George Perkins Marsh, 1857, Report, Made Under Authority of the Legislature of Vermont, on the Artificial Propagation of Fish (Burlington Vermont).

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REPORT ON ARTIFICAL PROPRAGATION OF FISH
by George P. Marsh.

TO HIS EXCELLENCY, RYLAND FLETCHER, GOVERNOR OF VERMONT:

The Resolution of the General Assembly, in pursuance of which the following Report has been prepared, does not appear to contemplate experiment or original observation upon the natural or artificial breeding of fish, and the report will therefore present such facts only as have been gathered from foreign and American publications on the subject, together with some considerations of a general nature, which may be thought to have a bearing on the proper action of the Legislature in reference thereto.

Man, whether savage or civilized, has a strong passion for the exciting and exhilaration pleasures of the chase, and an irresistible predilection for pursuits which involve the elements of variety, uncertainty, and chance, over the tamer occupations which demand the exercise of regular industry, and offer to their followers not brilliant prizes, but fixed and humble rewards. Many might, therefore, be disposed to question whether the advantages to be derived from the restoration of the quadrupeds, the fowls, and the fish, that once filled the forests, the atmosphere, and the waters, would not be more than counterbalanced by the mischievous influence, which the opportunity of indulging in pleasures so seductive as those of the sportsman would exert upon the habits of our population.

But aside from the obvious impossibility of so multiplying the wild animals of our territory as to affect seriously the habitual pursuits, or the graver interests of our people, it is believed that any possible evil from this source would be more than compensated by collateral advantages of a character not unlikely in the present state of American society, to be quite overlooked. The people of New-England are suffering, both physically and morally, from a too close and absorbing attention to pecuniary interests, and occupations of mere routine. We have notoriously less physical hardihood and endurance than the generation which preceded our own, our habits are those of less bodily activity, the sports of the field, and the athletic games with which the village green formerly rung upon every military and civil holiday, are now abandoned, and we have become not merely a more thoughtful and earnest, but, it is to be feared, a duller, as well as a more effeminate, and less bold and spirited nation. The chase is a healthful and invigorating recreation, and its effects on the character of the sportsman, the hardy physical habits, the quickness of eye, hand, and general movement, the dexterity in the arts of pursuit and destruction, the fertility of expedien (sic), the courage and self-reliance, the half-military spirit, in short, which it infuses, are important elements of prosperity and strength in the bodily and mental constitution of a people; nor is there anything in our political condition, which justifies the hope, that any other qualities than these will long maintain inviolate our rights and our liberties.

The training acquired in the sports of the chase, as exercised in England, has been of great value and importance to those classes of English society which are possessed of the means of participating in it, and in the severe crisis through which the British troops passed in the late Russian war, it proved to be the best preparation for the field and the camp, which it is possible for civil life and an age of peace to afford. In a country like ours, of small landed estates, narrow enclosures, and rugged surface, the chase could never be pursued upon the great scale, which makes it so attractive, and so imposing a sport in England; and it must be admitted that angling and other modes of fishing are under few circumstances attended

with as great moral physical benefits as the pursuit of the larger quadrupeds, but they are nevertheless analogous in their nature and influences, and as a means of innocent and healthful recreation at least, they deserve to be promoted rather than discouraged by public and even legislative patronage.

But however desirable it might be, in these and other points of view, to repeople the woods and the streams with their original flocks and herds of birds and beasts, and shoals of fish, it is for obvious reasons, impracticable to restore a condition of things incompatible with the necessities and the habits of cultivated social life. The final extinction of the larger wild quadrupeds and birds, as well as the diminution of fish, and other aquatic animals, is everywhere a condition of advanced civilization and the increase and spread of a rural and industrial population. The number of wild animals which have been thus altogether or nearly extirpated in quite recent times is by no means inconsiderable. Within a few centuries, the wolf and the bear, as well as some large animals of the deer family, have utterly disappeared from the British Islands; the wild ox exists only in the parks of one or two great landed proprietors, and the cock of the woods, a magnificent bird of the grouse tribe scarcely smaller than the turkey, formerly abundant in Scotland, had become totally extinct in Great Britain, and has only lately been re-introduced from Sweden; and the fox has been preserved from extirpation only by a public opinion which exempts him from ordinary agents of destruction, and spares him as the object of a manly sport.

So on the continent of Europe, the beaver is now so rare that he has been forced to relinquish his habits of associated life and action, and has become a solitary animal; the gigantic wild ox of the German and Slavonic states is confined to a single forest in Lithuania, and other large quadrupeds, which abounded in central Europe but four or five centuries since, are now only known by history and tradition.

