have since the beaver became established on them, is not wholly to be ignored.

Conclusions as to the relation of beaver to trout.—From the preceding discussion it is sufficiently clear that the relation of beaver to trout is a subject about which very little is actually known. It is obvious that here, as in the relation of beaver ponds to timber, much depends upon the conditions in the individual pond or stream. Topography here, too, counts for a good deal.

So long as so little is known regarding the true facts in the matter, the wiser course to pursue clearly would be to eliminate beaver dams on all important trout streams where the conditions created by them are suspected of being harmful. And since harmful conditions are hardly likely to be created in a single season, an annual trapping period specified for these streams would very probably keep the activities of the beaver within proper bounds, and would be more effective than periodic destruction of the dams. Where beaver dams have been established for a number of years, and have been accompanied by no evident evil results there can hardly be anything to gain by altering conditions, such as would be done by destroying the dams and lowering the water level. If it is true, as even some opponents of the beaver admit (see 19th Ann. Rep., Conserv. Comm., 1920, p. 117), that for a period varying from two to five years after a trout stream has been dammed by beaver, "there is a yield of numerous trout much larger than ordinarily caught before the stream was dammed," then it would seem that the rational and common sense thing to do is to take full advantage of this fact. For surely an agency which is believed to be so favorable to trout for a period as long as two to five years is too important an aid—secured without cost—to be thoughtlessly cast aside. What artificial measures that we take to increase our fish supply can boast of more lasting effects?

The notion entertained in some quarters that the beaver has been responsible for the depletion of the trout in the Adirondacks is probably erroneous. It may have been the chief cause in some specific instances in certain localities, and a contributory factor in others, but for the Adirondack region generally the contention can hardly be successfully maintained. In consideration of both the harmful and beneficial aspects that have been pointed out, it seems more probable that those two influences have just about balanced each other, so the total effect may be said to be neutral. The fact that certain streams which a few years ago were among "the best trout
streams in the Adirondacks” are now depleted, may or may not be explained satisfactorily by the presence of beaver dams. There are other possibilities. The very fact that these streams were known to be excellent trout streams may in large measure explain why they are without trout today. They would naturally attract an increasing number of fishermen from year to year—a process that goes on more or less imperceptibly—and a few seasons of the consequent intensified fishing might well in itself have been the primary factor in the disappearance of the trout. As one by one such streams become depleted, other “good trout streams” are sought out, and thus the story runs. If it were only the beaver-dammed “best trout streams” that have become depleted the case against the beaver might be stronger, but in other streams formerly known as excellent trout streams, and on which there has been no interference from the beaver, trout have also been reported to be diminishing in numbers. Then again, in some districts of the Adirondacks it is not even certain, apparently, that trout have appreciably decreased, in a relative sense, at least. In one of the most densely beaver-inhabited districts, the local ranger, a man born and raised in that section, who has fished, hunted, and guided since a boy, and whose knowledge of the entire region is probably more intimate than that of any other individual in the community, volunteered the statement that so far as he was able to judge, the trout fishing in that particular section is as good today as it was twenty years ago. However, in the Adirondack region as a whole, there seems to be little doubt that trout have been steadily diminishing in numbers in common with what has been true throughout the entire country, and in reference to which a hue and cry has been heard over a long period. It seems more likely, therefore, that the situation in the Adirondacks is the result of the same agencies which have been responsible for present conditions in the inland waters of the country generally, in the great majority of which no brute animal has been at hand to be made a convenient “goat”. The situation in the Adirondacks most probably is not one to be remedied merely by the expedient of eliminating the beaver.

In seeking a cause or set of causes for a diminishing trout supply, so far as the Adirondacks is concerned, the search might, it would seem, prove more productive of results if directed first toward agencies which already are well known to be making, annually, great inroads into the trout supply of lakes and streams. The steadily increasing number of anglers, excessive fishing, faulty fish-stocking practices, deforestation, pollution of waters, are some of the agencies which invite our attention first and foremost. In the methods alone
of stocking waters with trout may lie hidden a considerable part of the true answer to the question as to what becomes of the trout. There are, for example, the results of some experiments undertaken in 1923 and 1924 by the Biological Board of Canada, in cooperation with the fish departments of Ontario and Ottawa (Knight, ’25), which furnish food for thought. Out of a total of 97,500 trout fry and fingerlings planted in seven streams and two ponds, it is stated that the losses “In six of the streams were apparently total at the end of three months. In streams and ponds combined, apparently only 1,375 survived, being less than one and one-half per cent of the total fry planted.” And “the outstanding causes for the high mortality”, at least for southwest Ontario seemed to be “(1) warm, stagnant or peaty water; (2) enemy fish eating the fry as shown by finding fry or fingerlings in their stomachs; and (3) lack of sufficient natural food.” These experiments, therefore, as Knight points out, indicate a “loss of 98% of the fry . . . during the first three months after distribution,” thus emphasizing the importance of the methods of distribution, and demonstrating the necessity for a thorough examination as to suitability of every stream or pond in which it is proposed to plant fry. Later, Knight (’26) gives the result of further seining tests. In Forbes Brook, a typical trout stream of Prince Edward Island, “During the first week of July four thousand trout fry were distributed along a length of about one quarter of a mile of this stream. It was seined three months later with the following results:

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trout yearlings and older</td>
<td>319</td>
</tr>
<tr>
<td>Fundulus</td>
<td>82</td>
</tr>
<tr>
<td>Atlantic salmon parr.</td>
<td>33</td>
</tr>
<tr>
<td>Stickleback</td>
<td>16,152</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16,586</strong></td>
</tr>
<tr>
<td><strong>Surviving trout fry</strong></td>
<td><strong>1,664</strong></td>
</tr>
</tbody>
</table>

“The superintendent for fish culture for the Dominion of Canada assures us that Forbes Brook is a typical trout stream. The approximate loss of trout fry in Prince Edward Island streams will average, therefore, about 73 per cent, for three months.” Knight thereupon presents the following questions:

“(1) Are we feeding trout fry to older trout and inferior fish? What role is played by the 16,152 stickleback?

“(2) Are the fry being starved to death through shortage of natural food for 16,585 fish, apart from the food required for the 4,000 fry?
“(3) How many of the surviving 1,064 fry (if any) will be alive when they shall have become four years old?

“(4) Should we continue to distribute trout fry irrespective of the presence in streams of many enemy and competitive fish?”

Here, then, we probably have one fruitful line of endeavor which may be applicable to our own Adirondack region. But it is only one of a number of possibilities, for some experienced trout fishermen have indeed not hesitated to lay the blame at the door of the great army of automobile fishermen who every summer swarm into the North Woods and ply their art fairly or unfairly on every accessible pond and stream.

Among these various agencies mentioned, one might indeed with more likelihood discover the primary causes for any depletion of Adirondack trout that may be taking place, and until these agencies have been critically and impartially inquired into, there is little need of seeking farther afield. These influences are general and far-reaching. Says Dr. David Starr Jordan, the distinguished authority on North American fishes (‘25, pp. 335-336): “The trout are rapidly disappearing from our streams through the agency of the manufacturer and the summer boarder. In the words of an excellent angler, the late Myron W. Reed of Denver: ‘This is the last generation of trout-fishers. The children will not be able to find any. Already there are well trodden paths by every stream in Maine, in New York, and in Michigan. I know of but one river in North America by the side of which you will find no paper collar or other evidences of civilization. It is in the Nameless River. Not that trout will cease to be. They will be hatched by machinery and raised in ponds and fattened on chopped liver, and grow flabby and lose their spots. The trout of the restaurant will not cease to be. He is no more like the trout of the wild river than the fat and songless reedbird is like the bob-o-link. Gross feeding and easy pond life enervate and deprave him. The trout that the children will know only by legend is the gold-sprinkled, living arrow of the white water: able to zigzag up the cataract, able to loiter in the rapids: whose dainty meat is the glancing butterfly.” This is a gloomy picture indeed, but so far as the Adirondacks are concerned, our fears may be somewhat allayed, for it does not mention the beaver as having been one of the great destructive agencies here or elsewhere. Those who are greatly concerned over the alleged harmful relation of the beaver to trout may perhaps take heart and renew their hopes, for the agencies against which the finger of accusation is pointed surely are so much
less subtle in their operation and so much less difficult to understand, that thought and action directed toward their control or correction doubtless would hold much greater promise of arriving at a successful solution of the trout problem than would the expenditure of available energy on the more or less obscure, ill understood, and largely hypothetical factor of the beaver.

**BEAVER IN RELATION TO DEER**

Is the presence of beaver harmful to deer in the Adirondacks? There are those who hold it to be true and advance this idea as an additional argument against the beaver. The basis of this contention is the assertion that balsam fir, a winter food in the yarding places of the deer, is destroyed by beaver flows, and that as a consequence the animals suffer from lack of food at that critical season of the year. It is the claim of certain individuals that the deer are in the habit of returning year after year to the same swamps to pass the winter. Where these swamps become flooded as a result of beaver dams, the deer on their return find their food supply cut off, but their attachment for their old wintering grounds is so strong that they remain to suffer want and even starve, instead of seeking new yarding places elsewhere. There are a few who even profess to believe that a decrease of deer in some districts is due to this cause, and whose voiced feelings toward the beaver are accordingly very bitter.

This alleged harmful relation of beaver appears not to be well founded, being rather, as in the case of some other supposed effects of beaver activity, largely if not wholly theoretical. It is true of course that much young balsam fir is killed in beaver flows, and since this species is browsed more or less by deer in winter, it may be said to represent so much deer food destroyed. It is entirely possible, of course, that in some particular localities in certain exceptional winters, the destruction of balsam fir may have contributed in a measure to suffering among deer, but to say that Adirondack deer generally or to any important extent anywhere have been exposed to serious hardships because of the beaver, would be an extravagant statement unsupported by any established facts. Indeed, if our deer were dependent upon the balsam fir or other species of browse bordering the beaver-inhabited streams, they would surely long since have vanished from many localities where they still occur. It seems, therefore, that we have here again merely a species of theorizing indulged in by individuals who are inclined to seek minor causes for major effects, and who overlook or disregard larger
causative factors, particularly if these involve, as they often do, somewhat painful truths. In numerous beaver flows which I have had occasion to visit, both old and new, in and about which dense stands of young balsams often occurred, I have looked in vain for any concrete evidence that these places had served as extensive feeding grounds for deer at any time. It may be that such places exist, but I have some hesitancy in believing that my failure to locate any of them was merely a coincidence. Let us consider for a moment the condition to be expected in such a yarding place:

Anyone who has seen the effects of browsing by deer on young balsams is familiar with the fact that the branches and smaller twigs retain unmistakable evidences of browsing—even for a number of years, whether the young tree lives or dies. In and about beaver flows where balsam occurs in sufficient amount to be of importance to deer in winter, one should therefore expect to find abundant signs of heavy browsing, and not only on balsam fir, but also on young growth of deciduous species. In fact, if we are to credit statements that deer return winter after winter to these feeding grounds and there remain to eke out a miserable existence or starve on the scant food left to them on the edges of the pond, one should find the balsams growing in little thickets about the margins of some flows to be literally stripped by the deer in their extremity. So far as my own observations go, I have no reason to believe that deer have been caused to suffer or have been placed at a serious disadvantage by the presence of beaver. And so far as balsam fir is concerned as a deer food, I have seen nothing to indicate that it constitutes a very important item of food among deer either in the Adirondacks or elsewhere. More or less of it is browsed here and there, and it is possible that it is an important item in the dietary of deer from a nutritional or physiological viewpoint, but quantitatively, according to my personal observations, it is not fed upon to the extent popularly supposed.

Further testimony opposed to the view that deer have suffered from the presence of beaver is found in the statements of guides, rangers, and other residents who have seen no evidence of harmful influences. Ranger Robinson of Long Lake stated to me in 1921 and again in 1925, that although he was well aware of the charge made by some people that the beaver was detrimental to the Adirondack deer, he had never seen any concrete evidence of hardship to deer from this source, and that he personally therefore considered the notion to be unfounded. As Mr. Robinson remarked, the abundance of both food and cover easily accessible
outside the beaver flows was such as to preclude any probability of deer suffering from want of either.

But the most convincing testimony in refutation of the charges that beaver flows have been detrimental to deer is found in the repeated statements of residents in the most densely beaver-populated region of the Adirondacks, namely, northern Hamilton county, made to me personally in the summer of 1924. At the time of the opening of the first beaver trapping season, March 1, 1924, the beaver had, as is well known, reached the peak of their abundance. If these animals had been exerting an appreciably harmful effect upon the deer in any manner, it will be conceded, I am sure, that this would have been manifested at that time. Yet in this year and likewise in 1925, the local ranger, guides and other residents agreed most emphatically that there were more deer in this territory than there had been for several years past. From my own observations, having no knowledge of earlier conditions, I can only say that deer appeared to be no less plentiful in the most densely infested districts than in parts where beaver were few. But accepting the statements of the local residents mentioned as representing the most reliable information available on this question, it must be admitted that a maximal deer population co-existing with a maximal beaver population is rather contradictory of the notion that the presence of beaver has been inimical to the welfare of the deer in the Adirondacks.

So much for the theoretical harmful aspects of beaver activities upon deer. It will now be proper to point out another side of this question which is sometimes overlooked or ignored. It is a well known fact to all who have any acquaintance with the subject that beaver meadows are favorite feeding grounds for deer. This fact is readily admitted, though unconsciously, even by persons quite hostile in their attitude toward the beaver. A beaver meadow usually is rich in a varied assortment of shrubs, grasses, sedges and herbaceous vegetation, which is eagerly sought by such a selective feeder as the white-tail. Here the animal regularly resorts to feed, and even the novice soon learns that the beaver meadow offers him one of the best chances to see deer. Residents of the Adirondacks well know that many beaver meadows are frequented by deer even in winter, so long as they are not rendered inaccessible by deep snow. The Eleventh Annual Report of the Conservation Commission (1921, p. 61) tells of game protectors cutting hay in beaver meadows for the purpose of feeding deer in a hard winter, but while it may be questioned whether dried hay of the ordinary meadow variety would
be very attractive to deer even in a hard winter, there is usually included in such hay a considerable variety of "weeds" which are acceptable. The advantage of having some winter feed available without the labor and expense of hauling it from more or less distant points is an appreciable one. Beaver meadows in the Adirondacks are numerous and their total value as deer feeding grounds must be considerable. In considering the relation of the beaver to the Adirondack deer, therefore, the tangible evidence points strongly to an influence that on the whole is beneficial.

**BEAVER DAMAGE TO PRIVATE PROPERTY**

The unsightly appearance of dead trees and other growth on the shores of many beaver-dammed ponds and streams has been another source of irritation and complaint on the part of private land-owners and others. However, from my personal observations and experiences, I believe this phase of the question to have been rather unduly exaggerated by persons prejudiced against the beaver. In the case of larger tracts of private holdings, no one will question the more or less arduous task entailed in tearing out beaver dams in any numbers. But as a matter of fact I have personally encountered very little complaint from owners of larger tracts. The most persistent complaints as a rule come from the owners of lots bordering smaller lakes or ponds. However, in most instances of this kind, damage from beaver can usually be guarded against by a very moderate expenditure of time or money. Permission to trap beaver doing damage to private property can be obtained by applying to the Conservation Commission, if such a step becomes necessary. Destruction of scenery of this nature is not the work of a few days or weeks, nor even, in some cases, of an entire season, so that reasonable alertness on the part of the owner is all that is necessary to prevent it. By way of example I may mention one or two instances where I saw recently built beaver dams on private land, which, if permitted to remain a little longer, would threaten destruction of several acres of trees. Although the situation was complained of, no attempt had been made to tear out the dams at any time since they were started, nor to trap the animals at work on them; the matter was simply allowed to lapse.

During the previous survey the majority of the relatively small number of complaints of private owners were heard in the vicinity of Big Moose Lake. During the past season I did not find an opportunity to revisit these people and learn what further damage, if any, had been perpetrated by the beaver in the meantime. Dur-
ing my entire stay in the field, however, I encountered no complaints from private owners, but in the case of two properties on which beaver occurred, I heard rather feeble complaints from the caretakers. The complainants had reference mainly to the labor devolving upon them in tearing out dams which threatened to cause flooding of certain pieces of land or timber. In one case in particular the keeper stated he did not wish to have the beaver exterminated on the property, but only to have their control well in hand.

Aside from the damage done by flooding, there is the cutting of trees by the beaver for food. The small lot owner feels that he cannot afford to submit to such loss. If he happens to have a few ornamental trees or some fruit trees on his premises, and any of these are felled or damaged, he takes the matter especially to heart. Smaller groves of aspens are of course particularly subject to beaver depredations if situated near the water, and if larger trees among them are severed, other damage may be caused by these when they crash to earth. Only the evergreen species may be considered reasonably safe from attack, although even these are by no means wholly immune. But damages from cutting of this sort on smaller lots are really largely or wholly preventable. Each valued tree can be surrounded by wire netting or a protective wrapping, or the ground containing the most important trees can be fenced. For protecting the trunks of individual trees, various inexpensive devices may be used, such as barrel staves, gunny sacks or burlap, dried cornstalks, or other unpalatable material.

