XIII.—THE FISHERIES OF INDIA.*

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The subject which I shall have the honor to bring before you this evening is that of the fish and fisheries of India and its dependencies. Possibly there are other questions pertaining to the East which would prove more attractive and likely to engage attention than fish; but I think there is not one which could be selected more directly interesting to the teeming millions of our Indian Empire, and which requires so much investigation from our legislators, philanthropists, and scientific inquirers.

ORIGIN OF FISHERIES.—Doubtless one, perhaps the greatest, reason why many persons take an interest in this class of the vertebrate animals consists in the food they afford, and the occupation they give to man. But when we consider the subject more closely, we find that in our everyday life we are profiting extensively from the lessons which our ancestors received from the finny tribes. Man, in his savage condition, has the natural instinct of desiring food when hungry. Whether he can or cannot subsist solely upon vegetables is immaterial; his canine teeth demonstrate his carnivorous propensities, and, nauseated with a vegetarian diet, he would naturally seek change by the addition of animal substances. If living near water, more especially on the sea-coast, the hungry savage would first resort to such mollusks, crustaceans, and fish as he could capture in the shallows, or were left there by a receding tide; but as his wants increased, and the source of supply began to diminish, he would have to adopt other devices. He would wade after his prey, pursue them with spears, shoot them with bows and arrows, as the Andamanese do to this day, obtain them by setting up dams and weirs, or intoxicate them with poisons.

But, again (unless consequent upon some peculiar circumstances), the time would inevitably arrive when augmented captures would be desired; man would then have to venture further out, to dive after his prey, employ nets, to float upon a log, or fasten pieces of wood together as a raft, and in due succession would come the construction of a boat, and finally that of a ship—this last being necessary for the purpose of

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extending his range to better fishing-grounds, or exporting his spoils to distant markets. Consequently, the basis for navigation and commerce may reasonably be supposed to have been laid by man pursuing the finny tribes for the purpose of obtaining them for food, or conveying them dried or cured as an article of merchandise to transmarine countries. The very history of sea fisheries, which have been free to all, seems to point out that, as man increases in numbers, inshore captures of fish becomes insufficient for his requirements; or else that continuous fishing may diminish the supply, rendering it equally necessary that the fisherman's occupation should be extended to more distant localities.

A.—FRESHWATER FISHERIES.

Freshwater fisheries differ in many respects from marine ones; and we are all aware that, wherever any quantity of fresh water exists in the East, there we are almost certain to find fish; and this from a sea level to nearly the summit of the highest mountains. As a natural result, fishing is had recourse to, in various ways, in rivers, irrigation canals, lakes, tanks, ditches, inundated fields, and swamps. The importance of such fisheries is not solely in a ratio as regards their productiveness, but also in accordance with the character of the adjacent people as to whether they are or not fish consumers; while the sparseness or the density of the population has also to be taken into account.

Where no regulations are in force for the protection of inland fisheries, and should other circumstances be equal, that country or district which is most densely populated by man will be least so by fish. Individuals would rather live by fishing than by agriculture, because the trouble of capturing the finny tribes is less than that of tilling the soil. It becomes simply catching food, without a thought respecting future supply. Fish have been endowed with certain means of increase and protection; the number of their eggs may be enormous, while some forms keep guard over their eggs and likewise over their fry, in order to afford them protection from their enemies.

As, however, man increases, watery wastes (wherein the fish had been protected by grass, reeds, bushes, and the roots of trees) become drained and cultivated; predaceous man increases his means of destruction; an augmented population, possibly assisted by the unscrupulous manufacturer or miner, pollute the previously wholesome water, and a diminution of the finny tribe becomes apparent to the investigator.

With an increasing fish-eating population an increased supply of fish thus becomes a self-evident necessity, and this must be provided for by augmented captures or higher prices; the latter acting as a check on the poor, by more or less placing it out of their reach. This latter result may, consequently, eventuate in gradually diminishing the physical strength of the people. For a greater supply must be had from one of two sources, either from fisheries which previously have been insufficiently worked, or by overworking such as exist, by means of capturing

for present use those which ought to be left for a future season. Even if the extent of the water is so great, and the inhabitants so few, that this result need not be anticipated for several generations, still, populations under good systems of government have a natural tendency to increase. Means of carriage generally improve with time, and should neither regulation nor care of the fisheries be attempted, disastrous results must eventually be arrived at. Fish appear to have few friends and many enemies, and investigations as to their condition generally ends in giving increased license to their captors, for it is so easy to be liberal at other people's expense. We see interested parties and philanthropists (so-called) exclaiming against the hardship to the poor in not allowing every available fish to be secured. The majority of our law-makers are content to allow the fish to shift for themselves, and to leave the fishermen to be controlled simply by their own consciences. To-day's market, it is hoped, will be supplied; sufficient for this season, it is expected, may be obtained; so let to-morrow's wants be met as they can.

Classes of Indian fishermen.—The fishermen of the fresh water of India and Burma are divisible into two main classes: first, such as follow this calling as their sole means of livelihood; and, second, such as engage in it only occasionally, and as a subsidiary occupation. Who, then, are these Indian fishermen? Here, even within the limits of a single, or at least of a few generations, great innovations have crept in; for in the time of native rule, fishing was in the hands of distinct castes, but now it is only here and there that one comes across some remnants of these people, living in small communities, and frequently in the greatest poverty. At Combaconum, in Madras, there is a tradition that the fishing castes resident there were originally brought from Conjeveram as palanquin bearers, while at Broach, in Bombay, two subdivisions of these people are named in accordance with the villages from which they originally migrated.

Present decrease of fisheries.—In native states, fish have obtained great consideration. Thus in Mysore, in the time of Hyder Ali, very stringent fishery laws existed; whereas, at the present day, about two-thirds of the population of some divisions of the country occasionally add fishing to their other occupations, nearly every villager possessing a fish net or trap, to be employed as occasion or opportunity arises. Now fisheries are open to all; a fisherman's calling is no longer a profitable one, mainly due to the fisheries being depopulated. When whole districts were let to contractors, they were not so short-sighted as to permit an indiscriminate destruction; but now everybody does as he likes, when he likes, where he likes, and how he likes. Thus it has come to pass that among the animal productions of India, freshwater fish meet with the least sympathy and the greatest persecution; many forms having to struggle for bare existence in rivers which periodically diminish to small streams or even become a mere succession of pools,

or in tanks, from which the water totally disappears. They have their enemies in the egg stage, in their youth, and during their maturity; but among these man is their greatest foe, as any one who desires a fish diet captures these creatures whenever and wherever he gets the chance, irrespective of season, age, and size. In certain districts they simply appear to exist solely because man and vermin have been unable to destroy them.

Fisheries may be let to a contractor, and if their extent is large he takes partners or sublets portions; sometimes he employs servants, who are paid partly in money, or food, clothing, and lodging, and partly in a share of the captures. In some districts the fisheries, or a portion of them, are declared free, but a license fee is charged to the fishermen; or the general public is free to take fish for home consumption, but not for sale. Lastly, no regulations at all may exist, due to the general poverty of the fisheries, peculiar difficulties in their capture, or the general impecuniosity of the inhabitants.

When the public have more or less depleted fisheries, the fishermen become poorer and poorer, unless they turn to other sources of obtaining money; at first, no doubt pleased at the remission of rents, and the removal of all restrictions upon fishing, they employ redoubled energy, and thus augment their immediate profits. But soon the general public find that nothing precludes their fishing in any way they please; the markets become glutted, and the price may fall for the want of purchasers. But after two or three years fish become scarcer; fishing is no longer remunerative; removing the rents from fisheries and throwing them open to the public will not decrease the price of fish. The rates ruling in India are comparative to what obtains for meat and other articles of animal food. Fishermen, living on free fisheries, do not dispose of their capture below market rate, any more than farmers who possess rent-free farms sell the produce at less than their neighbors. If the fisherman benefits, the purchaser does not, and their misapplied energy eventuates in nothing but small fish remaining. The young have to be raised from ova of such as are merely one or two seasons old, while the younger the parent the smaller the eggs, and this, I believe, is one mode in which races of fish may deteriorate.

Natural and artificial causes affecting fisheries.—The rivers which have alpine sources, as such as descend from the Himalayas, have, exclusive of springs, two most abundant sources of replenishment. During the hot months this is derived from melted ice and snow, while during the monsoons the rains assist; we may then have the hill rivers forming torrents, rising rapidly, and as rapidly subsiding, and possessing no contiguous tanks into which the fish could retire. These animals are peculiar, or endowed with means of existence differing from such as live wholly or mostly in waters of the plains. Many of the fish are provided with adhesive suckers, situated behind the lower jaw or placed on the

chest, which enable them to fix themselves against rocks, and so prevent their being washed away by the stream.

Through the cold months, and generally until the setting in of the southwest monsoon in June, rivers are at their lowest, some at this period (especially in hilly regions) being merely a succession of pools, united by a more or less significant stream, in which limited localities the fish take refuge, and may be easily secured by fishermen.

