THE BEAVER OF THE RIDING MOUNTAIN, MANITOBA

AN ECOLOGICAL STUDY AND COMMENTARY

By H. U. GREEN

(*Continued from page* 50)

DAMS

The dams of all beaver ponds in the Riding Mountain are identical in general character, and although I have not had the good fortune actually to witness one under construction the manner of their building affords sufficient evidence of how they are raised and what material is utilized for the purpose. The following data were gleaned from the ponds under observation, and while excavating several old beaver sites in the Vermilion River valley.

From the evidence it appears that branches of aspen-poplar and willow and what loose woody material is available are conveyed to the site of the dam and laid with the butts, or thick ends, pointing upstream. Mud, fibrous debris, and sometimes gravel and stones, obtained from the near vicinity, are carried and deposited thereon to weight the material down and bind it together. Alternate layers raise the structure to the desired height. The dams constructed by the beavers of the Riding Mountain may be called "brush" dams, because no heavy material is used to build them. In fact anything over a diameter of 2½" is an exception worthy of special note. This, of course, does not apply to drift wood brought down by the stream.

It cannot be said at what point the work begins, but it would seem that the channel of the stream first receives attention. The structure is then extended across the valley floor to the base of the slope on one or both sides, depending upon the course taken by the stream.

When the brush work is completed and the crest well plastered with mud, there is reason to believe that the dam leaks in many places and to prevent the loss of water the inside face is ramped with mud. Many of the old dams examined not only have a sloping inner face but near the wings deep trenches follow the contour. It would seem that the trenches were dug for the purpose of securing mud to build the ramp.

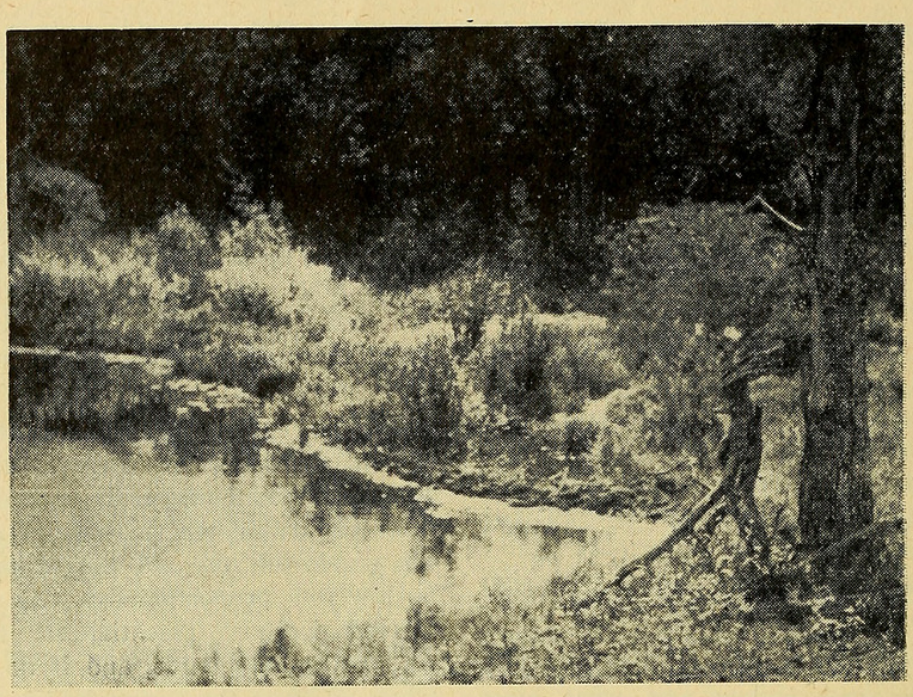
Silt, too, carried downstream by freshets, increases the bulk of the ramp, especially in the line of flow, and not only re-enforces the dam but assists materially to keep it watertight. Nevertheless a certain amount of leakage occurs from time to time about the crest when the pond is brim full and overflowing. The extreme ends, or wings, of the dam, where usually only a low mud wall exists, are always troublesome, for water constantly breaks the barrier and trickles away until the leak is noticed and the break repaired.