In regard to other kinds of damage, the Ninth Annual Report of the Conservation Commission, 1919, states (p. 48) as previously quoted that the beaver have frequently flooded public highways, and even railroads, and (p. 51) that great damage has been done to improvements, such as roads, docks, boat-houses, cottages, etc., that have been constructed on private land. Strangely enough, I personally encountered no actual damage of this sort, neither during the survey of 1921 nor that of 1924; and I did not hear of any damages of such nature from any of the people whom I interviewed. In one or two instances, however, possibilities for some damage to railroad grades might have developed. On one small stream bordering the roadside beaver dams had been started, and if they had been left unmolested an overflow might have occurred, and eventually perhaps some damage done to the highway. But I saw no cases where an overflow had actually occurred. The only instances met with or heard of where any difficulties in connection with a railroad appeared possible of development were noted near
Sabattis, in 1921, as described in the earlier report ('22, pp. 133-134). About two miles northeast of this station is a small stream which passes through a conduit under the roadbed. A beaver dam situated a short distance downstream from the tracks had backed the water up so that a little pond had been formed on each side of the grade (Fig. 112). From the section crew I learned that the chief annoyance resulting from the situation here came from the necessity of tearing out the damming materials which the animals persisted in stuffing into the culvert every night. No serious damage was imminent and the section crew had not taken the trouble to tear out the dam below the tracks—which was the primary cause of the pond—nor had they attempted to trap the animals and thus put a more effective stop to their activities. About three miles northwest of the station the railroad again crosses, at two points, a small stream which at that time was inhabited by beaver. The situation was such that undermining of the grade might have been accomplished if the beaver had been left undisturbed in their activities; and here, therefore, the dams were regularly torn out by the section crew. Instances such as these, where streams of a character suitable to beaver closely approach or cross a railroad grade, are not sufficiently frequent and their development into threatening possibilities is not sufficiently rapid to warrant looking upon them as anything but rare occurrences well within the control of the section crew.

So far as damage to docks, boat-houses, etc., is concerned, it is possible of course that such might occur, but it is doubtful if it would be either frequent or serious. The gradually rising water level of a beaver-dammed lake, pond, or stream might sooner or later interfere with a dock or a boat-house, or flood a cottage, but most people in the Adirondacks will, I believe, consider these possibilities more or less remote, and surely preventable by nothing more than ordinary precautions. On the other hand a larger tree, unexpectedly felled by beaver in a single night or two, may crash against or upon a cottage standing in its path, with more or less damage as a result. I saw one such instance in 1921, at Big Moose Lake. A six-inch poplar had been severed and in falling had lodged against the roof of a cottage. In this case the tree was too small to cause any damage, but in another case it might have been larger. As was true of the instance mentioned, depredations of this kind are of course more likely to occur where the premises are left unoccupied for a period of time, and no precaution taken to guard against them. Omission of precautionary measures is prob-
Fig. 111.—South Meadow Brook, North Elba region. Little possibility of damage to timber by beaver in such situations; 1924.

Fig. 112.—Beaver pond at railroad grade. Sabattis district; 1921.
ably in many cases due to unfamiliarity with the ways of the beaver. The animal is relatively new to a great many sojourners in the Adirondacks and its capacity for mischief of certain kinds is unsuspected. The case is very similar to that of the porcupine. The inexperienced camper in the North Woods, unacquainted with this prickly native, crawls into his comfortable tent for the night, leaving his axe, paddle, or other highly useful if not indispensable article in a convenient spot (both to himself and the porcupine) outside. In the morning his eye suddenly falls upon an axe handle or a paddle gnawed half in two, and as it slowly dawns upon his awakening senses that he has been given his first lesson on the habits of the porcupine, his ire is aroused and he solemnly resolves upon war to the death with the entire tribe.

**NUMBERS OF THE BEAVER**

One of the most important questions confronting wild life administration is that of animal numbers—the numerical status of the particular species concerned—whether it be game, fur-bearing or other kind of animal in which man is interested. Given reasonably accurate knowledge of the numbers of individuals of a certain species inhabiting a particular area, the question of what to do to gain the desired ends would, in many cases at least, be quite simple. Unfortunately the taking of a census of wild animals free in nature is a matter beset with much difficulty and liability to error even under the best of conditions. All that can be hoped for is usually only a reasonably close approximation, depending for its value in a given case upon the relative trustworthiness of methods or basis employed and on the existing conditions. In the case of the beaver, census-taking would probably be considered no more difficult and doubtless much easier than that of many other wild mammals that might be mentioned. Some advantages in the case of the beaver are that these animals are restricted to the water courses, reveal their presence by unmistakable signs, and build domiciles such as their lodges, which, though not furnishing exact information as to the number of individuals inhabiting them, are at least conspicuous indicators of family (and individual) establishments and permit a reasonably dependable average number for each inhabited lodge to be set down. Where many beaver live in burrows in the bank the task of counting establishments becomes of course more difficult, mainly because of the time required to find them. But in general it may be said that a beaver census sufficiently reliable for adminis-
trative purposes is possible of realization, and is dependent mainly upon the accessibility of the inhabited water courses and on the time required to explore them. The time factor indeed would in larger areas be the chief consideration. For practical administrative purposes where beaver may be legally taken, a reasonably safe numerical estimate may be arrived at also by an indirect method, and that is by strict official check upon the number of beaver taken each season, such, for example, as may be secured by means of a tag system, mentioned elsewhere in this article. Should buying or selling of an untagged skin be made unlawful, and should the trapper be required to report the results of the trapping season on penalty of forfeiting the privilege of trapping in the following season, the opportunities for abuse of the law and evasion of reports would be reduced to a minimum. In the course of a few seasons the number of beaver taken and the number of trappers engaged would together constitute a kind of barometer by which the tendency in the beaver population might be forecast, and the number of animals to be taken yearly regulated accordingly. I am well aware that in certain quarters there is more or less objection to the idea of requiring trappers to report their annual catch of fur to administrative departments, and likewise in regard to the annual bag of certain game species. The argument in opposition is usually, in the first place, that only a relatively small percentage of reports ever come in, regardless of threatened penalties; and in the second place, that the reports are untrue to such an extent that they have little value. The validity of these objections may be freely granted; nevertheless, the fact remains that before the administration of game and fur-bearing animals can be put upon a sound, scientific basis, means must be devised for keeping some kind of account of the outgo. The demand for reports from those who take from the common stock of wild life is in no sense a burden imposed, and those who take are primarily the ones whose interests the reports must inevitably serve. In final analysis it probably is largely a matter of education. Excepting a relatively small number of individuals here and there who may labor under the suspicion that their reports will be open to inspection by rival trappers and thus used to their disadvantage, when the average trapper or hunter eventually comes to realize that keeping account and furnishing the central office with accurate statements of his operations is the surest method for insuring the safety of his capital, he will doubtless be not only willing but eager to perform the relatively small part required of him for the common good.
Another source from which, so far as fur-bearing animals are concerned, reports might be asked, and from which prompt reports could, I believe, be looked for with a good deal of assurance, is the raw-fur buyers. Such men of this class as I have met, at least, are highly intelligent people, who willingly and promptly have furnished any data requested, asking only that these data be used in such a way as not to reveal the source—a most reasonable request, easily granted, and detracting not in the slightest way from their value.

In brief, therefore, it may be said, that the idea of securing reports from trappers as to their annual catch, is a thoroughly sound one, and regardless of any difficulties attending enforcement of such requirements, and any imperfections in the reports themselves, there is good reason to believe that by persistent efforts such a regulation can be made to function satisfactorily.

Probably the most common mistake made in estimating beaver numbers arises from taking the number of dams as a basis for calculation. It seems to be a rather fixed popular notion in some quarters that every dam represents a family unit in the beaver world, and even that the family lives in it, so that, merely by counting the dams and multiplying by a number representing an average family size, a fair estimate of the entire beaver population may be had. In addition to this fallacy I have also encountered the notion that the size of the pond or flow is a pretty safe measure of the number of beaver inhabiting it. Employment of this criterion sometimes leads to startling results. Thus, one guide and trapper, who acknowledged a rather intimate acquaintance with the beaver and its ways, related to me the difficulties of beaver trapping, and as an illustration, told about a certain beaver flow two miles in length in which a trapper, who had had considerable experience in trapping Canadian beaver, was able to secure but three of the animals in the course of the open season (1924) in the Adirondacks. Upon my asking how many beaver my informant estimated were in this flow, he quickly replied that in a flow of such size there were probably as many as two hundred beaver! It may be added that his estimate may have been influenced somewhat by the point he was trying to argue, namely, that there would be no danger in a yearly open season, because the animals were so hard to trap that relatively few would be taken.

I believe it will be agreed by all who have any acquaintance with the beaver in the field and who have given the matter any thought, that the number of occupied lodges is the safest basis on which to
estimate the beaver population in territory of any size, that is, provided that the territory is of such nature that the beaver for the most part build such habitations. Bank dens of course should be counted as lodges wherever found, but because of the greater difficulties in finding them their total number must often remain a matter for calculation on the basis of the probabilities as judged by the character of the banks or shores of the inhabited waters. On water courses where beaver signs are common and the banks suitable, but lodges absent, bank dens may, as a general rule, be confidently expected to occur.

In my previous study of the beaver, in 1921, using the number of occupied lodges as a basis, and allowing for a certain percentage of unobserved bank dens, I attempted to arrive at some sort of estimate of the number of beaver in the Adirondack Preserve. Since the Conservation Commission in its order to the Rangers had not required a count of beaver lodges, but only of the dams, the only actual figures available on the number of lodges were those obtained by myself during the course of the field work. I had, however, also kept account of the dams (in repair) met with, and after computing the ratio of houses to dams from my own observation, applied this ratio in securing a figure for the number of lodges represented by the dams reported by the Rangers. I may for convenience quote from my earlier article, ('22, pp. 164-165): "The total number of inhabited lodges found (personal observations) was 84, and of dams in repair, 168. Along a number of the streams explored, where no lodges are indicated [reference is to map] some doubtless escaped notice, but I believe that this number is not large. It is to be noted that the ratio of lodges to dams is 1 to 2.

"To arrive at an estimate of the number of beaver here represented we may assume that to each inhabited lodge there were at the time 2 parent beavers and (on an average) 4 young of the season. We may add to this an average of 4 yearlings, which had not as yet built lodges for themselves and would spend the winter in the parental lodge. This makes a total of 10 beavers to each lodge, and the 84 lodges, therefore, represent a population of 840 animals. (Cf. Seton, '09, Vol. 1, p. 452). A certain number of beaver undoubtedly live in bank burrows, but judging from the nature of the banks in this territory, I believe their number to be small, probably not as great as one-fifth of the number that live in lodges. Assuming, however, that it is a fifth, the bank beavers would number 168. This number added to 840 gives us 1,008, as the number of beavers inhabiting the water courses explored. If we assume further that the remaining
water courses of these districts which I was unable to visit contained an equal number of beavers, the figure becomes 2,016; or, if there were three times as many, which I believe to be improbable, then we have 3,024.

“We may now turn to the figures representing the Rangers’ beaver dam reports previously mentioned, and see what estimates may be derived from that source. These estimates, so far as they concern Herkimer and Hamilton counties, may be considered independently of those given above in connection with my own investigations, but it is well to bear in mind that the districts covered by me are included in the area in which, as will be seen later on, the majority of the beaver dams reported by the Rangers are located. My purpose is to arrive at some estimate of the number of beaver in Herkimer and Hamilton counties, and in the Adirondack region as a whole, on the basis of dams reported by the Rangers. It may be accepted that many unreported dams existed, and of course many new dams have been built since 1920, but the fact remains that the Rangers’ reports constitute the most complete and definite information we have as to the distribution and relative density of the beaver population in the Adirondack region generally.

“It seems important to mention some points revealed by these reports. With the Forest Department’s maps before me, I find that 587 dams for the entire region have been plotted for 1919, and new dams added for 1920 increase the total to 663. Of this number 481 dams are divided between Herkimer and Hamilton counties alone and more than half of these are confined to approximately the northern third of this area. In other words only a scattering 182 out of the total of 663 dams reported for the whole Adirondack region are located outside the two counties named, and these counties together contain the great majority of the beaver population. These facts should be noted since it is usually very easy to gain the impression that because a species of animal is plentiful in one part of a region, it is equally abundant in all other parts, although such may be far from the truth. And furthermore, such evidence as the Rangers’ reports furnish, should be given due consideration, lest any temptation arise to apply sweepingly drastic measures of control that might properly be applicable only to a part of the region.

“Now as to estimates. Accepting the same ratio of lodges to dams as previously given, the same number of beavers to a lodge and the same fraction of bank beavers, it appears that 481 dams in Herkimer and Hamilton counties represent 2,886 beavers. And proceeding in the same way with the remaining 182 dams scattered throughout the
Adirondacks, we shall have 1,092 beavers outside of Herkimer and Hamilton counties. If all the dams reported should constitute only one-half the number that actually exist, we have simply to double the sum of the two figures just mentioned, giving an estimated total of 7,956, or in round numbers, 8,000 beavers for the Adirondack region as a whole."

This, then, is the number of beaver estimated by me for the Adirondacks in 1921. According to Willoughby ('20 a, p. 628), the Conservation Commission had previously estimated that the Adirondacks harbored a beaver population numbering between 15,000 and 20,000 animals. But in the light of the known results of the two trapping seasons, it would seem that these figures were excessive, and that the estimate of about 8,000 beaver for the region in 1921 was not far wrong. In the survey of 1924, it was not possible to arrive at any worthwhile estimate by counting lodges, because of the disruption of beaver families resulting from the activities of the trappers. In the various localities examined, I recorded a total of 64 beaver lodges, which either were inhabited at the time or evidently had been inhabited up to the beginning of the trapping season. Among these, 24 at least showed every sign of having been unoccupied for some weeks, and a considerable fraction had been torn open by human agency. The remaining forty showed unmistakable signs of occupancy, with more or less material freshly added, but with evidence of the trappers' activities about many of them, so that it was not possible to decide upon any definite average number of beavers to each lodge. Of course in this case also allowance is to be made for lodges that were overlooked in each of the localities visited.

**RESULTS OF THE OPEN SEASONS**

As the result of the agitation that had developed for an open season on beaver, the Conservation Commission, empowered by the Legislature to grant a short trapping season, designated the month of March, 1924, as the period during which beaver might lawfully be taken. The Commission was given discretionary powers thereafter either to close or open the season as in its judgment the situation might warrant.

When I entered the field in June, 1924, I was, so to speak, sufficiently far behind the heels of departing trappers to find normal quiet restored, and it was possible to form a fairly accurate idea as to what the effect of the trapping had been. That the trapping had on the whole been very successful was quite evident. There were naturally some localities in which seasonal conditions had hampered
the trapper and a considerable proportion of beaver had escaped his traps; there were others which appeared to have been overlooked, or perhaps had been shunned because of being less easily accessible. But taking the beaver territory as a whole, the haul of fur had clearly been successful. In practically all the localities where beaver had been common, the local residents, rangers, and trappers freely admitted that many beaver were taken, and in one of the sections of Hamilton county where the animals had previously been especially plentiful, a ranger stated it as his belief that they had now been "pretty well cleaned out". But on most of the waters where beaver had before been established in considerable numbers there were still a good many left; where they had been few the elimination had been more nearly complete. The telltale evidence of the trappers' work was only too plain in the many deserted lodges, which in some instances had been torn open, in the great number of dams which recently had fallen into disrepair, with resulting low stage of the water, and in the absence of fresh cuttings, slides, and other familiar signs. Of course there is no reason to believe that the beaver has been brought to the brink of extermination by this one season of trapping. If an open season should again be declared next year, the total catch of beaver may be expected approximately to equal—indeed it might even exceed—that of the first season, for it is hardly likely that more than half of the total number were taken the first season, and this season's young will constitute a substantial addition to the numbers that remain. Then, too, a large catch is to be expected as a result of the experience gained by the trappers during the first open season, while the possibility of an increase in the number of trappers is also to be considered. Therefore, should a catch as great as or greater than the one of this first season be made next year, such an event need not be surprising. However, the fact remains that a heavy inroad was made on the beaver in the first open season, and this merely goes to prove, if proof were needed, how easily beaver can be controlled or exterminated, whichever plan be adopted. Incidentally it proves, I think, how very easy it is to overestimate the numbers of beaver in any such territory as the Adirondacks.