Among the artificial causes affecting fisheries in many districts are the irrigation works, which are formed by throwing a weir or bund across a river, and diverting a large amount of its water down a main irrigation canal. These weirs are usually built as stone walls across the entire breadth of the rivers, and consequently impede both the upward and downward passage of fish that are endeavoring to migrate, while, should they be sufficiently high, they entirely stop them. Where large under-sluices are present, fish can pass up such when open; but up the long narrow ones, as constructed in Madras, the strength of the current renders this impossible. The under-sluices are here closed, except where there is an excess of water, as during the monsoon months; and as the weirs have no fish-ways, not only is ascent towards the breeding-grounds intercepted, but fisherman are permitted to capture the fish which are detained here. Standing on those weirs, one can see the fish jumping against the obstruction, which they vainly hope to surmount; some strike against the piers of the bridge, others fall into the cascades, descending over its summit; but to them the wall is an impassable obstacle.

The irrigation canals may be said to be streams obtained by diverting a large amount of water from a river into a new channel, and this, of course, would be taken from above the weir; consequently, all fish descending the river would be diverted into the irrigation canal. If these canals are constructed for navigation as well as for irrigation, the fish can pass along them; but if due to falls, they are unsuited to navigation, then the fish can descend them, but are unable to reascend. They then become vast fish-traps, wherein all the finny inhabitants are destroyed whenever the canals are run dry in order to examine their condition and see what annual repairs are necessary. Passing off on either side of these canals are lateral irrigation channels, which are employed to water the crops directly, and at each successive replenishment of these another shoal of fish passes to inevitable destruction. Unprovided with gratings at their entrance, and kept filled only on alternate weeks, all the fish which enter invariably perish. The same destructive process exists throughout India wherever irrigation is carried on.

As the yearly rains cause inundations of the country by the overflowing of the rivers and tanks, fish move about in order to find suitable localities for breeding in, and the small streams and their outlets resemble the net-work of irrigation channels. Many species ascend them to to spawn, but find at every turn appliances invented by man ready for

their destruction. Persons may be watching to intercept them, engines or traps may be fixed in their course; or, should any breeding fish succeed in effecting their ascent, means are taken to insnare them on their return, while the fry are destroyed in enormous quantities—a proceeding which has been declared not to be waste because they are eaten.

Then there are tanks, some of which are, others are not, in connection with running water. Should they entirely dry up during the hot months, only such fish as bury themselves in the mud will survive to the next rainy season. As a rule, the owner of a tank, if it is employed also for fish-culture, leaves one portion (the deepest) in order to retain sufficient water to keep the finny residents alive, while, if very hot, boughs of trees or tatties are placed over this locality to mitigate the heat.

I shall now pass on to consider the fishes inhabiting the fresh water of India, Burma, and Ceylon. They may be divided into (1) those which enter from the sea for breeding or predaceous purposes, and (2) such as, more or less, pass their lives without descending to the salt water. The first class I do not propose giving any detailed description of, unless casually remarking upon such when the breeding of fish or the fisheries come under review.

Varieties of freshwater fish.—An exhaustive account of all the strictly freshwater forms would doubtless be interesting scientifically, but hardly so to the fisherman or general reader; consequently I shall restrict myself to observing that the fisheries alluded to contain about 369 species, appertaining to 87 genera. Of the spiny-rayed, or *Acanthopterygian* order, we have 19 genera, the members of which are most numerous in the maritime districts and deltas of large rivers, while their numbers decrease as we proceed further inland. Few are of much economic importance, if we except the common goby, spined-eels (*Mastacembelidæ*), the snake-headed walking-fishes (*Ophiocephalidæ*), and the labyrinthiform climbing-perch and its allies.*

Of the sheat-fish, or scaleless siluroids, we have 26 genera. The mouths of these forms are provided with sensitive feelers, which, serving as organs of touch, assist them while seeking their prey in turbid waters. All that are of sufficient size are esteemed as food, although, owing to their propensity for consuming unsavory substances, their wholesomeness appears, at times, to be questionable. The next 3 genera, gar-pike (*Belone*), Cyprinodon, and Haplochilus, are of but little value, but the 35 genera of carps and loaches are of the greatest possible consequence, affording a large amount of food to the population of the country. The remaining 4 genera, consisting of the curiously flattened *Notopterus* and 3 forms of eels, are of but little mercantile importance.

* These air-breathing fishes are of great economic importance; thus, when poisonous ingredients are washed into rivers, on the first burst of the monsoon, the fishes die, unless they are direct air-breathers, taking in atmospheric air direct, when they are often able to exist until the poison has passed down stream.

1.—Reproduction of fish.

How the reproduction of these fishes is carried on becomes a most necessary investigation, and in briefly considering such we might inquire into what migrations they undertake for this purpose? Whether the parents are monogamous, polygamous, or are annuals, dying after the reproductive process has been accomplished? The time of year when spawning occurs? Whether such is or is not deleterious to the parent? The size of the eggs, their color, whether they float or sink, are deposited in running or stagnant waters? If they are covered or left uncovered in their nests? If the male carries them about or protects them? Can their germination be retarded by artificial means or natural causes, as by the action of cold or their immersion in mud?

Migration of spawning fish.—That anadromous forms, as the salmon or shad of Europe, or the shad (*Clupea palasah*) of India, migrate from the sea to the fresh waters to deposit their eggs in localities most suitable for their reception is well known. If we examine into the migration of Indian fishes for breeding purposes in fresh waters, we find that such takes place under three conditions, viz.: (1) Anadromous forms from the sea to the fresh waters, as already adverted to; (2) Such species as may be considered pertaining to the mountains, or else deposit their ova in the rivers of the hills; (3) Such as are restricted to the plains, but which likewise undertake certain changes of locality at these periods. Of the migratory hill-fishes the various forms of large barbels (*Barbus*), termed *mahaseers*, furnish good examples. In the Himalayas they ascend the main rivers, but turn into the side streams to breed, while on the less elevated Neilgherry Mountains, in the Madras Presidency, the same phenomenon occurs, but with this difference, that they deposit their ova in the main streams because such are small, and perhaps due to their never being replenished with snow-water. Occasionally the fish are too large to ascend these mountain rivers, when they would appear to breed at the bases of the hills. Whether it is from the offspring of such that this genus has extended through the plains it is not my purpose to inquire in this place. When the rivers commence being in flood, adults are able to ascend to feeding-grounds which were previously inaccessible to them. Having spawned, they keep dropping gently down stream, during which time the amount of water is diminishing; thus the ova, when hatched, are completely cut off from the locality where their parents reside, precluding their making a meal of them. The fry, therefore, have the heads of the rivers to themselves in perfect security, and each torrent becomes transformed into a small stream intersected by pools, where they can remain until the next rain enables them to descend to the larger rivers. Of the migratory fishes of the plains we may observe many forms of carp, and this is more particularly observable where impassable weirs exist in Indian rivers; here they may be perceived in attempting to jump over the obstruction, and so common

is this phenomenon that the natives of India hang baskets, cloths, even native cots turned upside down, or anything equally suitable, over the sides of the piers, and into these the fish fall.

Monogamous and polygamous fish.—In Asiatic waters we have monogamous and polygamous forms and other phenomena as to breeding, which deserve attention. The walking, or snake-headed fishes (*Ophiocephalidæ*) of India, and other amphibious genera, are perhaps the best known of monogamous fishes; some of them reside in ponds, others prefer rivers, where they take up their residence in deserted holes which they find in the banks. The pond species delight in lying at the grassy margins, where the water is not deep enough to cover them, and here they are able to respire atmospheric air direct. The striped walking-fish constructs a nest with its tail among the vegetation, and bites off the ends of the waterweeds; here the ova are deposited, the male keeping guard; but should he be killed or captured, the vacant post is filled by his partner. The hissar, *Callichthys*, of South America, is likewise monogamous, constructing nests, which it also defends. The majority of fishes unquestionably are polygamous, as has been repeatedly observed, and, perhaps, as distinctly among the salmon as any other form in a wild state, and likewise in sticklebacks resident in aquaria; while, doubtless, fishes which migate in shoals for breeding purposes, as the mackerel, herring, or some forms of carp, are all polygamous.

Time of spawning.—The time of the year at which spawning is effected varies in accordance with the locality and the family of fish. This again appears to be further susceptible of modifications in accordance with the temperature of the water, and many other local causes, while there are some fishes which breed only once a year, others more frequently. I must here premise that some fishes do not appear to feed during the season of depositing their spawn, as the salmon, the shad, and the siluroid *Ariinæ*. In India an anadromous shad, termed "Pulla" in the Indus, "Ulum" by the Tamils, "Sable-fish" by the Madrasees, "Palasah" by the Telingis, "Hilsa" or "Ilisha" in Bengal, "Nga-thalouk" by the Burmese, breeds in rivers as already described. In Sind they ascend the Indus in February to spawn, descending in September. In the Cauvery, in Madras, they pass up when the first burst of the June monsoon fills the river, and they continue doing so for the succeeding four months. In the Krishna, which has a far greater velocity, but, similarly to the Cauvery, is filled in June, they defer their ascent until September, but it is not until the end of the month or commencement of October, when the river is subsiding and its velocity decreasing, that the majority arrive; whereas in the neighboring river, the Godavari, in which the current is less rapid, these fish ascend earlier to spawn, being most numerous from July to September. In the Hooghly they continue ascending throughout the June monsoon, and many are found still in roe in September. The main bodies of these fish ascend the

large rivers of India and Burma generally when the June monsoon commences, but not always at the same period, such apparently at times being dependent upon the rapidity of the current and other causes. That it is not due solely to the presence of rain-water flooding the river is evident, because those of the Indus and Irawadi are mainly caused by melting snows at this period, and likewise in the latter river these fishes push on to Upper Burma, to which country the monsoon scarcely extends, but where the inundations are due to snow floods. Probably the cause of the majority of fishes at these various periods ascending the different rivers to spawn may be due to their having been bred there, while inherited instinct causes them to select the most suitable times, when the shallows are covered with water and ascent is rendered practicable. It is evident that members of the same family, genus, or even species, may spawn at very different periods, due to local or climatic causes. There are also fishes which deposit their ova twice yearly, if not more frequently; these are generally freshwater forms, and are not rare, especially in tropical countries; as an example we have the walking-fishes.

