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MADRAS RECORD OFFICE.

Government of Madras.

Revenue **DEPARTMENT.**

G.O. No. 1052 — Press Mis.

141 142

Dated 9 — 5 — 1867.

Not to be folded or roughly handled

Proceedings of the Madras Government, Revenue Department, 9th May 1867.

No. 141. Read the following Proceedings of the Madras Government in the Public Department :—

Passing orders on Dr. Day's report on the streams of the Neilgherries, and on the experiments made for stocking those streams with fish. } (Here enter 1st May 1867, No. 488.)

No. 142. ORDER THEREON, 9th May 1867, No. 1,052.

Communicated to the Board of Revenue.

Miscellaneous.

(True Extract.)

(Signed) J. GROSE,
Under Secretary to Government.

To the Board of Revenue, with Proceedings Public Department, No. 488.

Exd. S. T. Augustin.

No. 7. Read the following letter from Surgeon F. DAY, F. L. S. and F. Z. S., to the Chief Secretary to Government, Fort Saint George; dated Fort Saint George, 11th February 1867, No. 536.

I have the honor to forward my second report upon the introduction of fish into the waters on the Neilgherry Hills, and my opinion, with reasons appended, why I do not advise the re-trial of the introduction of Trout.

2. The report has been delayed, owing to my having been on duty at Kurnool, by which I became separated from my specimens, books, and memoranda, some of which have, unfortunately, become destroyed.

3. The report is very lengthy, but I have condensed it as much as was commensurate with due explanation, so that it might be a sufficient guide to any future experimentizer; for the introduction, as far as it has gone, has been most satisfactory.

4. The scientific descriptions of the (36) thirty-six species of fish obtained during these researches, I found covered so much space, that I have despatched the paper to the Zoological Society of London, for publication in their Proceedings.

PISCICULTURE ON THE NEILGHERRY HILLS.

REPORT No. II.

By Surgeon FRANCIS DAY, F. L. S. and F. Z. S.

In my first report* respecting the result of an experiment for the introduction of European Trout into Ootacamund, by means of their ova brought overland in ice from England, I promised† to furnish a further account of the probable chances of success attending a second trial. I have now the honor to submit my opinion, giving in detail my reasons for scarcely believing that such would prove an eventual success. I have, also, in this communication, reported the result, as far as it has gone, of the successful introduction of some low country fish into the waters of the Neilgherry Hills.

* Dated 5th May 1866

† Paragraph 33.

This mountainous tract of country is now too well known to need any lengthened description, excepting as regards the suitability of its streams and pieces of water for the residence of fish of larger and better species than that existing when this experiment was commenced. After a minute examination, I am able to assert that a large amount of nourishment well-adapted for the sustenance of piscine tribes exists in the Hill waters, whilst the absence of any but one minute species of Minnow (*Paradanio Neilgherriensis*—Day) renders the artificial propagation of useful sorts from other places, not only a highly interesting scientific experiment, but one which, if successful, must augment the amount of the food productiveness of the Hills, besides affording an object of sport to convalescents, and an agreeable variety of diet to the invalid residents. Therefore, in an economic point of view, it appears desirable that fish should be cultivated, to an extent only limited by the amount of space and food necessary to their well-being.

The insects, shells, plants, &c., found in the waters are useless to man, except as affording food to the lower animals, more especially to fish; but as the Hills have only been fully known to Europeans during the last half century, attention has not been sufficiently drawn to the advantages which pisciculture might develope. Now the European element in the population has increased, the want of fish has become more and more apparent. It is considered in Europe that the revenue derivable from water ought to equal that from land, and to a great extent this should hold good in India. But the first step must be the study of this branch of Natural History; as fish, unless well preserved and attended to, will be of scarcely more pecuniary benefit than land which remains uncultivated.

The smaller species of fish serve for the sustenance of the larger; and in India where the carnivorous tribes predominate in the fresh waters, there are millions of tadpoles and frogs which,

although unsuitable for human food, form excellent sustenance for fish, and may thus help to adorn our tables, and minister to our luxuries and necessities. The pieces of water on the Hills which, from their size, appear best adapted for the abode and propagation of fish, are the Ooty Lake, and the Pykara and Avelanche rivers.

The Ooty Lake, situated 7600 feet above the level of the sea, is nearly 1½ miles in length, and would admit of great extension were a bund placed some miles lower down the present stream. In some parts, it is of considerable breadth, and very deep. It has been formed by a dam thrown across the openings between two hills. At the upper or south end, it is continually fed by a small stream, which escapes by an overflow under a bridge at its lower extremity; but the great bulk of the water is derived from the heavy rains during the monsoon. It is divided into two portions by a bund, with a bridge under the centre of it. The upper part is small in extent during the dry months, and has rank grass growing along its sides and on the little islands which are dotted over its surface, whilst it is exceedingly dirty from the deposits either washed down from higher levels during the monsoon time, or thrown into it from the Native Bazaar, which extends along its eastern side; it is also gradually silting up from the mud carried into it during the monsoons, or taken there from the cutting on the road to Coonoor. The lower and largest portion of the lake is clear, broad, and deep in places. Grebes (*Podiceps Philippensis*), a few Moorhens (*Gallinula chloropus*), and occasionally a Coot (*Fulica atra*) may be seen swimming about on its surface; the two former species breed there. The Brahminee Kite (*Haliastur Indus*), and Common Kites (*Milvus Govinda*) are generally skimming above the water, and the little King-fisher (*Alcedo Bengaliensis*) hovering about. Leeches abound; there is also a very large *Nepa*, some Water Beetles, and numerous *Lymnæa*; whilst, along the margin, in the warm weather, Dragon-flies may be seen in myriads. Frogs and crabs are not so abundant as in many pieces of water on the Hills. The temperature of the water appears to be almost invariably higher than that of the air.

The Pykara river takes a winding northerly course, diverging both to the east and west. It is at least ten miles in extent from the Makoorty Peak to the Falls. It passes along the base of, and between, granitic hills, and subsequently joins the Moyaar, which skirts at a distance the northern side of the base of the Neilgherries, and ultimately becomes incorporated with the Bowany at Danaikencotta in the Coimbatore District. Near the Travellers' Bungalow at Pykara, ten miles by the old road from Ooty, the river is about 40 yards wide in the dry season, and contains large and deep pools, divided by shallows, in which are large boulders of rock. On the fords the beds are gravelly, but covered by a fine red sand, with which the water appears impregnated. There are a few trees along the banks, which are in places moderately high. In wading across the stream, a person's legs are immediately attacked by numerous fine leeches, which absolutely swarm in the water. Crabs are captured at every throw of the cast net; frogs abound, as do also the ephemera of the Dragon-fly at certain seasons of the year, and a large *Nepa* is also occasionally perceived. Otters, *Lutra*——?, are sometimes seen on the banks of the river, and the minute King-fisher is not rare. The temperature of the water, from a few observations made, seems to be rather colder than what obtains in the stream at Coonoor.

The Avelanche river is fifteen miles by the road from Ooty, and not far from the Bungalow of the same name. It is 6725 feet above the level of the sea, and flows from west to east, taking a winding course amongst the hills, during which it is fed by numerous small streams. Eventually it flows into the Bowany, which skirts the southern, and a portion of the eastern, bases of the Hills, and after receiving the Moyaar, becomes incorporated with the Cauvery, not far from the Town of Bowany. Near the Avelanche Bungalow, the river is from thirty to forty feet in width. It is very clear, and in the dry season shallow—as the deep pools, at other times present, have then disappeared,—consequently, at mid-day, the temperature is high. The bed of the river is of granitic rock, full of small boulders of stone, intermingled in places with large boulders, small gravel, and sand. In parts, the banks are high, but not wooded. On displacing the stones in the river, innumerable ephemera of the Dragon fly are disturbed, some of which are of a large size. There are also numerous Water Beetles (*Dytiscus*); Crabs and frogs abound, but leeches appear to be absent.

There are other smaller pieces of water on the Neilgherries which require a short description here, although, for reasons which will be subsequently entered into, it was not proposed to stock them all with fish.

There is a fine pond under Burnfoot, close to the public road on the Ooty side of the Kaity Ghaut, which, when this experiment was commenced was destitute of fish; but I have now placed some Koravas (*Ophiocephalus gachua*—Ham. Buch.) in it, to be available in case of an accident destroying those in the Lake—in fact, as a supplementary stock, which it is to be hoped will not be required. The trunks of trees in this pond would make it difficult to net.

The Billicul Lake or tank is about eight miles from Ooty, and six from Seegoor, which is situated at the foot of the Hills, on the Mysore side. It is probably about 5700 feet above the sea, and when the adjacent house was first built by Mr. Rumbolt as a shooting box, was a small natural tank. It was subsequently enlarged in 1844, by Mr. Martelli, who then owned it. It was first stocked with fish from the plains, by Mr. Rumbolt, about 1839, and re-stocked by Mr. Martelli, with the assistance of Mr. John Sullivan, the Collector, with fish from the Seegoor river, and also from Barra, situated at the confluence of the Moyaar and Seegoor rivers. These fish have increased to a great extent, and from the situation of the lake, more than half way between the low country and Ooty, they are well acclimatized for transferring to the higher waters. Unfortunately, its bed is so full of large stones and trunks of trees, that it would be almost impossible to remove fish once placed in it; otherwise, it would form an excellent depôt.

At Coonoor, there are a few small tanks; but, with the exception of one at Inkerman, 50×100 feet in extent, wherein Murrul might breed, there are no places adapted for the reception and propagation of fish. There is a small tank at Woodcot, which I employed,* during the progress of the experiment, for keeping the fish in, for a few days, when they were first brought up from the low country, but the bottom was very foul; fortunately, a stream runs through it which can be turned on or off at pleasure.

* Leave for this purpose was given by Mr. Smith.

In this place, it may be as well to give a short account of the rivers which skirt the base of the Hills, below the Seegoor and Coonoor Ghauts, as the supply of fish for Ooty must be obtained from them. The examination of these pieces of water occupied much time.

