THE ZOOLOGIST:

A MONTHLY JOURNAL

OF

NATURAL HISTORY.

FOURTH SERIES.—VOL. XVIII.

EDITED BY

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PREFACE.

The present volume maintains its character as a publication for general Zoology; it ranges from *Rotifera* to *Homo*. The latter subject is found and illustrated as regards the Land-Dayaks of Borneo in Mr. Moulton's paper on zoological notes made in that island. This communication is very apposite to the pages of the 'Zoologist'; it teems with references to the zoological investigations made there by that great and well-remembered naturalist, Alfred Russel Wallace, who published his first notes on Borneo in these pages ('Zoologist,' 1855, p. 4803, and 1856, p. 5113). Another paper dealing with a fresh subject is that of Mr. Hugh Scott on "The Fauna of Reservoir-Plants" from observations made in the Seychelles Islands and Trinidad.

British Zoology, and especially British Ornithology, has again been the principal theme of the volume, as is the tradition of the 'Zoologist' from its commencement.

Among the great naturalists whose deaths this year we have had to deplore are found the names of Dr. Albert Günther, Sir John Murray, and Major Barrett-Hamilton; while one of our oldest contributors, George Bentley Corbin, an excellent Hampshire correspondent, has also passed away.

VALEDICTORY ADDRESS.

By the Editor.

In retiring from the Editorship of the 'Zoologist,' a position it has been my privilege and pleasure to hold for the last eighteen years—a milestone in a life—a few farewell words become necessary. I have learned very much during that time; I have

discovered how, apart from expert and official zoology, the love of that study permeates our community, and the aptitude for observation in the field—not a common possession—is found, though perhaps sparingly, in all classes, from the squire to the marsh-man. As age mellows one, the impression becomes greater that naturalists are born as such and not made, and for observational purposes the difficulty is to find them, not to create them. I have tried during my Editorship to offer to all such as are zoologically and observationally inclined the hospitality of the 'Zoologist.'

A striking episode of my experience during the last eighteen years is the substitution of the camera for the gun, more especially among ornithologists. This has been well expressed in our pages by writers, to mention only Selous and Heatherley, whilst other ornithologists elsewhere have advocated the same departure. We who commenced with the gun have now come to see the "better way." In British zoology, counties often lead like certain countries in other directions. During my officiate, Norfolk has become very prominent in these pages. I need only mention the names of Gurney and Patterson, among others, in this reference.

Natural history is now supported by many monthly journals, a contrast to the early days of the 'Zoologist.' In a general sense it is a matter for congratulation, but the effect on this Journal has been to keep many communications from its pages which formerly would have appeared therein.

In conclusion, I leave a pleasant task with the knowledge that I have received so much support from our contributors, and with the assurance that I have endeavoured to maintain the character of the 'Zoologist' as a "Monthly Journal of Natural History."

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THE ZOOLOGIST

No. 871.—January 15th, 1914.

SOME FISH-NOTES FROM GREAT YARMOUTH AND THE NEIGHBOURHOOD FOR 1913.

By Arthur H. Patterson.

The past year has not been remarkable for any great Ichthyological surprises, notwithstanding the long spells of fine weather obtaining during the greater part of it, and the high temperature which the ocean maintained even until late into November, when it yet registered some half-dozen degrees above the normal condition. Owing to the latter phenomenon, and probably the long continuance of southerly winds, with strong tidal influences, the advent of the Leathery Turtle (*Dermatochelys coriacea*)—two are said to have been seen together—may almost safely be laid. Some unusually large shoals of Mackerel of a goodly size characterised the fishing during the latter part of November. Most of my summer holidays and other spare hours were spent in my new houseboat (Moorhen II.) on the Waveney, so that I did not get into touch quite so closely with local fisherfolk as in some years.

With regard to the Turtle, the first intimation I received of its appearance was on November 11th, when I saw a note in a local paper mentioning its capture in the nets of a herring-drifter, its being sold on the fish market for £3, and its reputed shipment to Hamburg. It was also stated as weighing between 3 cwt. and 4 cwt., a weight vastly increased in a succeeding "par." in the same journal on the 13th, that to me was by no means satisfactory: the weight then given was 18½ cwt.! and

it went on to say that "it has been proved by the National (!) History Museum authorities to be an extremely rare Australian specimen . . . the strongest and heaviest ever seen in England." From a Lowestoft naturalist I afterwards ascertained that it was despatched to Messrs. Lusty, of Limehouse, importers of Turtles; and being unedible was very likely destined to be preserved. Also that the Scotch drifter that fell in with it broke its neck in hoisting it on board, although the wretched creature lived for two hours after the accident.

I wrote to the Cromwell Road Museum authorities, and received a reply from Dr. S. F. Harmer to the effect that no one at the Museum actually saw it, but the owners had telephoned some particulars. Dr. Harmer thus refers to it: "The statement that it is an Australian species is nonsense. The Leathery Turtle, though generally considered a rare animal, has a wide distribution within the tropics; and specimens are found from time to time, as stragglers, in various places." Pennant, evidently referring to this species, records two on the coast of Cornwall, taken in Mackerel nets in the early autumn of 1756, one weighing 800 lb., the other 700 lb. A third, taken about that time off Dorsetshire, equal in weight to the first-mentioned, was believed by Bell to be in the British Museum. Dr. Harmer tells me they have examples—one, for many years, from Devonshire, and another caught in Cardigan Bay in 1908, and had heard of another captured in 1909, eighty miles west of Cardiff.

Early in January I saw at a local fishmonger's a plaice of some 4 lb. weight, with the whole upper surface of a beautiful porcelain-like white, with the exception of a patch of brownish on the "face," and a narrowish dark streak near the upper pectoral fin. The fish was quite without any of the characteristic red spottings.

January 8th.—Considering the abundance of Haddock in the North Sea, in close proximity of Yarmouth, when I was a lad, its present scarcity is remarkable, if one can leave out the effects of the incessant trawling that then obtained. A 2-foot specimen was sent me from Eccles, where it had been caught on a line by a gentleman named Meale. It was a "slink," and so attenuated, either from disease, or from parasites (although only two or three *Lernæa branchialis* were taken from the gills),

that it weighed but a third of the proportionate normal weight, and looked something like a very bad imitation of an Eel. Abscesses on the gills suggested tuberculosis.

A second wretched specimen was sent me from Lowestoft by the Piermaster, on February 11th. For a length of 17 in., it only weighed 14 oz., and resembled nothing so much as a three-cornered file. The gaunt head, bare of all muscle, and merely covered by skin, looked like a skull bone, the huge eyes being unduly staring. There were a few fish-lice (*Caligus*) and a bloated *Lernæa* attached to one of the gills. There were no internal parasites, but all the organs were wasted and bloodless, and the liver was much diseased. I looked for the Hagfish, but found none. Between forty and fifty years ago, so numerously were Haddocks sometimes netted on the East Coast that, when the markets were glutted, many were taken back and thrown into the sea, in order to keep up the prices. But to-day, as a local fish merchant recently emphatically remarked, "should a Haddock show himself in East Anglian waters, he would be chased to death all over the place." One might imagine that such had been the fate of these diseased examples.

As recently as December 1st the present scarcity of Haddocks for the month was referred to in a certain journal as follows:— "The Haddock, which ten years ago was, next to the Herring, the most abundant of our food fishes, is becoming so scarce that at Aberdeen alone the shortage for the current year, up to the current week, as compared with the corresponding period of 1912, is 5200 tons." If the devil (of reckless greed) ever had a hand in anything, it was in the invention and improvident use of the trawl-net; and unless the use of this engine is forbidden on the spawning grounds of *Clupea harengus*, there will be a Herring famine in years to come.

Quantities of Sprats were being taken off the Suffolk Coast in early January. "Set" Sprats (fixed nets) and "trawled" ones are always scaleless and lustreless, and not nearly so sightly nor so edible as the "drove" Sprats—fish gilled in drift-nets.

In February a well-known angling expert in Norwich, having captured a goodly bag of Pike, offered several of them to his friends for eating, but was invariably met by the remark that they did not care for freshwater fish. This antipathy to the

freshwater species is fairly general in Norfolk, although here and there a rustic will gladly accept the biggest and slimiest Bream from an angler's catch for purposes of the table, although the usual fate of the various Roach, Rudd, and Bream is to be thrown either to the sow, or on to the refuse heap, to prove, in the latter alternative, a great nuisance. The gentleman in question, by way of experiment, had one Pike kippered and smoked, and then distributed sections of it among various persons, one of whom wrote: "I had for my breakfast a nice cut off the kippered Pike: cooked in the way usual for the dried Haddock, it was delicious, and with an entire absence of that slight muddiness of taste so often found with the Pike." The effort, however, was a failure, and these fish from the Broads are in no better repute. It certainly is a great pity that so much good food should be wasted; only Tench being held in any esteem. I can testify to the edible qualities of a 1 lb. Bream, filleted and boiled, and served up with any suitable sauce. In my younger days it was a frequent thing for poachers to net tons of these fish and despatch them to large inland towns for the consumption of Jews. To-day they are allowed to exist only for the delectation of anglers and (as some remark unkindly) the various benefits derived from a shilling rod-tax!

March 11th.—An Eel floating and struggling at the surface of Breydon, was found by an acquaintance of mine. He had been "picking," and was returning home when he observed the unhappy fish; he struck it with his eel-pick and managed to haul it safely into the punt. He afterwards sold this fine Eel for half-a-crown. Noting that its throat was unduly distended, he had the curiosity to force open the jaws, when he observed the tail of another fish: on extricating it, a task of some difficulty, he found it to be a Sea-Bullhead (*Cottus scorpius*), whose extended gill-spines had made its removal, either way, impossible for the Eel, which would certainly have perished by choking, had this man not chanced to fall in with the "unequally-yoked" and unhappy pair.

An almost similar fate attended another large Eel, in the following August, near Kendal Dyke, in the Thurne river, when a want of the sense of proportion led this fish to attempt a feat of swallowing that it was quite incapable of performing. Mr. Collinson, the water bailiff, was rowing towards Martham when

he noticed a very large fish, which proved to be a 7¼ lb. Eel, floating on the surface: on picking it up he was astonished to see the head and some three or four inches of another Eel, of some considerable size, protruding. Both had fallen victims to the voracity of the larger one.

Whether fishes are blessed with anything like a memory, or whether they are less susceptible to pain than most other creatures, has not yet been satisfactorily determined: evidence is conflicting. When trolling with a noted angler on one of the Broads, related an old sportsman to me, a large Perch was hooked, which broke away, tearing the membrane of its mouth. It was struck a second time, and again broke away, but a third hooking proved fatal. When the fish was landed three rents in the cartilage of its mouth were discovered. Yet strangely, some time since, when I was chatting with Miss E. L. Turner on Hickling Broad, she pointed out certain fishes that had come constantly to her houseboat to be fed; one of them, a war-scarred old fellow (a Rudd, I believe it was), she assured me had come to her vicinity two or three years running. The fish were curiously tame, and rushed at crumbs dropped quite close to my fingers. In 1913, Miss Turner told me that some Eels had become so tame and confident as to take crumbs from between her fingers. One day they were missing; probably they had taken some angler's hook, or had perished in some other way.

On March 18th an 11 in. female Gurnard (*Trigla gurnardus*) was sent to me by a fish hawker: its head was stunted, the upper lip overlapping the under one, on either side, the lower jaw protruding considerably beyond the obtuse little snout.

April.—A small Plaice, about 6 in. in length, measured 4½ in. across the back when the fins were distended. Placing the point of a pair of compasses in the centre of the fish (making allowance for a half-inch of "nose" and the caudal fin's measurement of 1 in.), the other leg of the compass made a complete circle of the fish; indeed, in sketching it, I first made a circle, and then easily "filled in" the whole.

The advent of an exceedingly fine Sturgeon in the little river Delph, near Welney, on June 16th, made quite a stir in that corner of Norfolk. Its weight was 31 st. 5 lb., and it measured 9 ft. 9 in. in length. The monster was despatched to Spitalfields,

where it was sold for £6: the fish auctioneer telling a newspaper representative that "it took six porters to bring it from Liverpool Street Station to my shop. It was wrapped in sacks and tied up with thick cords. I have never seen a fish so large, and I thought at first a small whale had been sent to me."

The fish had been first observed on the Sunday, and attempts were made to shoot it, but the cartridges were loaded with too small shot to make any impression on its scaly cuirass: even shot the size of peas, fired as they were through the water, had no effect. A net was drawn across the water to prevent the fish's escape: a boat was launched, and the owner of the shooting rights, a Mr. Smart, went in her armed with a weapon very like a strong boathook. This was thrust into the mouth and the head raised by means of it, then another man who was carrying the gun discharged it into a more vulnerable and vital quarter. Five men were required to land it.

On June 3rd, Mr. G. C. Gearing, fishmonger, of Lowestoft, very kindly sent me an example of the Boar Fish (*Capros aper*), the first he had seen during the thirty-five years of his business. It had been netted on Corton patch, about half a mile from Corton Lightship, in a shrimp-net. It was hardly so large as my hand, and is only the third I have examined since my first discovery of the species, locally, on July 9th, 1881. A second example, which I did not see, was netted off Yarmouth on the same date as Mr. Gearing's.

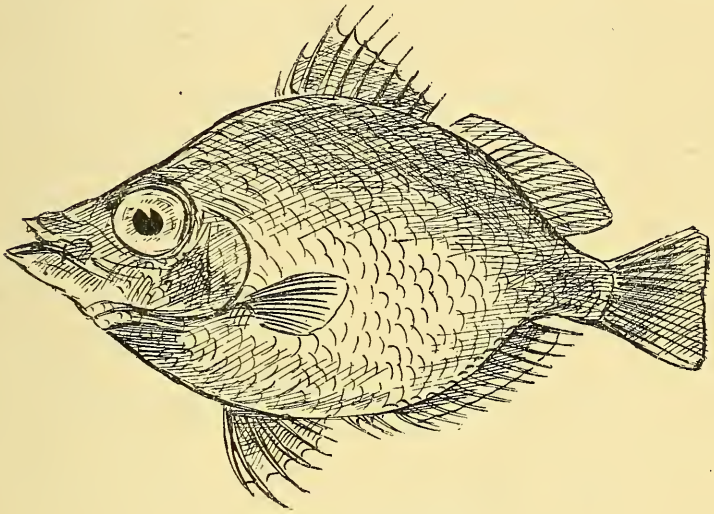
Whether there be anything in the belief among certain fisherfolk with regard to so-called "blind" Mackerel, I am not prepared to say. The belief is pretty general, and there is a Scarborough tradition to the effect that "it is no use fishing for Mackerel with a line before Seamer Fair [*i. e.* July 15th], for before that time they are unable to see." Ignorant fishermen may be certainly excused, when Pennant, probably on the strength of Lacapède's statement, who himself had been told it by a certain French Admiral, wrote as follows:—"In the spring the eyes of the Mackerel are almost covered with a white film, during which period they are half blind. This film grows in winter, and is cast off in the beginning of summer."

Dr. Day, ignoring his predecessors, in describing the diseases of *Scomber*, practically pooh-poohs the idea. I mention this

matter because two or three intelligent fishermen have recently spoken to me most emphatically in favour of such a condition being frequent.

The stomachs of some Eels taken in marsh ditches by means of a net, in August, I found to contain only a quantity of *Gammaridæ*.

Occasionally the smaller Pike will condescend to patronize an angler's worm. A gentleman fishing in the Bure at Acle, one



Boar Fish (*Capros aper*).

day in September, hooked and landed on a small worm a "jack" of 4 lb. weight; and within half an hour another angler, fishing with a worm, landed a 2-pounder.

The bottom of the cutting (leading into the Waveney) wherein my houseboat lies moored is, in summer, covered with a bright green, luxuriantly-growing coat of "silk weed." Some Swans came daily in August and early in September to feast on it; and several Roach which I dissected had their stomachs packed with it.*

The hordes of Herrings crowding each autumn into local waters would seem to be as numerous as ever, if a greater catching power and a record harvest are any criterion. The

* This weed is occasionally used as a successful Roach bait by London anglers.—(Ed.)

hugeness of the catch of 1913 has been almost phenomenal. It goes without saying that some vagaries of distribution would naturally follow such invasions; and, on October 29th, whilst some Aldeburgh fishermen were busy with rod and line among the Whitings—also uncommonly numerous on the Alde, twelve miles from the sea—Herrings were attracted to their lugworms which they were using as bait; at these they bit very much after the manner of Roach, and gave some lively play, a dozen in all being hooked. This distance from the sea had been eclipsed by a stray Herring that had wandered as far as Geldeston locks, on the Waveney, and was taken in a net with Smelts, some years since, a journey of quite eighteen miles from Lowestoft Harbour. This individual, had it entered Oulton Broad through the lock, or had it passed through Breydon, and so up the Suffolk river, must in any case have gone some miles in quite fresh waters.

The capture of individual adult Herrings by rod and line, above referred to, was not a solitary instance, although in this neighbourhood rather unusual. Day ('British Fishes') mentions their capture in Scottish lochs as a common circumstance, bare white hooks being drawn through the water at which they freely snatch. A writer in the 'Angler's News,' dealing with the subject, stated that at Calais Docks, from January to March, "spent" or spawned Herrings are to be seen in numbers preying on young Elvers. Anglers took advantage of their voracity, and captured numbers by impaling a small worm loosely on hooks that they drew quickly through the water. Juvenile Herrings, not longer than one's finger, are very freely taken every summer in the Lowestoft Basins, the anglers, of all classes and ages, using a tiny quill float and a single hook baited with a piece of Shrimp the size of a B.B. shot.

The strangest Herring story of the year was published in a local paper on November 25th, relating to a "bloater" that was being prepared for breakfast by a lady in Norwich. "She noticed something glittering, and her curiosity being aroused, she made the surprising discovery that a gem of some description was nestling among the offal. On washing the stone it was found to be a diamond of some worth, being highly transparent and colourless." The stone is stated as being the size of a marrow-fat pea, and had, it was thought, once been set in

a ring. If such were the case, the strange circumstance leads one's mind to queer speculation.

The Scad, or Horse Mackerel, has been exceedingly numerous this fishing, and running to a largish size. On one or two occasions the tide-mark, thick with dead Herrings and Mackerel *débris* from the nets drawn in by certain tides, was well sprinkled with fish of this species. I cannot understand why this fish is so despised locally as food, even by the very poorest.

The finding of an anchovy in a "swill" of Herrings was reported to me in the middle of October. This fish is of rare occurrence here, for the advent of such a remarkable species would speedily lead to its recognition. If Couch's remarks ('Cornish Fauna') still hold good, that "this fish abounds towards the end of summer; and if attention were paid to the fishery, enough might be caught to supply the consumption of the British Islands," it is surprising that individuals should not more often straggle round into the North Sea. The meshes of the nets are so much smaller to-day that few fishes, smaller than Herrings, striking them escape.

There was a remarkable inshoring of Whitings in September, the numbers keeping up without any seeming diminution well through November: it seemed to me curious that so comparatively few should be taken in the Herring nets considering the—I think I may say—myriads that came within the three mile limit. Every boy armed with a piece of knotted string and a couple of hooks, with almost anything for bait, seemed to be almost as successful in capturing them as those who had provided themselves with superior tackle and knowledge. The jetty was so crowded that folks fished, as it were, over each other, and the piers and beach were lined with sea-anglers. Some of the figures published of catches taken from the Britannia Pier are given as follow:—

Nov. 5th	...	978	Whitings	...	10	Dabs	...	4 Cods.
,, 6th	...	1859	,,	...	13	,,	...	5 ,,
,, 7th	...	1202	,,	...	14	,,	...	4 ,,
,, 8th	...	1263	,,	...	12	,,	...	5 ,,
,, 9th	...	1614	,,	...	4	,,	...	2 ,,
,, 10th	...	1311	,,	...	13	,,	....	3 ,,

At the harbour's mouth, on the Yarmouth side, there runs a

sort of concrete and timbered breakwater which is accessible from a staging by means of iron rings let into the buttresses supporting the staging. At high water, and for some time before and after, the water covers this low breakwater, and if it be rough waves break over it. Behind this is a kind of hollow, quite 6 ft. in depth, that is always full. Curiously enough Whitings frequently crowd into this pit, and some venturesome lad a year or so ago found, on dropping his line into it, that it was quite a fertile fishing ground: so at the fall of the tide it is a frequent resort of lads who occasionally capture a number of smallish sized fish. On October 29th I happened to look over the wooden pier into this hollow, and saw three or four lads fishing with improvised tackle—a long crooked osier, and, in one instance, a badly straitened hoop, with the sorriest of lines upon them. They were pulling out foot-length examples almost as quickly as they dropped in their hooks, using for bait small strips of very stale Mackerel, picked up on the tide-mark a short stone's-throw from the pit. A butcher lad, who had delivered his beef to some fishing drifter in the harbour, had encroached upon his master's time, but evidently was prepared to make excuse, if not atonement, with the silvery Whitings that nearly filled his basket.

Mr. F. T. Lenton, Master of Claremont Pier, Lowestoft, wrote me on December 1st that there had been exceptional takes of fine Whitings, one sea angler about a week before, having had a bag of twenty-two fish weighing 18 lb.

Mr. H. Tunbridge, the Manager of the Britannia Pier, Yarmouth, on December 6th wrote to the effect that "this season has been a record one for Whitings." From October 16th to December 5th a total of 57,326 had been landed thereon; also 351 Dabs, 396 Codlings, 5 Cods, and 4 Congers. Several Soles were caught in August and September.

I am obliged to Mr. Ernest B. Cooper, of Southwold, for a few notes on the Sprat fishing, &c. He writes as follows: "Sprat fishing has been very dull until this week: no Sprats were caught until the second week in November, and during that month the quantities landed at the Harbour were:—

Week ending Nov. 15th	...	...	233 bushels.
,, ,, ,, 22nd	....	...	140 ,,
,, ,, ,, 29th	....	...	150 ,,

About double the quantity is landed on the Beach, but no figures are available. A Bass about 12 lb. in weight was caught off the Pier in November."

I observed in the 'Daily Press' of December 10th that the Sprats "set in" abundantly, heavy catches being taken into Lowestoft by the Lowestoft, Kessingland, and Pakefield boats, ranging up to some eighty "maunds" (local *baskets*): these realized from 3*s.* to 3*s.* 6*d.* the maund.

My old friend Mr. Robert Beazor, fish merchant, writing me on December 9th, states that "the Smelt season was very poor, and to the workers not very remunerative: the fish were small. I take it that they do not like the polluted state of the water through which they have to pass to their spawning haunts: and I think that year by year their numbers are less. I found Salmon-Trout conspicuously absent, and those taken were small. The best take of the season came from Winterton. Our own local fisherfolk seem to have quite gone out of this branch of fishing [at one time our beach men made quite a feature of the autumn draw-netting for the 'trout']. The Mackerel season (May and June) was a fair one, and I saw only a few Scribbled Mackerel (*Scomber* var. *scriptus*), and one black one (*S.* var. *concolor*). I had during the year four Anchovies brought me for identification—Red Mullet a few. Large Mackerel came late in the Herring fishery. I weighed several; the largest was $2\frac{3}{4}$ lb., and many exceeded 2 lb."

The voracity and want of discrimination in the Pike is well-known; and the bold fellow occasionally attacks more than he can possibly hope to devour. In September a lady, bathing in certain baths at Norwich, was bitten severely in the ankle by a Pike of some 6 lb. or 7 lb. weight. The bite of a "jack" is by no means a pleasant experience, as I can remember to my own cost, when a 5-pounder seized my finger, closing its jaws with a vicious snap, puncturing holes that were slow to heal and extremely painful. I had to lever the brute's jaws open with a piece of wood before I could free my finger.

I have a note dated June 22nd recording the capture of six Salmon-Trout at Oulton Broad, near the lock, by one fisherman on that date, fishing with live Shrimps. On October 29th following Mr. J. T. Hotblack, of Norwich, in a letter to the

'Eastern Daily Press,' referred to reports reaching him from time to time of Salmon or Salmon-Trout being caught in the river (Yare)—July, August, and September (1913). Hewett, the Preservation Society's watchman (he stated), had found no fewer than seven dead and decomposing fish at various times floating in the river between Surlingham and Cantley. They were described as fish weighing between 12 lb. and 20 lb., suggesting they must be Salmon. Mr. Hotblack wrote me for particulars of three Salmon-Trout captured at Oulton, and agreed with me that such Trout as I had observed "jumping" may have done so through irritation by the dirty (sewage-tainted) water. His contention was that the Trout caught so commonly along shore, all down the Norfolk Coast, were "trying to find a freshwater stream to run up, and that they constantly enter our rivers trying to find a spawning-ground, which, as they are unable to get past the mills, they cannot do." I did not come to the same conclusion, seeing that they would have to travel a great many miles up any of the Norfolk rivers before finding a bottom and other conditions suitable for their purpose. Undoubtedly such Salmon and Salmon-Trout as have been met with well up the Yare and Waveney travelled up from Yarmouth and through Breydon, and not through Oulton Lock from Lowestoft Harbour. It is strange that the Salmon referred to above had not been observed *before they were found putrefying*. Had they really come upstream, or had they been cast overboard by a fishmonger?

Some very heavy catches of Mackerel were made by local drifters fishing with Mackerel-nets in November. On Sunday afternoon, November 23rd, a boat ran in with fish packed and piled in every possible locker and corner; the decks were thick with them, and the nets lay heaped—fish enveloped in the folds in hundreds—on decks and hatchways. They were still busy well into the night "scudding" (shaking out) the nets and pulling the larger fishes from the meshes, and piling them on the wharf in a huge heap 2 ft. deep, in an area surrounded by a flanking of "swills" (fish-baskets). Nearly seven lasts (70,000) of exceedingly fine Mackerel, many of them measuring 17 in. in length, were the result of the "strike"; but so many had "struck" that the nets "grounded" with the weight—*i.e.* sank

straight down—and quite fifty nets were lost with the fishes they contained. A boat's "fleet" of nets consists of one hundred and twenty sections, and reaches out, like a long-meshed wall, to something like one and a half miles, and is about eight to nine yards deep.

On the 26th the same boat returned again with a catch of 30,000 Mackerel that realized £120. Clearing the nets of Mackerel is a trying occupation for the fingers, almost every fish having to be individually pulled out of the meshes. A few days later another boat came in with eight lasts.

Late in November a sea-angler, fishing from the beach, hooked and landed a Mackerel, a by no means usual capture so near the shore, and a rare enough circumstance from any of the piers.

Years ago, when a number of old brigs and kindred "sea-waggons" served as colliers between Newcastle and Yarmouth, it was a common practice to trail a line astern for the capture of a few Mackerel. The hooks were encased in a small piece of lead-paper, the silvery bait evidently deceiving the rash, eager-biting Scombers. One ancient skipper, finding himself without lead-paper, managed to push the barb of a hook through a hole in a fourpenny-piece, and during the trip succeeded in bribing a baker's dozen—thirteen—of Mackerel to their own destruction.

Reverting to nets "grounding," a veteran Mackerel-catcher assures me that often meshed Herrings are more likely to swim up with the net and "frap about at the surface," but Mackerel "crook (die) at once, and their combined weight carries the net downwards, providing they strike heavily."

It would be out of place here to enlarge upon the purely economic aspects of the great East Coast Herring Fishery; the following statistics, however, may be worthy of mention. Briefly, about 800,000 crans of Herrings (800 million fishes!) had come in by the end of November, 40,000 crans having been delivered in one day alone (October 18th). Lowestoft had in the same period added a catch about two-thirds as heavy as that arriving in Yarmouth—1,300,000 crans for the two ports, a prodigious congregation of 1,300,000,000 fish! The weight of the Yarmouth catch may be set down at 155,000 tons, and for the two ports at 260,000 tons. Placing these catches upon the rail would have

required a thousand trains of twenty-six ten-ton trucks each! Up to the time of writing these figures (November–end) 457,212 barrels and 137,138 half-barrels of pickled (salted) Herrings have been dispatched in steamers to Russia, Germany, and other ports; one large steamer, the 'Indutiomare,' had gone to the Black Sea with a freight of 18,175 barrels, worth £20,000.

Thus it will be seen that with 999 drifters (Scotch and English) fishing out of the port, the thousands of men manning the boats, the thousands more working as coopers, carters, curers, and others; not mentioning the many incidental buyers, traders, and mechanics attached to the building, fitting, outfitting and feeding necessities connected with this great industry; and the thousands of Scotch lasses engaged in gutting, pickling, and other work, and the hundreds who lodge the girls and the men, the turnover in solid gold must be immense. Had Bertram lived to see Yarmouth the greatest Herring mart in the world and to revise his entertaining 'Harvest of the Sea,' he would have had to add matter to the book that his wildest dreams and speculations could never have depicted. If the streets of London are paved with gold, Yarmouth's roads and pathways are often ankle-deep in the greasy, oleaginous mire and mud, permeated with Herring oil and drip from the carts and baskets and barrels. The hooting of outgoing and incoming boats, often in continuous panoramic succession, with the rattle of wheels on the quays, is like Bedlam gone riotous; and the southern half of the town reeks of smoke and effluvia of "an ancient and fish-like smell."

Up to December 6th over 808,000 crans had been landed here, an increase over last year of more than 127,000 crans. On this date Herrings were getting fewer; but the record price of 91*s*. per cran—for a catch of six crans—was realized! Whether the hosts of the Herring are greater than in days of yore, I am not competent to suggest; that there must be far fewer devoured by Whales would seem to be an undisputed fact, when it is stated that "so enormous have been the catches of Whales [Rorquals, Humpbacks, &c.] made in the Norwegian whaling industry since the invention of the explosive harpoon in 1868, the figures of 1911 being 13,800 Whales, that it is feared that the animals are in danger of extinction." Such a slaughter

of these huge Herring-eaters, and the much fewer numbers of other predaceous Cetaceans, Cods, and other large fishes to be found to-day in this part of the North Sea, must make for at least a possible increase in this great East Coast harvest of the sea.

The Messrs. Paget writing in 1834 ('Sketch of the Natural History of Great Yarmouth') with regard to the then more frequent appearances of Cetaceans, remark: "*Balæna physalis* (Fin-backed Whale) has several times been seen and taken in the herring-nets"; and, again, "*Delphinus bidens* (Bottlenose Whale), a large one caught in a Herring-net, November, 1816; a smaller specimen about twenty years before." The first-named would belong to the Rorquals.

Only in the opening days of the great Herring Fishery did a few small carcases of Piked Dogs wash ashore: as the fever and hurry of the fishing intensified, everything was subordinated to the capture and to the inbringing of the Herring. Men worked night and day, often getting less than four hours' sleep in three days (a condition of labour with which trade unions *might* safely interfere), so that everything foreign to the desired catch was pitched overboard as soon as possible; not a solitary Shark, Dolphin, or Porpoise, to my knowledge, was brought into port; the only one of the first-named referred to in the county papers was an average-sized Porbeagle, taken near Sheringham; this a fisherman or two carted about in a barrow as a *rara pisces* for the sake of what few coppers the curious might bestow upon them.

Among the few Crustaceans worthy of remark, I have already recorded the capture of a large Edible Crab (*Cancer pagurus*) off the coast of Portugal (*cf.* 'The Zoologist,' Feb. 1913, p. 77), the large pincer claws of which I had seen mounted on a shield like a Fallow Deer's. The size of this giant may be imagined when I measured a free chela (or movable claw) at 6 in., working in a "hand" 9 in. in girth!

A male Velvet Crab (*Portunus puber*) was brought to me by a shrimper on April 28th; and on May 20th a medium-sized Crab came to hand with an extra leg growing on the left side, from an extra socket working on the "swivel" of the third leg from the tail.

On June 8th a very curious example was obtained, with the free chelæ adorned, or inconvenienced, by an extra point that turned off at a right angle and curved slightly under the fixed chelæ, so that very little movement could be made by the nipper; roughly speaking, it was as "lockjawed" as a rodent would be whose abnormal incisor tooth might have grown round and closed its point in the outside of the other jaw. On the 23rd a "big

Edible Crab (with abnormal pincer claw).

claw" was given to me to which was attached a smaller perfect claw with fixed and free chelæ quite in working order.

For the benefit of those who might like to see or study such crustaceous variations, I may add that these have been sent to Kelvingrove Museum, Glasgow, where many other similar finds have preceded them.

One other curious Crab that has been preserved for Yarmouth Tolhouse Museum came to hand on September 6th. The right pincer claw (looking down on it from above) is normal, but the left, of equal size to it, is turned quite in an opposite direction

(see illustration). The photograph unfortunately does not show the defaulting leg in its proper proportions. What use the Crab made of its freakish member could only have been known to its possessor, and the secret has been lost in the boiling.

In September somewhat unusual numbers of the Common Prawn (*Palæmon serratus*), many of goodly size, were taken by the shrimpers and met with a ready sale. One shrimper assured me he had taken as many as thirty on a tide.

Mr. F. C. Cook, of Lowestoft, sent for my inspection late in December (1912) an example of *Dromia vulgaris* taken off the 'Galloper' light-vessel (*vide* 'The Zoologist,' 1913, p. 38). I have never met with it at Yarmouth. Mr. Cook also kindly sent me a few notes referring to a trip made by him in a Lowestoft smack to the Smith's Knowl (about twenty-five miles out from the north-east corner of Norfolk) in the second week in September. The first two or three days were more or less blanks, as far as his experiences went! "Scarcely a haul was made but what two or three examples of the Angler-fish (*Lophius piscatorius*) were met with; those examined contained *great quantities of sand.* A large Cod was taken on the 11th, the eyes of which were sunken and colourless; and it was in a very emaciated condition. A malformed Cod was caught on the 12th, and also a bull-head variety of the Whiting; a second malformed Whiting being met with the day after. While trawling on the rough or 'Ross-bottomed' ground (where *Sabellæ* and shells, &c., abounded) in the vicinity of the Smith's Knowl Light, a great variety of Crabs was taken, among the more interesting of them were the Ross Crab (*Zantho rivulosa*), Porcelain Crab (*Porcellana longicornis*), Marbled Swimming Crab (*Portunus marmoreus*), and several Velvet Swimming Crabs (*P. puber*). The latter were very ferocious and menacing, and caused fun by the way they elevated and opened their pincer claws and ran at the skipper's dog, who, knowing from experience the penalty he had beforetime paid by playing with Swimming Crabs, wisely kept at a safe distance.

"A fine Sturgeon, weighing 20 stone and realizing £11 10s., was landed on Lowestoft fish-market on October 30th."

Some interesting notes and statistics were given in the 'Eastern Daily Press' of Dec. 6th, 1913, dealing with the little-known industries off the North Norfolk coast, which include those

of whelking, crabbing, cockling, and such like. For 1912, of a total weight for England and Wales of 55,103 cwt., 15,897 cwt. were landed at Wells, and 10,216 cwt. at Sheringham. One hundred boats are engaged in crabbing, and accounted during the past season for nearly a million Edible Crabs (*Cancer pagurus*). The gathering of Cockles by men and women is a hard but interesting calling. Mussel culture is a thriving industry, and is well looked after by Inspector Donnison. The capture of Herrings, Mackerel, Soles, Plaice, Brill, and Salmon-Trout is in a smaller way pursued ; whilst the quaint occupation of "worming" is made remunerative. The Lugworm (*Arenicola marina*) is pursued by "worm-diggers," who, armed with fork and basket, go to the wet sands at low water and search for their casts and deftly grub them out, a quick hand looking to bag a thousand under normal circumstances. These worms are great favourites with sea-anglers all over the eastern seaboard, and find a ready sale. There can be no doubt that Cods and other fishes prefer them to any other bait.

Norfolk Seals.—I have to thank that capable and enthusiastic officer Captain Donnison, the Eastern Sea Fisheries Inspector, for his September Report, which equals in biological and statistical interest any of its predecessors. But that part of particular interest to myself deals with the Common Seal (*Phoca vitulina*), that seems to have firmly established itself upon the maze of sandbanks in the Wash.

One would greatly wish to know *when* the Seal became what might be described as a settler in this country. Sir Thomas Browne (1605–1682) refers to it as "the Vitulus marinus sea-calf or seale wch is often taken sleeping on the shoare"; and again as "no raritie upon the coast of Norfolk at lowe water. I have knowne them taken asleep vnder the cliffes. diuers have been brought vnto mee. our seale is different from the Mediterannean Seale." Lubbock ('Fauna of Norfolk,' 1848) adds nothing to Browne's short notes; nor does Mr. T. Southwell in his second edition of 'The Fauna' (1879). In his 'Seals and Whales of the British Seas,' Mr. Southwell adds but little, dismissing with the merest paragraph its status on this coast as follows:—"In the great estuary between the Norfolk and Lincolnshire coasts, called the 'Wash,' this species frequents the

sandbanks left dry at low water, and, doubtless, many young ones are produced there annually."

According to Mr. Donnison's calculations, the Seal practically doubles its numbers in two or three years; to quote from the 1912 (September) Report:—"It was estimated that over 2000 Seals were in the estuary. . . . It was estimated that there would be 100 young Seals in this [Knock Sand] group of about 300."

In 1911 the numbers were put down at 1000, so that 3000 were expected "to rank" in 1913; of these, he tells us, £45 has been paid for "noses," at the rate of ten shillings each. Ninety Seals would seem a goodly number recovered; but when it is known how difficult wounded Seals are to bag, and that a dead Seal almost invariably sinks if slain in the water, the death-rate must have been considerably higher.

The Report is this year the more interesting, if disappointing, when "opinions" as to their predilections for certain fish, and the destruction they are capable of performing, are given by various fishermen, *not one of whom had by dissection examined the contents of their stomachs.* Like a perverted Mark Tapley, the average fisherman is only happy when he has something to grumble at; a number of them condemned the Seal as keenest upon prime marketable fish, Soles in particular. My own experience with several Seals I have kept in confinement was that Flounders (local "Butts") are their favourite prey; probably they are easiest to capture; and when Eels were to be had these were as eagerly devoured, bent double, rounded part foremost.

Mr. Donnison is rightly making an earnest endeavour to come to a just conclusion upon the Seal's reputed destructiveness and injury to the fisheries of the Wash, so that we may have further information on the subject. It would be a great pity if this interesting colony should eventually be extirpated; and a certain amount of cruelty which must follow on the methods used to accomplish at least a reduction in numbers is unpleasant to contemplate. The Eastern Fisheries Committee, I sincerely hope, will not "condemn unheard," but do the right thing between fisherman and beast. A vice-president of the Selborne Society writes me that the matter may be taken into consideration by the Society; he says:—"I am told that many

of the fishermen say they have no grievance against the Seals . . . the effect of offering such a large reward will simply be that every 'Tom, Dick, and Harry' with a gun will go out shooting Seals. . . . A large proportion of the heads produced are probably females and newly born young, which seems a great shame. These no doubt represent but a small proportion of those wounded."

With all my heart I hope the energetic Inspector will see the right thing done, and if it be possible that the evidence forthcoming should be in favour of these innocent animals, they will not be unduly harassed; and if it be proved necessary that a reduction in number be imperative, that vigilance will be exercised in doing the butchering "on the most approved modern methods" possible.

There is a significant remark made in the Inspector's March Report respecting a nose sent in; the particulars coming in with it were as follow: "The Seal I caught was a white, long-haired one; female." And the Inspector himself remarks:—"On January 17th, on passing Freeman's Channel, I observed a score of Seals on the Roger Sand, three or four of which appeared quite white alongside the others. When on the sands on March 14th . . . I then noticed that three or four of the Seals had long, rough hair, in colour a dirty white. They were slower than the others in reaching the water."

Now, as it is well known that the young of the Grey Seal (*Halichœrus gryphus*) are born white, and my somewhat limited experience of this species has led me to believe it less nimble out of the water than the commoner animal, one might suspect that the Grey Seal does more than occasionally occur in company with *Phoca*. A young female was killed on Breydon, November 28th, 1882; and in the 'Field,' 1904, some notes on this species by Mr. T. Southwell appeared. Herein he remarked that even young had been born, but that the conditions did not appear suitable to their long survival. He says:—"Although these sandbanks may form admirable nurseries for the numerous herds of *P. vitulina* which frequent them, no young Grey Seals deposited where the banks are covered by every tide can possibly survive, and they must . . . perish by drowning" (*vide* 'Nature in Eastern Norfolk,' pp. 319–320).

ON SOME GULLS OBSERVED IN IRELAND.

By Robert Warren.

Iceland Gulls (*Larus leucopterus*) in Cork Harbour.

For a long period of years I have had frequent opportunities of observing and capturing specimens of the Iceland Gull, and as I was particular in noting the dates and localities of the various occurrences, a copy of my notes may interest those readers of 'The Zoologist' who may not be personally conversant with the appearance and habits of this Arctic visitor, one of the most beautiful of the large Gulls, and certainly the most elegant and graceful in form and flight. When seen on the wing it is easily distinguished from its larger neighbour, the Glaucous, by its gracefully buoyant and gliding mode of flight, so different from the slower, heavier flight of that bird, similar to that of the Great Black-backed Gull. In its habits, so far as my experience goes, it is not a carrion-feeder like the Glaucous—I have never seen it feeding on carrion of any kind. I have often seen the Iceland Gull resting in pasture fields in company with the smaller Gulls, a habit I have never seen adopted by the Glaucous, which keeps nearly altogether to the shores and sands. The Iceland Gull I have often seen with the smaller Gulls in the fields following the ploughman, feeding on the worms and grubs turned up by the plough.

On one occasion an immature bird haunted one of my ploughed fields for over a month, day after day, only going to the estuary to drink and wash. From its great tameness I did not wish to shoot it, but tried to take it alive on a baited hook; this was easily managed, but unfortunately the poor bird was so hungry that in swallowing the bait the hook became firmly fixed in the gullet, and being unable to extricate it safely, I was obliged to put the bird out of pain, and sent the specimen to the Dublin Natural History Society, thus disappointing me in the wish to send a live specimen to the Dublin Zoological Gardens.

I first became acquainted with the Iceland Gull in Cork Harbour, a "flight" having visited it, in the winter of 1848–1849,

and individuals were observed in different parts of the harbour from time to time.

1849, January 25th.—The first I met was when returning from shooting on Seamount Marsh, and while walking along the embankment, a lovely bird flew close past; its buoyant gliding flight and white primaries at once identified its species.

On January 29th, when returning from Queenstown in my boat to Ringaskiddy, and just above Haulbowline Island, a fine bird passed our boat out of range, but returning as if to observe us more closely, and coming within easy distance, it was brought down by my brother by a shot from his light gun. This was only the fourth specimen known to have been obtained in Ireland. I presented the bird to my old and valued friend Dr. Harvey for his fine collection of native birds, and it is now, with the rest of his collection, in the Museum of the Cork University College.

On February 2nd, when returning with my brother from shooting on Seamount Marsh a fine specimen flew close past us, but as both our guns were unloaded after we had stopped shooting, this lovely bird, to our great disappointment, escaped us.

On February 8th, when returning from Queenstown in my boat, a fine creamy-coloured bird flew past our boat, but out of shot. This was the last specimen I observed in Cork Harbour. Having some time after left the district to reside at Moy View, Co. Sligo, my future observations of Wild Fowl and Sea Birds were confined to Killala Bay and the Moy Estuary, in the counties of Mayo and Sligo; these observations were made during the years 1851 and 1909.

1851.—On December 4th, when walking on the sands along the Moyne Channel in Moy Estuary, I shot an immature specimen as it flew past me. This bird I sent to my old and valued friend, the late William Thompson, of Belfast, who presented the specimen to the Belfast Museum. The day has been well impressed on my memory, owing to my shooting a grand specimen of the White-tailed Eagle on the sandhills. A pair of these fine birds had been, from October, haunting the sandhills of Bartragh, feeding on the rabbits and any dead fish thrown up on the shore. When returning, after shooting the Gull, I perceived an Eagle flying slowly over the sandhills, alighting on a little hummock. I remarked to my brother (who

was with me) that it was a good chance to try and stalk the bird from behind another little sandhill, and asked him to try it, but he only laughed at the idea of shooting such a wary bird. So, giving him the Gull to carry to the house, I made my way to the sandhills, and quietly crept up behind the sheltering hummock to within about ten yards of the one the Eagle was standing on. I put my gun to my shoulder as I raised my head over the sheltering hummock and, on the instant, the bird spread his wings to go, but too late, for I fired and knocked him dead with a charge of No. 5 shot. He was a very large bird, in the second year's plumage. Had he not been gorged with a heavy feed of Rabbits and Hake (over six pounds weight), I don't think I should have succeeded, the heavy feed causing him to be careless and not so watchful as usual.

On December 9th, when walking on the Enniscrone Sands by the river, I saw a very dark specimen, evidently in its first year's plumage, in the company of some Herring and Common Gulls; it was remarkably tame and unsuspicious, allowing me to approach within eight or ten yards.

1855.—On December 9th a bird, evidently an adult from its pure white plumage, flew close over Moy View Cottage towards the estuary sands.

1862.—On January 26th I caught, on a baited hook, the young bird (*ante*) that had been haunting the ploughed fields for over a month.

On January 27th, when riding along the Enniscrone Sands, among a number of small Gulls I observed a very dark-coloured bird that must have been in its first season's plumage; its tameness in allowing me to ride within eight or ten yards was also good evidence of the fact.

1866.—On January 6th I shot a bird in that creamy-coloured plumage that I consider the second year's stage. This bird had been in one of my ploughed fields for several days past.

On February 19th I rode within ten yards of a bird, in its first year's plumage, as it was resting on the Enniscrone Sands.

1873.—On Sunday, January 26th, as I was walking with my friend, the late Captain Dover, near Dooneen House, a bird flew out from the fields and pitched on the road within twenty yards of where we were standing, then after some time searching for

food, flew low up along the road for about two hundred yards, and then disappeared over the fields. This was a very dark-coloured bird, evidently in its first year.

1877.—On Sunday, January 28th, as I was walking to church across one of my fields, I saw resting on the grass, among a number of small Gulls, a young Icelander, so very dark in colour that it must have been in its first year's plumage.

On December 26th, resting on the water with a young Herring Gull, near Killanly Marsh, I saw a young dark bird.

On December 29th, when walking on the shore below Enniscrone to Carrahubbock to obtain some Purple Sandpipers for a friend, I observed a young Iceland Gull among some small Gulls in a grass field, but as there was nothing to disturb them, I continued my way to the Sandpipers' haunt, when having obtained the required number of specimens I returned, and when passing the field where the Gulls were resting I saw the Icelander still among them. Intending, if possible, to secure the bird, I was just entering the field when it rose, flying to the shore, and passing close to me; so, taking my gun, I brought it down with a charge of No. 5 shot. It was a very fine specimen, apparently in its second year.

1887.—On October 9th I shot the young bird that had been haunting the shore field, following the ploughman for several days, feeding on the grubs and worms.

1892.—On January 9th I fired at a young Iceland Gull flying past my boat.

On January 10th I again saw the Gull near the point, but without obtaining a shot.

On February 3rd, below Enniscrone, on the Carrahubbock shore, I saw an immature bird standing on a flat rock along with several young Herring Gulls. Having no gun with me, I was obliged to content myself by using my glass, by which I easily identified it, by comparing its slight build with the other Gulls, and having a clear view of the ends of the closed wings extending beyond the ends of the tail feathers.

On February 15th either an Iceland or Glaucous Gull was seen near Rinroc, but too far off to be identified (doubtful).