Effect of spawning on parent fish.—Has spawning any deleterious effect upon the parent fishes? To this, two replies may be given, as in some cases it renders their flesh unwholesome, while in others it does not cause their character as to food to be altered. The shad in the East are excellent eating up to the period when they have deposited their eggs, subsequent to which they become thin, flabby, and positively unwholesome; the salmon have similarly an unhealthy lean and lank condition, rendering them unsuitable for the table. Freshwater fishes that deposit a smaller number of eggs, or, perhaps, do so more gradually, or twice at least during the year, do not invariably appear to be so deleteriously affected by breeding, this condition being more restricted to the anadromous forms.

Size, color, and protection of eggs.—The size of the eggs, their color, and whether deposited in ponds or in the sea, are likewise questions affecting the breeding of fish. The forms which produce the greatest number of eggs are often those which live in large communities and spawn once a year. In an Indian shad I found 1,023,645 eggs. But other forms have likewise numerous eggs. I oberved 410,500 in a barbel (*Barbus sarana*); on the other hand, some fishes have large eggs, as a few of the sheat-fishes, and a genus of carp (*Barilius*). In such as spawn at least twice a year, and likewise protect their young, the number of eggs is less than what generally obtains in other genera; thus in a walking-fish (*Ophiocephalus*) I found 4,700.

As to the color of fish eggs, they are very diversified; in some freshwater siluroids they are of a light pea-green, as I have observed in the scorpion fish (*Saccobranchus fossilis*). Respecting the localities where fish deposit their eggs, these are exceedingly various, as might be anticipated, owing to some sinking in the water while others float. The

gar-fish (*Belone*), and the flying fish (*Exocœtus*), have filaments springing from their eggs for the purpose of attaching themselves to contiguous objects; others are covered with a glutinous secretion. In fresh waters eggs may remain at the bottom, either covered or uncovered.

Among the marine siluroids (*Ariinæ*), the male carries about the large eggs in his mouth until hatched; or it may be that he only removes them from one spot to another to avoid some impending danger. However this may be, I have netted many along the seacoast with from ten to twenty eggs in their mouths, and in one example was a young fry just hatched. In none of these large males was there the trace of any food in their stomachs.

Artificial hatching and transportation.—Bloch, at the end of the last century, made many experiments as to the feasibility of fish being artificially hatched, and also whether it was possible to convey the ova in safety for any considerable distance. He proposed placing the eggs of pond fish in mud, similar to that existing in the locality from which the eggs were procured, and he believed that when the mass had dried they could be thus removed without injury from one pond to another. His proposal was based upon the theory that frequently on dried-up ponds being refilled with water, young fish appear, which could only be due to the eggs having been present in the mud, but with their germination suspended. In India, as ponds dry up, some of the fish contained therein descend into the mud, where they estivate until the next year's rains set in. As these commence, and the mud liquefies, fish are perceived diverging in all directions, up every watercourse, no matter how small or how lately it may have been dry, while in a few days fry are distributed everywhere. Where the eggs come from which have produced these fry is a very interesting subject for investigation. Have they remained inside the mother fish, and did she deposit them as soon as the rains set her free? I cannot accept this theory, because I have witnessed fish removed alive from the mud, but they had no ova; and, secondly, because the fry are soon hatched after the setting in of the rains, while some of these fish are oviparous. It seems more reasonable to suppose that the fertilized eggs are imbedded in the mud, and, as soon as the rains occur, they become hatched out, and this would give us reason for attempting to ascertain whether ova of pond fishes imbedded in mud could be successfully transported long distances.

We know that germination of fish eggs can be retarded by cold. In fact, by the use of ice, those of trout and salmon have been safely conveyed to Tasmania and elsewhere.

2.—LEGISLATION ON FISHERIES.

Royalties and licenses in former times.—From the information collected between 1869 and 1873, it appeared that the fisheries in olden times were royalties, mostly let out to contractors, who alone in their respect-

ive districts possessed the right to sell fish, while they, as a rule, permitted the people, on payment, to capture sufficient for their own households. In was, in fact, a license on payment, resumable at will. Remains of this custom still exist in Lahore, while the leasing of fisheries is even now in force in many portions of the Indian Empire. Along the Himalayas, in the Kangra and other districts, the petty rajahs adopted a different method. To some persons they gave licenses to supply the fishmarkets, of which they virtually made them monopolists, while others obtained licenses for fishing with small nets for home consumption, but not for sale. In Burma, under native rule, a similar plan was carried out. There were no free fisheries, but inhabitants had the privilege, or perhaps right, to fish for home consumption on the payment of a fixed annual sum to the contractor for the district in which they reside. It is believed that under native rule the erection of fishing weirs was permitted in several of the streams in the Himalayas, but not to the extent that it is at the present day. In some districts landowners even now raise an income from the fisheries, claiming a third of the captures or a certain amount of money. Some of our officials consider that as the Government has permitted indiscriminate fishing, the exercise of long practice has converted such into a communal right.

Fishing under British rule.—As British rule has gradually superseded that of the native princes, so the modes in which fisheries were leased have become widely different, and in permanently settled estates, unless a stipulation to the contrary exists, they go with the land. In some localities it has been decided that the adjacent villagers or people possess certain communal rights with respect to them, due, it seems most likely, to a misapprehension. Although it has been proved that the landowner never received more than one-third of the produce, this does not demonstrate that the other two-thirds were public property, but that such expressed the share accruing to the fisherman in return for his labor in capturing the fish. It is the rule in India and Burma to remunerate by the proceeds. Sometimes the working fisherman has to dispose of his share to the contractor or lessee at a given rate; more rarely the fish are sold, and he receives a proportion of the returns, or he may be paid in kind. In some localities the British Government has leased fisheries, or imposed a tax on the implements of fishing, or a capitation tax upon the fishermen, but without interfering with the manner in which the fisheries were conducted. By degrees the tax on fishing implements was taken off, but the fishermen still became poorer, and in 1849, at least in Madras, many leased fisheries were thrown open to the public, resulting, as they were not regulated, in unliminated license, and thus an intended boon resulted in their depopulation. In Burma, the practice of employing fixed engines in irrigated fields and watercourses very largely increased when the native regime became abolished, as did also the custom of throwing weirs across creeks and minor streams.

Injury caused by free fishing.—Free fisheries have been permitted, due to several causes, such as the difficulty in making such sufficiently remunerative to bear taxation or the incidence of rent. This may be owing to the rapidity of the current, the paucity of fish, as in some hill streams and depopulated rivers, the depths of tanks, the presence of foreign substances in them, or the poverty of the general population. How general and indiscriminate fishing ruins fisheries, without any commensurate benefit accruing to the public, I have already stated. In these deteriorated but public fisheries, as soon as the monsoon has set in and the fry are commencing to move about, women and children are daily engaged in searching for them in every sheltered spot where they have retired for security, as, not being able to face strong currents or live in deep waters, they naturally resort to the grassy but inundated borders of rivers and tanks. Every device that can be thought of is now called into use; nets which will not let a mosquito pass are employed; even the use of cloths may be frequently observed. Neither are the agricultural population idle. They construct traps of wicker-work, baskets, and nets; these traps permit nothing but water to pass, and a fish once inside is unable to return, as they resemble some of our commoner kinds of rat-traps. So soon as fish for the purpose of breeding commence passing up the small watercourses at the sides of rivers and streams, these implements of capture come into use; breeding fish are taken, and the few which surmount the obstructions find the traps reversed, so that, although they have ascended in safety, it is by no means improbable that their return to the river will yet be cut off. In Burma a large triangular-shaped basket is employed in places where trapping is difficult, and a pair of buffaloes having been harnessed to it, it is dragged through the localities inhabited by the fry. Even when there are no restrictions, fishermen often find it advantageous to ply their occupation in concert. Sometimes large bodies of villagers proceed at certain seasons of the year to rivers which can be easily bunded, having done which, they kill every fish they are able.

Size of the meshes of nets.—In investigating what is the minimum size of the meshes of the nets in general use in India and Burma (excluding Sind), where no regulations exist declaring what such should be, I received the following replies from ninety-one native officials:

Five native officials report 1 inch as the size between knot and knot of meshes; five report below 1 inch; eighteen report one-half inch; five report one-third inch; twenty-four report one-fourth inch; one reports one-fifth inch; five report one-sixth inch; eighteen report one-eighth inch; four report one-tenth inch; two report one-twelfth inch; three reports one-sixteenth inch; one reports one thirty-second inch. And out of seventy more returns, fifty-three officials compared the size of the mesh to a grain of wheat, mothi, mucca, gram, dholl, lamp-oil seed, barley, tamarind seed, a small pea, a peppercorn, a large needle, a bodkin, quill, coarse muslin, will insnare a gnat, or hardly anything passes. The

remaining seventeen described the smallest size as follows: Size of finger or thumb, five; of half ring-finger, two; as big as a broomstick, one; size of half rupee, one; of a four-anna bit, one; of a quarter of an anna, one; of a two-anna bit, five; of a pie, one.

