

August 1894, near the Bernina Hospice in Switzerland, I came across several plants of *myosotis* growing by a pool. In some cases the flowers were a bright blue, but in others they were distinctly pink, several being entirely pink, and others showing pink blotches and lines. The plants were in a hollow, and on the day of my visit there was an extremely cold wind blowing.
London, December 2. HECTOR COLWELL.

Fire-fly Light.

REFERRING to my reply to Prof. S. P. Thompson (NATURE, July 29), concerning fire-fly light, I can confirm what then I wrote. Mr. H. Muraoka has sent to me from Kioto in Japan a letter from which I derive the following particulars. (1) In the neighbourhood of Kioto there are about nine kinds of *Luciola*, which Mr. H. Muraoka continues improperly to call, in German, *Johanniskäfern*. (2) The insects used by him were probably *Luciola villicollis* and *Luciola picticollis* (Kiesenn).
Florence, December 1. CARLO DEL LUNGO.

AN ENGLISH BEAVER PARK.

SINCE the Marquis of Bute established a colony of beavers on his estate near Rothesay in 1874, no such interesting experiment has been made in acclimatizing these animals as that which Sir Edmund Loder has carried out in Sussex. The beavers have now been inhabitants of his park at Leonardslee, near Horsham, for eight years, or rather they occupy an enclosure inside the park. There they have been placed on the banks of a small stream, with a rather rapid fall, a situation which exactly suits them. It is sheltered, for the valley is deep and wooded, and there was an ample supply of timber, large and small, in the enclosure when the industrious beavers, reversing the story of "Settlers in Canada," were brought from Canada and settled in Sussex. In the course of their eight years' sojourn they have ensured their comfort by constructing in great perfection, and in the most durable form, the engineering works for which beavers are so justly famed, and which gave rise to the Indian legend that the Creator, after separating land from water, employed gigantic beavers to "smooth" the earth into shape. Meantime the colony increases in number, so that some of the produce have been sold to go elsewhere. Nevertheless the beavers' industry is such that the size of their works, and consequently the area of the pool which they have formed, constantly increases.

The space in which they were originally enclosed was less than an acre. This was only one-third of the size of the Marquis of Bute's "beaver park"; but it gave quite sufficient scope for the beginnings of the colony. It was surrounded with a corrugated iron fence, which the beavers could not gnaw down, while at the same time they could not see through it, and so felt more secure and "private" in their park. Beaver engineering is directed entirely to one end. This is to form a pool deep enough and wide enough for them to be able to swim beneath the water to the entrance of their burrow, and to keep this entrance submerged in dry weather, when the streams run low, and covered with such a depth of water that even in the longest frosts, when the ice in Northern Canada is two feet thick, there shall still be water-space below it.

In the water the beaver knows it is safe; and, though it also stores branches for food below water, fastening them down with stones and mud, it is to serve as a place of refuge rather than as a storehouse, as a combined moat and temporary hiding-place, that the beaver forms his pool. All his clever engineering, his wood-cutting, building, canal-making and construction of "rolling ways," are subordinate to this end. The two last works, the beaver canal and the beaver road—the one for floating, and the other for rolling logs to the pool—are only

brought into play when the supply of timber near at hand is exhausted. But they are part and parcel of beaver devices, and, though only recently brought to notice, are not less creditable than their other feats.