1898.—On June 19th, as I was driving to Oghill, and when half-way between that place and Enniscrone, on passing a field

by the side of the road in which a man was ploughing, I was surprised at seeing an Iceland Gull along with some young Herring Gulls following the ploughman, feeding on the grubs and worms turned up. It was the first instance I have known of an Iceland Gull met in summer.

1902.—On January 29th either a young Iceland or Glaucous Gull, with a young Great Black-backed, was seen on the water near Killanly Marsh (not identified).

1905.—I omitted, by an oversight, to enter the exact date on which I walked to Enniscrone, after a heavy gale had been blowing, to see what birds had been driven into shelter. On reaching the sands I saw a large number of Herring Gulls, very noisy, hovering over a little sheltered bay near the Bath House. After watching them for some time, I recognised three Iceland Gulls in the crowd, so running down to the edge of the water I waited, closely watching the clamorous birds as they circled round, until one of the Iceland Gulls came within range, when I brought it down with an Eley's wire cartridge—a fine bird in the second year's plumage. I then reloaded, but having had only the one wire cartridge, I was obliged to use No. 5 shot; when a second bird came near I fired, but only slightly wounded it, and it flew away down the shore, the No. 5 shot being too light to act effectively on the thick coat of feathers on these Arctic Gulls. Although I waited for over an hour, the third bird gave me no chance of a shot.

On April 26th, I was walking along the Moy View shore with my dogs, and when I got to the point I saw at the other side of it, resting on the water, a young Herring Gull, and what I first thought was an Ivory Gull, on account of its white colour. I immediately returned, put up my dogs, got out my punt and paddling round the point, found that the Gulls had moved farther off. I moved on slowly and quietly, and getting within range, knocked over the White Gull, which, instead of being an Ivory, proved to be an Iceland Gull in the white stage, assumed both by Glaucous and Iceland Gulls the summer before the autumn moult, when they take on the adult plumage.

1906.—On December 10th as I was putting out my punt for a day's shooting, a fine Iceland Gull passed close by, flying round the point.

On December 14th I again observed the Gull. This was the last Iceland Gull I saw in the Co. Sligo, leaving Moy View in October, 1909, and coming to Ardnaree, Monkstown, Co. Cork.

Glaucous Gulls (*Larus glaucus*) in Killala Bay and the Moy Estuary.

1859.—My first acquaintance with this fine Gull was at Moy View on December 14th. There had been a heavy fall of snow the previous night. When looking for cocks, and passing along the shore from one small wood to another, a fine Glaucous Gull was flying past. I fired at it, but failed in stopping it. Evidently an adult from its very white appearance.

1871.—Either a Glaucous or an Iceland Gull was seen on the sands near Rinroc on March 29th.

1873.—On January 13th a fine bird seen on the sands.

On January 23rd, when out in my shooting-punt, observing a fine adult bird with some Herring Gulls near Cardens Island, I paddled on to it, but my small gun missing fire, the noise of the cap disturbed them, and they all flew off a couple of hundred yards; giving them time to settle down, I again moved near, and firing my big shoulder-gun, obtained a fine specimen of an adult.

1875.—A young bird seen on the sands.

1877.—On February 24th, seeing a fine bird flying past when my punt was hauled up I fired, but failed in stopping it.

On March 16th, when out in my shooting-punt down the Moyne Channel after Wigeon, a fine bird flew past, and wheeling round to take a closer view of the punt, came within range. I fired, and had the pleasure of bringing down a splendid bird in adult plumage.

On December 21st I saw on the sands near Scurmore a bird very dark in colour, but I think it was in its first year's plumage.

1878.—On January 17th, when in my shooting-punt down channel near Scurmore, and while I was looking at a young Black-backed Gull feeding on some carrion cast up by the tide, it was joined by a young Glaucous Gull, which though as large and strong-looking as the Black-backed Gull, had not the courage to fight for its share of the feast when driven away by the other Gull; flying further down along the shore it came to a dead dog,

on which it began to feed so greedily that it let me bring up the punt within shot, when it paid the penalty of its greediness by the receipt of a charge of No. 5 shot from my cripple-stopper. It was a fine full-grown bird in its first year's plumage.

1880.—On February 27th I shot the Glaucous Gull that, for several days past, had been feeding on the carcase of the bullock lying on the shore. It was so excessively wary and watchful that, day after day, I failed in obtaining a shot at it. However, this day I changed my tactics, and creeping a long way behind a fence, I got within range, but the moment my head appeared above the fence it was off, but too late to escape the charge of No. 5 shot that brought it down dead. It was a remarkably fine specimen of the Glaucous Gull (adult), weighing $3\frac{1}{2}$ lb., carpus measuring 17 in., length $28\frac{3}{4}$ in. Some time before I shot an adult 29 in. in length, carpus 18 in., but it was not so heavy.

Early in December I met a fine bird on the Enniscrone Sands feeding on a dead bullock. It was so wary that I was unable to get within range and, firing a long shot, it got off, though hard hit.

1895.—On February 5th, when down channel near Bartragh, in my shooting-punt, I saw a fine bird among some Herring Gulls near Barrett's Island resting on the water. They all rose on the approach of the punt, but it fled round Barrett's Island. I followed, and coming within range, knocked over a fine adult.

1901.—On January 1st I saw an adult bird near Bartragh, its flight was just as slow and heavy as that of the Great Black-backed Gull. However, I failed in obtaining a shot.

1905.—On February 14th, when out in my punt passing the point, I saw a bird that I thought was an Icelander from its size, but on shooting it, it proved to be a very small, immature Glaucous Gull.

This was the last either shot or observed by me, as I left the district shortly after.

It is strange that more Iceland Gulls have come under my notice than Glaucous Gulls, and also that I have seen only one Iceland Gull in adult plumage, while of the thirteen Glaucous Gulls observed, seven were birds in the adult plumage. Also, I may remark that severe winters did not increase the numbers of either species.

RELATIONSHIP OF SPECIES.

By H. Panton.

(Continued from vol. xvii., p. 455.)

About fifteen years ago I wrote a short paper as a kind of summary of hybridisation, in which the results seemed to me, as far as I could then gather, to tend to confirm the views I put forward, and I cannot perceive that they do not apply equally to the present time. I was then unaware that these different degrees of hybridisation had been worked out and named by Broca as long ago as 1864.* I will quote a good deal from my old article on the subject.

"Presumably, in the course of evolution, animals, when only slightly changing from each other, produce fertile young or mongrels; but when in the course of time their differences become intensified, they produce infertile young or hybrids; and finally, when still more changed from each other, they will be unable to produce young at all. And again, presumably, as these differences must grow gradually, there must be intermediate states between these three stages, *i. e.*, between the first and second, when the produce will be occasionally fertile (more or less); and between the second and third, when the contracting animals will only occasionally produce young."

Adding to the examples I then recorded, the table now gives:—

A. Animals producing fertile young (mongrels).

Examples: Bison and Cow, Yak and Cow, Zebu and Cow, Gayal and Cow, Jaguar and Leopard, Dog and Wolf, Dog and Jackal, Brown and White Bears, Zebra (true) and Ass. Golden and Amhurst Pheasant, Hooded and Common Crow, Pintail and Mallard, Tufted Duck and Pochard, and various other birds. (These correspond to Broca's Eugenesic hybrids, "being fertile

* 'On the Phenomena of Hybridity in the Genus *Homo*.'

inter se, and breeding easily and indiscriminately with the parent species.")

B. Animals producing young more or less fertile.

Examples: I was at that time only able to presume perhaps *Chrysomitris* and *Serinus*, but suggested that reports one heard of Mules breeding might serve as examples; since then I have seen that Broca had described several graduations from "Paragenesic" (with a "partial fecundity") to "Dysgenesic," "nearly altogether sterile" (*i. e.*, infertile with each other, but sometimes rarely breeding with one of the parent species, these three-quarters young being infertile): Broca's examples were chiefly drawn, and perhaps not very correctly, from various human hybrids. Another example, however, is Pigeon and Collared Dove (Suchetet).

C. Animals producing sterile young.

Examples: Lion and Tiger, Horse and Burchell's Quagga (which I only then included as "probable"), Duck and Muscovy, Blackcock and Pheasant, *Serinus* and *Carduelis*, *Serinus* and *Ligurinus*, *Serinus* and *Alario*, &c. This degree, "entirely infertile," Broca termed "Aganesic."

D. Animals mating, but not always producing young.

Examples: Horse and Ass (nearly always), *Carduelis* and *Pyrrhula*, *Ligurinus* and *Carduelis* (frequently), *Serinus* and *Pyrrhula* (very rarely).

Broca does not specify this stage. Lest it should cause surprise, I may state that I have included Horse and Ass here on the authority of Tegetmeier and Sutherland,* who state some mares quite capable of producing young to a Horse do not do so to an Ass. (I have *heard*, however, of *vice versâ* results being obtained.)

E. Animals mating, but not producing young at all.

Examples: Sheep and Goat, Eland and Cow (?), Buffalo and Cow (?), *Fringilla* and *Serinus*, Seedeater (*Crithagra*?) and *Serinus*.

These results, meagre though they be (I could name several more, however), seem to my mind to apply very correctly to the degree of relationship of the contracting parties.

In stage A. all these contracting parties seem to have very many if not entirely corresponding congeneric actions, or "in-

* 'Horses, Asses, Zebras, Mules, and Mule Breeding' (1895).

dividualism," and to be so nearly akin that they seek these mates with mutual satisfaction and as much or nearly as much avidity as they do their natural consorts.

In the middle division C. the animals have so far receded that hybrids of this class are harder to get. There seems to be less attraction between the combining animals, and they have often to be kept together, and away from their proper mates, before they will copulate.

In D. anyone with experience of Mule breeding will note the general want of affection between the ass and the mare, or the stallion and she ass.

And in E. this mutual intolerance is perhaps somewhat more apparent still.

All this looks so remarkably gradual, so evident and simple, that there appears no anomaly of any kind, except those which the arbitrary (and changing) barriers of our classification schemes erect. There are, however, a number of curious and contradictory results obtained by plant hybridisations that are difficult to understand; they occur also, as Mr. Finn has pointed out, in birds,* *viz.*, that a hybrid that is hard to get, Wood-Pigeon and Common Pigeon (and which we might expect to class in group D. or E.), proves fertile, and, therefore, apparently has to be included in group A. (I should like to see this experiment repeated.) I do not think these aberrant results (or as we think them aberrant) destroy the results which we get in the above table, or the evidence which this brings forward of a certain gradual tendency and law in hybridisation. These graduating results, however, perhaps do not seem altogether so amicable to the fascinating theory of evolution of species by spontaneous variation or mutation, as they do to "indefinite" variation. Darwin held it probable that species arise but rarely violently in this way (which is suggestive of the theory of Cuvier and others of the separate creation of species), but generally by the slowest and most gradual changes, as we will notice later on. Still this debatable point has never been settled. One must bear in mind, however, before definitely stating, as some may do, that these anomalies destroy our more general results, that in breeding with wild forms, environment or change of food

* 'The Feathered World.'

affects fertility in so much that many species, the Fox notably, fail, as a rule, to reproduce in captivity. Curious phenomena such as this emphasise the great power environment has on the reproductory organs, as Darwin long ago pointed out, and this impresses one to take the view that environment is one of the great causes of evolution. Therefore, we must bear in mind that this may be the cause acting on the anomalies mentioned above, and which therefore may by no means be anomalies, although, to be fair, one is bound to admit that this cuts both ways, and may invalidate or put out of court some of the seemingly correctly graduated examples I have given in my table. At the same time, one might mention that Darwin hardly makes out any case for his supposition that domestication affects fertility to such an extent as to cause species unfertile while wild to become fertile together in their domesticated forms.

At the time I first wrote out the above table I felt quite confident that it was the proper thesis; since then, however, I hope I have learnt to put no very definite trust in anything.

When we dabble in relationship between animals whose common progenitor we know not, the length of whose separation we know not, and whose blood affinities we know little of, we cannot expect our results to be always as we should expect. It might be permissible to speculate whether environment and other effects, which are said to produce the separation of species and cause their physical attributes to become different, can cause them to come together again, so that animals once sterile can once again converge and become so alike as to again breed. It might be possible for the germ plasm to be so affected, however unlikely; this would result in anomalies, and such phenomena as species becoming fertile together in confinement, while sterile in nature, as Darwin considered probable, but which might equally well be held to be improbable.

All the animals in Class A., term them different species, or genera, or what you will, one can only, independent of structure, hold to be, through blood affinity, nothing more than Nature's evoluting varieties, in the same way that the Cochin Fowl and the Minorca Fowl are varieties, or Newfoundland and Pug Dogs, and there is not much doubt that if these latter (having gone through exactly the same conditions of evolution

as they now have) were discovered wild, they would immediately be put down as different species, and held to be far more distinct than they now are.

Returning again to birds and taking, for instance, a favourite example of those who are fond of quoting the "extraordinary results of hybridisation," what can appear more unlikely (when we become familiar with their congeneric actions) than to expect the young of Chinese and common Geese to be sterile, although a classification (apparently faulty) formerly separated them? Again, how does an Amhurst Pheasant differ from a Gold more than an Azeel Fowl from a Hamburg? Why are the two former different "species," and the two latter different "varieties"?

These barriers would seem to be somewhat pedantic.

Turning to the *Anatidæ*, let us take some six species and note their grouping:—

1.	*Plectropterus* .	P.	D.	S.	Subfamily *Plectropterinæ*.
2.	*Anser* . . .	R.	—	—	Subfamily *Anserinæ* (Geese).
	Chlœphaga .	R.	D.	S.	
	Chenalopex .	R.	D.	S.	
3.	*Tadorna* . .	P.	D.	—	Subfamily *Anatinæ* (Ducks).
	Anas . . .	P.	D.	—	

Note.—P. = front of metatarsus covered with large plates. R. = metatarsus covered with reticulated scales. D. = windpipe dilated at lower end. S. = spur on wing.

We thus see that *Plectropterus* (Spur-wing Geese) is placed in one subfamily; *Anser* (true Geese) with the Upland Geese and Egyptian Geese (*Chlœphaga* and *Chenalopex*) in a second, *Anserinæ* (Geese); and the Shelduck (*Tadorna*) and true Duck (*Anas*) in a third, *Anatinæ* (Ducks).

From what I have been able to see of the natural habits, actions, dispositions, cross-breeding, and calls, I should consider them allied as follows (call it blood relationship, essence, germ plasm, physiological unity, or what you will):—

Anser (with *Bernicla*, &c.). .	Geese.
Plectropterus (?) . . .	Sheldrakes.
Chlœphaga	
Chenalopex	
Tadorna	
Anas (with *Dafila*, *Aix*, &c.) .	Ducks.

It would appear that they are so classed in the first list chiefly on account of the reticulations or plates on the metatarsus, general size, and length of leg. This grouping appears far from their true natures. All the birds that I have classed in my list as Sheldrakes are spiteful birds, with great similarity in habits and calls, and are all, I believe, infamous eating, while the peculiarities on which they are generally classed are perhaps parallelisms or independent mutations.

All these birds hybridise together more readily as I have grouped them than with members of the other groups. *Plectropterus* may be only a possible inclusion. It has interbred with *Chenalopex*, however, but I am not altogether familiar with it. *Chlœphaga* and *Chenalopex* have an individuality quite typical of Sheldrakes, that is, in the points I have named, and they no more look and act like Geese or Ducks than a black Donkey looks or acts like a black Horse.

Mr. Finn, whom I quoted just now, and who has written an interesting account of the different waterfowl,* is, I believe, struck with this resemblance himself, and styles the larger of these birds, or some of them, "overgrown Sheldrakes." *Chlœphaga* (the most Goose-like), which as a group is often referred to as "the Southern Brents," may resemble to some extent *Bernicla* (which is apparently a true Goose), but it has none of a Goose's ways or characteristics, neither has it any love for Geese, judging from how they hunt these birds about, when breeding, in a somewhat un-Goose-like manner.

Chenalopex resembles *Anser* in no respect whatsoever, except in the reticulated metatarsus, and *Tadorna*, which, being the smallest, most resembles the Duck tribe, seems in every way dissimilar to these latter birds.

I have had a good deal to do with *Tadorna* in confinement, and having been born where these birds breed in large quantities I have taken much notice of them and their natural habits. I have, for instance, when engaged in punt-gunning during very bitter weather (and when for several days and nights on end I would take up my quarters in a sailing boat), been particularly struck with the fact that I have never on any one single instance noticed Shelduck in company with any of the *Anatinæ*, even

* 'Fancy Waterfowl' (1900).

when the weather has been so severe that these others have been driven up into more or less mixed bands. I have read that *Tadorna* has interbred with *Anas*; this is, of course, quite possible, but although I have seen many Sheldrake hybrids *inter se*, or rather between birds which I have classed as "Sheldrakes" above, I have never seen this one, and therefore imagine it to be rare at any rate, and as, where a large variety of Ducks are kept, it is not always possible to be sure of the parentage, it would be well to be certain as to this before accepting these crosses.

The last uncongenial grouping, and one which seems by some naturalists so to be held, is in the *Viverridæ*, where we see the inodorous Genets classed with the strong-smelling Ichneumons.

Ought not the *Viverrinæ* to come with the *Felinæ* under *Felidæ*, and the *Herpestinæ* to join *Protelinæ* and *Hyæninæ* under a family heading *Herpestidæ*?

While the Genets appear to be long-faced primitive Cats, the Ichneumons, in their genital parts, much resemble the Hyænas, and the two groups appear dissimilar. Ichneumons, when attacked by an opponent of superior mettle, have a curious method of defence: they turn upon their backs and seem to fold their hind quarters back over their bellies, protecting themselves with their powerful jaws. (An Ichneumon easily kills a Ferret, which kills a Cat.) It is interesting to note that a Hyæna, when overmatched, has somewhat the same method of defence when tackled, for instance, by the Lion, except that it is apt to wave its legs about in the air rather more. Perchance, if related, as it may be, to the Ichneumon, it has more difficulty in arranging a safe position for its long evoluted (?) legs. Far be it from me to give advice to any Hyæna as to what it should do in such embarrassing circumstances, but, judging from what I have seen of the beast when so set upon, and from the fact that Hyænas have been found on the veldt with their legs bitten off but otherwise uninjured, it is possible it might come off better if it kept these tucked away after the fashion of its smaller relative; for it appears likely that the Lion has considerable respect for its powerful jaws.

To show how contradictory our classification is in indicating

kinship concerning such an important matter as the production of young (and incidentally the continuation of the race, even if only a mongrel one), one has only to summarise the instances given above, such as:—

The non-production of any young between members of the same species (*Oryctolagus* cuniculus* and *O. huxleyi*).

Between members of the same genus (*Bos taurus* and *B. bubalus*).

The production of sterile hybrids between those of another genus, *Equus* (*E. caballus* and *E. asinus*).

And the opposite results, such as the production of hybrids between members of even different families (*Ligurinus* and *Acanthis*).

And the production of possibly fertile hybrids between different genera, as *Cercopithecus* and *Cercocebus*, *Macacus* and *Cynopithecus*, and *Macacus* and *Papio*.

With a possible exception of *Cercopithecus*, I should imagine all the hybrids of the *Cercopithecinæ* would be fertile; a supposition hardly likely to be proved either way, unless, indeed, the subject receives as much attention in the future as it has neglect in the past.

(To be continued.)

* More generally known as *Lepus*.

NOTES AND QUERIES.

MAMMALIA.

An Albino Water-Shrew.—It may be of interest to note that the Natural History Museum has just received a nearly perfect albino of the British Water-Shrew (*Neomys fodiens bicolor*). The upper surface is completely white except just across the shoulders, but the under surface shows a certain suffusion of brownish. The specimen was sent from "South Hampshire" by someone who did not enclose his name. Should he see this notice, I should be obliged if he would send me his name and address for entry in our Registers.—Oldfield Thomas (Natural History Museum, S.W., Dec. 20th, 1913).

AVES.

Status of Blackcap and Garden-Warbler.—Mr. Butterfield asks for the experiences of other ornithologists in regard to the relative abundance of the Blackcap and Garden-Warbler.* The difficulty in forming a judgment, as he probably recognizes, is that of distinguishing the two birds' songs; for it is hardly once in twenty times that you get a satisfactory view of the singer. When the Blackcap sings its *whole* song there should be no doubt as to its identity; the song ends with a brilliant passage such as never occurs in the Garden-Warbler's. The Blackcap, however, often stops short of this final passage, and then there is less to distinguish it by. But though it is undeniably one of the nicer distinctions among birds' notes, it is still usually not impossible. The Garden-Warbler's song is quieter in manner and more level in tone; the Blackcap's has more of the effect of sparkle and "cross-hatching" among the notes. If my ear is to be trusted, it leaves me in no doubt about the correctness of Mr. Butterfield's opinion. Wherever I go in early summer I hear more Garden-Warblers than Blackcaps. The fact struck me last May in two such widely separated counties as Northumberland and Sussex.

The Lesser Whitethroat, curiously enough, is another bird which seems to retain an undeserved reputation for scarcity; curiously, because its song is so unmistakable that there should be no difficulty in estimating its relative numbers anywhere. There are parts of the

* 'The Zoologist,' 1913, p. 431.

country, no doubt, where it is scarce—Northumberland is one of them—but in ordinary country in most parts of England it seems to be common enough. It certainly is so, for example, in the plain of York and in Cheshire. In Sussex (last summer, at any rate) it was one of the commonest of the Warblers, and the "common" Whitethroat was singularly scarce. I do not think I should be wrong in stating that I heard twenty Lesser Whitethroats in Sussex for one common Whitethroat.—E. Leonard Gill (Newcastle-on-Tyne).

Glossy Ibis in Norfolk.—The Glossy Ibis (*Plegadis falcinellus*) has again been found in Norfolk, one having been shot on Oct. 28th, 1913, at Acle, nine miles west of Yarmouth. Mr. Lowne, our local taxidermist, on dissecting this bird, found it to be a male. The visits of this species to Norfolk generally occur during the autumn months. The following notes relating to the past eleven years may be of interest:—Nov. 28th, 1902, one shot on the river Bure. August 22nd, 1903, one shot at Halvergate, Sept. 3rd, 1906, four seen flying over Breydon; these escaped. Dec. 2nd, 1909, one shot on the marshes between the river Bure and Breydon. Nov. 2nd, 1912, one shot at Fleggburgh, and another shot on the Burgh Marshes on Dec. 2nd in the same year. All these localities are within about ten miles of Yarmouth.—B. Dye (Great Yarmouth).

Ornithological Notes from Yorkshire.—*Red-backed Shrike as a Breeding Species.*—In the sixties a friend of mine showed me a pair of the above species which had nested, so he alleged, on Silsden Moor—which, however, is not a moor in the ordinary acceptation of the term, but embraced some rough ground in an elevated part two or three miles north of Keighley—the authenticity of which I never doubted. I communicated the facts to Mr. Nelson, who considered the evidence not satisfactory, but on what ground it is not stated (see 'Birds of Yorkshire,' vol. i. p. 142). We have it, however, on the authority of S. L. Mosley that the Red-backed Shrike has nested near Keighley, and Mr. Walter Greaves, in his 'List of the Vertebrate Fauna of the Hebden Bridge District,' reports the nesting of this species, on the authority of J. Cunningham, at Dudwells in 1885 ('Birds of Norland Clough'). The Red-backed Shrike is a rare nesting species in Yorkshire. One (in addition to the above case) of the most recent cases is reported by W. Guygell in 1889 on Oliver's Mount, Scarborough.

On Nov. 29th, 1913, a Swallow was seen flying over the river Calder between Hebden Bridge and Mytholmroyd, near Halifax. In the seventies I saw one flying about near Bingley for a few days, but

each day it seemed to be getting weaker, and I have little doubt it ultimately died of starvation. This is the only one I ever saw in this district in November. Recently I spent about a fortnight in Belgium, and what struck me most in bird life was the comparative scarcity of the House-Martin about the towns and villages I visited. I was pleased, however, at seeing a fair number breeding in Dinant. The Swallow was by far the commoner species, and in one of the busiest towns I visited, it could be seen darting about in the principal streets after insects, much after the manner with us of the House-Martin. November, 1913, had been a most remarkable month for a high average temperature. Various species of birds on December 3rd were feeding in the wood on elderberries and blackberries of good quality. The Blue Tit is very fond of elderberries; indeed, the Tit family are very omnivorous in their feeding habits. I see the Marsh-Tit occasionally feeding upon the seeds of thistle, and H. B. Booth writes me that this species will feed sometimes upon the softer portion of maize. On Nov. 3rd I heard the Song-Thrush singing almost as if it were May, at Bingley, I believe the only instance so late in the season.—E. P. Butterfield (Wilsden, Yorkshire).

NOTICES OF NEW BOOKS.

The Gannet, a Bird with a History. By J. H. Gurney, F.Z.S. Witherby & Co.

This is probably one of the largest books devoted to the history of a single bird. Mr. Gurney writes: "My conscience pricks me with having occupied five hundred and sixty pages with the history of one bird, but I console myself with the reflection that, had the bird been the Cuckoo or the Raven, the book would have been much longer." Even now, if the Gannet's behaviour had been recorded by some of our patient and qualified bird-watchers, this publication could have been increased in size, and then it would have been none too big, for Mr. Gurney has inaugurated a new departure in the literature of natural history which may well, and will doubtless, be followed by other naturalists, though not, it is to be hoped, by the ordinary compiler. These pages are rich in topographical details and biographical reminiscences, and their author seems to have consulted most of the literature that it is possible to trace on the subject, some

of the translations contributed by the late Prof. Newton being particularly valuable.

Stress is laid upon the probable great longevity of this bird, based on its habits and limited nidification, and referring to the visit made by Ray and Willughby to the Bass Rock in 1661, Mr. Gurney makes the interesting remark that "there is nothing preposterous in the supposition that there may be Gannets living on the Bass Rock now which were there in Ray's time, for we know nothing of the ages which birds attain to."

An interesting chapter on "Mortality among Gannets and Liability to Accidents" promotes views on avian life outside the Gannet limitation. Mr. Gurney is of opinion that, "so far as we can judge, death from old age is by no means the usual termination of a wild bird's life. Reflection leads us to the rather startling conclusion that nine birds out of ten meet their deaths by accidents or by starvation." Good argument can also be found against the uninformed agitation sometimes prevalent that a destruction of sea-birds (including Gannets) is necessary for the purposes of human fish supply; Nature can be better left to manage her own supply and demand.

The Gannet has now found a biographer, and ornithology is enriched by a really good book, which will be authoritative and long-lived like its subject.

Bird Life throughout the Year. By John H. Salter, D.Sc. Headley Brothers.

This is a pleasantly written book detailing the avian events, arrivals and economy which, under normal circumstances, may be looked for and observed during the different months of the year in this country. It is well illustrated, many of the coloured plates, however, being taken "from cases in British Museum, South Kensington." Dr. Salter, on the whole, believes in the efficacy of game-preserving as a protection to many of our smaller birds. "It may be likened to the arm of the law which descends with crushing force on the evil-doer, while promoting the happiness and security of the general public"; and further on we read: "Comparison with the state of things which prevails upon the Continent brings the conclusion that England is pre-eminently the country of small birds, because nowhere else is

game-preserving so general. Only let the matter be carried on with rather more discrimination and humanity, and every naturalist will express his indebtedness to the system." The system doubtless, on the whole, works for good, but the danger is in the amount of ornithological intelligence of the "keeper," and the restraining influence of his employer. The operations of an ignorant and unchecked keeper, from the zoological point of view, are often deplorable.

In this book the general lover of birds will find much interesting information.

EDITORIAL GLEANINGS.

Flamingo in Langstone Harbour.—Mr. W. Kingdom-Murrill, writing in the 'Shooting Times' of December 20th, 1913, reports that an adult Flamingo was shot in Langstone Harbour, near Portsmouth, on Wednesday, December 10th. Although the bird showed no signs of captivity, naturally there is a doubt as to whether it may have been an escape, though there is nothing against the supposition that the successive south-westerly gales may account for the appearance of this southern species on our coast. It is, at any rate, the first known example that has been recorded from Langstone Harbour; but in November, 1883, a similar adult specimen was obtained near the Beaulieu River, nor far distant.

At the Quarterly Meeting of the Kent and Essex Sea Fisheries Committee, held recently (1913) at the Fishmongers' Hall, London, Dr. Murie reported that this season there had been very large quantities of fish, called "Fenians," caught off Leigh and Southend. These fish were like a small whitebait, and it appeared that they came periodically when the wind and tide were under certain special conditions. Mr. Hussey said that more Conger Eels had been caught this season that he had ever known. Off Deal, a Mr. Olbey had a large catch of Congers, nineteen of them weighing 316 lb. The largest weighed 40 lb., others 37 lb., 36 lb., and down to 10 lb. Off Dungeness, also, large quantities of Pilchards had been taken, and this was exceptional. At Deal it appeared that the temperature of the water was 3·1 higher than the average temperature in November for the last ten years. Several members also spoke of the fish mentioned by Dr. Murie, and said there were millions of them off the Kent coast. They were called "whiting pout" there.

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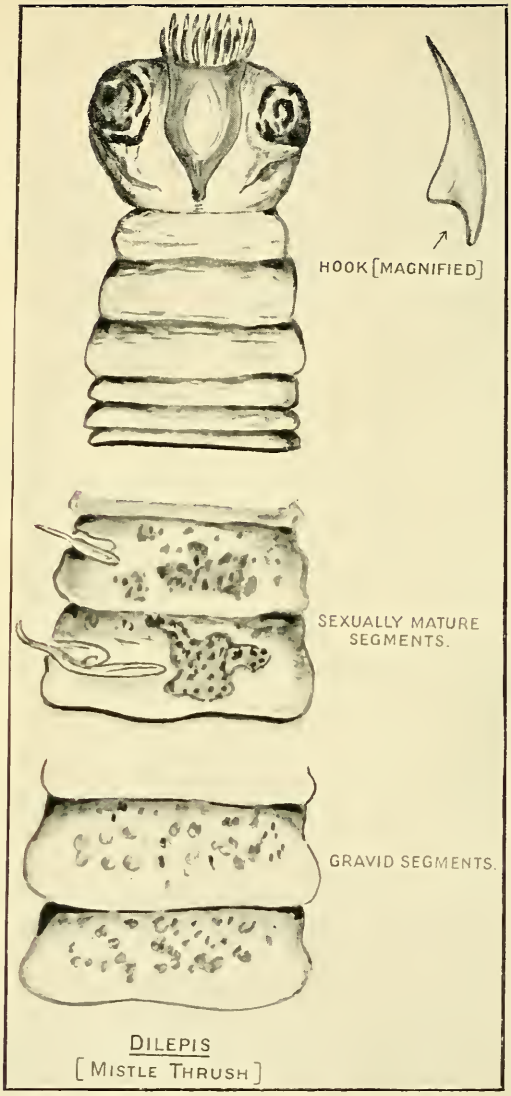
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PARASITISM IN RELATION TO BIRDS.

By H. Victor Jones
(Honours man in Zoology, and late Quasi Demonstrator in Zoology at the University College, Bangor, North Wales.)

(Plate I.)

Parasitism is a subject which at the present time is offering a wide field of investigation to biologists, especially so to bacteriologist and parasitologist proper.

Upwards of thirty Protozoa—representing the main division of the group—are known at some stage or other of their life-history to be parasitic in the human body; the presence of which causes diseases of a most vicious nature, such, for example, as "sleeping sickness," due to *Trypanosoma gambiense*. The so-called Leishman-Donovan body, the parasite of dum-dum fever or splenomegaly, and many others of a similar nature may be cited.

No less important is the parasitism as exhibited by the phyla Platyhelminthes and Nematohelminthes. These phyla show different degrees of parasitism, as will be seen from the following classification:—

Phyla.	Family.	Degree of Parasitism.
Platyhelminthes.	*Turbellaria.*	All free-living.
	Trematoda.	Endo-parasitic. / Ecto-parasitic.
	Cestoda.	All endo-parasitic.

These families are undoubtedly connected with one another.

The Turbellarians are all free-living, with the exception of a few marine forms which have taken to parasitism.

The Trematodes are all parasitic, showing ecto-parasitism as in *Polystomium integerrimum*, and endo-parasitism as in the Liver Fluke (*Distomum hepaticum*).

The Cestodes, on the other hand, are all endo-parasitic.

Taking next the phylum Nematohelminthes, we can tabulate it thus :—

Phylum.	Family.	Degree of Parasitism.
Nematohelminthes.	*Nematoda.*	Free-living and parasitic forms.
	Nematomorpha.	Also free-living and parasitic forms.
	Acanthocephala.	Solely endo-parasitic.

From the above we see that the *Nematoda* show free living and parasitic forms.

Such is the case also with the *Nematomorpha*. But when we come to the family *Acanthocephala*, it is seen that it has been specially constituted for the justification of a few peculiar genera, of which *Echinorhynchus* is the best known, and whose larvæ live in *arthropod* and the adult in *vertebrate hosts* respectively.

This paper will deal chiefly with the *Cestoda*, *Acanthocephala*, and *Nematoda* which were found in the alimentary canal of some of our common birds.

An attempt has also been made to show the relation, if any, between the *Mallophaga*, or lice, found on the birds and the number of parasites found in the intestines. The large table* will show the month, locality, food of bird, and position of parasite when found. The life-history of Cestodes in general might here be stated with advantage.

Life-history.—Cestodes are exclusively endo-parasitic, *i. e.*, they are found in the tissue or canal of the host upon which they prey. The larval life is lived in the tissues or chambers of *invertebrate* animals; while the adult stage of the Cestode is passed in some *vertebrate* host, with the exception of *Archigetes* sp.

* A single page only of this table is here printed.

It is thus seen that the *Cestoda* illustrate enteric parasitism with entire loss of alimentary canal. They usually alternate between two hosts, and show a *cestoid* and *cystic* stage, such as, for instance, *Tænia cœnurus*, alternating between Dog (cestoid) and Sheep (cystic).

A general survey of *Cestoda* furnishes the following characters :—

(1) Elongated flat worms with their cuticle and generally segmented body.
(2) Head may have hooks and suckers present.
(3) No mouth or alimentary canal; food being absorbed osmotically over the whole body-surface.
(4) Life-history of two phases :—
    (i) The cystic.
    (ii) The cestoid.
(5) No sense-organs.
(6) One or two longitudinally excretory vessels.
(7) Reproductive organs discontinuous from one proglottis to the other.
(8) Endo-parasitic.

Each joint, or proglottis, contains at first male genitalia; later on the female organs are developed, and ultimately self-fertilization takes place. Thus it is seen that the proglottides near the head, or scolex, contain testes. Next come the ones bearing testes and ovaries, and lastly appear segments bearing only fertilized ova, and thus bearing embryos.

A controversy has here arisen as to whether the Tapeworm is to be considered as a *colony*, and that each segment is a complete animal, or whether the whole number of segments is to be taken as a *single animal*. Steenstrup, and, following his suggestions, Leuckart, Von Siebold, Van Beneden, and others, came to the conclusion that a jointed Tapeworm is really a colony composed of two generations :—

(1) The head and neck being derived from the larva.
(2) The segments from the intercalated growth of the neck region thus constituting a second generation.

This colonial view was held from 1851–1880. Recent work has, however, shown that the Cestode, or Tapeworm, is more probably a monozoon.

Hatschek and Lang held the intermediate position.

Collection and Preservation.—The Tapeworms of birds are for the most part found in the alimentary canal (sometimes in the mesentery, having perforated the canal-wall). They are found in a fresh bird fixed to the wall of the canal by means of their suckers, or hooks, or both; the rest of the body, or the strobila, lies loosely in the lumen, and is *never very extended*, but generally contracted to a very short dimension, and always lies in the direction of the cloaca, due to the flow of excreta. The position occupied by these parasites in the alimentary canal is shown in the following tables, from which it will be seen that the greater number of parasites was obtained from the ileum or small intestine.

Method of Procedure.—The bird to be examined was laid on a dissecting board and the skin cut open from neck to cloaca, and deflected on each side so as to thus expose the pectoral muscles. The pectoral muscles were cut away, and the sternum completely removed.

By doing this the whole of the viscera is exposed *in sitû*. Next, the state of the viscera was commented upon in the following table, and any Tapeworms lying in the mesentery were collected :—

Number of Specimen.	Condition of Bird.	State of Viscera.	Number of Tapeworm.
—	Good.	Full.	—
—	Poor.	Putrid.	—
—	Poor.	Shrunken.	—
—	Fair.	Distended.	—

The whole of the alimentary canal was then taken out and pinned out on a wax table under water. Next the canal was laid open by means of a pair of scissors, and the contents examined. This was also done to the cæca (if present).

The large parasites were picked out, if loose, but if still adhering to the canal-wall they were allowed to remain for some ten minutes, when they release their hold and can then be bottled. The larger ones having been thus obtained, the fluid

contents of the alimentary system were poured into a large vessel, and a small quantity of a fixing agent * added; any small and transparent Tapeworms were by this means caused to become opaque and easily seen.

The Tapeworms obtained were allowed to wash in running water for about two or three hours, during which time they become extended to the full.

Fixing.—Next comes the fixing, which is performed by immersion of the worms in some fixing solution for a certain length of time. The fixing solution which acted best was the following:—Five per cent. corrosive sublimate, one per cent. acetic acid, ninety-four per cent. water.

The worms were allowed to remain in this fixing solution for about twenty minutes. Of course, in the case of the large ones more time was allowed.

Washing.—They were next transferred to running water to thoroughly wash out the fixing, a time generally extending over about twelve hours.

The next process was to pass the worms through varying grades of alcohol, commencing with sixty per cent. alcohol, then seventy per cent., next eighty per cent., finishing with ninety per cent. The time of immersion in each case being about twice the former; that is, four hours in sixty per cent. alcohol, and eight hours in seventy per cent., sixteen hours in eighty per cent. alcohol.

Staining.—From the ninety per cent. alcohol the worms were passed into some suitable staining solution. *Alcoholic borax-carmine* was found to be most suitable for staining *in toto*; *methyl green* was also used, but not so successfully. After being in the staining solution for about twenty-four hours, the specimens were toned down to the requisite depth of colour by immersion in sixty per cent. alcohol, to which nitric acid had been added—three drops of acid to one hundred cubic cms. of alcohol.

Dehydratin.—The stained Tapeworms were then again run through the varying strengths of alcohol, ending up with absolute alcohol to rid them of the water. From the absolute alcohol they were next transferred to xylol as a clearing agent. Oil of cloves was found to make them too brittle for mounting.

* Two per cent. corrosive sublimate in alcohol.

The specimens were then mounted in Canada balsam and labelled.

The following is a list of birds examined, showing the average number of ecto-parasites and endo-parasites per individual:—

Species of Bird.	Ecto-parasite per individual.	Endo-parasite per individual.
Starling (*Sturnus vulgaris*)	6·00	1·24
Blackbird (*Turdus merula*)	18·00	35·10
Rook (*Corvus frugilegus*)	160·40	—
Thrush (*Turdus musicus*)	12·70	15·00
Robin (*Erithacus rubecula*)	2·00	0·50
Cuckoo (*Cuculus canorus*)	—	1·00
Green Linnet (*Emberiza citrinella*)	—	—
Bullfinch (*Pyrrhula europæa*)	—	—
Sparrow (*Passer domesticus*)	—	—
Kestrel (*Falco tinnunculus*)	2 (hundreds of eggs)	—
Peregrine (*Falco peregrinus*)	eggs	—
Curlew (*Numenius arquata*)	120	49·50
Oystercatcher (*Hæmatopus ostralegus*)	20·30	4·20
Kittiwake (*Rissa tridactyla*)	9·00	—
Redshank (*Totanus calidris*)	—	—
Plover (*Ægialitis hiaticola*)	5·5	7·00
Woodpecker (*Dendrocopus minor*)	—	—
Tit (*Acredula caudata*)	—	—
Mudlark (*Anthus obscurus*)	2·50	1·20
Snipe (*Gallinago cœlestis*)	1·00	—
Chaffinch (*Fringilla cœlebs*)	—	—
Lesser Black-backed Gull (*Larus fuscus*)	—	2
Herring Gull (*L. argentatus*)	—	1
Tawny Owl (*Syrnium aluco*)	—	—

Twenty-four different species of birds were thus examined. The blanks are due to the fact that comparatively few birds of that species were examined, and therefore no data of any value could be obtained for the other columns.

From the above table, rough as it is, there seems to be a relation between the number of lice externally and the number of parasites internally, with the exception of the Rook and Hawks, in which no endo-parasites were found, probably due to the abundance of gastric fluid secreted, and which thus limits the possible number of endo-parasites to a very few, namely, those

which are very highly specialized in relation to the environment of very intensified gastric secretion.

N.B.—The number of endo-parasites seems to increase with the increase of ecto-parasites, which lends itself to the assumption that the lice may serve as *intermediate hosts* in most species of birds.

It is a well known fact that the greater number of lice are found on the head region, and especially near the mouth, which fact makes it conceivable that the parasite can easily find access into the alimentary canal of the final host (bird) from this possible intermediate host (lice), of which as yet so few have been discovered to the hosts.

The parasites found were Cestodes and Nematodes, and on examining the number of birds investigated, and the number of these parasites found, the proportion of Cestodes to Nematodes proved to be 4·4 Cestodes for every one Nematode; showing that 4·4 times more Cestodes were found than Nematodes. On the other hand, connecting the number with the numbers of birds infested, it was found that:—

Thirty-two per cent. birds infested by Cestodes.

Twenty-five per cent. birds infested by Nematodes.

The following is a table with a classification of parasites found in the different birds:—

Parasite.	Starling.	Thrush.	Blackbird.	L. M. Gull.	Curlew.
Dilepis undula	*	*	*		
Cheanotœnia parina (*?*)	*				
Monopylidium musculosum	*				
Anomatœnia constricta		*			
A. nymphœa					*

Family Hymenolepididæ (Raillet & Henry).

Family Diagnosis.

Tænioidea.

(1) Scolex with an armed rostellum or without.

(2) Hooks on rostellum, not hammer-shaped.

(3) Usually unarmed.
(4) A single, or, rarely, a double set of reproductive organs in each segment.
(5) Genital pores marginal and bilateral, unilateral, or regularly or irregularly alternate.

Subfamily Diphyllinæ.

(1) Rostellum armed or rarely absent.
(2) Suckers unarmed.
(3) A single set, or, rarely, a double set of reproductive organs in each segment.
(4) Uterus sac-like, simple or lobulated, or not persistent, breaking down into numerous egg-capsules, each containing one or several eggs.
(5) Pora-uterine organs not developed, adults in birds, mammals, and reptiles.

The diagnostic character of each genus will now be given also :—

Genus Dilepis (Weinland, 1858).

(From Cestodes of North American birds, by Ransom.)

Generic Diagnosis.

(1) The rostellum armed with a double crown of hooks, which possess long dorsal but short vertical root and a long blade.
(2) The inner longitudinal muscle layer consists of numerous bundles.
(3) Genital pores unilateral.
(4) Genital canals pass dorsal of the longitudinal excretory vessels and nerves.
(5) Vas deferens coiled.
(6) Seminal vesicæ not developed.
(7) Testicles in medullary portion of segment surrounding the female glands at the sides and behind, typically numerous (40–50), but may be reduced in number to 7.
(8) Uterus sac-like, with few or numerous out-pocketings.

Adults in birds and animals.

Family Hymenolepididæ, genus Monopylidium.

Generic Diagnosis.

Diphyllinæ.

(1) Rostellum armed with a double or single crown of hooks.
(2) A single set of reproductive organs in each segment.
(3) Genital pores irregularly alternate, rarely unilateral.
(4) Genital canals pass between the longitudinal excretory vessels and dorsal of the longitudinal nerve, or dorsal of both excretory vessels.
(5) Testicles numerous (20–40 or more) behind the female glands, or also lateral on both sides of the latter.
(6) Vas deferens coiled; seminal vesicle absent.
(7) Uterus breaks down into egg-capsules, each containing one or several eggs.

Adults in birds: Starling.

Family Hymenolepididæ, genus Anomatænia (Cohn).

Generic Diagnosis.

Diphyllinæ.

(1) Rostellum with double crown of hooks, with long dorsal and short neutral root and long blade.
(2) Genital pores irregularly alternate near the anterior margin.
(3) Genital canals pass between the longitudinal excretory vessels and dorsal of the nerve.
(4) Vas deferens coiled; seminal vesicle absent.
(5) Testicles numerous in posterior position of segment.
(6) Uterus sac-like.

Adults in birds and mammals: Thrush.

Type species:—(1) *Anomatænia constricta* in Thrush; (2) *A. nymphæa* in Curlew.

As will be seen from the above, the Starling is the bird which seems to be infested by the greatest variety of Cestodes.

The number of Cestodes collected was numerous, but the identification became very uncertain, due to the difficulty of making out the precise positions of the genital ducts and genital organs in general, owing to the fact that time did not permit of the microtoming of the segments, which in the majority of cases is essential for identification of the species.

Nematodes.—Of the Nematodes present the greater number by far belonged to the class *Acanthocephala* of the genus *Echinorhynchus.*

The *Echinorhynchus* larva is found in such intermediate hosts as the following:—(1) Amphipod (*Gammarus pulex*); (2) Isopod (*Ascellus aquaticus*); (3) Beetles, Flaps, &c.; (4) Grubs of Cockchafer.

Observation.

From this it is seen that the intermediate host is probably one of the insects contained in the diet of the bird.

The *Echinorhynchus* proportion to the other Nematodes found was 4–1; Round Worms to Thorn-headed Worms (*Acanthocephala*) as 1–4.

Acanthocephala.—This group embraces a small series of parasites which in general appearance resemble the Nematode Round Worms. They differ, however, essentially in possessing scolices covered with spines.

They are destitute of digestive organs. The species are entozoal in habit, abounding particularly in reptiles and fishes.

The part table (p. 53) serves to show the method of treatment in dissection, an attempt being made to show the contents of stomach and the condition of the bird. The following abbreviations are used:—V. G. C. = Very good condition; G. C. = Good condition; F. C.=Fair condition; P. C. = Poor condition.

Summary.

A few words here will not be out of place upon the importance of the relation of the diet of the bird to the bird itself. W. P. Pycraft, in his admirable little book on 'Bird Life,' has a chapter on the "Foods of Birds," in which he comments upon the following points.

The Wrybill Plover has its bill turned sharply to one side to enable it to pick out Crustacea from under the stones. This fact at once confines the Wrybill Plover to a diet of Crustacea for the greater part of its sustenance, and therefore whatever parasites the Wrybill may have will no doubt be connected and related to the diet of Crustacea.

The South American Hoatzin has made its crop do the work

of a gizzard. This hampers it in flight by the extra weight in front, and has even altered the shape of its breast-bone.

In the stomach of the Great Crested Grebe, which lives on fish, we never find stones or pebbles, but only feathers; why so no one has hitherto explained.

Tradition has it that the Snipe and Woodcock live by "suction," consequently they are cooked without the removal of the entrails.

These facts show what a vital relation exists between the food (therefore the method of feeding) and the structure of the bird.

In the same way a vital connection no doubt exists between the food and the parasite infesting the bird. Quoting Robert Newstead's records from the supplement to the 'Journal of the Board of Agriculture' of Dec. 9th, 1908, on the "Food of British Birds," it is seen that from his observations the insects chiefly found in the stomach contents, putting them in order of frequency, are:—

(1) Weevils (*Rhynchophora*).

(2) Dung Beetles (*Scarabæidæ*).

(3) Two-winged flies and their larva (Leather Jackets).