In like manner the moose, the deer, the catamount, the wolf, the lynx, the beaver, the vast flocks of pigeons and water fowl, and other birds of passage, which bore so important a relation to the nutrition and the sports of our fathers, are now almost unknown to the natural history of Vermont, and zoologists observe that the clearing of the woods and the complete change in the vegetable products of the soil and the insects that feed upon them, have produced corresponding changes in the kinds and numbers of those smaller animals which being neither valuable for their flesh or their peltry, nor obnoxious for their destructive propensities, are regarded with interest by few but the scientific naturalist.

It should be observed, however, that the partial or total disappearance of many of the smaller birds and land animals is not to be ascribed altogether to a diminished supply of their natural food, but in no small degree to the wanton cruelty of youth, which finds pleasure in the torture and death of innocent and defenceless creatures, and to a mistaken prejudice which often ascribes mischievous propensities to particular birds, quadrupeds, and reptiles that in reality, by the destruction of vast numbers of noxious insects, much more than compensate the little injury they inflict upon the crops. The insect in all stages, egg, larva, chrysalis, and winged imago, enters largely into the nutriment of birds and the small quadrupeds, and many of those which are popularly supposed to be destructive to grass and grain, in fact depend for their sustenance almost wholly upon insect life, and are accordingly useful as protectors, not injurious as destroyers, of the food of man.

But although we must, with respect to our land animals, be content to accept nature in the shorn and crippled condition to which human progress has reduced her, we may still do something to recover at least a share of the abundance which, in a more primitive state, the watery kingdom afforded.

The luxurious and extravagant habits of imperial Rome first introduced the artificial breeding, or at least feeding and fattening of fish, in both salt and fresh water ponds. With the overthrow of that empire, its civilization and its industry, this practice was discontinued, and the art forgotten. But it was revived in the middle ages by the religious observances of the Papal church, which, by determining that fish and certain

favorite species of water fowl were not flesh, and accordingly not forbidden food at seasons of fasting and mortification, ingeniously contrived to reconcile the indulgence of the palate with the discipline of Lent. To every favorably situated monastic establishment was attached a fish-pond, which not only supplied the tables of the professed during the prescribed fasts, but often yielded a considerable revenue from the sale of fish to worldly penitents. The success of the monks led to the extension of this branch of industry, and large ponds were constructed by laymen, so that in the sixteenth century fish-ponds were an appurtenance of most great estates whether lay or ecclesiastical.

It is well known that in the earlier periods of the history of Vermont, the abundance of fish in the running waters, and more especially in the ponds and lakes of our interior and our borders, was such as to furnish a very important contribution to the nutrition of a population which the cultivated products of the soil were scarcely adequate to sustain. Lake Champlain and the Connecticut, as well as those of their larger tributaries whose course was not obstructed by cascades, abounded in salmon, and after the disappearance of that fish, those important waters, and all the streams and ponds of the interior, long continued to furnish a liberal supply of different species of the trout family, and of other kinds hardly inferior in value. At present, the numbers of the fish in all our waters, as well as of the otter, the mink, the muskrat and the water-fowl that fed on them, are so much reduced, that this branch of the animal kingdom has ceased to possess any pecuniary value in Vermont; and on the contrary the few that remain are popularly regarded as, in an economical point of view, rather a detriment than an advantage, as furnishing a temptation to idleness, not a reward to regular industry. The diminution of the fish is generally ascribed mainly to the improvidence of fishermen in taking them at the spawning season, or in greater numbers at other times than the natural increase can supply. It is believed moreover, and doubtless with good reason, that the erection of sawmills, factories and other industrial establishments on all our considerable streams, has tended to destroy or drive away fish, partly by the obstruction which dams present to their migration, and partly by filling the water with saw dust, vegetable and mineral coloring matter from factories, and other refuse which render it less suitable as a habitation for aquatic life.

It is however probable that other and more obscure causes have had a very important influence in producing the same result. Much must doubtless be ascribed to the general physical changes produced by the clearing and cultivation of the soil. Although we cannot confidently affirm that the total quantity of water flowing over the beds of our streams in a year is greater or less than it was a century since, or that the annual mean temperature has been raised or lowered, yet it is certain that while the spring and autumnal freshets are more violent, the volume of water in the dry season is less in all our water courses than it formerly was, and there is no doubt that the summer temperature of the brooks has been elevated. The clearing of the woods has been attended with the removal of many obstructions to the flow of water over the general surface, as well as the beds of the streams, and the consequently more rapid drainage of our territory has not been checked in a corresponding degree by the numerous dams which have been erected in every suitable locality. The waters which fall from the clouds in the shape of rain and snow find their way more quickly to the channels of the brooks, and the brooks themselves run with a swifter current in high water. Many brooks and rivulets, which once flowed with a clear, gentle, and equable stream through the year, are now dry or nearly so in the summer, but turbid with mud and swollen to the size of a river after heavy rains or sudden thaws. The general character of our water courses has become in fact more torrential, and this revolution has been accompanied with great changes in the configuration of their beds, as well as in the fluctuating rapidity of their streams. In inundations, not only does the mechanical violence of the current destroy or sweep down fish and their eggs, and fill the water with mud and other impurities, but it continually changes the beds and banks of the streams, and thus renders it difficult and often impossible for fish to fulfil that law of their nature which impels them annually to return to their breeding place to deposit their spawn.