When a dam is well constructed and becomes reasonably watertight there is no necessity for adding other than repair material for several seasons. With the passing of time, however, the ponds silt up and the depth of the water is lowered proportionally. As previously explained depth is essential for the welfare of the beaver inhabitants, and if no measures were taken to offset the accumulation of silt the pond would ultimately become unsuitable to occupy with safety. To overcome this the dam is raised and the depth of water increased. There is, of course, a limit to the height of a dam, which explains the abandonment of several old sites that have reverted to small areas of meadow land.

With the passing of time willows, grass, and other rank vegetation take root on the crest and outer face, binding the material more strongly together. As the dam becomes old the woody substance decomposes and the structure becomes a mass of closely packed mould. In many instances it appears like a natural barrier.

The fact that the surplus water of all ponds examined, including in particular Sites Nos. 1, 2, and 3, invariably finds an outlet by way of a spillway situated where the dam crosses the channel of the stream is interesting because every dam appears to have been purposely constructed so as to form a depression thereabouts as if to direct the swiftest flow of water to where it can be most conveniently carried away. When one considers that sudden freshets naturally follow the lowest part of the valleys which, unless badly silted, are the stream beds or channels, consequently a spillway in the main line of flow prevents the possibility of the crest of the dam being washed away. This, I believe, is another instance of engineering foresight highly creditable in so small a mammal. Of course there may be some other explanation.

No dams have been encountered that are actually straight, although they follow a line of definite direction. The majority are semi-



Dam at Site No. 1. The stream in the background comes from the spillway. The stream to the right originates from a leak beside the bank.

Photograph by H. U. Green.

circular, semi-elliptical, or serpentine. The reason for deviation from straight line construction is, I think, that after selecting a dam site the beavers are influenced by the contour of the ground and take advantage of the highest elevations and avoid as much as possible any hollows or low ground that would require additional labour to fill. This contention appears to be borne out by evidence after a careful survey of almost any beaver site, old or new. Consequently all the Riding Mountain beaver dams are of greater length than a direct line from bank to bank. This, I feel quite sure, is yet another example of beaver intelligence, for to reason how an engineering project can be accomplished with a minimum of time and labor, is to think of three things at once.

The longest dam recorded measured 276 feet in length; the shortest 25.5 feet. Both were approximately 4 feet wide at the base, and 4 feet and 4.5 feet in height.

The dams at the ponds under observation measured as follows:

Site	Length	Extreme width at base (approx.)	Extreme height
No. 1	119'	4.5'	4.6'
No. 2			
Upper pond	205'	5'	3.8'
Lower pond	108'	6'	4.5'
No. 3	253'	5.5	5.4'

Apart from the main dams of the ponds under observation, and elsewhere, other small dams are built below and some distances away, creating little pools whose purpose I cannot explain. In my early notes they are referred to as "buffer" dams because it was then believed their design was to act as a buffer should the main dam suffer sufficient damage to allow a large volume of water to escape. Later investigation, however, indicated that the crests of the small dams was considerably lower than the crest of the main dams, and should the main dams break the pools created by the small dams would be capable of holding no more water than they would do under normal conditions. Had the crests been of equal height the "buffer" dam idea is tenable, at least in theory. On the other hand, if the water retained by the small dams backed up to the base of the main structures with sufficient depth, weight and volume might offer a certain amount of resistance to strengthen them in an emergency. But this does not occur, even in times of flood. The pools are fed from the overflow of the main ponds by way of the spillway of the dam and the channel of the stream across which the smaller dams are built. I would also point out that no water connection exists between the ponds and the pools other than the shallow stream of the overflow.

Island lodge Site No. 1 in mid-winter. In seasons of heavy snowfall the lodge would be entirely covered.

Photograph by H. U. Green.

The idea of a water route for the conveyance of food to the pond, gathered from the lower reaches of the valleys, was also considered as an explanation for their presence, but the lack of sufficient water between the dams at once questions the possibility of their use for this purpose. In any event there would be no object in the beavers' journeying far afield in search of food or building material when in every instance an ample supply could be harvested about the banks of the main ponds. There is, though, a possible value to the pools. They may afford havens of safety to the beavers when abroad away from the vicinity of the main ponds.