Then comes a scale of others which we will neglect. He ultimately comes to the conclusion that birds on the whole are beneficial to the interests of horticulture and agriculture. Each species of birds, he states, has its own particular diet.

These observations by so able an authority confirm the fact that the probability of finding the solution to the occurrence of particular parasites in particular species of birds lies in the particular diet characteristic of that species.

Further Observations.

Occurrence of Extra Cæca in Birds Examined.—An examination of the table shows the presence of extra cæca in birds examined. The cæca, in most cases, were granular in composition, and the lumen was very small. They varied from $\frac{1}{4}$-inch to $\frac{3}{4}$-inch in length, and generally occurred about nine inches above the ordinary cæca. Most of the Mudlarks* showed extra cæca.

* Local name for Rock-Pipit (*Anthus obscurus*).

Abnormalities. — The abnormalities observed among the number of Tapeworms collected were few. The chief diversions from the normal type were :—(1) Interpolated segments; (2) Perforated segments; (3) Irregularity of the genital organs.

(1) *Interpolated Segments.*—Here the extra segments were triangular in shape and wedged in between two normal segments. No genital organs occurred in these interpolated segments.

(2) *Perforated Segments.*—Three cases of this abnormality were observed. The perforation was clean and not jagged, and showed for about three segments.

(3) *Irregularity of Genital Organs.*—In a Cestode from the Plover some of the segments showed the genital openings to be irregularly disposed, instead of unilateral.

In conclusion, it may be stated that several of the parasites, about fifty, were permanently stained, mounted, and duly labelled.

Bibliography.

(1) 'Encyclopædia Britannica.'

(2) 'Catalogue of Entozoa, 1853, of the British Museum.'

(3) 'The Journal, Board of Agriculture.' "The Food of British Birds," by Newstead.

(4) 'Wild Birds Useful and Injurious,' by Archibald.

(5) 'Tæniod Cestodes of North American Birds,' by Ransom. 1909.

(6) 'Parasites. Entozoa,' by Cobbold.

(7) 'Agricultural Zoology,' by Theobald.

(8) Cambridge Natural History, 'Protozoa.'

(9) ,, ,, ,, 'Worms.'

(10) 'Lancet,' 1883–7, 1877, 1868.

Bird.	Locality.	Month.	Food in Stomach.	Ecto-parasite.	Position.	Endo-parasite.	Parasites. Position in Alimentary Canal.				
							Œsoph.	Duodo.	Ileum.	Cæca.	Rectum.
Starling (male).	Llanfair-fechan.	March		Mallo-phaga.	General.	1 Nema-tode.	—	In distal por-tion.	None.	None.	None.
Starling (male). G. C.	Bangor.	,,	Small shells 5; larvæ and shells; very little herbage.	Mallo-phaga.	Head.	4 Nema-todes.	—	One, largest.	Three.	—	—
Starling (male). G. C.	Bangor.	,,	2 grs. oats; No. of hairs; 4 white bodies; 1 larva.	—	—	—	—	—	—	—	—
Starling (female). P. C.	Bangor.	,,	1 beetle; 3 larvæ and shells; large piece of bone.	—	—	—	—	—	—	—	—
Starling (male). G. C.	Bangor.	,,	Numerous beetles; 1 larva and shell; grit.	Mallo-phaga.	General.	—	—	Contained cyst on outside.	—	—	—
Starling (female). P. G.	Bangor.	,,	Fat undigested.	—	—	—	—	—	—	—	—
Starling (female). F. G.	Bangor.	,,	5 large beetles and 1 small one; 2 larvæ and shells; spider; 2 small larvæ; 1 large caterpillar.	—	—	—	—	—	—	—	—
Starling (female). G. C.	Llanfair-fechan.	,,	Scale leaves very plentiful, mostly vegetable.	Mallo-phaga.	Head.	—	—	—	—	—	—
Blackbird (fem.). G. C.	Llanfair-fechan.	,,	General.	—	—	2 Acantho-cephala; 5 Tapeworms	—	—	—	—	—
2 fowls (female).	Bangor.	,,	—	—	—	50–60 Round Worms.	—	—	—	—	—
Rook (male). G. C.	Llanfair-fechan.	,,	Beetles; no scales; vege-table.	Numer-ous.	General.	—	—	—	—	—	—
Thrush (male). V. G. C.	Llanfair-fechan.	March 13	Vegetable, &c.	—	—	—	—	2 Cestodes.	10 Tape-worms.	—	2 Tape-worms.

COROPHIUM LONGICORNE: AN ORNITHOLOGICAL STUDY OF A CRUSTACEAN.

By F. J. Stubbs.

During the summer of 1913 I spent some weeks as the guest of Mr. J. Franklin Kershaw at his house on the Kent Estuary, in Westmorland; and, as the garden where we spent much of our time reaches down to the tide-mark, I was able to make a long series of connected observations on the animal life of the sands. Besides the wide areas of vegetated *salt-marsh*, there is a great stretch of level sand which is covered by the sea only during the highest tides once a fortnight; and in each intervening fourteen days there is a period of over a week when the shore is never covered and remains quite dry.

For my present purpose I took an area of one square mile of sand lying between Arnside and Sandside. The sand here is somewhat muddy, and, between the tides, unusually firm and smooth of surface. A motor cycle (as I noticed one day) leaves a mark no more than an eighth of an inch deep; yet, when I held an ordinary garden spade upright on the dry sand at the edge of a pool, and rocked the handle gently from side to side without applying any downward pressure, the implement in less than a couple of minutes sank so deeply that it could not be withdrawn by a direct pull. These remarkable quicksands, which occur on many parts of this coast, sometimes collapse beneath one's feet in an alarming manner, although a moment before the surface had been hard, dry, and apparently solid.

This square mile of firm level sand in front of the house—and I exclude now the salt-marsh, the permanent pools, and the regular channel of the river—supports a wonderfully simple invertebrate fauna and practically no plants. Once or twice I noticed a faint green tinge over a few square inches of sand, possibly due to the alga *Halosphæra*; and, very rarely, a few fronds of *Fucus* were left behind by the tides. The molluscs

Tellina and *Hydrobia*, abundant lower down the estuary, were here very scarce; and the only worm was *Nereis dumerilii*, which existed in very scanty numbers in burrows half a yard deep, and was apparently absent from large parts of the ground. *Arenicola*, although abundant in Morecambe Bay, and at the mouth of the estuary, did not occur on the area I examined at Sandside.

The dominant animal was the Amphipod crustacean, *Corophium longicorne*; so far as I know, there was no part of the shore free from this organism. It burrows in the sandy mud, making U-shaped passages about two inches in depth, and throwing small castings on the surface. In an aquarium these castings take the form of fairly stable tubes projecting for half an inch or so above the sand, but in the moving waters out of doors, or on the exposed surfaces, the material is merely piled up at the mouth of the burrow. The castings indicate the presence of the animals; and, as I have said, this square mile of sand was dotted with them. Their number varied, but I did not take the trouble to count the castings; I did, however, make many counts of the numbers of crustaceans present in different square inches of sand, never seeing less than fourteen, nor more than thirty-five. Near Humphrey Head, on the Lancashire coast, the animal is unevenly distributed, being absent from the pure sand, and abundant in the muddier gutters; and in these I found that a single square inch of sand contained over fifty crustaceans in various stages of development. In September Mr. A. Rodgers, examining the shore at Silverdale for me, found them quite absent from the great stretches of the comparatively pure sand.

For the present investigation round numbers will be quite sufficient, and we can take twenty as the number of crustaceans inhabiting each square inch of the shore at Sandside. Eleven animals of various sizes picked at random and drained on blotting-paper weighed altogether exactly two grains, and this gives us a total of over seven hundred tons of these crustaceans for the square mile. The preponderance of *Corophium* over all other forms of visible invertebrate life enables us to dismiss the molluscs and worms, and the resulting simplicity allows us to consider the subject from an interesting point of view.

The burrows I examined never reached a greater depth than two inches, and most of them were little more than an inch. I

know nothing relating to their enemies when the water covered the sands, but clearly during the dry week of each fortnight they could only be preyed upon by birds; and my observations were directed towards the latter creatures. Here was a matter of seven hundred tons of food lying a couple of inches beneath the surface, and, one would think, open to the attacks of many shore birds. From July 23rd to August 18th, with one or two slight breaks, I was either on the sands or within sight or earshot of them at all states of the tide, and all parts of the day; the keen eyes of my wife and of my host were also pressed into these studies. The results are interesting chiefly from their negative character.

The actual channel was comparatively rich in life—Shrimps (*Mysis* sp.), immature Herring, Sprats, Spotted Gobies, Flounders, Sea Trout, and Sand Eels. From the refuse thrown up by the nets of the salmon fishers I took a Smelt and many of the curious *Aphya minuta*, our smallest vertebrate. These no doubt were the attraction for a flock of about a score of Arctic Terns (*Sterna macrura*) and one Little Tern (*S. minuta*) that appeared on August 8th. A heronry two miles away was seldom represented on my area, and I never here saw a bird fishing. Curlews were noisy and moving all the time, but as they confined themselves to the tidal pools which I knew to be full of young Flounders, Gobies, Shrimps, &c., and as I never actually saw them working the uncovered sands, I will omit these also. Twice in July I observed parties of eight or ten Dunlins (*Tringa alpina*)—in full breeding plumage, and perhaps belonging to the large race—feeding on *Corophium*; on both occasions they were accompanied by a pair of Ring Plovers (*Ægialitis hiaticola*). The Common Sandpiper (*Totanus hypoleucus*) kept strictly to the water's edge, as did the few Redshanks (*T. calidris*) that were about up to the first days of August. The Green Sandpiper (*T. ochropus*) did not appear until the 18th, when I saw one in a gutter on the marsh. The Lapwing (*Vanellus vulgaris*) was constantly present at the edges of the richer pools, and a small number—not more than thirty—were generally to be seen about the wetter portions of the newly uncovered sands. Possibly these were feeding on *Corophium*, but this is doubtful; in one instance the small shell *Hydrobia ulvæ* was the attraction.

The only other wader coming to my notice was the Oystercatcher (*Hæmatopus ostralegus*), a common bird in this part of England. On August 14th a flock that I estimated to contain six hundred birds came up the river, and we saw two other large bodies join the first one. Altogether there must have been not less than a thousand birds—more, one thought, than could have been hatched in the whole of England. After performing a number of striking aerial evolutions they vanished over Morecambe Bay, and we saw them no more. The regular "garrison" of my square mile consisted of about eight Oystercatchers. These were very tame, coming to within a few feet of the garden, and sometimes I saw one prod the dry sand with its bill, obviously in search of *Corophium*; but after perhaps a score of thrusts the bird would return to the pool. The marks of the bill on the level surface were visible from a distance of many yards.

From my observations I conclude that in Westmorland at least this particular crustacean is quite well protected from waders. *Corophium* is described by Quatrefages as a migrant on the coast of France, appearing in swarms in April, and vanishing suddenly in October—in a single night, he states. On November 7th Mr. Kershaw wrote from Sandside :—"*Corophium* now very scarce, and I dug in a dozen places before finding any. Towards the mouth of the estuary they seem commoner. Some of the burrows now go down for five or six inches"; and in December they were still present in small numbers. For the present I would suggest not migration but hybernation, either by means of eggs or fertile females, and a seasonal summer abundance, as in the case of so many invertebrates. But clearly there is much to be learnt about the species. Indeed, in Spence Bates's work on the 'Amphipoda' (p. 281), the author cannot even be certain that *Corophium* makes its own burrows. I can decide this, for those I kept in an aquarium burrowed at once, and in due course formed the tubular prolongations of the mouths of the galleries which I have already described. A number of crustaceans were dissected, and cleared for microscopical examination, but without any success in ascertaining their food.

As the summer advanced, ducks in increasing numbers used the sands as a diurnal resting place. The majority were Mallard

(*Anas boscas*), but I saw one lot of Teal (*Nettion crecca*), and recognized several Shovelers (*Spatula clypeata*). By the way, the latter bird is far more of a salt-water duck than is generally supposed. I have observed it both on the Lancashire and the Scottish coasts, and on three occasions I have found the stomachs (including that of an Irish specimen) full of the shells of *Hydrobia*. I saw none of the above three ducks under circumstances which suggested that they were interested in *Corophium*. The Shelducks (*Tadorna cornuta*) came up each day with the tides, and worked the shallow pools in a half-hearted manner; and as these waters held nothing except the crustaceans, I must include the bird as an enemy, but almost a negligible one, of *Corophium*.

A mile or so distant from the area under observation there is an important breeding place of the Lesser Black-backed Gull (*Larus fuscus*), and throughout the spring and summer the sands are crowded by the birds. But I never saw one of these Gulls attempt to disturb the crustaceans, and do not hesitate to say that *Corophium* is not a regular item of food for the species. Out in Morecambe Bay the Kittiwake (*Rissa tridactyla*) and the Herring Gull (*Larus argentatus*) were numerous, and I saw a single Common Gull (*L. canus*) inland near Kendal on August 9th; none, however, was noticed at Sandside during my stay, and the only other Gull besides the Black-back was the ubiquitous Black-headed Gull (*L. ridibundus*). On my arrival I found a few young and adults settled on the sands, and when the Black-backed Gulls vanished (August 1st–5th), there was a great influx of Black-heads, and these commenced immediately to prey upon the crustaceans, and confined themselves to this diet. It is quite possible that the Black-backs from the great Foulshaw gullery move *northwards* in August, for, at the end of that month, in 1910, I noted the species as the commonest Gull amongst the lakes; and in a flying visit at the beginning of August few were to be seen.

At this point we may stop to consider that on this square mile of sand, and within two inches of the surface, there are seven hundred tons of animal food untouched by terrestrial vertebrates, and brought within reach of aquatic organisms for but a very short period each fortnight. The birds which visited

the estuary, with one or two negligible exceptions, made no attempt to reach the crustaceans; the faithful surface of the sand recorded every disturbance of the burrows; and although it was natural to think that a restless party of birds were actually feeding, a subsequent examination of the spot, or careful observation through our glasses, proved that the *Corophium* burrows were not disturbed.

The Black-headed Gulls, although feeding exclusively on *Corophium* for many days, were powerless to reach the crustaceans inhabiting the uncovered sands. They could catch only those living in sand covered by water, and if the water was more than three inches deep they were again powerless. Each pool, however, shrank visibly from day to day, until the water vanished completely; and thus each day brought a smaller ring of new ground within reach of the birds. The method employed in feeding, although often observed, and described in several northern journals, seems to have escaped wider notice in the regular literature of ornithology.

The Gull stands in the water, and, holding its body horizontally, *dances* vigorously with alternate steps for a minute or more, but with no change of position. This action on the sand, possibly by filling up the burrows, alarms the crustaceans, which rise to the water and scatter in flight. As soon as they appear the bird stops its dance for a second or so, and, still remaining precisely in the same spot, snaps in the water at the swimming animals. On imitating the action with the tips of my fingers, and of course with the same result, I found that the crustaceans were readily detected by the sense of touch as they struggled to the water; and this suggested the possibility of the webs of the Gull's toes being used as tactile organs. The point is well worth consideration, for if established it would explain the presence of highly developed webs in birds which are addicted to wading but rarely use their feet in swimming.

Sometimes a Gull would remain in one spot for so long a period as half an hour, gravely and patiently dancing the whole of the time. The result would be a crater-like depression six inches in diameter and an inch deep; but, if the birds were not disturbed, they would move gradually *backwards*, and in the course of a few hours make shallow furrows varying in length

from a foot to twelve yards. One furrow that I measured was exactly twelve yards long, and had occupied its maker for at least three hours, and possibly twice this time. Now, allowing the width of the disturbed sand to be six inches (really this is the distance between the summits of the ridges thrown up on each side of the furrow), and the number of crustaceans twenty to the square inch, we find the total weight to be about a pound and a half. The greater part of this would go down the throat of the bird, for I do not think that many of the crustaceans are allowed to escape once they are driven from their burrows.

As the pools diminish in size these curious markings are left on the bare sand, sometimes in great numbers where the Gulls have been congregated. I do not know if anyone has ever noticed these very conspicuous furrows, but I should expect them to present rather a stiff problem for an enquiring mind who did not think of the agency of birds. I ought to add here that I have often observed this very extraordinary dancing habit of Gulls on other estuaries, but I think it safest to say that I have no note of the actual species, nor of the food sought. Possibly the Black-headed Gull may prove to be the only species addicted to the habit, for I have seen it so employed while in the immediate company of other Gulls that stood by and looked rather hard-up for a meal. On the estuaries of the Conway and of the Clwyd I have sat and watched the Gulls dancing in the mud on very many occasions.

In the summer of 1912 a tiny sandy bay on the north coast of Yorkshire was swarming with Sandhoppers (*Talitrus locusta*),* and each evening a flock of a hundred Black-headed Gulls, accompanied by either two or three immature Kittiwakes, patrolled the sands, snapping up these agile crustaceans. Each bird marched steadfastly forwards, and picked at any hopper that *happened to be in the air within a couple of inches of its beak at the moment the bird had disposed of the last one captured.* The resulting gait was indescribably ludicrous to watch, for it resembled a violent form of palsy as the accompaniment of a

* Possibly this is the species that crammed the stomach of a Cuckoo (*C. canorus*) shot by Dr. Stejneger on the coast of Kamtschatka. He called them "the *Gammaridæ* which abound on sandy beaches."

preternaturally grave and decorous walk. Thus the whole flock marched on, each head bobbing with clock-like regularity, and in apparent aimlessness; but probably most of the snatches were successful, although of course we were too far distant to detect the actual insects. When it was too dark to read we could still see the Gulls working as freely as ever, and could not but admire the perfection of eye and beak that made this business possible.

On our Westmorland estuary we found the young birds of the year, fresh no doubt from the great Ravenglass gullery, as assiduous as their elders in the remunerative dance. At night, when it was too dark to see them, we could plainly hear the measured splashing from the tireless birds; and in what way are we to understand how they were enabled to see the crustaceans through a couple of inches of disturbed water? Bad enough in the daytime, it is either worse at night or—the Gull has a sense of sight of a quality unknown to us, and with powers that merit a position as a sixth sense. There are many published records of the Black-headed Gull catching insects in flight, and it has been observed that regular aerial feeding excursions are made after dark.*

The fauna of the more or less permanent tide-pools was too complicated for exact observations, but the shallower pools could be surveyed with great convenience, and I was able to convince myself that, exclusive of microscopical organisms, they were inhabited only by *Corophium*. Gulls, therefore, which were seen at these places could be feeding only on this crustacean, and on nothing else.

I would like again to draw attention to the fact that birds of the year were using this curious "dancing" method of obtaining food in July. Is it instinctive? If not, and if they were merely following the example of their elders, why did not the Kittiwakes off Grange copy their companions? Do other birds, in other localities, feed on *Corophium* or similar sand or mud inhabitants in a similar manner? Do the Gulls tread out other inverte-

* Perhaps here I can repeat a note (*cf.* 'Naturalist,' 1908, p. 456) of my own on a Buffon's Skua, the stomach of which contained the remains of Craneflies and a species of Syrphid, the last recognized by the characteristic "false-vein" of the wings.

brates besides *Corophium*? These matters may be worth the attention of ornithologists.

P.S.—Writing on January 28th Mr. Kershaw says:—"I have not seen more than three Gulls on the sands for weeks. They are Black-heads, and the black feathers are beginning to come. One is the bird I mentioned before—it trails one wing, but seems to fly all right. . . . Yesterday I marked out two areas of sand, four inches square each, one on the edge of the solid sand near the high-water mark, and the other farther out. I dug down for about six inches (although none of the burrows went down farther than three inches), carried the sand indoors, and passed it carefully through a muslin sieve. There were forty-six *Corophium* Shrimps, three Worms (*Nereis*), and a few (*Tellina*) shells about an eighth of an inch long. . . . I have not seen any Gulls 'dancing' lately."

According to these observations the crustaceans are fourteen times more abundant in July than they are in January; and, clearly, their disappearance cannot be put down to migration. Ornithologists are only too well aware of cases where the phenomena of migration have been explained by a theory of hybernation, but I cannot recollect an instance like the present case of *Corophium*, where *migration* has been suggested, when hybernation appears to be the fact.

A DIARY OF ORNITHOLOGICAL OBSERVATION MADE IN ICELAND DURING JUNE AND JULY, 1912.

By Edmund Selous.

(Continued from vol. xvii., p. 422.)

June 17th.—The quest of the Falcons having failed, and Sigurdsson having told me that a small river which ran into a lake near the one where I had watched the pair of Great Northern Divers, was the haunt of the Horned or Slavonian Grebe, we returned to-day, and pitched the tent upon the crest of a low hill, overlooking both the one and the other. The river, in its general course, was a mere stony burn amongst low hills, but, upon coming out from amongst these into the flat, marshy land at their bases, formed a small creek running parallel with the lake, for some way, before curling round the hill I have spoken of, to join it. In England there might have been both Moorhens and Dabchicks here. The water was weedy, and flags grew in patches, here and there, along the green, marshy banks, but so thinly as not to conceal, except at some distance, either the bird or the nest. There were two of the latter, the probable owners of which disappeared at our approach, but I was in time to see one pair, whose Dabchick-like character I recognized at once, through their superior plumage, engaged in the performance of what was probably a courting action, though it may be more developed earlier in the season. The two birds fronted each other, then rose, both together, Penguin-like, in the water, and, after a moment or two, sank down upon it again.* I was now left alone, with the tent, but as this had been designedly pitched so as to be invisible from that part of the stream which I intended to watch, I soon left it and sought out a place of espial

* The Great Crested Grebes do the same (though I have seen them do more), as also the Red-throated Divers.

on the slope of the hill, right overlooking one of the nests, and near enough to it to give a capital view with the glasses.

This was about 9 p.m., and, for some forty minutes, there was only the pleasure of expectation, which, however, with anything like certainty at the end of it, is a sufficiently keen one. Then a pair of the Grebes swam up the stream from the lake, in a very purposeful way, without any stopping. They entered the clump of rushes, and, making directly for the nest, the female sprang up and lay all along it, just as the Great Crested Grebes that I watched in Suffolk used to do, as a preliminary to coition. The male now came up to the nest, and remained by it, for a few minutes, then turned and continued to swim up the stream, and the female, after remaining in the same attitude, for a few moments, with a quick motion, raised herself and slid off into the water. I assume, from her actions, that she had ascended the nest with the special object alluded to, though the male, for some reason—just as was so often the case with the last-mentioned species—failed to respond to the invitation. Some little time afterwards, the birds came again, and exactly the same thing took place. The attitude of the female, with the head and neck laid all along on the flat platform of the nest, was unmistakable, as, for a moment or two, the intent of the male was also, for he was, again, half-hearted, and did not come up on the nest. Twice after this the pair swam up again, but the nest itself was now the matter of interest. They dived twice or thrice, close about it, and after each time the female jumped up on to it, and moved and arranged its materials with her bill. That she brought something to it, each time, from the bottom seems likely in itself, but I could not observe that she did, and as a considerable part of the nest must lie below the surface of the water, she may have been paying attention to this. Neither could I observe that the male brought up anything and added it to the structure. This probably means that he did not, nor did he ascend the nest, but there can be no doubt that he, too, was interested in it. Another time the female came to the nest alone, jumped up on it and remained there a few minutes before leaving it again.

These Grebes uttered various sounds when visiting the nest, both as they swam up the stream, and when in its near neigh-

bourhood, but not when actually by it. One of the notes was a sort of soft chuckling cackle, and there were various other ones very suggestive of satisfaction, which I cannot recall sufficiently to set down. Another note often uttered, but not, I think, by one of the pair in question, was a sort of mewing sound, followed by a deep guttural one. Altogether there was a great variety of utterance.

June 18th.—It was a little past 6 a.m. when I first looked at my watch, and, about an hour afterwards, I saw the pair of Grebes swimming up the stream in the same purposeful manner as yesterday, and also the last thing overnight, as I was getting my bed ready—at a quarter to one, namely. I was now dressed, and creeping down to my place of observation, behind some low rocks on the hillside, was so lucky as to see both birds, together, upon the nest, the female lying along it in the manner described, and the male a little raised on his feet just behind her. The next moment he stood upright, or nearly so, and coition was effected. During its continuance, both birds constantly uttered a short, sharp note, which was shriller, I think, in the male than the female—at any rate, both were not alike. After coition, the birds came down, off the nest, and, for a short time, kept quiet amongst the flags. They then came out upon the open water, where, in a little pool-like bend of the stream, they floated at ease, together, and seemed full of content and satisfaction. Sometimes they dozed or went to sleep, and I noticed that their sleeping attitude was not the general one of birds. They drew back the head, indeed, but without turning it round, and pressed the beak into the feathers of the throat or upper breast, instead of hiding it amongst those of the back and shoulders. The head itself, however, was thus brought right into the middle of the back, and looked like nothing so much as the little knob on the top of a pork pie. In this attitude they seemed to be really asleep, for the brilliant, light ruby-red eye was invisible through the glasses, though quite plainly seen at other times. After awhile, one of them began to dive for food, and, though the water was not clear, I could each time see it go down for some way, and the body always presented a smooth, oval outline, showing that the wings were not used under the water, as they are by various diving birds. The legs were always

visible whilst the bird was, and once I clearly saw them in action. The dive was always in the Shag or Cormorant style—a leap up, and then down, that is to say—but not with the same verve and energy, nor would it be expected of these soft and rounded little creatures, slightly enlarged and much glorified Dabchicks. So far as I was able to observe, I believe it was weed this bird was feeding on—at any rate, I never saw it with a fish in its bill. When the one bird had fed and the other rested sufficiently, both swam together down the stream in the same intent, business-like manner in which they had ascended it, and I thought they were going out into the lake. But they soon stopped, came back again, and again preened and idled on the water. It was now that I twice saw them go through the same courting action which I have before described, the only difference being that it was a little less pronounced. They did not, perhaps, stand quite so bolt upright in the water, at any rate they had a little stoop forward, and subsided, again, almost immediately—it was more perfunctory in fact. Two or three times, also, when thus in each other's company, they both, as on a common impulse, swam up closer together, and then, fronting one another, with beak turned to beak, but not now touching, and without rearing themselves up, made a curious little twittering cry, thus presenting exactly the same little scene of reunion and mutual expression of gladness as I have so often seen pass between the male and female Dabchick. The note, however, was not nearly so shrill, nor did it rise in intensity, as with the latter, so that the performance was not quite such a striking one. Also, like Dabchicks, these beautiful little Grebes would, sometimes, whilst swimming —generally when in full swim, so to say—make a little pause and, almost instantaneously, a little, gentle rise of an inch or so out of the water (too soft to call a jump), just showing the silky white of their breasts before sinking down again, and swimming on. So like Dabchicks are they, indeed, that I believe, with the exception of the notes, which are not the same, and of which they seem to have a greater variety, an accurate description of the habits and actions of the one species would be equally accurate for the other. This, however, may to a large—perhaps to an equally full—extent be said, substituting the Great Crested Grebe for the Dabchick. Unless for some special

development which has not yet been recorded, it seems probable indeed that all the members of the family have the same habits.

After a short interval, filled up in these various ways, this pair of Grebes swam down the stream, but at a certain bend of it, in which was the next defined patch of rushes, the male of another pair that had made these their headquarters made a little bull-like rush out from them at the intruding male, as he chose to consider him, holding his head down on the water, and advanced like the ram of a battleship. The latter was put to flight—actual flight for a little—for some way down the stream, and then went on into the lake. The female was not interfered with, nor yet when sometime afterwards she approached a narrow, fringing belt along the shore, opposite the larger one. She then swam back, up the stream, into her own home-waters, where I lost sight of her, for after keeping, a little, in the neighbourhood of the nest, she left it, and went on. Some time after this—about 10 a.m., to be precise—I saw the male of the other pair of Grebes swim from his clump of rushes to the opposite side of the stream, and there, just off the shore, take up some weed or other material in his beak, and return with it to the nest. This he did several times, at short intervals, sometimes diving, but, as it seemed to me, more as on his way to one bank or the other than to get weeds from the bottom. This he may sometimes have done, however, though, if so, they can have been but small pieces, but, as a rule, he either took weeds from the surface, or pulled the growing flags. I kept expecting the female to come and share in the work, and more eagerly, but I only thought I saw her do so once, and now doubt if I did at all. I saw, however, both birds mount the nest, in succession, and then one of them again, at short intervals. Since I had been given to understand that there were no eggs, yet, in any of the nests of these Grebes, this only suggested to me that the birds were still building, and kept getting on to the nest, to arrange the materials they were bringing to it, especially as I thought I once saw the female doing so. Nevertheless remembering my experience with the Great Crested Grebe when in Suffolk, I determined to try a long and difficult stalk down the side of the hill on which I was, and over a considerable stretch of flat, tussocky grassland, to the bank of the stream itself, if possible, in order to watch the birds

more closely. This I succeeded in doing, part of the way on my back and the rest crawling flat, till I was at last so close that I not only saw the vividly bright ruby-red iris of the bird's eye, as it sat on the nest—which I at first thought a spot of red plumage—but the small light pupil in the centre, of a green-grey or yellowish colour. It was the female, not however occupied in building the nest, but merely stationary upon it, but it was not till I had got nearer still—perhaps within twenty feet—that I was able properly to distinguish the structure of the nest, amidst the rushes. I lay enjoying this close view, for some time, when I heard a very soft note, quickly repeated, something like "croo, croo, croo, croo, croo," which, though it got nearer, seemed hardly to get louder, till, at last, the male came stealing through the rushes, to the side of the nest, and, his partner coming off it into the water, he sprang up, and took her place. After a time, which, in my constrained position, seemed long enough, there was another change, but when the male, now relieved in his turn, began swimming up the stream, he must, I suppose, have caught a sight of me, or of something to make him suspicious, for, as far as I could hear only (I dared not now raise my head), he flew, for a little, along the water. Still the female kept her place, but, some time afterwards there was a sudden loud utterance of the curious mewing note I have before mentioned—a loud mew, in fact—upon which she showed instant anxiety, and quietly dropped off the nest. The male, however, in spite of his sudden alarm-note—for it must surely have been his—and previous flurry, came on to the nest again, but the female was now in a state of suspicion, to which her own observations kept adding, so, seeing that things would not continue longer in their natural course, if I remained where I was, I crawled away over the flat and up the hill again, to a point on the summit, from which I could still see the nest, with the sitting male. It was now, of course, perfectly evident that, in spite of the continued bringing of weed to the nest, incubation had begun with these Grebes, and also that both sexes shared in it. The subsequent intervals, whilst I watched, at which the pair relieved one another, were as follows. At about 12.30 p.m., the female, who had waited about, anxiously, to do so, and whose fears were now dissipated, took her place on the eggs. At 1, the male

returned, and relieved her. At 1.30 the female again took her turn. About five minutes before 2, the male reappears, and, in a minute or two, I see him leap up on the nest. I miss seeing the female come off, but she was on it up to a little before. In about a quarter of an hour, she returns, but keeps to the stream, and the male leaves the nest, to join her. For a few minutes, they swim about together, at one time, very cosily, side by side and almost touching. Then the female goes on, and the male brings some more material to the nest, for which he once dives. He then swims some way down the stream, but very soon comes back, and, at 2.25, the female leaves the nest, and rejoins him. They swim a little together, again, going down stream, but, very soon, the male returns, and, at 2.32, takes his place again. I fancy that in the interval between then and 4 p.m., when I went to my tent for breakfast, he must once more have given up his place, and afterwards retaken it. Of this, however, I cannot be sure, and he had certainly sat unrelieved for a considerable time before I left—comparatively, that is to say, for the quick intervals at which the two have relieved each other upon the nest is here the salient feature, and may be peculiar to this Grebe, since I have not observed it either in the Dabchick or Great Crested one.

There is no doubt as to the great beauty of this species. The rich russet chestnut of its sides, contrasting with the glossy slate-blue of the back, its neck russet also, the plum-bloomy ruff, the jewel-like eye and beautiful, almost golden, tufts of plumage on the cheeks—all this, with the silky and silvery white of the under surface which, when it rises on the water, is still its loveliest adornment, makes it one of the gorgeous-plumaged birds of the world, much more in keeping with a tropical landscape than with these cold and colourless regions. There, perhaps, it might purchase security by the fiery blending and salient inconspicuousness of its hues, but here it is as badly off for plum-trees or orange-trees as is the Tiger for bamboos, over the greater part of its range. It swims over waters that are grey, and by shores that neither in themselves nor through their reflections at all resemble its own plumage; and it makes its large brown nest amidst thinly-growing, green flags, and sits there with its head, like a small sun, shining above it, a ruby

set in each side the sun. Still, it must not be forgotten that there is the bird's own reflection in the water, with which, when sufficiently emphasized, it must harmonize to perfection. Here, then, at least, is one quite satisfactory background. I cannot myself think of another, but, should it still be thought necessary, there is no doubt one might be designed.

Still, with every assistance, and for all that has been said, these Grebes, as examples of assimilative colouring, seem to me to stand in a very different category to such a bird, for instance, as the Golden Plover. Whilst on the way here from the homestead, a nest of one of these birds was located, and marked for me with a few turfs by Sigurdsson and, for some time now, I have watched the female as she sits with almost the whole of her body exposed, yet the mottled and nondescript markings of the back and breast seem to fade into the general coloration of the whole of the surrounding landscape, which is a wide expanse of brown earth, tawny grasses, and grey moss, in the unsalient interblending of which her own comparative insaliency is hardly to be distinguished at a moderate range, through the glasses. The general tone and colour-wash here seem designed for the eye to rest on, without being caught or detained, but this does not apply so well to the deep black of the throat, breast, and abdomen (speaking of the male more particularly) which show when the bird walks about. This, being the nuptial garb, has probably been gained through sexual selection, as, indeed, the golden back also, though in the latter there is far more reconcilement between two not necessarily opposed principles; for why should not sexual selection sometimes have operated under the control of the larger power, Natural Selection, which would, in this case, have fixed the kind and the limit of the adornment? Indeed, in a wide way, this must always be so, for directly the advantages gained by the race, owing to special attractiveness being acquired by the one sex in the eyes of the other, began to be overpowered through the greater destruction due to its consequent enhanced conspicuousness, this process would be checked, and a compromise between it and the other effected.* With the Golden Plover, in

* Of course all is really Natural Selection, and the seeming opposition merely a fluctuation in the manner of its action.

the breeding-season, the compromise appears to have been this, that it has been permitted to look conspicuous enough, whilst walking about, but not in the same degree, whilst incubating, since here the black parts, being undermost, are hidden, or partially hidden, whilst the mottled back, though more beautiful, is, notwithstanding, more assimilative. Partially hidden, I have had to say. The case, I confess, would show better if no such qualification were needed, but the particular bird which I have now for some two hours been watching, and which I believe to be the female, has sat all the while remarkably erect upon the nest. *En revanche*, however, she has also sat very motionless—I am hardly sure if I have seen her move once.

All over the country now, wherever these birds are at all (and they are widely distributed) one sees them and hears their plaintive pipe, and the conduct of any one of them that one approaches is generally in relation to the nest on which its partner is sitting. For instance, as I got up to the nest which I am now watching, the male of the pair was standing within a few feet of it, and as I advanced he moved away at but a short distance in front of me, showing an evident but yet moderate and well-governed degree of anxiety. Wishing to see how things would go, I followed him, and he kept for a long way at the same measured distance in front of me, stopping when I did, piping, as it were, conventionally, in fact, with professional adroitness, leading me away from the nest—for such certainly seemed to be his idea. Go where I would, I could not get rid of this bird. When I had walked to a distance away from the nest which I thought might certainly have satisfied him, he still kept about me, coming down, sometimes here, sometimes there, but never far away from me, and sometimes quite close. After some time I walked diagonally to another point, from which I could better watch the nest, nearer, indeed, but still at such a distance as, to a being with no knowledge of binoculars, might well have seemed perfectly safe. Now, for a little while, I thought he was gone, but, all at once, he was close at hand again, with his eye, as before, fixed professionally upon me, as though he had no idea of letting me get away. In fact, he watched and sentinelled me, nor was it ever possible to attribute his actions to causes irrelevant to myself—it was plain to the extremity of

plainness that they were in absolute *rapport* with my own. I sat in the place I had chosen for a long time—half an hour at least, or an hour—and began to think that I should never see the return of the female to the nest—for I had startled her off it in the first instance—when, all at once, my eye happened to catch her standing there, and putting up the glasses I saw her make the series of little advances, with short pauses between, which ground-laying birds are accustomed to do when returning to their eggs, and shortly go on to them. All this while the male Golden Plover had kept by me, but now he gradually and, as it were, in an unabrupt manner, took his leave, and for another hour, perhaps—more, I think, for it is now nearly 9 p.m.—I have been left alone. His cue apparently had been to watch me narrowly and, if possible, to get me away till his consort thought it safe to return to the nest, after which he was off duty. My own cue now, however, is to approach the nest again and see what happens. Accordingly I do so, but nothing happens that happened before, for the female bird sits on till I am almost on her, and there is no male to divert me this time. Still I feel sure that the one that was there and watched me so narrowly was the sitting bird's mate. He cannot, after all, be always at the nest.

Returning, now, to the tent, I have the unexpected pleasure of seeing four Great Northern Divers swimming on the lake together. Fine handsome birds they are, with their bold contrasting colouring of black and white that would flash finely in the sun, if there were one, as I have seen it do, in snatches, with a single bird; but there is no sun now for this great state occasion. They have a majestic appearance, one may almost say, with their velvety black heads and necks of the same, set off with their white semi-collarets. They are like superb Spanish beauties, with raven hair, in black mantillas, and finely developed, but they have not the soft grace and loveliness—for it amounts to that—of our own Red-throated Diver (our own, because it breeds with us) whose charm is more subtle and captivating—a fay, an Undine. All these four birds swim with a curious sort of uncertainty, seeming to have no fixed purpose or direction, so that the deviation, by ever so little, of any one of them from the line of advance is a reason for any or each

of the others deviating in sympathy, and thus they become grouped, separated and amalgamated again, as each draws or is drawn by another. They have a habit of stretching out the head and neck along the water, and swimming so deeply that sometimes only the upper line of these and the top of the back —or even that alone—can be seen, but whether they are fishing or drinking, or engaged in anything special, when they do this, I cannot make out. Sometimes two would come together, as though by mutual attraction, seem about to touch with their bills, then both dash under water, as in coquetry or bashful confusion. As their mood grows more sprightful, first one and then another takes wing, rising with a great deal of preliminary flapping along the water, flying then, for a little, low over it, and coming down on it again. In this last I made special note of the mode of transition from flight to natation, as shown more particularly by one of them, or rather I concentrated my attention more strongly on this one—no doubt the performance was representative. Instead of descending upon the water at a slant, as does a Duck, and as I have seen the Red-throated Diver do, he sank down upon it while flying quite horizontally, and yet not abruptly so, but very gradually—a mode which had a curious new grace in it. At length, one of the quartette flew round a bend of the hills, probably into some other sheet of water, opening out from beyond where this lake narrows, at what seems its one end. Then, from the distance, came the quavering note which I have described, and, before long, first one of the remaining three, and then the other two, flew after and were lost to me.

Of the two pairs of Horned Grebes that have taken this little stream—or rather this little end of it, which, alone, is adapted for the purpose—as a breeding-place, I doubt if the birds that have eggs ever go abroad on the lake together, or, at least, not often or for long. The other pair, however, that have not yet laid, resort there at intervals, and disport themselves on its broader expanse, in a larger and wilder way. I noticed them diving, splashingly, and then, for a time, going only just beneath the surface—in frolicsome mood, as it seemed. From these merriments they repair to the nest, both to add to its structure, and also for the special purpose, as is now apparent,

of coition upon it. Evidently the nest, with this species, as with the Great Crested Grebe—probably the whole family*—is "love's roseate bower."

Wishing, now, to see if they also shared the habit of covering the eggs, when leaving them, with some of the materials of the nest, I walked along the bank of the stream past that one of the two nests belonging to the incubating pair. I have no doubt the bird was sitting at the time, but it was sufficiently wary to let me see nothing of it, and when I passed, two eggs alone were but partially visible through pieces of flag laid across them. This is just what it might have been with Dabchicks, in which species (as I have personally ascertained) the habit is neither invariable nor always completely carried out. As the number of eggs laid by this Grebe varies (we are told)† from two to four, I cannot say whether there were more than these two, in the nest, but completely covered.

(To be continued.)

* As also (I can now add) some other families.

† Dresser's 'Birds of Europe.'

NOTES AND QUERIES.

AVES.

Status of Blackcap and Garden-Warbler.—I can assure Mr. Gill* that in this district, or perhaps I ought to say on this property, the Blackcap far out-numbers the Garden-Warbler, and is, in fact, our commonest Warbler. In forty years I have found but three nests of the latter, whereas in any normal season one could find upwards of thirty nests of the former. I have always been most careful about the identification, and have invariably watched the bird *on* the nest when there has been any possibility of a mistake. It is very curious, and I can see no reason why one bird should be so rare and the other so common, when the locality seems equally suited to both. Some years ago I spent several days in the Blagdon Valley, and thought Garden-Warblers slightly predominated over Blackcaps. In Hungary, where both species are numerous, we found about an equal number of nests of each.—Heatley Noble (Temple Combe, Henley-on-Thames).

Waxwings in Suffolk.—The first we heard of the visitation of the Waxwing (*Ampelis garrulus*) was on Christmas Day (1913), when my daughter reported two seen on Dec. 22nd close to their house at Rougham by her husband and herself. They got a good view of the birds through glasses at less than twenty yards' distance, and could distinctly hear the call they gave. The Waxwings were feeding on hips, and were fortunate in having the glasses brought to bear on them instead of a gun.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds).

Nutcracker in Surrey.—By editorial request I have pleasure in sending particulars of the Nutcracker in my possession, which was taken in Addington Park, Surrey, on October 14th, 1913. The reason for not recording it before is because I sent it to my nephew, who forwarded it to Mr. J. A. Coward to identify and get properly stuffed, and it was returned this week with his remarks. It is the slender-billed form (*Nucifraga caryocatactes macrorhynchus*). Its habitat is,

* *Cf. ante*, p. 36.

roughly speaking, Siberia, and a winter wanderer westward into Europe; while, strange to say, it is more frequently met with in England than the thick-billed Scandinavian bird. It breeds in the mountainous regions of Europe as far south as the Pyrenees, is found eastward to Japan, and is of casual occurrence in Great Britain. Hartert (?) classes it as a vagrant, and there are about forty authentic records of its occurrence. It inhabits elevated forests chiefly of coniferous trees. The specimen referred to was found in some Scotch firs at an altitude of 460 ft. — Edwd. N. Mennell (The Hostel, Shirley, Croydon).

Hybrid Ducks.—With reference to Mr. Panton's notes (*ante*, pp. 33, 34) I may say that in 1912 and again last year a Pochard drake paired with a female Sheld-Duck in Christchurch Park, Ipswich. One young bird was reared in 1912, and two last year, which were all alive and well on Dec. 23rd. They are handsome birds, more like the Pochard than the Sheld-Duck, both in habits and plumage. Mr. Damant, the caretaker of the birds in the park, takes great interest in his charges, and would, I am sure, be pleased to show these hybrids to any naturalist. They are quite tame, and will come for food offered them.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds).

Muscovy and Duck.—In Mr. Panton's article on "The Relationship of Species," he includes in class C as animals producing sterile young the Duck and Muscovy, and states that in this class hybrids are hard to get. Also, that "there seems to be less attraction between the combining animals, and they have to be kept together, and away from their proper mates, before they will copulate." My experience of the Muscovy is that he is a general nuisance, and will copulate with any of the *Anatidæ* at all times, from a tiny call duck to an Egyptian Goose, and also that the results are fertile, judging by the awful mongrels too often to be seen in our public parks. It may be of interest to state that, at a farm in North Lancashire, Muscovys were nesting on the crossbeams in an empty barn thirty or forty feet from the floor. They were seen to fly through the ventilation holes, and, on investigation, we saw them walking along the beams to their nests, which were situated where two beams crossed. When the young hatched, they were simply pushed off the beam, to fall on the floor, without being damaged, just as Mallard have been seen to do when nesting in a tree.—H. W. Robinson (Lancaster).

A January Corn-Crake.—On January 27th a strange bird was shot near Oxted in Surrey and sent to me the next day for identification.

It was a Corn-Crake (*Crex pratensis*), in decent condition, and half through the moult. Winter occurrences of this species are always worth recording, especially in connection with south-eastern England, where the bird is now rare and not familiar to sportsmen.—F. J. Stubbs.

PISCES.

Neoceratodus forsteri in Queensland. — This fish, commonly known as the Burnett Salmon from its flesh, is still abundant in the only habitat in which it survives, the Burnett River, South Queensland. As an angler was fishing in the river recently, with a net some sixty yards in circumference, he enclosed, and in three hauls captured, no fewer than twenty-four specimens of this unique "lung-fish." Some of the fish were very large, and the weight of a portion was stated at 90 lb. per fish.—James Troubridge Critchell (22, Basinghall Street, E.C.).

NOTICES OF NEW BOOKS.

The Snakes of Europe. By G. A. Boulenger, LL.D., D.Sc., F.R.S., &c. Methuen & Co., Limited.

"There is no work in the English language dealing with the Reptiles of Europe." This is the first sentence in the Preface, and is no longer true, for Dr. Boulenger has now adequately and authoritatively supplied that want by the publication of this volume. He has also, again, cleared the ground from some early misconceptions, for in his family divisions "the presence or absence of a poison organ is left out of consideration," and the definitions of the families are based exclusively on osteological characters. Coloration and markings are also shown to be often but secondary and sometimes misleading guides in the discrimination of species. "If we were to be guided by colour and markings alone, how could we believe that an adult four-lined *Coluber quatuorlineatus* is of the same species as the handsomely spotted *Coluber sauromates*? and yet if we

compare the young of these two snakes we find them to be absolutely identical in their markings, and, in the absence of any structural differences, we are forced to conclude that they only represent two forms of the same species, of which the latter is the more primitive." Again, colour and markings are frequently, perhaps too frequently, employed in theoretical conclusions and suggestions. Such an instance is found in the eye-spot on the hood of the Indian Cobra. But, as Dr. Boulenger observes, "at present it is as inexplicable as the lugubrious emblem on the thorax of the Death's-head Moth. It cannot be suggested that it is a warning mark intended to terrify intruders, for when the Cobra is at rest the hood is folded, and the characteristic marking is not displayed; whilst, as soon as it is aroused and the hood expanded, it faces its enemy in such a way that the spectacle, or ocellus, is not to be seen." Again, as regards the now excessive advocacy of "mimicry"; among Snakes "there are equally striking instances of what one would regard as mimics if they only occurred together; thus, there is no better case of general resemblance between a poisonous and a harmless Snake than we find in the Indian Cobra and the *Coluber corais* of Tropical America, where Cobras are absent, or between a Viper and the Boid *Engyrus asper*, from New Guinea, where no Vipers exist."

But we must quit these delightful realms of philosophical zoology or a wrong impression may be given of the book. It is practical to the last degree, and the naturalist and student will find, by description and illustration, what he requires to aid him in the identification and knowledge of European Snakes, the British species being thus included. There is a good and useful bibliography, as well as distributional lists to readily enable the student to follow the range of species in the different parts of Europe.

The Life of the Mollusca. By B. B. Woodward, F.L.S., &c. Methuen & Co., Limited.