Fixed fishing apparatus.—The fixed engines employed in India and Burma are mainly divisible into two forms: (1) Those manufactured of cotton, hemp, aloe fiber, coir, or some such material; and (2) others constructed of split bamboo, rattan, reed, grass, or some more or less inelastic substance. Those which are manufactured of elastic substances include all stake-nets, but when the meshes are of a fair size they are a legitimate means, when properly employed, for the capture of fish, but are occasionally to be deprecated, especially when used solely to take such as are breeding. But in some of these implements the size of the mesh is so minute that no fish are able to pass. There it stands, immovably fixed across an entire waterway, capturing everything, the water being literally strained through it. In one instance, in the Panjab, a whole shoal of mahaseer was observed to be captured by natives fixing a net across a river, and then dragging another down to it, thus occasioning wholesale destruction, and ruining the rod-fishing for the succeeding season. This plan is a very common procedure throughout India, as is also constructing earthen dams across streams, leaving a channel or opening through their center, where a purse-net is fixed, and arrests every descending fish. The largest numbers are taken towards the end of the rainy season, for as the waters fall countless lakes and pools of all sizes are formed on the lowlands in the vicinity of rivers. These, which during the floods were lateral extensions of the stream, now become lakes, having one or more narrow outlets into the river; across each opening nets are stretched, or a weir of grass constructed, and every fish which has wandered up becomes a certain prey to the fishermen.

Fixed engines constructed of non-elastic substances are still more destructive to fish than are such as are made of net, and which are more liable to be rent. Their forms are exceedingly numerous, their sizes infinite, while the interstices, between the substances of which the weirs or traps are composed, appear everywhere much the same, whether examined in the ghats of Canara, the yomas of Pegu, the Himalayas, or on the plains of India or Burma. Still, local influences must occasion some modifications. In hilly districts, as the monsoon floods subside and the impetuosity of the mountain torrents has decreased, they can be erected without being liable to be washed away. Up the hill streams (as I have already observed) some of the most valuable of the carp ascend to breed, and there are now but few which are not weired, and the parent fishes have the greatest difficulty in reaching their spawning grounds. Some, however, surmount the difficulties opposing their ascent; a few deposit their spawn; this completed, the rains are now passing off, the force of the current lessening; but what now occurs to those

fishes which commence descending, trying to regain their low country rivers? I omit in this place how spearing, snatching, or snagging, netting, and angling are carried on, only referring to how fixed engines are employed. Weirs are now erected every few miles, through which the waters of the hill streams are literally strained, while each is fitted with a cruive or fishing trap. The probabilities are that the great majority of the mahaseer which reach the rivers of the plains are the last year's fry that have fortunately escaped destruction during the dry months, and with the first floods have obtained a free highway by the standing weirs being swept away. Wicker traps are likewise constructed across convenient rapids; here few fish can pass without entering, while these are examined twice daily. Or should there be no rapids, such are artificially formed by laying large stones in a V-shape across a stream, while at the apex of this is a trap. Or a mountain stream is conducted down a slope over a large concave basket, so that all descending fish are pitched into it, and speedily suffocated by the rushing water or other falling fish, which act like a succession of blows, preventing their ever rising again.

In addition to the larger weirs and traps, there are minor sorts most extensively employed, especially in the plains; some to capture breeding fish ascending up the smaller watercourse during the rain to deposit their spawn, others to arrest them and their fry attempting to descend the stream as the flood waters recede; and there is not a district, except perhaps in Sind, in which this mode of capture is not carried on. And some officials now speak of the use of these contrivances as communal and prescriptive rights, and their prohibition as an interference with private property.

Movable fishing apparatus.—Movable fishing implements are of two varieties: (1) Those manufactured of cotton, hemp, aloe-fiber, coir, or of some such material; and (2) others made of split bamboo, rattan, reed, grass, or other more or less elastic substances. Large drag-nets, having fair-sized meshes, are used mostly during the dry months, and employed for the purpose of obtaining fish from pools in rivers into which they have retired awaiting the next year's floods. But the movable nets which occasion the most damage are those with small meshes, and principally employed for taking the fry of the fish as they are first moving about; they may be cast-nets with fine meshes, wall-nets dragging up some small watercourses, purse-nets similarly used, and even sheets may be thus employed. In some places several cast-nets are joined together, to stop up all passage of fish along a stream, while others are employed above this obstacle; or several fishermen surround a pool, each armed with a cast-net, and these they throw altogether, giving the fish but little chance of escaping. In Sind the fishermen float down the Indus, in certain suitable localities, upon a gourd or hollow earthen pot, while the net is let down below them; as a hilsa fish, *Clupea ilisha*, ascends up the muddy and rapid stream, it strikes against the dependent net, which is

made to contract like a purse by means of a string that the fisherman holds in his hand.

Irrespective of the modes already detailed as in common use for capturing freshwater fish in India and Burma, there are a number of what may be termed minor plans likewise in force. Sheets have already been remarked upon as employed for taking the fry which have ascended small watercourses, or are found in shallow water, while they may also be used as dip-nets, being sunk in an appropriate place, and raised by strings attached to the four corners, as soon as the fish have been enticed above. Or on the bushes sheets may be placed; here the fry seek shelter from the rays of the sun, and the whole concern is lifted bodily up. A little grain or bread is likewise found useful as a bait. Two pieces of rattan may be employed, crossing one another in the middle, where they are tied together; the ends are then bent downwards in the form of two arches. Here a net is attached, and this the fisherman presses down upon the fish, which are then removed by the hand. In some places they may be so frightened as to permit themselves to be readily taken; thus ropes to which at intervals are attached bones, leaves, stalks of kurbi or jowaree, or pieces of solar (pith), or small bundles of grass, are stretched across a stream; two persons, one at each end, constantly jerk this rope, causing the fish to dart away towards nets that are fixed to entrap them. Snares of the most varied descriptions are almost universally employed; but in some localities angling may be said to be almost unknown, especially in Orissa, or districts where wholesale poaching is preferred as easier and more successful. One method of using hooks is perhaps as cruel as could well be devised. A number are securely fixed, at regular intervals of about 3 inches, to a line for employment in a narrow pass in a hill stream. When used, the rope is sunk from 18 inches to 2 feet below the surface, and held by a man on either bank; others drive the fish towards this armed cord, and as they pass over it the line is jerked for the purpose of hooking the game. In some places dexterity has been arrived at by constant practice, and many fish are thus captured. The desire is to hook the game by its under surface, but, as might be supposed, although in some cases the hooks penetrate sufficiently deep to obtain a secure hold, such is by no means invariably the case. The struggles of the wounded creature frequently are sufficient to allow it to break away, often with a portion of its intestines trailing behind it. If its gill-covers have been injured, respiration may be wholly or partially impeded; crippled, it wanders away to sicken and die in an emaciated state, while, should it be captured before death has stopped its sufferings, it is useless as food, unless to the lower animals. Baited hooks are in some places fastened to lines which are tied to bamboos fixed in the beds of rivers, or to bushes or posts at their edges, and so managed that when a fish is hooked the line runs out. Or a somewhat similar plan is to have a cord stretched across a river, floated by gourds; to

this the short lines which have the baited hooks are attached, but so that they are not long enough to reach the bottom; these are visited every few hours. In some districts night-lines are baited with frogs. Spearing fish by torch-light is extensively practiced in the Punjab and in the Presidency of Bombay, or they may be speared during the day-time in the cold months of the year, when they are not very active. Two persons usually engage in this occupation; the one punts the boat along as noiselessly as possible, while the fisherman stands at the prow silently pointing to the direction to be adopted, and uses his spear when he gets a chance. Shooting fish with guns is carried on in Oudh, and occasionally elsewhere. This is more especially employed for the snake-headed walking-fishes (*Ophiocephalidæ*), which are frequently seen floating on the surface of the water as if asleep. They may be approached very closely, but the game usually sinks when killed, and has to be dived for or otherwise obtained. Cross-bows are also employed for a similar purpose in Malabar. In Mysore—observed the native officials of the Nagar division—fish are taken by nets, traps, hooks, cloths, by the hand, by baskets of different shapes, by damming and draining off the water, by shooting, by striking them with clubs, swords, or choppers, by weirs, and by various descriptions of fixed engines; in short, by poaching practices of every kind, as well as by fishing with rods and lines, and poisoning pools of water. Even fishes' eggs do not escape the general hunt to which the persecuted finny tribes are subjected in these days, the ova being collected and made into cakes, which are considered a delicacy.