The small Seegoor river is about 2000 feet above the level of the sea, and is formed by the Ooty stream which receives one branch from Marlimund, and another from between Marlimund and Billicul. It joins the Bowany at Barra, about seven miles from Seegoor, to the right of Tippoocaudoo. It is at a much higher elevation than the Bowany at Mettapolliem, and not above twelve miles from Ooty, whereas the latter is twenty-five. Therefore, did it contain the fishes required, and could a fisherman and coolies be procured there, it would be that best adapted for stocking the Hills; but, unfortunately, owing to its feverish locality, coolies cannot be obtained there, and the only fisherman in Ooty positively refused to go there for more than one day. This difficulty, however, I partially obviated by making a drag net, and taking coolies with me to use it. I also made an arrangement with a writer at Seegoor to send me Carp captured with a rod and line. The bottom of this river is full of boulders of stone, and contains some deep pools, divided from one another by fords. The banks are covered with trees.

The Culhutty stream is the continuation of that from Ooty. Before it reaches Seegoor, it is joined by a small stream from Marlimund, and is of the same description as the others. Behind the Travellers' Bungalow, is a water-fall with a deep pool below, whilst further down, two or three other tributaries join it. The stream is capable of being dammed across, and would form a good depôt for Carp brought up from Seegoor, for conveyance to the upper plateau of the Neilgherries; but, unfortunately, there are many holes in its bed, and small fish hide themselves under the stones and are difficult, and sometimes impossible, to capture; whereas, should any sudden storm occur, the dam would be washed away.

On the Cleveland Estate, a Coffee Plantation belonging to Captain Fuller, about ten miles from Kotagherry and six above Shemogah, at an elevation of probably 3000 to 3500 feet above the level of the sea, is a stream about 20 feet in width. The bed is rocky, but contains pools about five feet in depth, between which the fall is great—in one place as much as one foot in four. In this

stream are some *Barilius rugosus* (Day), or Indian trout, which grow to about six or eight inches in length, and are of the same species as those in the neighbouring low country. This fish is hardly adapted for pisciculture, neither is the stream of sufficient size for that purpose ; but their presence in such a spot proves that there is no fear of fish being washed away in such large streams as the Pykara river. About a mile lower down the stream, a species of Carp is found (*Puntius Grayii*—Day), and a small Loach (*Nemacheilus Guntheri*—Day), which are both too small to be of any service. The latter is also found in a little stream between that place and Kotagherry.

The Carterry stream, which passes Kaity as it flows into the low country, where it joins the Bowany, contains some small Minnows of the same description as those found on the upper plateau of the Hills. Otters are numerous there.

The Bowany river at first skirts the base of the Hills, but diverges as it approaches the Hullicul Droog, so that it is five miles from the base of the Coonoor Ghaut at Mettapolliem, where it is about 1000 feet above the level of the sea. It is broad and never dries up, even in the hottest season. It receives the streams from the south and east of the Neilgherries, as well as from the Calicut District ; consequently, although the south-west monsoon does not extend as far as Mettapolliem, still the river at that time is very full. It is also affected by the north-east monsoon. Its bed is granitic, with large and small boulders of stone, so that a drag net cannot be effectually employed, and consequently only cast nets are used. The banks are finely wooded, and it surrounds many islands in its course. During the south-west and north-east monsoons, the channel is full, and the water very muddy, and as soon as this occurs, the species of fish begin to change : other sorts, such as the *Notopterus*, come down from higher situations, and, as the intensity of the current augments, the smaller streams become flooded, and the Carps either descend the river until they are said (by the Natives) to reach the Cauvery, or they ascend to tributaries as yet unaffected by the rains, or better suited for spawning and obtaining food from. Immediately the rains fall the Chennakenoor stream, Carps flock up it from the Bowany, and every Native who possesses a rod and line takes to angling ; so common are fish, that a moderately expert hand can, in a few hours, obtain what it requires two coolies to carry. Eels, Murrul, Koravas, Wahlahs, Katurnas, and some other species do not appear to migrate, but seek protection from the current by getting behind rocks, or beneath stones, thus effectually preventing their being captured by nets. If any of the other sorts remain, they are said to be rapidly destroyed by the muddy, or as the Natives term it, the red water ; but this assertion is doubtful, although on one occasion the banks of the river, for miles on each side, were rendered most unpleasant by the odour arising from the decomposing fish. In November 1865, a severe storm occurred, after which the banks of the Bowany were strewn with putrid fish for twenty miles above Mettapolliem, and the inhabitants were greatly alarmed lest a pestilence should be the result. Whether the presence of mud in the water is the true solution of this mortality may well be questioned. It is true that in Malabar, when the freshes join the sea, many of the sea fish die, and Trout in Europe are also frequently destroyed by the admixture of muddy water coming from manured fields ; but, in this case, did the mud alone destroy the fish, they would hardly be found to spend muddy streams to deposit their ova, and the Carp would scarcely live in the Billicul Lake, which is often exceedingly muddy. In fact, it is most probably only when the rains wash down the filth in large quantities from villages and localities in which cattle are numerous, that the destruction of fish is caused thereby.

The Kullaar river, close to the base of the Hills, below the Coonoor Ghaut, is much smaller than the Bowany, of which it is a tributary. As it brings down water from the Coonoor and Kotagherry side of the Hills, it is generally clear during the south-west monsoon. Its bed and banks are similar to those of the Bowany on a smaller scale.

In the foregoing, I have endeavoured to give a short description of the pieces of water either on the Hills, or at their bases, and the next question which arises is their temperature ; for on this very much depends, as it must decide their adaptability for tropical, sub-tropical, or temperate genera. Here it is necessary to make a short digression, in order to enter upon the climate of the Hills in general. As they are situated between two oceans, near the line

of demarcation of both monsoons, they are exposed from June to September to the south-west monsoon, and in October are again slightly affected by the north-east monsoon. The question of elevation will be subsequently considered.

" The air during the months of January, February, and March is intensely dry ; the point " of saturation (or temperature to which the air must be reduced to deposit any part of its " moisture) being occasionally as low as 13°, the temperature of the air being 60°. In April it " begins to fluctuate, and in May the quantity of moisture increases very perceptibly, being " accompanied by rapid changes in the electrical condition of the atmosphere, indicated by " thunderstorms and heavy showers, but of short duration. During June, July, and August it is " nearly charged with moisture ; in September it is again fluctuating ; in October and November, " moist ; and in December it begins to reassume its dry state." (*Baikie, p.* 76). The mean annual rain-fall, according to the same authority, is 44·88 inches.

Frosty weather begins about the end of December, and in January the nights are so cold that it frequently freezes in the valleys, but during the day the sun is very powerful, although a current of cold air commences in the morning and lasts until about mid-day. In February the frosts become somewhat stronger, but in March the weather gets milder. In fact, after this month, it becomes too warm for pisciculture, unless with species from warmer climates than that of England, whilst the Indian fresh water species must be cultivated during the monsoon months.

It will be unnecessary here to say more than that, by various calculations, deduced from experiments, the temperature of the air is found gradually to decrease, and become more rarefied, the greater the elevation ; and at elevations of not more than two miles, 1° of Fahrenheit for every 300 feet is considered about the correct calculation.

The question of the effects of the direct rays of the sun in the rarefied atmosphere of the Hills is very important with respect to its bearing on the water. Fortunately, there are certain disturbing elements, such as the wind and vegetation, which scatter the heat, as well as others which it would take too much space to enter on here, where the question under discussion is merely a synopsis of what has been done in pisciculture on the Hills, and the probabilities of its success or failure. Grass and plants assist in dissipating the heat as far as the earth is concerned, but this is not observable with regard to water, and it consequently obtains that the heat of stagnant or nearly stagnant water, such as the Lake at Ooty, is far greater than could, *a priori*, be supposed.

As to the success or failure of the acclimatization of fish, it must be observed that, although they may live, grow, and apparently thrive in certain localities, the great question is whether they will breed, or, if they do so, whether the young will degenerate ? It is, therefore, of the greatest importance to ascertain correctly the heat of the water ; but before entering on this subject, it may be advisable to give the temperature of the air at Ootacamund :—

Thermometer in Ootacamund.*

	Mean temperature.	Mean maximum.	Mean minimum.	Mean range between day and night.	Average.			Remarks.
					6 A. M.	3 P. M.	9. P. M.	
January.....	51	61	41	20	45	57	47	
February....	53	63	42	21	45	59	49	
March.....	57	68	46	21	58	63	62	
April.	60	68	51	16	58	63	62	
May.....	60	68	51	16	57	63	63	
June.... ..	58	66	50	15	57	60	58	
July...	55	61	50	11	52	61	54	
August.....	56	62	49	13	57	60	56	
September..	56	62	50	11	54	60	58	
October. ...	55	62	48	13	50	62	53	
November...	53	60	45	15	50	61	52	
December..	51	60	52	17	46	60	48	

* Note.—Compiled, with the omission of fractions, from *Dr. Baikie's Account of the Neilgherries*—Observations on seven years, 1831-33 & 1853-56.—Appendix pp. viii. and ix.

The following Table shows the greatest differences in the average of the monthly maximum and minimum, as observed by Dr. Baikie and Mr. Ross :—

	Maximum.		Minimum.	
	Highest.	Lowest.	Highest.	Lowest.
January...	67	57	44	39
February	69	60	45	38
March...	72	62	50	43
April...	73	64	53	50
May	76	61	53	49
June...	73	60	52	47
July	65	59	53	48
August	67	58	51	47
September	65	60	53	48
October...	67	59	49	46
November	66	58	46	43
December...	63	56	43	42

The observations made in the Government Gardens at Ootacamund, during two years ending July 1866, again differ from those both of Dr. Baikie and Mr. Ross. The following facts have been collated from them :—

	Dry bulb of Thermometer.		Difference in any one day.	
	Highest.	Lowest.	Greatest.	Least.
January...	80	35	37	12
February	79	42	38	25
March	82	41	37	21
April...	86	49	32	16
May	78	45	32	14
June...	77	49	22	3
July	70	46	21	3
August	70	46	23	1
September...	77	35	35	6
October...	74	44	27	2
November	74	41	31	8
December	78	31	38	11

On comparing Dr. Baikie's and Mr. Ross' experiments with the results of the above, we find the mean yearly maximum given by Dr. Baikie to be 67°, that by Mr. Ross 61°, and at the Government Gardens 69? ; whilst the yearly minimum given by Dr. Baikie averages 48°, by Mr. Ross 47°, and at the Gardens 49°. Dr. Baikie states that the mean temperature of Ooty is 56°, whilst the bservations recorded in the Government Gardens, taking the mean maximum and minimum, pl-

it at 59°. The following is from the Meteorological Observations in respect to Greenwich, taken from the Government report for 1860 :—

	Mean temperature.		Mean maximum.		Mean minimum.	
	Greenwich.	Ooty.	Greenwich.	Ooty.	Greenwich.	Ooty.
January...	39·9	57·5	45·0	71	34·8	44
February...	36·3	59·5	42·5	74	30·1	45
March...	42·1	63	49·2	76	35·0	50
April...	44·6	64	53·7	75	35·6	53
May	55·0	63·5	65·5	73	44·6	54
June...	56 7	59	65·0	66	48·5	52
July	59·6	57	69·2	63	50·1	51
August	59·5	58	67·2	65	51·8	51
September	54·6	58·7	63·4	68	45·8	49·50
October	51·5	59	58·6	68	44·5	50
November	41·0	58	46·7	68	35·3	48
December...	36·3	57·5	40·6	70	32·0	45

From these figures, it will be seen that, in January, in London, the average maximum is about the same as the average minimum in the Government Gardens at Ooty ; but in February it is about 3° warmer. In October, the maximum in England is 8° warmer than the minimum in Ooty ; in November, the maximum is not 2° above the minimum in Ooty ; and in December, the maximum in England is 5° warmer than the minimum in Ooty.