In this book Mr. Woodward has had the somewhat difficult task of combining a description of the well-known outer coverings or shells with that of the living animals within them. Both

are necessary to a knowledge of the Mollusca, but we so frequently find the study of one branch naturally, and necessarily a museum one, in the ascendancy, or contrariwise an anatomical or physiological one, which is more adapted to the laboratory and less to museum purposes. Mr. Woodward has succeeded in his twofold task, and from his precise and yet constrained method the reader can at once see that he could have filled a second or even a third volume, had opportunity been afforded him. The zoological literature of the future will probably be that of the big volumes rather than that of the compressed handbooks, for the results of bionomical observations and evolutionary conclusions have now ceased to be the points for footnotes and have become the subject-matter of chapters; and this is the charm of modern zoology which our author has fully shown in these pages. Thus we are told: "The mottled markings on the shell of the common Garden Snail play on a small scale the same part that they do in the Giraffe, and serve to make the wearer less conspicuous in the shadow of vegetation. The dun colour of the Desert Snail (*Helix desertorum*), like that of the other desert animals, harmonizes with the prevailing tint of the habitat. The arboreal *Ariophanta dohertyi*, of Sumatra, is of a delicate green colour, and almost invisible among the foliage on which it dwells. Many of the Slugs, by their colouring and markings, are rendered inconspicuous in their natural surroundings, such as *Limax arborum* on trees, *Geomalacus* (the Kerry Slug) on lichen-covered rocks, &c." It is these observations which give to shells an interpretation in nature, apart from their interest in the conchological cabinet.

"Classification," "Geological History," and "Present History and Distribution" are also adequately described, and we, at least, know no book where the molluscan story is so fully told, and where so much information can be obtained in a small compass. We wish, however, that if a bibliography was impossible by exigencies of space, some bibliographical references could have been added to the text, so that the less informed reader could more fully follow up many of the interesting and important facts and observations referred to. Mr. Woodward has told us so much that we would fain know more.

Camping in Crete. By Aubyn Trevor-Battye, M.A., F.L.S., &c. Witherby & Co.

Mr. Trevor-Battye has written a most interesting book on an island well known for its archæological treasures. Its zoology is also peculiar and important in its derivation, for we have been already told by Dr. Scharff that "no less than seventy-seven molluscs of Crete out of one hundred and twenty-one inhabiting the island are peculiar to it." Mr. Trevor-Battye himself has added a Shrew (*Crocidura caneæ*) to the list of its mammalian fauna, and has compiled an interesting list of the birds seen or obtained between "March and the end of June." He has also given an enumeration of the conspicuous plants which he observed or collected, with the very justifiable remark that his list may be found useful by future visitors to the island

The reader will soon find himself on intimate terms with the author of this volume. He writes of "terrestrial animals (other than man)," a philosophical conception not always apprehended by claimants to the absolute distinction of *Homo*. Mr. Trevor-Battye's experience at a certain monastery is distinctly entertaining. He mentioned to the priests and deacons therein how interesting the story of the visit of Paul to Crete and the shipwreck chapter as detailed in the "Acts" must be to them. "The Prior admitted that he *had* heard it." The deacon also was extremely hazy on the incident. Fortunately on the shelves were several volumes of the "Epistles of the Apostles" in a somewhat unused condition, and by their aid, and the inducement of our author, the deacon read the shipwreck story to the brothers and servitors, to their delight and information.

Mr. Trevor-Battye narrates an instance of a well known protective resemblance which he observed at Furnés. He had been collecting seed of a shrub in which the seed-capsules are thickly grouped above the nodes of the branches. His boy brought him one having apparently a double set of seed. "As soon as I had it in my hand, I noticed that the lower set was not composed of seeds at all, but entirely of little snail-shells, so closely imitative of the seeds that they might quite easily deceive any snail-eating bird." The shrub is known as *Vitex agnus-castus*.

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THE ZOOLOGIST

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SOME EAST SUSSEX OLIGOCHÆTS.

By the Rev. Hilderic Friend, F.R.M.S.

While treating of the distribution of British Annelids (1) * in this Journal, I gave in April, 1913 (vol. xvii., ser. 4, pp. 151–2), a list of the *Lumbricidæ* of Sussex. In the same volume I also described some new species of *Henlea* (pp. 81–91), while in other articles in the 'Zoologist' and the 'Journal of the Royal Microscopical Society' I had added still further to our knowledge of the subject. Up till the present, however, no attempt has been made to bring under review our knowledge of the entire order of Oligochæts. As I have, so far as I am aware, been the only naturalist to study the subject, the following records are entirely based on my own observations in the county.

It will be necessary, for the sake of completeness, to recapitulate some of my earlier statements (7). My researches commenced in November, 1890, and were continued in March, 1892 (2). The *Lumbricidæ* collected on these occasions numbered fifteen species. In addition, a number of *Tubificidæ* and *Enchytræidæ* were examined, but many of these have not as yet been reported on.

In 1897 I compiled a list of Sussex Earthworms (3) so far as then known, and enumerated sixteen species; *Octolasium profugum* being the latest addition to the county records. For many years, owing to my residence at a distance and my other researches, no further progress was made, but in 1911 *Helodrilus*

* The numbers in brackets refer to the Bibliography.

oculatus was discovered. In December of that year I had to visit Hastings, and was fortunate enough to discover many interesting things. The number was increased during a stay of some days in Sussex in July, 1912, while a visit to Sedlescombe in August, 1913, enabled me to make yet other discoveries. Practically all of those which were new to science have already been described in this or other journals; but there are a few species which are at present unknown in any other part of the kingdom, to which attention must be drawn before a list of all known species is drawn up. Hastings itself has proved to be peculiarly rich in Enchytræids and Tubificids; but, owing to the paucity of lakes, ponds, and streams, there seem to be very few *Naididæ* or allied forms, though these abound around London.

Of the Henleas which I described in this Journal (1913, pp. 81–91) a considerable number have been found in Sussex, and in several instances the descriptions were based upon material collected at Hastings in December, 1911. My most successful hunting-ground on that occasion was a bit of waste land between the sea and the Bexhill road near the Bopeep Station. One or two bridges are found here under which the streamlets flow into the sea, and it was found that Enchytræids delighted in the moist, cool situations provided by the wall on the one side and the earth, frequently enriched by decaying seaweed and other vegetable matter, on the other. Here I found many specimens of *Henlea marina*, *H. curiosa*, *H. arenicola*, *H. heterotropa*, and others new to science.

Alexandra Park also proved to be a very valuable hunting-ground. The decaying leaf-mould usually harbours a number of interesting Lumbricids, such forms as *Dendrobæna subrubicunda*, *D. arborea*, *Eisenia fœtida*, *Lumbricus rubellus*, and *L. castaneus* being the most frequent. In a manure-heap I found, in addition to many Brandlings and *Enchytræus albidus*, a form of *Eisenia* which is uncommon. Unfortunately the material in this case was immature, and I have not hitherto been able to obtain a fresh supply for its determination. The matter is, however, worthy of mention, as showing that the possibilities of further discoveries are not yet exhausted.

The mud on the margin of the pool in the park proved to be

very rich in material, and both here and in the runnels which lead to it I have found material which has not up till the present occurred in any other locality. One or two of the species merit special notice.

Ilyodrilus meganymphus, Friend (1912, J. R. M. S., p. 289); the locality unfortunately not then recorded), belongs to the Tubificids. Its specific name is due to the large spherical cœlomic corpuscles (nymphus = lymphus, whence our term lymphatic). In this respect the creature resembles *Rhyacodrilus*, which is a link between the *Tubificidæ* and the *Naididæ* (4). The chloragogen cells begin in segment 4, which is in advance of the usual position. Curiously enough, while it simulates *Rhyacodrilus* in the matter of cœlomic corpuscles, it closely resembles the red-blooded Enchytræids in the vascular system. This is of peculiar interest, seeing that the blood-vessels in the *Tubificidæ* are usually much more profuse and the system much more complex than is the case with the Enchytræids. It is the discovery of such unusual forms as these which at once makes systematic lists and definitions a problem, and yet throws such a flood of light on the evolution of species.

Haplotaxis gordioides (G. L. H.). In 1896 I gave an account (5) of a worm which had been sent to me by a medical man in Essex. It was new to science, and was named *Dichæta curvisetosa*, Friend. The name was changed in 1899 to *Phreoryctes dichætus*, Friend. Up till the present no further specimens have been found. Michaelsen (10) in 1899 published an account of *P. gordioides*, and included the Essex species, in spite of the great differences between it and the type. In 1900 (9) he issued his valuable monograph on Oligochæts, and called the worm *Haplotaxis gordioides*, and still persisted in including the Essex form. On December 21st, 1911, I had the good fortune to find the worm which bears this name in Alexandra Park, Hastings, and was able instantly to recognize it and to see how greatly it differs from *P. dichætus*. Thus, at the present time we have two species of *Haplotaxidæ* in England; in addition to a third well worm found in East Anglia but not yet described.

Tubifex heuscheri, Bret., was also collected near the park. It has not been found elsewhere in Great Britain up till the present time; making the third unique species.

It should be noted that my observations are limited to a triangle, the base of which extends from Hastings to Pevensey, and the two sides joining those places with Robertsbridge.

On the occasion of my last visit to Sussex in August, 1913, I spent an hour in examining the Annelid fauna under moss and liverwort by a bridge over the little stream which flows through the meadows or "brooks," as they are locally called in the picturesque village of Sedlescombe, and here I found some species of Enchytræids which had not previously been recorded for Sussex. It may be of interest to note that one of these was *Chamædrilus chlorophilus*, Friend (6). Though first described from material collected in Derbyshire, I found, on looking up my notes, that I had already found it in Sussex, but had not been able to identify it, and so had put my description aside to await fuller light. Thus it happens that Sussex has the honour of giving us one of the first reliable records for this hitherto unknown Annelid.

These preliminary observations must suffice to prepare the way for the systematic list. The families and genera are for convenience of reference arranged in the order adopted by Prof. Michaelsen (9). Unfortunately there has, up till the present, been no reliable record for either the family *Æolosomatidæ* or *Naididæ*. These contain many species of microscopic worms which inhabit the mud or vegetation of fresh or brackish waters. We begin, therefore, with the *Tubificidæ*, another family of freshwater worms, but of larger dimensions.

Tubificidæ.

Setæ of various kinds; male pore on eleventh or twelfth segment, with spermathecal pore on adjoining segment. Upwards of a dozen known genera. Michaelsen (9), pp. 36 *seq.*, 522 *seq.* The Sussex genera at present on record are limited to three, *viz.* *Limnodrilus*, *Ilyodrilus*, *Tubifex*. I believe *Sænuris*, *Clitellio*, and *Psammoryctes* might be found if carefully sought. *Rhyacodrilus* also, which I have shown (4) to be more nearly related to the *Tubificidæ* than the *Naididæ*, is found in Essex, and should occur under similar conditions in Sussex.

1. *Limnodrilus hoffmeisteri*, Clap.—Michaelsen (9), p. 43. Alexandra Park, Hastings, June, 1912. Not uncommon in the county by streams and in pools.

2. *L. udekemianus*, Clap.—Michaelsen (9), p. 45. Alexandra Park, Hastings, June, 1912, and elsewhere. First collected for certain at Amberstone Grange, August 30th, and at Battle and Sedlescombe, August 31st, 1911.

3. *L. papillosus*, Friend.—1912, Friend (6), pp. 276–7. "First found at Kew, August, 1911, and since discovered in gleanings from the neighbourhood of Battle and Hurstmonceaux, Sussex." Hastings, June 20th, 1912.

4. *L. aurantiacus*, Friend.—1911, Friend (8), p. 414. "My notes show that this species is widely distributed in the South of England, from Derbyshire to Kew and Sussex." Friend (6), p. 275.

5. *Ilyodrilus meganymphus*, Friend.—1912, Friend (6), p. 289. Described from specimens found in runnel in Alexandra Park, below the Bohemia entrance. Found December 21st, 1911.

Other species of *Ilyodrilus* occur in Sussex, but the *Tubificidæ* of Great Britain are under careful revision, and until my work is somewhat more advanced, it would only result in confusion to give further records here.

6. *Tubifex tubifex* (Müller).—Michaelsen (9), p. 48. Friend (6), pp. 291–2. *Tubifex* is common in Sussex as in most parts of England, but hitherto several different species, and even genera, have been confused under this name. I have taken different forms in Alexandra Park, at Battle, Dallington, Hurstmonceaux, and elsewhere. The same observation is true of *Tubifex* which is made of *Ilyodrilus*. I have notes made many years ago which suggest that *Psammoryctes* was at least once collected by me in Sussex. The muddy banks of rivers, as at Shoreham, would be prolific hunting-grounds, but have never yet been worked. *Heterochæta costata*, Clap., and other very interesting Annelids are sure to abound there, as they do in similar localities on the Thames estuary.

6*a*. *T. heuscheri*, Bret.—Near Kite's Nest, Hastings, June, 1912; only British record.

Lumbriculidæ.

Sigmoid setæ either forked or pointed, four pairs on each segment. Girdle in a very advanced position (segments 3–7). Ten or a dozen known genera, of which only about one half are

as yet known in Great Britain. *Rhynchelmis limosella*, Hoffm., which was found in Hants in 1913 is almost sure to occur, and one or two species of *Stylodrilus* must also be indigenous. Hitherto, however, only one genus, and but one species of that, is on record.

7. *Lumbriculus variegatus* (Müller).—Michaelsen (9), p. 58. First found by me in Pevensey Marsh in 1892. Taken in Alexandra Park, Hastings, June 20th, 1912. Not uncommon among water-weeds in streams and ponds or lakes.

Enchytræidæ.

Setæ present, except in *Achæta*, straight, sigmoid, or bent near the internal extremity. Girdle usually on segment 12; but sometimes advanced three or four segments (as in *Chamædrilus* and *Buchholzia*). Spermathecæ opening between segments 4 and 5; either free within the cœlom or more frequently attached to the intestine. Dorsal pores in one genus (*Fridericia*). Blood usually red in the Pachydrylid section, otherwise colourless or yellowish. A very large and interesting family, concerning which I have written much during the past three years, especially in the 'Journal of the Royal Microscopical Society' and in these pages (1). One new genus (*Chamædrilus*, Friend) is at present known only in Britain, where, however, it is widely distributed. To the genus *Henlea*, as well as to *Fridericia*, I have recently added many new species. So far as our present knowledge goes, England has more Enchytræids than any other country. I give the Henleas alphabetically.

8. *Henlea arenicola*, Friend.—1912 (6), p. 586. Found at Bopeep, Hastings, December 21st, 1911, and first described from the material there collected.

9. *H. curiosa*, Friend.—1912 (6), p. 588. Same locality and date as foregoing.

10. *H. fragilis*, Friend.—1912 (6), p. 588. Same locality and date.

11. *H. fridericioides*, Friend.—1912 (6), p. 587. Same locality and date.

12. *H. heterotropa*, Friend.—1912 (6), p. 589. Same locality and date.

13. *H. hibernica*, Southern.—1907, 'Irish Naturalist,' vol. 16,

pp. 70–1, with plate. First Sussex record, Sedlescombe "brooks," August, 1913.

14. *H. lampas*, Eisen.—Michaelsen (9), p. 70. Friend (1), 1911, p. 465; (8), p. 321; (6), p. 584. The species as emended found at Hastings, December 21st, 1911.

15. *H. marina*, Friend.—1912 (6), pp. 589–591, with illustrations. Bopeep, December 21st, 1911.

16. *H. rhætica*, Bretscher. — 1912, Friend (6), pp. 593–5. Hastings as before, and again November 25th, 1912.

17. *H. triloba*, Friend.—1912 (6), p. 596. From the Bopeep station, December 21st, 1911.

18. *Buchholzia appendiculata* (Buch.).—Michaelsen (9), p. 72. Hastings, June, 1912; Sedlescombe "brooks," August, 1913.

19. *B. focala*, Friend. — 1914, J. R. M. S. (now being published). Hastings, December 21st, 1911.

20. *B. tenuissima*, Friend. -- 1914, J. R. M. S. (see 19). Collected June 12th, 1912, Alexandra Park, Hastings.

I have recently revised and extended our records for this genus, adding some new British species; but am at present unable to decide whether or not a further species is to be added to the Sussex list. My Sedlescombe material is as instructive and interesting as it is perplexing, and must receive further study.

21. *Marionina* sp.—Not adult; Hastings, December 21st, 1911. This group of red-blooded Enchytræids is very extensive, and it is no exaggeration to say that, if the coast and estuaries of Sussex were to be carefully examined, a score of species at least could be collected. The genus, with its ally *Lumbricillus*, is under revision.

22. *Enchytræus albidus*, Henle.—The commonest species of this genus. Found everywhere in well-rotted manure. Very abundant in old manure-heap, Hastings, December 21st, 1911. See Friend (3) for earlier record.

23. *E. buchholzi*, Vejd. Sedlescombe, 1897. See last note.

24. *E. minimus*, Bret.—Michaelsen (9), p. 92. Hastings, December 21st, 1911.

25. *E. nigrinus*, Bret.—Hastings, December 21st, 1911. This is one of several species which have been discovered since Michaelsen's Monograph (9) was published. Other species await determination.

26. *Fridericia michaelseni*, Bret.—Michaelsen (9), p. 100. One of the most widely distributed species of this genus. Hastings, December 21st, 1911.

27. *F. bulbosa*, Rosa, and a variety or allied form at the same place and time. Also Sedlescombe, August, 1913.

28. *F. variata*, Bret. Hastings, same time and place as foregoing.

29. *Fridericia* sp.—One of the bisetose forms, not yet sufficiently diagnosed. Sedlescombe "brooks," August 16th, 1913.

This list of species belonging to the genus *Fridericia* leaves much to be desired. Nearly one hundred species are known to science, about half of which are British, and forty or fifty species ought easily to be found in Sussex. The genus *Achæta* is at present unknown in this county.

30. *Chamædrilus chlorophilus*, Friend. — 1912, Friend (6), pp. 257 *seq.* This interesting Annelid appears at present to be unknown outside the British Isles. Hastings, June, 1912; Sedlescombe "brooks," August 16th, 1913.

Haplotaxidæ.

31. *Haplotaxis gordioides* (G. L. H.).—Michaelsen (9), p. 108. Quite distinct from *H.* (*Dichæta*) *curvisetosa*, Friend ('Essex Nat.' vol. 9, p. 110), with which Michaelsen confuses it. I found the genuine *H. gordioides* at Hastings, December 21st, 1911; a day memorable for the many discoveries made during a couple of hours spent between Bopeep and Alexandra Park.

Lumbriculidæ.

32. *Allurus* (*Eiseniella*) *tetrædrus*, Sav. — Michaelsen (9), p. 471. Not known in November, 1890. Friend (7), p. 22. First record for Sussex, 1892. Friend (2), p. 123. Since found in many parts of the county.

33. *Eisenia fœtida*, Sav.—Michaelsen (9), p. 475. First Sussex record, 1891. Friend (7), p. 21. Found everywhere in manure. In the Gensing Gardens I once found a variety which was peculiar, but I cannot at present put hands on my memoranda.

34. *E. rosea*, Sav. (=*A. mucosa*, Eisen). First Sussex record, March, 1892. Friend (2), p. 124. In May, 1892, my mother

collected for me at Dallington, the consignment consisting of seven species (*Allurus tetrædrus*, *Eisenia rosea*, *A. chlorotica*, *A. caliginosa*, *B. constrictus*, *L. rubellus*, and *L. castaneus*), the specimens of *E. rosea* being marked, "very typical."

35. *Allolobophora longa*, Ude. Friend (2), p. 123. First found at Dallington, March, 1892, and frequently since. More abundant in many places than the true Earthworm, with which it is often confused.

36. *A. caliginosa*, Sav. (forma *turgida*, Eisen). Friend (2), p. 124. Forma *trapezoides*, Hurstmonceaux, July 23rd, 1889.

37. *Aporrectodea chlorotica*, Sav.—With many aliases, some of which accompany the first record for Sussex, November, 1890. Friend (7), p. 21. Very common and widely distributed. Inside Pevensey Castle.

38. *Dendrobæna subrubicunda*, Eisen (= *rubida*, Sav.).—Friend (2), pp. 123–4. Very abundant, as a rule, in old manure and among leaf-mould. Alexandra Park, December 21st, 1911.

39. *D. arborea*, Eisen.—First found in Sussex, March, 1892. Friend (2), p. 123. Not common, but found again December 21st, 1911, in an old log on the shore at Bopeep.

40. *D. mammalis*, Sav. (=*celtica*, Rosa).—In tree-stump with the last at Dallington, March, 1892. Friend (2), p. 124. Rare; but found most frequently in road-scrapings which have "ripened."

41. *Helodrilus oculatus*, Hoffm.—A worm of peculiar interest. By the side of dykes at Boreham Bridge, by the Fish Market, Hastings, and on the way to Kite's Nest Farm; apparently generally distributed in Sussex.

42. *Bimastus eiseni*, Lev.—Apparently rare in Sussex. First record, March, 1892. Friend (2), pp. 123–4.

43. *B. constrictus*, Rosa.—The Sussex record for March, 1892 (Friend (2), p. 123), was the first for Great Britain. June, 1912, I found one specimen in a gutter beyond the Fish Market, Hastings, with *H. oculatus*, *L. rubellus*, and *A. chlorotica*.

44. *Octolasium profugum* (= *lacteum*, Oerley).—*Supra*, p. 81. Dallington; first and only Sussex record.

45. *Lumbricus rubellus*, Hoffm.—Friend (2), p. 123. Generally distributed.

46. *L. castaneus*, Sav. (= *purpureus*).—March, 1892. Friend (2), p. 123. First record, November, 1890. Friend (7), p. 21.

47. *L. festivus*, Sav. (= *rubescens*, Friend).—Near fir plantation between Brightling and Dallington, March, 1892. (2), p. 123. Not common in Sussex.

48. *L. terrestris*, L.—Friend (7), p. 20. Dallington, Hurstmonceaux, and elsewhere.

In addition to the foregoing, I have to record the occurrence of a small tender worm at Ecclesbourne. It was found in July, 1912, but died before I could examine it alive. A second collection was made and preserved. No single example was adult, but it seemed undoubtedly to belong to the genus *Allurus*. Pending an opportunity of seeking for it again, I have named it *Allurus mollis*.

When we remember that a county like Nottingham, without a seaboard or estuary, and with hardly any hills, already records nearly a hundred Annelids, we cannot repress the suspicion that many new species await discovery in Sussex; and if two hours' work could in December, 1911, yield such rich results, what might we not expect if a steady and systematic search were carried out? I shall be glad of any assistance in this most important branch of research. Gleaning should be placed in tin boxes and addressed Pocklington, York.

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RELATIONSHIP OF SPECIES.

By H. Panton.

(Continued from p. 35.)

Referring to the cases of hybrids which (as Mr. Finn mentions) are hard to get, one might point out these may be hard to obtain in two ways, *viz.*:—either that it is difficult to get the parents to copulate, although conception is general when this does occur, or that although copulation is frequent no conception takes place. This point ought not to be lost sight of. Further, it has always seemed to me that it is far harder to get "uncongenial" hybrids (that is, sterile ones or aganesists) amongst lower animals than in the higher forms.

These sterile hybrids, I have noticed, appear to me to be the results of what one might term true miscegenation, that is, the parents show in general little natural liking for each other, and thus I take it that in lower forms with small brain capacity, intelligence as suggestive and incitant to copulation is wanting (and this intelligence seems largely operative in the production of horse and ass hybrids), and that therefore copulation is much rarer than in the higher forms.

Arguing by the above table of hybrids and congeneric habits, a hybrid, the parents of which mate readily, should be fertile, or again, when they show aversion or indifference, as happens where their habits are not congeneric, we might look for a sterile hybrid, and this is generally the case. I can conceive no explanation of this other than gradual evolutionary divergence of germ-plasm. It is suggested by certain authorities that in cases of infertility the physiological unit may be divergent or in dissimilar architectural multiples, and thus unable to combine; be this as it may (and we will refer to it later), it seems to me that it is always possible for the germ-plasm and outward form to run away from each other, *i. e.*, there being more divergence

or less *than is apparent*, and that although outward form has altered, the germ-plasm has not done so to the same extent or *vice versâ*, *i.e.*, as regards such practical powers as reproduction, and the congeniality and similarity this suggests.

One of the most puzzling cases that crop up is the lack of breeding results from such apparently connected birds as Carolina and Mandarin Ducks, as remarked by Finn, but we are getting rather in advance of our argument. To return: the infertility of agenesic hybrids is an unsolved problem, but it is possible that it is not essentially different to the infertility of inbred species.

Let us see what happens in this latter case, which is often carried out thus. Man takes an extreme type, and keeps breeding this type probably against any type that environment would select as the carrier of the germ-plasm. Man then produces what we may call an "uncongenial host," and the uncongeniality of the host probably adversely affects the vigour of the germ-plasm, thereby causing sterility. In short, Nature refuses to be led down the wrong path.

In the same way the hybrid bred from two very divergent forms is probably an uncongenial host, far indeed from the two forms Nature has been evolving: it probably has a twofold diverse "drive," and although the two parent forms have combined to produce the hybrid, and given so to speak the germ into its keeping, the hybrid combination, either from the general uncongeniality of the parental forms (to each other) that Nature has been producing, or its "driving" in two opposite directions through the influence of two different parental germ-plasmatic "driving" powers, cannot unite in full vigorous combination and undividedness to produce the perfect ripe filial germ-plasm; the ovum and spermatozoa never, I believe, in sterile forms becoming mature or "ripe." Admitting that the driving force of these two evolutionary parental forms be a bio-chemical one, the general explanation need not be different.

As sterility arises from interbreeding, as well as from violent crosses, it may be that it is, as stated above, from much the same cause, and if this were so it would be some evidence against the suggestion that the latter is due to a difference in the architectural unit as suggested by the school of Weismann.

To follow out interbreeding mercilessly, this procedure must

continue for generations, and as it is usually performed on animals, entails housing in the same way and feeding on (probably) a similar unvarying diet.

This must result in time in a deprivation to the system of anything tending to induce change or variety (with its probable benefits) in the germ-plasm.

This cannot be compared to the conditions which would obtain on the various islands, &c., where inbred creatures such as rabbits, &c., tend to multiply and increase. Here they get access to varying foods, which in their individuality they no doubt assimilate to varying degree, and where copulation with cousins many times removed is at least possible: both these causes ensuring some change in the system, however slight, from the stagnation that must result from the close inbreeding as practised by man, which cannot be compared to the natural evoluting inbreeding which takes place in the case of the rabbits quoted above, or such other examples as that of the red deer of New Zealand or the buffaloes of Australia. The latter move with the Unknown Cause of Evolution, the former against it, or rather tries to do so.

One may further reason that continued inbreeding may be likened to the prolonged subdivision of the germ-cells of primitive life, which goes on for a time, but ceases for some unknown reason at a certain point, unless some other strange cell combines with it to give it fresh vigour. Also, it seems likely that the infertility of divergent forms can be more easily explained by the growing dissimilarities of the germ-plasm.

It only seems reasonable that the germ-cell should require, as an inducement to give birth to a new life, a partner not too extreme, neither too satiate, nor too uncongenial. If, as one imagines, in the formation of cells, it is the union of the two separate individuals that causes the renewed productive powers, it would seem that inbred animals necessarily obstruct this process; the mating cells would in these types supply no new individuality to forward the above end. The rejection of a dissimilar and uncongenial unit can equally well be imagined.

Against the architectural theory: while mutations may and apparently do occur in varying degree as regards outward form, I am unable to find any definite or clear distinction between the

result of these and that which we might expect to be the outcome of less sudden variations (indefinite), and, moreover, the apparently graduating decline of fertility in the evoluting species given in the table of hybrids seems to render unlikely any such explanation as the above architectural theory suggests.

Any violent or abrupt change of germ-plasm seems in the face of these graduating results to be unusual, although one must admit this graduating evolution of germ-plasm is revealed in what appears to the eye as very apparent jumps as regards the outward form. However, are not the long-haired cavies as fertile with individuals of the parent type as these latter normally are *inter se*? and also the fertility of crosses of Zebu and European cattle, surely mutants showing a difference sufficiently great in jumping power to illustrate my meaning as to the congeniality of the germ-plasm as contrasted with the divergence of the outward form of these types. On the other hand, this graduating germ-plasm theory does at times receive a nasty jar, as notably in the instance of the beetle *Leptinotarsa rubicunda*, but perhaps I had better refer to this later on, and merely state now that, although this example seems at variance with our graduation theory of the germ-plasm, it is not unlikely that in some cases this jump in the plasm does take place; that the plasm does at times arrive more quickly at an uncongenial stage than appears general. This need not, however, force us to accept any such improbability or probability as an architectural physiological unit.

There is, of course, the question of blood parasites to be considered as bearing on sterility, which has been put forward as the cause of the sterility of certain species, such as some of the bison herds which show unsatisfactory breeding results. Upon matters such as these, and others such as the sterility of human races as the Tasmanians, one loses oneself in conjecture. The sudden sterility of the Tasmanians, for instance, appears, if not attributal to blood parasites or inbreeding, to be almost supernatural, psychological perhaps.

Another point, in which I imagine the more correct relationships of animals from similarity of germ-plasm as against structural changes are shown, is from the resemblance in the generative organs found in the various orders. While nutri-

ment, habit, and environment might be expected to very greatly affect the other organs, there would appear no very great reason why the form of the former should necessarily change, nor, broadly speaking, do they. Copulative organs and actions can have apparently no great reason for changing, nor would one expect them to be so liable to be influenced by evolution as bodily form, and they certainly appear to be the last to change; and in this respect the divergence in these organs between Platyrrhine and Catarrhine primates appears to be extremely suggestive of long separation and great divergence.

One feels bound to refer to divergence of results as shown in some reciprocal crosses between the same two species. Darwin refers to Kolreuter's experiments ('Origin of Species') thus:—

"*Miribilis jalapa* can easily be fertilised by the pollen of *M. longiflora*, and the hybrids thus produced are sufficiently fertile, but Kolreuter tried more than two hundred times, during eight following years, to fertilise reciprocally *M. longiflora* with the pollen of *M. jalapa*, and utterly failed."

An explanation of this curious fact appears hard to find. As, however, there does not appear to be any difference in the fertility of the hybrids that can be bred reciprocally, possibly some theory of "uncongeniality" might apply to these cases. When definite light is shed on such problems, one may expect to see much of the puzzle of hybridism laid bare. Considering the fact that many females are not fertile with certain males of their own species, it seems unwise to lay too much stress on the aberrant infertility of these reciprocal combinations.

If the theory of gradually separating forms shown by infertility is correct, some intermediate form should connect two others. No definite experiments to test this have been made, as far as I know.

Kolreuter, however, experimented with five forms or varieties of the common tobacco, and found that, although all these forms and their hybrids were perfectly fertile (even when tried reciprocally), one of these forms when crossed with *Nicotiana glutinosa* produced hybrids less sterile than the other four forms produced when crossed with this species.

After summarising the examples given above, and in the endeavour to draw deductions from them, one is prepared to

admit that matters may appear somewhat complicated. So diverse, indeed, do all these examples of hybridization appear to most writers in relation to the usual classification, that I am not aware that any recent authority has made any endeavour to put forward any theory on these matters. The best they seem to do, that is, the few who comment thereon, is to make some such statement as "we now know that hybrids are not by any means invariably infertile," while many others give no details or examples of such results as I have given above, nor even refer to the subject at all. Dewar & Finn * and Bartlett † certainly produce an array of instances, but apparently make no attempt to summarise or explain them, and they therefore leave the subject much the same as when they entered upon it.

Other writers touching on these matters explain that, whereas fertility was formerly considered to be the absolute test of a species, later investigations have discountenanced this theory. Such criticism is merely negative, and is very possibly far more unsound than the original belief which it condemns.

Many modern biologists are fond of drawing attention to the inviolability of the germ-plasm, which they explain is housed, guarded, and handed on from generation to generation, uninfluenced by and unaffected by all "indefinite variations," which are therefore not inheritable. To a certain extent only does this appear feasible. It seems altogether too strict and unplastic a way of putting matters, nor does it appear sound reasoning compared with Darwin's statement that environment and change of diet are the causes of evolution and differentiation of species. That these act on the germ-plasm seems probable, affecting it through the digestion and blood and inducing it, as the parent of the next generation (plasmatic and corporeal) to, as it were, initiate and stimulate these variations in the latter, to be in turn (the next generation) acted on in the same manner and urged further along the new path.

The seeming resultant that strikes one as produced by all this is a belief to a certain extent only in the immutabilty of the germ-plasm, in that it is not so vitally affected as the outward form, as shown by the "fluctuations" and "mutations"

* 'The Making of Species.' † 'Wild Animals in Captivity.'

which occur in species, and which are so apparent to the eye; no matter that the germ-plasm initiates these changes, or is affected by them (such as they are), they are more apparent than real, that is, as indicating any definite change in the parent germ-plasm, in so far as to any change in powers of interbreeding, conception, and the begetting of young. For instance, these "fluctuating" and "mutating" animals are almost invariably quite fertile with recent similar developments of each other, as shown by the interbreeding of some wild and all (as far as I know) domestic varieties. Therefore it seems feasible to suppose that the germ-plasm changes only gradually, as suggested by the results given in the table of hybridisation, showing the gradual reduction of fertility given above, and that there are not generally any sudden changes or "jumps" in this germ-plasm in the nature of anything akin to mutation, such as are visible as structural changes to the eye. If, as suggested by Weismann, the physiological unit of the germ-plasm is built up architecturally (any alteration in design may possibly be a later development denoting greater changes) or whether, as more recent investigators suggest, the changes are due chemically to ferments, it is still possible the change is a gradual one and rarely effected suddenly, even if, as De Vries holds, there are times of violent activity in the life of a species, during which it tends to throw off mutations. As far as I can reason, the examples I have quoted appear to be evidence sufficiently strong to show gradual changing of the germ-plasm (more or less rapid though it may be through such stimulating effects as changing environment and food), no matter how spontaneous or important the visible jump may be. I believe that the inward invisible germ-plasm relationship (which one might expect would be reciprocated in blood tests) is most generally the true evidence of relationship as opposed to that entirely founded on every structural difference, great or small. This does not mean, however, that structural evolution and germ-plasm changes do not go hand in hand, for it would seem that it is only generally in the closer relationship of the various groups that one, so to speak, gets ahead of the other.

For instance, let us assume two forms evolute out, both, perhaps, still largely feeding on the same substances, the evolu-

tion being caused through one taking to climbing, or swimming, or jumping. It is more than probable that the outward form immediately begins to adapt itself by harmonious development to the changed circumstances (such as the unique loss of a great toe development in the Patas Monkey and digitigrade walking), thus leaving the animals more related in blood relationship than they appear (though this is, perhaps, not well illustrated in the above example), through the internal essences being similar, or, at most, more gradually acted on in later generations through a change of diet on the part of the separating form.

It is in the adult Patas that the curious doglike form suggestive of high speed is most noticeable; the young do not show it so prominently. Hence I imagine the general want of comment on this special development.

One may deny the above divergence, that is, the apparent difference in the rate of evolution of germ-plasm and structure, but, although outward form and germ-plasm must be in real unison, one cannot deny that, if one drew up a classification based on germ-plasm affinity (which I have held in these notes is shown in results of hybridism), this classification would certainly be apparently opposed in many cases to the one of structural similarity, as in the instances that I have given; but that I believe that this opposition would be only apparent, and have nothing to do with the real harmony between germ-plasm and structure, I have in these notes tried to make clear.

One might imagine change of diet to be one of, if not the greatest factor in inducing evolution, and environment of importance chiefly in so far as it offers opportunity of this change. Effects of change of diet would, one might conjecture, in time affect, through the anabolic action of the chromatin, the internal economy and blood of the animal, and one might expect that its influence must begin to be felt before aught else.

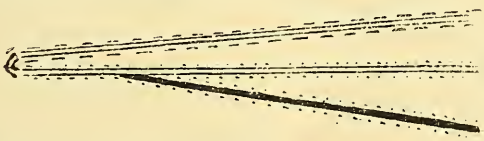
In the case of the Horse and Ass the difference in form and habits seems more important than is generally supposed, and appears to contrast somewhat with the congeniality of the germ-plasm which results in conception. I might also remark here on an instance given earlier in these notes—on the differentiation of the Chaffinch groups from the other finches—that it is possible, instead of the view of the divergence given above, that through

the insect-eating proclivities of *Fringilla* a difference may have arisen in the germ-plasm of this group as compared with *Acanthis* and kindred genera, which causes the infertility between them, but that otherwise the relationship between *Fringilla*, *Ligurinus*, *Acanthis*, *Serinus*, &c., is co-equal. I do not think this view probable, however (although it might account for their readiness in pairing), but imagine the one I gave when commenting on this to be more correct.

It is hard to keep from what appears to be arguing in a circle, and arriving at the commencement of our argument again, and at the apparently opposite conclusion that the germ-plasm changes through diet, while the structural change may not occur, and that therefore the latter is, in such cases, the truer test of relationship, and that the usual methods of classification are correct. In this way, one might imagine a germ-plasmatic change, let us say, through diet, but there would seem to be no apparent necessity that there should invariably or of necessity be any great corresponding structual change, unless environment through adaptation ordered otherwise; and one might argue that this is indeed what one apparently finds in the above quoted cases of *Fringilla* and *Acanthis*. Allowing this, one may quite reasonably further contend that *Ligurinus* evoluted out further back than the separation of *Fringilla* and *Acanthis*, but through the similarity of food keeps a similar germ-plasm, but on account of some physical labour develops a diverse structure (powerful beak) for crushing larger seeds. The development being diagrammatically something as follows:—

Fig. 1.

(Inner lines show germ-plasmatic, and outer lines structural similarities or changes.)

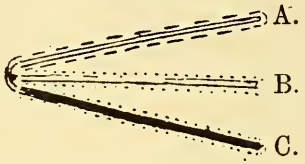


Where A and B retain the same fertility-producing plasm, from which C has diverged, structural changes being *vice versâ*.

And from this one might assert that *Fringilla* and *Acanthis* were more nearly related to each other than either to *Ligurinus*.

As before stated I do not hold this view, chiefly because the congeneric habits more than hint at a connection similar to that figured earlier in this paper. One feels, however, bound to bear this style of evolution in mind, and in the case of such an evolution of three species as figure 2, it would be hard to say which two of the species was nearer the third.

Fig. 2.



When I am speaking of structural changes, I wish to state that I do not imply by this any great structural change, but merely those minor differences that are generally credited as denoting generic divergence, or rather the lesser rank that generic modern divergence tends to assume.

If (going back to figure 1) we place *Anas* at A, *Aix sponsa* at B, and *Aix galericulata* at C, we may be on the track of the curious interbreeding results got from those forms, *Aix sponsa* hybridising more readily with the *Anatinæ* than it does with its apparently nearer relation *Aix galericulata*.

I cannot account for these anomalies unless it be by some such hypothesis as the above, or modifications of this by parallelism or convergence.

In using the term "relationship" for animals, it is necessary that we note clearly what we mean. In using this term "near relation" for human beings, we mean that those persons are nearer (genealogically) to a grandfather than to some remoter ancestor, that is, one farther back in the genealogical tree. It would seem that we ought not to so understand this term, when we apply it as meaning nearness or divergence in species.

For instance, in the case of the Porto Santo Rabbit. This animal is supposed to be descended from European Rabbits about the beginning of the fourteen hundreth century, being turned down on this island.

It is probable that the original ancestor of the European wild Rabbit and the English wild Rabbit are not connected

genealogically till hundreds of years before this, till perhaps before the time of the North Sea.

However, the Porto Santo Rabbit, isolated in a restricted environment, has apparently become very subject to evolutionary duction. It has apparently altered in habit, size, and structure, and now refuses to breed with ordinary Rabbits. One should say, therefore, that it is "further" in relationship to the Continental Rabbit than the latter is to the English, though genealogically this is by no means the case.

It is curious to note that this Porto Santo Rabbit, although it differs from the common type in all the above points, is but merely classified as a subspecies of *Lepus* (or rather *Oryctolagus*) *cuniculus*. What is the reason for this? None other, I should imagine, than the fact that we are unconsciously influenced by the fact that we know it has only evoluted out in the short space of six hundred years. Were this not known, would it not be held at least a distinct species? However, it seems absurd to liken the differences between this form and the common Rabbit to the usual small subspecial distinctions that generally hold good.

Are we not to consider different forms as different species because they have come quicker into being than perhaps often happens? If so, this strikes at the mutation theory.

(To be continued.)

LITHOBIUS LAPIDICOLA, Meinert, A CENTIPEDE NEW TO THE BRITISH FAUNA.

By Richard S. Bagnall, F.L.S., F.E.S.

Whilst spending a short holiday in North Devon in August of last year (1913), I observed a smallish Lithobiid which occurred in the Ilfracombe district, amongst the larger pebbles and under stones at the foot of the cliffs at Hele Bay, the bathing cove, Ilfracombe, and at Lee Bay, where it was not only found on the shore but on the cliffs also. I could not identify it with any of our known British species and accordingly sent specimens to Dr. Brölemann, who with his customary kindness readily identified them as *Lithobius lapidicola*, Meinert, a South European species.

It comes in the group *Archilithobius*, and according to Latzel near to our species *calcaratus*, though Von Attems* places it in another subdivision, with *pelidnus*, *mutabilis*, &c.

L. lapidicola was described by Meinert in his 'Myriapoda Musæi Hauniensis,' ii., Lithobiini† in 1872, and a description will also be found in Latzel's 'Die Myriopoden der Oster.-Ungar. Monarchie.' ‡

I regret that I have not yet found the opportunity of making a study of the species and therefore cannot, at present, offer any further remarks.

* "Die Myriopoden Steiermarks," Sitz. k. Akad. Wiss. Wien Math.-Naturw. Classe, civ. 1895, pp. 117-238.

† Naturh. Tidskr., viii. 1872, p. 228.

‡ I. Die Chilopoden, 1880, p. 106.

ON THE LOCATION OF THE SACCULUS AND ITS CONTAINED OTOLITHS IN FISHES.

By Colonel C. E. Shepherd (Indian Army).

Whilst as a rule every fish that has otoliths has six of them (three each side), in different families they are located in the head in different ways, and these are characteristic of the families. The otolith in the sacculus is the sagitta, the otolith in that portion of the sacculus known as the lagena is the astericus. In many fishes the position of the sagitta, the bone of the skull being very thin immediately under it, becomes apparent on removing the epibranchial arches and the adjacent tissues, the opaque body of this otolith showing distinctly through the thin bone. This, however, is mostly seen in the case of a fresh head; those that have been preserved in any way often lose this transparency of the bone, although in some cases it is retained. This transparency is not peculiar to any fish in particular, but is to be seen in many different families, whilst other members of the same family do not show it. It is to be observed in *Gadus merlangus* (the Whiting); in several of the *Pleuronectidæ* (the Flat fishes); in several of the *Characinidæ*, and many others which will be mentioned later on. In the cases where the sagittæ can be seen they are always inclined at an angle to the middle line down the length of the fish, the backward end of the otolith being nearer to the middle line and the end pointing forward being further away, so that a line drawn through the direction of the otoliths would make an acute angle with the middle line, the apex of the angle being directed backward. When the thickness or opacity of the basi-occiput does not permit of the sagittæ being seen, their position is often indicated by a more or less defined, prominent bulging of the bone on each side of the middle line. In some fishes the position of the sagittæ is shown by two bony excrescences on the under side of the skull, diverging from one another to suit

the divergence of the sagittæ. This is seen in *Antennarius hispidus*, a small-sized member of the Angler family from the Indian Ocean; in *Ophiocephalus punctatus*; and markedly so in *Anabas scandens* (the Climbing Perch of India), where the bony excrescences look like the buds on opposite sides of a twig just before they burst open. When the skull is opened by a vertical cut down the middle, the differences in the location of the sacculus can more readily be appreciated. In some fishes this lies nearer the eye orbit, in others it is further away. Again, in some it is close to the middle line of the head, in others it is away to the side of the skull; this is noticeable in the *Gobiidæ* (the Gobies); in *Tetrodon leopardus* (an Indian Globefish); and in *Anableps tetropthalmus* (the Four Eyes of Demerara). In the *Mormyridæ* (Nilotic fishes) quite a different arrangement to the usual one is to be seen. The sacculus is attached in *Mormyrus kannume* to a bladder-like termination of the swimming bladder, and is situated at the back part of the skull. In some families the sacculus is completely embedded in the basi-occiput bone, which has to be carefully split up to extract the sacculus and its contents. This is so in the *Characinidæ*, the *Cyprinidæ* (the Carps), and the *Siluridæ* (the Cat fishes); all belonging to the *Ostariophysi* suborder of fishes, *i.e.* those that have their swimming bladder connected with their hearing organs by means of a series of bony ossicles known as the "Weberian ossicles." In other fishes the sacculus with its enclosed otoliths, although embedded in a bony pocket, is not so solidly encased as in the *Ostariophysi*, and the opening where the junction of the sacculus with the utriculus is effected is more patent. In some this opening is small and the bony walls of the pocket have to be cut away to release the sacculus; in others the opening is big enough to allow the sacculus to be lifted out through it. Other fishes have the sacculus lying fairly open in a depression rather than a pocket, whence it can be lifted out with a pair of forceps and removed, a trifle of bone perhaps having to be cut away to release one or other end of the stone; this is so with *Gadus merlangus* (the Whiting). Again, the sacculus may be lying in the open on the floor of the brain cavity, it can be picked up and removed without further trouble; this is so with *Zeus faber* (the John Dory), and *Batrachus surinamensis* (the

Pacuma of British Guiana). Differing, then, as they do in the quantity of bone with which the sacculus is surrounded, there is also a difference as to the roominess of the bony pockets. With the *Ostariophysi* the sacculus fits compactly in the cavity provided for it, with no room for movement. In *Brama raii* (Ray's Bream, Couch), on the contrary, the cavity is much longer than the sagitta in its sacculus, and this could be moved backwards and forwards freely. In the *Sciæindæ* also the pocket for the sacculus is roomy. In those fishes having a well-defined lapillus, the third otolith, there is always a cavity in the skull for the "*Recessus utriculi*" to rest in, this being that part of the ear labyrinth holding the lapillus. Notably is this so in the *Siluridæ*, to accommodate what in some of this family is a very large stone; this cavity is well-defined on the outside by a bulging-out of the bone of the skull: this is clearly seen in *Arius spixii*.

To get a more definite idea of the location of the sacculus and of the otoliths it will be as well to take the families *seriatim* of such as have been available for examination.

Polypteridæ.

Polypterus senegalus has the pocket for the sacculus high up at the side of the skull and open; the sacculus could be extracted with a little manipulation without cutting away any bone. In this fish the asteriscus* is the largest of the three otoliths.

Acipenseridæ.

Acipenser sturio (the Sturgeon). In this fish the sacculus contains otoconie as well as a solid sagitta.

Amiidæ.

Amia calva (the Bowfin of North America) has the asteriscus as the largest of the three otoliths on each side. The location of the sacculus and its contents is shown from the outside by a swelling on the basi-occiput of thin shiny bone. The sacculus and labyrinth of the ear are situated in a recess separated from the brain in the cranial cavity by a diaphragm of cartilage. The sacculus is in two well-defined portions, the lagena, the posterior and larger one, holding the asteriscus (fig. 8, p. 109).

* Figured in the 'Zoologist' (vol. xiv., p. 294, pl. ii. f. 5).

LEPIDOSTEIDÆ.