As to the actual total number of beaver taken in the Adirondack region during this first open season I have no means of knowing. So far as I am aware no attempt has been made to provide an effective tagging system by which a reasonably accurate check might be kept on the quantities of beaver skins sold. Any figures on the total therefore, must be looked upon merely as the best estimates that can
be given in the circumstances. But while this holds true when speaking of the total number, I am able to present some figures which, though incomplete, are reliable so far as they go, and are important in that they may be taken as the minimal number of beaver taken during the first open season. These are the figures furnished me by a number of fur buyers who regularly cover the Adirondack region and who collectively probably purchase the bulk of the raw fur of all species taken in that territory. A certain number of beaver skins admittedly are shipped out by individual trappers to be sold outside the State. What percentage of the whole such skins represent is unknown, but some fur buyers believe it to be small. The actual number of beaver skins purchased by the fur buyers whose figures I have been given amounts to 2478. In round numbers we may therefore say, that a least 2500 beaver are actually known to have been taken as a result of the first open season.

In regard to the total number of beaver possibly taken in the Adirondacks, two of the fur buyers mentioned gave an estimate of 5000 for the first season.

Since the above was written another open season has passed, and another set of figures has kindly been furnished me by the same buyers. Their combined purchases amount to 3573 beaver skins for the season of 1925. For the same reasons as in the first instance this number is likewise incomplete, but it gives us a minimal known quantity of beaver skins taken. So far as its bearing on the total beaver catch of the Adirondacks goes, the number has no more significance than the figures given for the first season, but the presumption is that the principal fur buyers above mentioned secured at least one-half, if not three-fourths, of the beaver fur taken in the Adirondacks. Two of the fur buyers referred to stated that although their purchases for the second open season exceeded those of the first, it was their opinion that the beaver population had been severely reduced and that if an open season should again be declared in 1926, a startling reduction would be discovered. They were accordingly in favor of a closed season for this year.

**Income from beaver skins.**—In 1924 the average price paid to the trappers for a certain lot of 889 skins was $16.88. Accepting the even figure of $16 as the average price for 2478 recorded skins, we have the sum of $39,648 paid to the trappers who took them. Assuming that a total of 5000 skins in all were taken, we have a sum of $80,000. For a lot of 1600 beaver skins taken in 1925, the price paid per skin ranged from $18 to $25. Taking $20 as the
average for the 3573 recorded skins of this season we have the sum of $71,460. We may then say that as a result of two open seasons on beaver in the Adirondacks, those who trapped received collectively at least $111,108; and if we accept an estimate of 5000 beaver skins as the total taken in each of the two open seasons, taking $16 and $18 respectively as the average price per skin for these two seasons, we get the very respectable sums of $80,000 and $90,000, or a total of $170,000 as representing the cash payments to that part of the Adirondack population which took part in the trapping of beaver.

THE BEAVER AS A POTENTIAL ECONOMIC ASSET

From the facts presented under the two preceding headings, it can hardly be questioned that the beaver constitutes a natural resource of very real importance to the people of the Adirondack region. The income from the beaver catch of the two open seasons represents a sum of money that would not have been forthcoming from any other source. In other words, the people who trapped are collectively better off by at least $100,000 than they would have been without the beaver. It is not necessary to argue that the value of the timber killed by beaver must be deducted from this sum, for as previously stated this timber (it is mostly on State land) could not, because of Constitutional restrictions, have been cut or sold even if it had not been damaged by beavers. It may be true also that the number of persons who trapped beaver was relatively small, so that the money from the sale of skins came into the hands of but a few people; but doubtless many others could have found equal opportunity to trap had they cared to do so. In any case it is probably true that the larger part of the money received by the trappers will be spent in the communities in which they live, and the communities as a whole, therefore, directly or indirectly, are gainers. While the great majority of those who trap do so to sell the furs secured, there are also a few who trap beaver in order to have the skins made up into furs for themselves or for members of their families, thereby effecting a considerable saving in cash outlay. It requires no great effort of the imagination to grasp what it would mean for the Adirondack region to be able to harvest a fur crop of such magnitude as that of either of the two recent open beaver seasons as a permanent annual affair.

Another aspect of the economic value of the beaver is the attraction it offers to summer visitors. While this is a less easily computed value, it is actually a very real one, as anyone may determine
to his own satisfaction by questioning numbers of tourists whom he meets in the Adirondacks during the summer months. The residents are well aware of this fact. The Ranger in one district informed me that at the time I saw him he had already personally conducted forty-eight visitors to see a certain beaver dam. Owners of camps have not hesitated to admit the attraction offered by beaver and beaver works to their summer guests. In the Fifth Annual Report of the Conservation Commission (1915, p. 20) it is stated with regard to the beaver that “Their dams and workings furnish points of interest which now annually attract thousands of vacationists . . .” And in the following Annual Report (1916, p. 17) we are again told that “The universal testimony from hotel men and others in touch with the large numbers of summer tourists is that the beaver and their dams and houses constitute one of the most interesting phases of the wild life of the woods.”

USEFULNESS OF THE BEAVER POND

While no one will question that a beaver pond frequently may be a matter of annoyance, it is not generally the unmitigated nuisance or evil that some rather violently prejudiced persons would have it appear. Reservoirs of water in a forested region are generally of considerable value, and the question of whether they were erected by man or by beaver is of secondary importance. The water stored in a series of beaver ponds on the upper sources of a stream may be sufficient to keep the stream flowing through a period of drought, and the value of such water storage may in some localities become of more than theoretical importance. As an illustration there may be presented a statement from Moody, then of the State Conservation Commission of Wisconsin (Amer. Forestry, Vol. 22, 1916, p. 224), who quotes “the land commissioner of a large and wealthy lumber company of northern Wisconsin” as follows: “Until within a few years ago, there were no beaver in the country [parts of Wisconsin] and the water level lowered over three and one-half feet. This had the effect of draining the swamps, so that the front went down below the roots of tamarack and cedar timber.

“Such timber . . . finally began to die from want of nourishment. Since the beaver came back no tamarack or cedar is dying; for their dams protect us from fires and floods; the waters of the country have been conserved, and we have had no drouth. There are large lakes in this country which would be dry were it not for the work of beavers a century ago. The Government surveyor
meandered lakes in many places that became dry land after the early trapper had destroyed the beaver.'"

Reference was made in my former article (22, p. 141) to the importance of beaver flows in the event of forest fire. In that connection an argument in opposition to the beaver was quoted which held that the beaver flows in case of fire would be more of a disadvantage than an advantage, because they "make it impossible to maintain good passable trails, and therefore render communication difficult." This point so far as actual facts go, seems not to be well taken. If the reference is to trails built for communication during the progress of a fire then a beaver flow might perhaps offer some difficulty provided the trail had to be laid across it, and provided the pond was deep and wide and there were no convenient dams on which a crossing could be made. But such a combination of circumstances would seem to be quite exceptional, and the argument practically amounts to saying that a broader stream is more of a disadvantage than a narrow stream in the fire protection system in a forest region, where a serious fire is ever a possibility in almost any portion of it and at almost any time during the fire-hazard season. If on the other hand the reference is to the permanent trails of the Adirondacks, then, so far as any actual evidence is concerned, damage to these trails by the beaver by flooding or in other ways likewise seems to be rather exceptional. Although, in the two seasons of observation on the beaver situation, I have tramped over a good many Adirondack trails I have happened upon but a single instance where a trail had been flooded by beaver in a way to delay progress dry shod. In this case the trail crossed a little stream where the ground was low, and a foot-bridge of three or four lengths of poles had been constructed. It was in an old burn, and the water was only about knee deep at the most and offered no difficulties to wading.

It is interesting to note that in other parts of the country the fire protective value of beaver flows is sometimes frankly recognized. To quote again the land commissioner of the Wisconsin lumber company, who remarks on this phase of the subject thus: "Forest fires are the greatest menace and drawback to the prosperity of this country, for the farmer as well as the lumberman, which confronts us today. In unsettled districts the beaver is the only fire-fighter and the only protection we have. Their dams, which have been built along small streams, have had the effect of raising the water level in this part of the country, on the creek bottoms and marshes, which form most effective barriers against fire. In some cases these barriers extend across entire townships."
Some interesting data on beaver ponds in the West are furnished by Houk (’24). The U. S. Forest Service found that in the Cochetopa National Forest, near San Louis Valley, Colorado, the water stored above the beaver dams in that forest alone amounted to 1241 acre-feet, that is, 1241 acres covered to a depth of one foot, or “the equivalent of 24,000 Colorado statute inches running for 24 hours, or enough to irrigate 39,000 acres of land for one day. . . . In the Silver Creek Valley alone, 46 dams were located in a total length of about 5 3/4 miles. These dams averaged about 660 feet apart, although they generally occurred in groups with a somewhat closer spacing. In some cases the water was backed up above the dams to depths as great as 5½ feet. If these structures had been built of concrete, by man, and the concrete had cost $5.00 per cubic yard—a very conservative estimate,—the dams would have cost from $11 to $1026 apiece, and their total cost would have been about $10,000. This is for the Silver Creek Valley only. Considering the entire Cochetopa Forest, the total cost of the beaver dams on the same basis, would be about $200,000.”

“Consequently”, continues Houk, “it is evident that the value of the beaver as an aid to irrigation is of no minor importance. In fact a plan has already been developed and put into operation in Colorado, whereby beavers are taken from one section of the state, where they are plentiful, and transplanted, as it were, to other sections where their services are more essential. . . . One case is recorded where a rancher, who had only enough water to irrigate a small garden plot before he imported beavers, now has sufficient water to cultivate forty acres successfully.

“The plan followed is to save the beaver storage until late in the summer, when water is scarce and crops are badly in need of moisture, then to cut the dams and allow the water to drain into the irrigation ditches. Within 24 hours the beavers have the dams repaired so that they are again storing water for another emergency. Thus the beaver storage can be utilized several times in one season if necessary.”

PROGRESSIVE EVOLUTION OF THE BEAVER FLOW

In the foregoing discussion the beaver flows and beaver meadows have been considered merely as such, and no allusion has been made as to the possibility that neither the one nor the other may be a fixed and permanent feature of the landscape. Yet such is actually the case, and this thought should be a source of some comfort to those to whom the beaver flow of today is a matter of such deep con-
cern; who see in it nothing more than a blot upon the landscape, a peril to deer, a curse to the woods trampler, and even—if one should take some alarmists at all seriously—an ominous forecast of impending doom to the entire Adirondack forest.

While much has been said in lamentation and condemnation regarding the beaver flow, no one apparently has arisen to bemoan the presence of the beaver meadow, the nestling pond, the swamp, or the wooded valley. Rather these have all been viewed with considerable interest and satisfaction; they are held, in fact, to be desirable features of the general landscape. And yet how many of these may not, if their full history were known, have had their origin as beaver ponds of the past, the dams of which long ago became buried from sight? Doubtless a great many have had just such a history. “For instance,” says Tarr (’02, p. 200), “the early settlers of New York found hundreds of these little ponds and swamps caused by the dams thrown across small streams by beaver.” And Radford (’06, p. 395): “Judging from the extensive remains of the beavers’ occupancy still visible in all parts of northern New York (such as beaver meadows and remnants of dams), it is evident that every lake and pond was occupied, and every river, brook and rill, from the largest to the most insignificant, thickly peopled with these industrious and prolific animals. They seem to have completely possessed the land, and to have been abundant almost beyond our present conception.” Now, while the popular mind readily recognizes that the beaver meadow may be a logical successor to the beaver pond, it does not so easily grasp that there are other possibilities, or that the beaver meadow is not necessarily an end result in itself; that it may be but a step in the onward march of events; that it represents but a stage in an orderly process of succession in nature and is due in its turn to be followed by other conditions. Seeds of forest trees will find lodgment and growth in its fertile soil and ultimately the meadow will have been succeeded by the sheltering swamp or the wooded valley, as the case may be, and if on the other hand a permanent pond should come to be, that, too, would doubtless find an acceptable place in the scheme of things in the distant future. Time is an important consideration. We are naturally prone to confine our thoughts too closely to the present state of things, with little or no thought of what the future may bring. And in this concern for things as they are, we too often forget what the past has taught, that many of these same things are quite certain in due process of time to change for the better without work or worry on our part. Let us glance for a moment at the past history of the beaver in
New York State. Radford, who has looked into the early history of the beaver, estimates that in the days of Champlain the beaver in the area covered by this state must have numbered "not improbably several million." He quotes from an old Dutch writer that in 1671 the province of New Netherland furnished "full eighty thousand beavers a year". And "all the evidences show," say Radford, "that the beaver was fully as abundant in the Adirondacks as in other parts of the State; so that if dividing by three, we make the assumption that there were one million beavers in the Adirondacks at the commencement of the white man's settlement, we have an estimate probably as accurate as could be deduced at the present time." One reason for the great abundance of beaver at that early day, lay in the fact that the Indians then did not place any particular value on the beaver, either as fur or meat, and as the author mentioned states, "It is known that the Indians had a superstitious regard for the beaver,—ever associating him with the creation of the world—which may have had some influence on his practical immunity from pursuit."

From these enormous early numbers the beaver population steadily decreased under the onslaught of the fur trade until by the year 1800, according to Radford's estimate, the number "in northern New York" was about 5,000. Thereafter the decline continued, until at the time of the re-introduction of the beaver in 1905, there were probably not more than the equivalent of two or three families remaining, for, contrary to the general belief, the species did not reach complete extinction in New York State.

Now, the point I wish to emphasize here is, that despite the vast numbers of beaver that history clearly shows populated the region, no great calamity seems to have befallen the Adirondack forest or its waters; at least history apparently records no crises of any kind arising from the presence of too many beaver. When the beaver was re-introduced twenty years ago, no one then had noted, and no one apparently had even a recollection of, any disfiguring scars left on the landscape by the activities of earlier colonies. Therefore we of today, too, may look ahead without undue anxiety as to the beaver situation. What will be the condition a hundred years from now, or even half a hundred, no one may presume to predict; but should the beaver remain, it may be safely said that beaver ponds will come and go, in the future as in the past, and neither the forest nor the waters, the fish nor the deer, will have been seriously affected thereby. Nature is a great leveler and will take care of many things unaided. And any beaver meadow or swamp, lake, or wooded valley
that may some time come to be as a result of some beaver pond of the present, will doubtless be as acceptable a feature of the Adirondacks of the future as these same things are to us in our own day and time.

BEAVER FARMING

At a time when fur farming is enjoying so much popular attention as at present one would hardly expect to be forgiven if a discussion of the beaver were concluded without at least some reference to the subject and the possibilities of this animal in such connection. Consequently the topic is touched upon—and no more—for it is one about which both knowledge and experience of dependable and proven nature are largely wanting.

As an animal for raising in enclosures the beaver has a number of important qualifications. It is easily tamed, especially if captured when young, and is disposed to be healthy and not highly susceptible to epizootic disease; it will eat a variety of vegetable matter aside from its favorite bark, and its social instincts are such as to permit of some concentration of numbers of its own kind. Yet if beaver farming on any larger scale and for profit were to be attempted, it is at least my own view that it might be made successful only by providing areas sufficiently large and with sufficient natural resources in them to ensure to the animals the same kind of existence as that which they are ordinarily wont to enjoy in their native haunts. There should be plenty of water, an adequate food supply, such as aspens, or cottonwood, birch, willows, alders, a variety of shrubs and other vegetation, berries, etc., and abundant opportunity for building dams and lodges, and for burrowing. Artificial ponds may, perhaps, in some places be created, with all the important requirements of beaver life, or natural ponds may be available so that enclosing the whole within a fence would be entirely practicable. In the case of streams, however, fencing may prove difficult where high water, strong current and drift materials create a periodic problem.

The item of sufficiently large area is so important that any thought of enclosing such a "farm" must include careful consideration of the expense that may be incurred. If one contemplates raising only a few of the animals, as a pastime or merely to supply the family with furs, and is not primarily concerned with profit, then the undertaking becomes relatively simple. But in the minds of most people who think about fur farming the question of profit is doubtless the primary or only consideration, and since the location would not always be a matter of free choice the problem of
effectively retaining the animals within a given area is one that must be faced. To some there may be available water courses or parts of water courses where natural barriers of a kind may occur that would aid in the solution of the problem, otherwise fencing offers the only alternative; and the proper fencing of a length of stream sufficient to permit of beaver farming on an extensive and profitable scale would require a considerable outlay of money.

All things considered, for those who might have larger tracts of suitable land the best method of beaver farming would doubtless be to dispense with the fence, but provide adequate protection for the animals from disturbance and, by various means available for maintaining the food supply and the other necessary conditions, try to encourage the animals to remain within their territory. If such a tract be adjacent to cultivated or peopled areas there would be the possibility of annoyance or damage caused by beaver which now and then would be likely to stray beyond the limits of their preserve. This would not necessarily always be considered a serious problem, for many persons would probably be only too glad for a chance to take such beaver, provided no legal restrictions existed.