It will now be necessary to observe upon the temperature of the waters on the Hills. More extended observations are greatly needed ; but the following is a synopsis of those made by myself, the majority being from the waters of the Ooty Lake, the heat of which is almost invariably greater than that of the surrounding atmosphere. Variations in temperature may depend upon several causes, such as the power of the sun's direct rays, which, as previously stated, are again influenced by many counteracting agents, as the force of the winds, the clouds, &c. It is also affected by the amount of moisture in the atmosphere assisting or preventing evaporation. But taking a large series of observations, it appears probable that the heat of the water is very rarely below that of the surrounding air, although at certain periods, such as during the bursts of the monsoon, it sinks down nearly to a level with it. From this, we gain the following : that, given the heat out of doors, but in the shade, at Ooty, at any period of the year [winter ?] that of the Lake will very rarely be found less, but occasionally greatly to exceed it, especially at mid-day. It appears to absorb and retain heat in the hot weather, and even during the burst of the monsoon ; in a number of observations made while the cold winds were blowing, it was very rarely as low as the atmosphere. For comparison, a Table of the heat of the water in various places on the Hills is given, taken at different hours, and dividing that before the burst of the monsoon on June 12th, from that subsequent to it from June 22nd. Running streams were, of course, colder than standing water.

Date.	Place.	6 A. M.		12 A. M.		4 P. M.		6 P. M.	
		Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.
From May 20th to June 12th 1866.	Ooty Lake.....	57·50	67·50	71·	77·	70·	79·	61·	73·
	Coonoor stream...	62·	60·	69·	75·	72·	74·	65·	67·
	Half way down Ghaut...	...	...	...	...	77·	74·	75·	75·
	Bowany river.....	77·	79·	96·	92·	91·	86·	82·	82·

Subsequent to the first burst of the monsoon, the following were the average observations noted :—

Date.	Place.	6 A. M.		12 A. M.		4 P. M.		6 P. M.	
		Air.	Water.	Air.	Water.	Air.	Water.	Air.	Water.
From June 22nd.	Ooty Lake.....	56·	57·	58·	64·	59·	68·	57·	65·
	Coonoor stream...	60·	61·	68·	70·	61·	68·	61·	65·
	Half way down Ghaut...	...	...	...	...	65·	70·	...	...
	Bowany river..... ...	72·	70·	81·	79·	...	...	76·	78·

In a stream in the Government Gardens, in the middle of December 1866, Mr. Batcock was good enough to take seven observations with a Maximum and Minimum Thermometer. These he records as follows : average maximum, 72° ; avarage minimum, 50° ; highest point noted, 72° ; lowest, 42°.

From the limited period at disposal for making these observations, my figures must not be received as exactly correct, but as a near approach to what exists. The Thermometer was always placed in the shade and in shallow water. This, of course, raised the temperature ; but as fish ova are deposited in shallow water, the heat given is that to which the fish eggs would, no doubt, be subjected, and which, as will be subsequently shown, will be too great, it is to be feared, for fish from an English, climate ever to thrive in. Prior to the burst of the south-west moonsoon 15° was the greatest difference marked at mid-day between the water in the Ooty Lake and that in the Bowany river. Subsequently, as the moonsoon did not extend its range to Mettapolliem, it might have been anticipated that the difference would have been more marked, but such was not the case. During these cloudy days the temperature in the low country sank so much, that the greatest difference between the water in these two localities at mid-day was only 14½°, although the elevation differs by about 6600 feet. From the limited observations I was able to make, I was led to the belief that the proportionate heat of the water continues much the same. The Thermometer in the Bowany*, which at the latter end of May stood at 92° at 12 A. M., was only 79° at the same hour on June 22nd. It is true that on the latter date there was a considerable amount of rain water from the Hills in the stream ; but on the same day I examined the waters of the Kullaar river, which, although perfectly clear, showed the same reduction in temperature. Therefore, as a simple question of heat, it appears that the waters of the Neilgherries would be more suitable for low country fish than for those from Northern Europe ; for, although the increased coldness of the water may retard the hatching of the fish, such will not weaken the fry, but has been observed in Europe to have exactly the contrary effect. On extending these observations to the Seegeor river, and the Chennakennoor stream, which are situated nearly 2000 feet higher than the Bowany at Mettapolliem, but still are in the low country, I found the difference of temperature between these streams and the water of the Ooty Lake to be only 7° ; consequently, it may be assumed, other things being equally favorable, that fish from these localities would be best adapted for conveyance to the Hills.

The question of the temperature of the water is most material as regards the genera of fish introduced into it. To all appearances water may be well adapted for Trout, but too great heat alone will be sufficient to vitiate all other desirable points. The Salmon and Trout family, which partially or entirely pass their existence in fresh water, have no representatives either in the plains or the Hill Districts of India. In fact, if we turn to their geographical distribution, we find that the situations in which they thrive best are pieces of water which are at least occasionally or partially fed from snow-clad lands, subject, at certain or uncertain periods, to the influence of a temperature which falls below the freezing point, and where ice is sometimes perceived in the streams. Without asserting this to be necessary to their existence, or, perhaps I should say, to their propagation, still this coldness of the water appear to be necessary to their ultimate success.

* Placing a Thermometer on a dry stone in the bed of the Bowany river, at 6 P. M., on May 31st, it stood at 92°.

In Australia, where Trout are now being introduced, the air is cold enough in the winter months for the water to freeze.† In the columns of "*The Land and the Water,*" in reply to some inquiries made by me, as to the temperature considered necessary for trout to thrive in, the following remarks appear:—"We may "conclude that in the Trout streams of England at their sources (being springs), the water rises at "about 50° ; but their temperature is subsequently affected and regulated by the seasons of the "year and other conditions, and ranges say "from 30 to 70 degrees. I think 40 to 60 "degrees the most favorable. I have found the "eggs to do well at 30 degrees, the young fry thriving at 45 degrees ; but in our rearing ponds "at Sunbury, this last summer, I found the young fish doing remarkably well with the temper-"ature of the water up to 70 degrees in the day time. There certainly was a sharp stream "running. The mean temperature during the last fortnight (September) has been about 60 "degrees ; this day at noon it was 59 degrees."

S. Ponder, Esq.

From the foregoing, it appears more than probable, as in December the average minimum of the water in a running stream at Ootacamund was only 50 degrees, whilst the average maximum was as high as 72 degrees, that Trout can hardly be a success. By means of ice the temperature at this period may be lowered sufficiently to hatch and rear the ova. Breeding pot in future years in the open must be considered, and another trial of this experiment appears to be scarcely desirable, or rather cannot be expected to succeed. I shall, further on, show that the Fauna of the Neilgherries is almost exclusively tropical, and, therefore, it is scarcely probable that a species of fish from the colder region of England will succeed in their streams.

The fishes of the Hills, prior to the commencement of these experiments, may be divided into those indigenous and imported, a description of each of which will be shortly given at the end of this report*. On the upper plateau of the Neilgherries there appears to be only one indigenous species, commonly called a Minnow (*Paradanio Neilgherriensis*—Day), which is to be found in the Ooty Lake, the Pykara and Avelanche rivers, and the Kaity and Coonoor streams. It is a carnivorous carp, belonging to a tropical Fauna, and rarely exceeds 3½ inches in length. Once or twice a stray Eel (*Murœna maculata*—Ham. Buch.) has been taken at Ooty; but as this species is often brought up alive for sale from the low country, it may reasonably be supposed that these solitary specimens may have escaped, especially as it is certainly not to be obtained by fishing in any of the pieces of water.

About ten miles below Kotagherry, on the Cleveland Estate, at an elevation of about 3500 feet above the level of the sea, there is a species of fish found, known as the "Indian Trout" (*Barilius rugosus*—Day), which grows to about six inches in length. A little lower down, probably at about 3000 feet, is a small Carp (*Puntius Grayii*—Day), and a little Loach (*Nemacheilus Guntheri*—Day), which is also found in the small stream between that locality and Kotagherry. Some others also exist close to the base of the Hills, in the various streams descending to the plains, but they are the same as those in the rivers of the low country, and can thus scarcely be included amongst the Hill Fauna. In the Billicul Lake are several species which have been imported, viz., a Carp (*Puntius* [*Barbus*] *Carnaticus*—Jerdon), several of which have been captured, the largest weighing nearly 4lbs., a female, and full of roe : in the rivers of the plains this species is said to attain to 25lb. in weight ; a Loach (*Nemacheilus semi-armatus*—Day), which grows to six inches in length, and, although esteemed by the Natives, is scarcely worth the trouble of carriage ; a Paradanio (*Paradanio aurolineatus*—Day), which grows to about 5 inches in length ; and a very fine species of Minnow (*Rasbora Neilgherriensis*—Day), which is reputed to grow to eight inches in length, and breeds rapidly. These fish were all full of roe in April, and also at the end of June. They are said to breed in the north-east monsoon, as the south-west extends only very slightly to Billicul. My researches distinctly showed, even had there not been so many fish present, that this elevation is well adapted for them ; that they obtain sufficient sustenance, and breed ; in short, that they have

† Dr. Lang gives 80°6 as the mean maximum of the air in the year in Queensland, and the mean temperature as 61°1.

* Omitted, being too long. But sent to the Zoological Society.

become thoroughly acclimatized on the Hills, although originally from the plains. But it must be observed that they were brought up from Seegoor, which is 1900 feet higher than the Bowany at Mettapolliem, so that they were more innured to a colder temperature.