The gravelly reach which this year forms an appropriate place of deposit for eggs, and for the nutriment and growth of the fry, may be converted the next season into dry land, or on the other hand, into a deep

and slimy eddy. The fish are therefore constantly disturbed and annoyed in the function of reproduction, precisely the function which of all others is most likely to be impeded and thwarted by great changes in the external conditions under which it is performed. Besides this, the changes in the surface of our soil and the character of our waters involve great changes also in the nutriment which nature supplies to the fish, and while the food appropriate for one species may be greatly increased, that suited to another may be as much diminished. Forests and streams flowing through them, are inhabited by different insects, or at least by a greater or less abundance of the same insects, than open grounds and unshaded waters. The young of fish feed in an important measure on the larvæ of species which, like the musquito, pass one stage of their existence in the water, another on the land or in the air. The numbers of many such insects have diminished with the extent of the forests, while other tribes, which, like the grasshopper, are suited to the nourishment of full grown fish, have multiplied in proportion to the increase of cleared and cultivated ground. Without citing further examples, which might be indefinitely multiplied, it is enough to say that human improvements have produced an almost total change in all the external conditions of piscatorial life, whether as respects reproduction, nutriment, or cause of destruction, and we must of course expect that the number of our fish will be greatly affected by these revolutions.

The unfavorable influences which have been alluded to are, for the most part, of a kind which cannot be removed or controlled. We cannot destroy our dams, or provide artificial water-ways for the migration of fish, which shall fully supply the place of the natural channels; we cannot wholly prevent the discharge of deleterious substances from our industrial establishments into our running waters; we cannot check the violence of our freshets or restore the flow of our brooks in the dry season; and we cannot repeal or modify the laws by which nature regulates the quantity of food she spontaneously supplies to her humbler creatures.

It is therefore not probable that the absolute prevention of taking fish at improper seasons, or with destructive implements, or indeed that any mere protective legislation, however faithfully obeyed, would restore the ancient abundance of our public fisheries, though such measures might no doubt do much to render them somewhat more productive than they at present are, if the legal and moral power of the legislature to enact and enforce appropriate laws on this subject were somewhat greater.

Although the fortieth section of the Constitution of Vermont, which secures to the people of the State certain rights of hunting and fishing, entrusts the General Assembly with a large discretion in the regulation of those rights, yet is it not clear that the Legislature possesses all the power required for the complete protection even of an experimental public fish- breeding establishment, and the State certainly at present has title to no suitable localities for such a purpose. Besides this, the habits of our people are so adverse to the restraints of game-laws, which have been found peculiarly obnoxious in all countries that have adopted them, that any general legislation of this character would probably be found an inadequate safeguard. But however this may be, the difficulties of a co-operation with other States by concurrent legislation seem, for the present at least, insuperable. The subject is by no means well enough understood to enable us to determine the proper character of a code so comprehensive as to embrace the territory of three or four states, and there is such a difference of local conditions between States, one of which controls the outlet of a great river as well as the entire course of many of its tributaries, and another whose jurisdiction extends but to the water's edge of the upper portion of its current, that the provisions applicable to one could have little adaptation to the circumstances of the other. The State of Connecticut is in all respects very favorably situated for experimenting upon the restoration of salmon and shad, and whenever that State and Massachusetts shall have adopted protective or promotive systems suited to their respective conditions, it will be the duty and interest of Vermont to resort to such co-operative measures as the interests and circumstances of the State shall seem to require.

It is believed that our main reliance in this, as in all other matters of economical interest, must be upon the enterprise and ingenuity of private citizens, and that until States more advantageously situated for

experimentation than Vermont, shall have taken the initiative, our legislative action should be limited to such further protective laws as private establishments may require, and (which is earnestly recommended,) the granting of liberal premiums for judicious and successful private efforts in the restoration and improvement of the fisheries.

In many European countries, where restrictive and prohibitory laws of all sorts are much more rigidly enforced that with us, the preservation of land and aquatic game has been an object of legislation for centuries, but none of these systems have ever been attended with general success, and the possessors of great forests and fisheries, whether royal or private, every where depend rather upon guards and enclosures than upon the terror of the law, for the protection of the objects of the chase or the fishery.