Animals destructive to fish.—There are certain vermin in the East which are destructive to fish, some when in the immature, others when in their matured state. Commencing with the crocodiles, two distinct genera have representatives in the waters of India. The true fish-eating crocodile, *Gavialis gangeticus*, with its long and slender snout, attains upwards of 20 feet in length, and is a resident throughout the main courses and affluents of the Indus, Ganges, Brahmapootra, and Mahanadi Rivers, but absent from Burma, and most of those in Bombay and Madras. This species is usually afraid of man, except when he invades the locality where it has deposited its eggs. Their diet appears to consist mainly of fish, turtles, and tortoises. In 1868, I found it was one of the sights of Cuttack to watch these enormous reptiles feeding in the river below the irrigation weir which impedes the upward ascent of breeding fish. The long brown snout of the crocodile would be seen rising to the surface of the water holding a fish crosswise between its jaws; next, the finny prey was flung upwards, when, descending head foremost, it fell conveniently into the captor's comparatively small mouth.

Crocodiles, like predaceous fishes, swallow the finny tribes head first, because, if they are of the spiny-rayed forms, their spines are thus pushed backwards, lie flat, and do not injure the creature which is

swallowing them. Were they taken in tail first, this would erect the spines, and wound every animal which should endeavor to swallow them. Doubtless some forms, while in transit, wriggle themselves round, and get fixed in the gullet of their captors, as the fatherlasher of our coasts.

To show their prolific powers, I may observe that the overseer in charge of the Narrage weir in Orissa came across a brood, and within three hours shot sixty-nine. When at this place I obtained a young one that had become entangled by its teeth in a fishing-net, and asked the fishermen if they ever destroyed them. Astonishment was depicted on their faces, and they protested against the supposition that they had ever been guilty of such a mean action. Their argument was that both classes belonged to the fish-destroying races, therefore, on the principle that hawks do not pick out hawks' eyes, they consider it would be wrong to cause their death. As to the destruction they occasioned, they admitted it, but also observed that they would do as much if they were able. It must not therefore be hoped that fishermen will assist in clearing rivers of these monsters; neither will the native sportsman throw away a single charge of powder and ball on such unremunerative game; which he could not sell and would be unable to eat.

The common crocodile, *Crocodilus palustris* and *C. porosus*, are found in most parts of India and Burma. The reptiles, although often termed man-eaters or snub-nosed crocodiles, assist in depopulating the waters of fish, and it has appeared to me that it is only when they find an insufficiency in the finny supply and carrion that they turn their attention to man and the larger mammals. Every traveler in the East must have seen these logs of wood, as they appear to be, lying for hours at the sides of rivers or on rocks above the surface of the stream, and which sink so noiselessly into the current as almost to make one believe one's eyes had been deceptive, for how could anything so large have so quietly disappeared? In 1868, when at Cuttack, the crocodiles' appetites were not appeased by the fish they obtained, so they commenced consuming human beings, horses, and cows, varying their diet with an occasional sheep or goat. Doubtless, in large rivers, as the Ganges, these reptiles have their redeeming qualities, being the natural scavengers and consumers of carrion. Human beings are now no longer permitted piously to place their dying relatives by the side of the sacred stream, fill their mouths with mud, and leave them to be carried away by the waters or adjacent crocodiles; neither are corpses interred in the current of the holy river. If fish are insufficient, and the crocodiles are not to be destroyed, from whence are these reptiles to obtain their subsistence? The common law of self-preservation will induce them to feed on the cattle of the neighboring country or on such human beings as unwarily approach too near to the waters in which they reside. This is no fancy sketch, but I will adduce merely two instances that came under my notice in 1868. At Cullara exists a hole or pool in the Nuna River to

which these monsters resort during the dry season, and a short time prior to my visit they had succeeded in carying off five adult human beings; while near the Baropa weir two women and one horse were taken by crocodiles in a single month.

Otters are likewise very destructive, especially in the hilly districts, and when they have exhausted the fish they turn their attention to the frogs. In fact, the large frogs, *Rana tigrina*, are evidently considered great delicacies by these animals, for when kept domesticated they even seem to prefer them to fish. In some rivers, as the Ganges and Indus, the porpoise, *Platanista*, is a great fish consumer.

When mentioning animals which compete with man in destroying fishes, there are some families that must not be omitted, although I propose only casually to allude to them. Birds which eat fish are exceedingly numerous, not only in the true swimming and wading forms, but even the Indian pewit may be observed during the dry months, taking its share of the smaller examples of the finny tribe which are more or less exposed to view in the drying-up pools. Snakes luxuriate in irrigation canals and revel in luxury at the bases of the larger weirs. In that across the Coleroon, when the water was low, I was plainly able to see these reptiles lying in wait for the fishes attempting to ascend. I should suppose I never saw less than twenty any evening I examined this weir on its down-stream race. Tortoises and turtles are fish consumers; while most fishes prey upon their weaker neighbors or their eggs. Near Ganjam, a native official informed me that he had ventured out one night to see how murrul, the walking-fishes, were captured. The fisherman was provided with a long flexible bamboo as a rod, and as a bait used a live frog. Hardly had the frog splashed into the water when a moderate-sized murrul seized and swallowed it. Desirous of observing what would next occur, the fish was left on the hook, as a bait for anything else. Before long a large water-snake was seen swimming towards it, and soon had the fish inclosed in its capacious jaws, and in this fashion all three were pulled together out of the water. Frogs appear to relish fish-eggs, and to be by no means adverse to devouring the fry occasionally.

Legislative protection of fish.—Considerable discussion arose upon this subject in India, some high officials suggesting that a falling-off in the quantity of freshwater fish is no reason for legislative interference, unless it could be demonstrated that a danger of annihilation existed. The viceroy summed up the question in the following suggestive sentences: "Is the present plan of non-interference likely to insure to future generations the fullest possible supply of this food staple? Is it even such as to insure their inheriting a supply equal to that which now exists. The governor-general in council apprehends that both these questions must be answered in the negative, and not only is there no prospect, as matters now stand, or of an increased supply hereafter, but

that, owing to the absence of precautionary measures and reasonable restrictions, the existing supply is diminishing."

Before concluding this portion of my paper, I must refer to an experiment which has been made in India for the purpose of protecting fisheries. If no destructive waste was existing prior to the commencement of protective measures, no augmentation of the fish would have become apparent; if, however, very beneficial results have ensued, there does not appear any reason why such should not be extended elsewhere. In South Canara, Mr. H. S. Thomas observed that it may be doubted whether the poisoning of rivers or the wholesale destruction of fry is most injurious to fisheries; while the effect of prohibiting the finer and closely-woven bamboo cruives has been that the most ignorant, and therefore the most obstinate, opponents have been convinced by the testimony of their own senses, and have exclaimed, to use their own words, "Truly the river is everywhere bubbling with fry;" and, what is still more to the point, their practice has not belied their words, for they have taken to fishing on grounds that were before considered profitless. Two years' discouragement of poisoning, and one year's discouragement of fine cruives, have worked such a change that it has been demonstrated, beyond cavil even of the ignorant and of the most interestedly opposing, that marked advantage can be reaped from the adoption of these two simple measures alone.

What measures have been instituted in order to mitigate the condition of the fisheries I have been unable to ascertain. Sir Richard Temple says, "No result worthy of note." An act (VII of 1875), however, has been passed for Burma, for the protection of the fisheries; while Mr. Buckland, member of the revenue board in Calcutta, remarked (November, 1879) that the following figures show the progress which is being gradually made at Goalunda, at the confluence of the Ganges, and Brahmapootra, where hilsa fish abound: Fish cured 1875, 1,362 maunds; 1876, 4,835; 1877, 10,800; 1878,* 14,000. He concludes that "there is, therefore, some reason to hope that Dr. Day's proposal may bring some good fruit after awhile."

3.—Consumers of Fish.

Before passing on to the sea-fisheries, I propose considering what proportion of the people of India and Burma use fish as food, or rather can do so without infringing caste prejudices.

In the Panjab, comparatively few of the inhabitants are prohibited by their religion from consuming fish, but there are many Hindus who reject it, as well as the rural population of some districts. But of those residing in towns, and in hilly ranges, it appears that, if the Brahmans are excepted, the consumption of fish is limited only by the

* This shows an increase of 1,043,215 pounds of fish in a year in one locality, where in the first of the four years nearly 112,073 pounds were prepared.

paucity of the supply and the cost of the article. In Sind fish is generally eaten by the population of the province, whether Mussulman or Hindu, except the Brahmans. In the northwest provinces, containing about 28,000,000 of population, out of twenty returns received from native officials seventeen give more than half of the people as not forbidden by religious scruples to eat fish. In Oudh, the majority of the people appear to eat fish, but the supply is unequal to the demand. In the Bombay Presidency, the majority of the inhabitants of the inland districts are consumers of fish when they can procure it. In Haidarabad, Mysore, and Coorg, more than half the population are fish consumers; in South Canara, 89 per cent; in Madras, the majority, the exceptions being Brahmans, goldsmiths, high-caste Sudras, the followers of Siva, Jains, &c. In Orissa, more than half the people; in Bengal proper, from 90 to 95 per cent; in Assam and Chittagong, almost the entire population; and in Burma, in the form of *nga-pee* its use is universal.