It will be as well to make a few remarks upon the rivers skirting the bases of the Neilgherry Hills, as regards their finny inhabitants, more especially the useful varieties.

In the Seegoor river I captured the same species as those in the Billicul Lake, as well as the *Nemacheilus Denisonii* (Day) and the *Garra gotyla* (Ham. Buch.) and *Garra Jerdoni* (Day), which are abundant and grow to six inches in length; but as they are adapted to running streams, they are very difficult to transport; also, the Spotted Trout of the Europeans (*Barilius rugosus*—Day), in reality a Carp, which is only adapted for living in rivers, although young specimens bear transporting pretty well, and the *Ophiocephalus gachua* (Ham. Buch). Eels and some other species are said to be obtained there, but I could not procure them on a personal search.

In the Bowany, the varieties of fish are much greater, and there are some more valuable species. The following is a list of those I captured:—*Ophiocephalus Marulius* (Ham. Buch.)—Poo Verarl, Tamil; *Ophiocephalus striatus* (Bloch.)—Curroopoo Verarl, Tamil; *Ophiocephalus gachua* (Ham. Buch.)—Korava, Tamil; *Mastacemblus armatus* (Lacep.)—Allaree, Tamil; *Notopterus Pallasii* (Cuv. and Val.)—Ambutan Wahlah, Tamil; *Hemibagrus punctatus* (Jerdon)—Psetta Kulletee, Tamil; *Hypselobagrus cavasius* (Ham. Buch.)—Vella Kulletee, Tamil; *Wallago attu* (Bloch.)—Wahlah, Tamil; *Wallago Malabarici* (Cuv. and Val.)—Chotah Wahlah, Tamil; *Glyptosternum Lonah* (Sykes)—Kul Kulletee, Tamil; *Nemacheilus Guntheri* (Day); *Nemacheilus Denisonii* (Day); *Garra gotyla* (Ham. Buch.); *Garra Jerdoni* (Day); *Labeo kontius* (Jerdon)—Currumunnee Candee, Tamil; *Labeo Dussumieri*, (Cuv. and Val.); *Labeobarbus tor*, (Ham. Buch.); *Puntius* [*Barbodes*] *gracilis* (Jerdon)—Coatee Candee, Tamil; *Puntius dubius* (Day); *Puntius Carnaticus* (Jerdon)—Poaree or Saal Candee, Tamil; *Puntius Grayii*, (Day)—*Puntius filamentosus* (Cuv. and Val.)—Sawaal Candee, Tamil; *Puntius arulius* (Jerdon); *Amblypharyngodon Jerdoni* (Day); *Rasbora woolaree* (Day)—Woolaree Candee, Tamil; *Barilius rugosus* (Day)—Aart Candee, Tamil; *Barilius* [*Pachystomus*] *cocsa* (Ham. Buch.); *Paradanio aurolineatus* (Day)—Parrah Cunjoo Candee, Tamil; *Paradanio elegans* (Day); *Esomus* [*nuria*] *Maderaspotensis* (Day); *Chela argentea* (Day)—Wellachee Candee, Tamil; *Belone cancila* (Ham. Buch.)—Coco Meen, Tamil; *Murœna maculata* (Ham. Buch.)—Vellangoo, Tamil.

Amongst the foregoing, the Striped or Black Murrul—*Curroopoo Verarl*, Tamil—grows to about three feet in length, and is captured, not only in the sluggish parts of the river, but also in tanks and wells. It deposits its ova during the monsoon time, and is much esteemed for eating both by Europeans and Natives. The Orange Murrul—*Poo Verarl*, Tamil—grows to about the same size as the last, but is only found in rivers, where it is said to get into holes in the banks. Owing to the Murrul having hollow heads, wherein they are able to retain water, they live a considerable time out of their Native element; but the Orange Murrul does not bear transporting well, and is better adapted for stocking rivers than tanks. The Small Murrul—*Korava*, Tamil—grows to about a foot in length, and is found both in rivers and tanks. It is easily distinguished from the young of the Striped Murrul, by having a reddish orange margin to its tail, and back fins. It bears transporting better than any other of the same tribe. The Spined Eel—*Allaree*, Tamil—grows to upwards of two feet in length, and is found both in the Bowany and in tanks; it is good eating, but rather rich. The Spotted Katurna—*Psetta Kulletee*, Tamil—grows to about a foot and a half in length, and is fair eating. The Silver Katurna—*Vella Kulletee*, Tamil—grows to the same size as the last. The Wahlah attains about 3½ feet in length, and is good eating, although rather rich. The small Wahlah is equally good eating as the last, but only grows to about a foot in length. The Common Eel—*Vellangoo*, Tamil—is found of a very large size, and is excellent eating. Amongst the Carps are several exceedingly fine species, especially the *Poo Meen Candee*, which attains a very large size in suitable localities, and the *Puntius* [*Barbus*] *Carnaticus* (Jerdon), which grows to about 25lbs. in weight, and may be found in droves in the Seegoor, Chennakennoor, and other streams when the freshes are down. They are esteemed good eating, but are rather bony.

The fish on the Hills (at least the only indigenous species) belongs to a distinctly tropical Fauna, and to the Carnivorous Carps. It may therefore be as well in this place to examine into the Flora and Fauna of the Hills, for the purpose of inquiring whether the tropical or temperate families predominate.

The Zoology of the vertebrate division of the animal kingdom has been better worked out than that of the invertebrate; still, much remains to be done by future inquirers, and many a gap needs filling up. The animals living in freedom in their native wilds will give us the best clue to the adaptability of the Hills to a tropical or temperate Fauna.

The Mammals of the Neilgherries still remain to be thoroughly investigated by some future Zoologist. Unfortunately, owing to my having been so suddenly ordered away, the collection I made has been greatly injured, and some of the specimens destroyed, as I had no time to take steps for properly securing them. The following, therefore, only comprises a portion of those best known in the class Mammalia. In the order UNGULATA, family ELEPHANTIDÆ (Gray), the Elephant and Wild Hog are found on the lower slopes, but have been gradually driven from, or destroyed by sportsmen on the upper plateau. Amongst the BOVIDÆ (Gray), the Spotted Deer (*Axis maculata*—Gray), the Barking Deer (*Cervulus moschatus*—De Blainv.), the Sambur (*Rusa equina*—Cuv.), the *Tetracerus quadricornis* (De Blainv.), and the so called Ibex (*Capra*——?) are found. In the order GLIRES, and family JERBOIDÆ (Gray), the small Striped Squirrel (*Sciurus palmarum*, Linn.), the *Sciurus sublineatus* (Waterhouse), and the Flying Squirrel (*Pteromys Petaurista*—Pallas sp.); in the LEPORIDÆ (Gray), the Hare, (*Lepus nigricollis*—Fr. Cuv.); in the HYSTRICIDÆ (Gray), the Porcupine, (*Hystrix leucura*—Sykes); in the MURIDÆ (Gray), several rats and mice, common also in the plains, are found. In the order FERÆ, and family FELIDÆ, the Tiger (*Felis tigris*—Linn.), the Cheetah (*Felis Pardus*—Linn.), the Hyæna (*Hyæna striata*—Zimm.), the Wild Dog (*Cuon primævus*—Hodgson), the Jackall (*Canis aureus*—Linn.), the Fox (*Vulpes Bengaliensis*—Shaw), the Mongoose (*Herpestes griseus*—Geoff.), and the *Herpestes Elliotii* (Gray), an Otter (*Lutra? Aonyx?*) and a Bear (*Melursus lybicus*—Mayer); also a Shrew Mouse, and the Musk Rat. In the order PRIMATES, and family SIMIADÆ, is one Monkey (*Semnopithecus Johnii*—Fisch.); and amongst the VESPERTILIONIDÆ are several species of Bats.

The foregoing are some of the most common and well known Mammals of the Hills, and on examining their general characteristics, we cannot but perceive that the tropical forms predominate; whilst, if we observe the members of the various genera, we see the little Striped Squirrel of the plains most numerous, even as high as the summit of the Kaity Ghaut, where they also breed. In fact, the Sambur with its young are frequently found on the summit of the Hills, and even cubs of the Tiger and the Cheetah have been observed in that elevated region. It has, it is true, been stated, and apparently with reason, that in the colder regions they lose much of their ferocity, but no one has yet asserted that climate to be unadapted to their existence and propagation. In short, few, if any, Mammals are obtained on the Neilgherries, that are not common to the plains surrounding their bases.

If we now turn to the reptiles of India, we find the same general rule of the preponderance of a tropical Fauna, which obtains amongst the Mammals. The various divisions of the order CHELONIA are absent, except around quite the base of the hills, or the neck of land connecting them with the Mysore territory; whilst the Crocodiles and Water Lizards appear to be totally absent, and the Land Lizards (*Lacertidæ*) are sparingly distributed. The *Acanthodactylus Nelgherriensis* (Jerdon) is recorded from Coonoor. Amongst the Skinks (*Scincidæ*), the black striped species, *Eumeces bilineatus* (Gray), is very common even on the summit of Elk Hill, overlooking Ooty, where it may be found under the stones. Amongst the Geckos (*Geckotidæ*) the *Gymnodactylus Indicus* (Gray); and in the *Agamidæ*, the Flying Lizard (*Draco Dussumieri*—D. and B.) was obtained by P. Grant, Esq., the Collector, a short distance below Coonoor, where he shot one out of three, which he found on a tree: he had previously obtained specimens in the same locality, and has one still preserved. The *Calotes nemoricola* (Jerdon) was also found at the foot of the

Joonoor Ghaut, whilst the *Calotes nigrilabris* (Peters) is exceedingly common even on the summit of the Hills, especially in gardens and hedges; the *Salea Horsfieldii* (Gray) is also present, and the *Chameleo vulgaris* (Daud) is by no means rare amongst the lower hill slopes.

In the order of snakes (OPHIDIA), the following have been recorded as captured on the Neilgherries.*

* "The land and fresh water snakes of the Madras Presidency", by Captain Beddome—Madras Quarterly Journal of Medical Science.

Sub order VIPERINÆ; CROTATIDÆ; TRIMESURUS:—*Trimesurus Malabaricus* (Jerdon), *Trimesurus Strigatus* (Gray), *Trimesurus Wardii* (Jerdon). TRIGONOCEPHALUS: *Trigonocephalus Elliotti* (Jerdon.)