Lepidosteus osseus (the Long-nosed Garpike of North America) has a well-defined pocket for the sacculus at the side of the head, The sagitta* in this fish is the largest otolith.

CERATODONTIDÆ.

Neoceratodus fosteri, called the Burnett salmon, another name being the Dawson salmon of Queensland, Australia. This, the only living example known of this family, has no indication on the lower side of the skull showing the location of the sacculus; but at the top of the skull two prominences show, when the skin is taken off, that indicate the upper part of the vertical semicircular canals of the labyrinth. In the specimen examined there were only four otoliths found, two on each side. An illustration of them is given natural size (fig. I., 1, p. 107). The two upper ones are from the right side of the head, the two lower from the left. The lapillus is the upper one of each set, the other being the sagitta. These otoliths are very chalky-looking and not so porcelain-like as in teleostean fishes. The texture can be compared in the photograph with those shown (fig. I., 3 and 4).

LEPIDOSIRENIDÆ.

The otolithic material in the head of *Lepidosiren paradoxa* is in the shape of dust, otoconie.

ELOPIDÆ.

Megalops atlanticus (the Tarpon) has the sacculus lying in a bony pocket fitting the sagitta closely, with a distinct pocket for the lagena portion of it. The lagena itself is well developed and holds a fair-sized asteriscus. The pocket for the sacculus is open at the top.

ALBULIDÆ.

Albula conorhynchus, the specimen secured, came from Java; the site of the sacculi is shown by two prominent swellings under the basi-occiput. The sacculus is not embedded in a bony pocket, the sagitta could be easily lifted out. It is large for the size of the fish.

* See 'Zoologist' vol. xiv., p. 294, pl. ii. f. 6.

MORMYRIDÆ.

In this family the sacculus is at the back of the skull, to one side, away from the middle line and separated from the cavity holding the brain by a diaphragm of a thick skin-like substance. The ear membranes are attached to an ovoid-shaped bladder, a prolongation of the swim-bladder. The whole arrangement is totally different from that of any other family of fishes. This is

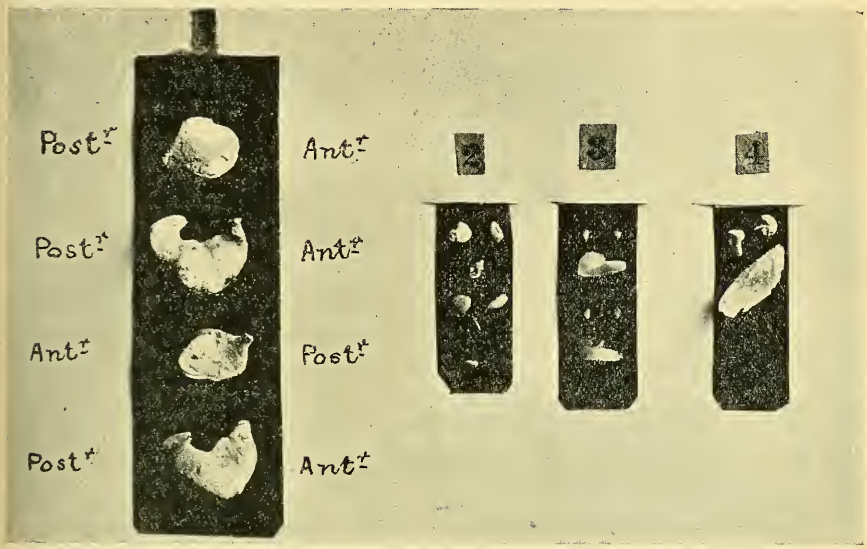


FIG. I.

1. NEOCERATODUS FOSTERI. 2. HYODON ALOSOIDES. 3. OSPHROMENUS OLFAX. 4. Otoliths from right side only of POLYNEMUS TETRADACTYLUS.

seen in *Mormyrus kannume*, *Hyperopisus bebe*, and *Marcusenius isidori*, all from the Nile River. In *Mormyrus kannume* the lapillus is the largest otolith of the three (fig. II., 11,p. 109). It is, however, nearly equalled by the astericus. The length and breadth of the two are nearly equal, but in thickness the lapillus is the greater, the astericus being, as is usual with this stone, comparatively thin.

HYODONTIDÆ.

Hyodon alosoides (the Mooneyes of Canada) has no outside evidence of the position of the sacculus as far as the bones of the skull are concerned; but it may be noted that the sacculus lies

just under the forward end of a white leathery tissue forming the end of the swim-bladder, where this is connected with the ear labyrinth. The sacculus is embedded in a bony pocket which requires cutting away. The lagena lobe of the sacculus is larger than the front portion, the astericus being larger than the sagitta. The lapillus, however, in this fish is the largest of the three otoliths (see fig. I., 2, p. 107). The upper three are from the right side of the head, the lapillus being to the left, the asteriscus to the right, and the sagitta below them. The three lower in the same order belong to the left side. A similar system is kept to in all the other illustrations of the otolith. When otoliths have been missed in dissection their place is left blank. When, however, a whole side is wanting, the ear labyrinth of that side has been kept for other purposes.

NOTOPTERIDÆ.

Notopterus afer, an African fish, has very thin transparent bone under the pockets in which the sacculus is contained, but this is covered by a prolongation of the swim-bladder, which requires to be removed to allow the sagittæ to be seen. The sagitta of this fish has a long spike of a projection to it; this is peculiar to the family of this fish. A complete set of the otoliths of *N. kapirat*, an Indian fish, is shown (fig. II., 3, p. 109).

OSTEOGLOSSIDÆ.

Osteoglossum bicirrhosum (the "Aroowana" of British Guiana) has no external indication to point out the location of the sacculus. It is much enclosed in bone, which has to be split up and cut away to obtain the sacculus and its contents.

PANTODONTIDÆ.

Pantodon buchholzi, an African fish of small size, has a fairly large and solid sagitta; it is shown (fig. II., 9, p. 109).

CHIROCENTRIDÆ.

Chirocentrus dorab, from the Indian Ocean, gives no indication from the outside as to the situation of the sacculus. It is much embedded in bone.

CLUPEIDÆ.

Clupea harengus (the Herring) has its sacculus lying in a bony pocket that has to be cut away to get the sacculus out.

The same with *C. finta* (the Twaite Shad) and *C. ilisha* (the "Hilsa" of Bengal, but called "Pulla" in Scinde).

SALMONIDÆ.

Neither in *Salmo salar* (the Salmon) nor in *S. fario* (the Trout) is there any external indication of the situation of the otoliths. In the latter fish the pocket is open at the top, the sacculus could be lifted out without trouble. In *Osmerus eperlanus* (the Smelt) the sacculi are covered by two little ovoid

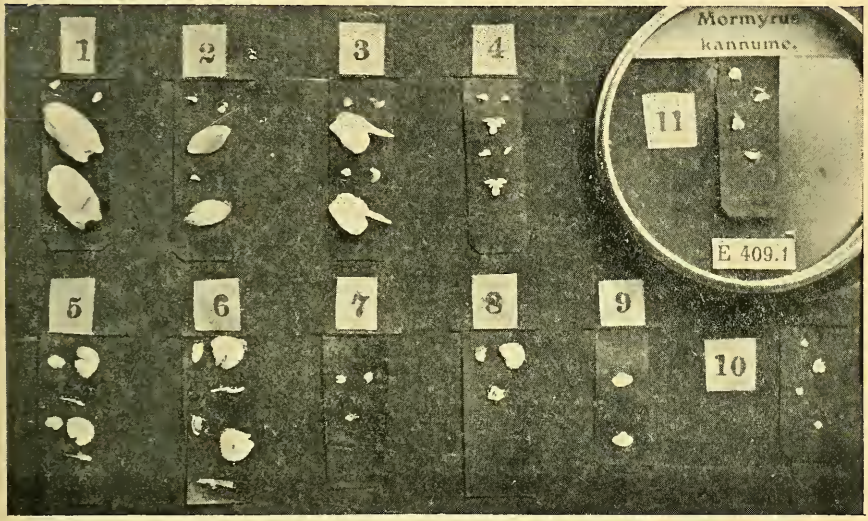


FIG. II.

1. NEBRIS MICROPS. 2. ANABAS SCANDENS. 3. NOTOPTERUS KAPIRAT.
4. ZEUS FABER. 5. ERYTHRINUS SALMONEUS. 6. MACRODON TRAHIRA.
7. PLECOSTOMUS BICIRRHOSUS. 8. AMIA CALVA. 9. PANTODON BUCHHOLZI.
10. BALISTES CAPRISCUS. 11. MORMYRUS KANNUME.

lumps of thin bone on the under side of the basi-occiput, which allow the sagittæ, large for the size of the fish, to be seen.* *Salvelinus willughbii* (the Charr) has no external indication of the situation of the sacculi. The basi-occiput has two swellings on the under side, but dissection reveals that they only cover the muscle actuating the eyeball. The sacculi really lie above this muscle. The cavity containing the otolith is open at the top, and the sacculus can be lifted out without cutting away of bone.

* *Salmo salar* and *Osmerus eperlanus* are figured in 'Zoologist,' vol. xiv., p. 293, pl. i. 13, 14.

(To be continued.)

NOTES AND QUERIES.

AVES.

Status of Blackcap and Garden-Warbler.—With regard to the correspondence on this subject, I can state that here, a few miles west of Lincoln, in my experience, the Garden-Warbler is far commoner than the Blackcap. I have frequently noted the fact.—F. L. Blathwayt (Doddington Rectory, Lincoln).

Status of Lesser Whitethroat.—Referring to Mr. Gill's remarks (*ante*, p. 36) regarding the status of the Lesser Whitethroat, I quite agree that the distribution of this species as given in most ornithological works is very imperfectly mapped out; this, no doubt, is owing to its having been confused with two or three other species of Warblers. Gilbert White mentions a "rare, and I think a new, little bird frequents my garden, which I have great reason to think is a Pettychap. It is common in some parts of the kingdom. This bird much resembles the Whitethroat, but has a more white or rather silvery breast and belly, is restless and active, like the Willow-Warbler, and hops from bough to bough, examining every part for food; it also runs up the stems of the crown-imperial, and putting its head into the bells of the flowers, sips the liquor which stands in the nectarium of each petal," which was evidently referable to this species; and it is quite obvious that much confusion existed in the mind of the late A. G. More when he wrote his work on the distribution of birds during the breeding season; and in the Yorkshire records by Thos. Allis, many of which are extremely doubtful. This species appears to be less common and more restricted in its distribution in the western than in the eastern half of England, but even in the eastern counties it is very irregularly distributed, and the same remarks would apply to Wales. It is said, however, to be fairly common in some parts of Cheshire and also in Derbyshire, which has not been my experience regarding its status in the latter county, but my visits have been comparatively short, consequently my observations on that account may not be so valuable as more prolonged sojourns would have been. My visits have been chiefly confined to the

Peak District, the general physical features of which are very similar to North-west Yorkshire, and such conditions are not suitable habitats of the Lesser Whitethroat, at least in its Yorkshire range. In this district (Wilsden) I have only three occurrences for over forty years; twice it has bred, and, curious to say of both instances, almost in the identical bush in the Aire Valley, near Bingley. It is said to be an early breeder—much earlier than the Whitethroat—but I think this is a mistaken idea. It seems to prefer feeding among the higher branches of trees than the commoner species. Even to the seventies very little was known regarding the distribution of this species in Yorkshire, and it is to be feared that much confusion exists at the present time. In the north-west of Yorkshire it is a very rare nesting species. Morris says it is found near Halifax, but probably he copied his statement from the source which supplied Thos. Allis with his information. It is, however, hardly probable that the Lesser Whitethroat will be commoner there than in this district. In some districts to the east it is fairly common, or at least not rare, *viz.*, about Neatherby, Thorp Arch, and Boston Spa, whilst in the neighbourhood of York it is said to be more abundant than *Sylvia cinerea* (Nelson); further south-east, about Beverley and the Holderness district, it is more sparingly distributed. It is not uncommon in the Huddersfield district, but is said to be absent from the district of Sheffield, although Thos. Allis reported it as common in 1844, and it is also absent from the neighbourhood of Flamborough Head. It is sparingly distributed in some of the valleys in the neighbourhood of Whitby, and the same remarks apply to Staithes and Loftus, in North Yorkshire, and it is a summer visitor to Marske and Ellerton, in Swaledale. It breeds but locally in some parts of Wensleydale, and was considered a rare bird about Wakefield until the year 1870, but this might be on account of its having been overlooked or confused with some other species—a common mistake up to within a recent date; the Lesser Whitethroat is not included in the list of birds of Washburndale by Roebuck and Clarke, nor in the list of birds of Langstrothdale by Wood. Much remains yet to be known of its range in Yorkshire. This, however, is certain, that it is a rare breeding species in North-west Yorkshire, and nowhere can be called abundant except in the central plain. Personally I have never met with this species more commonly than its near ally *cinerea* in any part of Yorkshire.—E. P. Butterfield.

Waxwings in Yarmouth and the Neighbourhood. — Unusual numbers of Waxwings (*Ampelis garrulus*) have visited the east coast

during the present winter, six having been seen at Yarmouth, four in the adjoining parish of Caister, and several others in the neighbourhood. I received three examples from Runham, about four miles from here, one on December 20th and two on the 24th. The first of these was a very fine specimen, having wax-like appendages on the tail, besides seven on each wing. These appendages are very rarely seen on the tail; this circumstance probably not occurring more than once out of twenty examples. On the wings the red tips vary in number from three to seven, according to sex and age. One bird taken at Yarmouth had no sign of red on its wings, and the band across the tail was a greyish white instead of yellow. I should think this is the record season for this species.—B. Dye (Yarmouth).

Waxwings (Ampelis garrulus) in Bedfordshire.—The first reported occurrence of the Waxwing in Bedfordshire during the past winter is given in the 'Bedfordshire Times and Independent' in its issue of December 19th, wherein one is mentioned as having been shot near the River Ivel at Biggleswade. On January 20th one of two was killed in a garden along the Clapham Road, in the borough of Bedford; the other that was in its company has been seen in the same grounds several times since. Another was obtained at Colworth House, Sharnbrook, on January 22nd. The previous known occurrence of Waxwings in this county was one obtained early in 1904, killed in the Bedford Cemetery. Earlier records were in the winters 1882–83, 1884–85, 1889–1890, 1892–93, 1894–95.—J. Steele Elliott (Dowles Manor, Shropshire).

The Little Owl Breeding in Somerset.—On May 24th of last year I had a set of five eggs brought to me taken the same day by a farm labourer at Doulting; he said they were Owl's eggs, and that he had taken them from the decayed head of a pollard elm tree. The eggs puzzled me, for although they were almost identical with some eggs of the Little Owl in my possession, I could not say with certainty they belonged to that species: I mentioned the matter to a few friends in the locality who promised to keep a look-out for any strange Owls. During the past autumn Mr. Arthur Elton saw a small spotted Owl flying about the fields close to the ground, pitching here and there on low branches of trees, and on February 3rd last he shot one close to his farmyard at Bodden, a mile or so from Doulting, and brought the bird to me on February 4th; it was without doubt *Athene noctua*. I sent it to Mr. W. J. Clarke, of Scarborough, to be set up, and the following are his notes taken on dissection:—Adult female, eight and three-quarters of an inch in length and six inches

and a quarter from the carpal joint of wing to longest primary, weight five ounces and a half; its stomach contained a few small pellets of the hair of some small mammal, and the hard portions of a single small beetle. I now conclude that the eggs mentioned above are genuine eggs of the Little Owl, and that this species breeds in this particular spot on the Mendips, about two miles north-east of Shepton Mallet. This is, I think, the first discovery of its breeding in Somerset, but not of the presence of the bird. I may add that it was not my wish this bird should have been shot, and Mr. Elton has promised not to shoot another, should one happen to come in range.—Stanley Lewis (Wells, Somerset).

Iceland Gull in Co. Mayo.—On January 27th an Iceland Gull (*Larus leucopterus*) in immature plumage was shot on the island of Bartragh, Killala Bay, by Miss Kirkwood. When leaving the house for the shore, she saw it flying slowly past, and pitching on the strand a couple of hundred yards away it began feeding. Having her light gun with her, she immediately commenced stalking the bird, and coming within range fired, knocking it over, but as it was only winged she has kept it alive, in the hope of taming it and curing its wounded wing, and if successful intends sending it to the Zoological Gardens, Dublin.—Robert Warren (Ardnaree, Monkstown, Co. Cork).

OBITUARY.

Dr. Albert Günther.

At the request of the Editor of this Journal I have to offer to its readers a brief obituary notice of the late Dr. Albert Günther, a task congenial to one who was associated with him for many years, in fact, during the greater part of the period 1856 to 1895, when he was connected with the British Museum.

It will not, however, be on account of the position he held in that Institution that he will be known to future zoologists, but by the extent and character of his voluminous writings.

From an authoritative source we are informed that he was born at Württemberg on October 3rd, 1830, and was educated at Stuttgart Gymnasium, and at Tübingen, Berlin and Bonn Universities, obtaining the degrees of M.D., M.A., and Ph.D.

At the conclusion of his University courses he visited London, and his services at the Museum commenced in 1857, being first employed on a 'Catalogue of Colubrine Snakes,' published in 1858, and extending to nearly 300 pages. In the same year was issued his 'Catalogue of Batrachia Salientia,' pp. 176, with 12 plates. He then commenced his great work the 'Catalogue of Fishes,' completed in eight volumes. These comprised over 4000 pages with text figures, and occupied most of his time during the next twelve years. In 1877 was issued his 'Account of the Gigantic Land Tortoises' (living and extinct), containing 96 pages of text and illustrated with 55 plates.

His report on the Reptilia, Batrachia and Fishes from Melanesia, and Reptilia from the Western Indian Ocean, obtained by H.M.S. 'Alert,' was published in 1884. The foregoing constitute practically all the works published by the Museum, of which he was author.

His other chief writings are:—'Die Fische des Neckars,' 1855; 'Handbuch der Medicinischen Zoologie,' 1858; 'The Reptiles of British India,' 1864; 'The Fishes of Zanzibar,' 1866; 'Description of Fishes from Vancouver' in J. K. Lord's "The Naturalist in Vancouver Island and British Columbia," Appendix, 1866; in the Appendix to vol. ii. of 'Mouhot's Travels in the Central Parts of Indo-China,' &c., "Lists of New Species of Mammalia, Reptiles and Freshwater Fishes," 1864; 'The Fishes of the Nile' in Petherick's "Travels in Central Africa," vol. ii. Appendix, 1869; 'Reptiles and Fishes of the South Sea Islands' in Brenchley's "Cruise of H.M.S. 'Curaçoa'," 1873; 'A List of the Saurians of Australia and New Zealand' in the "Zoology of the Voyage of H.M.S. 'Erebus' and 'Terror'," vol. ii. 1875; 'Fishes from the Arctic Regions' in Nare's "Narrative of a Voyage to the Polar Regions," vol. ii. Appendix 4, 1878; 'Die Fische der Südsee,' 1873–1910; 'Introduction to the Study of Fishes,' 1880; 'Shore Fishes of the "Challenger" Expedition,' 1880; 'The Deep Sea Forms,' 1887; and his 'Account of the Pelagic Species,' 1889; 'Description of Fishes from the Arctic Regions' in Markham's "A Polar Reconnaisance—Voyage of the 'Isbjörn' to Novaya Zemlya," Appendix i. 1881; 'Herpetology of Matabale Land' in Oates's "Matabeleland and Victoria Falls," Appendix iii. 1881; 'Report on the Fishes' in Tizard and Murray's "Exploration of the Faroe Channel in 1880 in the 'Knight Errant'," 1882; 'On the Reptilia and Batrachia' in Godman and Salvin's "Biologia Centrali-Americana," 1885–1902; 'List of Reptiles and Fishes collected on the Upper Yang-tze-kiang,'

&c., in Pratt's "To the Snows of Tibet through China," Appendix ii. 1892; 'Report on a Collection of Fishes made during an Expedition to Lake Rudolf' in A. D. Smith's "Through Unknown African Countries," Appendix A, 1897; 'Report on a Collection of Reptiles and Fishes made on the Ogowé River and in Old Calabar' in M. H. Kingsley's "Travels in West Africa," Appendix iii. 1897.

In addition to the foregoing more or less extensive productions, he was the author of very numerous papers published in the journals of the Royal, Linnean, Zoological, and other Societies, and in other periodical publications. As many as three hundred can be attributed to his pen. The whole of his writings occupy some ten thousand pages, illustrated by a very large number of beautiful plates and text figures. He was also one of the editors of the 'Annals and Magazine of Natural History' from 1875 to 1912, and edited the first six volumes of the 'Zoological Record,' 1864–69.

This will give the reader an idea of the literary work accomplished by Dr. Günther; but it must be remembered that for twenty years (1875–95) he was Keeper of the Zoological Department, and the amount of administrative work connected with that position is only known to those who have served immediately under him. The supervision of his staff, the preparation of numerous reports in connection with the individual members of the staff, monthly and annual reports of progress and work accomplished, the supervision and editing of catalogues and guides issued by his Department, besides the consideration of all proposed acquisitions, and the attending to considerable correspondence continually arriving—these are only the principal duties which came to him as Keeper. It is, indeed, surprising that he found time during that period to publish the important works and treatises which issued from his pen.

Dr. Günther was in a great measure responsible for the careful removal in 1882–84 of the Zoological Collections from the British Museum in Bloomsbury to South Kensington, a very considerable undertaking, which was accomplished practically without injury to any of the specimens. He also to a great extent directed their subsequent rearrangement in the building where they are now displayed.

At Dr. Günther's recommendation the building at present containing the immense collections preserved in spirit was erected. The formation of the general and zoological libraries resulted also from his recommendation, and he was especially proud of having got together the groups of British nesting-birds, with their natural

surroundings, which have proved of such interest to the general public.

Mainly through Dr. Günther's recommendation the National Museum is indebted for the possession of many valuable collections of the greatest scientific interest. Among these may be mentioned the following:—The Gould collection of Birds, Baly collection of Phytophaga, Bates collection of Heteromera, Zeller Lepidoptera, the Keyserling Arachnida, Frey Lepidoptera, the Moore Indian Lepidoptera, the Atkinson Coleoptera and Rhynchota, the Saville-Kent Corals, Parker Foraminifera, Pascoe Coleoptera, Morelet Land and Freshwater Shells, Captain Shelley's African Birds, Godwin-Austen's Indian Birds, the Oates collection of Birds of Pegu, the Sclater collection of Birds, the Grote North American Lepidoptera, and many other minor collections.

Many most important additions to the Museum collections were acquired by presentation during the same period, and in some cases it was doubtless owing to Dr. Günther's tact and urbanity that these donations were received.

Many honours were conferred upon him by various societies both at home and abroad. He was elected Fellow of the Royal, Linnean, and Zoological Societies, and filled the offices of Vice-President of the Royal Society (1875–76), and President of the Linnean Society (1898–1901). He was recipient of the Royal Society's gold medal in 1878, and also that of the Linnean Society in 1904. In 1880 he was President of the Biological Section of the British Association.

On the authority of one eminently qualified to express an opinion on the zoological work accomplished by Dr. Günther, it can be stated without fear of contradiction that he was the foremost ichthyologist of his day, and his *magnum opus*, the 'Catalogue of Fishes,' has never been replaced by any similar comprehensive work. His writings on the Reptilia were also on the same high level.

Dr. Günther was a man with a strong personality, but with all his firmness of disposition he ever maintained a friendly relationship with those associated with him in the work of the Museum, and when freed from that official relationship he at once became the most pleasant of personal friends, of whom he had a very wide circle.

He was twice married, and leaves a widow and two sons to mourn his loss. His death took place this year on February 1st in his home at Kew, and he was buried at Richmond in the presence of those he loved and many sorrowing and devoted friends.

E. A. Smith.

Major Barrett-Hamilton.

Gerald Edwin Hamilton Barrett-Hamilton, only surviving son of the late Capt. Samuel Barrett, who, in 1887, assumed the additional name of Hamilton; of Kilmanock House, Campile, Co. Wexford, was born 1871; educated at Harrow and at Trinity College, Cambridge, where he graduated B.A. in 1894, taking a First Class in the Natural Science Tripos, in the same list with his friend Dr. Edward Adrian Wilson, who was afterwards to become the artist to Barrett-Hamilton's great book on the British Mammals. Called to the Bar at the Inner Temple, 1896; in May of that year, with Professor D'Arcy W. Thompson (now C.B.), he visited the Fur-Seal Islands of the North Pacific on behalf of the Foreign and Colonial Offices, with a view to the investigation of the Natural History of the Northern Fur Seal, "with special reference to certain disputed points which have a distinct bearing on the industry connected with the skins of the animal." * While the Professor proceeded direct to the Pribiloff Islands, Barrett-Hamilton had instructions to visit the Commander Islands (near the coast of Kamchatka). Later they proceeded together to S. Paul Island, the largest of the Pribiloff group, returninn home at the beginning of the next year. Barrett-Hamilton had formed a collection of small mammals, together with specimens of the Northern Fur Seal, a series of skulls of Steller's Sea-Lion, and a skin which was mounted for the National Collection at Cromwell Road. There were also fair collections of birds, fishes, and invertebrates.

He served in the S. African war, 1901–2, in the latter year being gazetted an Hon. Captain in the army. In 1903 he married Maude Charlotte, only daughter of F. S. Eland, Esq., of Ravenshill, Transvaal, who survives him, together with six young children. Served as High Sheriff for Wexford, 1904. In 1905 he was promoted Major of the 5th (Militia) Battalion (Special Reserve) Royal Irish Rifles; elected F.Z.S. and M.R.I.A.

Between 1898 and 1904 he gave numerous lectures in all parts of the United Kingdom on different subjects connected with the mission, including papers before the British Association in 1898 and 1899.

His report on the Behring Sea Mission was so well received that he gained special recognition from the Government; and later was asked to report on the collection of mammals made during the

* 'Proc. Zool. Soc.,' 1897, p. 190.

Antarctic voyage of the 'Southern Cross.' * Previously to this he had applied (as he has himself told us in his "Appreciation of Dr. E. A. Wilson," published with part xiv. of his 'History of British Mammals' in August, 1913) for appointment to the scientific staff of Scott's first Antarctic Expedition (1901–4), when Wilson was selected, doubtless on account of his marvellous skill as an artist, combined with his qualifications as a doctor; while to Barrett-Hamilton fell the honourable task of compiling for the use of the expedition the chapter on Seals in the 'Antarctic Manual' (1901).

There is something singularly pathetic in the coincidence of the author pausing during the publication of his principal work to write an appreciation of his artist who had perished in the Antarctic; and only five months later the publishers again pausing while a similar sad office is performed by an old friend (Mr. Oldfield Thomas, F.R.S.) of the author, who has now himself died on what may be called the threshold of the same Antarctic.

He maintained a weekly correspondence from his Cambridge days until his death in 1907 with Professor Alfred Newton, who took the greatest interest in and guided his career, and who always regretted that his life was not wholly given up to zoology. His output of papers and notes on all branches of zoology was very large, but space does not allow an extended notice of them.

Early in 1904 Barrett-Hamilton "approached" the present writer by asking if he could supply certain specimens of British mammals for the National Collection at South Kensington, but in his third letter he divulged his real object:—"I may as well tell you straight out that I have accepted the invitation of the owners of Bell's 'British Quadrupeds' to bring out a new edition of the work, and I am very anxious that it should be as good and up-to-date as possible. That is why I am anxious to obtain reliable information upon the moults, periods of gestation, &c., of the smaller and rarer carnivora, on which points I believe that no one has anything like the knowledge which you have." Correspondence on a subject so congenial to both of us once started, has flowed ever since, generally with very short intervals, ending only with his lamented death, ten years later. Another quotation or two will help to show the early stages of the work, though not by any means its inception, because from his youth he had cherished the idea, and his preparations began early.

* "Report on the Collections of Natural History made . . . during the Voyage of the 'Southern Cross.'" Mammalia. 1902. Sold at the British Museum Natural History.

A few days after the last letter quoted from, he wrote:—"Certainly no one would do a perfect book, but there is room for more accuracy and detail than has already been placed before the public." Ten days later:—"What I think I shall most need your assistance in regard to are certain small matters. . . . Then again, if you can favour me with a general criticism of my work when it takes shape, I shall of course be very grateful. . . . I hope presently to send you some draft MSS. on *Mustelidæ*."

Considerations of space preclude many quotations, and it must suffice to record that the first part of the great work eventually appeared on October 18th, 1910, and that since then the present writer has read every proof, making every kind of criticism and suggestion that seemed to him improvements, with frequent consultations and discussions, Barrett-Hamilton proving a charming person to try to help, because he was always so grateful, and (what was even more to the point) because he adopted a very large proportion of the suggestions!

On July 10th, 1913, he wrote:—"I wonder if you will be surprised or shocked when I tell you that I have accepted a mission from the Colonial Office to go and study the whaling at South Georgia. I couldn't refuse it, . . . and it is a beautiful trip *viâ* Portuguese ports. . . . I am much troubled about my 'British Mammals.' . . . I count that the knowledge which I shall get on Whales will more than recompense the book for any slight 'hold up,' and I am hoping to use my spare time in writing the Whale parts of it. It's most curious that fifteen years ago they should have sent me to Kamchatka, which no one had ever heard of, and now to South Georgia, which is nearly as bad in the opposite direction. But I am a lucky naturalist to get these trips. . . ."

Writing at sea on his passage out, on October 15th last (posted at Cape Verdes), he begins a long letter:—"The world is very small! Here I am, sailing to South Georgia under your old friend of the Finland [= Finmarken] whaling days, Capt. I. Bryde,* who sends you his best respects! Your volume of reprints [= of Whaling Reports] has been of the very greatest use to me, as I hope you will be glad to hear. I have been abstracting information from it the last few days, and in some respects your statistics are the most valuable I can find. I hope to use them for comparison with those to be obtained later

* *Vide* "Reports on Finwhaling off Coast of Finmarken," 'Zoologist,' 1886–1890, and his father in those published 1884–85. Also 'Saga Book of the Viking Club,' 1895–6, vol. i., p. 322.

on in South Georgia. I hope you will be kind to me about my 'Mammals' while I am away."

After a passage of thirty-five days, he reached South Georgia, accompanied by an assistant from the Natural History Museum. On December 2nd he wrote again, "for post as opportunity offers," another long letter about Whales, enclosing elaborate analyses compiled from the above-mentioned Reports in the 'Zoologist' (1884–90). He adds:—"I haven't seen a great many Whales yet, only a few (of each) Finners, Humpbacks, Blue and Sperm; but the notes which I have been able to make support or amplify yours. . . . I arrived here on November 10th. I find the place most interesting—Sea Elephants, Sea Leopards, Weddell's Seal, four or five kinds of Penguins, Albatrosses, and numerous *Procellariidæ*, all to be studied, besides the Whales, but at present I am chiefly engaged with the latter. I haven't time to write a full account, as when there are Whales on the platform I am there from 6 a.m. Some days the weather is charming, and of course we have the summer sun, but it blows and snows frequently, and there is little vegetation yet."

This letter was received on January 14th, and on the 17th occurred his apparently almost sudden death from heart failure.

The melancholy news was conveyed from South Georgia to the Falkland Islands by a whaler, a run which occupied a week. Another week was occupied by a cablegram thence to South Kensington; and from there the sad fact, lacking of course all details, was communicated to Mrs. Barrett-Hamilton, who has since heard that his body is being brought home by the whaler 'Orwell,' due at Liverpool about February 27th, so before this appears in print he will no doubt have been laid to rest near his Wexford home.

One would wish to write much more about him, who always believed the best of everyone, but already the limit of space is considerably exceeded.

Alfred Heneage Cocks.

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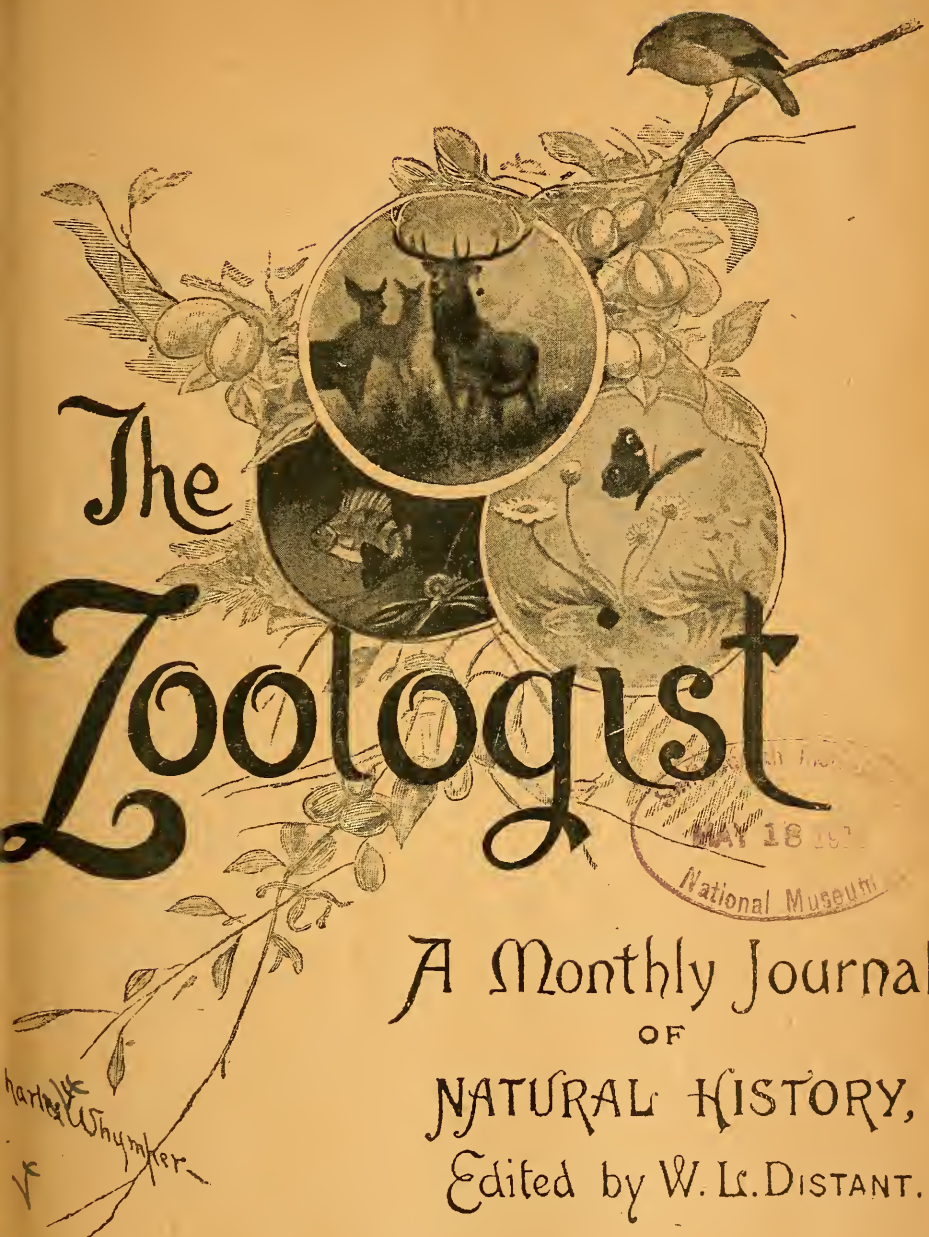

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THE ZOOLOGIST

No. 874.—April 15th, 1914.

SOME NOTES ON EELS (*ANGUILLA VULGARIS*) AND EEL-CATCHING IN BEDFORDSHIRE.

By J. Steele Elliott.

The River Ouse has for centuries had a reputation for the number of Eels taken from its waters. In the time of King Edgar a rent of 2000 Eels was paid by Stuntney Fen to the monastery of Ely. This payment eventually ceased for six years, and after a trial held at Cambridge the arrears of 12,000 were required to be paid, in addition to the annual rent of 2000 Eels.*

For the earliest mention of Eels in the county of Bedfordshire we are indebted to the Domesday Survey. Herein is given the Eel value paid as part rent at certain of the water mills as under :—

2 Mills,	Tempsford,	paid	120	Eels	and	40/–
1 Mill,	Little Barford,	,,	125	,,	,,	12/–
2 Mills,	Eaton Socon,	,,	100	,,	,,	36/6
2 ,,	Stanford,	,,	50	,,	,,	29/–
2 ,,	Clifton,	,,	150	,,	,,	40/–
1 Mill,	Putnoe,	,,	100	,,	,,	30/–
1 ,,	Chainhalle,†	,,	100	,,	,,	40/–

* Dugdale, 'History of Imbanking,' &c., 2nd edit., p. 183.

† The locality of this Manor, in the Half-Hundred of Buchelai, has never been satisfactorily determined. Channel's End, in the parish of Colmworth, is suggested in the 'Victoria County History, Bedfordshire' (vol. i., p. 237), and again Ravensden, in the 'Bedfordshire Historical Records' (vol. i., p. 63). Neither of these writers seems to have taken the *Mill* into considera-

1 Mill,	Goldington,	paid	100	Eels	and	30/–
1 ,,	Cardington,	,,	100	,,	,,	40/–
1 ,,	Willington,	,,	100	,,	,,	12/–
4 Mills,	Stotfold,	,,	400	,,	,,	80/–
1 Mill,	Bromham,	,,	125	,,	,,	20/–
1 ,,	Great Barford,	,,	80	,,	,,	22/–
1 ,,	Roxton,	,,	260	,,	,,	33/–
1 ,,	Oakley,	,,	200	,,	,,	26/–
1 ,,	Odell,	,,	200	,,	,,	36/8
1 ,,	Bromham,	,,	100	,,	,,	40/–
1 ,,	Harrold,	,,	200	,,	,,	36/8

A total of twenty-five mills paying as part rent 2610 Eels.*

There does not appear to have been any fixed custom as to a part payment of mill rents by Eels, as the other seventy mills in the county referred to in Domesday paid by money value alone. Such rentals varied, from a mill at Sharnbrook rented at 16 pence and another at Keysoe 2/–, to one at Clapham at 40/–. Whether the right of taking Eels in fixed traps was restricted by the holders to certain of their mills only is a moot point, but not an improbable one, as any additional traps fixed above their respective mills would seriously affect their catches.

River Ouzel.

Heath and Reach. Grange Mill.—One trap, 4 ft. 6 in. × 13 ft. Average take of Eels per year, 3½ cwt. Heaviest catch, 1½ cwt. Largest taken, over 4 lb. First trap on this tributary of the River Ouse. Owing to the chemical refuse flowing into this stream at Leighton Buzzard, the taking of Eels at this mill has considerably depreciated.

Holcot Mill.—One trap, 3 ft. 6 in. × 6 ft. Average take of

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tion, which, judging from its comparatively high rental, must have been one of the most important in the county. Therefore we can reasonably presume the position of this Manor was adjoining the Ouse, and not remote from any important stream, as either of those two localities place it. Even from the part payment of the rent with Eels, it is as practically certain it could not have been either of the above-mentioned localities.

* It seems probable that there would be some restrictions as to size or weight of Eels in these payments, but nothing is recorded in the Domesday Book.

Eels per year, 28 lb. Largest taken, over 2 lb. First trap on this tributary of the Ouzel, which stream flows through the Woburn Park pools.

River Ivel and its Tributaries.

*Doolittle Mill** (*Ampthill*).—One trap, 2 ft. × 6 ft. Very few Eels are taken. Largest, 2 lb. Trap worked irregularly. First trap on this tributary of the Ivel.

Campton Mill.—One trap, 2 ft. × 6 ft. 6 in. Average take of Eels per year, 1 cwt. Heaviest catch, 15 lb. Largest taken, over 5 lb. Trap worked regularly. First trap on another tributary of the Ivel.

Shefford Mill.—Two traps, 3 ft. × 11 ft. and 7 ft. × 11 ft. Fixed inside mill and under floor. Average take of Eels per year, 4 cwt. Heaviest catch, ¾ cwt. Largest taken, over 6 lb., others 5 lb., and several over 4 lb. Trap worked regularly. First traps on the main stream of the Ivel.

Astwick Mill.—Trap destroyed about 1908. Average take of Eels per year was about ½ cwt. Formerly the first trap on this tributary of the River Hiz.

Langford Mill.—One trap, 6 ft. × 14 ft. Inside mill. Average take of Eels per year, 2 cwt. Heaviest catch, 1½ cwt. Largest taken, over 4 lb. Trap worked irregularly. Now the first trap on the Hiz.

Holme Mill (*Biggleswade*).—One trap, 4 ft. 6 in. × 13 ft., inside mill; two traps, 4 ft. 6 in. × 12 ft., outside mill. Average take of Eels per year, 5 cwt. Heaviest catch, 1 cwt. Largest taken, over 4 lb. Trap worked regularly. Four miles of water on the combined stream to Shefford Mill and Langford Mill.

Biggleswade Mill.—One trap, 6 ft. × 13 ft. Inside mill. Average take of Eels per year, ¾ cwt. Heaviest catch, 30 lb. Largest taken, 4 lb. Trap worked irregularly. One mile of water to Holme Mill.

Sandy Mill.—Three traps, 3 ft. × 16 ft. Average take of Eels per year, 2½ cwt. Heaviest catch, 40 lb. Largest taken, 4 lb. Traps worked regularly. Three miles of water to Biggleswade Mill.

* The first mill on a stream is oftentimes known as the "Doolittle" Mill. There is another mill of this name near Eaton Bray.

Southill Pool.—One trap, 5 ft. × 7 ft. Average take of Eels per year, ½ cwt. Heaviest catch, several times over ½ cwt. Largest taken, 2 lb. Trap worked irregularly. Area of pool upwards of 33 acres.

Blunham South Mill.—Two traps, 4 ft. × 14 ft. 6 in. Average take of Eels per year, 4 cwt. Heaviest catch, 1½ cwt. Largest taken, over 5 lb.; three weighing 15 lb. taken in one night, March, 1912. Traps worked regularly, March to October. One and a half miles of water to Sandy Mill, and also stream from Southill and Warden pools.

Blunham Mill.—Two traps, 4 ft. × 16 ft. Average take of Eels per year, 3 cwt. Heaviest catch, 62 lb. Largest taken, 3 lb. Traps worked regularly. One mile of water to South Mill.

Tempsford Mill.—One trap, 4 ft. × 16 ft. Average take of Eels per year, 2 cwt. Heaviest catch, 1¼ cwt. Largest taken, four weighing 16 lb.; caught December, 1912. Trap worked regularly. One mile of water to Blunham Mill.

River Ouse.

Turvey Mill.—Three traps, 4 ft. × 16 ft. Average take of Eels per year, 5 cwt. Heaviest catch, 1 cwt. Largest taken, 5 lb., and several of 3 lb. and 4 lb. Traps worked regularly. Three miles of water to Lavendon Mill, in Buckinghamshire.

Harrold Mill.—One trap, 11 ft. × 27 ft. Average take of Eels per year, 1½ cwt. Largest taken, over 4 lb. Traps worked irregularly. Three and a quarter miles of water to Turvey Mill.

Odell Mill.—Two traps, 7 ft. 3 in. × 17 ft., 4 ft. 3 in. × 13 ft. Average take of Eels per year, 1 cwt. Largest Eels taken, 3 lb. to 4 lb. Traps worked irregularly. One and three-quarter miles of water to Harrold Mill.

Sharnbrook Mill.—Traps dismantled about 1890.

Milton Mill.—Three traps; two 5 ft. × 16 ft., one 3 ft. × 16 ft. Average take of Eels per year, 7 cwt. Heaviest catch, 4½ cwt., in one night in 1909. Largest taken in fifty years, 4½ lb. Traps worked regularly. Eight and a quarter miles of water to Odell Mill.

Oakley Sluice.—Three funnel traps, 4 ft. × 15 ft. Average take of Eels per year, 3 cwt. Heaviest catch, 300, about 1890. Largest taken, 6½ lb. in October about 1890. Traps worked

irregularly. Four and three-quarter miles of water to Milton Mill.

Bromham Mill.—One trap, 4 ft. × 16 ft., inside mill and alongside wheel. Average take of Eels per year, 6 cwt. Heaviest catch, 1½ cwt. in one night; 7 cwt. in a month about 1890. Largest taken, 6¼ lb. Trap worked regularly. Four and three-quarter miles of water to Oakley Sluice.

Kempston Mill.—One trap, 8 ft. × 15 ft. Average take of Eels per year, 1 cwt. Largest taken over 6 lb. Trap worked irregularly. Two and a half miles of water to Bromham Mill.

Duck Mill, Bedford.—Demolished and traps removed, 1890.

Cardington Mill.—Three traps, 4 ft. × 15 ft. Average take of Eels per year, 2 cwt. Heaviest catch, 3 cwt. in twenty-four hours, about 1909. Largest taken, 4 lb. Traps worked irregularly. Five miles of water to Kempston Mill. The "New Cut" would no doubt take the greater proportion of Eels from above Bedford direct to Castle Mill.

Castle Mill (*Goldington*).—Two traps, 9 ft. × 15 ft. and 5 ft. × 42 ft. Average take of Eels per year, 8 cwt. Heaviest catch, 2 cwt., about thirty years ago. Largest taken, under 4 lb. Traps worked regularly. Two miles of water between this and Cardington Mill, and in addition, that proportion of the Eel supply *viâ* the "New Cut" from Kempston Mill.

Roxton Sluice.—One funnel trap, 5 ft. × 12 ft. Trap broken and not used for several years past. One of 9 lb. is recorded from information given to me by the late Mr. Martin George, of Tempsford, taken at Roxton Sluice about 1880.* I have since heard what was probably the same Eel spoken of as weighing 7 lb.

Eaton Socon Mill.—Four funnel traps. Three 4 ft. × 16 ft., one 4 ft. × 12 ft. Average take of Eels per year, 15 cwt. Heaviest catch, 10 cwt. in three days, about 1909. Average weight, ¾ lb. to 1 lb. Largest taken, 4 lb. 10 oz., length 37 in., in August, 1909.† If traps were worked regularly, an average of 1 ton per year could be taken. Ten miles of water to Castle Mill.

There are fourteen additional water-mills in the county at the present day where Eel-traps are not fixed.

* 'Victoria County History, Bedfordshire,' vol. i., p. 101.

† 'Bedfordshire Times and Independent,' August 6th, 1909.

The measurements of the traps are the extreme sizes taken from inside the sluice-gates. The average weight of Eels is taken from a period of the last ten years. The records of the heaviest catches taken in one night and the largest Eels obtained is from information generally.

The weight of Eels taken at the respective traps is in a few instances approximate only; the quantity taken at any particular mill is dependent upon how regularly the traps are worked, and in relation also to the number of Eels taken in other traps above stream. But the general total would not be affected. This shows an annual take within this county of 3 ton 18 cwt., which, taken at an average weight of ½ lb. each, would number nearly 17,500 Eels: At the local market price of 6d. per lb. the total catch would be practically £220 value, or even more if the London trade were supplied.

Drainage of the fens and the watershed of the Ouse generally must have accounted for a considerable decrease of Eels, and further no fish could be subjected to greater persecution by their capture, and it is not surprising to find that it would be impossible for several of the mills mentioned in the Domesday Book to take at the present time even as many as formerly paid for part rent.

Eels working down the Ouse from above Bedfordshire have to pass eleven traps within this county alone, or, again, nine traps from the upper reaches of the Ivel, any of which traps are practically capable of taking every Eel on migration.