It is of interest to note that the first of the small dams (sometimes a series may be found) which I now term "supplementary" dams, are invariably built in the first narrow place or gorge below the main pond. This might suggest that the location of the main dam was governed by this consideration as well as other necessary qualifications. The thought quite naturally occurs, why is not the narrowest part of the valley where the first "supplementary" dam is constructed selected as the location for the main dam. Less work would be required, although the structure would necessarily have to be higher in order to hold back enough water to create a pond of sufficient depth. The logical answer seems to be that the height of a dam necessary to accomplish its purpose is out of the question as the volume and weight of so much water behind a short high dam would quickly carry it away, while a long dam of medium height would more equally distribute the pressure. I have dwelt at some length upon these several points because they are important factors when appraising the efficiency and technique of beaver work.

The distance between the main dam and the first "supplementary" structure seldom exceeds 200 feet. Sites Nos. 1 and 2 have only one "supplementary" dam; Site No. 3 has a series of seven, extending a distance of approximately half a mile from the pond. Except for the first dam all are short, somewhat flimsily built and easily washed away.

The "supplementary" dams of the ponds under observation measured in length as follows:

Site No. 1 37′

Site No. 2 16′

Site No. 3 15′, 7′, 9′, 5′, 6′, 4′, 3′.

The measurements are approximate.

LODGES AND DENS

Strange as it may seem Man was not the first mammal to construct for himself and his family a roofed shelter above ground level, or to appreciate the value and strength of the arch

as a principle in building construction. In each instance he was forestalled by the beaver, for while ancient members of our race were shivering within the draughty shelter of open caves the genus Castor was cozy in a self-made home.

A beaver lodge is indeed a marvel of animal craftsmanship, fashioned to shed rain and bear heavy falls of snow, solid in structure against the assault of land dwelling enemies, and comfortable within at all seasons of the year.

Lodges built by the beavers of the Riding Mountain range may be divided into two kinds:— the "bank" lodge, built on the bank beside deep water, and the "island" lodge, with water on every side. The material utilized in their construction is the same as employed to raise the dams, with the exception that heavier material is sometimes used.

Lodges vary in size depending upon their age, for as more material is added each season than is actually necessary to replace the loss by erosion, the structure in the course of time may assume almost gigantic proportions in relation to the size of the occupants. Size, therefore, is a rather good indication of age, especially when considered in connection with the appearance and height of the dam.

The largest lodge located in the Riding Mountain during the course of my studies, appeared immense. It was very old and had not been occupied by beavers for many years, although there was ample evidence that several generations of skunks had taken advantage of a ready-made home since the beavers' death or departure. Measured from the bottom of the dry pond in which it stood, the extreme height taped 10′ 9″, but originally it must have been much higher because the mass had settled considerably. The extreme diameter at the base measured approximately 19′. Time, though, has no doubt caused the base to spread making the present measurement excessive. When carefully demolished three entrance and exit tunnels were found, the largest, or main entrance, capable of permitting a lean man to gain admittance. The "room" was still very large, roughly circular in shape, with an extreme diameter of 4′ 7″. The height of the roof from the floor measured 8″. This measurement, however, offers little indication of the original height, which was probably three times as great. I estimated the material in this lodge would weight at least 2½ tons.