Sub order COLUMBRIDÆ; RHABDOSOMA:—*Rhabdosoma microcephalum* (Gunther). CORONELLIDÆ: *Simotes Binotatus* (Dum. and Bibr.). TROPIDONOTUS: *Tropidonotus Stolatus* (Schleg.). COLUBRINÆ: *Cynophis Malabaricus* (Jerdon). DRYIOPHIDÆ: *Tropidococcyx Penotati* (Gunther). SILYBURA: *Silybura Ellioti* (Gray), *Silybura Beddomii* (Gunther). ELAPSIDÆ: *Collophis concinnatus* (Beddome). UROPELTIDÆ; SILYBURA: *Silybura ocellata* (Beddome), *Silybura brevis* (Gunther), *Silybura Neilgherriensis* (Beddome). PLECTURUS: *Plecturus Perrotteti* (Gray), *Plecturus Guntheri* (Beddome).

Out of the foregoing seventeen snakes, recorded as occurring on the Neilgherries, five have been also captured on the Annamullays, and one of these in Ceylon, whilst another is common in the plains. Although the remainder are at present unknown, excepting in elevated localities, they are all distinctly tropical species, belonging to tropical genera.

Out of 118 species of birds, recorded by Jerdon,† either as residents on, or visitors to, the Hills, or personally collected, 110 have been taken on the plains, or on lower ranges of hills, whilst 12 have been captured in Europe, although only half of these were found in its northern latitudes. Seventeen of the above species have been observed unquestionably to nest on the Hills; and five, which are mostly winter visitants to India, have been known to breed in Northern Europe. There is only one, if it is the same species, the *Fulica atra*, which breeds in both climates.

Birds of India.

Thus it appears that the Avi Fauna of the Neilgherry Hills is mostly tropical, and although some sub-tropical forms are present, the existence of birds common to a temperate climate is very exceptional.

To enter fully into all the invertebrate animals found on the Hills, would be a work of great labor, covering a large amount of space, with hardly a commensurate advantage in the question of geographical distribution as bearing on pisciculture, but still the subject must not be dismissed without a few observations.

Amongst the COLEOPTERA some species are perhaps peculiar to the Hills, but the great majority are the same as those found on the plains, although they decrease in number as the ghauts are ascended, and some even ceasing at the base, as for instance the pretty but blistering *Mylabris cichorea*. The same may be said of the LEPIDOPTERA, with the exception that there is scarcely a species of butterfly found on the Hills which is not also present on the plains. But it is very curious to observe the gradual decrease in number and species as one ascends the ghauts from Mettapolliem, where the variety is numerous, towards Coonoor. This decrease is first apparent in number, and then in species, many of which cease altogether at Coonoor, and others remaining, but gradually decreasing in number as Ooty is approached, where there are comparatively few. It may be safely asserted that the tropical species predominate amongst the Lepidoptera.

The Flora of the Hills is of an exceedingly varied description, an analysis of which would require a very extensive collection, and a great amount of study, the materials not being at hand from which a perfectly satisfactory conclusion can be drawn. A simple enumeration of families, genera, and species existing, would hardly give a true idea of its varied character. The lower slopes, of course, are distinctly tropical, as are also Coonoor, Billicul, and nearly as high as the Avelanche and Pykara, but above these elevations the sub-tropical forms commence. Individuals

of the same genera as found in the southern latitudes of Europe are common, although the species is generally different; but, notwithstanding, there is a deficiency, distinctly pointing out that the climate differs from that of Northern Europe, or even England for instance. It may be that the great variations of temperature which occur there between the summer and winter months are requisite to bring English trees to a state of high perfection—for example, I may instance the Apple, Pear, Filbert, Gooseberry, Currant, and many other garden fruits, which do not thrive at Ooty; whilst, amongst the flowering plants, such as the Geranium, Fuschia, Dahliah, and others, which it is necessary to keep indoors during the winter in England, this precaution is not requisite at Ooty, where they remain out with impunity during the cold season.

From the foregoing, I think we may fairly conclude that certainly the Fauna, if not the Flora also, is nearer to that of the tropical plains, than to that of a cold or even a temperate climate; that Mammals of the low country thrive and breed at the summit of the plateau; that the frogs of both localities are identical; that the snakes at the lower parts of the Hills are tropical, and at the summit semi-tropical; that eminently tropical birds build their nests and rear their young at Ooty; and that insects of the plains are found almost as high as the summit of the Hills. At the same time, it cannot but be evident that many of each of these divisions of the animal kingdom, which are common on the plains, are absent from the higher parts of the Hills. Indeed, as elevation is attained more and more genera gradually disappear, whilst some new ones obtain; but even these, as a whole (subject of course to many exceptions), belong to a tropical Fauna, or, if to a genus found in a temperate region, are usually also common to a tropical one.

When I perceived that the Trout experiment was evidently failing, being aware that, even if it were subsequently tried again, it could only be after the lapse of some time, I considered it very undesirable to leave the Hills without another effort to stock the waters with fish. Therefore, on April 16th, I addressed an official letter to the Collector of Coimbatore, suggesting their importation from the plains, as the upper end of the lake appeared to be admirably adapted for Eels and Murrul, and the lower for Carp, the only doubt being whether the water was too cold, which I did not believe it to be. Of course, only time can prove whether fish thus transported will thrive, and breed without deterioration. The Pykara river will, no doubt, do excellently for large Carp and Murrul. I had previously tested the possibility of bringing them up alive to Ooty from the plains, and either alone, or with the assistance of Mr. Batcock, of the Government Gardens, had succeeded in importing upwards of a hundred fish from the Billicul Lake, and the Seegoor and Pykara rivers, with comparatively small loss. I found that the Rasboras and Paradanios carried well, as also the large Carp, provided they could be kept alive until the evening.

The presence of Carp, weighing as much as 5 lbs., in the Billicul Lake, was conclusive evidence of their thriving in that locality; and as there were ova inside the females, there was reason to suppose that there were young ones in the same piece of water, which, by the great increase amongst the Rasboras and Paradanios, proved that there was nothing in the water deleterious to the breeding of fish. Why no young Carp could be found was a mystery, but it appeared to me that the absence of any grass or weeds round the lake or pond rendered breeding impossible. But that fish will not breed in some pieces of water has been seen elsewhere; for instance, in Lady Rodney's pond, at Alresford, in Hampshire, Carp grow to an enormous size, but, though ova is found in them, they never breed.

I have shown that the Billicul Lake is suited to the residence, acclimatization, sustenance and increase of fish originally introduced from the plains, and as no attempt had up to this time been made of a similar nature, either at Ooty or Pykara, to prove the contrary, it was reasonable to suppose that these pieces of water might be equally well adapted for the finny tribes. About this time, Mr. Burnett, of the Wynaad, was good enough to present me with a collection of fishes from his estate there, situated 3000 feet above the level of the sea; and amongst these specimens I found a young Murrul—*Curroopoo Verarl*, Tamil—(*Ophiocephalus striatus*—Bloch), which convinced me that this species would live and breed in elevated localities. In the north of India it is seen at Dharwar, and other parts nearly of the same height.

I must again refer to the geographical distribution of the following seven species of fish, which I hoped to have been able successfully to introduce on to the Hills, besides the Common Eel.

	Billicul, about 5700 feet elevation.	Seegoor, about 2900 feet elevation.	Bowany, 1000 feet elevation.
Ophiocephalus marulius	...	...	Present.
,, striatus	...	...	,,
,, gachua	...	Present.	,,
Labeobarbus tor	...	Absent.	,,
Puntius Carnaticus	Present.	Present.	,,
Paradanio aurolineatus	,,	,,	,,
Rasbora Neilgherriensis	,,	,,	,,

Those found thriving at the highest elevations appeared best adapted for transporting to the upper plateau of the Hills. At the same time it did not appear indispensable that they should be obtained from the highest level.

The *Ophiocephalus gachua* (Ham. Buch.)—*Korava*, Tamil—grows to, at least, one foot in length, and from 1 to 2 lbs. in weight. It is esteemed as excellent eating, and appears to be one of the species best adapted for transporting from place to place, as it lives in the hottest Districts as well as in deep and cold wells. Sunshine and shade, heat and cold, seem almost immaterial to its existence and propagation, although they affect the size to which it grows. It can be easily transported either in hot or cold weather. Thus, one day when I was bringing nine of them from Coonoor to Ooty, in a chatty of water, they experienced a change of 21° in temperature, without apparently producing any deleterious effects. Another time, at Culhutty, on July 19th, 1866, a cooly turned one of them accidently out of a tin can of water ; this occurred at 5-55 P. M., when the temperature of the air was 69°, and was not discovered until 8-45 P. M., or about three hours subsequently, when the fish was found on the gravel walk outside the Bungalow perfectly well and uninjured. Two days later it was turned into the Ooty Lake. I afterwards was able to try a still more interesting experiment proving the strong vitality of this species. On July 25th, I was going from Wellington to Mettapolliem, and on passing the Kullaar bridge, found it under repair, and a master carpenter with several Natives at work there. As, at a former period, I had vainly endeavoured to obtain some of the little fish I saw swimming about in the stream, I offered the Maistry an Anna for every sort of fish he could capture before 4-45 P. M., when I expected to return. Amongst those he procured, was a young *Ophiocephalus gachua* ; but having nothing in which to carry it, I moistened my handkerchief in the river, and rolled him up in it, leaving his head uncovered. An hour subsequently, I put him into a small stream of water by the side of the road ; he gave three gasps and was as well as ever. At 6-45, I repeated the dipping, and at 8-45, on my arrival at Wellington, he was quite well. The next day, he was placed in the Coonoor stock pond, and on August 2nd, removed with 14 others into the Ooty Lake. Vitality must be great in a fish which will bear an ascent of nearly 5000 feet, carried in a wet pocket handkerchief, which was only moistened twice during the journey, which occupied four hours.