Nor does it sufficiently appear that the governmental establishments for fish-breeding in France and elsewhere in Europe have yet accomplished any very important results beyond the supply of spawn to private operators, and, what is of more consequence, the furnishing of satisfactory experimental evidence that the artificial breeding of fish is not only practicable, but may be pursued with advantage as a branch of private industry, requiring less labor, and not more care or skill, than most other rural employments, by any person who possesses a sufficient extent of appropriate territory and water.

There is little which is new in the methods now followed in France, and they are substantially the same as those originally proposed in Germany by Jacobi, and successfully pursued by him and his successors for a century, though it is but lately that they have received the attention their importance merits. That, with such modifications as difference of climate, species, and natural facilities shall require, they will be equally successful with us, there is no ground for doubt, and the effort to introduce them is well worthy of public encouragement.

As has been already remarked, the fattening, and to some extent, the breeding of fish wholly in artificial reservoirs has been long and widely practiced in Europe, and not unfrequently in this country, but it is not believed that methods, which leave so little to nature can be advantageously pursued on a larger scale. Trout thus grown are so inferior in flavor to fish caught in brooks and mountain lakes, that they can scarcely be recognized as belonging to the same species, but if hatched, protected, and fed during the first year or two in artificial waters, and then dismissed to seek such food as nature provides, they equal in all respects naturally bred fish, and may be greatly multiplied in number, without any diminution in size, or deterioration i n quality. The introduction of fish from distant waters, and their naturalization in their new homes is also practicable to an indefinite extent. Thus the gold fish of China, accidentally escaping from artificial reservoirs in this country, breeds and thrives in American rivers; many fish have found their way from the Hudson to the Great Lakes, and from the lakes to the river, since the opening of the New York Canal, and multiplied in both, and it is even said that a gentleman in New York has succeeded in so far changing the natural habits of the shad, that they pass the whole year and freely breed in his fresh water ponds, without returning to the ocean, or having otherwise access to salt water.

The subject of artificial fishbreeding has attracted much attention in other States, and many interesting experiments have been already tried, or are now in progress, in different parts of the Union. Printed accounts of these are readily accessible, and they are therefore not here detailed, but it has been thought expedient to append to this report an abridged translation of an excellent essay by Professor Vogt, of Geneva, in Switzerland, together with extracts from a Report to the Legislature of Massachusetts, and from the Transactions of the Connecticut State Agricultural Society.

It is recommended that a sufficient number of these documents be printed for general distribution in all parts of the State, and it is thought that they, with Fry's complete treatise on Artificial Fish-breeding, published in New York in 1854, and Garlick's Treatise on the artificial propagation of fish, published at Cleveland, Ohio, in 1857, both of which may be easily obtained, together with such experience as a few

trials cannot fail to give, will furnish all information necessary to enable any person of ordinary intelligence and possessed of the requisite local facilities, (such as clear ponds, or a sufficient extent of the course of a perennial brook), to prosecute this branch of industry with advantage.*

The amount of care, time and money required for commencing and continuing a moderate breeding establishment in favorable situation, is altogether insignificant, and would not perceptibly increase the labor or the expense of an ordinary farm, while on the other hand, our supply of healthy and agreeable diet might be greatly augmented, and the general prosperity proportionally advanced.

If private persons undertake experiments in the breeding and rearing of fish, whether for scientific investigation or purposes of profit, there is no good reason why industry and capital thus employed should not receive the same protection as the breeding of any other animal, and it is believed that some legislation should be adopted, prescribing the same penalties for the taking of fish in waters which the proprietor has publicly signified his intention of appropriating to his own exclusive use, as for a trespass or a theft committed upon any other personal property.

It is probably too early to attempt the adoption of legislative measures for restoring the primitive abundance of the public waters of Lake Champlain, but when private observation and experiment shall have made the subject more familiar, it is to be hoped that means may be devised for again peopling them with the lake shad (white-fish,) the salmon, the salmon-trout, and numerous other species of fish, which formerly furnished so acceptable a luxury to the rich, and so cheap a nutriment to the poor of Western Vermont, but which now are come almost as nearly extinct as the game that once enlivened our forests.

GEO. P. MARSH.
Montpelier, Oct. 10, 1857.

*Note.--It deserves to be noticed, by way of suggesting a caution which it may be important for us to observe, that the forming of large artificial reservoirs, and damming up or otherwise obstructing and diverting the natural flow of water, has in many instances been found injurious to the health of the vicinity by promoting miasmatic exhalations, and that these works have in Europe often serioiusly impeded the drainage of the soil, and other modes of physical improvement. The tenacity with which the monks adhered to their privileged fisheries, long delayed the execution of the most interesting and remarkable enterprise, the draining and elevation of the bed of the Val di Chiana in Tuscany; and extensive tracts of the richest soil in Sicily are at this moment kept in the condition of barren and pestilential wastes by similar causes.