As Buddhists, the Burmese profess a religious horror at the taking of the lives of lower animals, but being immoderately fond of fish diet, they console their consciences (while indulging in it) with the idea that the deaths of those animals used by them as food must be laid to the account of the fishermen, and cannot in any way be attributed to the consumer's fault. The walls of their temples have pictures of the terrible tortures the fishermen will have to endure in a future state of existence. In some of these interesting representations are large fires being stirred up by devils, while other evil spirits are dragging more fishermen in nets towards the burning, fiery furnace, helping on some by striking fishspears into them from behind, and hauling them forward by hooks and lines towards the place of punishment.

But, it may be asked, are these ponghees' (priests') practices in accord with their teachings? By no means, as the following example will show. At Yahdown, on the banks of a branch of the Irawadi, a fisherman (Een Thoogye) built a *Kyoung*, or monastery, as his great hope was to be termed a *Kyoung taga*, or founder of a monastery, a highly prized title amongst the Burmese. Ponghees came, and ponghees went away, but they did not care to remain and partake for any lengthened period of the hospitalities of their host and disciple. At last one old priest appeared, who seemed to consider the quarters as desirable. To him, in great trepidation, the owner put the following question, "Why, my father, do not the ponghees approve of my monastery, for none but yourself have remained over the going down of two suns?" "Because, my son," replied the holy man, "do you not break the law by depriving fish of life?" "True," he answered, "but were I not to do so, how could I supply your table with fish, or how could I live were I to give up my employment?" The only reply he could obtain was, "Better to fast while keeping the law, than to feast while breaking it."

With sorrow the disciple took the priest at his word, and for three days refrained from fishing, giving his preceptor merely vegetables for his diet. On the fourth morning, when the same fare appeared, the ponghee observed, "My son, when you fish the river, does your net extend all across, permitting no fish to escape; or is a portion of the river free for those which select to pass to one side?" "Not all across, but only one-third of the way," he answered. "Well then, my son," said the priest, "I have been seriously considering the subject, and have arrived at the conclusion that, if you leave room for the fish to ascend or descend the stream, and they will not avail themselves of it, but rush headlong into the net, the fault is theirs and not yours. Even Guadama blessed the hunter who met him when he was hungry and supplied him with venison. This was accounted as a meritorious act, although he must have killed a deer to obtain it. So go, my son, and procure me some fish, for I am hungry." From that day the priest consumed his fish in quietness, and refrained from inquiring from whence it had been procured.

Supplies to the markets.—Investigating how the local markets were supplied with fish up to 1873, the replies from native officials gave the following results. In the Panjab one in ten markets was sufficiently supplied; in the northwest provinces, one in three; in Oudh, one in four. In Bombay the amount was stated to be insufficient in all, and the same reports came from Haidarabad, Mysore, and Coorg. In Madras, near the sea, the quantity of fish was sufficient, but only in one in ten of the inland markets. In short, merely one-tenth of the bazars were reported as fully supplied with fish; and of this tenth one-fifth obtained them from the sea-coast.

B.—SEA FISHERIES.

Fisheries, to a more or less extent, exist in the Indian Ocean, as well as up the mouths of the larger rivers, in backwaters and estuaries, while parallel to certain places, especially along the coasts of the Madras Presidency, vast mud banks are present in the sea, having such a thin consistency that many kinds of fish are able to obtain abundance of food there, as well as a suitable locality in which to deposit their ova. The most casual observer cannot fail to perceive how numerous are the varieties and vast the number of the finny tribes in the seas of India, but from some cause—whether due to the legislative enactments and local obstructions, or to native apathy and impecuniosity—the harvest has, up to within the last two years, been comparatively untouched; an enormous amount of food still remains uncaptured, while famines are devastating the contiguous shores.

Want of space must be my excuse for not entering upon the various forms of fishes which populate the seas of India, and I pass on to their economic uses, for their well-stocked fisheries should be exceedingly valuable, as affording an inexhaustible supply of animal food, not only

to persons residing in their vicinity, but also inland, should means exist to transport such in either a fresh or salted condition. The extent of the seaboard of India and Burma has been estimated at 4,611 miles; the fisheries are uninfluenced by recurring droughts, and ought to afford an inexhaustible harvest of food along the entire coast of the country.

Irrespective of mere food, maritime fisheries ought to be serviceable directly, as producing isinglass, fish-oils, and manure; or indirectly, as necessitating materials for the building of vessels, the manufacture of nets, hooks, and lines, the carriage of produce, &c. The modes adopted for utilizing fish as food along the sea-coasts of India and Burma may be considered under (1) fresh fish, how far they can be conveyed inland; (2) dried fish and its varieties; (3) cured or salted fish, and how prepared.

Transporting fresh fish inland.—How far can fresh fish be conveyed inland? In examining this question, if the employment of ice or salt is omitted, the distance sea-fish can be carried inland, while fresh, depends upon several circumstances. The season may curtail this, as during the hot months putrefaction commences very rapidly; while some forms, especially the immature, the herring, and the siluroids, decompose more quickly than others; and the same result follows close packing, or want of protection from the full force of the sun's rays. Usually fish are not landed until after sunrise, while those brought on shore of an evening are generally kept where they are until the next morning, coolies being averse to traveling after dark. On the other hand, facilities of carriage may exist, as railways, water communications passing inland, or arrangements made for this purpose. As a general rule, inland places having no special facilities for carriage do not receive uncured sea-fish in a wholesome condition upwards of 10 miles from the beach where they were landed. Should, however, the fish be first opened and cleaned, some salt rubbed in, and care taken in their conveyance (as warding off the sun's rays), they may be safely carried considerably further. But salt being very expensive, it is seldom employed for this purpose, or else a very slight amount is used, and putrefaction has often set in prior to the fish being disposed of for human food.

Varieties of dried fish.—What varieties of dried fish exist in India? Due to reasons which will be given subsequently, it has become the custom along the shores of British India, which are subject to the salt tax to its full extent, simply to dry fish in the sun. This can be done with smaller and thinner forms, as *Ambassis*, *Equula*, the Bombay duck (*Harpodon nehereus*), many of the herring and small varieties of immature forms, but not with the larger fish; however, even from these last, slices may be cut and sun-dried. In some localities small fish are first buried in the sea-sand, in order to obtain a little saline substance, and subsequently sun-dried. In damp weather such articles rapidly decompose, while in the hot months they are attacked by innumerable insects.

Salted fish.—Lastly, how are fish salted? The processes employed are chiefly divisible into the two following: (1) Those cured with monopoly salt, or salt which has paid the Government tax; and (2) those prepared with salt-earth, or spontaneous and untaxed salt. It must be here remarked that I have very little information as to what changes have been effected during the last five years, but I believe a slight (5 or 10 per cent) import duty has been collected on salt fish landed from foreign ports, while the salt-tax in Sind, Bombay, and Madras has been increased to a very considerable extent. I propose first referring to salt and its cost; for wherever the fisherman or fish curer can obtain this condiment at a cheap rate, there marine fisheries flourish; where it is dear, his occupation is destroyed, except for the purpose of supplying daily wants and a little surplus for salting or sun-drying. This will be most easily explained by referring to the different districts in detail.

Exportation of salted and dried fish.—The amount of salted and dried fish exported by sea from Indian ports was as follows (the value is given in pounds, computing 1 rupee at 2 shillings*):—

Five years ending.	From Sind.	From South Canara.	From Malabar.	From Coromandel coast.
1857–'58	£8,472	No returns.	No returns.	No returns.
1862–'63	13,004	No returns.	£26,272	No returns.
1867–'68	18,725	£6,969	48,207	£1,753
1872–'73	22,944	14,921	90,849	4,513

The duty on salt in Sind was 2*s.* a maund of $82\frac{2}{7}$ pounds avoirdupois, sometimes less, during the entire period comprised in the above table.

Government tax on salt.—The first great increase in salting fish occurred in 1860–'61, in which year the duty was raised in Bombay from 2*s.* to 2*s.* 6*d.* a maund. The next spurt of this trade, in Sind, was in 1864–'65, when the salt-duty in Bombay was again raised from 2*s.* 6*d.* to 3*s.* a maund. Possibly the importations into that Presidency from Sind would subsequently have been more, but the Government decided, in 1867, to admit all salt fish from foreign ports, where no salt-duty exists, into British India free of duty, to the immense advantage of the Portuguese settlements and the Meckran coast, but completing the ruin of Indo-British fishermen and fish-curers, unless they were advantageously located.

In olden times salt was allowed duty-free in British territory, for salting fish; but this enactment was repealed (year not ascertained) because the excise officers considered that it assisted smuggling.

The following table, being returns from different districts on the west or Malabar coast of Madras, shows the annual sales of Government or

*In the United States the shilling is worth 24.3 cents, and the rupee is worth 43.6 cents.

monopoly salt, along with the value of the salted and dried fish, which were exported by sea:

Year.	South Canara.		Canore.		Tellicheri.		Travancore and Cochin.	
	Fish.	Salt sold.	Fish.	Salt sold.	Fish.	Salt sold.	Fish.	Salt sold.
		Maunds.		*Maunds.*		*Maunds.*		*Maunds.*
1863–1864	£1,057	191,002	£96	11,053	£1,459	72,505	£5,416	728,208
1864–1865	8,036	168,270	219	7,032	1,504	57,516	6,052	643,897
1865–1866	875	184,174	11	9,856	194	62,135	7,061	672,370
1866–1867	1,124	151,113	12	9,728	1,825	57,381	7,337	497,088
1867–1868	875	174,629	303	8,721	2,011	56,502	7,803	558,766
1868–1869	114	176,465	520	9,045	4,319	63,340	7,130	573,639
1869–1870	2,053	147,173	4,340	8,807	5,839	72,616	6,096	574,119
1870–1871	2,927	136,967	1,470	7,932	5,309	57,624	5,833	593,389
1871–1872	2,845	177,482	695	12,008	5,340	88,674	6,987	577,268
1872–1873	5,980	135,839	951	6,985	8,429	77,332	.....	.....