But fortunately for the preservation of the Eel from extermination, the mill traps are often worked but intermittently, as when the miller's trade is good and the water supply limited it is oftentimes all required for motive power and none can be spared to pass through the sluice-gates for Eel-catching, and so at many of the traps they oftentimes escape capture.

The taking of Eels is principally by means of fixed traps, traps that are probably very little different in their construction from those of Norman times.* A trap consists of an upward sloping

* 'Victoria County History, Bedfordshire,' vol. i., p. 212, says: "The Eels so often found in Domesday as forming a portion of the mill's render came of course from the mill-pool." This is obviously incorrect, the Eels being taken from the stream above the mill.

grid with an upright end fixed between the sluice-walls, and three to four feet from the mouth of the sluice-gate. When the gate is slightly raised, the power of the higher stream forces the water into the trap, and any Eels that enter are carried upwards to the head of trap; here they lie in a wooden trough protected from the force of the water, and if the traps are so constructed, this trough is continued through the sluice-wall to an Eel-well built in the bank of the stream, where, with a continuous stream of water passing through, the Eels can remain until they are marketed, although in many such wells they are liable to a fungoid growth if left for many weeks; hence many Eel catchers prefer to keep them in perforated wooden boxes in the open river.

Funnel traps are used at Eaton Socon, Oakley, and formerly at Roxton. These traps have a wired, funnel-shaped covered-in entrance that quickly converges into a boxed-in trough, along which the Eels pass to the transverse trough leading to the Eel-well. The objection to these traps is partly their instability, but more particularly their liability to get quickly choked up with weeds, sticks, and other refuse, and the difficulty of freeing them again in comparison with the open traps.

Other means of taking Eels are with the independent basket traps, which are usually about three feet long and constructed of osiers; these are placed on the bottom of the stream, and of course have to be baited. A number also used to be taken with night-lines. But both these methods are far less practised now than formerly. Some few are secured by angling, usually with a hook, but occasionally by a needle-threaded worm.

Eel-gleving, once a common method of taking Eels, is now almost unknown. A gleve is a four- or five-bladed spear attached to a pole some 15 ft. long, and used by continually thrusting it into the bed of the stream wherever Eels were considered likely to lie. Any Eel struck by the gleve is forced up by the blow between the blades and held securely in that position by the rows of barbs along each edge of the blades. The shallower streams with a more or less even bottom are most suited for their capture, hence gleving was far more frequently practised on the Ivel and other smaller streams and backwaters than on the Ouse itself.

Of the life-history of the Eel little can be gleaned from those

persons in charge of the traps, and less is credited by them of their migration and breeding in the open seas. Yet, strange to say, these countryfolk can seldom offer any explanation for their movements down the river, or again for the young passing up stream. That they breed in the mud is usually taken for granted, and some will go so far as to maintain that they have seen the young taken from a ripe female.

The most favourable time of the year for the adult migration of Eels towards the sea is from mid-July to mid-October. There is also oftentimes a considerable spring movement about April, when good catches are frequently made, and by some the proportion of large Eels is considered greater at that time of the year, but others are of the opinion that the majority of larger ones come late in the autumn. Erratic movements occur during almost any month of the year, and occasionally heavy catches are made, even in the winter months, during a spell of mild weather, as for instance, some $2\frac{1}{2}$ cwt. were taken at Eaton Socon traps in December, 1911.

Some few Eels are occasionally taken during the daytime, more particularly if the traps are inside the buildings or covered in, and thick water is running at the time. When taken during the day it is a most invariable sign for a heavy catch to follow at night. As a rule Eels start to "run" about two hours after sunset, and continue "running" until midnight, after which hour very few pass into the traps, as I have frequently satisfied myself from personal observation, throughout the dark hours of the early morning. Neither can this limited movement be accounted for by all the Eels in any section of the river having been taken owing to the usual short distances between the traps, as where much longer reaches of water occur the results are the same. The darkest nights, with thick water and wind south to west, are most favourable to migration, any moon considerably checking their progress. After a thunderstorm the greatest catches are usually made, and if such stormy weather or thick water continues, their migrations will be prolonged for several successive nights. Frosty nights immediately check their running, and no Eels are taken in snow water.

Water-weeds that have been cut and floated down the stream and allowed to accumulate across the river above the trap

gates are an attractive cover for Eels, and help the catches considerably.

Many persons affirm that Eels travel short distances overland, but I have never had satisfactory proof of this. It is well known that Eels kept in close confinement will free themselves if possible, and then endeavour to find their natural element again, but I have never known them leave their natural haunts or any large area of water for such a purpose. In 1897, when Southill Lake was temporarily drained, the head-keeper, at my instigation, removed a number of Eels and placed them in a large pond which had no stream flowing out of it. Some of these Eels were captured for many successive years, showing annual increase in weight, and practically every one was eventually accounted for.

The young Eels enter the River Ouse at the Wash in April, and reach this county in the early summer months, having covered a distance of some sixty-four miles, overcoming all the difficulties of weirs, sluice-gates, and other obstacles by their indefatigable progress. By this time they have usually attained a length of 4 in. to 6 in.* The smallest, of which I have a note, being $3\frac{3}{8}$ in., taken at Blunham Old Mill sluice-gates, July 24th, 1912, with many others of a larger size.

The migratory Eels taken at the traps usually weigh from 6 oz. to 1 lb., and a few up to 2 lb. in weight; possibly smaller Eels may descend, but the openings between the bars of the traps would usually allow such to pass through and escape. Eels taken over 2 lb. in weight are the exception, and although many instances are given under the heading of those taken at the traps of fish over 6 lb. in weight, I have so far not been able to properly authenticate any record of an Eel being obtained even of 5 lb. in weight. Large Eels are said to be very coarse eating.

Of the rate of migration of our Eels down the river very little is known, but such progress is evidently slow, as their

* "I have noticed them in the latter part of the summer at the side of the Ouse near Bromham as small, thread-like specimens of about an inch or more in length" ('Victoria County History, Bedfordshire,' vol. i., p. 101). Evidently a misstatement of facts, as the Elvers do not enter the Ouse from the sea until at least nearly three inches long.

movements are so intermittent and impeded, and, as already stated, restricted to a few hours in the night. From the upper reaches of the Ouse in Bedfordshire Eels would have a journey of some one hundred miles before reaching the Wash, and under all circumstances it seems probable that such a journey would take at least a month or more to complete.

The number of years that Eels remain in these waters before returning to the sea seem to vary considerably, and it is difficult to satisfactorily account for this retarded migration.

The largest Eels taken are usually females, the females growing more rapidly and attaining a larger size than males.

There is a considerable variation in the colour of the migratory silver-bellied Eels; they range from pale green to black and light yellow to dark brown. By many Eel-trappers these are considered two separate species, the former being termed "Black Eel," and these are said to be generally of large size. Then, again, the undeveloped and at present non-migratory yellow Eel is termed the "Yellow-bellied Eel" and "Mud Eel"; these are considered a smaller species. Those Eels that have developed the enlarged mouth that is attained previous to their final transformation are spoken of as "Frog-faced Eels" and "Bull-headed Eels."

There is a strong belief that Eels feed and enter into any carcase lying in the water and will be seen to leave such bodies when disturbed. Hence we occasionally hear this ignorant and ghastly story applied to drowned persons.

There is no doubt that the Eel from a commercial standpoint is worthy of more consideration, and the present decreasing supply obtained could be very much increased by reasonable protection. There should be a close season for them at the sluice traps during part of the migration period, and some means devised of helping the young Eels to overcome more easily these difficulties of access to the upper reaches of the river.

ON THE LOCATION OF THE SACCULUS AND ITS CONTAINED OTOLITHS IN FISHES.

By Colonel C. E. Shepherd (Indian Army).

(Concluded from p. 109.)

Ostariophysi.

In this suborder the families of the *Characinidæ*, the *Gymnotidæ*, the *Cyprinidæ*, and the *Aspredinidæ* have the asteriscus as the largest otolith. In the families of the *Siluridæ* and the *Loricariidæ* the lapillus is the largest. In all the families the sagitta is rod-like, or perhaps would be better described as like a splinter.

Characinidæ.

The sacculus in this family is thoroughly embedded in a bony cavity which has to be carefully split open to expose it; it is found completely filling the cavity. In *Erythrinus salmoneus* (fig. II., 5) the position of the sacculus is indicated from the outside by two polished-looking little excrescences of the basi-occiput. *Macrodon trahira* (the "Haimara" of British Guiana) has similar excrescences, the bone of them being very thin (fig. II., 6). *Myletes setiger* (the "Paca" of British Guiana) does not show these excrescences. The lapillus in this family is well developed, and lies in a special cavity at the side of the skull, but not showing palpably on the outside. *Leporinus arcus* and *L. maculatus* show their sagittæ through the thin bone underlying them, which, however, lies flat and does not stand out at all.

Gymnotidæ.

Of this family only two small specimens have been available for examination—one a *Eigenmanuia virescens*, the other a *Sternopygus macrurus*; they were too small to allow of any external indications being noted. The asterisci were found to be the largest of the otoliths.

Cyprinidæ.

This, the Carp family, like the latter two families, has the sacculus embedded in a bony cavity, and the conditions are very similar, except that with the *Cyprinidæ* there is no external evidence of the sacculus, nor does the recess in which the lapillus rests show prominently on the outside.*

Siluridæ (the Cat fishes).

This family also has its sacculus embedded in bone, as have the last three noted above. The lapillus, however, is the largest otolith, and in some of the *Arius*† species it is a very large stone, and consequently has a very large recess in the inside of the skull to accommodate it. This stone can be lifted out of its recess without much or any cutting away of bone. Externally the situation of the lapillus can be judged by a smooth swelling prominence of bone over it.

Loricariidæ.

Plecostomus bicirrhosus (called the "Sea Hussar" in Demerara; it is, however, a freshwater fish) has the ear labyrinth lying open in a double cavity at the side of the skull quite different to the boxed-in condition in the *Siluridæ*. As with them the lapillus is the largest otolith (fig. II., 7); the difference in size was made up by the more solid build of the lapillus, which does not come out in the photograph.

Aspredinidæ.

In *Aspredo sicuephorus* the bone had to be cut away to get out the sacculus. The asteriscus is the largest of the otoliths.

Apodes.

In *Anguilla vulgaris* (the Eel) the position of the otoliths is revealed externally by two very slight swellings of thin bone. *Myrus vulgaris*, a Mediterranean Eel, has the sacculus in a cradle-like cavity, from which it could be lifted out. The lapillus in this fish is not quite like the usual shape of this stone; it has

* For illustrations of the asterisci of some Carps, see 'Zoologist,' 1910, p. 3, figs. 20, 21, 22, 23; see also 'Zoologist,' 1910, p. 293, fig. 16. The splinter-like sagitta is faintly visible.

† See 'Zoologist,' 1910, p. 293, fig. 19, and p. 294, pl. ii., fig. 4.

also a slight hook at its extremity. In *Conger vulgaris* (the Conger) some thin but not transparent bone of the basi-occiput shows the site of the sacculus. The sagittæ are large.

Esocidæ.

Esox lucius (the Pike) has no external indication of the site of the sacculus. This is contained in an open pocket from which it could be easily lifted out; it shows no distinct lagena, but the asteriscus can be seen through the tissues of the sacculus; the sagitta also shows through.

Scopelidæ.

In *Scopelus punctatus* the sagittæ lie in two ovoid pockets that show on the outside; the thin bone under them permits of their being seen.

Cyprinodontidæ.

In *Haplochilus playfairii* the pockets for the sacculus are at the side of the head, and two excrescences on the under side of the skull show their situation. *Anableps tetropthalmus* (the "Four-eyes" of British Guiana) has no outside indication of the site of the sacculus; it rests in an open cavity at the outer side of the brain chamber.

Fierasferidæ.

The comparatively large solid sagittæ of *Fierasfer acus*, a Mediterranean fish, show clearly through the transparent bone underlying them.

Gastrosteidæ.

The "Sticklebacks" have no outside indication of the position of the sacculus apparent. As may be surmised, the sagittæ are very minute.

Centriscidæ.

In *Centriscus scolopax* (the "Trumpet Fish" or "Bellows Fish") there is no external evidence of the site of the sacculus. It lies loose on the floor of the skull, with no apparent special cavity for it.

Syngnathidæ.

Syngnathus acus (the "Pipe Fish") has no external indication of the site of the sacculus.

Scombresocidæ.

Exocœtus pœcilepturus (the "Flying Fish") shows the position of the sacculus by two distinct excrescences of the base of the skull. The sagittæ are large for the size of the fish. *Belone annulata* (the "Garpike") has two elongated bosses of thin bone, not so much under the basi-occiput but at the under side of the skull, that cover the sacculi and show their position. The sagittæ are small for the size of the fish.

Ammodytidæ.

Ammodytes lanceolatus (the Sand Eel or Launce) shows the site of the sagittæ by a piece of thin bone underlying them; this does not stand out, however, from the skull. The sagittæ are small.

Antherinidæ.

In *Atherina hepsetus*, a Mediterranean fish, the bone of the base of the skull is very transparent. The sagittæ could be seen quite plainly *in situ*. In *Atherinichthys bonariense* (called the "Sea Pajerrey" at Buenos Aires) the site of the sacculus is indicated by two elongated prominences of thin bone, but not transparent enough to show the stones. In *A. argentinense* (the "Freshwater Pajerrey") the thin bone over the sacculus is not markedly prominent, neither is it transparent enough to show the stones, which are of but moderate size for the size of the fish. The sacculus part holding the sagitta is in an open pocket; the stone could be lifted out through the open top. The lagena end of the sacculus is, however, covered with bone which had to be cut away to get out the asteriscus.

Mugilidæ.

The sacculus of *Mugil braziliensis* (the "Queeriman" of Demerara, British Guiana) rests in a bony pocket that is open at the top. The lagena is long, and runs back at the end of the pocket into a burrow of its own in the basi-occiput. *M. capito* (the Grey Mullet) has two strong bony prominences on the basi-occiput that continue upwards round the side. This upward portion is what lies more immediately under the site of the sacculus, which is placed in a long bony pocket; the lagena is a very decided prolongation of the sacculus, and holds a fairly

large asteriscus of crescentic shape. The sacculus pocket is open at the top, but bone has to be cut away to free the lagena. In this family the sagitta is of fair size and very much curved.

Polynemidæ.

In *Polynemus tetradactylus* (the "Mangoe Fish" of Calcutta, where it is also called "Tapsi machli," adopting one of the native names) the site of the sacculus is indicated exteriorly by a slight swelling of the basi-occiput bone. The pocket containing the sacculus is open at the top; the sacculus could have been easily lifted out but for the lagena portion, which runs back into a bony burrow encasing it completely, and requiring to be cut away to extract it. The otoliths from the right half of the head are illustrated (fig. I., 4).

Sphyrænidæ.

Sphyræna vulgaris (the "Barracuda") has the sacculus lying in a groove in the bone of the skull, which is open at the upper end, a little bone, however, has to be cut away to free the sacculus altogether. The otoliths in this fish lie more parallel to, *i. e.* with less divergence from the middle line of the fish at their forward end, than is the case with so many other fishes.

Stromateidæ.

Stromateus niger (the Pomfret" of India) does not show externally the situation of the sacculus; inside, the sacculus is in a pocket open at the top, but cased in with bone at the sides. The lapillus has a marked recess in the skull for itself.

Ophiocephalidæ.

In *Ophiocephalus punctatus* the situation of the sacculi is well marked by two excrescences on the under side of the basi-occiput, which stand well out.

Anabantidæ.

In *Anabas scandens* (the "Climbing Perch" of India) the sacculi are located in two prominent excrescences, which, when the branchial arches are removed and the skull reversed, show remarkably clearly. The lagena is a long prolongation of the sacculus; it has a little pocket to itself. The sagittæ are fairly large and solid for the size of the fish (fig. II., 2).

Gadidæ.

In this family of the Cod and its congeners the sagittæ are large, and their location is shown from the outside by a swelling of the basi-occiput, and in some cases, as in *Gadus merlangus* (the Whiting) and *G. minutus* (the "Power"), by the thin bone covering the stones allowing the opaque white bodies to be seen. In some the sagitta can be easily picked up from the inside with forceps; this is the case with *Merluaias vulgaris* (the Hake); in others, a very little clearing away of bone enables the sagitta to be got out. This is so with *G. merlangus* and with *Molva elongata*, a Mediterranean relative of the "Ling." In *Uraleptus maraldi*, another Mediterranean fish, on the contrary, the sacculus is completely embedded in bone, its place shown exteriorly by a large swelling of the basi-occiput, which is out of proportion to the size of the sagitta when this is got out.

Berycidæ.

Beryx splendens shows its sagittæ through the thin bone that underlies them below the skull. These otoliths are large.*

Pempheridæ.

The sagitta in *Pempheris russellii* is comparatively large.

Centrarchidæ.

In *Kuhlia marginata*, a fish from New Guinea, the site of the sacculus is marked by a piece of thin bone, slightly elevated, that shows the whole length of the sagitta through it on each side, looking like grains of barley in shape. The sacculus is embedded in a bony pocket requiring to be cut away. The sagitta is a moderate size; the asteriscus is, however, very small in size, even for this usually small stone.

Lobotidæ.

In *Lobotes colonorum* the sacculus lies in a strong bony pocket requiring to be much cut away to free it.

Percidæ.

In *Acerina cernua* (the Ruff, Pope, or Jack Ruff) the two well-defined pockets holding the sagittæ are covered with thin

* See illustration, 'Zoologist,' 1910, p. 293, pl. i., 9.

flexible bone, which allows the stones to be distinctly visible from the outside. Inside, the pockets are open at the top. In *Perca fluviatilis* (the Perch) the site of the otoliths is very apparent: two bulbous swellings, one each side of the basi-occiput, mark it unmistakably. The sagitta, large for the size of the fish, is well embedded in a bony pocket and the lagena well defined.

SERRANIDÆ.

Serranus gigas (the "Dusky Perch") (Couch) has its sacculus in a long deep pocket, with room enough in it to allow the sagitta to be freely moved backwards and forwards in it. In *S. cabrilla* (the Comber) and *S. scriba*, a Mediterranean fish, smaller members of the family, the sacculus is more boxed in; the sagitta has not so much room for motion. In *Apogon rex mullorum* the thin bone below the sacculi permits the sagittæ to be clearly located; they are large for the size of the fish. *Ambassis urotænia* has two large, almost hemispherical, protuberances of thin bone under the sacculi; the opaque bodies of the sagittæ show through. These stones are large for the size of the fish.

PSEUDOCHROMIDIDÆ.

In *Lopholatilus chamæleonticeps* (the "Tile Fish" of the North Atlantic Ocean) the sacculus is held in a bony pocket open at the top, through which the sacculus could be seen projecting, but bone had to be cut away to extract the otoliths.*

SCIÆNIDÆ.

Amongst these fishes the sagitta is large, and consequently a palpable swelling of the basi-occiput shows the position of the sacculi and their enclosed stones. *Umbrina cirrhosa* (the Umbrina) (Couch) has a large pocket for the sacculus well open at the top, the whole of the ear labyrinth on each side was picked out at once, no cutting away of bone being found necessary, the semicircular canals only needed to be cut across. In *Corvina nigra*, a Mediterranean fish, the sacculus is in a big roomy pocket open along the top but closed at the ends. The lagena stretches well away at its extremity of the sacculus, and has a roomy pocket to itself. In *Nebris microps* (the "Butterfish" of Deme-

* For illustration, see 'Zoologist,' 1910, p. 294, pl. ii., 1.

rara) the position of the sagittæ is well defined from the outside, the bone under them being thin. They are large and inclined at a sharp angle ; their pointed ends upward, and the other end,

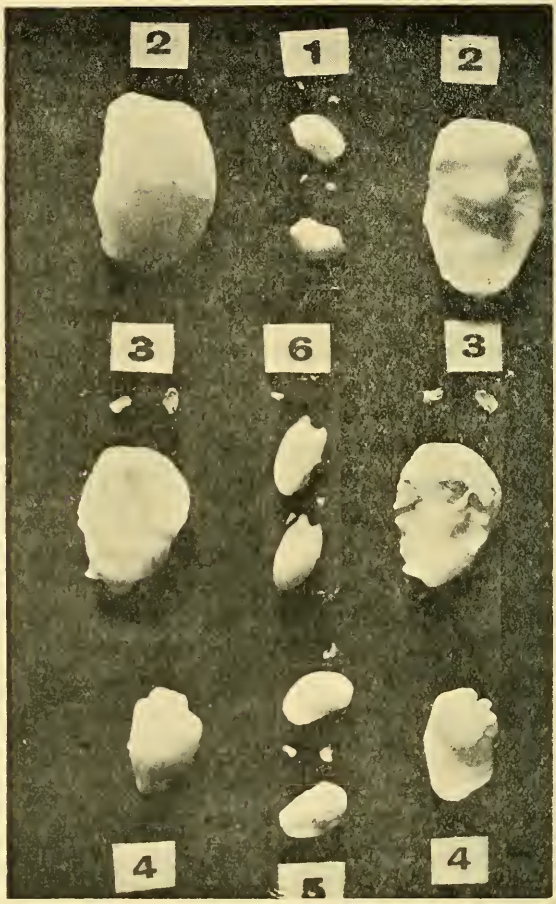

Fig. III.

1. Sciæna maculata. 2. S. aquila. 3. Micropogon furnieri.
4. Plagioscion surinamensis. 5. Otolithus maculatus.
6. Nebris microps.

which has two small projections, a curious example in sagittæ, downwards (fig. III., 6). (Shown reversed to bring out these projections.) There is no defined lagena, the asterisci being

enclosed with the sagittæ but at the lower end of the sacculus. In *Ancylodon jaculidens* (the "Weak Fish" of Demerara) the decided swelling of the basi-occiput at its forward end becomes almost hemispherical. The sagitta is large. In *Sciæna amazonica*, a South American fish, the position of the sacculus from the outside is easily located. Many of the Sciænoid fishes have an excrescence on the concave side of the sagitta which is notable in *S. aquila* (fig. III., 2). In others the excrescence is formed of granules. This can be seen in fig. III., 1, 3, 4, and 5; in No. 6 the granules are on the stone, but too faint to show in the photograph. The "sulcus acousticus" in these fish also takes a peculiar curved right angle bend; this can be faintly traced in fig. III., 1, 4, and 6.

Sparidæ.

In this family the sacculus is enclosed in a bony pocket, which has to be cut away to free the sagitta and asteriscus. In *Pagellus centrodontus* (the Sea Bream) the lagena is a broad prolongation of the sacculus. In *Oblata melanura*, a Mediterranean fish, the bone under the sagittæ is thin and semi-transparent.

Mullidæ.

In *Mullus surmulletus* (the Surmullet) (Couch), although the sacculus is in a pocket open at the top, a great deal of bone has to be cut away to free it completely.

Caproidæ.

Capros aper (the "Boar Fish") has the sacculus in an open recess; the whole can be lifted out without cutting away any bone.

Chætodontidæ.

In *Heniochus macrolepidotus*, an Indian Ocean fish, the sacculus is embedded in a bony pocket, which has to be extensively cut away to release its contents. The sagitta is a fair size.

Osphromenidæ.

Osphromenus olfax (the "Gourami"), a fish from Java, has the site of the sacculus marked by two prominent bulbous swellings of the basi-occiput bone that project even into the cavity occupied by the superbranchial organ that this fish has, it

being one of the *Labyrinthici*. The sacculus is enclosed in a bony pocket that requires considerable cutting away to get it out. The sagittæ are large for the size of the fish (fig. I., 3).

Embiotocidæ.

The sagittæ in this family are underlaid by thin bone that allows of their site being seen. They are large for the size of the fish. The anterior end is free of bony covering, but the posterior end goes back into a bony cavity that requires opening up to free the lagena end of the sacculus. Of four specimens examined, two came from Japan and two from the west coast of the United States of America: *Neoditrema ransonnettii* and *Ditrema temminckii* from the former country, and *Cymatogaster aggregatus* and *Hysterocarpus traski* from the latter.

Cichlidæ.

In *Cichlosoma bimaculatum* (the "Patwa" of Demerara) and in *Crenicichla saxatilis* (called the "Sun Fish" at Demerara) there is no external indication of the site of the otoliths; the sacculus is embedded in a bony pocket, but requires only a little cutting out. In *Tilapia nilotica*, a Nile fish, the sagitta is large and much curved; the sacculus required to be cut out.

Labridæ.

In *Labrus maculatus* * (the Ballan Wrass) and in *L. mixtus* (the "Cook") there is no external evidence of the site of the sacculi. From the inside the sacculus can be easily lifted out from the shallow recess in which it lies. The sagitta is deeply notched on both sides, so much so as to require tender handling to prevent it splitting up longitudinally.

Carangidæ.

Caranx trachurus (the "Scad," also called the "Horse Mackerel") has a well-defined bony pocket for its sacculus open along the top for a short distance. At its lower end this pocket has a constriction in it, but again expands to form a special cavity for the lagena, which is well defined and contains a fairly large asteriscus; the sagitta † also is a fair size. *Lichia amia*, a Mediterranean fish, has the sacculus in a long, trough-like,

* See 'Zoologist,' 1910, p. 293, pl. I., 12. † *Ibid.*, pl. I., 7.

bony pocket open at the top ; the lagena is a long protruding continuation of the sacculus holding a fairly large asteriscus. *Seriola dummerilii* (one of the "Yellow Tails") and *Temnodon saltator* (the "Skipjack") require the bony pocket to be cut away to get out the sacculus.

SCOMBRIDÆ.

This family have small sagittæ for the size of the fishes. In *Sarda mediterraneus* * (the "Pelamid") (Couch) the pocket for the sacculus is small, it inclines upwards, and is embedded in bone with a small opening at the top. It is situated well in the posterior part of the skull. From *Auxis rocheii*,* the sacculus could be extracted through the opening at the top without any cutting away. In *Cybium commersonii*, an Indian fish, the sacculus has to be cut out. In *Scomber scombrus* (the Mackerel) there is no external indication of the position of the sacculus; although lying in a pocket, it is not much enclosed by bone; it is visible through the opening at the top.

BRAMIDÆ.

Brama raii has a long pocket for the sacculus, allowing this to be moved backwards and forwards in it. The sagitta is comparatively small.†

ZEIIDÆ.

Zeus faber (the John Dory) has its sacculus lying openly on the floor of the brain cavity, it can be picked up with a forceps without further trouble. The sagitta is small and most peculiarly shaped (fig. II., 4).

PLEURONECTIDÆ.

Many of this family show the sites of the sacculi very plainly to the external view by a slight excrescence of the basi-occiput, the thin bone allowing the sagittæ to be seen. Owing to the distortion of the head in this family, the sagittæ seem to lie one above the other instead of side by side. In *Psetta maxima* (the Turbot) and *P. laevis* (the Brill) the sacculus is contained in a bony pocket. The latter fish and *Pleuronectes limanda* (the Dab) show the site of the sacculus through thin bone. *P. platessa* (the Plaice) shows the rings of growth of the sagitta from which the age of the fish is deduced most clearly when it is first taken out of a fresh head.

* See 'Zoologist,' 1910, p. 293, pl. I., 1 and 2. † *Ibid.*, pl. I., 3.

Gobiidæ.

In this family the sacculus is placed in a recess away to the outer side of the skull and rather high up. The sagitta is large considering the usually small size of the fish. In *Gobius jozo* and *Periopthalmus koelreuteri* the sagitta can be seen, the bone being thin.

Scorpænidæ.

Sebastes imperialis, a Mediterranean fish, has a skull that, in the part underlying the sagittæ, is transparent, and the stones are visible as they lie in the head. The sagitta is embedded in bone all round but open at the top; the bone has to be cut away to free the sacculus and its contents. The otoliths of *S. norvegicus* (the Bergylt) (Couch) are fairly large.*

Cottidæ.

The site of the sacculi in "*Cottus bulbalis*" (the "Bullhead," in Cornwall it is called "Stingdom") is shown by two small swellings of thin bone.

Triglidæ.

In *Trigla lyra* (the "Piper") the sacculus lies in a recess so open at the top that the sacculus can be lifted out. It is the same with *T. gurnardus* (the Gurnard); there is no external evidence of the actual location of the otoliths.

Dactylopteridæ.

The sacculus in *Dactylopterus volitans* (the "Flying Gurnard") lies openly on the base of the skull, there being no special cavity for it.

Trachinidæ.

Trachinus vipera (the "Lesser Weever") shows the position of the sacculus exteriorly by two bulbous excrescences of the basi-occiput, which diverge very much at the anterior ends. The sagitta is confined at both ends, although the pocket is open at the top. The stone is of moderate size.

Nototheniidæ.

In *Trematomus hansoni*, a fish brought from the waters of Victoria Land in the Antarctic, two prominent excrescences of

* See 'Zoologist,' 1910, p. 293, pl. i., 10.

thin bone jutting out to the right and left of the basi-occiput give the location of the sacculi, the sagitta showing through. The sacculus is in a pocket open at the top, through which it could be lifted out without cutting. The sagitta is of fair size.

URANOSCOPIDÆ.

The site of the sacculus in *Uranoscopus scaber*, a Mediterranean fish, is shown by a large swelling externally. The sacculus lies in an open depression, the lagena end extending into a pocket of its own.

CALLIONYMIDÆ.

In *Callionymus lyra* (the "Skulpin") the sacculus lies openly on the floor of the cranial cavity; no special depression exists for it.

BLENNIIDÆ.

There is no external evidence of the situation of the otoliths in *Anarrhichas lupus*, the largest British representative of this family, and known to fishermen as the "Cat Fish." The sacculus lies in a shallow open depression: the whole sacculus was lifted out without difficulty. It was the same in a specimen of *Blennius ocellaris* (the "Butterfly Blenny"). The sagittæ in this family are small.

BATRACHIDÆ.

The basi-occiput in *Batrachus surinamensis* (the "Pacuma" of Demerara) shows a large bulbous swelling under the site of the sacculus quite incommensurate with the size of the sagitta when this is got out. The sacculus lies in an open depression; the lagena is attached not at the extremity of the sacculus, but placed about a quarter of the length of the sacculus from the posterior end.

ZOARCIDÆ.

The sacculus lies in an open cavity, from which it could be picked out entire in *Zoarces viviparus* (the "Eel Pout").

OPHIIDIIDÆ.

The bone of *Ophidium barbatum* is very thin where it lies under the sagittæ, which are plainly visible through it; they are large and solid. The angle they make with the middle line of the skull is very distinct.

Lophiidæ.

In *Lophius budegassa*, a Mediterranean species of the "Angler" family, the sacculus rests in a shallow flat depression.

Antennariidæ.

Antennarius hispidus, from the Indian Ocean, shows the position of the sacculi under the base of the skull by the bone under the pockets standing out in divergent sections.

Balistidæ.

The sacculus in *Balistes capriscus* (the "File Fish," also called the "Trigger Fish") lies in a pocket open at the top, through which it could be lifted out. The sagittæ are small (fig. II., 10). *B. niger* is similar.

Tetrodontidæ.

In *Tetrodon leopardus*, a "Globe Fish" of the Indian Ocean, the ear membranes lie in a cavity at the side of the skull away from the middle line and at the posterior end of the brain cavity.

Molidæ.

Orthagoriscus mola has no otoliths; it is supplied with otoconie only,* in this respect resembling the cartilaginous fishes.

When dissecting for otoliths one is occasionally met with a difficulty in finding one, or sometimes both, of the particular stones; *e.g.*, one lapillus, or asteriscus, or perhaps both asterisci. At first want of skill may be held to be responsible for the non-success, but as skill improves and experience shows that even fairly large stones are missed, it begins to be surmised that perhaps the stones in these cases are non-existent, and have never been developed. To quote some cases; eight different species of the *Lutjanus* family were examined, and in one case the left asteriscus could not be found; the note made at the time reads, "The left asteriscus missed, the sacculus and lagena were got out entire, and the most careful search was made, but not a vestige could be found." In all the other cases both, and in this

* See article by Professor D'Arcy W. Thompson, "On the Auditory Labyrinth of *Orthagoriscus*." 'Anatomischer Anzeiger,' iii., Jahrgang, Nos. 4 and 5, 1888.

particular fish, the right asteriscus having been recovered, it only leaves the surmise that in this instance there was no left asteriscus. In a *Platax vespertilio*, one of the *Chætodontidæ* of the Indian Ocean, no lapilli could be found, although careful search was made. The lapillus, as a rule, is very easily got, and in four allied genera they were got; it would seem that in this particular *Platax* they may have been wanting. In a *Lopholatilus chamæleonticeps* that was most carefully dissected, the sacculi were got out whole; the lagena of each showed as a distinct little purse, but on searching them no asteriscus could be found in either. There were two observers on this occasion, and had there been an asteriscus in either lagena it could not have escaped observation. In a *Brosmius brosme* examined, one lapillus, that on the left side, could not be found, the tissues came out whole, the "recessus utriculi" with the sacculus, and most careful search was made; to judge by the right lapillus, it is a fair size, and could hardly have been overlooked in the careful search made. In two of the *Characinidæ*, a *Hydrocyon brevis* and an *Alestes nurse*, the rod-like sagitta was wanting in the first on the left side, and in the second on the right side. In each case the sacculus was got out whole, but no trace of the sagitta could be found; the same care was exercised that resulted in the sagitta being found on the opposite side in each case. In a former paper ('Zoologist,' 1910) a note was made pointing out that three cases of abnormal sagittæ had been come across; in these the abnormality consisted in the difference of the structure of the stones to what is usually the case, it would therefore perhaps not be assuming too much to surmise that the abnormal might be also met with in the guise of an otolith being wholly wanting. More evidence is, however, requisite in this matter, and it would be of interest if others who have made researches in otoliths would publish their experiences on the subject. In this connection it is interesting to note that Couch, in his 'Fishes of the British Islands,' vol. iv., in the article on the Carp, has as follows:—"Nor is this the only remarkable irregularity of structure, for I am informed by Edmund T. Higgins, Esq., who has carefully studied these objects in various orders of fishes, that in the Carp the otoliths (bones of the ear) are not always alike on both sides; in fact, that in some in-

stances they are altogether wanting on one side. The position of these bones is also different from what is the case in other fishes, so that the bone termed the *malleus* is at a distance from another called the *incus*, and it is serrated all round the border." Mr. Higgins is right when he says the position of these bones (" stones," he should have called them) is different from what is the case in other fishes, for the asteriscus is so much more completely embedded in a bony cavity, as mentioned *ante*; it is the largest of the otoliths in this fish, and so came under observation, the small rod-like sagitta being overlooked. The *malleus*, as he calls it, is evidently the asteriscus as at present named; as he says, it has a serrated edge all round (see the illustrations in the article on the " Asteriscus in Fishes " in the ' Zoologist,' 1910). The *incus* of Mr. Higgins is the lapillus, which, as he describes it, is at a distance from the *malleus* (asteriscus). Presumably Mr. Higgins was dealing only with British fishes, and so did not come across specimens of the *Characinidæ*, when he would probably have recognized the resemblance in their case to Carps. His evidence as to the occasional absence of the otolith in the Carp is noteworthy. A converse case to the absence of an otolith was met with once in a *Lenciscus dobula* (the Dace), the " recessus utriculi " on the right side of the head held two lapilli, whilst that on the left side held the normal one lapillus. In this case, three lapilli having been found precludes any idea that by some chance the one from the left side had got mixed up with that on the right side, and so account for the two on this side.

This paper cannot be concluded without recording, with many thanks, the obligation the writer is under to many institutions and personal friends for specimens received of fishes described; and in particular his indebtedness to Mr. R. H. Burne, of the Royal College of Surgeons, for much help, always most kindly given, in dissecting heads, and but for whose help much of the interest of this article would have been wanting.

NOTES AND QUERIES.

MAMMALIA.

The Water-Shrew (Neomys fodiens bicolor) in Worcestershire.—Whether this melanistic form of the Water Shrew is proportionately distributed in Great Britain or more or less local is not as yet known. In this neighbourhood it is certainly rare, and only in one instance, at Wribbenhall on December 25th last, have I been able to obtain a specimen.—J. Steele Elliott (Dowles Manor, Shropshire).

AVES.

The Thrush's Song.—The facility with which some birds incorporate the notes of other species in their song is well known, and our common Song-Thrush (*Turdus musicus*) is as apt an imitator in this way as most of them. A rather curious, and I think unusual, instance of the kind may at present (March) be heard here, and it suggests enquiry as to how the habit may be acquired. We have in this neighbourhood, at 1000 ft. about the sea, comparatively few small birds resident during winter, not more than an odd pair or two of Thrushes remaining; the significance of this becomes apparent below. The male of the only pair of Thrushes resident in our garden started singing on February 4th—an ordinary song. Since that date several others have appeared and sung every fine morning. One of these constantly makes use of the triple call of a Redshank (a by no means singular occurrence), occasionally one reproduces a note or two borrowed from the Curlew. Just a week ago, one began giving such a perfect imitation of a Wood-Lark's song that, though it was practically impossible for the latter bird to be here, I was obliged to go into the plantation before I could really convince myself on the point. On most fine days the song is frequently repeated at intervals, in the ordinary Thrush's song, but it is gradually losing its perfection. Now, the curious thing is that we never have any Wood-Larks in this part of the country (rare accidental visitors, of course, excepted), and one wonders how the Thrush has picked the song up, and where? It is pretty certain that it is not a resident Thrush, and quite certain that it has never heard the Wood-Lark's song here. Can it have

lately come from a district where that song was familiar just now? It may be added that it is only occasionally that a Redshank is to be heard here, but Thrushes might pick up the notes of that bird not so very many miles away.—George Bolam (Alston, Cumberland).

Visitation of Black Redstarts (Ruticilla titys).—It is well known that the Black Redstart is a regular visitor to certain parts of this country. This winter, however, I am inclined to think that the species has visited us in greater numbers than usual. This is especially obvious in the case of Northumberland, where previously there have only been six recorded.

Northumberland.—Holy Island, November 5th, 1913; adult male ('British Birds'). Chopwell, November, 1913; adult male. "Feeding on green fly," P. Charlton. Woodhorn, Ashington, November, 1913; adult male, T. Robinson ('Newcastle Weekly Chronicle'). Cullercoats, December 26th, 1913; female. Cullercoats, February 10th, 1914; immature. The last two birds were both moving south in a leisurely fashion along the shore.

Cumberland.—Workington, December 21st, 1913; adult male, John Wilson ('Carlisle Journal').

Lincolnshire.—North-east coast, October 13th, 1913; rarely met with in this county. Four previous records ('British Birds').

Somerset.—Taunton, October 9th, 1913 ('Field').

Norfolk.—Norwich, December, 1913; adult female ('Canary and Cage Bird Life').

Wales.—Llandudno, January 10th, 1914, T. A. C. Valley, January 14th, 1914, T. A. C. ('Manchester Guardian'). It would be interesting to hear if this species has occurred in other localities where it is usually rare.—J. M. Charlton (Brampton, Cumberland).

Redbreasts' Nest in a Tree.—A pair of Redbreasts in Waterlow Park, Highgate, commenced on March 4th building a nest in a hole in the trunk of a tree nearly 10 ft. from the ground, a rather unusual site.—H. Kirke Swann (Finchley).

Notes on the Nightingale (Daulias luscinia).—The Nightingale, which had been falling off to a marked degree for ten years or more, last year (1913) visited this district in something approaching its former numbers and, to my astonishment, one pair nested and successfully reared a brood in our garden. I had begun to think that we were not going to have any Nightingales at all, as I neither heard nor saw one until April 24th, which was the date upon which our bird was first noted by me—it was singing at the further corner of

the back garden at 9 a.m. A Lesser Whitethroat, which I had been waiting for, evidently arrived at the same time, and this bird, too, finally mated, and a brood was reared on our premises. The Nightingale was mostly singing all day, from the 24th to the 28th, yet it was not until the latter date that it began to sing at night, when it commenced some time before 10 p.m., and this night-song continued until May 6th, when I detected the arrival of a female, and from that time it ceased. The song usually commenced at about 9.45 p.m., and must have continued throughout the night—the bird would be singing at midnight, I heard it whenever awake, and it would still be singing at daybreak. Rain stopped it at once—the night of the 3rd was wet and gloomy, and except for one or two outbursts at 10 p.m., the bird was silent, and the following night, although singing with great vigour, it instantly ceased on rain commencing to fall at midnight. I first discovered the presence of a female at 2 p.m. on May 6th, and believe she had but just arrived, and from that time, except for an occasional attempt at about 10 p.m., the night song ceased, although another Nightingale was singing at a distance of little over two hundred yards away. It was the male who selected the spot, and he seemed determined that no alteration should be made, if I may judge by his conduct when in the presence of the female, and accordingly she commenced to build on the morning of May 9th, and the nest was finished and contained one egg on the 15th. As far as I know, the female did all the building, and she appeared to work until 9 a.m., or a little later, and then left off for the day. The nest, constructed of the usual dead oak leaves, &c., was built upon some bundles of old pea-boughs which had been stacked against a laurel hedge, preparatory to being burned, and was at a height of 3ft. above the ground. Sitting commenced May 19th on five eggs, a duty apparently undertaken only by the female, and she was removing the egg-shells on the evening of June 2nd, the young leaving the nest on the 14th of that month. I expected to be able to see something of these young birds after leaving the nest, but it was only with great difficulty that anything could be seen of them; I do not think more than one at a time was ever seen by me, though they must have often been quite near me in the garden. With the parent birds, however, it was very different—they were more tame and confiding than the familiar Robin—but the presence of a cat was instantly detected, and they never left it all the time it remained anywhere near the nest or young. The young birds made more noise while being fed in the nest than I supposed would be the case.

The male had practically ceased singing by June 9th, though I did hear it for a moment on the 13th.—Robert Morris (Uckfield, Sussex).

Status of Blackcap, Garden-Warbler, and Lesser Whitethroat.—*Bedfordshire.*—Throughout the whole of the county the Garden Warbler outnumbers the Blackcap by about two pairs to one, and the Lesser Whitethroat is about as common as the latter species.

Shropshire.—I can only speak from personal experience of the neighbourhood in which I live, and here the Garden-Warbler is even commoner, numbering probably three pairs to one, the Lesser Whitethroat again being about equal to the Blackcap. The distribution of our breeding birds in the British Islands is as yet very imperfectly known, and it would be of very considerable scientific value if a complete record, showing this distribution by means of shaded maps in colour or otherwise, could be published.—J. Steele Elliott (Dowles Manor, Shropshire).

Waxwing in Suffolk.—A hen Waxwing (*Ampelis garrulus*) was picked up dead at Beyton on January 21st, and brought to me in the flesh. It had certainly been shot at, but was in very good condition when found, and is now in the Ipswich Museum.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

The Little Owl Breeding in Somerset.—I see a note in the 'Zoologist' (*ante*, p. 112) from Mr. Sanley Lewis, of Wells, Somerset, on the subject of the Little Owl (*Athene noctua*) breeding in Somerset. This is not, as he thinks, the first dicovery of its breeding in this county. The Little Owls have nested here close to my house for the last four years, to my certain knowledge, and possibly longer. So far they do not appear to have developed any excessively predatory habits amongst young game in this part of the country. The nests always contain a plentiful supply of young rats and mice, and I have once found a Thrush.—H. L. Popham (Hunstrete House, Pensford, near Bristol).

Gannet Choked by a Gurnard.—I am indebted to Mr. John Renwick for a rather curious photograph of a defunct Gannet, which was taken by one of a geological party (Mr. N. G. Reid) on the shore at Turnberry, in Ayrshire. The dead bird had met its death in a way which, I was told when at Ailsa Craig, has happened on previous occasions, *viz.* in trying to swallow a Gurnard (*Trigla* ?), whose spinous dorsal fin had become wedged in its throat, with the result that the Gannet, unable either to swallow the fish or get rid of it, was starved. The Gurnard is a very common fish in British seas,

and Gannets certainly do prey upon small ones with impunity, but in this case a larger one than usual had been captured, judging from the part of it which is still visible in the bird's open mouth. It appears that other birds besides Gannets have met with a similar

fate, for in the 'Zoologist' for 1894 (p. 265) there is an account of a Great Northern Diver being choked by a Gurnard, and on p. 308 of a Cormorant which was choked by a Flounder.—J. H. Gurney (Keswick Hall, Norfolk).

Hybrid Ducks.—Referring to the three Pochard and Sheld-Duck hybrids (*ante*, p. 76) at Christchurch Park, Ipswich, I saw them again on March 4th. They are, I should say, a drake and two ducks, and will probably be the only ones bred, as the Sheld-Duck appears this year to have paired with a drake of her own species. It was rather interesting to watch them on the water, the Pochard keeping near the other two, but at a respectful distance, while his old mate seemed entirely to ignore him, and to be quite happy with her partner. — Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

Early Arrival of the Stone Curlew.—On the night of March 11th, on which occasion the moon was very bright, the moat close to my daughter's home at Rougham was visited by a bird which could only have been a Stone Curlew (*Œdicnemus scolopax*). The note was

described to me as exactly like "the Great Plover's human whistle" mentioned by Tennyson, and I was also told that the Dabchicks, which have now returned to the moat, seemed from their calls to be much disturbed by the unusual sounds. It is an early date for the Stone Curlew; I have a note of one which I handled in the flesh at Bury on March 25th, 1899. — Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

Avicultural Notes.—I have been asked by a well-known ornithologist to write an account of my tame Swift (*Cypselus apus*). I found the little creature last summer on June 30th, when passing through the village of Bircher, about five miles from the town of Leominster, where I live. It had fallen from its nest, and was making strenuous efforts to climb up the wall of the house back to it, for the nest was under the eaves just above where the little creature was struggling on the ground. The old birds were screaming joyously overhead, appearing to know nothing about it.

The little Swift was about two inches long, its colour was grey, the quills were just beginning to appear, and even at that early age the last joint of the wings took an upward curve. It appeared to be strong and healthy. I placed it under a clump of weeds near by in the shade, as it was a very hot day. I was spending several hours on the common a mile further on, and finding it still there on my return in the evening, I took it home with me. For the first four or five days I fed it every half hour on small quantities of blight. For the next month I fed it on mountain bread, the food used for young canaries, but it did not thrive at all well on it. It hardly grew at all, and the development of the feathers was very poor; its body was covered at the end of a month but very thinly, and the wings were covered with short feathers. At the end of July I went to stay on Bircher Common for ten weeks, and took the bird with me. At this time I began to feed it on wasp grubs; these it liked very much. I led an outdoor life and took my little Swift everywhere.

It developed very quickly under these conditions; the wings grew very long and strong, and appeared to be quite normal, but for some reason or other it has never used its wings for sustained flight except on one occasion. I had left it upstairs, and while sitting at breakfast, suddenly heard a flutter of wings and the little Swift alighted at my feet, passing on its way an open window and door. I only kept it in confinement when necessary for its safety. While staying on the common I used to hang its basket on the garden fence, when it would climb about and retire to its basket again of its own

accord. We picnicked out a great deal, sometimes walking for miles, and the Swift always came with us, and when putting up sandwiches, I had always to remember a piece of wasp-comb. I once put its basket down in the fern some distance from where we were sitting, thinking it was securely fastened; two hours later, when I went to it, I found it hanging in the fern. It was at this time fully fledged. Another day, when at the highest point of the common from which an extensive valley slopes, I threw it up in the air, but it only fluttered down into the fern and made no attempt to fly away. I carried it with me on bicycle rides very often, hanging its basket on the handle-bars; on one occasion it accompanied me on a ride of twenty-six miles. At first it showed restlessness but very quickly became accustomed to it, and would settle down at the bottom of its basket as soon as it was hung on the bicycle, not moving till the end of the ride, when it would begin to chirp and climb up the side of the basket. I thought this showed great intelligence; also it would attract my attention when shut in its basket, if hungry or thirsty.