One of the greatest difficulties during the progress of this experiment, was in obtaining the fish ; for, although the Collector gave every assistance in his power, and directed the Sub-Magistrate of Mettapolliem to assist me in my operations, I found the latter most apathetic and indifferent: constant excuses were forwarded instead of the fish, and the same common Native tale was told me at all times, whether I was present or elsewhere, viz., that the water was unsuitable, but that after a few weeks or months it would be just right, or, at other times, the proper sorts of fish were absent ; sometimes muddy water was requisite, or, when that was present, none could be captured until it was clearer ! At a later date, about the end of July, when young fish of a proper size became plentiful, having ascertained by experience the best methods of conveying them, I was in the position to be able to make a contract with a Native at Mettapolliem, which I found very successful, being cheaper in the end, and greatly expediting my efforts. The agreement entered into was, that I should pay eight Annas a head for every fish taken by myself alive out of the

Coonoor stock pond ; whereas I found that those collected personally varied from a Rupee four Annas, each, and upwards. The captures immediately increased, and in a week twenty-five *Ophiocephalus gachua*, and two *Ophiocephalus marulius*, with several Carps, were safely removed from Coonoor, and the experiment assumed a different aspect. But, subsequently, the contracting Native went to Coimbatore, leaving another party to carry out the arrangement, and the fish sent up again decreased in number. Another agreement into which I entered with an East Indian at Seegoor, for bringing up Carp, was not so successful. I offered four Annas a head for them delivered alive in Ooty, but, not receiving any, was obliged to increase it to six Annas. His employer had previously tried the experiment, and sent me up six large Carp at the cost of one Rupee.

Young fish are the best to transport, as they travel more safely, and do not knock themselves about so much in the transit—therefore, are not so much exhausted, and fewer die ; but as fish breed in the monsoon time, the young are scarcely ready for removal before the end of July or beginning of August, when they abound in the Bowany. But if the species breed in October, such as the Rasboras at Billicul, the young are best taken at the end of that month, or beginning of November ; but as these months are very cold on the Hills, it would be unadvisable to choose this period for the experiment. March, April, and May are said to be good months for obtaining fine young fish for conveying to the Hills. The most desirable period of the year could not be chosen in this instance, as the experiment was only sanctioned in May, and was commenced on May 23rd, when I left Ooty and reached Mettapolliem on the Bowany river the same evening. The season best adapted for these experiments appears to be between the bursts of the monsoon, for reasons which will be subsequently detailed.

The geographical distribution of the species of fish found on the Neilgherries, in the adjacent low country, and in the intermediate elevations, claimed my particular attention, as much information may be gleaned from this, respecting which species will be likely to thrive best at the highest elevations, and feel the change of climate least. Thus, amongst the *Puntius* genus we find in the Bowany, 1000 feet above the level of the sea, the *Puntius Carnaticus* (Jerdon), *Puntius Grayii* (Day), *Puntius arulius* (Jerdon), *Puntius filamentosus* (Cuv. and Val.) ; but out of these four, only the first is found in its natural wild state at Seegoor, 2900 feet above the level of the sea, and it had been imported to Billicul, about 5700 feet above the sea. This species, which attains 25 lbs. in weight, appeared best adapted for trial.

At the time the experiment was commenced, there were five species of low country fish acclimatized on the Hills, and one indigenous species ; the others had been imported from the Seegoor stream. Five out of these six species never exceeded six inches in length, the *Puntius Carnaticus* alone growing to a large size. A few miles from Kotagherry, but at about the same elevation as Seegoor, four species were found : one *Barilius*, an Indian trout, the same as found at Mettapolliem and Seegoor ; one *Nemacheilus*, the same as found at Mettapolliem ; a *Puntius*, which is common in the same place ; and one species differing from any in the plains. But none of these were worth transporting to the upper plateau, their size being so insignificant.

The varieties of fish in the Bowany and Seegoor rivers worth transporting have been detailed ; it now remains to observe upon the best method of carriage. It must be remembered that the higher the elevation from which they are brought, the more probability will there be of their thriving on the upper plateau ; consequently, those from Seegoor, 2900 feet above the sea, are better adapted for acclimatization than those taken from Mettapolliem, 1900 feet lower, although the species may be identical. However, in this case, it must not be forgotten that the Seegoor river eventually finds its way into the Bowany, and that, during floods, some species of fish from the latter stream frequently migrate up their tributaries ; consequently, a fish at Mettapolliem one day may, in the course of a few days, be found at Seegoor. Some species, however, do not appear to migrate thus, and these were not deemed the best for this experiment.

The best time of day for capturing fish depends greatly on the mode employed, the locality, and the season of the year. On the Hills, the middle of the day seems to be the best for netting ; whereas, in the plains, this period is too hot (unless in cloudy or rainy weather), and the mornings

and evenings are preferable. During the first burst of the south-west monsoon, very cold winds commence at night time, and continue until about 10 or 12 in the day; this renders the water in the chatties intensely cold, and causes the death of fish thus conveyed. Fish caught by a hook are always liable to injury; consequently, those taken in a net are best adapted for stocking other pieces of water. Eels are captured either in baskets at night time, or by hooks; in either case great care should be always taken in releasing the fish, as fatal injuries are often inflicted by carelessness at this time. The fish*, as they are captured, should be placed in earthen chatties, two-thirds full of water, with grass floating on the top, and wrapped round outside with wet leaves or grass, which is certainly a great desideratum, although whether it assists in the elimination of oxygen from the air, or simply by affording shade, is questionable. The chatty should be placed in a moist tub, until sufficient have been obtained; or, if this be not available, a small net may be tied over each chatty, when they may be put into a shady part of the river or pond.

*Excepting Eels.

The time of year best adapted for introducing fish could not be ascertained with certainty at the commencement of the experiment, as the Seasons at which they bred were unknown. Neither the Carps, the *Ophiocephalidæ* or the *Bagridæ* can be introduced by means of their ova. The principal season for depositing ova in this portion of India appears to be during the south-west monsoon on the western side, and the north-east monsoon on the eastern. Owing to this, the eggs are deposited at a time when the greatest rush of water occurs; but in consequence of the stringiness of the ova, and its being attached to grass, it is not washed away, whilst the young obtain abundance of food. Thus, fish brought up before June and October, respectively, would be in breeding condition, if they were of sufficient age, and would, of course, be worth much more than a non-breeding one, unless the deposit of ova were stopped by the change of temperature. Many of the fish in the Seegoor river have finished breeding at the end of the south-west monsoon; but the Bowany commences from the south-west quarter, and flows to the north-east, so fish may be found in it which breed at both periods. It is probable that in the first year the ova will come to nothing, or that, at all events, a large proportion of it will be barren; but the second year the fish ought to breed. As a rule, young fish bear transporting better than large ones; but they must not be *very* young fish, as the infant Carps die rapidly. The large fish require more oxygen than the small, and they also beat themselves about more, and get frequently injured in the transit.

My first experiments in conveying fish in India were made in tin cans between Billicul, and Ooty, Pykara and Oooty, and Seegoor and Ooty. In two of these first attempts, I had the assistance of *Mr. Batcock*, of the Government Gardens at Ooty, and of some coolies who could be thoroughly relied on. When the experiment was carried on, on a larger scale, I extended my distance to Mettapolliem, 25 miles from Ooty, and above double the distance from which I had previously brought them. It may safely be asserted that, with increased distance, the probabilities of success are proportionately lessened, and I found many experiments necessary, and much time occupied, in devising the best methods of conveyance, and ascertaining the proper season of the year. There is only one fisherman on the Hills; and this man, who had assisted me in my original experiments on a smaller scale, unfortunately became ill, and I could not obtain his services. At first, I always rode by the side of the coolies from Mettapolliem to Ooty, leaving the former place about 6-30 P. M., and arriving at the Lake about 7 A. M., having changed the bearers at Coonoor. This personal supervision was necessary, for the purpose of inspecting the success or the reverse of each mode of carriage; the best plan respecting changing the water; and the rapidity of death, with the manner in which it occurs, in the various species experimented upon. Had I not been present, the reports given me might have been true or the contrary (I could not depend upon them); and from these statements I might have drawn erroneous conclusions. Some of the information thus obtained has been utilized, although much still remains to be practically tested. After I had eventually matured my plans, and had ascertained the species which bore transporting best, and the method most adapted to ensure success, I desisted from personally accompanying the coolies, as my presence was no longer necessary, and I found that riding up the cold ghauts at night time, so frequently, brought on bad attacks of fever, accompanied by other unpleasant symptoms. Thus, while employed in supervising the operations, I was also enabled to extend my researches into the fish found at other parts of the Hills, together with the time of year at which they breed. I also obtained, and brought in, species from Billicul, and elsewhere. When my plans were matured, and I had shown the manner in which fish could be successfully brought in alive to Ooty from the plains, I established a stock pond at Coonoor, and was able to make a contract by which the *Ophiocephalidæ* and Carps were brought up and placed in this pond, from whence I personally removed them twice a week, and placed them either in the Ooty Lake or Pykara river, as I deemed best. I also made arrangements for receiving the large Carps (*Puntius Carnaticus*) at Ooty from Seegoor; also Eels from Mettapolliem.

There are several methods for the carriage of the fish, each of which has its advantages and disadvantages, viz., an earthern chatty on a cooly's head; one large chatty slung on a bamboo, and carried between two coolies; two chatties slung one at each end of a bamboo, and carried by coolies; tin watering cans; a wooden tub slung on a bamboo between two coolies; or a cask placed on a cart. Good careful coolies are very necessary, as, if they shake the chatties or cans much, the water splashes over, whilst the fish become frightened, and dash themselves against the sides, sometimes even jumping out, thus being greatly, and often fatally, injured. Therefore, a fine net should always be tied over the top of the carrying chatty or can, to prevent their falling on to the hard road. This shaking is especially perceptible in wooden tubs slung between coolies'; and for the same reason casks on country carts without springs should be avoided. Care must be taken that the coolies do not empty out the water; for, as they are paid by the trip, the result is immaterial to them, and they occasionally lighten the load, by emptying it out at the commencement of the journey, and refilling the chatty when near the termination: on arrival, the fish are, of course, dead, but it is a very difficult thing to prove whether the water has or has not been tampered with. The inside of the conveying vessel should be as round as possible; thus, the inside of chatties are especially suitable, whereas, when tin watering pots are employed, unless the spout is well stuffed with grass or leaves, small fish wriggle themselves up, and thus miserably perish. The vessel should, in the day time, be well tied around with ferns or leaves, to keep off the effects of the sun's rays, and these again should be kept moist, to promote evaporation. Chatties carried on coolies' heads should have a small basket beneath them, as the men's hands become so benumbed, that there is danger of the chatty falling. I found that the safest and most expeditious plan was to have single chatties carried on coolies' heads (when they had two, they invariably emptied out the water, the weight being too great; and the chatties slung on bamboos were always greatly shaken). When fish are much shaken about in carriage for any length of time, they probably feel in their way as ill as do human beings, cows, horses, goats, and even the albatross, on board-ship, although the manner in which they suffer is not preceptible to us. Thus, amongst some young *Ophiocephalus gachuas* brought from Coonoor to Ooty—a distance of ten miles, the journey occupying three hours and a half—looked very tired; so they were placed one evening in a large tub of water, with plenty of leaves floating about, and some grains of rice thrown on the top: the next morning, they were as lively as if they had just been removed from their Native river. A tired fish may be easily recognized, as it does not look so bright and fresh, and the crown of the head is of a duller tint, whilst the dark greenish back looks muddy and of a lighter colour. The greatest injury to the *Ophiocephalidæ* will almost invariably be found on the summit of their flat heads. It seemed at first doubtful how this occurred, but it was subsequently observed that it was occasioned by their jumping up, and hitting the top of their heads against the cover of the vessel containing them. This was obviated to a great extent by letting a good quantity of grass float on the water; but there must not be too much, or the fish appear to climb up it, and jump from thence upwards—thus increasing, instead of lessening, the danger.

