Letters to the Editor.

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The Losses in Trout Fry after Distribution.

MAY I ask the co-operation of readers of NATURE—fish culturists and anglers—in testing the reliability of some experiments which were designed to ascertain the numbers of trout fry which survived out of a given number distributed in depleted trout streams? The importance of the experiments can scarcely be overestimated, because if corroboration of the Board's results is obtained in different parts of Canada and in the United States, then, if economic results are aimed at, fry will have to be rigidly excluded from all waters excepting those which are known to be suitable.

Three public bodies in Canada co-operated in carrying out the experiments during the summers of 1923 and 1924: (1) The Ontario Department of Fisheries, which furnished the fry and fingerlings and in most cases distributed them; (2) the Department of Fisheries, Ottawa, which appointed an experienced hatchery officer to check the determination of losses; and (3) the Biological Board of Canada, which appointed Mr. H. C. White to carry out the operations in the field.

In 7 streams and 2 ponds a total of 95,700 fry or fingerlings were planted, some in June of 1923, and some again in June of 1924. In 6 of the streams the losses were apparently total at the end of three months. In streams and ponds combined, apparently only 1375 survived, being less than 1½ per cent. of the total fry planted.

The method of determining the losses was that of seining the streams or ponds and counting the survivors. A net fine enough to catch the smallest fry, and long enough to stretch across a brook, is used. A stout brail or stick, about 3 or 4 feet long, is attached to each end of the net. Heavy leads are fixed to the lower side of the net, so that fry may not escape at the bottom. The upper side is held above the water by the two men who operate the net, one on each side of the stream.

The seining should be done over and over again—a dozen or more times if necessary; in fact, often enough to ensure that almost every survivor is caught. Towards the end of the seining it may be necessary to have a third man rile the water thoroughly by stirring up the bottom of the stream in advance of the two seiners. This was done in order to prevent the fry from seeing and avoiding the net. Some practice is necessary in seining, otherwise the results will be untrustworthy.

In one of the brooks seined by the Board it was found that the fry ascended the stream about 40 rods above and 90 rods below the point of distribution. If it is desired to shorten the distance to be seined, and catch all ascending and descending fry, then two fine wire screens should be placed across the stream, one, say, 20 to 50 rods above, and the other 20 to 50 rods below the point of distribution. In each of these screens there should be inserted a cylindrical wire fish-trap, funnel-shaped at one end and joined by a smaller cylindrical wire tube or sleeve to an opening in the central part of the screen, so that the trap can be removed and cleaned at pleasure. The screen and the trap should be carefully constructed so as to catch all ascending or descending fry, and thus discover how many fry migrate up or down stream.

The outstanding causes for the high mortality which was found in south-west Ontario seemed (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.

The results of the Board's experiments thus far are a severe condemnation, not of fish culture as a whole, but of the prevailing method of distributing fry in streams, namely, dumping them at any point most convenient to a highway or travelled road. They should be distributed with fair uniformity along the upper stretches of streams or along the margin of ponds where trout naturally lay their eggs, if they can find suitable spawning beds.

The experiments demonstrate, or at least indicate: (1) a loss of 98 per cent. of the fry (for the method of planting used and the streams investigated) during the first three months after distribution; (2) consequently a greatly increased cost of production per fry; (3) the necessity of a thorough examination as to the suitability of every stream or pond in which it is proposed to plant fry.

At present we are planting fry in the dark, and in some cases we are feeding them to coarse or useless fish.

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Kingston, Ontario,
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"Bordered" Squares of Fifth Order and their Magic Derivatives.

FIG. 1 is an ordinary "Bordered" square consisting of a "Heart" (in the associated position, the three rows, three columns and two diagonals of which sum to 39) and a "Border" formed of complementary numbers (25·1, 24·2, 23·3, etc.). There are 26 such "Hearts" and 605 "Borders," and, including inversions of the "Borders" and reversions of the "Hearts," there are 174,240 squares of this type with one inversion that has a similar number. These "Hearts" can be in 21 positions in a square of fifth order, and altogether with these "Hearts" in all their positions, I have calculated that there are more than 649,000 squares of fifth order of this type of "Heart."

The above, however, are not the only kind of "Hearts." Fig. 2 shows another where the diagonals are not magic, that is, do not sum to 39 and do not have their complementary numbers in the heart. These are used for the corner numbers of the completed square. There are 135 such "Hearts" and 306 "Borders," giving a total of 88,128 squares with one inversion giving an equal amount. How many there are in the remaining 19 positions is quite unknown.

Fig. 3 shows still another kind of "Heart," where the diagonals are irregular and the number 13 is not in the "Heart." Thus the type of square of Figs. 1 and 2 is not feasible, but other positions of the "Heart" are practicable (see Fig. 3). There are only 12 such "Hearts" including the complementary "Heart," and the number of squares in all the different positions of the heart quite unknown.

So far in a square of fifth order, in a row or column the sum of the numbers of the "Heart" to the rest of the row or column has been as 39 : 26. But these are not the only proportions, and with certain exceptions all the proportions from 38 : 27 down to 26 : 39 can be made. The exceptions are 28 : 37 and 27 : 38, for which I have been unable to make "Hearts" under the conditions required. If in these squares each number be subtracted from 26, then the proportions