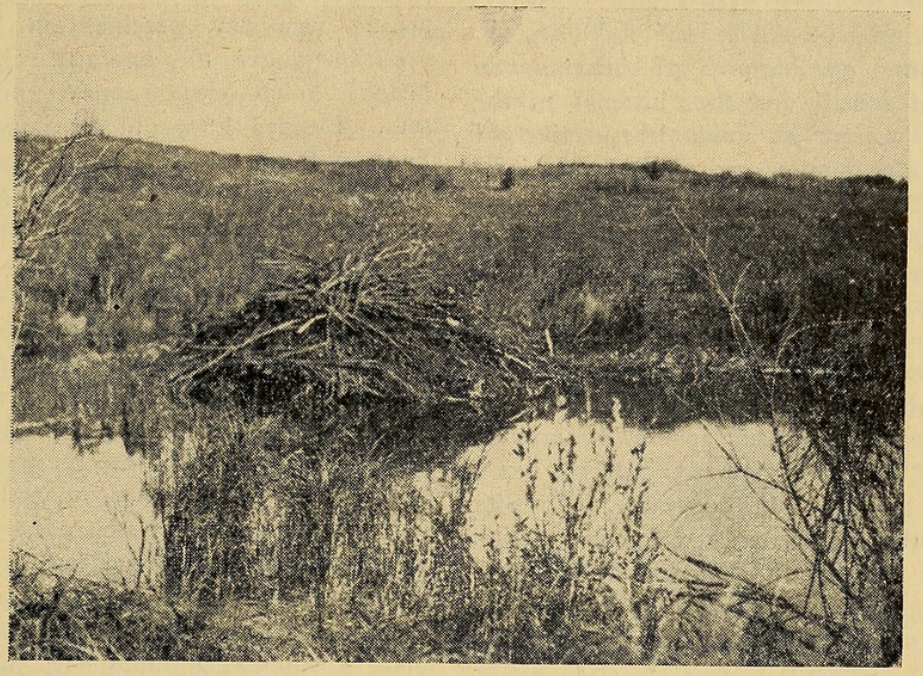
Many other old lodges situated in dry ponds were demolished in order to learn the manner of construction, size of "rooms", and number of entrances and exists. None approached the previously described structure in bulk or dimensions.

Every lodge investigated contained only one "room", including the lodges in the ponds under observation. The latter, of course, were not destroyed or damaged in any way in order to obtain data relative to their formation.

The "rooms" of the lodges were found to be of various shapes, some almost round, other roughly square or rectangular. All were more or less symmetrical. The floor of the "rooms" consist of sticks covered with a layer of mud from 2 to 4″ deep, inclined slightly towards the main entrance which, I think, is intentional to allow a beaver emerging from the water to drain off and so keep the "room" as dry as possible. Except when evidence of other animal occupation was visible the floors were still strewn with shredded willow bark, and some contained the debris of the last meal. The largest "room" of the lodges examined was in the old lodge previously described. The smallest would scarcely permit two beavers to move about in comfort. Generally there was ample room for an adult pair and their "kittens".

The distance between the floor of the "rooms" of the occupied lodges and the water level of the pond averaged about 7″. This measurement is of vital importance to the beavers and is in relation to the height of the dam as an increased depth in the pond would tend to flood the lodge. On the other hand, insufficient water would offer a better opportunity for land dwelling enemies to enter, beside endangering a winter food supply stored nearby. Consequently when a pond silts up and the crest of the dam is raised to give greater depth to the pond, the floor of the lodge must also be elevated, the "room" enlarged, and the bulk of the lodge increased.

Two tunnels or plunge holes to each lodge is the general rule. Three were sometimes found, and I have one record of four. In each instance, regardless of number, they entered the pond well below water level. What appears to be the general entrance and exit is always the largest in diameter, proceeds direct to the water, and is almost perpendicular. The remainder, whether one or more, invariably take opposite routes to the outside either from the floor or walls of the "room", sometimes passing beneath the floor to the water. The need for at least one large tunnel is apparent when it is realized that food material, some of which consists of



Lodge at Site No. 2, September 23rd, 1933. Note the loose material placed about the apex and the food pile in the water to the right.

Photograph by H. U. Green.

small branches, is conveyed to the lodge for consumption. The other tunnels, too, are undoubtedly constructed to serve the special purpose of emergency exits when a hurried departure of the inmates becomes necessary with the least possible delay.

A beaver lodge is generally described as a conical mass of woody material plastered with mud and fibrous debris, but I think it may perhaps be said that the structure is a mass of hardened muck reinforced with woody material to give shape and strength. Judging from the old lodges demolished it would appear that the amount of mud and fibrous debris is about proportional to the bulk of sticks and twigs. The presence of so much soft material baked by the sun undoubtedly keeps the interior free from trickling leaks during heavy rains. It is also absorbent, keeping the interior of the lodge cool in hot weather and assures sufficient moisture in the mass at freezeup so that the walls may become almost like concrete when filled with frost.

For the reason that the size of a lodge, if occupied by beavers, increases with age the inside walls of the interior can be trimmed back and the "room" enlarged. This occurred at Site No. 3 in the autumn of 1932 without endangering the occupants from outside influences. The average maximum thickness of the walls of 19 old lodges examined was 21.5 inches.