In some suitable sections opportunities might be found for owners of adjoining tracts to enter into some sort of mutual agreement by which the propagation of beaver and the harvesting of its fur could be made profitable. As an adjunct to timber raising it certainly would have merit in many forest areas. The species of trees utilized by the beaver for food are mostly of rapid-growing varieties, so that the upkeep of an adequate supply would offer no great difficulty. The fur crop would be an annual one, and if we assume, for example, a cut-over area to be adequately supplied with water and properly stocked with beaver, it might, probably, not be difficult to show that the beaver fur crop from such a tract would, in the time required for a new crop of timber to mature, amount to a very considerable sum; it might in fact even exceed the timber crop in value.

As in most other fur farming enterprises at the present time, the raising of beaver for breeding and stocking purposes would probably be considered the most appealing prospect. The price per head or per pair for these purposes would be placed at three or four times the market value of the prime skin, and by the strength of long range advertising and glowing paragraphs about the riches that would flow to those who would but see their golden opportunity, a considerable market might be developed in this connection. But the exploitation of this field would doubtless yield but temporary and by no means lucrative results, and the cultivation of the
raw fur market would probably present a more permanent basis on which to build.

It would appear, therefore, that beaver farming for fur, and by the extensive rather than the intensive method, is the only kind of “farming” of this animal, which, except to the promoter, in the present state of our knowledge and experience offers a reasonable prospect of being a successful venture; and the bigger the area the better the prospect.

**BEAVER MEAT AS HUMAN FOOD**

In the early history of this country beaver meat doubtless had a place on the table along with that of other game. Old writings speak of beaver’s tail as a recognized delicacy, and we may safely infer that the flesh of the animal was prepared by the dames of that day in as varied and appetizing a manner as was the flesh of the deer, the rabbit, the squirrel, the turkey, or the grouse. In this day of corn-fed hogs, fatted turkey, capon, baby beef and artificial appetites, the mere suggestion that the flesh of some of our less popularly known wild animals is edible, is often met with nothing but undisguised astonishment and horror—exceptions always to be expected among certain of our foreign elements whose tastes are trained to a more nearly omnivorous diet and whose protein predilections at any rate embrace everything feathered from chickadees and wrens to woodpeckers, cuckoos and kingfishers.

In a recent bulletin on the muskrat (’25) I quoted from Lantz (U. S. Dept. Agri., Farmers Bul. 869, p. 23) a number of cooking recipes for that rodent, and there is no reason why the same directions could not be applied with equal success in the cooking of beaver meat. Personally I have always made it a practice to eat the flesh of any beaver that I have taken, and have, without exception, found it pleasant to the taste. My own preference with beaver, as with meat of other wild game, is to place the meat in the pan and fry it, or to broil it; but I have also eaten it boiled, as well as fried after first parboiling it. But individual tastes differ, here as in other things. As an example of an open-minded effort to overcome prejudice and cultivate a taste for beaver meat, I may mention the case of a friend, an Adirondack guide and an excellent camp cook. The beaver was a large one and furnished meat sufficient for a number of meals for two. My friend had cooked the meat himself, and according to what he considered the best method, theoretically. The result was, in my own estimation, really excellent, and I did full justice to the sizzling hot portions which he
served me. In the case of my friend, however, the psycho-reflexes appeared to be giving trouble and he could make but little progress. Then, purely by accident, in getting ready a hurried meal one day he served some of the beaver meat cold. The effect was now entirely different; he enjoyed his portion very much and declared that he had discovered the form in which beaver meat appealed to his palate. He also discovered that there was now but little of it left.

The quantity of meat on an animal the size of a beaver is really quite considerable, and it is here respectfully suggested that any one who traps beaver and has not already discovered the palatability and nutritive qualities of its meat should give it a fair trial. I am sure that nothing more will be necessary to establish its good standing in his esteem, and furthermore it may constitute a welcome addition to the family larder as a substitute for more expensive meats of the market; which would simply mean that he would derive a greater profit from his trapping.

**WAS THE INTRODUCTION OF THE BEAVER A MISTAKE?**

If one were to judge solely by the adverse criticism and complaints which in the last few years have been emanating from certain sources, one might seriously question whether the introduction of the beaver into the Adirondacks twenty years ago was not after all an economic mistake. That it was such a mistake is the conclusion one is most likely to draw after reading some of the published estimates on the amount of timber “destroyed” and the general statements as to the amount of other forms of damage estimated to have been done, threatened, or merely assumed to have been done by the beaver since its establishment in the Adirondacks. It is well to bear in mind, however, that the heaviest estimated damage, namely, that to timber, represents, or represented at the time the estimates were made, the total damage after the lapse of fifteen years of unrestricted freedom of the beaver in the Adirondack forest. By inference and implication, if not by more direct statement, it was suggested that this damage, for each year that the beaver remained unchecked, increased directly as the number of beaver increased. Such a situation would, however, hardly be consistent with the actual facts, for as pointed out in the earlier bulletin, there are certain definite limitations to the capacity as well as the tendency of beaver to flood land and timber. And then at this point it is well to direct attention again to the fact mentioned before, that according to Article VII of the Constitution of New
York State, the timber in the Adirondack Forest Preserve is not to be taken off for any purpose whatsoever, so that it seems somewhat beside the point to emphasize the high monetary value of beaver-killed timber. Ere the people decide that the lands of the Forest Preserve shall no more be held "forever inviolate," a new growth of trees may be far on the way to replace any that may have been destroyed by beaver. Moreover, one of the purposes back of the protection of the Adirondack forests was the protection of the water supply, and to this important end it may truly be said that the dams of the beaver have contributed their fair share.

Over against the actual damages caused by the beaver we may place the actual returns in money received from the sale of its fur. In view of the amount of such returns mentioned in the preceding chapter no one, I believe, will seriously insist that the beaver is an economic liability, but that it is on the contrary an important natural resource from which, with proper management, a substantial annual income might be derived for an indefinite period. The two open seasons in the Adirondacks have, according to some local views, opened the eyes of many people to the real value of beaver. As a number of persons expressed it, the wages represented by the month of beaver trapping exceeded for many people the money earned in any like period of time throughout the rest of the year, and this money came at a time when it was most welcome. That some damage should have resulted during a long period of protection is only what might have been expected, and the same holds true for almost any other species of animal, however innocuous ordinarily, if, unrestrained by man or by natural enemies, it be permitted to continue for years to multiply its kind. Any plan to introduce a species of such well known habits as those of the beaver is not complete without some provision for its proper control at the proper time and at the proper place. Control in this case consists mainly in taking a certain number of the animals; in other words, of harvesting a part of the crop. In order to get the highest returns on the investment the crop should of course be taken at the proper time of the year, and this is possible even in places where damage may be threatened. Proper control, it might be said, is here synonymous with proper management, and its attainment entails a certain expense on the part of the State. To help defray the cost of operation, if not wholly to meet it, a tag and license system would seem to answer the purpose. Such a system has been in operation, for example, in Minnesota (see Avery, '22), apparently with entire satisfaction. The license fee is one dollar and the tag fee three
dollars. By this system the state in three years received as revenue $3,736 in license fees, and $15,372 in tag fees, or a total of $19,108. The estimated value of beaver pelts taken in that time was $100,829. "A large number of settlers and residents of the northern portion of the state," says Commissioner Avery's report, "have been directly and materially benefited by this opportunity to trap beaver, and the policy of the department has been to confine the trapping largely to actual settlers and residents of the localities where the trapping has been permitted."

Taking a broad view of the question, therefore, based on net returns that have been derived both in our own state and elsewhere, and on the inherent possibilities of beaver culture, it would seem that only the careless or prejudiced thinker is likely to contend that the introduction of the beaver into the Adirondacks was an economic mistake.

**DISTRIBUTION OF THE BEAVER**

In regard to the present distribution of the beaver in the Adirondacks any statement ventured must necessarily be both incomplete and-inexact. On numerous little ponds and streams in out-of-the-way places, and even on those more or less frequently visited by man, the animals may be present without the fact becoming known immediately. The two open seasons to which the beaver has now been exposed doubtless have had their effect on the distribution during the last two years (1924 and 1925), through the breaking up of family groups and mated pairs. In many instances, since the close of the trapping season, the rangers had not visited waters previously known to be beaver-inhabited, and consequently were unable to state whether or not there was any evidence that some of the animals remained. They also frankly admitted that there were some water courses in their districts on which beaver might be present although unknown to them. Then there remain the many localities which time did not permit me personally to visit, and for which no detailed reports on local distribution of beaver are available.

Despite the deficiencies of the data it is desirable to convey a general idea of the distribution of the beaver within the Adirondack Preserve, and for that purpose recourse is had to the accompanying Map 6. The unmarked areas are not to be regarded as without beaver, for many are known to occur in them; they are simply areas for which no definite information as to the local distribution was obtained. The marks mean that on the water courses indicated beaver were known to exist at the time, or that they had been present prior to the first open season (March, 1924).
THE BEAVER AS A WILD LIFE PROBLEM

At the present day, therefore, when our natural resources of many kinds are being heavily drained and public attention is turning more and more towards the call for conservation, it would seem to be the wiser policy to treat the beaver as a valuable resource worthy of cultivation rather than as a nuisance to be suppressed or eliminated. In the West and Mid-west there is rapidly developing an appreciation of the economic possibilities of beaver, among wild life administrators, and in due course of time the modern viewpoint will find wider acceptance. With us in New York State the chief reason for our backwardness in recognizing the possibilities of beaver culture is doubtless the very novelty of the situation. The idea of beaver as a source of income is a new thing to present generations here, and the many questions arising in connection with its management and control under modern conditions are new anywhere. Present systems of wild life administration are not always of a kind best adapted to meet new situations easily and quickly, but no change is perhaps soon to be expected in this direction so long as wild life administration remains a political institution; the pressure at any rate must come from the public. The beaver is but a phase of the wild life problem in general, and the problems of wild life administration are becoming more and more complex as population increases and the area of natural habitat decreases; hence the need of expert knowledge and an unprejudiced viewpoint. Our constant aim in wild life administration should be to study present conditions closely and, so far as possible, foresee and capitalize the possibilities of the future. To that end our administrative machinery must be plastic enough to admit of ready adjustment to new situations and of modification according to rising needs.

THE NATURAL HISTORY OF THE BEAVER

Description.—The beaver has been described in the literature so often that detailed description here is hardly necessary. Attention has often been called to its close general resemblance to the muskrat, both in form and in habit, but except in the case of very young specimens, which are not often encountered by the average tourist in beaver country, the large size of the beaver is usually sufficient to distinguish it from the muskrat. Nevertheless it behooves the inexperienced to look sharply if he is out to see beaver, for when the animals are in the water and are swimming even a practiced eye may often be deceived; the part shown above the water at such times,
especially when seen at a distance, has little to distinguish the one from
the other. Should the animal become alarmed and suddenly dive the
question may be settled on the instant; but even in diving the two
are not always distinguishable, for the muskrat may go down with a
warning slap of its tail—though not so loud, it is true—and the
beaver may sink beneath the surface without an audible sound.

In general coloration the adult beaver is reddish brown, due to
the color of the long overhairs, while younger specimens are gen-
erally of a darker cast, and old ones often have a sprinkling of white
hairs about the head. This coloration has reference to the fur in dry
condition and when examined in good light. But the woods tramper
rarely sees the beaver in such favorable situations and conditions that
he can say with certainty just what its shade of color may be. By
him the beaver is more likely to be seen when its fur is wet, so that
his impression is that of a blackish animal rather than of a reddish
brown one.

Especially distinctive features of the external anatomy of the
beaver are its paddle-like scaly tail, its large webbed hind feet, not
unlike those of a black-footed goose, and the presence of a cloaca
which renders the sexes practically indistinguishable outwardly
except for the presence of the better developed mammae in the
female.

The remarkable tail of the beaver quite naturally has been the
subject for correspondingly remarkable speculations as to its use.
That an organ shaped so much like a paddle should have suggested
such a use is plain; likewise that an organ shaped so much like a
trowel should be thought actually to have such a use is understand-
able; and the thought that an organ so appropriately flattened and
conveniently swung from the body should have the functions of a
trailer, a travois, or a barge assigned to it is even quite ingenious
and romantic. But, sad to relate, so far as any strictly established
facts go, we shall be obliged to consider its use to be merely the
prosaic one of a steering organ or rudder, though doubtless serving
at times even as a scull or accessory propeller. These are probably
its primary and most important functions; but when the animal is
standing erect on its hind legs, as in the act of gnawing off a tree,
it serves as a support, like the third leg of a tripod. Its use as a
water-slapping signalling organ is doubtless of less importance than
either of the other two in the daily humdrum of beaver life, though
it may be argued that the far-reaching warning signals sent forth
by its means may have, or have had, considerable significance in the
preservation of the species from its enemies. However that may be,
its use as a steering organ is unquestioned by any one who has seen
the beaver in action, and although it might be thought that its effec-
tiveness as a rudder would have been greater had it been flattened
laterally instead of dorso-ventrally, yet as a matter of fact the tail of
the beaver can be tilted on edge to a degree sufficient for all purposes
it is designed to serve. The need for a broad powerful rudder by an
animal of such tug-boat habits as the beaver is plain enough.

The popular notion that the tail is used as a trowel doubtless
arises from the fact that the freshly added mud on beaver lodges
and dams often has a smooth, patted-down appearance; but this is
due to the dragging of the tail or of the body and the treading of
the feet rather than to any trowel-like manipulation of the tail in an
effort at plastering. Were it otherwise we should frequently find
clearly marked impressions of the beaver’s scale-covered tail on the
soft doughy mud which often covers considerable areas on the
lodges. But the habit of the beaver of slapping with its tail occa-
sionally, especially when alarmed, has possibly, as remarked by
Samuel Hearne (see Morgan, p. 311), given rise to the popular
fallacy.

The size of the tail is considerable. In a large male specimen of
Adirondack beaver which I took in 1925, the scaly paddle-like por-
tion measured 10½ inches in length, and 5¾ inches across its widest
part. It had a gash on each side, representing old wounds which
may have been caused by the teeth of a rival.

The fore feet are small, unwebbed, and weak-looking as compared
with the hind feet; but they are provided with strong claws for
digging—the longest about three-quarters of an inch in length—and
have hand-like functions similar to those of muskrats, mice, and
other rodents generally. They are not employed in swimming, but
are then held close to the sides in a way to offer least resistance
to the water. On the hind foot the long toes are all joined by a
broad web extending to the base of the claws. The foot is thus
actually a very efficient paddle, propelled by powerful leg muscles.
The longest claws are about as long as or longer than the longest
claw of the fore foot, broader, and more bluntly rounded at the tips,
generally from wear. On the first and second toes, however, the
claw are usually sharp-edged and unworn, due perhaps to the fact
that because of their position they are not easily subject to abrasion.
The second claw is peculiar in that it possesses a somewhat flattened,
horny lobe extending from its base on its ventral side, forming thus
the so-called “split nail.” This lobe apparently is somewhat variable
in development, for in some specimens a similar structure, though
not so well developed, is present on the first hind toe, also; the difference seems to be mainly the degree of cornification. Just what the function of this structure may be is a matter about which there has been more or less speculation. By some writers it is believed to serve as a comb for removing parasites from the fur; a sort of delousing instrument as it were; others have suggested that it is used in removing splinters from between the teeth, which seems to me very doubtful. Bailey ('23), from observations on young beavers in captivity, says that the nail of this toe "clamps down over a long soft lobe, opening and closing like a duck's bill," and supports the view of its comb function.

In point of size the beaver is the largest North American rodent. Large adult specimens have been found to weigh as much as 50 to 60 pounds, and Benson ('24, p. 290) states that the largest beaver which he raised in captivity "weighed eighty-three pounds at two years of age." This must, however, be considered an exception, due doubtless to heavy feeding and the inactivity of confinement. Records given by Seton ('09, pp. 447-448) vary from 30 to 68 pounds for what evidently were adult specimens, and Bailey ('22, p. 4) gives 50 pounds as the weight of "A fair sized, probably 3-year-old, female beaver, caught near Ashland, Wisconsin," which had a total length of 42.5 inches. "Yearling beavers," according to Bailey, "weigh apparently 25 to 30 pounds; two-year-olds about 40 to 45 pounds; and three-year olds probably 50 pounds. Old and large beavers reach a weight of 60 to 70 pounds, and there are records of old and very fat beavers weighing from 100 to 110 pounds." The average weight of adults therefore probably is not over 45 to 50 pounds. Anyone who has attempted to carry a full-grown beaver will doubtless place the weight at a higher figure, but the beaver in the flesh is a rather difficult thing on which to get a good grip, and its weight is accordingly easily exaggerated. Nevertheless the beaver is really a formidable animal in size and strength, and were it not for its clumsiness on land it would have need to fear but few enemies in its native haunts. However, the adaptations of the beaver are especially suited for movement in the water, its short legs and heavy body forming but a poor combination either for agility or grace on dry land; and no one seems more alive to this fact than the beaver itself, for it seldom ventures any great distance away from the protection of its favorite element.