The table shows that the amount of annual exports of salt and dried fish in Western India had very little, if any, connection with the quantity of monopoly salt which was disposed of.

Curing fish with salt earth.—In the native state of Cochin, the sale of salt in ten years, ending 1872–'73, owing to augmented duty, was reduced by two-thirds, while it was during this very period that the great increase in the amount of exported salt fish began. In the contiguous British district of Chowghaut, although in the year 1872 £1,067 8*s.* worth of salt fish were exported, only £46 worth of monopoly salt was disposed of. The cause of this is susceptible of an easy explanation. Owing to some flaw in the land or revenue laws, or else due to an immemorial custom, it was ruled that the people might collect salt earth in order to cure fish for their own consumption; while, there being no law restricting their disposing of any surplus they possessed, a large trade in selling such sprang up. Consequently, fish-curing did not require a large capital to commence with. This induced an increased demand for fish; the fishermen's trade became remunerative, and an immense amount of animal food found its way into the market which would otherwise have been lost. That this is the correct explanation is shown by examining the state of the fisheries on the eastern coast of the Madras Presidency at the same period. There the right to gather salt earth is not recognized, but, observed one official, the practice of salting fish must be increasing, considering that the price of the fish, which formerly cost 2*s.*, has been reduced to 1*s.* 3*d.* or 1*s.* 6*d.* This reduced value of the fish was doubtless due, not to the increased prosperity of the fishermen, who were evidently in a miserably poor state, but that the absence of salt wherewith to cure fish had diminished the demand for the article, and fishermen had to be content with a lessened price. The Madras revenue board* (May 14, 1873), observed that the fishermen numbered through-

* One of the members of the revenue board at Madras, writing to me on November 8, 1882, observed, "The industry (of salting fish) is really commencing at last; 400 tons more were salted this year than last, and 80 more yards for curing are to be opened in a month or two.

out the Madras Presidency 394,735 persons; that the answers elicited by the questions put by Dr. Day have directed the attention of the board to the subject of the influence of the salt duties on the trade of fish-curing, and they see reason to think that a great practical hardship exists, which they would advocate immediate endeavors to alleviate. A small amount of fish is prepared with monopoly salt in Madras,† especially for local consumption and export to Ceylon; but the amount of this condiment employed by fish-curers cannot be great, as it makes no perceptible figure in the amount of salt disposed of. In Bengal, the excised salt appears never to be employed for fish-curing, and the fisheries are in a neglected state; or, as observed by the collector of Balasore, "Fish sold in the markets are so stale that no European would touch them, and most of them are putrid. The people in this district do not salt their fish; they dry them in the sun, and eat them when they are putrid. They like them in this way, and there is no reason why this should be interfered with." Salt was then (1870) subject to a duty of 10*s.* for 82 pounds weight. Farther to the eastward, in Burma, the salt duty was 1*s.* fo the same quantity, sun-dried fish a rarity, the fisherman's trade flourishing, while salt fish, or crustaceans in the form of *nga-pee*, invariably formed part of every meal among the indigenous population.

Proportion of salt to fish.—It will be necessary to remark upon the amount of salt which must be employed in order to prepare properly a given quantity of fish. In Sind 20 pounds of monopoly salt are added to 82⅔ pounds of fish; on the western coast of Madras, as Tellicheri, 28 pounds of salt are used to 82⅔ pounds of small fish, as mackerel, herring, &c. It appears that, for the purposes of the trade, one part of monopoly salt is necessary to about three parts of fish. However, at Gwadur, in Beloochistan, where this condiment is very cheap, a larger proportion of it was used than in either Sind or in India. Fish cured with salt earth, or spontaneous but untaxed salt, require a much larger amount of this antiseptic than they do of monopoly salt, or nearly three (upwards of 2½) parts of salt earth to one part of fish.

Effect of the salt-tax.—The cost of salt, it will be perceived, must have a bearing upon the state of the fisheries; where it is cheapest (other things being equal) the fisherman's trade will be most developed. Along the coasts of Beloochistan, where there was no salt-tax (1873) large communities were supported entirely by fisheries, their captures being cured and exported for the Indian or Chinese markets. The same remark applied to the Portuguese settlements of Goa, Daumaun, and Din, the salt used there costing about 3*d.* per 82⅔ pounds weight, whereas in the contiguous British territory it stood at the salt-pans at about 4*s.* Hence the foreign fishermen were able to use this condiment

†The salt-tax in Madras in 1859 was 2*s.* per maund, but has since been raised as follows: 1859–'60, 2*s.* 9*d.*; 1860–'61, 3*s.*; 1864–'65, 3*s.* 4½*d.*; 1869–'70, 4*s.*; 1875, 6*s.*; now 4*s.*

freely, and the cured articles were preserved in a superior manner, more wholesome to the consumer, and able to be carried farther inland. In short, fisheries thrived along the Beloochistan coast and the Portuguese settlements, due to the excise on salt being not excessive or entirely absent. In the Bombay Presidency the fisherman's market became restricted to the sales for immediate consumption or else for sun-drying, or, as the collector of Tanna observed, "Whether fish is dried as above, in preference to its being salted, is a question I have been unable to ascertain. It is very probable that it has been resorted to in the place of curing by salt consequently on the excise duty levied on salt." Wherever salt earth could be obtained free of duty along the western coast of Madras there the fisheries thrive, the fish-curer requiring a large supply of fish. Along the east coast of Madras the collection of salt earth was more or less prohibited, and the fisherman's trade, except near large towns, is not very flourishing. But in Bengal the fisheries are, or were, worst off, sun-drying being the only curing which fish obtained. Lastly, in Burma, where salt is cheap, the fisheries were thriving. Before concluding this portion of my subject, I would observe that it is not to be supposed that fish cured with salt earth are of the best quality; on the contrary, it imparts a bitter and unpleasant flavor, and is believed to engender disease. But the poor cannot be particular respecting the taste or smell of their food; the cost is the important question. Salt earth costs about ½*d.* a basket of 144 pounds weight, depending upon its quality; but, as I have observed, it takes three times the amount that it is necessary to employ if excised salt is used. But $82\frac{2}{7}$ pounds of monopoly salt was taxed 3*s.* 7½ *d.* at this time; now 4*s.*; whereas 246 pounds of salt earth cost from three-fourths penny to 1*d.*, and this is the reason of the latter being preferred by fish-curers for the purpose of preparing fish for the trade; for if monopoly salt at its present rate was used, the article, at least to the general public, would be simply unpurchasable. Fish are plentiful in the sea. The reason why the harvest remains ungathered is not due to the apathy of the fisherman or the unwillingness of the general public to be consumers of fish, but solely a result of the heavy cost of salt, and that a consequence upon the Indian salt-tax.

1.—Condition of fishermen.

Having briefly enumerated the fish which stock the seas of India, and how the fisherman's and fish-curer's occupations are injured by the incidence of a heavy salt-tax, I pass on to the fishermen and their condition, as it was a few years since. Doubtless, should no sufficient market exist for the produce of their industry, some of these people will leave fishing and engage in other pursuits; while those who remain endeavoring to make a livelihood, as did their forefathers, will seek the cheapest way and easiest method by which such may be accomplished. A very little acquaintance with the habits of fish suffices to teach the

fishermen that the smallest kinds are taken with the greatest ease; as preferring the vicinity of the shore, and seeking their food in shallow waters, they are more readily captured in weirs, or with fixed engines and traps, than are the larger, more predaceous, and strictly deep-sea forms. But by disturbing the shore, and destroying or driving away the small fish and crustacea, the food is being diminished which previously decoyed the larger and more predaceous forms in, thus scaring away what would otherwise be the natural supply; and then it is erroneously asserted that the amount of fish has decreased. The fisherman's business is to supply personal requirements and family wants; consequently, if he obtains as much of the finny tribes as he can find a market for or otherwise employ, no injury is inflicted by such a proceeding; because, so long as salt is not available (owing to its price) for the purpose of curing the surplus which may have been captured, meeting the small local demand for fresh fish is all that is really requisite.

The deep-sea fishermen, or rather those who ply their occupation outside the shallow waters of the littoral zone, as a rule do so by means of nets, or with hooks and lines. Deep-sea netting is not carried on to any great extent, partly because of the insufficiency of a good market to render such remunerative, and likewise owing to the expense which would be necessary in obtaining the requisite nets, and the cost of building seaworthy boats. Fishermen are not to be ranked among the moneyed classes, and so they have to borrow money, at exorbitant rates of interest, wherewith to supply themselves with the requisites for their work. As an instance, in Sind a net suitable for sea-fishing would involve the outlay of £40 or £50 [about $225], while it does not usually last more than a year. A boat costs about £100 [$485], and ought to be serviceable for several successive seasons. The money having been borrowed, the fisherman who is the borrower disposes of the whole of his capture at half the market rates to the person who has supplied him with the money. Still this leaves a surplus, due to the existence of a good market for the fish-curer's trade.