In rainy weather, when there are cold winds blowing, tin cans are best suited for carrying the fish in, as, the evaporation being less, the water does not become of so low a temperature as in earthern chatties. During the transit, a little water should now and then be removed from the vessel, and some more added from the nearest source; for, in very cold weather, it will be found that

water in its natural state is warmer than that in the chatties or tins. On warm days, the same plan should be pursued, for the purpose of oxygenation. Verarls (*Ophiocephalidæ*) especially in the cold months, are best carried by mixing a large proportion, as much as one-sixth, of mud in the water. Eels, and Allarees (*Mastacembelidæ*) should be conveyed in hollow bamboos, or in chatties, in wet grass mixed with mud. They must not be carried in water; for, if it is deep, they will be drowned. Open baskets are not advisable. On August 7th, at 4 P. M, nineteen large Eels were despatched from Mettapolliem in an Eel basket, and reached Ooty at 4 P. M., the next day. Neither grass nor mud had been made use of, no cumblies had been thrown over the basket coming up the Ghaut, and they had not been placed in water en route; consequently, only two were alive when received. On May 24th, eight fine Eels were placed in a tub of water, at Mettapolliem; as they were continually escaping, a net was thrown over the top to prevent their exit, but a few hours subsequently they were all found dead. A *Mastacemblus armatus* shared the same fate from being carried up the Ghaut in a chatty of water. Care must be taken that the coolies do not tie cloths over the mouths of the chatties, to prevent their escaping.

It must be remarked that many deaths occurred amongst the fish, not from their having been brought up to the Hills, but from the shaking and consequent exhaustion sustained in the long journey, or from the cold experienced in the chatties going up the Ghaut. The *Siluridæ* (scaleless fishes) were least able to sustain this sudden change, and most of them perished before their arrival at Ooty. Two of them were put alive into the Coonoor stock pond, at the commencement of August, but on being removed two or three days subsequently, by means of a net, they were both found to be dead; whether this was occasioned by the temperature, the muddy bottom of the pond, or from exhaustion, is questionable. During the end of May, I personally brought up one *Hypselobagrus cavasius* alive, and placed it in the Lake. Theoretically, therefore, the *Siluridæ* would be unsuited for the elevated plateau of the Neilgherries; but, practically, such may not be the case. Amongst the fishes sent me from the Wynaad is a *Bagrus*, a *Wallago*, and a *Saccobranchus*, and they are known to thrive well in that locality; whilst from the elevated district beyond Cottayam, in Travancore, I have received a *Bagrus* and a *Hara*. Therefore, we may practically infer that when their acclimatization elsewhere is attempted, they should be transferred in the hot months, during the night time, and we should not too hastily decide that they are unadapted to the Hills. Verarl and Eels can be conveyed at any period, but the former do best placed in a stock pond half way up; the latter should be carried the entire distance in one journey. Carp from Seegoor seem to be best carried on a dull windy drizzly day, between the bursts of the monsoon, in tin cans. They should leave about 4 P. M., so that they may reach a stock pond formed in the Culhutty stream by 7 P.M., from whence they can be transferred the next morning to Ooty or Pykara. Stock ponds of stagnant water, like that at Coonoor, are not well adapted for keeping Carp for more than a very short period. When the young Carp are beginning to get about in droves, in July and August, it is a good season for bringing them up from Ooty; but only about half the number sent arrived alive.

A few experiments instituted showed the rapid changes from heat to cold which some tropical fish can bear without injury, but which must prove fatal to others. July 7th was a very warm day, and the water in the Coonoor stock pond stood at 76° at 12 A. M., and was, of course, the same in a chatty, which, before leaving, was carefully surrounded by moist fern leaves. It contained nine live Verarls (*Ophicephalus gachua*—Ham. Buch.) which arrived at Ooty at 4-45 P. M., when the air was 62° and the water in the lake 67°, while that in the chatty was only 55°. They were all well, although, in less than five hours, they had experienced a decrease in temperature of the water in which they were of 21°; they certainly seemed to like their transfer to the warm lake. Still the cold on that day was nothing comparatively speaking to that experienced on the ghauts, where, however, it was impossible to read off the temperature by moonlight. On another day, when the heat was much the same as above, when bringing in fish from Billicul to Ooty in tin cans, I found, on arriving at the latter place, at 6 P. M., that the temperature had sunk 13°, but was only 5° less than that of the lake. The decrease of temperature is, in fact, nearly twice as great in earthen chatties surrounded by moisture, as it is in tin cans. The coldness of the water depends upon the evaporation, which is increased or checked by many disturbing causes,

but is chiefly affected by the rapidity of the current of air, and the amount of moisture in the surrounding atmosphere. Thus, at the commencement of the monsoon, with cold and comparatively dry winds rushing down the ghaut, the water in porous chatties rapidly cooled, and the same also obtained after a few dry days in the monsoon; but when the rain had continued uninterruptedly for days, the evaporation became slight, and the difference between the temperature of the air and the water was not great. As a rule, water is 1° colder in chatties than in tin cans. To ascertain this accurately, I placed a similar earthern chatty containing water in an open verandah out of doors, with the wind blowing upon it, and a tin watering can of water by its side. The difference in temperature was as follows.

	6 A. M.	8 A. M.	10 A. M.	12 A. M.	2 P. M.	4 P. M.	6 P. M.	8 P. M.	10 P. M.
Temperature of air.....	59	58	60	62	59	62	58	59	58
Do. of water in chatties.	52	57	57	57	59	60	56	62	61
Do. of " tin cans.	53	58	58	60	60	64	57	62	61

In the hot months of the year, chatties should be used in the conveyance of fish. They should be only two-thirds full of water, and care should be taken that they are sufficiently strong to bear the weight of the fluid. In the cold months, tin cans are best adapted for this purpose. Bright moon-light nights should, if possible, be chosen for these experiments, as artifical lights do not admit of such strict scrutiny over the coolies as they require.

Of course, fish must feel the rapid changes of temperature in the air during the ascent. Persons going up the ghauts, who are accustomed to similar variations, and are warmly clad, still feel it greatly, and how much more so must fish, who find their Native element getting colder and colder, until it eventually becomes very much lower in temperature than the water in its natural state on the summit of the hills.

If it is necessary to keep fish for a night, in order to transmit them elsewhere on the following day, they should be placed in a wooden tub near an open widow, in a well aired room. It must be covered by a net, to prevent their jumping out; plenty of grass should be floating on the surface of the water; and a little very finely chopped raw meat thrown in. The *Ophiocephalus gachuas*, if left without food, will bite the red tipped tails of their fellow prisoners, probably mistaking them for meat.

As I found that many fish died between Coonoor and Ooty, probably from the length of the journey being too great, I determined on making a stock pond at the former place, and this plan succeeded admirably. This was not established with the idea of enuring them to the change, but to avoid the large proportion of deaths from exhaustion; for a tired, hungry fish, which had been cramped up in a tin can or chatty, would not be likely to finish the journey from Coonoor to Ooty so well as if it had had a good rest, and been fed for a few days in the pond. In reducing theory to practice, I found that several fish which were apparently dead, and must inevitably have been so before long, had they continued the journey, revived on being held in the warm hand in the water of the pond. *Mr. Smith*, of Woodcot, obligingly placed a pond in his garden at my disposal for this purpose. This I ascertained had been in existence many years, as newly made ponds are not adapted for the reception of fish. On one side, we cut a deep channel, so that, when necessary, we could empty out nearly all the water, whilst the stream on the other side, which supplied it, could easily be turned on or off. In the cold months, everything should be done to facilitate removing the fish as easily as possible, as the coolies do not like standing about in the water, as they become very cold, and frequently attacks of fever are engendered thereby. A drag net is a necessity, it should extend quite across the pond, and must be heavily leaded to prevent the escape of the Verarls, which dive down into the mud. As no drag net was procurable in Ooty, and I could not obtain the services of a fisherman with one, I was obliged to make one myself. It was thirty feet long, by six deep. If the fish arrive before sun down at a large piece of water like the Ooty Lake,

they should be placed in the eastern side, so that they may obtain as much as possible of the sun's rays. Verarls should also be put in near some rocks in the water, under which they may hide, and Carps near weeds ; but these must not be too thick, as, when first placed in the water, the fish require time to recover, and, if they get caught in the weeds, there is danger of their being drowned. If they turn over on their backs or sides, they should be retained in the hand, and held in the natural position in the water ; in this way, they generally recover, and quietly swim away. They should not be placed in deep water, as they do not appear to recover so easily as in the shallows, and it is much colder. The spot should be carefully watched for an hour or two, as in their exhausted condition they can be easily captured by the hand.

I considered it best to establish distinct colonies of fish in the lake, by turning them in at different parts, and, therefore, introduced some at the northern end, some at the Willow Bund, and others in apparently favorable localities. Whether this will answer practically, by disseminating the species over the lake, remains to be proved ; at all events, the probabilities are in its favor, as from one end of the lake to the other is a considerable distance for fish to spread without assistance, and they might thus only have remained near where they were placed originally.

We now come to the important question of the result of the experiment, or rather, I should say, to the number of each species safely transported into the waters of the Neilgherry Hills*, which are as follows :—Eels 16 ; *Puntius Carnaticus* 28 ; *Ophiocephalus marulius* 2 ; *Ophiocephalus striatus* 10 ; *Ophiocephalus gachua* 149 ; and some of *Labeo Dussumieri*, *Rasbora Neilgherriensis*, *Paradanio aurolineatus*, *Barilius rugosus* ; besides a few *Puntius gracilis*, *Puntius filamentosus*, &c., making 116 more.