Viewing the beaver in the light of its fitness to its environment, we may, therefore, speak of it as a land animal that has become especially adapted to locomotion in water. In this element it is
really at ease. Here it carries on many of its activities, and here it seeks refuge at the first sign of danger. On land it is slow, awkward and lumbering, with no means of defense except its chisel-like teeth, claws, and powerful jaws. Though lacking neither strength nor weight it is built for the pursuits of industry and peace rather than of bloodshed and strife, and nimbleness for the beaver has little virtue.

**Breeding Habits.**—Relatively little information of an exact nature is available regarding the breeding habits of the beaver. The reason for this is the same as in the case of so many other wild mammals, namely, that those in best position to obtain the desired information are usually not specially interested, or, if they have the information, it never reaches the printed state. The trapper, for example, has numerous opportunities to secure valuable facts in regard to the life histories of many animals which he traps, but he rarely takes time for systematic observation and still more rarely makes written records, so that much that he sees is destined soon to fade away in his memory until details become indistinct and little remains except more or less indefinite impressions. Then, too, certain observations, as for instance, those on early stages of pregnant uteri, are of such nature that they presuppose some slight knowledge of anatomy, if they are to have the stamp of reliability.

As to breeding habits, so far as the beaver in its natural environment is concerned, it is uncertain in the present state of knowledge whether the animal is to be rated as a monogamist or a polygamist. Seton ('09, p. 471) without qualification says that "The Beaver is a strict monogamist," and that the union is "for life." Bailey ('22, p. 9) on the other hand says that "Like all rodents, beavers are polygamous, and the fact that fights among males take place indicates that the older ones strive for supremacy." This conclusion, since no other evidence is cited, apparently rests only upon the evidence of analogy with other rodents. Morgan ('68, p. 30) states: "They pair, and with their offspring live in the family relations until the latter attain maturity, when they are forced to leave the parental lodge. . . . Each family has its own lodge and burrows, and its separate stock of winter provisions; and there is no authentic evidence of action among several families, either in building or repairing dams. If such instances have occurred they must be exceptional."

In view of this conflicting testimony, unsupported by any evidence of conclusive character, the question is one of those that must
be left to the future for a final answer. Certain circumstantial evidence would point to a monogamous state—such, for example, as the family group of male, female, and young (of one or two seasons) often reported as inhabiting the same lodge. Furthermore, it would seem that if the beaver were polygamous the numbers of beaver in many localities should multiply much more rapidly than seems to be the case. Bailey (l. c., p. 9) reports finding “in a large house in August, 2 females, 1 male, and 6 good-sized young”, but does not state what evidence he may have found, if any, that there had not been a second male, or that the young represented the offspring of both females and not of one only. It is not entirely improbable that the beaver may be monogamous as a general rule, but occasionally bigamous and even polygamous. Where trapping occurs, for example, it is possible that, should a great many more males be taken than females, polygamy may be more prevalent than monogamy; but if, as Bailey states, “the sexes are about evenly divided in numbers”, then it would hardly seem probable that polygamy is unusual among the beaver.

The mating period for Adirondack beaver is probably February and early March, the young being born in May or early June. The gestation period is said by Morgan (l. c., p. 31) to be “from three to four months”, by Seton (‘09, p. 471), about three months, while Dugmore (‘14) gives it as “fourteen weeks.” Only under conditions of control in captivity of course can the period be determined with any degree of accuracy.

Regarding the size of the litter the best evidence seems to be that of Hearne (“Northern Journey,” p. 241) quoted by Morgan (‘68, p. 31): “The Indians, killing them [the beaver] in all stages of gestation, have abundant opportunities of ascertaining the usual number of offspring. I have seen some hundreds of them killed at the seasons favorable for these observations, and never could discover more than six young in one female, and that only in two instances; for the usual number, as I have before observed, is from two to five.” Further circumstantial evidence of the number of young in a litter is found in the fact that the female beaver normally has only four nipples. More than four young at a birth is therefore to be considered exceptional, although sometimes reported on apparently good authority. Morgan, for example, mentions a William Bass who had found “eight young beavers in a foetal state in one female, and eight young beavers born alive in a single lodge.” The same man “had also found six young ones a number of times, and all numbers below this down to a single beaver.” For the
Adirondacks, Mr. W. E. Sanderson informs me that he had opened a female which contained four fetuses. He also had the report of one trapper who had taken a female with six, and of another who had taken one with but a single fetus; but as an illustration of the fallibility of data sometimes received from such sources it may be mentioned that the fetuses counted by Mr. Sanderson in the female opened by him, were miscounted by the trapper who explained that the placenta represented a second litter of young which would develop later!

So far as available evidence goes it is doubtless true for the beaver as for many other multiparous mammals, that in the case of young females and of those beyond their prime, the litters are usually smaller than are those of females in the prime of life. The first litter of a young female may number but one or two, whereas the following litters may number four or more. Some evidence on the litter size of beaver in captivity is furnished by John T. Benson ('24, p. 290) who writes that one of two female beaver kept by him "gave birth to but three young ones each year, with the exception of the first year, when she had but two." Unfortunately no data for the other female are given.

The age at which the beaver begins to breed is not definitely known, but there is some reason to believe that as a usual thing they do not mate until two years old, although occasionally there are individuals that breed when a year old. Bailey ('22, p. 9), for example, remarks that "Beavers apparently begin breeding when one year old, as one or two embryos are often found in females of 25 or 30 pounds, but some may not breed the first year." Seton ('09, p. 472) states that "At two years they are old enough to mate, but are not fully grown till 2½ years old." From my own experience I am inclined to believe that only the earliest born young, if any, are likely to breed the next following spring—that is, when a year old. I have taken young beaver in the latter part of August, and have seen others taken at about the same time of year, which I rather doubt would be sexually mature by the following March. In the Northern States where the waters do not open up until late in spring most yearling females which had mated would of necessity be living in parental lodges, and one would be obliged to assume that their litters would be brought forth in these same lodges. Therefore, even if only a fair percentage of such yearling females actually breed, we should find many lodges in which there were both children and grandchildren, parents and grandparents living together at the same time. If such conditions exist the sociability of the beaver
Fig. 113.—The long dam on Big Brook, Long Lake region: 1924.
must indeed come up to all that sometimes is popularly claimed for it. Lacking, however, the necessary evidence it seems more reasonable to think that the young beaver, as a rule, do not mate until they are about two years old. With the arrival of their new sisters and brothers in the parental home the yearlings will be obliged to shift for themselves, and during the course of their second summer they are probably the builders of many of the new lodges and bank dens that make their appearance. Some "board out," possibly, until their presence in the old home may again be tolerated, and the enlarged family may then pass the coming winter in the same lodge. But, ordinarily, probably, the habitations established by the yearlings in their second summer become the birthplaces of their own first litters when the following season rolls around.

Regarding the number of litters in a season, this is one point on which little uncertainty exists. An animal of such large size and slow growth can hardly have more than one litter in a season, though exceptions may possibly occur even here. Young of relatively small size may be met with late in summer, but these are more probably to be looked upon as late born and not as second litters.

The young beaver at birth is fully furred, though lacking the long overhairs that appear later, and its eyes are said (Seton, l. c., p. 471) to be open "from the first." Morgan ('68, p. 134) speaks of a young "domesticated" beaver three weeks old sustaining itself on bark; and (p. 222) remarks that "at six weeks of age it will wear itself." By this time, probably, they will have already ventured outside the lodge with the mother. In the latter part of July, in Minnesota, I once captured a young beaver about the size of an adult muskrat, which I found among the bushes in the vicinity of the lodge. By August, or before, many, probably, have begun to take part in some of the activities of beaver life, such as gnawing off small saplings and young shoots of food trees, repairing dams, etc., for the instinct to work manifests itself very early in the beaver. Thus, in Bennett's article on the Beaver, quoted by Morgan (l. c., pp. 327–328), is the account by "Mr. Brodie" of a beaver in captivity, "very young, being small and woolly", in which "The building instinct showed itself immediately it was let out of its cage and materials were placed in its way; and this before it had been a week in its new quarters. Its strength, even before it was half grown, was great. It would drag along a large sweeping-brush, or a warming-pan, grasping the handle with its teeth so that the load came over its shoulder, and advancing in an
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oblique direction till it arrived at the point where it wished to place it."

The question as to what part the male parent takes in the care of the young beaver is sometimes raised. It is commonly supposed that the male remains away while the young are small (e. g., Seton, '09, p. 472; Bailey, '22, p. 9). "Naturally his duties are small," says Seton, "since he is not called on to nurse, feed, lead or defend the young, but some fathers are considered models when they refrain from doing bodily harm to their offspring, and are especially admired if they keep away altogether while the young are helpless in the nest." Bailey states that "The father apparently remains away while the young are small. . . ." The direct evidence for the view that the male remains away is the fact that males are frequently found living by themselves at some distance from the lodges. This I have personally often verified. In addition, I have also found younger beaver, evidently yearlings, living thus away from any known lodges, in the summer time. And on one occasion I took an older female beaver which showed evidence of not having bred that season (it was in July) and which apparently was living by herself a considerable distance from where any other beaver were known to be located. This specimen had lost a forefoot at some past time. All accounts agree that the male rejoins the family later in the season. Upon those who say that the beaver is polygamous will fall the responsibility of answering the question as to which of his several families the father rejoins. Or is he supposed, perhaps, to divide his time diplomatically among them all?

Age Attained.—How long may a beaver live? The answer is uncertain. Here, too, we must distinguish between the age that a beaver may possibly reach in optimum conditions, and the average life span of beaver in average conditions of environment, subject to disease, accident, or death by violence at the hands (or teeth) of its enemies. In a region like the Adirondacks where natural enemies are few and where protection from trapping had extended (until the two open seasons) over a period of twenty or more years, the chances of long life for the beaver in a state of nature had been exceptional, perhaps, and it was to be expected that a good many grizzled patriarchs of the clan might have been found when the first trapping season opened. Morgan (l. c., p. 222) speaks of the Indians as believing, "From such imperfect data as they possess," that the beaver "lives from twelve to fifteen years." These same figures have apparently been accepted and repeated by
more recent writers on the subject. But Enos Mills ('13, p. 193) refers to a beaver which he saw from time to time "Through eighteen years, and he must not have been less than four years of age when I first met him." For beaver in captivity there is the statement of Mr. John T. Benson ('24, p. 290) who "started twenty years ago with one male and two females... One female died in 1911, and the male died in 1921." Since Mr. Benson's letter is dated January 17, 1924, the female evidently died when not less than seven years old, and the male when not less than 17. The second female Mr. Benson sold to the Hamburg (Germany) Zoological Garden, in 1922, and saw the same animal there in September, 1923. This female, then, was at least 19 years of age and still living.

Senses.—Although the physiologist has long recognized a considerably greater number of senses, in the popular mind the orthodox five of hearing, seeing, smelling, tasting and feeling still constitute the full allotment not only of man but of the more familiar animals about him. The belief that animals possess these senses rests upon common observations and experiences of everyday life, for it is easy even for a child to see that animals hear, see, smell and feel, and often it is plain enough also that they enjoy a sense of taste. It is only too obvious that in acuteness the majority of these senses of animals are vastly superior to our own, and we speak easily of the "sharpness" of their noses, ears, or eyes, accordingly as their behavior impresses us. Now the beaver, too, has its fair complement of sense organs, and many a one who has put his patience and ingenuity to the test in efforts to see this romance-enshrouded creature has satisfied himself that the majority of its sense receptors are at least as efficient functionally, if not more so, as the same sense organs of many other wild mammals. Upon the sense of sight, hearing and smell, the beaver is dependent for daily, or nightly, safety and existence, so far as his natural enemies are concerned, although against his greatest enemy, man, they avail him little. Of these three, hearing and smelling play the chief part, for the beaver, it may be said, lives continually in an environment of "low visibility." His eyes are often spoken of as "short sighted", though it is not always clear just what meaning is supposed to be conveyed by that term; probably that the beaver can not see clearly objects at a little distance from him. His eyes are small, and that fact doubtless is an additional reason for the belief that his eyes see little. But just what and how well the beaver sees with his eyes
we have no better means of knowing than we have of knowing what and how well the rat sees with its eyes; or how well larger animals like the fox, the bear, or the deer see with their eyes; or, for that matter, even such remarkable creatures as the birds which are recognized as having the most efficient organs of sight among existing vertebrates. It is a fact well known to naturalists and other observers that wild animals—birds and mammals particularly—will often come very close to a person so long as he remains perfectly still; but if he moves a hand or utters a sound they take instant alarm. In other words, the form of man—usually most feared of all creatures—may be seen clearly enough, but it has no significance except when in motion. This is not evidence of defective eyesight, but of dull brain, lack of understanding and of capacity to interpret impressions that come by way of the sense of sight. And this inability to discriminate is one that many other animals—most of them in fact—share with the beaver. Even the wily fox, usually considered an "intellectual" among beasts of the field, is no exception. Thus one day while I was stealthily moving along the edge of an Adirondack pond I chanced to see a fox coming along the shore in my direction. Placing myself upright beside a slender tree in an open spot directly in his path, I stood perfectly still and awaited his coming. He actually came across the open space to within 6 paces of me before he stopped, looking directly at me, and to right and left, sniffed the air with evident suspicion, then turned and sneaked off on a detour to the right. Even then it was clear that his eyes had told him nothing; but in the still air his nose had caught and conveyed a faint message which he better understood.

On a number of occasions I have seen beaver at some little distance take sudden alarm as I came into view silently, in a canoe, in circumstances where there could hardly have been any question but that the animal acted upon a visual rather than an auditory or olfactory stimulus.

I have before (‘22) quoted Dugmore (‘14, p. 107) where he refers to young beaver as being able to see a hawk "even though it appears as a speck in the heavens", and while the remark may exaggerate the distance there is hardly any doubt that the beaver, if its view be unobstructed, may be able to see moving objects at much greater distances than is generally supposed. Moving objects against the sky above would be more easily seen, and the young beaver doubtless early learns to expect hostile "moves" from that direction.

On dark, moonless nights when I have paddled about noiselessly
in a canoe, in lakes or rivers where beaver were out in numbers, I 
have often been able to approach within a few feet of the animals 
as they swam about in the vicinity of their lodges. Yet from their 
behavior it was evident enough that they could see the silently 
gliding canoe, though no sound was audible, at least to human ears, 
and the question of smell was eliminated whenever advantage could 
be taken of soft night breezes.

But the ear and the nose are the sense receptors upon which 
the beaver most often must rely for warning against its enemies, 
and these are probably as sensitive as those of any other rodent. 
As a distance receptor the ear doubtless plays the more important 
part since it is not so dependent upon every capricious breeze, but 
so far as development and sensitivity are concerned the two are 
apparently equal. Naturally the currents of air near the ground 
or at the surface of the water are much more restricted than at a 
higher level and consequently the air as a carrier of odors can not 
be depended on by the beaver to the extent that is possible for a 
taller animal like the deer, for example, and comparison with such 
forms therefore is likely to place the beaver at a great disadvantage. 
It is thus quite possible that the beaver places its main reliance upon 
its ears for warning about the nearness of enemies, while the olfac-
tory organ finds its chief and primary function in its selection of 
food, intercommunication between the sexes and other members of 
the species, etc. As in men so doubtless in the beaver and other 
mammals, the sense of smell is closely associated with that of taste, 
both in selection and enjoyment of food. By its sense of smell the 
beaver probably distinguishes its favored food trees which it fells; 
and a bite of the bark would serve the same purpose. It is rather 
a common notion that trees about the bases of which the bark has 
been gnawed more or less by the beaver, but no further attempt at 
felling made, have been rejected as undesirable; as if the animal 
were able in some mysterious way to judge the condition of the 
higher branches and the top of the tree—the more favored parts— 
by the character of the bark at the base, which often is thick and 
dry. It is possibly quite true that standing trees like the aspen may 
in individual instances be rejected because the bark at the base is 
dry and unpalatable, but every "sampled" tree left standing can 
hardly be thus explained; nor is it safe to assume that every tree 
felled has been selected on the strength of the taste of the bark at 
its base. Numerous beaver-cut aspens can be found about every 
long established beaver pond, which represent a waste of effort 
entirely since no part of the tops has been utilized; and other
Fig. 114.—Hemlock one foot in diameter, partly severed by beaver. Loon Lake, Beaver River district; 1921.

Fig. 115.—Large poplar felled and almost wholly peeled by beaver. Jimmy Pond, Tahawus region; 1924.
species again, such as an occasional green pine, spruce, ash, etc., are cut down, sometimes with much labor, simply to be left to slow decay. The more plausible explanation of all this lies probably in the fitful responses of the beaver to various stimuli affecting it, causing it to go through the motions, so to speak, of many of its established habits; but to such things purposefulness need not necessarily be assigned.