Castes among fishermen.—The sea fishermen in most parts of the coasts of India assert that in olden times they were divided into two distinct classes: (1) Those who captured fish in the deep sea, or beyond their own depth; and (2) others who fished from the shore and in the backwaters and creeks. Now, owing to the depressed state of the fishing trade, the deep-sea fishermen (except where salt is cheap or a good market exists) have taken to the less expensive occupation of plying their work inshore. In several parts of India, more especially in the Madras Presidency, they have customs of a patriarchal nature, but which are more strictly observed on the Coromandel than on the western coast. In Sind there are four divisions of the fisherman caste, each being under its own chief, who is hereditary, and his business is to settle caste disputes and other trifling matters, also to conduct the religious ceremonies con-

nected with marriages and deaths. In the Bombay and Madras Presidencies, headmen to the fishing castes likewise exist; in some localities they are hereditary, in others elective; or should there be no headmen, matters are laid before certain wealthy individuals of their own caste, whose decision is final. In places where the fishermen are native Christians, the priest appears to be appealed to in order to settle disputes.

In olden times the fishing castes held a much more important standing than they at present possess. Commanded by their own chiefs, they were ready to engage in military expeditions. The Samorin, in 1513, sent a deputation to Portugal, and his ambassador, who turned Christian, was knighted under the name of "John of the Cross," by John III. On his return to India he was banished from the Samorin's court, as a renegade from the faith of his fathers. In 1532 he joined the fishermen, and appears to have been installed as their chief, as he headed a deputation of eighty-five of them to Cochin, soliciting the assistance of the Portuguese against the Mohammedans. The whole of the embassy are said to have become converts to the truths of Christianity, so a Portuguese fleet was sent to their relief, and 20,000 are reputed to have immediately consented to be baptized. Ten years subsequently, Xavier instituted a church for these people.

It appears probable that the present organization of the fishing classes is the remains of some ancient system, for on no other supposition can the existence of individuals holding an extensive sway be accounted for. The village or patriarchal system of an elective headman to such of his caste as inhabit each street and hamlet, is what is seen elsewhere among laborers; so likewise is the hereditary headman over several villages. But among the fishermen there exist priestly chiefs, two of whom are to be found on the eastern coast, one being at Madras and the other at Cuddalore, the territory of the former stretching up the Coromandel coast, while that of the latter reaches towards Cape Comorin. A third is found in South Canara, where he exercises spiritual control over a large district, and it is by no means improbable that others may exist. These chiefs, whose offices are hereditary, claim and receive fees and fines from those of their caste living within their jurisdiction, and they are the final referees in all cases of caste or family disputes.

The next grade is also hereditary. These mere petty chiefs or headmen hold sway each over only a few villages; their duties are the same, and some of their fees seem to have to be transmitted to their superior. On one of these headmen dying without heirs, a new one is elected by the people of the caste. Lastly, the fishermen have the elective headman, who is chosen by the residents of a single hamlet; his duties are to decide disputes, to be present at marriages and religious ceremonies, often to fix the work, and assist in certain Government duties; his emoluments appear to be very trifling.

Financial methods and poverty of fishermen.—Passing on to the condition of the fishermen (as it was a few years since) in Sind, they have to

pay a tax of 10*s.* a ton yearly on their fishing-boats, while I have already alluded to the rate at which they borrow money for the purpose of procuring boats and nets. Here these people are well off. At Gujerat, in Bombay, the fishermen are poor, and the precarious living they make often induces them to accept service as sailors, laborers, or anything that insures them a steady competence. Although following out the condition of the fishermen in various districts must have rather a sameness, it will be necessary to do so in order to see clearly whether these people are really in a prosperous or in a poverty-stricken condition; whether, in short, it is the case that they are in the utmost misery, not due to their own laziness, but as a result of British legislation imposing prohibitory duties on salt, which is even now being made heavier and heavier, regardless of the injury to these people, and the enormous loss of food to the inhabitants at large. In the Junjura district the fishermen supply themselves with boats and nets; six or ten club together to obtain a boat and net, dividing the produce; here they have decreased in numbers. At Broach they are also said to have diminished. The same report comes from Kaira. In Rutnagiri the practice of salting fish has decreased during the last fifteen years in consequence of the increase in the price of salt, but the fisherman are said to have increased. If, however, the practice of curing fish has decreased while the number of fishermen has augmented, such must be due to a greater demand for fresh fish, or else the fishermen, from increased numbers, must be worse off than they previously were. However, the official from Canara gave a similar reply. The commissioner observed that at present no larger number of men are engaged on fisheries than are required to provide sufficient for local consumption. The practice of curing fish has largely diminished, owing partly to the falling off in the amount usually captured, and also to the duty on salt in British territory.

In the Madras Presidency, we are informed that, in the Tinnevelli collectorate, the fishermen, as a rule, are a very miserable lot of people, and exceedingly poor. The way in which they work is by a system of advances made by traders, a few of whom reside in each fishing village, and supply all the requisites for fishing, as well as the boats, taking one-third of the captures as their share. In the Nellore district, although no one claims exclusive rights to the sea fisheries, the inhabitants of the different villages are exceedingly tenacious in order to prevent fishermen from other localities plying their occupation within what they believe to be their limits. In the South Canara district, where the use of spontaneous salt is, or rather was, not prohibited, the number of sea fishermen is stated to have increased of late years. This augmentation has been computed as high as 15 per cent. The same symptom of prosperity was reported all down the Malabar coast. At Ponani there is an annual increase in the number of fishermen. At Cananore the owners of boats and nets supply them to these people, as well as advance certain sums of money. The money-lenders sell the

captures, half the proceeds going to either party; if, however, the take is insignificant, the boat and net owners surrender their share to the fishermen. A like plan obtains at Tellicheri, where the fishermen have framed rules for their own guidance, one of which is the right of the first discoverer, among a lot fishing together, to a school of fish; he is allowed to capture them without hindrance from the others, even though at the time when the fish were discovered he was not prepared to launch his net. Passing out of the districts where the free collection of salt earth is permitted, another change for the worse in the condition of the fisherman is reported. In Madura it is said that, on the whole, the sea fishermen have increased, but that the aboriginal fishing castes have decreased, owing to emigration or to their becoming sailors. At Ootipadaram the native official estimates the daily earnings at three pence, taking all the year round, and excluding costs, and at Munjery at from three halfpence to nine pence, while at Tenkarei their earnings are computed at from three pence to one shilling a day. In the Tanjore collectorate they are reported to have decreased in some places, but remained stationary in one locality. A little better report comes from Madras, but there the fishermen are also employed as boatmen, which is very profitable, while the vicinity of large stations affords a sale for fresh fish. Without tracing out the condition of these people in each district on the coast, it will be sufficient to say that they are poor and miserable, but not so badly off as in the Bengal maritime districts, where they appear to be quite poverty-struck. Passing on to Burma, with its cheap salt, we find the sea fishermen well off.

If we pass in review the reports from all the sea districts, we find the fishermen well off in Sind, while, unless in the vicinity of large towns, they are miserably off in the Bombay Presidency. Along the western coast of Madras, with its untaxed salt earth, these people prosper; but once round Cape Comorin, where the collection of spontaneous salt becomes a penal offense, they become, as observes the collector of Tinnevelli, a very miserable lot of people, and such is the same account all up the Coromandel coast, except where there are large towns. With poverty we find them reported to be decreasing in numbers, due to cholera or other diseases, emigration, or accepting service as lascars in coasting vessels. These are a people who in olden times were among the most prosperous of the inhabitants along the coasts of India; who, when the Portuguese first landed, were able to bring large armies into the field; whose occupation is now thought unworthy of the care of the legislature, except when it seems possible to impose new taxes on their industry, in the shape of an augmented salt-duty—as a European official remarked, that sympathy ought not to be wasted on fishermen, for they are an independent, careless, and drunken set of men. This gentleman, trained up in the latest school of political economy, I believe, merely placed on record what are the feelings of many who are acquainted with the state of this trade, for by careless and independent

he probably meant idle, which idleness is due, first, as I have already explained, to the incidence of the salt-tax; and, secondly, that when salt is unobtainable, did they exert themselves, the market would become overstocked.

Résumé.—Such is a brief outline of the fisheries of India, the part they subserve in providing food for the people, and the hindrances under which they suffer. Excellent and painstaking as are our Indian officials, there are but few among them who have time to interest themselves respecting the complex question of fisheries, while the fishermen are among the most patient of the races of India, and the least likely to bring their grievances to notice. It thus comes to pass that the philanthropist, with mistaken zeal, throws open freshwater fisheries to the people, causing their depletion or almost ruin.

The legislator believes that permitting the fishermen to collect salt earth, or obtain salt duty free, will only be assisting the smuggler, and allows him no exemption. The financier, requiring money, sees in salt-taxes the best means of obtaining it, and forgets, or perhaps never investigates into, how such is detrimental to the health of the inhabitants, and ruinous to the fisheries; while the high official who permits matters to drift as every chance wind blows is merely following, in respect to fisheries, the example given in this country, where they are by turns cared for or disregarded, and every interest save those of the finny tribes has its advocates and upholders of its vested rights.

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