* Exclusive of those imported by myself prior to May 24th.

The success of the experiment must be left to time to determine. Some of the above may breed, and others not ; but surely the attempt to utilize this large expanse of water, and render it subservient to the wants of man, by furnishing a delicacy for his table, and ministering to his pleasure by giving him sport, should not be lightly regarded. The probabilities are that the *Ophiocephalidæ*, the *Rasboras*, and *Paradanios* will breed and thrive ; the doubt is respecting the large Carp, and whether, if it breeds, the young will deteriorate or not. This, time can only solve ; and a few years rest will be necessary to give them time to increase and multiply. But, before entering upon the local restrictions which personally appear desirable for their protection and development, it may be desirable to glance at what Government has done, or is doing, for the preservation of the fishes of India as a whole, whether on the sea board, in running streams, little brooks, or stagnant water.

Taking the vast expanse of the sea board of India, no restrictions appear to exist as to the time of year, or the method employed, in the capture of fish. Any one may capture them as he pleases, without fear of any judicial interference, and this liberty extends to all, including Natives of Ceylon, foreigners from the Persian Gulf, from China, and many other parts. This privilege does not arise from prescriptive rights, or in any way owing to hereditary immunities, as it is well known that fishermen in Native States paid taxes on their nets, and often a percentage on their captures. This law was even enforced by the Dutch in Malabar, and by the Portuguese at Goa, who also decreed that no fish could be sold, or even given away, until the Catholic Clergy had taken either what they required for their personal use, or deemed necessary for the religious establishments under their control. In the same way, the Native Princes had always enforced a tax invariably upon all fresh water fish captured ; and so stringently has this been carried out that, even in Hyder's time, the punishment for evading it was, it is said, the loss of the right hand. In British Burmah, also, I observe that in the sale of tracts of country, amongst other reservations, are all rights with regard to the fisheries of the rivers in those parts. Private rights cannot interfere with Government preservation, excepting perhaps in those cases where Europeans have purchased Coffee Estates with all rights over the streams flowing through their estates, provided they do not diminish the supply of water to their neighbours. In a despatch from the Home Government to that of Fort Saint George, in the Revenue Department, No. 13 of 1843, it is requested that all matters relating to the Neilgherry Hills be adjudicated, and, in paragraph 63, "that the

control of all streams and canals be in the hands of Government." (*Ouchterlony's "Memoir of the Neilgherry Hills," p.* 45.) In the *Manual of Instructions for the guidance of the Revenue Officers of the Coimbatore District*, in the disposal of applications for land on the Neilgherries, and sanctioned by Government, December 19th, 1849—in continuation, January 7th, 1850, *Revenue Department, No.* 1213—is the following paragraph :—

Paragraph XV.

"It is clearly understood that Government reserve to themselves in the fullest manner "the complete control over all streams, springs, "reservoirs, and channels of irrigation. No stream "is to be diverted, nor its water taken for purposes of irrigation, without the special cognizance and sanction of the Revenue Authorities of the district. Springs, streams, rivulets, &c., should, when practical, be specially exempted from the lease." If the control be still in Government hands, and not rendered obsolete by custom, it is evident that it must be in the power of Government to pass any order it considers necessary for the purpose of improving the rivers and streams on the Hills, or the Ooty Lake, which is certainly entirely Government property. Amongst such orders, the protection of existing fish, and the propagation of new species, would be a legitimate subject for consideration.

The Ooty Lake, which is the largest piece of water on the Hills, and in the centre of a large European community, is of great consequence. Unfortunately, it cannot be denied that of late years the upper end has silted up, and, before many more seasons have passed, it is not improbable that that portion above the Willow Bund will be dry. Two causes have apparently contributed to this: that most immaterial in point of quantity, but most injurious from its deleterious quality, is the drainage of the Native Bazaar, which, foul in smell to a degree, and in every way detrimental to health, finds its outlet in the Lake ; and in this filth, which generates fever, bowel complaints, and other diseases, water cresses are grown for the benefit of the community ! !

That this is merely an experiment cannot be forgotten, but still, if it is successful, as I have little doubt it will be, it is capable of leading to the most useful results as a whole. The first thing is to ascertain which species of good eatable fish will breed on the Hills without deterioration, and then the important question arises whether we cannot give other countries, of the same temperature as the Neilgherries, fish, to people their hitherto uninhabited waters, which are at present lying useless and unemployed, or have very few fish in them. The *Ophiocephalidæ* are the best edible species ; and if they breed and thrive in the waters on the Hills, there is no reason why they should not do so in those rivers of Australia which have been found too hot for the propagation of Salmon and Trout, or even in the South of France and Southern Europe generally ; and they might easily be transported to the Mauritius. What a vast field of inquiry is here opened to the Pisciculturist ! And surely one which would be of the greatest service to so many of our fellow creatures is well worthy the consideration of a Government.

Then, again, looking nearer home, the question must arise whether nothing can be done to protect large tanks and suitable pieces of water in the vicinity of large towns and Military Stations, from the constant proaching and indiscriminate destruction of fish now going on. Could not many of these watery wastes be made subservient to raising good edible fish for the population, and which, by enforcing certain restrictions, might always be sufficient ? Surely, this might easily be done, and although it might throw a few fishermen temporarily out of employment, this ought not to stand in the way of such a vast increase to the food productiveness of the country. The presence of fish is also well known to be most serviceable in conservancy.

The English Government at the present time is enacting laws for the prevention of the suicidal policy of the wholesale destruction of the finny tribes, and enforcing regulations for their preservation. In France, it is well known that stocking rivers and pieces of water with fish, and the acclimatization of species from other countries, is a work of great public utility, and has so largely increased the supply of food, that the subject is now placed under the administration of the same department of the State as are the roads and bridges.

For the preservation of the fishes placed in the Hill waters, I would suggest, should the experiment be completed, the protection of the Ooty Lake and the Pykara and Avelanche rivers ; for

practical results can only be expected in proportion to the pains taken to develope them ; and fish imported to the Hills, and unprotected, are not more likely to thrive and increase so situated, than they are in the plains or in European waters. Surely, now when so many have been introduced, they should be taken care of.

The first question which would have arisen, had the experiment been completed in October 1866, would have been when fishing might safely be commenced. They breed at from two to three years of age ; but it is unlikely that those brought up in 1866 will deposit ova the same year. It may therefore be considered that the first breeding season will commence in 1867, and that only with those which were at least a year old when brought up. After the breeding season in 1869 will, therefore, be the earliest period for the fishing to begin, unless the number of fish be greatly increased, and thiscannot be done without a corresponding increase in the expense. The number brought up must be in accordance with the money laid out, and it may be estimated that the cost of capturing them, carriage, &c., would be about ten Annas a head for the best sorts, such as the *Ophiocephalidæ*, the large Carps, and the Eels.

Secondly, the question of "closed months" is very important, to allow the fish to deposit their ova without disturbance, as it is highly necessary, at least for the first few years, that they should not be interrupted during the breeding season. This is generally during the south-west monsoon, which begins on the Hills about the middle of June ; only a few breed during the north-east monsoon. I would, therefore, propose that no fishing be allowed from June 15th to September 15th of any year, in the pieces of water previously mentioned, or in any stream joining them, within a hundred yards of the junction, as spawning fish invariably go up small streams to deposit their ova.

During the time fishing is allowed, all netting, or other engines of destruction, should be strictly prohibited, with the expection of Eel baskets in the lake, and only rods and lines should be allowed to be used. In Europe, a certain small sum is charged for permission to angle, and if a similar plan were adopted on the Neilgherries, it could be open to no objection, and the proceeds might be employed to protect the fish and pay the conservator. This arrangement would be fair both to Europeans and Natives, as the latter do not angle for sport, but to sell their captures. At the present time, a small cup full of Minnows sells for four Annas ; but let netting be stopped and conservancy adopted, for every cup full of fish taken now, there will be a bucket full when the fish are in good order.

In a scientific point of view, I would point out the advantage of completing this experiment, now so nearly finished ; and regarded in an economic light, I beg to suggest its great importance ; whilst, should it be successful, it may be extended by future utilization to the plains. My opinion is that, for the completion of the experiment, two dozen more of each of the following species should be introduced, both into the Ooty Lake and the Pykara river, viz., the *Labeobarbustor*, *Puntius Carnaticus*, *Ophiocephalus Marulius*, and *Ophiocephalus striatus*; and from conclusions deduced, and experience gained, during the progress of my experiments, I would suggest that the proper period for completing the experiment would be from the middle of August to the middle of October—previous to this, the young fish, which must be employed, are scarcely ready for removal, and subsequently, the weather is too cold for the purpose.

11*th February* 1867. (Signed) FRANCIS DAY.

No. 8. ORDER THEREON, 1st May 1867, No. 488.

The Governor in Council directs that the thanks of Government be conveyed to Surgeon Day for his useful and interesting report on the streams of the Neilgherry Hills, and on the experiments which have been made under his direction, with the view of stocking those streams with fish. The Government concur in the conclusion at which Doctor Day has arrived, that the prospects of success are so small as not to justify any further expenditure in connection with the introduction of Trout into the Neilgherry streams ; but, with the view of completing the experiment

of introducing fish from the low country, they desire that the Collector of Coimbatore will instruct his Special Assistant to make the necessary arrangements for procuring two dozen more of the several species mentioned in the last paragraph of Doctor Day's report, for the Ootacamund Lake and the Pykara River. This should be done, as Doctor Day suggests, between the 15th August and the 15th October. The Collector will inform his Assistant that the Government are much interested in the success of the experiment, and that all the precautions suggested by Doctor Day should be carefully attended to.

2. The Government are not prepared at present to legislate for the preservation of fish during the breeding season. On the Neilgherries, however, where complete control over all the streams, reservoirs &c., has been reserved to Government, there is no reason why the Magistrate should not prohibit fishing at such seasons as he may deem proper. Mr. Grant will report what orders he may think it advisable to issue on this point.

(True Extract).

Chief Secretary.

To Surgeon F. Day.
To the Collector of Coimbatore.
" Revenue Department.

Exd. J. H. Burns.

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Passing orders on
Dr. Day's report on the Streams
of the Neilgherries & on the
experiments made for stocking
those streams with fish.
dated 1052 9th May

With Order

A. 1418 142

No. 1052.

Communicates
to the Board of Revenue.

9th May 67.

5 Copies to the Bd of Revenue & Dro A.D. No 488 Desp 12 9th