**Voice.**—While the beaver should not, perhaps, be classed as a mute animal, vocal sounds are so rarely heard even by the more frequent visitor to its haunts that generally it may pass as voiceless. In this respect, too, it is in a class with the muskrat, for in vocal efforts these two are about equally seldom engaged, and when they are, the results are not greatly dissimilar. On a number of occasions when very stealthily approaching and listening beside a beaver lodge I have heard what might be termed murmurs or gruntings of the animals within, and these sounds would cease instantly when I made some little disturbance which caught their ears. Whether these sounds were made by young or old or by both I could not determine with certainty, but possibly by both. Mills ('13, pp. 26-27) credits the beaver with having a strange shrill whistle which he considered to be a note of alarm, suspicion, or warning. Beaver which I have trapped uttered no vocal sounds. One large male, which even made two or three attempts to charge me, simply gave vent to some rather mild explosive nasal exhalations. A young beaver (above referred to) which I caught and held captive for a little while struggled hard to break away, but uttered no vocal sounds. Godman (1831, p. 31) makes the statement that “The young beavers whine in such a manner as closely to imitate the cry of a child.” Likewise Mills (loc. cit.) remarks that a young beaver when alarmed “gives a shrill and frightened cry not unlike that of a lost human child.” Dugmore ('14, p. 169) speaks of their “animated conversation in beaver language, which sounds like a strange subdued mixture of children's voices and very young pigs squealing, varied now and then by a puppy's cry.” In northern Minnesota, in 1922, my wife and I heard a rather loud cry emanating from a beaver lodge on the opposite shore of a little bay on which our camp was situated, which might easily have been likened to a cry of a human infant. It occurred after sundown, when the beaver had begun to come out and bestir themselves about the lodge. Whether the cry came from young or adult I cannot positively say, but presumably a young one. The cry was repeated and its source in the lodge was unmistakable.
Intelligence.—It is only natural that an animal which itself is so generally unfamiliar yet the works of which are so conspicuous, interesting and widely known as those of the beaver, should be popularly credited with a very high degree of intelligence. Perhaps the size of the beaver and the fact that it is a mammal, when coupled with its remarkable activities, also serves to associate with it, in the popular mind, attributes more nearly approaching the human kind than those of the ordinary run of familiar wild things. As a matter of fact, however, there are many smaller, less conspicuous forms of life which do things that are even more wonderful to behold than are any of the works of the beaver, yet these are not looked upon generally with an equal degree of wonderment. There is, for example, the cobweb of the spider; the comb of the honey bee; the work of the harvester ant; the nest of the oriole. All these when minutely examined compel fully as much admiration as does anything performed by the beaver. Were these animals and their works as large and conspicuous as the beaver and the structures built by him, they doubtless would stimulate in the average individual an equal amount of thoughtful reflection. And surely the lowly muskrat has a fair claim to an equal intellectual rating with the beaver, for as pointed out in another place (Johnson, ’25, p. 276), the absence of dams is the only feature wherein the works of the muskrat can be said to differ in any essential respect from those of the beaver.

The brain of the beaver, like that of other rodents, is smooth and there is no reason to place the animal on a higher intellectual plane than that of the other members of its order, as for example, the house rat, the squirrel, the porcupine, or the muskrat. Each after its own kind has through a long evolutionary history inherited a certain nervous structure and with it a certain behavior, and while these in the remote past had their simpler beginnings, their complexity increased with increasing complexity of the requirements of life, until, in response to the demands of continued successful existence and adjustment to their environment, we find them at the present stage exhibiting such a highly complicated series of reactions, or instincts as we are wont to call them, that they are exceedingly difficult to analyze into their component elements. Superficially the operation of these reflexes, responses, or instincts suggests mental processes of reasoning from cause to effect as in the case of man, and we consequently interpret much that the beaver and other interesting animals do as the expression of some of the higher attributes of the human mind, whereas it is more properly to be
looked upon as the expression of well established though somewhat modifiable habits, come about through repetition of reflex actions. The young beaver needs no instruction from his parents in order that he may build lodges and dams or fell trees. These accomplishments would not become a lost art if the old generation should pass away. The young of the oriole needs no lessons in the art of nest building before starting its first nest, nor does the young spider require assistance in designing and constructing its first web. Likewise the young beaver is born a latent builder of dams and lodges and a feller of trees and needs but the proper stimulus, at the proper stage in the growth and development of its functional organization, to start the chain of events which ultimately results in the remarkable structures which we look upon with wonderment and admiration, and which, to quote from the previous bulletin (p. 175), "usually appear so well adapted to a purpose that we sometimes are tempted to believe that the animal must have been conscious of the effect of each step in the process and that the whole had been carefully planned out beforehand. But we experience much the same feeling when we consider the ways of the ants and the bees." We see in all these things illustrations of the fine adjustment and fitness of organisms to their environment.

Food Habits.—The beaver is by nature a vegetarian, and as a general statement it may be said that its food consists principally of the bark of deciduous trees. Occasionally one encounters the erroneous popular notion that the beaver eats fish, but this is usually in districts where the beaver is unknown except in name. It may be said, however, that while the beaver is by choice a vegetarian, it is not therefore to be concluded that it never touches animal food. It is true of many other rodents that they occasionally eat animal matter, when opportunity is given, and there is no reason to assume that the beaver is an invariable and unfailing exception. It is, however, not to be understood that the beaver is in any sense predatory in nature, and any animal food that it might on rare occasions indulge in would be such as it accidentally may find in its path.

It is probably invariably true that where any of the various species of aspens or cotton-woods are available the bark of these trees constitutes the first choice of the beaver as food. Whether this is due to any particular flavor of the bark to which the beaver is partial, whether the softness of the wood has any bearing on the matter, or whether there is some relation between the past geographic origin of the beaver and of the genus *Populus* are questions which may not be readily settled offhand.
Fig. 116.—A dam 7 feet 1 inch high, on southwest inlet creek of Clear Pond, Long Lake region; 1921.

Fig. 117.—The huge lodge on Cold River; longest diameter 35 feet, shortest 28 feet; height 7 feet. Long Lake region; 1921.
Fig. 118.—Island lodge on Sargent's Pond, Forked Lake region; 1921.

Fig. 119.—Beaver lodge on Thayer's Brook, Long Lake region; 1921.
In addition to the bark of deciduous trees, the beaver probably eats a great variety of green matter of other sorts, such as buds, grasses, sedges, bark of shrubs, young leaves, berries, rhizomes, roots, flags and other plants growing in or about the water. Such variety is available only in the summer months, and at that time less is eaten of bark; in winter, in its northern range, its sustenance is doubtless limited to the bark and buds of stored boughs.

In the course of the Adirondack beaver study the following species of trees and shrubs were found cut by beaver:

- American aspen
- Willow
- Large-toothed aspen
- Hemlock
- Yellow birch
- Balsam fir
- Canoe birch
- White cedar
- Red maple
- White pine
- Beech
- Spruce
- Black ash
- Mountain ash
- Pin cherry
- Mountain holly
- Alder
- Red-osier dogwood
- Red Raspberry
- Button-bush

This list, while doubtless far from complete, includes probably most of the species more commonly available to the beaver in the Adirondacks. The evergreens, that is, hemlock, spruce, pine, and cedar, are hardly to be classed as food trees of the beaver, although the bark seems to be eaten to a slight extent in certain localities at certain times; but most often such trees after they have been cut down are neglected, or some of the boughs may be severed and added to lodge or dam. These evergreens are sometimes found felled by the beaver even where the usually favored species are also at hand, and the reason for such waste of effort is sometimes a topic for popular speculation. It does not very strikingly support the cherished notion about the great sagacity of the beaver, and then refuge is found in the explanation that the animal fells such trees merely for practice or for the purpose of keeping its gnawing teeth sharp. But there are nevertheless times when the beaver actually eats more or less of the bark of conifers. Thus the writer who calls himself “El Comancho,” in the American Lumberman for February 28, 1925, pages 45–47, in reference to the beaver in the Cascade Range, remarks that “here in this high valley there are none of these trees [cotton-wood, willow, quaking aspen] except alder and this is scarcely touched, while great trees of cedar, hemlock, fir, pine and spruce are cut right and left.
“It is entirely unusual for beavers to cut this class of trees at all yet here a large colony has, for years, cut the evergreen trees and lived on the bark.” An accompanying photograph shows a group of three large cedars, perhaps 12 to 15 inches in diameter, gnawed off by the beaver “and then left unused except for a few of the smaller upper limbs, which were cut off and floated away.” Beaver-cut cedars in the Adirondacks are, so far as my observations extend, of rather unusual occurrence, but at Jimmy Pond, near Tahawus, in the summer of 1924, within a small area in the vicinity of a beaver lodge, I counted the stumps of 26 small white cedars which had been severed by the beaver. On the lodge I picked up 6 more or less completely peeled cedar sticks about 5 to 6 feet long and 1 to 2½ inches in diameter, indicating that the bark had been used. The bark had likewise been stripped from the basal parts of a number of standing cedars which were 2½ to 3 inches in diameter. In this vicinity there was no lack of more desirable food trees so that cedars had evidently not been resorted to as an emergency ration, but the bark may have been used for bedding.

Of the occasional hemlock, spruce, balsam fir, and white pine which I have seen cut by beaver there was no conclusive evidence that any of the bark had been eaten. The pines were very small, perhaps only an inch or slightly more in diameter, while the balsams, firs and spruces were in no case more than about 2½ or 3 inches in thickness; and the largest hemlock (Fig. 114) measured about 1 foot. In two localities I found some rather large black ash trees felled by beaver, the diameters running from about 8 to 15 inches. The cuttings of the mountain ash, mountain holly, red-osier dogwood, and button-bush were all what might better be called occasional instances. Next to the favorite aspen food, the yellow birch seemed to have preference over the other species of larger trees.

The primary purpose of the tree felling of the beaver is to secure food; the other purposes for which the trunk or limbs may be used after the bark has been peeled off and eaten, such as dam and lodge building, are of secondary nature. Where food trees are plentiful only the green, fresh bark of the younger boughs and of the top part of a tree is eaten, so that much waste occurs where the beaver works. The boughs and the slender top portion of a tree are usually gnawed off and dragged to the water’s edge where the bark is peeled off. Large trunks on which the bark has not been touched may be found lying where they fell; but again such trees may be stripped of their bark where they lie (Fig. 115). If a trunk is more than about 4 or 5 inches in diameter it will most likely be left where it fell, but
smaller trunks are gnawed into sections of varying lengths and these individually transported to the feeding places at the waterside, or some other retreat. Feeding places are often conspicuous by their heaps of peeled sticks, poles, etc., but most of these are eventually used as building material for the dam (Fig. 116) and the lodge. This may be looked upon as an example of economy in the use of materials as well as in the expenditure of energy.

When feeding, the beaver uses its forepaws for holding and manipulating the smaller branches, which are usually gnawed off into shorter sections. Slender sticks no bigger around than a lead pencil, and smaller, are manipulated with dexterity and the last vestige of bark removed. On a still evening in the wilds when the beaver are out foraging in force the sound produced by a family of beaver vigorously nibbling and crunching their bark together, all at the same time, may be audible at a considerable distance, especially when heard across a body of water, and produces a rather curious effect. One evening in Northeastern Minnesota, a few years ago, as my wife and I were paddling across a lake toward our camp, we became aware of a peculiar sound, the source of which was at first not certain; it seemed to come from no particular direction. The sun was just about to set and the evening was one of those wonderfully still ones when not a leaf is stirring, and the lake was like a mirror. When we first became aware of the sound we were about a hundred yards from the west shore, and as soon as it was evident that what we heard could come only from the shore, we urged our canoe noiselessly in that direction. As with our nearer approach the sound became more audible, it resembled the vigorous gnawing of some animal inside of a hollow, resonant tree trunk. But presently, as we entered the deep shadows of the shore and were scrutinizing the water line, we soon made out the dark form of a beaver sitting in the shallow water along the shore, energetically crunching away at his meal of bark and apparently oblivious to everything else about him. But it was clear immediately that this beaver was not dining alone. The same sound, we could now hear, was emanating from a number of points, and as we peered intently into the shadows another and another hunched-up form revealed itself, until, within a distance of perhaps fifty feet, we counted seven beaver, members of a family evidently, gnawing and munching their crisp evening meal in chorus. So intent were they all upon their pleasant occupation that they seemed entirely unaware of the silent object that floated on the glossy surface only a few yards away. But, our curiosity satisfied, silence was no longer necessary. A
word was spoken as the canoe glided quickly forward; the crunching ceased on the instant and deep silence reigned for what seemed minutes. Then a tremendous slap broke the stillness, and the glossy lake surface a hundred feet out was shattered as a spray of water shot into the air.

Storage.—In its northern range where the streams and lakes freeze over in winter, the beaver is then denied the privilege of foraging abroad and is limited to such food supply as it has laid by for its winter use. Here is where the storage habit of the beaver further demonstrates the fitness of the animal to its environment. If it were a winter sleeper the problem of winter food would be a simpler one, but being "up and about" all through that season its larder must be filled before the waters are frozen over.

The winter food supply of the beaver consists of piles of green boughs which are stored in the water in the vicinity of the lodge or bank burrow. In the winter time the beaver swims under the ice to these store heaps, gnaws off a section of a branch and returns to the lodge to feed, repeating the process until its appetite is appeased. The store piles are gathered in the latter part of the summer and in the fall, the activity of the beaver in this respect, in the Adirondacks, becoming noticeable as early as the latter part of August, but progressing more rapidly as the season advances. Since only the bark is utilized it follows that the food stores for a family of beaver must be quite considerable quantitatively in order to tide them over the long winter, and this involves much labor in cutting down the trees, severing and dragging the limbs or sections of trunks to their water courses, and towing them thence to their storage places. The winter larder includes the favorite species such as aspen, cotton-wood, birch, willow, etc., where these may be had, but doubtless in some localities the beaver may find a generous supply of roots of water lily and spatterdock accessible under the ice, without the labor of previously gathering and storing them; and many larger trees, when severed, fall into the water where they are allowed to lie, and can probably be reached under the ice when the waters are frozen over (Dugmore, '14, pp. 51, 63).

That the winter stores of the beaver in most ordinary situations are adequate for its needs is evident from the very considerable left-over piles that may be seen in many places. It is quite possible, however, that in some instances these remains may have early deteriorated in quality, and have for that reason been rejected.

In captivity beaver have been fed, apparently with satisfactory results, on such foods as carrots, potatoes, rutabagas, turnips, apples,
alfalfa, clover, etc., together with cuttings of various deciduous trees from which they were permitted to gnaw the bark as in a state of nature.

Lodges and Bank Dens.—The beaver, like the muskrat, may build a lodge or “house,” or it may make its den at the end of a burrow, dug by itself, in the bank. Whether it lives in one or the other depends, to a large extent at least, upon the existing conditions. In many localities the nature of the banks is such that burrows can not be dug, and the animal is forced to build a lodge for its habitation. The same beaver in another situation would probably live in a bank den. It is doubtless true, as suggested by Seton (’09, p. 460) and Dugmore (l. c., pp. 14-15), that the bank burrow in its evolutionary history antedates the lodge; and where bank conditions are suitable and the water of sufficient depth the beaver may rarely resort to lodge building.

The bank den ordinarily is but an enlargement at the inner end of a burrow of which the opposite end, or entrance, opens below the water line. The length of the burrow is variable, sometimes 40 to 50 feet long (Bailey, ’22, p. 7); but ordinarily, where the banks permit, they probably do not exceed 10 or 15 feet. The den chamber is a more or less dome-shaped excavation about 2½ to 3 feet or more in width, and about 18 to 24 inches in height, varying more or less in size according to the requirements of the occupants. These chambers of course are usually situated above the average water level, but in some cases where the banks are low the occupants are forced to move out during flood stages. Along the Raquette River and also on Moose Creek, northwest of Loon Lake, I saw a number of bank dens which had been abandoned, and exposed by the giving way of the rather thin roof; but the walls of some of them were otherwise intact and the size and form of the den cavity had not been altered.

Bank dens, be it understood, are by no means wanting even where the beaver builds lodges. A beaver family which lives in a lodge may have several bank dens, if conditions permit, and these serve as places of retreat when the animals are frightened from their lodges. The bank retreats are often revealed where the water level in a beaver pond has fallen greatly, and the system of channels and burrows thus exposed is sometimes quite elaborate, making clear to the uninitiated why it is that beaver when driven from their lodges frequently disappear so utterly from sight, even where the pond might seem too small to conceal them effectively. Such bank burrows, according to Morgan (’68, p. 239), in the earlier days in the
Hudson Bay territory were extensively made use of by the Indians in capturing beaver in the winter months.

The lodge or “house” of the beaver is always an object of interest and because of its size and conspicuousness it is not often overlooked even by the most casual observer. Actually the beaver lodge differs but little from the muskrat “house,” except in size and in the materials of which it is constructed. The muskrat depends chiefly upon reeds, rushes, etc., while the beaver uses mainly sticks; but the reason for this probably lies in the kind of materials most conveniently at hand in the particular habitat of each, and in the character of material which each is able and accustomed by virtue of strength and habit to manage.