In the present paper we shall not use the technical phrases of hydraulic engineering, but term the reservoir made the "pool," and the containing barrier the "dam." In Canada, when the beavers were numerous, these dams were noticed to be so nicely adjusted in form to the material with which they were made, and to the force of the stream which they barred, that they could be classified in relation to these circumstances. Dams built mainly of mud and stones had a different section from dams built of sand and wood; and some made across rapid streams were curved, to resist the extra strain. But the greater number were made of battens of wood about three feet long, with the crevices stuffed with mud, stones, and the twigs and small branches; and in every case the first engineering principle necessary in the construction of a dam is observed. This is that the top shall be exactly level, so that the water of the pool, which must overflow, because the stream enters it from the top end, shall flow evenly over the whole length of the dam. As every one conversant with that most difficult form of the profession—river engineering—knows, any small gap or inequality soon ruins a dam. The water pours through these by preference, and at once cuts a gap. The beavers know this, too, and at Leonardslee, no less than in Canada, constantly examine the top of the dam, and mend the smallest gap along the line. The Leonardslee dam is of the ordinary kind, not curved but straight, and built of battens of wood, made of the boughs from trees cut down inside their enclosure, or from those which were given them as food. In all cases they ate most of the bark; then they cut the sticks into lengths of about three feet, and worked them into the structure. Plenty of mud was pushed into the crevices on the upper side, and all the small twigs and sticks were pushed in to make the whole dam tight. With great judgment they spared a small oak growing just below the dam. This now acts as a support to the structure; all the other trees in the enclosure, except those protected by metal guards, and one very large fir, were either felled, or attempted to be felled. It seems obvious that they kept this tree purposely as a buttress; for the dam is made higher and, therefore, wider each year, as the pool above increases; the tree is now almost in the centre, and its roots are already worked into the dam foundations. Even the baby beavers at Leonardslee, no bigger than rabbits, are put to "light jobs" in mending the dam, and the elders are most industrious. Each winter brings down a quantity of mud, which would make the pool shallower. But the beavers raise the dam so rapidly that the pool gains in depth, and spreads for a long distance up stream and laterally. The dam is at least five and a half feet high, and the depth of water above it five feet, yet it is so well made that, though the human-built dams of several artificial pools higher up the stream were carried away in a winter flood, the beaver-dam was undamaged. Near the point at which the stream enters the enclosure three large trees, formerly on the bank, are now submerged in three feet of water, owing to the fresh height added to the barrier below. The beavers had begun to cut these trees down—a very hard task, but one in which they would have succeeded had not the water risen so fast that they were floated off their legs when trying to go on cutting. One large beech tree, standing on a raised bank washed by the ever-increasing pool, was an object of envy to the beavers. They concluded that the quickest plan was not to cut it down, as it was very large and the wood hard, but to dig it up. So, with the aid of the increasing waters, they undermined the tree, which fell across their pool. This gave them occupation for some

weeks. They ate every morsel of bark off the trunk and branches, and then cut off the boughs, gnawed them into lengths, and took them to the dam and to their "lodge." The latter began as a burrow in the bank. As they gradually enlarged this, and filled up the bottom with wood chips, they broke open the roof to get head room, and constantly added to the dome with mud and sticks. It is now a large untidy mound on the bank, which at this point is steep.

The process described above accounts partly for the evolution of the beaver lodge from the burrow. But the keeper of Lord Bute's beavers stated that the beavers at Rothesay did clean out the old shavings which they took in to make beds of, and plastered them on the outside of their lodge, or on the same embankment. The present writer inclines to believe that this is likely to be correct, not in every case, but in some, for it is very much in keeping with beaver character. In such cases he ventures to offer the following solution of the growth of the lodge, in cases where the beavers remove their bedding of chips. The water above the dam, owing to the causes mentioned above, rises higher yearly. This must also raise the level in the sub-aqueous passage leading to the beavers' chamber, and in time tend to invade the chamber itself. To remedy this the beavers would naturally raise the floor, and leave the débris of old "beds" on it, piling fresh stuff on the top, and at the same time quarry out the roof, both for head-room and to get fresh earth for their floor. When once the artificial roof was made the same process would go on, until the rising water flooded out the floor altogether, and surrounded the lodge, as one sees it in old Canadian pictures. The lodge would thus take the beehive, moated, form which it has in those conventional plates, even though it lacks the windows which the French artists added for effect. The beavers occasionally escape by burrowing under the corrugated iron fence. This is not always intentional on their part, and they are easily caught again. Whenever one gets out it travels up the stream, visiting the pools above. There a box-trap is set next night, baited with dog-biscuit, of which the beavers are fond, and the animal is certain to be caught. One beaver, out for a stroll like this, tried to cut down a large Scotch fir, and did cut down a silver birch. The first indication to the keeper next morning that a beaver had escaped was the sight of this tree, in full leaf, lying across a path.