It would seem that the "island" lodge is the preferred style of habitation for beavers on the Riding Mountain range as only two "bank" lodges were located, one quite old and unoccupied, and the other at Site No. 1.

The construction of a "bank" lodge is similar in every detail to a lodge built in the water, except that as dry ground is used for the greater part of the foundation, less material is required. There are possibilities, too, of increasing the accommodation of a "bank" lodge to include an additional "room" or den beneath the ground, connected with the lodge by a burrow. An addition of this kind occurs at the "bank" lodge at Site No. 1, and, I presume that similar dens may be found wherever "bank" lodges exist. In this instance the burrow extends from the floor of the lodge a distance of 11′ in a direct line to the rear, terminating in an almost circular den 32″ in diameter with an extreme height of 13.5″. The burrow, after it leaves the lodge, is 16″ below the surface, sloping downwards to the mouth of the den, 21″ underground. For added protection the den was excavated by the beavers beneath a dense clump of willows, the roots of which would prevent to a large degree the efforts of four-footed enemies to dig them

out or in other way molest them. The beavers frequented the den as much as the lodge.

Although only one family of beavers, an adult male and female and the "kittens" of the ensuing year, occupy a pond, irrespective of whether there are one or more to a site, it is usual to find two lodges at each location, and from the evidence gleaned at the sites under observation one or both are inhabited during the open seasons. In the winter, only one is occupied. Since its creation, and up to 1930, the single pond at Site No. 1 contained the "bank" lodge alone. In the autumn of that year, however, it became necessary for the beavers to construct an "island" lodge to prevent being frozen in on account of low water. At Site No. 2, where two ponds exist, there is a lodge in each pond. Site No. 3 has two lodges.

The following are the measurements of the lodges at Sites No. 1, 2, and 3. A consideration of the figures gives a rough estimate of the size of the "rooms".

		Height above water level	Diameter at water level	Max thickness of walls
Site No. 1	"Bank" lodge	4′6″	12′2″	23″
	"Island" lodge	5′5″	17′5″	26″
Site No. 2	"Island" lodge *Upper pond*	4′8″	17′3″	20″
	"Island" lodge *Lower pond*	5′10″	16″	19″
Site No. 3	"Island" lodge *No.* 1	5′8″	15′4″	22″
	"Island" lodge *No.* 2	4′9″	13′	21″

The number of entrance and exit tunnels of the lodges at Site Nos. 1, 2, and 3, is as follows:

Site No. 1	"Bank lodge	2.
	"Island" lodge	2.
Site No. 2	"Island" lodge *Upper pond*	2.
	"Island" lodge *Lower pond*	2.
Site No. 3	"Island" lodge *No.* 1	2.
	"Island" lodge *No.* 2	3?

Regarding the manner of building, I was fortunate enough to witness the construction of the "island" lodge at Site No. 1 during the autumn of 1930. The water of the pond was lowered in late July through a breach cut in the dam by a farmer seeking to drain the Kennice Meadow above in order to procure hay. The season was dry, precipitation light, and evaporation above the average. As a result the "bank" lodge became unsafe for winter quarters. Besides it would be impossible to store food without danger of the pile freezing to the bottom. I was fearful of the beavers' future, and watched very carefully to see what they would do to avert disaster.

On September 12th, I noticed that several aspen-poplars had been felled in a nearby stand and stripped of branches. A number of willows were also cut from a clump beside the water a few feet from the "bank" lodge. Where this material was taken to, it was impossible to ascertain, for all trace was lost at the water's edge. On September 19th, a raft of sticks appeared on the surface of the pond beside the deep channel of the river. An examination of the raft showed that it was deep in the water and rested upon a submerged hummock, the top of which was about 3′ below the surface. It consisted of green aspen-poplar branches cut in sections, dry willows, numerous stones up to 4″ in diameter, gravel, and fibrous debris. The raft was solid enough to bear my weight. This was the foundation of the new lodge. On September 26th the base of the lodge was well above water, composed of small sticks, mud, and muck. The centre of the base was loosely filled with material in constrast to the outside which was of solid construction. On October 5th, the exterior of the structure was complete. The centre, though, was a tangle of sticks mixed with a little muck toward the outside edges. By October 8th, an entrance tunnel had been cut through the submerged foundation opposite the deep channel of the river to the floor of the "room" and the loose material from the centre removed by way of the tunnel. Another tunnel was also cut almost at right angles to the first. The inside aperture of this entrance was flush with the wall. The floor of the "room" was complete, covered with a layer of mud sloping slightly towards the entrance of the first tunnel whose inside aperture was flush with the floor. On October 10th, the beavers were harvesting and the beginning of a food pile made its appearance beside the lodge. At this time dry grass and shredded willow bark was found inside.