Writers on the beaver sometimes classify the lodges according to their situation as bank lodges and island lodges; and, according to Seton (l. c., p. 463), “when the island is a mere upturned root or hummock, we reach the final and most specialized dwelling of the beaver, the moated lodge in the pond.” Starting with the bank burrow as the primitive habitation of the beaver, the evolution of the lodge or house, may, according to Morgan (l. c., p. 165), have been somewhat as follows, to quote: “The burrows of beavers inhabiting river banks are said to be occasionally detected by a small pile of beaver cuttings found heaped up in a rounded pile, a foot or more high, at the extreme end of each burrow. . . . It is but a step from such a surface-pile of sticks to a lodge, with its chamber above ground, with its previous burrow as its entrance from the pond. A burrow accidentally broken through at the upper end, and repaired with a covering of sticks and earth would lead to a lodge above ground, and thus inaugurate a beaver lodge out of a broken burrow.” From personal observations I am able to verify the existence of such beaver habitations mentioned by Morgan where a bank den, the roof of which has given away, has been repaired with sticks and mud, and where therefore the condition presented might well be called a combination of bank den and surface lodge; in other words, an intermediate step in the evolution of the lodge. However, the habit of transporting materials doubtless first originated in connection with food gathering and storage, and that may raise the question whether the lodge may not have been evolved in some connection with the store pile, as Merriam (’86, p. 277) has suggested with regard to the muskrat house.

The sites chosen by the beaver for their lodges are rather varied. Sometimes they are open, exposed places on the bank (Fig. 117), or in a pond or lake (Figs. 118, 119); again they may be snug,
Fig. 120.—Muck-plastered beaver lodge near Sargent's Pond, Forked Lake region; 1921.

Fig. 121.—Two spiral beaver cuts on a large birch. Big Brook, Long Lake district; 1921.
Fig. 122.—Newly started dam on Meadow Brook, North Elba district; 1924.

Fig. 123.—Upstream side of a dam, exposed by draining the pond. Long Lake region; 1921.
sheltered coves or nooks, or spots concealed by dense growths of alders and other trees found in such situations. Concealment seems, however, to be a minor consideration on the part of the beaver so far as its lodge is concerned, if indeed that factor enters in at all, for concealment because of its size would generally be futile, and because of its fort-like character, quite unnecessary.

As in the case of the muskrat house, the beaver lodge, when on the bank, is at times constructed over an already existing plunge-hole which then becomes an entrance to the lodge; at other times the building of the lodge and the digging of entrances apparently go hand in hand, and the enlargement of the chamber proceeds little by little as the structure grows. Along rocky shores the impulse to build seems often to be furnished by some crevice or cavity among the rocks, which then becomes the initial chamber or a part of it. And some instances of this sort which I have seen appeared anything but ideal situations for a lodge. Where a lodge is located in a pond and is surrounded by water a few feet deep, it is probable that it rests upon some elevation where the water was shallow when the structure was started; when in a flow caused by a beaver dam, the water level probably was lower at the time the lodge was new, and additions to the lodge were made continually as the dam grew in height.

The interior of a beaver house is usually simplicity itself, consisting merely of a single, rather low-vaulted chamber which has literally been gnawed out. The walls are studded with the ends of gnawed off sticks which are not, however, permitted to project recklessly into the interior. The floor may be only a few inches above the water level, the highest and driest part serving as a bed. A number of lodge interiors which I have examined contained only a scant litter of shredded wood, but some writers (e. g., Morgan, '68, p. 143; Dugimore, '14, p. 24; Warren, '10, p. 143; Seton, '09, p. 464) speak of grass being found in their beds, while Mills ('13, p. 123) tells of some moss and leaves also being used. In some localities I have found that considerable patches of grass had been cut and removed by beaver, doubtless for bedding purposes.

Although, as elsewhere stated, the beaver lodge as a rule probably represents the home of a family group, there are quite certainly many instances where lodges as well as bank dens are inhabited by solitary individuals, and likewise some instances where more than a family group is represented. Where a pair of beaver with their young of the season and also those of the previous season (yearlings) pass the winter together, their number may be as large as 10 or 12, perhaps, and in the case of exceptionally large lodges it is possible
that, except in the breeding season, members of more than one family may at times live together. For example, some very large lodges have been described as made up of two or more closely adjoining but actually separate lodges. In such instances the walls originally separating the individual chambers gradually become gnawed through, so that the whole may give the appearance of a single large structure with a number of communicating rooms. I have seen one instance in the Adirondacks where, to judge from the outside appearance, a large “house” was made up of three closely adjoining lodges, representing possibly successive abodes of the same family.

Where beaver are undisturbed and the food supply holds out, they may continue to occupy the same house for several years. Since the animals keep adding materials to the lodge each year through the summer and autumn months, such a lodge gradually increases in size and in a few seasons may become a relatively huge affair. It is not certain that the interior is enlarged proportionately—probably not—but some excavating work doubtless goes on, as a result of the sagging of the roof if for no other reason, and in time, or in order to meet the space requirements of the occupants, the chamber may become very much larger than it was originally. Morgan (1, c., pp. 141–143), who measured the chamber of a beaver lodge that was 22 feet 6 inches, and 16 feet 4 inches, in its long and short outside diameters, respectively, found it 7 feet 8 inches in length and 7 feet wide, but its vertical height only 1 foot 4 inches. Bailey (26, Pl. 9) presents a photograph of a Wisconsin beaver lodge which “was said to be 14 feet high and 40 feet wide.” In north-eastern Minnesota a certain beaver house which I noted first in 1914, when it was a rather small structure, was still occupied when I revisited it in 1920 and had then grown into a huge affair which bore no resemblance to the original. In the Adirondacks I found several lodges that must be considered very large. Of the two largest, which I measured, one was 32 feet in its longest diameter, 29.5 feet in the shortest, and 6 feet 7 inches high from the bottom; the other was 35 feet in its longest diameter, 28 feet in the shortest, and 7 feet high (Fig. 117). Such structures are really impressive evidence of activity of dumb animals, and worth going out of one’s way to see. Unfortunately, when the occupants are trapped or they desert these habitations and the work of constant repair and addition ceases, the whole soon settles into an uninteresting heap of blanched sticks, more or less overgrown with rank weeds and grass which find lodgement in its mudpatched walls. However, its usefulness even then
probably does not always cease, for doubtless it is a welcome rent-free castle to many a smaller tenant, such as muskrat, mouse, or mink—any one of which may be abundantly satisfied with nothing but a cavity in the wall—or to the larger otter which may appropriate the whole interior to itself and family.

Most beaver houses, at least in the northern range of the animal, receive a “plastering” of mud or muck where such materials are available. Evidence of such plastering may be seen on almost any occupied Adirondack beaver lodge (Fig. 120). This daubing with mud is never done with such systematic thoroughness as one is sometimes led to believe, but is rather a sporadic, haphazard performance which leaves much of the lodge bare while other parts may be over-supplied. I have never seen a beaver lodge evenly or completely plastered all over with mud, in one season. A little is added now and a little then, and in the course of a few seasons most parts of the house receive, of course, at least some mud or muck. It is generally true, as we often read, that the mud-plastering is done in the fall, as winter approaches, and that it is the last thing done to the “house” at that season. However, I have seen many a lodge which was having mud daubed on it in June, in July, and in August, just as sticks are also being added from time to time during the summer months, and the mud-daubing activity in the fall is perhaps relatively no more intensified than the stick-piling activity. Furthermore, the carrying of the mud is not always a finishing process in the building of a lodge, for in the Adirondacks I found that much fresh mud had been added to the pile of freshly cut alders that formed the foundation of a new lodge. Many lodges that I have seen have also had more or less mud mixed with sticks throughout the thickness of the wall, and others to which materials were being added had fresh mud and freshly cut sticks deposited in such a way that the two evidently were being added at the same time—but in no sense in any alternate fashion, now a little mud, then a few sticks, etc. In some cases the mud doubtless is washed off or driven down into deeper parts of the walls by rains, so that certain lodges seen in the early summer months, especially, may present little or no evidence of mud daubs on the surface (Fig. 119).

It is sometimes said that the beaver provides for ventilation in its lodge by leaving the roof thinner at the top. This is an attractive notion but it is obviously going a little too far to attribute to the beaver any conscious realization of the value of ventilation. Furthermore, the need of ventilation in the lodge probably does not exist to the extent imagined, for the walls as constructed are in themselves
sufficiently porous in many parts to admit all the air required by the occupants—even in the largest and thickest-walled lodges. It is, however, true that many beaver lodges are quite thin-roofed at the topmost part, but this fact probably can be accounted for easily by the general shape of the lodge. Many lodges take on a more or less conical shape as they grow, since the sticks and slender poles are usually dragged up lengthwise with the slope. In such lodges the narrower topmost or apical part, where poles and sticks find less secure lodgement, would require special attention if it were to be mud-plastered evenly with the rest of the lodge; but such special attention I have not seen manifested. On the other hand, many other lodges are built broader at the top—though with no conscious design on the part of the beaver—and therefore are about as thick-walled in that part of the roof as elsewhere.

Lodges which are inhabited may usually be recognized easily by the presence of little dabs of fresh mud, freshly cut boughs, or newly peeled sticks, all of which are added from time to time through the summer months. Many lodges also possess more or less well defined damp trails leading up one side or another, which the animals have worn by their repeated trips when carrying materials, or perhaps merely by frequent excursions to the top of the lodge for reconnoitering or resting purposes during their nightly activity.

Tree Felling.—The remarkable flashlight photographs of Dugmore and of Shiras have revealed much in regard to the actual manner in which the beaver works. The felling of large forest trees is really a prodigious task for an animal armed with only four chisel-like teeth, and the exact manner in which it is accomplished was not a matter of general knowledge before the beaver was artfully tricked into making his own faithful photographic records for the advancement of science. Standing erect on his hind legs and with his tail as the third member of a tripod the beaver firmly braces himself and with powerful jaw muscles drives his teeth into the wood and gouges out chips sometimes of a size to excite our surprise. The size of trees felled is often more surprising. Bailey (l. c., p. 6) mentions a beaver-cut balsam poplar in Montana that measured “46 inches across the stump.” In the Adirondacks may be found numerous aspens and birches—and also an occasional ash tree—that are more than a foot in diameter at the cut. The two largest aspens I found there severed by beaver measured 17.5 and 18.5 inches respectively. I saw no larger aspens to fell.

The amount of labor expended by the beaver in felling trees is frequently all out of proportion to the use made, or that can be
made, of the tree when it is down. Here is where one sees abundant evidence of stupidity on the part of the beaver. Only a relatively few branches at the tip may be green, the rest dead and dry. Nearby may be several living green trees of smaller size, and these are left standing. Many trees also are severed which are so surrounded by others that they cannot fall to the ground; an intelligent glance upward would have revealed that fact.

When a tree has been felled the branches are gnawed off and dragged to the feeding grounds or to the storage pile, and in the case of smaller trees the trunk also is sectioned and removed. It may require the work of a number of nights. Trunks more than four or five inches in diameter are not often sectioned and dragged away. They may be peeled where they lie or left to rot. When a trunk or large limb is sectioned the length of the individual sections sometimes is remarkably uniform; again, it may vary considerably. Any relation that may exist between length of a section and its thickness is probably a very rough one, determined by the ability of the animal to drag it—a trial and error method. Much labor here, too, is wasted.

The direction in which a beaver-cut tree falls is determined by the direction in which the tree previously leaned, by the wind, by the form and weight distribution of the tree, or by the accident of shape and location of the cut made by the beaver. The majority of trees bordering water courses lean more or less toward the water. Numerous examples may generally be found in any beaver country which abundantly disprove the still lingering popular notion that the beaver can fell a tree in any desired direction.

When severing a larger tree the beaver usually gnaws completely around the trunk so that the cut has an hour-glass shape. Smaller trees are often gnawed from one side only; and the same is true sometimes for trees as much as 10 to 12 inches in diameter (Fig. 114). Other trees may be severed in a less workmanlike manner. Accessibility determines the method. Some trees are so nicely balanced that they do not fall until almost completely severed; most yield sooner. Occasionally one sees a tree that has a spiral cut, like a corkscrew. A few such trees which I have seen stood on the edge of an elevation so that the beaver moved from higher to lower ground, or reversely, as it gnawed around the trunk. Figure 121 shows a birch 3 feet 7 inches in circumference, with two spiral cuts. The upper cut was doubtless made when there was a layer of crusted snow on the ground, for it is too high up even for an adult beaver to reach in any other probable manner.
Most cuttings are made within easy reach of the water, but there are times and places when the desired tree species can be had only at greater distances. At various places in the Long Lake district I found the stumps of freshly cut aspens that were from 200 to a maximum of 300 feet from the nearest water, as measured by pacing. Doubtless greater distances occur, but the necessity for longer foraging expeditions exists probably in but few places in the Adirondacks.

Details with regard to the exact manner in which a beaver plies his tools when felling a tree have been given by Morgan ('68, pp. 176-177), and many cuttings which I have personally examined confirm his description: "It is made evident by running the inferior incisive teeth in a beaver's skull over these several cuts, that the upper incisors are used for holding, while the cutting is done by the inferior; and more than this, that but a single tooth is used at a time, the other following in the space made by the previous bite." Occasionally, however, both lower teeth cut at the same time, as may be distinctly seen, especially at one end of some chips. In this case the chip or shaving planed off has the width of two teeth and its two parts are not split asunder, but are separated merely by a shallow longitudinal groove on the inner or concave surface; the outer or convex surface as presented when both teeth have passed shows a slight longitudinal ridge between the tooth marks. Another point in regard to the chips, which may be mentioned, is the difference in appearance of the cut surface at their two ends. In numerous larger as well as smaller freshly cut aspen chips which I have examined the tooth marks at one end were smooth, but at the opposite end rough, as if made with a much blunter tool. The explanation for this is probably simple: the end bearing the smooth cuts is the starting point. The wood here is solid, before each bite is taken, and the tooth consequently makes a clean smooth passage. As the cutting proceeds toward the middle of the length of the chip, and beyond, the tooth (one or both) pries and splits—as well as cuts—out the chip which accordingly yields before the tooth as it is now being severed at its attached end, and thereby is produced a more ragged cut.

The time required by a beaver to sever a trunk of a given thickness is uncertain since there is a lack of actual observations. Much depends, of course, upon the kind of tree. An ash tree or a birch would require much more time than an aspen or a cotton-wood. Beavers are intermittent workers, as evidenced by the abundance of partly severed trees, large and small, that may be seen in most beaver localities. Morgan (I. c., p. 220) estimated that three beavers
Fig. 124.—Small dam containing many stones. Outlet of Trout Pond, Beaver River district; 1921.

Fig. 125.—Beaver canal; exposed bottom the result of lowered water level in pond. Clear Pond, Cranberry Lake region; 1924.
could fell a 12-inch tree in two nights. Seton ('09, p. 465) says: "Two beavers can cut down a three-inch sapling in three minutes and a six-inch tree in an hour or two." The number of chips cut out of a tree in felling it gives us another kind of measure of the beaver's skill, in much the same way as it does for the axman. In the Cranberry Lake region I chanced upon a number of freshly cut aspens (*P. grandidentata*), evidently the work of an adult beaver with a perfect set of incisors. The trees had been completely severed and the chips, comparatively large and few, were all lying undisturbed at the base. I counted all chips an inch or more in length; smaller fragments were so few that they were disregarded. The following gives the diameter of the stumps at the lower edge of the cut, and the number of chips over one inch in length beside each:

<table>
<thead>
<tr>
<th>Size of tree</th>
<th>Number of chips</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 5/16 inches</td>
<td>29</td>
</tr>
<tr>
<td>2 11/16 inches</td>
<td>25</td>
</tr>
<tr>
<td>3 1/16 inches</td>
<td>33</td>
</tr>
<tr>
<td>3 5/16 inches</td>
<td>56</td>
</tr>
<tr>
<td>5 5/16 inches</td>
<td>140</td>
</tr>
</tbody>
</table>

As to the number of beaver that may take part in gnawing at the same tree at the same time little is known. Morgan (l. c., p. 220) states that three beaver have been seen gnawing at the same tree, and remarks that there would hardly be room for more. Mr. W. H. Dunham, of Piseco, informed me that he had once watched two beaver at work on a tree. They gnawed by turns. There is no reason to suppose that there are any fixed rules in this matter. Many large trees are probably severed only after much intermittent gnawing by the same individual or by a number of individuals working at different times. Many cuts are started but never finished. The beaver belongs to no union and does not work by the clock. In his tree felling he is rather desultory during the early summer when much other succulent food is available, but he assumes business-like efficiency in the fall when the impulse to prepare for winter is upon him.

The primary purpose of the beaver in felling trees is to secure food. After the bark has been gnawed off and eaten the peeled sticks and poles are usually added to dam or lodge, if such exist, but these uses are to be interpreted as secondary. Many freshly cut unpeeled boughs also may be added to the dam or lodge. This, according to my own observations, is true especially when a new dam (Fig. 122) or lodge is started and where other material is not within easy reach. As the building operations progress the animals
by their prolonged stay in the locality cut considerable quantities of boughs and saplings for food purposes, and the resulting peeled sticks and poles furnish convenient building material.