We mentioned above that the Leonardslee beavers had not made either a canal or a rolling path. There is no need for either; for there are no more trees to cut down, or logs to roll from a distance. But it is worth devoting a few lines to these, two of the less known, but not least extraordinary exhibitions of beaver intelligence. An old-established colony soon clears off all the timber near its home. In order to convey the more distant logs to the dam they carefully clear paths, and roll the battens of wood down to the water. But the beaver canal, to which proper attention was first drawn by Mr. Lewis Morgan, is, in the writer's opinion, more wonderful still. It is nothing more nor less than a waterway, or several waterways cut from points on the stream to such parts of the adjacent plantations or woods as the beavers wish to visit, or cut timber in. Sometimes, also, it is made through the centre of an island, to make short communication by water. To this canal the beavers roll their logs, and then tow them to their dam. It has been urged that these canals are accidental, merely worn out along the customary roads; some are, no doubt. But wherever the writer has seen tame beavers kept, even at the London Zoo, he has seen them at different times cut trenches to the edge of their pool, though as that at the Zoo was surrounded by a stone rim, the beavers could not fill the trench with water. Of course, there this trench was only a few feet long. But it is quite clear that Lord Bute's beavers,

which had a considerable area in which to cut their timber, tried to dig canals. This is the description given by their keeper, who, though well acquainted with beaver stories, evidently had never heard of the canal. "Their burrows they make by cutting a road from the middle of the dam for several yards into the dry ground, where they scoop out a dome-shaped burrow. . . . Some of the roads to these burrows are from fifteen to twenty yards long, and so level that the water follows them in the whole length"! Here is, undoubtedly, an instance of the beaver canal.

Those who care to compare the methods of the Canadian beavers acclimatised at Leonardslee with the works and ways of the European beavers still surviving in Norway, will find an interesting account of the past and present history of the Norwegian beaver, by Mr. R. Collett ("Bieveren i Norge"),¹ illustrated with twelve plates of beaver lodges and dams, and supplemented by an English summary.

The beavers' present range is confined to the Stifts of Christiania and Christiansand, but a few remain on Bratsberg Amt and Stavanger Amt. The larger colony is on the River Nisser (or Nid), the westernmost colonies being on the river Mandal. In all cases they feed not on fir, but on deciduous trees, mainly the aspen. When not on the banks of large rivers they make dams, one of which, near Hellersli (Trungen), was built entirely in three weeks, and formed a lakelet more than 100 yards across. The length of the dam was 14 metres. In only one respect do the habits of the Norway beavers differ from those of the Canadian species. Those that live on the banks of the large rivers cannot make a dam over such rapid and deep waters. Yet these rivers rise and fall, and there is a danger of the lodge being either flooded or left high and dry. In these places the beavers build long lodges, at right angles to the stream, and sloping up the bank. When the river rises, the beaver can go up to the higher end of his lodge; when it falls, the entrance is still submerged and safe.

In 1880 Mr. Cocks estimated the number of beavers surviving in Norway at 60; in 1883 Mr. Collett believes there were 100. Since 1894 and 1895 the beavers have been protected by law in their two principal haunts, for a period of ten years in each district.

C. J. CORNISH.

SCIENTIFIC INVESTIGATIONS OF THE LOCAL GOVERNMENT BOARD.²

THE Annual Reports of the Medical Officer of the Local Government Board constitute in many respects the best treatise on practical hygiene we possess. Their diligent perusal by the embryo health officer would equip him as no ordinary text-book can do for the intelligent discharge of his duties. It would be well if candidates for Public Health degrees were examined upon the salient features of these reports. The volume for 1895-96, which has just been issued, contains certain features of interest. There is the usual admirable summary of the year's work by Sir Richard Thorne; statistics with regard to vaccination, and a compilation of returns of notified infectious diseases in urban districts and in the county of London. Valuable reports are also contributed by Dr. Copeman and Dr. Buchanan upon outbreaks of enteric fever, and by Dr. Sweeting upon an outbreak of diphtheria. The able report by the late Mr. R. W. Thomson upon the sewerage and drainage arrangements of certain valleys in the counties of Monmouth and Glamorgan, leads one to join in the regret expressed at the loss of this talented official. It is, how-

¹ Bergen: Grieg's "Bogtrykheri."

² Twenty-fifth Annual Report of the Medical Officer of the Local Government Board, 1895-96.