It takes very little water, and takes it from my mouth; it has a queer little habit of shaking itself in anticipation as I take the water into my mouth; it generally sits on my hand both to eat and drink. At the end of September the wasp grubs came to an end—from then till the present time I have fed it on meat maggots. I give it thirty for a meal every two hours, killing them first by snipping off the heads with a pair of scissors. I once tried to see how many it would eat; when it reached fifty I left off, but the bird would have eaten more. I find thirty are as many as it can digest well. It takes them from the end of my finger, but never attempts to help itself, even when the food is close under its beak, it seems not to recognize it. It takes exercise by beating the air with its wings while holding tightly to the edge of its basket with its claws. The legs appear to be very weak. I have never seen it walking without at the same time flapping its wings; in this way it gets over the ground very quickly. It very much objects to being on the ground, and will very quickly climb up my dress till its head is under my chin; there it will hang for hours, nibbling occasionally at my throat, and no occupation or position will dislodge it. As an adult bird it is very silent; it has only two cries—one a kind of scream which it utters with its mouth very wide open to show annoyance, the other is a monotonous shrill chirp, very much like the song of the cricket; this cry it kept up continually when young, often through the night as well. On one

occasion the Swift was hanging on the outside of its basket near the fire, and the warmer it became the louder grew its song, when a Toad walked in, evidently attracted by the song and expecting a meal. The Swift is extremely sensitive to cold, and for this reason I found it impossible to keep it in a cage. I did try it, but it wandered aimlessly about and seemed very unhappy. Then I tried putting flannel in the bottom of the cage; it immediately burrowed under the flannel, so this quite decided me. I have kept it in quite a small basket, the lid of which is generally open; it never attempts to come out except when it is time to be fed; it can gauge the two hours as accurately as I can, then it will come on to the edge of the basket and look at me. A weird little object it looks, with its large deep eyes. If I do not notice it, it will begin to flap its wings, and if that does not gain attention, it will flutter to the floor. I place flannel in the basket, and also cover it with flannel, and I keep a hot-water bottle underneath, well wrapped up to allow a little heat to filter through. One of its happiest moments is when the bottle has been newly filled; it spreads itself out on the flannel, almost like a bird taking a sun-bath. It sleeps with its neck and head flat on the flannel and never behind its wing. It has a very good digestion, and has never cast up any pellets. It is apparently healthy and in good condition, and, I think, quite happy.

It moulted slightly all through the winter, and in the second week in January it shed in one night all the feathers from head and neck, and a thin line on each side of the breastbone; in about three days the new quills appeared, and the plumage developed in about a fortnight, much stronger and healthier than the first growth. I did not notice any signs of migratory restlessness; at the time the Swifts were leaving I left it out of doors constantly that it might go if it wished. It plumes itself a great deal, but I have seen no inclination to bathe.

In its habits the Swift is quite unlike the ordinary cage bird; it enjoys being caressed and handled, it will close its eyes while being stroked, and flutter its wings and at the same time utter its faint little chirp in a most fascinating manner. It comes into my bed every morning, and if I do not wake when it is ready to come, it will utter its cry of annoyance; as soon as the lid of the basket is opened it will flutter on to my shoulders and creep into my neck, wedging itself tightly between my neck and the pillow; when it has enjoyed this position for a short time, it will come out and nibble my face for something to eat, and after it is satisfied, will retire with great speed

back to its position under my neck.—Rosamond S. Twyman (Sunnyhurst, Leominster).

VERMES.

Notes on a Small Collection of Earthworms (Lumbricidæ) from the Island of Islay.—So little has been done among the Earthworms of Scotland that I should like to add a few records to the Rev. Hilderic Friend's paper on the "Distribution of British Annelids" ('Zoologist,' 1913, p. 262). Hearing that no Earthworms had, apparently, ever been collected in Islay, I made a collection when I was in the island in August, 1913. The summer was an exceedingly dry one, and worms were difficult to find. Mr. Friend was good enough to identify my specimens as follows:—

1. *Dendrobæna subrubicunda*, Eisen.—The Gilt-tail.
2. *Allolobophora longa*, Ude.—This species is widely distributed in Scotland.
3. *A. caliginosa*, Sav.
4. *Aporrectodea chlorotica*, Sav.—A common worm in Scotland.
5. *Octolasium studiosum*, Rosa (= *O. cyaneum*, Sav.).—Local.
6. *Lumbricus rubellus*, Hoffmeister. — Generally distributed in Scotland.
7. *L. castaneus*, Sav.—Plentiful on mainland.
8. *L. terrestris*, Linn.—One of the commonest and most generally distributed.

It will be seen that there are no rarities in the list; but island faunas are always of interest, and possibly, in a more favourable season, several species might be added. They are all widely distributed forms which have been reported from the Scotch mainland. The Brandling (*Eisenia fœtida*, Sav.) is, however, not among them, and I am almost certain that I have seen it in manure-heaps on other occasions when I was in Islay.—Harold Russell (16, Beaufort Gardens, S.W.).

CUMBERLAND NATURE RESERVE ASSOCIATION.

Some of the many readers of the 'Zoologist' may perhaps be interested to know that a Cumberland Nature Reserve Association has been recently formed, with the Right Hon. J. W. Lowther, Speaker of the House of Commons, as President, the Mayor of Carlisle, Major S. C. Ferguson, as Chairman, and Mr. L. E. Hope, Curator of the Carlisle Museum, as Hon. Secretary. The objects of the Association are twofold: the promotion of Nature Reserves in Cumberland, and the institution of a Watcher's Fund for providing protection to plant and animal life

in the county, particularly to those of the rarer birds requiring special protection during nesting. Already one Nature Reserve has been established in affiliation with the Association, namely, on Kingmoor Common and adjacent wood, near Carlisle, where nesting-boxes have been fixed and drinking ponds prepared. A list of the fauna and flora of the Reserve is to be prepared this year, and it will be interesting to see what beneficial effect the protection has. At one time this common was a favourite breeding ground for the small summer visitors, and also one of the richest grounds in the county for the botanist, but of late years, through having been let for cattle-grazing, it has become very much depleted. An appeal is made to all interested in the preservation of our native fauna, some of which, like the Peregrine Falcon, Buzzard, and Raven, are the special objects of the egg-collectors' greed, and it is hoped sufficient funds will be raised for this purpose. The Association will be glad to receive subscriptions from any of your readers who are interested in the preservation of these birds, and subscribers can, if they wish, have their subscriptions ear-marked for this purpose. — D. Losh Thorpe, M.B.O.U. (Loshville, Carlisle).

OBITUARY.

Sir John Murray.

Sir John Murray, whose sudden death owing to a motor accident took place on March 16th, will always be remembered as a great contributor to the science of Oceanography. He was born at Coburg, in the province of Ontario, in 1841, and when sixteen years old came to Scotland, and, after a short period spent in the Stirling High School, entered the University of Edinburgh. Here he studied enthusiastically and successfully, but his independent spirit declined to be bound by a systematic curriculum, and he never took a degree. It was, however, his work in Professor Tait's laboratory which led to him being appointed on the scientific staff of H.M.S. 'Challenger,' when in 1872 she started on her memorable cruise round the world. From that time the success of the expedition became his main object in life. He voluntarily undertook the registration, packing and despatch of the enormous collections sent home from the various ports visited by the expedition. These were all consigned to the University of Edinburgh and, except for the purpose of replacing

evaporated spirit, remained untouched until her return in 1877, to unpack them. It is a striking tribute to the care which had been taken that out of many thousands of bottles only four were broken. In 1881 he succeeded Sir Wyville Thomson as editor of the Reports which were just beginning to appear, and for twenty-three years superintended the issue of those fifty ponderous tomes, containing over 29,000 pages and about 3000 lithographed plates, charts, and other illustrations. He contributed himself, in collaboration with the late Abbé Renard, an epoch-making volume on the 'Deep-sea Deposits'—a work which laid the foundations of that branch of science, and which will always be essential to the worker in it, even though he may disagree with some of its conclusions.

Although when this task was finished he initiated other scientific enterprises, he still regarded the 'Challenger' expedition as *the* great work of his life, and recognized this by naming his house and one of his sons after the vessel.

His later works included expeditions in the 'Knight Errant' and 'Triton'; the foundation of marine laboratories at Granton and Millport; a bathymetrical survey of the Scottish Lakes (undertaken in conjunction with his friend, the late Mr. Fred. Pallar); the exploitation of Christmas Island; and an expedition, along with Dr. Johan Hjort, in the Norwegian steamer 'Michael Sars,' the cost of which was borne by Murray himself. Its results were published in a joint work entitled the 'Depths of the Ocean,' in 1912.

It is needless to add that he received degrees and decorations and other distinctions too numerous to mention, but the memory in the hearts of those who knew him and worked with him is that of a man endowed with a deep-seated love of truth and of science for its own sake, and a loyal comrade who unflinchingly, not to say brutally, told his friends just what he thought of them to their faces, and never spoke ill of them behind their backs; of one who, though he might seem unfeeling to the outsider, could always be depended on for sympathy and help in time of need.

W. E. H.

George Bentley Corbin.

We regret to record the loss of another old and valued contributor to the 'Zoologist' in the person of Mr. G. B. Corbin, who passed away on March 12th last, aged seventy-three years. Mr. Corbin was quite a self-made man; he was educated at the National Schools, and this education terminated at an early age, when he was

taught his father's business of a cabinet-maker and upholsterer. He then continued his education at evening classes with considerable success. But he was a true lover of Nature, and his great natural history lore was acquired first-hand in the fields and woods by his gifts of intelligent observation. In this he found the pleasure and purpose of his life.

In 1862 he contributed his first paper to the 'Zoologist,' "The Macro-Lepidoptera of Ringwood, in Hampshire," with a supplementary note by the Rev. Joseph Greene, M.A., and since that time he had been a more or less continuous recorder in our pages. We may recall his paper "On the Occurrence of the Needle-tailed Swift for the second time in England," which was published in 1880, and we are glad to learn from his relatives that this specimen "will eventually be added to the National Collection at South Kensington."

Mr. Corbin had a considerable number of friends and correspondents among eminent naturalists, including Charles Darwin and Charles Kingsley. With the former the subject was "Insectivorous Plants," with the latter the interest was focussed in the proof of the presence of the Smooth Snake in the New Forest. In his declining years he pursued the business of a taxidermist, and we are informed that for over thirty years he was a member of his church choir.

NOTICES OF NEW BOOKS.

The Life and Habits of the Badger. By J. Fairfax Blakeborough and Sir A. E. Pease, Bart. 'The Foxhound' Offices, Piccadilly.

Some years ago Sir A. E. Pease published a monograph on the Badger, after its appearing as articles in the 'Yorkshire Post.' Even since that date much more material has been collected and some statements revised, while Mr. Blakeborough, in conjunction with the previous writer, has now produced a thoroughly up-to-date and attractive volume on one of the most interesting members of our mammalian fauna. Few Englishmen, indeed, have seen a Badger in his native haunts, while some of us, in

days now long past, may remember that animal domiciled and captive in certain sporting resorts where "Badger-drawing," so called, was and could be witnessed; a cruel practice, now happily discarded. This book takes us to the creature in its natural haunts and advocates its preservation; may Brock long remain with us despite much ignorant persecution!

As regards the vexed question of mange and its possible dispersion by Badgers and Foxes, the evidence seems to promote a negative conclusion. Brock is a very cleanly animal, and Badgers "may very occasionally become mangy in a country in which the scourge has for long been prevalent among Foxes." Mr. Blakeborough has "no hesitation in saying that Badgers in a hunting country do far more to aid and abet the sport than to spoil it. Man, with his desire to have the credit of preserving Foxes, and still rear a huge breed of Pheasants, with a minimum of danger, has done far more to ruin Foxes and Fox-hunting than ever Brock has or will do. Hand-fed, hand-reared Foxes are the mangy, ring-running brutes so often found nowadays."

As regards the theory of protective colouring as applied to the Badger, some reasonable and qualifying facts are contributed. "If the Badger wears the best coloration for night, why was a Fox made red with a white tag often to his brush instead of white on his face? He also is a nocturnal animal. If a black tail is concealing, a white tail is revealing. The Ratel, similarly coloured in many respects to the Badger, is diurnal as well as nocturnal, so that what is supposed to suit a nocturnal animal has to do duty by daylight too."

The book is well and pleasantly illustrated.

Animal Communities in Temperate America, as illustrated in the Chicago Region; a Study in Animal Ecology. By Victor E. Shelford, Ph.D. London: The Cambridge University Press.

This book is the result of a study of the whole animal life of a distinct area in connection with its environment. This is too seldom done. Few naturalists, indeed, are intimately acquainted with the whole fauna attached or incidental to their

private gardens, and equally few have a knowledge of the fauna and its environment in the larger detail of their own neighbourhoods. Dr. Shelford has produced a volume which will not only incite this study but prove a model for that purpose; it is rich in observational information and focusses attention on the environmental causation of many animal communities.

There is a very useful discussion on our methods of animal protection. "Mistaken and sentimental ideas cause the killing of many useful animals and the protection of many noxious ones. The farmer kills Snakes and Skunks whenever he has the opportunity, though they are among the most useful animals." Shrews are frequently killed, though they are destroyers of Mice, as is also the case with the House Centipede, though it is the enemy of household pests, &c. Dr. Shelford is not a theorist, and he does not advocate some very prevalent and popular suggestions. Thus, we read in his summary of mimicry:— "One species of insect (or other animal) resembles another. The theorist finds or thinks one of them is distasteful to birds (or other animals). He further discovers or concludes that the species, not having a bad odor or taste, is not eaten by enemies because it resembles the distasteful species. The species having the bad odor or taste is the model. The species not having the bad odor or taste is the mimic. The mimic arose and attained its perfection because those individuals of the mimic species which resembled the model species survived." The argument is at least clearly stated, though its conclusion is apparently unaccepted, and this is not to be regretted, for a theory may be sound and probable, but liable to be distrusted through extreme advocacy and by the sometime employment of unsifted evidence; opposition thus becomes a tonic.

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May 15th, 1914.

No. 875.

The Zoologist

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A Sparrow-Hawk receiving the contents of Keeper's gun.

THE ZOOLOGIST

No. 875.—May 15th, 1914.

ORNITHOLOGICAL REPORT FOR NORFOLK (1913).

By J. H. Gurney, F.Z.S.
(Assisted by Members of the Norwich Naturalists' Society.)

(Plate II.)

As usual I take up, with the Editor's permission, the duties which fall to an ornithological coroner, and in doing so feel it to be a matter for satisfaction that these annual "Norfolk Notes" are now, for the most part, the records of birds identified, not killed. Gamekeepers, however, still continue to shoot many creatures, both winged and furred, which they had better let alone. It happened to the present writer last year (July 18th) to inspect a gamekeeper's "larder-tree," on which were suspended the following delinquents (besides many Hedgehogs, Squirrels, Stoats, Weasels, and Cats): twenty-six Jays, two Hooded Crows, one Spotted Woodpecker, six beautiful Kestrels, and three Tawny Owls; afterwards increased to eight Owls, as I was informed, in spite of the law, which is a dead letter. During the summer an adult Hobby was sacrificed to a keeper's ignorance, just at the time when it should have been going to nest (May 21st), and this happens every year. Forty-seven years ago Henry Stevenson could write of the Hobby as a very regular summer migrant, but Plate II. shows what happens to Hawks in Norfolk nowadays. I am afraid a good many Kestrels and Brown Owls were also killed.

The Spring Migration.—The spring of 1913 was chiefly noticeable for a lamentable deficiency among our garden favourites—Willow-Warblers, Whitethroats, Nightingales, Redstarts, Garden-

Warblers, and Blackcaps, which were almost as few in number as in 1912. Can it be that they are drowned in crossing sea when on migration, or is it more probable that they perish in the destructive "roccoli,"* which find such favour in Italy?

The usual migration of Rooks and Crows passed Cromer, flying E.S.E., a direction which, if maintained, would bring them to land near The Hague. Fieldfares also and Redwings were seen leaving, but no Buzzards. There was a marked coastal movement of Wagtails.

The first Spoonbills were a fine pair seen on Breydon Broad by Mr. B. B. Riviere on May 1st; wind S.E. to S.W., force 2. Many other birds were on the mud-flats, including five Sheld-Ducks, Wigeon, Shovellers, and a White-fronted Goose (G. Jary), all of them travellers going north or east. From that date until August 16th there were twenty-six days out of one hundred and six on which the watcher was able to register the presence of Spoonbills. According to his carefully kept notes, the longest period during which there was not a Spoonbill on the Broad was from May 29th to June 11th. On June 25th Mr. C. R. Gurney and I had a distinct view of three, and on July 6th there were four, this being the largest number seen by the watcher on any one day. In recording the visits of Spoonbills Mr. Jary has always been requested to carefully observe the direction of the wind. Accordingly, in looking back at his notes for many years, we learn that forty-four Spoonbills have come to Breydon Broad with a N.E. wind, and seven with a N.W.; twenty more have come with a W. wind, eight with a S.W., and six with a S. wind. These observations were all made in April, May, or June, and a good deal may be gathered from them. Evidently in the spring it is a N.E. wind which generally brings Spoonbills; but this is curious, because in April and May their desire on leaving southern Europe would be to migrate north, or perhaps north-

* These "roccoli," or devices for catching birds, especially Thrushes, are numerous throughout the north of Italy; they consist of small groves of low trees, trimmed and trained for the most advantageous disposal of thin one-inch mesh nets, while inside these seductive arbours is heard the piping of different sorts of decoy-birds. The nets are kept going during the migratory season, and everything down to a Long-tailed Titmouse is killed if captured by the peasants. There is, however, no reason for supposing the death of more victims in 1912 and 1913 than usual.

west. Do they then prefer to migrate with a wind which is against them? There is, however, another solution, namely, that it is a N.E. wind whereby they are checked, and without which many would pass on without halting on the Breydon mud-flats. This latter theory seems highly probable, and it certainly appears that when the wind has been S., a few only (fourteen in about as many years) have stopped on Breydon Broad, the rest presumably wending their way to a breeding-place in Holland.

Mr. F. C. Jourdain is of opinion that the largest Spoonbill settlement in Europe is probably that at Obedszka-Bara, in the Gegenwart (see Jakob Schenk, 'Aquila,' 1908, p. 245), but it is not likely that our Breydon birds nest there, or even pass it on passage.

The Breeding Season.—All Norfolk gamekeepers agree that the 1913 hatch of Partridges was excellent, the weather being dry and yet not too hot, but in spite of these favourable conditions the young birds died in the strangest manner. Various suggestions were made to account for this mortality, of which perhaps the most plausible was that their insect food had been destroyed by the floods of August, 1912 (see 'Zoologist,' 1913, p. 175).

Mr. N. Tracy is to be congratulated on again succeeding in finding a Curlew's nest near King's Lynn on May 13th, and he subsequently ascertained that the eggs, of which there were four, hatched.

The Autumnal Migration.—The autumn migration to the east coast of England, and particularly to Norfolk, commences in August; it continues with fluctuations for three months, and the sequence of species is always pretty much the same, but the number of individuals composing each species varies greatly. If there are strong N.E. winds, a rush of birds may be expected, including rarities from Asia; but if the weather be open, with little wind, the migrants pass over the coast of Norfolk without stopping. This annually invading army may be roughly divided into two great brigades of birds, namely, those arriving in September, when a great host of Wheatears, Redstarts, Warblers of all sorts, Flycatchers, Nightjars, Sparrow-Hawks, and Kestrels deploy on our shores; and, secondly, the great rush in October and November of Grey Crows, Rooks, Jackdaws, Snow Buntings, Sky-Larks, Redwings, and Thrushes. The second inrush is the

more noticeable of the two, because the birds are partly day migrants, and so force themselves on man's observation.

Of the three hundred and nineteen species which are considered to be admissible into the Norfolk list, all, except seven, are now known to be migrants.

The autumn of 1913 was too fine for local ornithologists to expect great things, nevertheless the wind blew steadily from the north-east from September 2nd to 8th, and this was favourable for rare birds. Accordingly Mr. E. C. Arnold, who was on the shore every day from September 2nd to 15th, was able to report a steady arrival of birds. But this only went on as long as the wind was from the north-east; on the 9th it changed to west, and at once Mr. Arnold remarked a disappearance of both waders and small Passeres. It was no longer in the right quarter for them, and consequently they ceased to pass. The Ortolan Buntings and Barred Warblers had already put in a fleeting appearance, but few in numbers, and their stay short. The latter must now be looked upon as an annual visitant, given suitable weather, having already occurred in Norfolk about sixteen times. Of these, ten are stated to have come with a north wind, and one with a very gentle south wind, while in four cases the wind's direction was not noticed. All have come very nearly at the same date, namely, between August 27th and September 12th.

The first October rush of birds was registered at Great Yarmouth by Mr. T. Chasen on the 12th, and again another rush was witnessed to the north of that town on the 19th. Further to the north Mr. B. B. Riviere noted a big passage of birds at the mouth of the Wash on October 21st and 22nd, which will be described later on. Very few birds of prey came over; indeed, owing to the present system of persecution in Norway, they get scarcer every year, and although there was an extraordinary plentitude of wasps' nests, only one Honey Buzzard arrived, and that was taken at sea (C. B. Ticehurst).

The Effect of Wind on Norfolk Birds.—If you have not been already troubled with too many theories about birds and wind, I should like to add a few more words on this puzzling subject, which seems to baffle some of the best ornithologists. My old friend Heinrich Gätke, for whose meteorological observations,

although they have been impugned, I have a great respect, cites "the simple fact that, whereas birds appear in great number when the wind is in a particular direction, they are scarcely seen at all when it is in some other quarter" ('Heligoland,' p. 74). This was the opinion of the veteran observer, but it has been challenged by later writers. In another place he says: "All species, without exception, approach in largest numbers to the earth's surface when very light south-easterly winds, accompanied by clear warm weather, happen to prevail for any length of time in the lower regions of the atmosphere" (T. C., p. 76). If this be true of Heligoland, it is probably equally true of the coast of Norfolk.

It has to be remembered that the wind often changes two or three times in a day, and observers do not always keep pace with these changes. Take the following, which is only one entry among many: "September 9th, 1913. At 7 a.m. the wind was E. at Northrepps, at 9 a.m. it was N.N.E., at 10 a.m. it was N.N.W., at 4 p.m. it was due N." These readings were from the clouds, which I generally find to be the best weather-cock.

Again, there is another point not to be forgotten, namely, that migrants cannot be much affected by any wind except that through which they are passing. Now migratory birds commonly travel high, and it may not unfrequently be observed upon the coast of Norfolk that, while the lower stratum of clouds is moving with the wind at a fair pace, the higher ones appear to the eye as absolutely stationary. Accordingly, if the birds have just descended from a height, it is not the lower stratum which has governed their movements but the upper.

This was first remarked by a very acute observer, Mr. F. D. Power, who formerly visited the Norfolk coast every autumn, and was led by long experience to attach great importance to wind in its effect on birds. In a little work entitled 'Ornithological Notes from a South London Suburb,' which deserves to be better known, Mr. Power says:—"These contrary currents may often be observed in studying the movement of the clouds, and I have many times seen migrants on passage against this higher wind at such an altitude that, had not my attention been attracted by the traveller's notes, I should have missed the movement altogether" (p. 58). Gätke, who observed this, speaks of sometimes

hearing the calls of Rooks from above when the birds themselves were too high up to be seen (T. C., p. 207).

Again, when little bands of Passeres, such as Finches, Buntings, Larks, Pipits, Wheatears, and Swallows (bands often composed of four or five individuals only), are to be seen going the wrong way—that is to say, north-west, when they should be going south or south-east—as often happens in the autumn (chiefly in September), it surely must be held that their movements are ruled by wind. These retrograde movements are coastal movements, and are especially to be observed near Cromer. It may be granted that they are partly due to the rounded outline of Norfolk's sea-board, but the main factor is wind.

The Winter Migration consisted of large arrivals as usual of Blackbirds, Wood-Pigeons (especially on November 21st),* Snipe, Wild Duck, Teal (over 200 in one small pond), &c., in December, as well as Waxwings and Woodcocks, the two best bags of the last-named being made at Sheringham (23) and Stratton (22). No Little Auks. As regards Waxwings, their numbers, although considerable, cannot have equalled what were seen in the great Waxwing winter of 1866–7, nevertheless the attention which they attracted was universal; although the whole eastern seaboard of England was visited, it seems to have been in Norfolk that the largest number landed. The credit of adding the Waxwing to the list of British birds has generally been given to Martin Lister, but as a matter of fact it belongs to a Norfolk naturalist, the celebrated Sir Thomas Browne, who was the first to detect this migrant from the north, and the same observer also added the Bearded Tit to our avifauna.‡

* Which coincides with observations in Kirkcudbrightshire, where, in twenty-five years, the Duchess of Bedford had never seen anything approaching their numbers ('Scottish Naturalist,' 1913, p. 283).

‡ The Waxwing being a very notable and conspicuous bird, early attracted attention in Western Europe, and a good deal might be compiled about it from Continental literature of the sixteenth and seventeenth centuries. Conrad Gesner in his 'Historia Animalium' alludes to an enormous flight of Waxwings in Germany (lib. iii. p. 674):—"Garruli Bohemici anno Salutis MDLII inter Moguntiam [Mainz] & Bingam [Bingen, twenty miles distant] juxta Rhenum maximis examinibus apparuerunt n tanta copia, ut subito qua transuolabant, ex umbra earum veluti nox appareret . . ."

Principal Rarities.—The principal rarities during 1913 were a Sea Eagle in March, an Ortolan Bunting in April, a Night Heron (?) in May, two Roseate Terns in June, a Yellow-breasted Bunting (*Emberiza aureola*), five more Ortolans, and two Barred Warblers in September, a Glossy Ibis in October, and the inrush of Waxwings in November and December. From a beautifully executed drawing of the Yellow-breasted Bunting with which Mr. E. C. Arnold has obliged me, it can be seen how close a resemblance there is to his first one, of which the 'Zoologist' gave a figure (1906, plate ii.). This rare Bunting has been added to Mr. W. R. Lysaght's fine collection.

Weather Conditions.—The autumn was a very fine one, and was protracted far into November, the first sharp frost not occurring until the 23rd of that month (A. W. Preston). Rainfall 23·52. The figures used for denoting the force of the wind are the same as at the Meteorological Office in South Kensington. Force 1 is not enough to move a weather-cock, force 3 is a gentle breeze, and force 5 a fresh breeze sufficient to make smacks shorten sail, while force 7 is a moderate gale, in which they remain in harbour, with a velocity attaining to 32–38 miles an hour.

January.

1st.—The New Year opened with Thrushes in song, and a day afterwards the Mistle-Thrush and Sky-Lark were also singing at Brunstead, and a Bearded Tit was detected by my correspondent, the Rev. M. C. Bird on the common.

17th.—A Bernicle Goose taken on that once celebrated resort of wildfowl, Breydon Broad, where I have not heard of one since January, 1910 (E. C. Saunders).

20th.—Shoveller at Calthorpe (M. C. Bird).

23rd.—Great flock of Golden Plover at Horsey (M. C. Bird).

26th.—The Bittern's boom heard on the Broads, one of the earliest of spring sounds there. Plenty of Jays about, and more cock Blackbirds than usual.

February.

1st.—At Mr. Robert's to-day a Slavonian Grebe,† a Great Crested Grebe, and a Red-throated Diver,† all just sent from Rockland Broad; the Slavonian Grebe's eye was red, encircled

with yellow, but in one which I once had alive this was reversed, it being the inner circle of the iris which was yellow.

March.

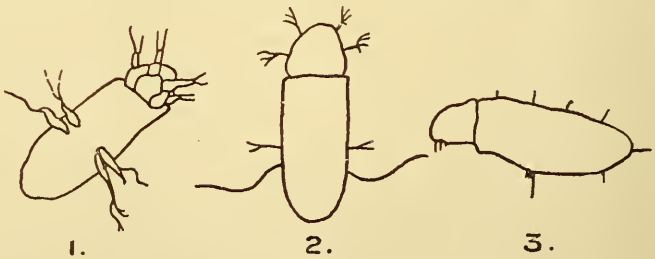
4th.—A Sea Eagle seen at Fritton Lake, near Yarmouth, by Mr. Buxton, flying rather low against a south-west gale; nothing more was heard of it. Sand-Martin at Foulmere (H. Halls).

11th.—W.S.W., 3. The customary departure of Rooks and Hooded Crows was marked at different places on the coast by Mr. F. C. Cook ('Zoologist,' p. 373), the Rev. M. C. Bird, and Mr. Burdett.

23rd.—S.S.W., 4. At about half-past five in the evening Mr. W. Burdett, gardener, was surprised to discover no fewer than sixty Pied Wagtails which had settled for the night on a comparatively short length of wire-netting used for covering fruit in a small garden, about a mile from the sea. These Wagtails are not only highly migratory, but more gregarious than authors have hitherto noticed. As early as February 22nd Mr. F. C. Cook saw over forty, evidently migrating ('Zoologist,' p. 373); these also were near the sea, and a movement was also noticed at Brunstead by Mr. Bird on March 11th.

April.

7th.—A Gannet† caught alive off Sheringham (Sir Digby Pigott), and on the 12th another † also was taken alive at Over-



1. Under side. 2. Upper side. 3. Side view.

strand, both fine adults. A careful search was made in both for the singular Mite which inhabits the Gannet's large subcutaneous air-cells. This creature, which, though small, is easily discernible with the naked eye, was first described by

Colonel George Montagu under the name of *Cellularia bassanæ*. Mr. William Evans, who has made a study of parasites in birds, is inclined to suppose that *Cellularia*, when it has reached its adult stage, makes its way through the skin of its host, and might be then found reduced in size, hidden among the Gannet's feathers. This will partly account for the very great difficulty which some have experienced in finding it. If any of your correspondents who may happen to skin a Gannet could secure me a specimen of *Cellularia* I should be extremely obliged, as it is desirable that a better figure of this singular form should be secured than that here reproduced from 'The Memoirs of the Wernerian Natural History Society.'

28th.—S., 3. An adult male Ortolan Bunting taken in a market garden at Yarmouth (E. C. Saunders).

29th.—Bittern booming at Hickling, and a pair of Short-eared Owls seen (Bird).

MAY.

6th.—*The Norfolk Broads.* To the gullery on Hoveton Broad, where there are considered by the owner to be three hundred Black-headed Gulls' nests this year. There are also an exceptional number of Redshanks on the marshes, whose strange quiverings and pirouettings have been so well described by Mr. J. S. Huxley (P. Z. S., 1912, p. 51). An egg of this species, which we found, was taken by Mr. G. H. Gurney and placed under a hen; it hatched out on June 4th, incubation having lasted twenty-four or twenty-five days. By dint of judicious feeding upon ants' eggs and very small worms, this young Redshank did well for four days, and would have lived longer if the hen had not killed it. The great size of its legs struck us as being out of all proportion to its little body. Mr. Arthur Patterson considers that Redshanks were remarkably numerous in the valley of the Waveney, and their abundance this spring has been noticed elsewhere by other observers; in a limited area he estimated a hundred pair, some of which must have bred very early, for Mr. F. Chasen saw young ones which were able to use their wings on April 25th. This increase may be due to protection, or, what is more likely, to the sediment left on the marshes by the great flood of August, 1912, which would probably breed the sort of food Redshanks eat. Prior to this, Mr. Patterson

says the Bure marshes were becoming drier every year, and the Broads also are shrinking sadly in places. On June 10th, although not a very warm day, Redshanks were going through their amorous performance at Hoveton with a strange series of quiverings and up and down movements, very hard to describe in words, but not inaptly compared by Mr. Huxley to the motion of a switchback railway. All the time the performance is accompanied by a series of monosyllabic notes, very different from the shrill whistle of autumn and early spring. Although most of it takes place in the air, they sometimes alight on the ground, or even on a gate-post, where they seem quite at ease.

8th.—On the Broads again—always so delightful at this time of the year—this time listening for Bitterns, of which Mr. R. Gurney and I heard one, but not distinctly, owing to too much wind, and for the same reason the Bearded Tits did not show themselves. If it had been a fine day, we should not have been long without seeing the males chasing one another among the brown reeds, which they so much resemble. As the boat was "punted" noiselessly along with what our men call "a quont," a Water Rat, alarmed by its approach, was seen swimming in "the dike" with a young one in its mouth.

9th.—A Coal Titmouse† has now nine eggs in a box in the garden. By the time the young ones are ready to fly, it will be a marvel how those at the bottom escape suffocation, but the Coal Titmouse is fond of close quarters, in which air seems to be of no consequence. It is not an unusual thing for this species to seek the warmth of a haystack, where it finds some convenient hole to burrow into at night, where with a small net it is easily caught.

13th.—Your correspondent Mr. Butterfield asks for information about the Blackcap and Garden-Warbler (1913, p. 431), but I can only say that both these sylvan Warblers have been again scarce. To-day a dead Blackcap was lying on the path—there being no cause to account for its death. A favourite as a songster, this pretty bird is at the same time too much of a fruit eater to be any friend of the gardener's; indeed, it will hardly wait for him to go for his dinner before it sallies forth into the raspberry-canes, where it indulges greedily, going on eating sometimes until the feathers of its face are smeared with the red juice.

The Willow-Warbler has a better reputation, but I have so often seen him among my raspberry-canes that it is impossible to acquit him of a *penchant* for the fruit also, although this species is stated in the fourth edition of Yarrell's 'British Birds' (i., p. 434) not to eat it.

14th.—The increase of the Common Linnet calls for a word or two; in this parish more than a score of nests came under observation in a very limited area, and our market gardeners are calling out loudly, accusing it of doing a great deal of harm to the seeds and young growth of radish, lettuce, and cabbage crops.

16th.—A Night Heron reported to be on Holkam Lake, also a Ruddy Sheld-Duck, but this may have escaped (S. K. Long).

25th.—A Quail † found by Mr. F. Chasen under telegraph-wires at Yarmouth; a Mistle-Thrush was also "telegraphed," and another † washed up by the sea.

June.

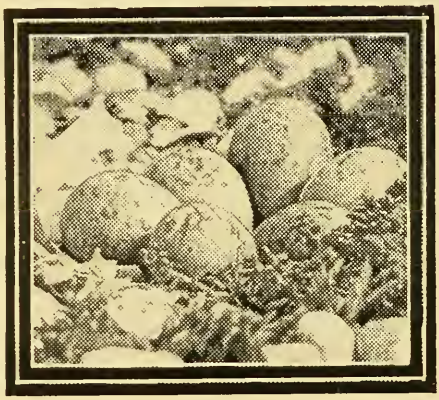
2nd.—Mr. B. Dye states that nine Grey Plover were seen on Breydon Marshes, and again on the 9th eight were seen, possibly the same birds, all of course in summer plumage. I once saw four at Blakeney so late as June 14th, but their occurrence at this season is somewhat remarkable, and must be confined to individuals which have no intention of breeding surely.

11th.—By dint of protection the Bearded Tit, or "Reed Pheasant," as our marshmen call it, now holds its position. Fifteen or sixteen years ago, owing to the rapacity of one or two dealers, there were probably not thirty nests from which the young got clear away in the whole Broad district, but now eighty or even ninety nests would not be too liberal an estimate. They are early breeders, and to-day some were feeding young ones, but young Bearded Tits are to be seen as big as their parents by the middle of June. The eggs, five or six in number, are occasionally laid at the end of March, and have a pink tinge when fresh, which is lost in blowing. In April Mr. B. B. Riviere was shown a nest containing ten eggs, seven of which were in their proper place in the nest, and three more were showing through the lining. I once heard of a nest at Hickling with twelve eggs, but in both these cases they were probably two

clutches, laid by different females, the second having been deposited after the first was forsaken. Common as is the Cuckoo on our Broads, I have only once heard of its selecting a Bearded Tit's nest for its egg, and in that case, as the clutch was taken, there is no proof that the young Cuckoo would have been reared by its foster-parents.

17th.—Eight Oystercatchers on Breydon Broad (G. Jary).

18th.—There is now an Oystercatcher's nest † at Blakeney with three eggs, and another with six (see photograph), the



Eggs of Oystercatcher.

produce of two hen birds in the opinion of Mr. William Rowan, who spent some time at the Point with Professor Oliver. I learn from Mr. Rowan that a third nest was discovered containing three fresh eggs, which a Rook subsequently ate, and that Oystercatchers were locally considered to have been more numerous in 1913 than for some years.

20th.—Enjoyed another excursion with Sir E. Gurney to the Broads, where there is always something to see, but we were sorry to miss the pair of Montagu's Harriers from the marsh where they had been last year. However, this disappointment was more than balanced when a little before half-past five a fine Bittern was viewed approaching with lazy flight, extended legs, and retracted neck from the same direction as one had come when Mr. Bonhote and I were on this Broad one warm July day two or three years ago. On perceiving itself watched by three

people, it rose considerably, but soon dropped again to its original level, some fifteen feet above the reeds, among which we eventually saw it settle. I should have liked at once to have searched for the nest, but the owner was obdurate, fearing that the birds might forsake it, a feeling with which one could not but sympathise. The return of the Bittern to Norfolk of late years has been accompanied by a general desire to protect it on the part of the Broad owners, and it is hoped that this good action will have the support of the public who use our Broads in summer. The "boom" of a Bittern is a curious sound, not often to be heard; it is hushed in the middle of the day, but towards evening this nocturnal "Butter-bump" as it has been called in allusion to its note, becomes more lively. By listening carefully, we could easily distinguish five successive "gasps," rising *in crescendo*, and terminating in the deep "bump," whence its name, but sometimes there were only three "gasps," which agrees with the statement of Francis Willughby that the number is always uneven.* Whether it goes on serenading its mate all night is hard to say; on the present occasion I can testify that its "boom" could be heard up to 11 p.m. and again at 4 a.m. the next morning—*i. e.* sixteen minutes after sunrise—breaking forth about once in four minutes, and this went on with clock-like regularity until past six o'clock. I believe it is not yet settled whether the female Bittern can boom or not, but at any rate she does not do it nearly as loud or as often as the male. Mr. W. P. Pycraft in a recent article ('The British Bird Book,' iv., p. 338) leaves the question open, merely remarking that the syrinx, which is usually considered to be the voice organ in birds, presents no modification. An old eighteenth century naturalist, Dr. Lamb, however, mentions having found in repeated dissections a loose membrane on the inner side of the windpipe in the male, which the female does not possess ('Zoologist,' 1880, p. 318). It is through the nostrils, which are distinctly larger than a Heron's, that the sound is believed to come.

24th.—A pair of Roseate Terns identified at Blakeney Point by Mr. Bishop, and also by the bird-watcher, who were both near enough to see their rosy breasts, besides at once noticing the

* "Boatus numero impari vel tres simul, vel quinque edit, ut aiunt" ('Ornithologiæ Libri Tres,' p. 208).

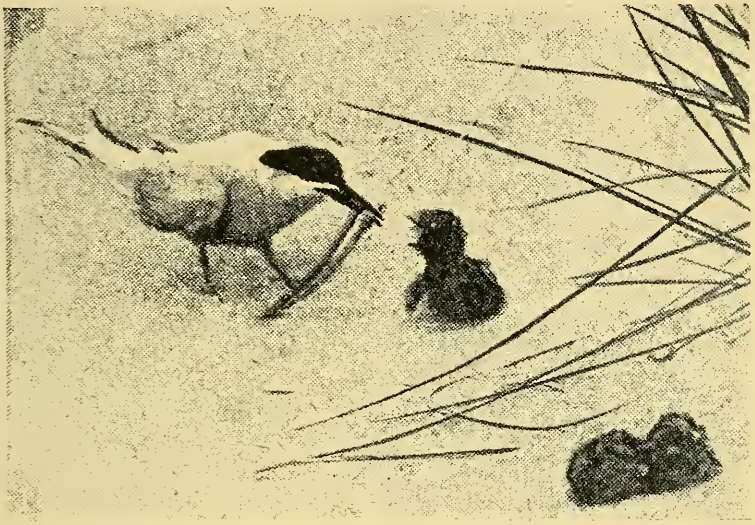
difference in their cry of "crake, crake," harsher than that of the Common Tern. Although not remembered by these observers, the 24th was the identical day on which two Roseate Terns† were shot here by a boy in 1896. A pair were seen also at Wells in June, 1897 (Norwich Nat. Trans., vi., p. 512), and another at the Point in May and June, 1902, and they are even supposed to have nested at Hunstanton ('Ootheca Wolleyana,' ii., p. 301). This species seems to be on the increase (*cf.* 'British Birds,' vii., p. 242), and the Arctic Tern to be getting rarer—at least on our coast.

25th.—Two nests of the Lesser Tern, and afterwards a third nest, all with eggs, found by Mr. F. Chasen near Yarmouth, where they are not known with certainty to have bred for many years. At Wolferton, Mr. G. Cresswell reports first eggs of the Common and Lesser Terns on May 13th, and the first young of the Common Tern on June 5th and of the Lesser on June 4th. Here they generally use the shingle for their nests, but at Blakeney the marram grass (*Psamma*), and perhaps in rare instances the shelter of *Suæda* bushes (*S. fruticosa*).

30th.—*Blakeney "Ternery."* Last year's report commented on the flourishing state of this well-protected ternery, and on the increase of Sheld-Ducks, of which, on the 30th, Mr. C. Gurney and I put up thirty-nine, showing how they have responded to protection (see 'Zoologist,' 1886, p. 93, and 1887, p. 141). With the Terns we were very much disappointed, for not only was the number less than had been seen on previous visits, but also there had been a most unfortunate mortality among the young, three-fourths of which were lying dead on the sand, and other downy mites were scarcely able to crawl. The watcher in charge considered that they had been starved by lack of Whitebait, their usual food, he having opened several nestlings and found no food in them. Mr. William Rowan, who was staying at the Point* some ten days later, remarked on the

* In 1912 Blakeney Point was purchased from Lord Calthorpe by "The National Trust for Places of Historic Interest or Natural Beauty," and a small house has been built on the sand-hills for the use of botanical students, under the leadership of Professor Oliver. During the first week in July about one hundred and thirty Terns and fifteen Lesser Terns were ringed under his direction by Mr. Rowan, with rings supplied by Mr. Witherby.

Whitebait to be seen lying about in numbers among the Terns' nests, whither they had been brought by the parent birds for their dying young, by that time too feeble to eat them ; or it may have been that the fish were too large. One can hardly imagine a nestling Tern making a meal of a Sand-Eel as large as the one which is being offered by the bird in the photograph,



Lesser Tern feeding young one.

but in some cases, as suggested by Mr. Rowan, the old Terns may have been kept off their nests too long by visitors. The Terns at Wells are reported to have suffered in the same way, but not those at Wolferton.

July.

29th.—A Tufted Duck and five young ones seen on the Bure at Salhouse by Mr. H. C. Davies, and afterwards by Mr. Barclay, were identified beyond dispute. A nest had been previously reported to Mr. B. B. Riviere by one of the gamekeepers, which doubtless produced this brood ; it may have belonged to a male which Mr. Barclay and I saw on Hoveton Broad on June 11th, and to a female which had been "pricked," and was known to be about in that neighbourhood. The nesting of the Tufted Duck on this side of Norfolk is of very rare occurrence, but I am

informed by Miss Turner that in 1912 a pair nested and had eggs at Hickling, but being disturbed, forsook their nest. Mr. Riviere says there have been three Pochards on Rockland Broad nearly all the summer, and earlier in the season on another large Broad he identified three Garganey Teal.

August.

6th.—A Green Sandpiper † received by Mr. Roberts, and on the 10th there were four † together at Intwood stream, a part of which had been emptied of water for the removal of mud, and on the 15th another at the same place. This is called "fyeing out" a stream in Norfolk, and it is extraordinary how quickly these Sandpipers find out when this operation has taken place, leaving exposed what is to them a rich feeding ground, which possibly they discover by a sense of smell, an organ much more acute in birds than is generally supposed. During the present summer a pair of Green Sandpipers have been continually seen on a large pond at Hanworth (G. Davey), where in September they were joined by three more, which, from their lighter tints, Colonel Barclay judged to be young ones. The odd thing is that these Sandpipers are also here in the depth of winter; at which season I have repeatedly seen single Green Sandpipers in December and January.

29th.—The Grey Wagtail † arrived, before its usual time; this species is said to have bred in Suffolk ('The Field,' October 1st, 1910).

September.

1st.—Two young Arctic Terns † shot at Yarmouth (F. Chasen).

2nd.—*September Migration.* At 4 a.m., and probably much earlier, migration was in swing with a gentle wind from the north-east, for although it was still too dark to discern the feathered travellers, Mr. F. Chasen could recognize the calls of Dunlin, Ringed Plovers, Terns, Curlews, Oystercatcher (1), Sandpiper, and Turnstone, possibly attracted by the still burning lights of Yarmouth. At Cromer, where the wind was S.E., 2, at 2 o'clock and E. at 7 p.m., several migrants were noted by different people. So were others by Mr. E. C. Arnold at Blakeney, where the wind was the same as at Yarmouth, *viz.*, N.E., 2, and these included the rare Barred Warbler. Another

Barred Warbler was identified by Mr. Richards on or near the shore, as well as three or four Ortolan Buntings, and a few Bluethroats; these latter always an indication of the great September movement being in progress.

3rd.—E.N.E., 2, at the mouth of the little river Glaven, where a Razorbill and a Great Crested Grebe in the estuary marked its continuation; while inland a solitary Snipe was shot (T. E. Gunn), and a few days afterwards Mr. Gunn had two more.

4th.—Mr. Arthur Patterson, ever on the *qui vive*, had a wave of small migrants at Yarmouth to record to-day, the town park being full of Redstarts, Willow Warblers, Robins, &c., so that Mr. Patterson thought there were seventy in one clump of shrubs. Birds of all sorts were now on the move, and Mr. Arnold, with his usual good fortune, annexed a Yellow-breasted Bunting (*Emberiza aureola*) near "The Hood." In his diary the wind is entered as N.E., 1, with a squall, while in mine it is marked as E., 2, at 8 a.m. The two previous occurrences of this Asiatic Bunting were with a very light N.W. wind (1), and a N.E. (4). There is nothing to beat a strong east or north-east wind to bring a big rush, as witness what happened in September, 1903 (see 'Zoologist,' 1904, p. 209). But besides rare birds, there was great restlessness among some of the commoner ones, especially Whinchats, of which species about forty were counted in one small field of cut peas, about a mile and a half from the sea, and that in a parish where at other times they are unknown, but, like the Redstarts, they did not stay long.

6th.—At 8 a.m. the wind at Northrepps was N.E., 1, where fifteen minutes later the gardener saw a Greater Spotted Woodpecker fly over the house, followed a few minutes afterwards by a Wader whistling loudly. This was the day on which the first Bluethroats were seen at Lowestoft by Mr. C. B. Ticehurst.

9th.—S.W. to N.W., with rain at Blakeney. House Martins passing along the beach (Arnold). Six Sand Martins † going north-west against the wind at Overstrand. Swifts passing at Stalham (Bird).