**Dams.**—The dam is generally the most conspicuous and impressive of the beaver’s works. The total amount of labor involved is often prodigious. The size may vary from one only a few inches in length and height, damming a tiny trickle, to vast structures several feet in height and hundreds—even thousands—of feet in length. The solidity of a beaver dam may be such that a man or a horse can cross upon it without danger of its giving way or being seriously damaged. The durability of the dam depends, however, upon constant repair, for by the very nature of its material it is open at every point of its entire length to the disintegrating influence of water. Not that the dam frequently bursts throughout any considerable part of its length and goes out suddenly; but the filling gives way here and there, the openings once started grow rapidly larger, and in a few days a great fall in water level appears in the pond above. Sometimes, however, a considerable part of a dam may give way of a sudden, and the water goes out with the rush of a miniature Johnstown flood. I once saw an instance of such a thing in Northeastern Minnesota, where the whole middle section of a good-sized beaver dam had suddenly given way, and the rushing water left a swath of bent and muck-festooned bushes and saplings which gave ample evidence of its volume and force.

The dam serves the beaver in a number of important ways. It produces a pond of such depth that the water does not freeze to the bottom in winter, a very important matter in the northern parts of its range. Since the lodge in such cases is situated in the pond or on its banks, the beaver secures liberty of movement under the ice, and entrance and exit from its lodge are safeguarded. The deep water provides also accessible storage places for his winter food supply. Throughout the season of open water the pond offers a safe retreat from natural enemies; and, what is more important, good transportation facilities for food and building materials. It is probably quite safe to say that water transportation has been practiced by the beaver fully as long as by man himself; and for the beaver, as for man, the method is economical. The laborious task of dragging its cuttings overland is not of course entirely avoided by the formation of ponds, but it is often very much reduced.

Dam building by the beaver is usually confined to smaller and shallower streams. Where a stream is more than about two and a
half or three feet deep at low water stages, it is not usually dammed; but deeper streams may of course be dammed in their shallower places such as where rapids or shoals occur. The strength of the current is also a factor, and except at shallow places or where rocks or other objects are present to lend support for its materials, the beaver can not lay a dam across a swift-flowing stream. The width alone of a stream is no deterrent, generally speaking. The most favored streams seem to be such as have a permanent flow, and are shallow and of slow current.

The sites chosen by the beaver for their dams often seem to be the best available; but the popular notion that the animal goes about the selection with thought and foresight after the manner of an irrigation engineer is absurd. Almost any dam, after it has been built up into a substantial structure, appears well situated; but at the time the first sticks were laid much criticism might have been levelled at the judgment displayed by the beaver.

The first steps in the building of a beaver dam are simple and can easily be traced by anyone sufficiently interested, in the many newly started dams met with in various parts of the Adirondacks, and especially in the latter part of the summer when the animals increase their activity. The first materials laid in place may be green boughs or dead sticks (Fig. 122), but mud and even stones may be added also. The dead sticks found along the water courses are often water-logged, and the green boughs require but a relatively short time in the water to become so. The difficulty of keeping the materials in place is consequently not great. Natural obstructions, shallow water, or feeble current generally prevent the materials from being carried away at first, and with every addition the mass becomes heavier. I have, however, seen many instances where more or less material has been carried down stream before the mass became sufficiently resistant. Boughs are generally found with the butt end upstream, but numerous examples occur where they lie across the current, diagonally, and in every intermediate position. Often the particular position of a stick has been brought about by action of the current; often also it represents the position in which the beaver placed it. The method of least resistance for the beaver is to drag the boughs butt foremost. As the dam increases in height poles and sticks are probably dragged in mostly over its top, from the pond above, and thus come to lie in compact parallel arrangement, at right angles to the long axis of the dam, and on its lower face. Mud, muck, fibrous rootlets, and other débris is brought up from the bottom and added to the dam as the building progresses. The
Fig. 126.—Part of a beaver "tote road" leading to a pond. South Meadow Brook, North Elba district; 1924.

Fig. 127.—Channel cut by beaver through crest of high bank of Cold River, Long Lake district; 1921.
upstream side is filled in with mud and other materials deposited there by the animals themselves, but a good deal of such material is also supplied on the spot, without transportation cost to the beaver, for the crest of the dam serves as a catch-all for rubbish of all sorts floating downstream. Another important factor in filling up the interspaces in the dam is the settling of water-transported sediment, the upstream face in consequence becoming a relatively smooth, mud-infiltrated, sloping wall (Fig. 123). The tenacity of such a structure is perhaps sufficiently obvious although appreciated only by those who have undertaken the task of tearing one open.

In shape, beaver dams may vary greatly, depending upon a number of factors such as position of trees, boulders, or other natural obstructions which may either be avoided or, on the contrary, may be utilized as supports for the dam; on the action of the current which in some places tends to displace the materials during the building process; on the conformation of the stream bed, and of the banks where the water overflows as the wings of the dam are extended; and doubtless on other factors attributable to impulses and vagaries of the animals themselves. The popular notion that the dams are built with a curve upstream so as to offer greater resistance to the water, has little to support it beyond the law of chance. The downstream curve may be seen with equal frequency and often to a reckless degree; and zig-zag shapes are common.

The length of the dam is also highly variable. A stream in a narrow valley with steep sides is no place to look for a long beaver dam, but it may furnish a record for a high one. The longest dams are likely to occur where the valley is broad and the banks of the stream very low. In such a place, as soon as the channel is obstructed by a dam, the water begins to overflow at the sides. The beaver then extend the two ends of the dam, and as the water continues to spread, the efforts of the animals to impound it keep pace, so that the dam may eventually, if the valley be broad enough, measure hundreds of feet in length. Dams of such length are not the work of one season but rather of many; and some old dams may represent the labor of a number of successive generations of beaver. Mills ('13, p. 79) mentions a Montana beaver dam that was 2140 feet long.

In the Adirondacks, prior to the opening of the season on the beaver in 1924, I met with a number of dams of notable length and height. The longest dam seen was about 375 feet, measured along the crest by pacing; but its height was not more than about 3 feet at the channel. This dam was in fresh repair. Dams from 100 to 200 feet long were more frequent. The long dams are not, how-
ever, particularly impressive to the viewer unless they are free from overgrowing and concealing vegetation and are so situated that a commanding view is offered of their entire length. For that reason dams of only moderate length but so situated as to be conspicuous frequently offer a more interesting sight. An example of this kind of dam is shown in Fig. 113, as seen in the summer of 1925, on Big Brook, in the Long Lake region.

But height rather than length is what makes a beaver dam loom large. However, dams more than five or six feet at the highest are in most beaver localities the exception rather than the rule, and the highest parts are even then most often limited to short sections of the structure, usually at the channels of the streams which they span. Mills states with regard to the long Montana dam mentioned above, that two short sections of it were 14 feet high—an extreme example—but in greater part it was less than 6 feet. During the survey of 1921 I encountered four Adirondack beaver dams which in point of height are entitled to special mention. So far as I have been able to learn they were probably the highest dams built by beaver in the Adirondacks since the re-establishment of the species twenty years ago. One of these (Fig. 92) was situated on the outlet stream of Lower Gull Lake, in the Big Moose Lake region. This dam measured 146 feet in length along the crest and was built slightly curved. At its middle section it measured 8 feet 8 inches from its crest to the bottom of the shallow stream. The second one (Fig. 109) was found on McCann’s Brook in the Blue Mountain Lake region. This was really a more formidable structure than the preceding, but not so impressive to the eye because the highest portion spanned a deeper and broader stream. This dam was about 150 feet long and measured a little more than 11 feet 1 inch from its crest to the bottom of the creek. The stream was a trifle more than 4 feet 1 inch in depth so that a wall 7 feet high was exposed above water at the middle section. The first of these two dams was not easily accessible and was apparently unknown even to local residents. The second was about three miles distant from the highway and relatively easy to reach. Both could be classed as interesting things in nature which many a tourist would have gone out of his or her way to see.

The other two dams were smaller. One (Fig. 116) was situated on the southwestern inlet of Clear Lake (Lake Eaton, on some maps), Long Lake region, and was 110½ feet long, and 7 feet 1 inch high at the channel; the other (Fig. 104), also in the northern Long Lake region, was about 100 feet long, and 8 feet high as
measured from the bottom at the channel, but because of a blockade of the channel below this dam the distance between water levels was only about 3 feet 4 inches.

The usual materials found in beaver dams have already been mentioned. Occasionally one sees other materials such as stones on the dams and wonders how they got there. The beaver evidently carries stones in the same way that it carries mud. Just what purpose the stones serve is sometimes difficult to see, but it is probable that a stone in a proper situation may evoke the transportation and building impulse in the same way that a stick does. On a few occasions I have also seen stones, the weight of which I estimated to be from 5 to 7 pounds, on the top of good-sized beaver lodges. In some instances beaver have used stones in the construction of dams apparently because of absence of other suitable materials. Thus Mills (’13, p. 65) mentions dams which were constructed of cobblestones and clay, in “localities almost desti-
tute of trees,” and in the Bad Lands of Dakota he “saw two dams made of chunks of coal.” But stones are sometimes used even where the usual materials are easily available in quantity. In Newfoundland, for example, Dugmore (’14, p. 35) found dams constructed largely of stones, and Figure 124 shows a similar dam which I happened upon in the Adirondacks. Dugmore gives the weight of the stones in the Newfoundland dams as no more than “three to four pounds,” and, with possibly a few exceptions where the weight was greater, the same holds true for the Adirondack stone dam mentioned. But Mills (l. c., p. 9) makes the statement, though without giving the nature of the evidence, that “Three or four [beavers] have rolled a one-hundred-and-twenty-pound boulder into place in the dam.”

Canals.—The canal work of the beaver is by some writers, e. g., Dugmore (l. c., p. 66), considered better evidence of intelligence than any of its other works. “Of all the work done by beaver,” says this writer, “nothing can compare for cleverness with the canals they construct. These canals, I venture to say, are a demonstra-
tion of the highest skill to be found in the work of any animal below man.” I have elsewhere (’25) pointed out that the canals dug by the muskrat are entitled to equal consideration, so far as they may represent evidence of intelligence in the builder, but it may be questioned whether the building of a canal by a beaver or a muskrat is any more evidence of intelligence than the building of a dam or lodge by these same animals, or the construction of a web by a spider. The usefulness of each is equally
apparent, but the idea of this usefulness, one may safely say, was equally absent from the "minds" of the builders. The beaver probably can no more help digging canals under the impulse of certain stimuli than the spider can help building its web. The beaver canal can therefore hardly be looked upon as any better evidence of intelligence than that of the dam or the lodge; but different stimuli are at work.

Beaver canals are, so far as my own observations extend, not frequently met with in the Adirondacks at the present time. The reason for this is probably the absence of those conditions which stimulate the beaver to canal digging. In most beaver-inhabited localities in the Adirondacks the watercourses are not bordered by open meadows which the animals might be reluctant to cross overland, and which—this is probably more important—would present the conditions necessary to "set off" the canal-digging impulse. Where the borders are relatively steep and high, stony, or rocky, one need not look for beaver canals. Where low surroundings are covered with trees and shrubs canals may, however (Fig. 125), be found, provided the soil is sufficiently free from roots and stones to offer suitable physical conditions, and provided further that those other factors, whatever their nature and kind, which serve as the necessary stimulus to digging, are present.

The usefulness of the canal in the life and work of the beaver is as obvious as that of the dam. It offers the animal greater range of movement by its easiest and safest means of travel, and facilitates the transportation of food and building materials from the distance.

In width beaver canals may vary from narrow trenches no more than a foot wide to capacious channels a yard or more across; in length from a few feet to a few hundred yards; and in depth from a few inches to two or three feet. Seton (‘09, p. 458) says that the longest canal he ever examined "was a very old one at Gal Pond, near Wanakena, St. Lawrence County, N. Y., August 4, 1908. It was 654 feet long, nearly 4 feet wide, and led from the pond to a grove of poplar and yellow birch. Although abandoned for fully fifty years it was very well marked and showed many Beaver cuttings." Like many large dams the long canals probably represent the work of years and are monuments to a number of generations of beaver. In many cases the surface canals are but extensions of submerged canals dug in the bottom of the pond. These bottom canals may be seen exposed in many beaver ponds which have been drained. They were dug when the dam was in its
infancy, and the water in the pond too shallow to suit the needs of
the owners; often they converge to the entrances of the lodge, and
are similar to the sunken channels about many muskrat houses.
In places where the excavated soil is of the proper consistency it
is sometimes carried and deposited on the banks of the canal, so
that the work appears as if it had been done by human agency.

At the end of the surface canal there may be a tote road, with
or without a slide. The beaver tote road as well as the canal has
its points of interest, and the two are in many instances merely
complementary parts of the same transportation system. Like the
tote road of the logger, that of the beaver is a temporary affair.
It may serve for transporting the cuttings of a single tree; or of
a considerable number, in which case it may then be in use more
or less throughout the season and becomes a broad, conspicuous
trail (Fig. 126), worn to the bare earth by the dragging of branches
and poles. In places these trails may be three to four feet wide
and upwards of two hundred or more feet long; but inland they
usually split up into branch trails which gradually fade out as the
limits of operations are approached. Frequently one finds that
obstructing bushes and smaller saplings on these tote roads have
been gnawed off and dragged away with the rest, and occasionally
fallen tree trunks or old stumps barring the path have been deeply
gashed, and projecting points gnawed off in efforts to clear a thor-
oughfare for transportation. In 1921, on the steep high bank of
Cold River, northern Long Lake region, a series of parallel tote
roads of the beaver presented an interesting appearance where trails
leading from the foraging grounds, some rods away in an aspen
thicket, were continued as deep channels cut through the crest and
into the steep side of the hundred-foot bank (Fig. 127). The
earth dislodged by their digging and their dragging of the cuttings
had collected into fan-shaped heaps at the foot of the slides, which,
when seen from the river, had the curious effect of a take-off at
the foot of a ski-jumper’s slide.

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MAP 4. MAP OF WESTERN PART OF AREA EXAMINED IN NORTHERN HERKIMER AND HAMILTON COUNTIES OF THE ADIRONDACKS, SHOWING LOCATION OF BEAVER WORKS, 1921.

- Dams personally examined.
- Old, abandoned dams.
- Dams reported by others.
- Dams torn open.
- Inhabited lodges.
- Abandoned lodges.
- Lodges reported by others.
Map 5. Areas Examined in Northern and Northeastern Hamilton County, 1921.
MAP OF THE ADIRONDACKS
SHOWING MAIN DISTRIBUTION OF BEAVER
PRIOR TO THE FIRST OPEN SEASON — MARCH 1924
BASED CHIEFLY ON OBSERVATIONS BY CHARLES E. JOHNSON
IN 1921 AND 1924.
ROOSEVELT WILD LIFE FOREST EXPERIMENT STATION
SYRACUSE, N. Y
MARCH — 1927

Map of New York state with marked areas indicating the distribution of beavers. The map includes numerous place names and geographical features.
THE ROOSEVELT WILD LIFE MEMORIAL

As a State Memorial

The State of New York is the trustee of this wild life Memorial to Theodore Roosevelt. The New York State College of Forestry at Syracuse is a State institution supported solely by State funds, and the Roosevelt Wild Life Forest Experiment Station is a part of this institution. The Trustees are State officials. A legislative mandate instructed them as follows:

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While this Memorial Station was founded by New York State, its functions are not limited solely to the State. The Trustees are further authorized to cooperate with other agencies, so that the work is by no means limited to the boundaries of the State or by State funds. Provision for this has been made by the law as follows:

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By these laws the Empire State has made provision to conduct forest wild life research upon a comprehensive basis, and on a plan as broad as that approved by Theodore Roosevelt himself.

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1. The Status of Fish Culture in Our Inland Public Waters, and the Role of Investigation in the Maintenance of Fish Resources... Dr. William C. Kendall.
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1. The Relation of Wild Life to the Public in National and State Parks...Dr. Charles C. Adams.
2. The Big Game Animals of Yellowstone National Park...Edmund Heller.
3. The Food of Trout in Yellowstone National Park... Dr. Richard A. Muttkowski.
4. Current Station Notes...The Director and Editor.


1. The Birds of the Yellowstone National Park...Milton P. Skinner.
2. Current Station Notes...The Director and Editor.


1. The Muskrat in New York: Its Natural History and Economics... Dr. Charles E. Johnson.
2. Current Station Notes...The Director and Editor.


1. The Summer Birds of Central New York Marshes...Aretas A. Saunders.
2. Additional Notes on the Summer Birds of Allegany State Park... Aretas A. Saunders.
3. Current Station Notes...The Director and Editor.


1. The Economic and Social Importance of Animals in Forestry, with Special Reference to Wild Life...Charles C. Adams.
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