Presuming that the work on the lodge commenced on September 12th and terminated on October 9th, which I believe to be correct, the labour of 28 nights was expended on the structure.

Towards the end of October, after the conclusion of a late harvest, a quantity of loose sticks

were placed, butts downwards, about the sides of the lodge with the thin ends terminating across the apex. The apex, it should be said, was free of solid material, merely a network of sticks through which air filtered to the "room". When winter comes the welfare of the occupants of any beaver lodge can be ascertained by means of a wisp of vapour feathering through a hole in the snow above this efficient ventilator, telling of life within. Since this lodge was built it has assumed much larger proportions. In the spring of 1931, numerous sticks were thrust into the walls and covered with mud. In the autumn of 1931, a great deal more material was added than necessary to replace that lost by erosion during the summer. Owing to the lateness of the season when it was built the beavers were undoubtedly working against time and probably did no more than erect a habitation with a small margin of safety and comfort to meet the emergency that faced them.

The manner of lodge construction as shown by my observations proves conclusively that when building a habitation beavers do not leave the centre of the structure clear of accumulated material as the work proceeds, although the evidence is in favour of a deliberate intention to place little or no muck other than about the walls. I cannot say whether the floor of the lodge is made during the course of construction or after the "room" is formed, or if the inside walls of the "room" are finally covered with mud. Regarding the latter, I feel sure that no additional material is applied after the projecting sticks are cut flush with the walls and removed together with other interfering debris. In any event, a beaver lodge is a very masterful piece of work often given no more consideration regarding its technical details than an instinctively built bird's nest. There is, of course, no comparison.

Apart from lodges, every beaver pond on the Riding Mountain range includes one or more dens, visited by the beavers from time to time and probably used as hideouts when danger threatens. Burrowed in the banks of the pond at a place where the ascent of the slope is steep, they terminate in a "room", high above the water, large enough to shelter an entire beaver family. The entrance may be deeply submerged; often it is in shallow water approached by a canal, and sometimes above the surface at the water's edge. Investigation of the dens located at the sites under observation, and in many dry ponds, show that the roof of the "rooms" is from 18″ to 24″ below ground level, protected above by the roots of trees or shrubs in the same manner as the den behind the "bank" lodge at Site No. 1. They are generally some distance from the lodge. Never close by. I have one record of a beaver den excavated beneath a large granite boulder, the bottom of which is the roof. The length of the tunnels between the entrance and the rooms could only be roughly estimated. I would say that usually they are between 15′ and 20′ long, measured in a straight line from above.

A number of holes in the banks of the Vermilion river, and elsewhere in the Riding Mountain, indicate from the manner of their construction that they were excavated by beavers. As they were more or less remote from ponds there is some suggestion of occupation by migrants travelling down stream. Shredded willow bark was found in the "rooms" of more than one, together with peeled aspen-poplar sticks and other vegetable debris. It is quite possible that migrating beavers may even have survived a mild winter within these shelters, gathering food from day to day.

(To be concluded)

NOTES AND OBSERVATIONS

NIGHT ALARM.—On June 9th, 1929, at the north narrows of Moose Lake, Manitoba, I saw a bear (*Ursus americanus*) swim out just after dark to a long narrow island occupied by gulls and terns, and at its northern and nearer end only about one hundred yards from shore. In the darkness he could only be seen for a few feet after he left shore. However, pandemonium broke loose on the near end of the island, and gradually progressed along its length. After a while all was quiet again. Unfortunately I did not have an opportunity to visit the island and see if there were any signs of his passage.

The attitude of the bear throughout was that of one who had been there before.—C. H. D. CLARKE.

MOOSE SEEKS SHELTER FOR YOUNG. — Late in August, 1929, members of a forest survey