10th.—The old Cuckoos have all left, but the young are now on migration. To-day Mr. E. T. Roberts received a well-grown young bird, evidently a flier, and having the curiosity to examine its stomach, found therein on dissection a dense mass of rather

long hairs, which had effectually insinuated themselves into the lining of the bird's gizzard. There were three good-sized caterpillars in its throat, still undigested, and these resembled the larvæ of the Tiger Moth or Fox Moth, both of which are very hairy, and no doubt similar larvæ supplied the hairs in the

Stomach of a young Cuckoo.

gizzard. That somehow or other caterpillars' long hairs frequently find their way into the cuticle of the gizzards of Cuckoos has long been known, but it must be rare to find so many as in the present case.*

14th.—At 7 a.m. the wind was S.S.E., 3, but at Blakeney it veered round to N.E., with thunder, and here a large migration of House Martins and Swallows, as well as of Linnets, came under Mr. Arnold's notice. The great number of House Martins which in September travel through East Norfolk has been before alluded to ('Zoologist,' 1906, p. 133, and 1909, p. 130), and a plausible suggestion thrown out, namely, that they follow the western shore of the North Sea, and not the eastern.

15th.—N.E., 2. Several Kingfishers reported by Mr. Arnold as being at no great distance from the shore had possibly crossed the sea in the night.

* My late father recorded the presence of hairs in *Oxylophus serratus* ('Ibis,' 1859, p. 246).

23rd.—Two Crossbills at Northrepps (W. Burdett), and one on October 1st, nor did I hear of any more in East Norfolk until December 11th, when I saw two † at Hempstead on Scotch firs.

25th.—Several Jack Snipe already over (Bird); a Bean Goose shot on Breydon (Saunders).

October.

1st.—E., 5. No migration remarked by any of my correspondents, but it was probably going on, as the wind was high, and the next morning Mr. Chasen found a Wheatear and two Sky-Larks killed by telegraph-wires, and noticed several Robins on the beach.

7th.—*October migration.* W., 1. At an early hour (7.30 a.m.), going on to the beach between Yarmouth and Caister, which, like Blakeney further north, seems a favourite landing-place, Mr. Chasen at once perceived that an extensive migration had set in during the night, and was in full progress, Chaffinches, Linnets, Sky-Larks, Starlings, Crows, &c., all coming from the north-east.

16th.—Several Siskins and a Mealy Redpoll (B. Dye).

19th.—S.W., 2. Another big migration noted at Yarmouth by Mr. Chasen, the birds coming as before from the north-east. Searching under the telegraph-wires he found two Starlings, two Titlarks, one Redwing, one Blackbird, and a Jack Snipe, all quite fresh, probably killed during the night.

20th.—An Eared Grebe brought in to the birdstuffer's. Seven Shore-Larks taken in a clap-net (B. Dye).

21st.—S., 3, at Yarmouth. Mr. B. B. Riviere writes:—"At Hunstanton there was a falling glass, rain, and S.W. wind. During the whole morning up to mid-day there was a large migration of Sky-Larks, Starlings, and Lapwings, with a few flocks of young Rooks, and three or four larger flocks of Linnets. All the birds were following the coast-line, coming out of the east beyond Holme, passing Hunstanton, and turning south-west along the shore of the Wash towards Heacham. In the afternoon I saw a Wheatear and a Black Redstart."

22nd.—W.S.W., 1, at Yarmouth. Mr. Riviere writes again:—"At Hunstanton with very light S.W. wind. From 7 o'clock in the morning until mid-day there was a very big passage of Chaffinches, Greenfinches, Linnets, Sky-Larks, Starlings, Rooks,

Lapwings, Meadow-Pipits, and Reed Buntings, all following the coast-line in the same direction as on the day before. I also saw a flock of Shore-Larks on the beach, and two more Black Redstarts."

23rd.—Finches and other birds still coming in from the sea near Yarmouth (Chasen).

28th.—Gossy Ibis † at Acle ('Zoologist,' *ante*, p. 37).

NOVEMBER.

6th.—A Firecrest was shot at Cley by Mr. H. P. Williams.

14th.—A number of Rock-Pipits on Breydon Broad embankment (B. B. Riviere).

15th.—Mr. Arthur Patterson received a Waxwing from St. Olave's, to be quickly followed by others, and for eight or ten weeks they continued coming over the sea. Altogether the presence of about one hundred and six was announced, for the most part near the coast, but very likely some were counted twice over. Most observers were content to watch them, and the number shot was not great, the most received by any one taxidermist being fifteen; this was the more creditable because of their great tameness, which was remarked in several cases, possibly in part due to exhaustion, but they are said to be very tame in Finland. An interesting observation was taken at Cromer on February 7th by Mr. Henry Cole, who early in the morning (about 7.30 a.m.) saw, at no great distance from the sea, a little flock of about fifteen, apparently then landing from the Continent. Owing to the great scarcity of berries, a good many of the Waxwings betook themselves to gardens, where there was a better chance of finding food, and some even penetrated into Norwich, six appearing in Earlham Road, two in Newmarket Road, and one in Surrey Street, where it had the ill-luck to get down a chimney (R. Mills).

DECEMBER.

2nd.—House Martin at Haddiscoe (H. Cook).

10th.—A Land-Rail hanging up in a Yarmouth game-shop (Chasen).

20th.—About this date Mr. Gunn had a Black Redstart from Holkam; on the 28th Mr. F. H. Barclay saw one on Cromer lighthouse hills, and a week after that one was caught so far inland as Hollesdon.

30th.—A cock Pheasant † weighing 5 lb. shot at East Walton (Birkbeck).

Migratory Gulls coming Inland.

In October and November the farmers round Norwich are fond of manuring their fields with what are sold as "gyps," *i. e.*, the gills and insides of Herrings. As eight hundred and twenty-four million (824,000,000) Herrings were brought into Great Yarmouth this autumn, "gyps" were cheap. Unless this unsavoury garbage is ploughed in quickly it becomes a great attraction not only to the Black-headed Gulls, but to the larger species too, which somehow find it out, and come inland in large numbers, so that it is not unusual to see two hundred Gulls on a single field, and that even in mild weather, when there ought to be no shortness of other food. Whether these Gulls are to be regarded as migrants or as partial residents is hard to say.

In this connection reference may be made to the Report recently issued by the Suffolk and Essex Fishery Board on the food of Gulls, and since brought before the Norwich Museum Association, in which the following analysis of a number of dissections is given.

Contents other than Fish found in Black-headed, Common, and Herring Gulls.

	Black-headed Gull.	Common Gull.	Herring Gull.
	Per cent.	Per cent.	Per cent.
Fish of all varieties present in	28	24·5	18·2
,, useful as human food present in	13·5	17·5	10·4
,, useless as human food present in.....	14·5	7·0	7·8
Marine Food other than Fish.			
Shrimps (*Pandalus* and *C. vulgaris*)	27·0	14·6	5·2
Lugworms (*Arenicola marina*)	7·6	2·4	—
Ragworms (various *Polychætæ*)	6·7	3·7	—
Molluscs	4·8	3·7	7·8
Small Crustacea.....	8·5	2·4	2·6
Crabs (various shore Crabs).....	7·7	7·3	16·9
Echinoderms—			
Starfish, Brittle Stars, Sea Urchins	—	—	18·2
Whelk-spawn (*Buccinum undatum*).....	—	—	10·4
Land Food.			
Earthworms	18·3	18·5	6·5
Wireworms	3·8	·0	·0
Beetles	9·6	1·2	1·3
Craneflies.....	5·7	11·0	1·3
Other insects	3·8	8·5	1·3
Cereals	2·9	11·0	19·5
Garbage	3·8	13·4	11·7

Tenacity of the Weasel.

An incident of instinct at fault, which is not without precedent, but shows the extraordinary tenacity of the Weasel in holding on to its prey, must be related in conclusion.

Sometime during November (exact day forgotten) Lady Layland-Barratt, who was driving her car near Happisburgh, was greatly surprised at seeing a Hawk—presumably a Kestrel—rise from the ground with a Weasel, not in its talons but suspended from the bird's breast, which it was apparently hanging on to with its teeth. The Hawk soon dropped to the ground, but rose a second time with the Weasel still hanging on, and flew heavily and with apparent difficulty over a field, where it was lost to view. It was a case of the biter bit, and it is a pity we cannot know the sequel. As the scene was near the sea, the Hawk may have just come over, and in the early morning light seized the Weasel in mistake for a Mouse, an error which probably cost it its life.

THE FAUNA OF "RESERVOIR-PLANTS."

By Hugh Scott, M.A. (Cantab.), F.L.S., F.E.S.
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It has long been known that a number of insects and other animals are to be found in the water and detritus which accumulate in the hollow leaf-bases and other receptacles possessed by various tropical plants. But perhaps it is not a matter of common knowledge how extensive and diversified is the fauna dwelling in such situations, how largely peculiar it is to its habitat, and how remarkable in some cases are its relations to its curious environment. The present writer became interested in this subject in 1908–9 while engaged in collecting the invertebrate fauna of the Seychelles Islands, and his interest was increased in 1912 by a slight examination in Trinidad of the fauna of certain epiphytic *Bromeliaceæ*. These latter are the most interesting of all reservoir-plants, and much has been written of their fauna. Recently there has appeared a long and most interesting paper entitled "Les Broméliacées épiphytes considérées comme milieu biologique,"* in which the author, Monsieur C. Picado, embodies the results of an extended study of the inter-relations between these plants and their fauna. Therefore it may not be inopportune to attempt to give some general account of the fauna of reservoir-plants as a whole, and of *Bromeliaceæ* in particular, in relation to its environment.

Many widely different plants possess receptacles of one kind and another in which water can accumulate, and it seems best to adopt Picado's name "*reservoir-plants*" to include the whole of them. The term "terrestrial waters" is used to denote pools, &c., on the ground, as opposed to those elevated above the ground in plant-receptacles.

Permanent marshes and other standing terrestrial waters do

* Bull. Sci. France et Belgique, sér. 7, vol. 47, fascic. 3, 1913, pp. 215–360, pl. 6–24.

not usually exist in the heart of great tropical forests. Owing to loss of water by transpiration, draining of the soil by roots, and other causes, *tropical forests and permanent marshes are to a large extent mutually exclusive.* The same thing applies, though less markedly, to many temperate forests. If then there are no permanent marshes over large areas of tropical forest, how does this affect all the animals which, either throughout their whole lives or in certain stages of them, are dwellers in marshes and pools? Are such creatures absent from the forests? On the contrary, many amphibious and aquatic creatures exist in such forests, and they are able to do so *because the place of terrestrial pools and marshes is taken by accumulations of water in reservoir-plants.* In some of these the water collects only at times, in others it is permanent. But in most parts of the world, and more particularly of the tropics, great forests contain reservoir-plants of some kind. It is not attempted here to give an exhaustive list, but let us review briefly the *principal* kinds and the fauna which has been found to inhabit them.

(A.) First there are certain plants which hold water only *accidentally*, and then only for a time. The most important examples are the bamboos, which often hold water in the ends of broken stems, in the spaces between sheathing leaf-bases and stems, &c. Such accumulations of water have been found in Malaysia to contain larvæ of Culicid and Chironomid flies, and of Dragonflies, and in Central America to contain larvæ of Mosquitoes of the Megarhine group.

(B.) True *reservoir-plants*: these are plants which quite normally possess water- or detritus-holding receptacles.

First may be mentioned the order *Musaceæ*. *Musa*, the banana, holds water between the stalks of its great leaves, and in the New World tropics *Heliconia* holds water in its gaudily-coloured, cup-like floral bracts. These plants are said only to hold water temporarily, but in both have been found certain aquatic insect larvæ, especially those of Mosquitoes.

Next, one may refer to the well-known pitcher-plants, *Nepenthes*, of the Old World tropics. In these the midrib is prolonged beyond the lamina of the leaf, and bears at its end the pitcher. Insects attracted by the honey-glands of the pitcher are drowned in the water which it contains, and the plant absorbs

the products of their decay. Dipterous larvæ of several families (*Culicidæ*, *Phoridæ*, *Anthomyiidæ*) have been found living in these pitchers. If it be true, as is asserted, that the plants actively secrete a digestive product to act on the substance of drowned insects, then it is noteworthy that the living larvæ withstand the action of this digestive product and flourish in the pitchers.

Passing back to the New World, one finds, in the temperate forests of part of North America, the Sarracenias. In *Sarracenia* nearly the whole leaf forms a long narrow pitcher. In these pitchers the water often dries up; nevertheless larvæ of *Culicidæ* and *Chironomidæ* have been found in them, certain of which are regarded as peculiar to this habitat. It is stated that the Culicid in question, *Wyeomyia smithi*, Coq., lays its eggs in the pitchers even when the latter are dry, and that hatching is deferred till the pitchers refill with water.

In the Hawaiian Islands a species of *Eriocaulon* provides a habitation for the larvæ of a Culicid and for a species of Cyclopid Crustacean. This case is different in several respects from the others under consideration. The plant is a perennial herb with grass-like leaves, and it was found, not in forests but floating on a marsh; in spite of this, investigation failed to reveal the presence of the animals mentioned in the surrounding waters of the marsh—they were detected only in that between the leaves of the plant.

Among the *Liliaceæ* there is the well-known discovery of Perkins, also in the Hawaiian Islands; that is, that the hollow leaves of a plant of this order are inhabited by certain Agrionid Dragonfly larvæ.

Palms.—In the mountain-forests of the Seychelles * the present writer found a fauna, numerous both in species and individuals, inhabiting the spaces between the overlapping leaf-bases of certain endemic palms. These spaces contained not water but moist organic *débris*. The fauna was principally coleopterous, and included representatives of *Aphodiinæ*, *Scydmænidæ*, *Pselaphidæ*, *Staphylinidæ*, &c., several of the species being found nowhere else. Only some of the palms have their leaf-bases so formed as to hold detritus. In others the spaces are far too narrow, and consequently contain neither *débris* nor fauna.

* Trans. Linn. Soc. London, ser. 2, Zool., vol. xiv., 1910, p. 24.

The *Pandanaceæ*, or "screw-pines," are trees with stilt-roots and heads of spirally-arranged long narrow leaves. The leaf-bases overlap in such a way as to form abundant spaces capable of acting as reservoirs. In both the Hawaiian and the Seychelles

Fig. 1.—A small tree (*Acnistus arborescens*) bearing a large number of epiphytic bromeliads (*Tillandsia*); Costa Rica. (After Picado.)

Islands* animals have been found inhabiting them. In the mountain-forests of the Seychelles the water in these plants is permanent, and they were found to contain a varied and interesting fauna, including Woodlice, Snails, Earthworms, a

* Trans. Linn. Soc. London, ser. 2, Zool., vol. xiv., 1910, p. 24.

Land-Leech, a Land-Nemertean, lepidopterous larvæ, larvæ of a Drone-fly (*Eristalis*), various Coleoptera, including a true Water-Beetle (*Copelatus*), and a peculiar flattened Cockroach. The *Eristalis* larva and the *Copelatus* are purely aquatic. They were never found elsewhere but in *Pandani*, and indeed in several localities where they were obtained there was no other water for them to inhabit. The *Pandanaceæ* are confined to the Old World tropics, and, regarded simply as reservoir-plants, they

FIG. 2.—Various epiphytic *Bromeliaceæ*; Costa Rica. (After Picado.)

appear to occupy somewhat the same place in the Old World as the *Bromeliaceæ* do in the New.

It is to a consideration of these last, the *Bromeliaceæ*, most important and most interesting of all reservoir-plants, that one now passes. They have usually an exceedingly short stem and a rosette of fleshy leaves arranged so as to form a kind of funnel admirably adapted for holding water and *débris*. The majority of forms are epiphytes, *i. e.*, they grow, not on the ground but on trunks and branches of trees, and it is with the epiphytic kinds that we have to do. Some *Bromeliaceæ* grow on the ground—the pineapple is one such—but these do not

concern us, since their leaves are not so constructed as to form permanent water-reservoirs.

The *Bromeliaceæ* are confined to the tropics of the New World, and to understand their importance as reservoir-plants, one must realize the immense numbers of individual bromelias of the epiphytic kinds which are present throughout great forest areas in Central and South America and the West Indies. They are one of the most striking features of neo-tropical vegetation, and in many places are so numerous that they seem to push and crowd one another to obtain a foothold on branches of trees. Figure 1 shows a large number of a species of *Tillandsia* growing on quite a small tree; in figure 2, large specimens of more than one epiphytic kind are seen held up to view. For these two figures and the diagram (figure 3) I am indebted to the courtesy of Monsieur Picado, in whose paper they were published; as I possess no photographs of bromelias he has allowed me to republish these. In many places where these plants abound, there is no other permanent water save that which collects in them; I have myself seen a big area of forest covering a mountain-top in Trinidad, and other pieces of forest in Dominica, where this was so.* The bromelias and their contained water and detritus may be regarded, as Monsieur Picado has most aptly expressed it, as a great permanent marsh, broken up into countless small parts, which are elevated at various heights above the ground.

Environmental conditions of the "bromelia-marsh" and their effect on the fauna.—The bromelia-marsh has several other peculiarities as a habitat for marsh-living animals. First, in many places the water never dries up. Though it may evaporate considerably during the hot hours, it is *daily* replenished by the condensation of atmospheric vapour in the form of mists, as well as being frequently reinforced by rain. Secondly, the water is *not* foul. Though containing animal and vegetable *débris*, it is free from accumulation of decomposition-products. This most important fact is due to the action of the plants themselves. The roots of epiphytic bromelias usually act only as holdfasts, fastening the plant firmly to the branch on which it grows, but taking no part in its nutrition. The plant lives entirely on the

* Ann. Mag. Nat. Hist., ser. 8, vol. x., 1912, p. 424.

water and detritus which it collects between its own leaves. It has special absorbent scales on the lower part of its leaves, and these scales take up not only water and inorganic salts but organic substances as well.* Hence the purity of the water; hence also the fact that the solid *débris*, deprived of inorganic salts and of organic decomposition-products, consists very largely of cellulose, which substance is present in much larger proportion than it is in the mud of most terrestrial marshes.

Thirdly, if a vertical section of an epiphytic bromelia be made (see fig. 3), it is seen that the inner part, where the leaves

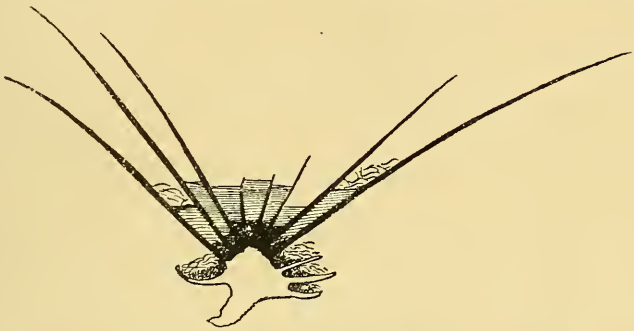

FIG. 3.—Diagrammatic vertical section through an epiphytic bromeliad; explanation in text. (After Picado.)

are still alive, forms a number of water-holding compartments. So closely do the leaves fit that these interfoliar spaces are *isolated from one another*, so much so that the water in them stands at different levels. This inner part of the plant has been termed by Picado the "*aquarium*." The outer part, consisting of the stumps of dead and fallen leaves and of solid *débris* formerly accumulated in the interfoliar spaces, is termed the '*terrarium*"; in it the compartments are not isolated from one another.

Now, plainly, all this must have a far-reaching effect on the

* The fact that bromelias absorb inorganic salts through their specialized scales has long been known, but their power of taking up organic substances has not been so fully understood. Picado's paper is largely concerned with this latter point. As the result of an elaborate series of experiments, he concludes that the plant actively secretes a definite substance which acts chemically on decomposition-products. But it is beyond the scope of this article to enter into this matter in detail.

fauna inhabiting these plants. (1) The geographical distribution of many forms of life is affected, since the bromelia-marshes are present over great areas of country where aquatic and amphibious creatures could not otherwise find any habitation. (2) The water being permanent, many bromelia-dwellers have no fixed season for egg-laying, but may be found in various stages of development at all seasons. (3) The purity of the water is of great import, for many animals can live in the bromelia-marsh which could not exist in foul waters. (4) The isolation of the compartments of the " aquarium " affects some creatures. For example, the bromelicolous larvæ of certain Megarhine Mosquitoes are very cannibalistic, and though a number may hatch and start life together in a single compartment, after a time only one survives. Thus frequently a single full-grown larva is found in each compartment, and probably, if the compartments were to intercommunicate, many less larvæ would survive than actually do.

The bromelia-fauna.—Having now considered the nature of its environment, let us turn to the fauna itself. A knowledge of its existence dates back certainly as far as 1879, when Fritz Müller published his discoveries of certain bromelicolous animals in Brazil. Recently many contributions to the subject have been made by a number of writers. The researches of Calvert and of Picado in Costa Rica have added especially to our knowledge of this fauna.

The latter author, in his work already cited, gives a list of about two hundred and fifty bromelicolous species. Many (but not all) of these are considered to be *exclusively* bromelicolous, *i. e.* not to occur elsewhere. A full discussion of the reasons for this would be lengthy, but it may be stated that, first, many aquatic animals are found in bromelias over large areas in which there are no other waters suitable for their existence; secondly, in some cases, when terrestrial waters are present in the vicinity, careful search has failed to reveal in these the presence of the bromelicolous species.

The opinion is expressed by Picado that, in proportion to the restricted nature of the environment, the bromelia-fauna is as diversified as any in existence. The following groups are actually known to be represented in it :—

Protozoa.
Rotifers.
Planarians.
Leeches.
Oligochæt Worms.
Gasteropoda.
Crustacea (Ostracoda, Copepoda, Isopoda).

Insecta:—
Thysanura.
Earwigs.
Cockroaches.
Other Orthoptera.
Thysanoptera.
Hemiptera.
Ants.
Perlid larvæ.
Dragonfly larvæ.
Caddis-fly larvæ.
Lepidopterous larvæ.
Beetles and beetle-larvæ of a number of families, including a true water-beetle (Dytiscid).
Dipterous larvæ, including *Culicidæ*, *Chironomidæ*, *Tipulidæ*, *Rhyphidæ*, *Borboridæ*, *Anthomyidæ*, *Syrphidæ*.

Peripatus.
Myriapoda.
Acari.
Phalangids.
Pseudoscorpions.
Scorpions.
Spiders.
Vertebrata: tailed and tailless Batrachians.

Special relations of members of the fauna to their environment.—Several of the more general relationships between the bromelia-fauna and its environment have been considered under the heading "Environmental conditions of the bromelia-marsh." Some special cases may be briefly mentioned.

Bromelias may be upset by storms and temporarily emptied of their contained water. Many of the fauna can survive temporary desiccation, and some have special means of holding on to the plant. A remarkable case is that of a small Syrphid larva * which has ventral suckers; a phenomenon parallel to that seen in the larvæ of another family of flies, the *Blepharoceridæ*, which cling to the rock-faces of waterfalls, &c., by means of suckers.

It appears that some bromelicolous creatures, whose congeners in terrestrial waters swim well, do not swim in the narrow spaces of the "aquarium," but rather climb on the leaves. Reference may be made to one of the longest-known bromelia-dwellers, a Caddis-fly larva found in Brazil by Fritz Müller. This insect, which Müller named *Phylloicus bromeliarum*, con-

* Picado, *op. cit.*, pp. 263, 358.

structs a beautiful little case of pieces of leaves. Müller found an allied larva with a similar "house" inhabiting rivulets in the same region. The pupa of the rivulet-dwelling species (which he referred also to the genus *Phylloicus*) agrees with many other trichopterous pupæ in having the middle legs fringed with hairs to form a swimming-organ, which aids it in reaching the surface on its emergence from its cocoon. The pupa of *P. bromeliarum*, however, is devoid of these fringes, which may be correlated with the fact that it probably has no need to swim in order to reach the surface in the narrow spaces of the plant.*

One of the most interesting bromelicolous animals is an Agrionid Dragonfly, *Mecistogaster modestus*, Selys. The insects of this genus are characterized by the extremely exaggerated length and slenderness of the abdomen, which gives them a highly remarkable appearance. Till recently nothing was known of their early stages or breeding-places, but in 1900 it was suggested that they might breed in bromelias. In 1908 specimens were actually bred by Knab from larvæ found in these plants in Mexico, and Calvert in 1909–10 worked out the life-history of the insect in Costa Rica. The abdomen of the larva is not disproportionately long, and the extreme length in the imago is acquired by a very rapid extension during the hours immediately following emergence from the nymph-skin. Thus it may be that the great length of the abdomen in the adult is a secondarily acquired character, and Calvert has suggested that it is possibly an adaptation for ovipositing between the leaves of bromelias in spaces which are too narrow and deep to admit of the female climbing down.†

* I am indebted to Mr. K. J. Morton for referring me to the literature on this matter. Müller described and figured these larvæ in a paper "Sobre as casas construidas pelas larvas de insectos trichopteros da Provincia de Santa Catharina," Arch. Mus. Nac. Rio Janeiro, iii., 1878. He mentions *P. bromeliarum* on pp. 114, 115, without naming it, and again (in the Supplement) on pp. 131, 132, this time giving it its name; the case of the larva is figured on pl. 9, fig. 17. In the following year (1879) he published a paper in English in the Trans. Ent. Soc. London, and on p. 137 of this volume he refers to the same larva, but without giving it a name. It is also referred to by McLachlan on p. vii. of Proc. Ent. Soc. for that year.

† Calvert, 'Entomological News' (Philadelphia), vol. xxii., 1911, pp. 402–411 and 449–460, pls. xviii.–xix.

Mention must also be made of a new species of Tingitid Bug (*Leptostyla gibbifera*, Picado, *op. cit.*, p. 303), of which great numbers were found in certain bromelias by Picado. These insects feed on the plant, inserting their buccal stylets into its tissues. They remain thus motionless for hours at a time, and it frequently happens that they are caught and held by a gum secreted by the plant, as the result of the wound made by the insect. When thus held fast, one of two fates may attend them: either they may perish, engulfed in the gum; or, if they survive the hot hours of the day, they may be liberated by the melting of the gum at evening, when it receives moisture from the atmospheric condensation. The greater number of those which are thus held gummed to the leaves are immature, and these immature specimens are armed with a number of ramifying spines of rather terrifying appearance (see Picado's figure). As the insects must be absolutely at the mercy of their enemies while thus held fast, these spines might be regarded as a means of defence. But examination shows that each branch of these spines bears at its apex, not a sharp point but a transparent and very delicate vesicle. Unless the vesicles contain some irritant, such fragile structures must be of doubtful protective value.*

Speaking more generally, the creatures normally frequenting bromelias derive their sustenance directly or indirectly from the plants. Some are *phytophagous*, attacking the plant itself: among these are certain Coleoptera, Acari, Hemiptera, some Orthoptera, larvæ of Lepidoptera, &c. Others are *saprophagous*, feeding on *débris*; such are Cockroaches and Earwigs, Millipedes, Pseudoscorpions, and Isopod Crustacea. Others again are *predatory*; among these are *Peripatus*, Scolopendrid Centipedes, Batrachians, Spiders, and many more. Some of the Spiders spin webs above the surface of the water in the compartments of the plant, in such a way as to catch winged insects when they emerge from their aquatic nymphs and take flight; other bromelicolous Spiders chase their prey in the open—such are the numerous Salticids.

Origin and dissemination of the bromelia-fauna.—There are

* Picado states that he has also observed the young of another Tingitid similarly gummed to the leaves of *Euphorbiaceæ* of the genus *Croton*.

several ways in which species of animals can be supposed not only to have reached the bromelia-marsh in the past but also to reach it still from time to time. Some minute kinds, such as Copepods and Rotifers, could be transported in the form of eggs or cysts by wind. In steep places mud and water, perhaps containing living things, may often be splashed over the boughs of trees by landslides. Many species also have doubtless colonised the plants by active migration. Some would take to frequenting bromelias in order to derive a living from them, either directly or indirectly, in the manners indicated at the close of the preceding section. Others may resort to them in order to escape the evil effects of drought. This may be the case with Snails, Planarians, and Earthworms. In the Seychelles a Land-Nemertean and a Land-Leech were found sometimes in damp places on or near the ground, at other times between *Pandanus* leaf-bases; is not the moisture possibly the attraction of the latter situation? In India, too, certain Oligochæt Worms have been found in hollows half full of water in tree-trunks, whither they resort on the drying up of their habitats on the ground; it is stated that they have been observed in the very act of this migration. As to creatures such as Dragonflies, Caddisflies, &c., it is not hard to imagine that, if they wandered in their flight far into the depths of forests and found there no terrestrial waters, they might lay their eggs in the only available water—that in the reservoir-plants.

All this does not explain the origin of *exclusively* bromelicolous species. But is it not conceivable that if some individuals of a species became established in the bromelias, and that if their ranks were not frequently reinforced by the arrival of others of the same species from without; that then they and their descendants might be affected by the isolation in so special a habitat, just as some other forms are affected by becoming restricted in their habits to special food-plants or in other ways? Might not modifications occur, culminating in the forms affected becoming so distinct as to be regarded as separate species? *

* For a discussion of isolation and segregation of forms due to difference of habits, see the highly suggestive "Introductory Essay on the Hawaiian Fauna," by Dr. R. C. L. Perkins, recently published in 'Fauna Hawaiiensis' (vol. i., part 6, 1913). Perkins lays the greatest stress on *isolation* as a

Several of the above suggested methods of colonisation of the bromelias will also apply to the *dissemination* of the fauna, its passage from plant to plant. But there are also other ways in which it can be *passively* disseminated. For instance, bromelias often grow at different levels on the same tree, and if a plant be upset by any accident its contents may be spilled into others growing below. In such passive ways the fauna need not only descend; it can also slowly ascend. Bromelias reproduce largely by lateral budding, and the young plants grow to a slightly higher level than that of their parents, and in their turn produce buds which push a little higher, and so on. Each lateral bud grows up through one of the interfoliar spaces of the parent plant, and in so doing may carry with it some of the contained water and fauna. Also the boughs and trunks to which the bromelias cling grow slowly upwards and outwards, carrying the epiphytes with them. Thus the *Bromeliaceæ* with their fauna may climb slowly, till they are perched right aloft in the green roof of the forest.

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factor in the production of the great number of endemic species in the Hawaiian Islands. He distinguishes carefully the two kinds of isolation, *viz.* (1) that due to the existence of geographical barriers, and (2) isolation and segregation of forms *inhabiting the same area* due to difference of habits.

NOTES AND QUERIES.

AVES.

Abnormal Coloration in the Common Snipe.—On February 9th Mr. G. Jefferies, of Leadenhall Market, sent for my examination a strange Snipe received in the ordinary way of trade from an English estate. The bird certainly had a most striking appearance, but this was due entirely to the colour of the legs and feet. In plumage, beak, and eyes it was nothing but an ordinary *Gallinago cœlestis*—perhaps a little above the average so far as brightness of colour was concerned; the axillaries held as much white as black in their pattern. The legs and feet were a clear golden or orange buff, flushed here and there on the toes with salmon-pink, and on the "heel" or hinder aspect of the tibio-tarsal joint with pale lemon-yellow; the claws were dark slate-grey. I have many notes on abnormally coloured feet in other birds, but it is the first time I have noticed a Snipe aberrant in this detail.

Exactly a month later Mr. Jefferies sent me a cream-coloured Common Snipe received from Ireland. It was a partial albino deficient in both black and brown pigment, and could be likened in general appearance to a Collared Turtle or the back of the female Sand-Grouse. Such a variety is not very rare, and of itself hardly worthy of record; but I saw at once that the feet and legs were exactly the same yellowish buff as in the first-mentioned individual. There were the same touches of salmon-pink on the toes, and of lemon-yellow on the heel, distinguishable on close examination. In this Journal for 1911* I ventured to suggest that the Common Snipe was one of the most variable of our birds, and the present note may therefore be offered as some addition to my previous remarks.—F. J. Stubbs.

Large Clutch of Great Crested Grebe (Podicipes cristatus) in Glamorgan.—On April 24th I found a nest of the Great Crested Grebe containing the unusual number of six eggs and within a few yards of the spot where, on April 20th, 1912, my friend and I obtained a

* "The Development of the Snipe," pp. 205 and 265.

clutch of nine, as recorded in this Journal (1912, p. 427). A pair of these birds have now visited Hensol for the last four years, and I think it probable that the same pair of birds have laid these two large clutches. On April 18th, on wading out to the nest, I found that it was empty, so that an egg must have been laid daily from that date, and the clutch, although large, may not have been complete. There was no decrease in the size of the eggs last laid, which could be distinguished by being less stained than the others. I have found two Moorhens' nests this year containing fifteen and twelve eggs within sixty yards of each other. By the appearance of the eggs both clutches were laid by a single female.

The Blackcap is much commoner than the Garden-Warbler in this district. The Lesser Whitethroat is rather a scarce bird here, and I have only found it nesting once.—F. Norton (69, Whitchurch Road, Cardiff).

NOTICES OF NEW BOOKS.

Report on Cetacea Stranded on the British Coasts during 1913. By S. F. Harmer, Sc.D., F.R.S. Printed by Order of the Trustees of the British Museum.

This Report and others that will subsequently appear must prove to be of the greatest importance to British zoology. The Board of Trade in 1912 decided to issue a circular to all Receivers of Wrecks instructing them to send telegraphic information to the British Museum of the stranding of Whales. The records of 1913, thus procured, with the exception of three obtained during 1911 and 1912, form the substance of this Report.

The number of Whales, Dolphins, &c., reported during 1913 was seventy-six, though the number given cannot be regarded as completely accurate, because evidence has been forthcoming that some of the specimens originally reported as "Porpoises" have really been Sharks. A definite determination of the species has been found possible in only a small proportion of the cases. This has generally been based on the examination of the entire

animal or some part of it, which has been forwarded to the Museum. In a few instances a representative of the Museum has visited the spot where the specimen was stranded, and the evidence thus obtained has been the authority for the determination.

Calculations made by "curve" process show a sudden rise from two specimens in July to fifteen in August, while the maximum was reached by twenty-one in the first half of October. A conclusion is considered legitimate that a larger number of Cetacea, which have not been captured by fishing-boats, are stranded during August, September, and the first half of October than at other times of the year. It also seems that, although the case is not certainly made out by figures, there may be some connection between the stranding of the Cetacea and the position of the Herring fishery at the time. Reference to the species obtained is given in this excellent Report, and three distributional maps are provided. This publication is worthy of the high standard of our great Natural History Museum.

Animal Life by the Sea-shore. By G. A. and C. L. Boulenger. 'Country Life' Limited.

We have to recall early days—some fifty years ago—for books on our seaside zoology. Our shelves still contain 'Sea-side Studies,' by George Henry Lewes; Charles Kingsley's 'Glaucus, or the Wonders of the Shore'; 'The Sea-Side Book' of Dr. Harvey; and the delightful writings of Philip Henry Gosse. Then somewhat of a hiatus ensues, Step published his 'By the Deep Sea' in the late nineties; but the time had arrived for a more modern guide, and the Boulengers have produced it. "A strictly systematic treatment has been avoided, the classification adopted being intended to meet the requirements of the non-scientific reader, who is introduced to the subject in the simplest manner compatible with accuracy."

Seaside visitors who are wearied with the band on the pier, the comic efforts of minstrels on the beach, or a melancholy contemplation from a beach-chair, will find in the pages of this book an animal romance which they can unravel for themselves.

Natural history lovers and students will possess a safe guide in these authoritatively written and well-illustrated pages, and by their help return from a summer holiday neither wearied nor jaded, but rejuvenated by a healthy recreation and intelligent pursuit. We recommend this volume as a seaside companion for a summer holiday, while it will be appreciated by any naturalist. Such books have a zoological mission among the general public apart from their value to naturalists.

Wild Game in Zambezia. By R. C. F. Maugham, F.R.G.S., F.Z.S., &c. John Murray.

The contents of this well-illustrated volume constitute a happy blend of the experiences of a sportsman and naturalist, and it is with the latter we are most concerned, for Mr. Maugham has much to tell us of the splendid but now attenuated vertebrate fauna of the African plains. He can also think for himself. Thus the peculiar coloration and markings of Zebras, which against a background of thin forest or high grass makes them easily overlooked—as was observed by the late Francis Galton years ago—has been accepted by many as a typical example of protective coloration. But before man commenced his destructive work these animals knew but one enemy, the great carnivora. "These hunting as they do by night and by scent, could not, as it seems to me, have been regarded as the dreaded source of danger. One therefore asks oneself in vain what the reason for a protective colour scheme for use *by day only* could possibly have been?"

In reference to the suggested game extermination in order to decrease the number of Tsetse Flies, which seem to spread with the game and increase in numbers as the herds increase, Mr. Maugham writes of vast tracts of "fly country" from which game is absent, and in some cases have been absent during the recollection of natives. The writer on African mammals cannot afford to miss a careful perusal of this book, though in some cases a little caution must be used. Thus we read, "Secretary-birds pursue their benevolent mission in the slaughter of the Snakes"; but probably the author is quite aware that the Snake is not by a very long way the principal food of this bird.

Many will rejoice to read in the introduction the sympathetic recognition of the "Camera Sportsman." He quotes with approval the view of Mr. Dugmore, "The life of any animal, be it bird or beast, is far more interesting than its dead body." True words, and the writer of this notice wishes he had always followed that maxim.

A List of the Birds of Australia. By Gregory M. Mathews, F.R.S.E., &c. Witherby & Co.

A complete list to date of the birds of Australia, "containing the names and synonyms connected with each genus, species, and subspecies" will be valued by all ornithologists. Mr. Mathews has given his adhesion to what may be called the newer nomenclature, including the use of trinomials, and there can be little doubt that this advanced method has come to stay, though it may seem somewhat foreign to many of us who have been schooled in another method. The whole question is fully discussed in the Introduction.

As regards the vast stride made in a knowledge of the avifauna of Australia, we are struck with the statement that "no endemic land bird from Australia was known to Linné when he published his 'Systema Naturæ' in 1758 and 1766"; and in recognizing the early writings of Latham, most naturalists will agree with Mr. Mathews in his conclusion that "there can be no question as to who should be considered the 'grandfather' of Australian ornithology, conceding to John Gould the Australians' tribute of 'father.'"

The list has been very carefully and thoroughly compiled, and possesses an excellent index.

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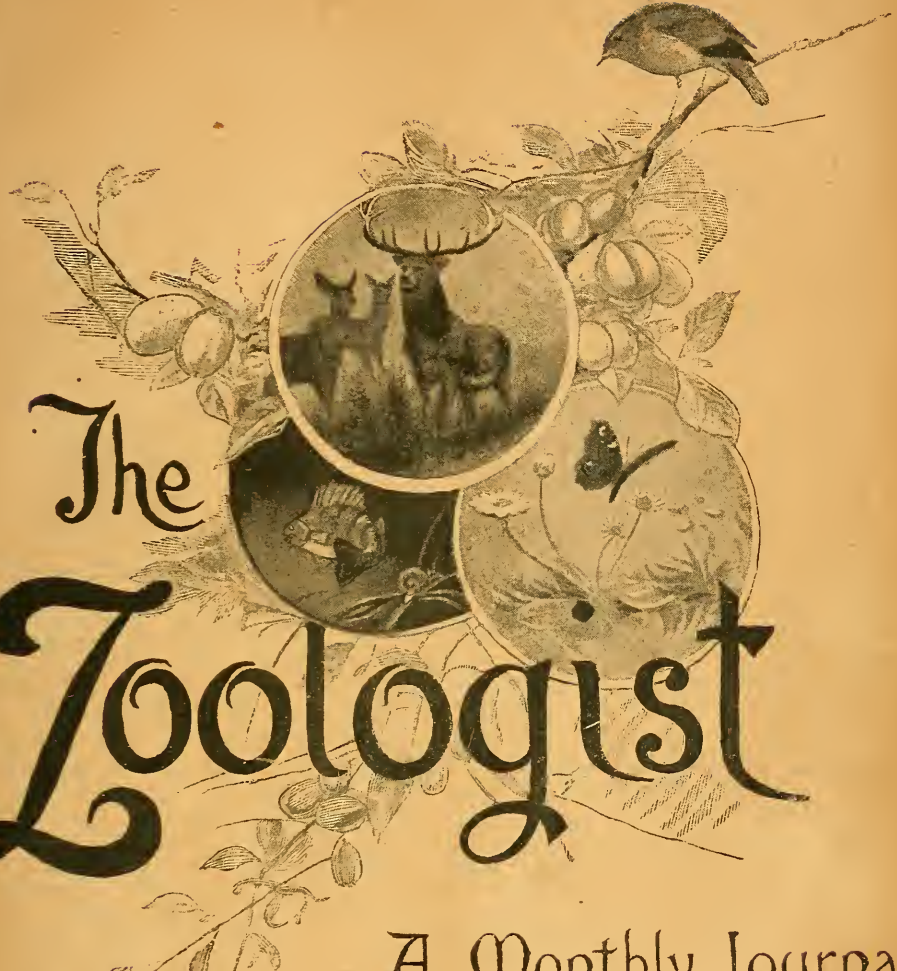

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THE ZOOLOGIST

No. 876.—June 15th, 1914.

NOTES ON THE FAUNA OF THE COUNTRY OF THE CHESS AND GADE.

By T. E. Lones, M.A., LL.D., B.Sc.

For some years past, and particularly since the year 1910, I have made an extensive series of notes on many species of animals in the country of the Chess and Gade. These notes and others to be made later will be the chief sources of the following account of the fauna of the above-mentioned country. At present, those most easily adapted for publication relate to the Rotifers, and these animals will be described first, following on with other forms of animal life in the order which may seem to be most convenient.

Particular attention will be given to the conditions under which the various species occur, the relative numbers of individuals of different species, and, in some cases, certain changes which have taken place and are taking place in the numbers of individuals of the same species.

The country of the Chess and Gade is somewhat triangular in form, its base being a sinuous line on the southern side of the Chilterns, and its apex being near Rickmansworth, where the waters of the Chess and the Gade meet the waters of the Colne, one of the tributaries of the Thames. Excepting some small scattered areas, such as those near Chesham and Leverstock Green, where tertiary outliers occur, the country is chalk, usually covered by post-tertiary deposits of very variable thickness and composition.

Being essentially a chalk country, many of its valleys and dells are normally dry, but, large areas being covered by the aforesaid post-tertiary deposits, the short grass characteristic of a chalk country is to be found only on parts of comparatively small extent. Numerous woods and copses occur in most parts, and there are also many large private estates and parks, in some of which are many fine Deer. Further, on several of the commons found in most parts of the country there are extensive growths of bracken and furze, which often serve as cover for Pheasants, Partridges, Rabbits, Foxes, and other animals.

There are only a few large sheets of water, and these are connected with the rivers or the Grand Junction Canal; this canal, it may be stated here, runs along or close to the old bed of the Bulbourne (a tributary of the Gade) and that of the lower Gade. On the higher grounds, *e.g.* on Chipperfield Common, Cholesbury Common, and Berkhamsted Common, and at Wigginton, Hastoe, and various places between Chesham and Berkhamsted, there are many small pools, the depths of which rarely exceed five feet.

It cannot be said that, in number of species, the aquatic fauna is a rich one, but this disadvantage, from a naturalist's point of view, is compensated for by the remarkable differences between the faunas of the several pools. These differences will be best understood from the following account of the fauna, given in accordance with the method previously explained. The Rotifers, as already stated, will be dealt with first, commencing with some of the commoner ones.

Rotifera.

1. *Salpina mucronata*, Ehren.—In those pools in which there is a large quantity of weeds, especially duckweed, this is one of the commonest Rotifers. From April to September the specimens are very numerous, and in May and June large numbers of empty loricas of the same Rotifer are also to be found. The presence of a large quantity of duckweed and the situation of the pools at a comparatively low level seem to favour the occurrence of large numbers of *S. mucronata*. This, at least, is what my notes suggest. Where these conditions are found, *e.g.*

at Langleybury Pool (elevation above sea-level about 200 ft.), Berkhamsted Castle moats (about 300 ft.), and Parsonage Farm Pool, Abbots Langley (about 400 ft.), the numbers of specimens obtained have been very large; on the other hand, at Wigginton Pool (700 ft.), among the Chilterns, the numbers obtained have not been nearly as large as in the pools before mentioned. Again, at many places close to the Chess, the Gade, the Bulbourne, and the canal, are extensive watercress-beds, through which the river or canal waters are diverted. Some parts of these beds have been much less disturbed than the rest, and contain, besides watercress, small quantities of starwort and duckweed. In these parts only comparatively small numbers of specimens of *S. mucronata* are usually found.

Often when seen beneath the microscope the specimens of *S. mucronata* swam about quite freely and rather rapidly, but if the water on the slide contained some vegetable matter, they usually spent their time by moving about this. Their long toes, resembling the blades of ancient Roman *gladii*, were frequently swung forwards so as to be almost parallel to the long axes of their bodies. The comparatively large, bright red cervical eye-spot was always easily seen.

2. *Pterodina patina*, Ehren.—Most of the specimens of this Rotifer were obtained from Langleybury Pool, the rest being chiefly from Parsonage Farm Pool, Abbots Langley, and Berkhamsted Castle moats. All those examined were taken during the spring and summer months. Very many samples of water from Parsonage Farm Pool were taken nearly every month during 1912 and 1913. Not a single specimen of *P. patina* was seen in the 1912 samples, but several specimens were obtained in March and August of 1913.

The specimens from Langleybury Pool were exceedingly numerous in May and June, 1913. Most of them showed a few bosses, but indistinctly. These Pterodinas usually glided slowly through the water, occasionally turning their edges to view, when they presented a comic resemblance to a broken-down pedlar carrying a load on his back. When gliding through the water with their dorsal surfaces exposed to view, the trunk-like foot was almost always out of sight, by reason of its being extended downwards to allow the setæ at its extremity to touch

the slide; it was only occasionally extended horizontally so as to project a little way beyond the edge of the lorica.

3. *Pterodina valvata*, Hudson.—Among a large number of Pterodinas obtained from Langleybury Pool on May 12th, 1913, were some which, being but slightly stippled, were remarkably transparent. These presented about a dozen comparatively large bosses, which were well-defined and nearly equidistant. As they glided slowly across the field, these Pterodinas were beautiful objects. Fig. 1 represents one of them, its foot being drawn in order to show its peculiar form, although this particular specimen rarely extended its foot beyond the lorica, when exposing its dorsal part to view. After gliding about for some time, it attached itself by its foot to a piece of *Conferva* and then remained stationary or nearly so for a long time.

I did not see one of the specimens of *P. valvata* fold its lorica, although I watched for a time in expectation of seeing this phenomenon, from the occurrence of which the specific name of the Rotifer was derived. It seems, however, that *P. valvata* rarely folds its lorica, for Mr. P. H. Gosse says: "As a rule, the folding of the valves is somewhat rarely performed. I have observed probably hundreds at various times, and I think I have not seen half-a-dozen folded" ('The Rotifera,' &c., C. T. Hudson and P. H. Gosse, vol. ii. 1886, p. 113).

4. *Brachionus rubens*, Ehren.—A vast number of specimens of this beautiful and active Rotifer were obtained on October 3rd, 1913, from a small, shallow pool at the eastern side of Potten End, and close to the road from that place to Water End. The water of this pool was quite green with *Confervæ* and minute aquatic plants. Many specimens were also obtained on October 15th, 1913, from Wigginton Pool. The water of this pool also was of a green colour, as seen in the collecting bottles, but not nearly as green as the water of the Potten End Pool, there being only a comparatively small quantity of *Confervæ* and minute aquatic plants in the Wigginton Pool. This difference in the nature of the waters of the two pools probably accounted to an important extent for the great difference in numbers of *B. rubens* in the two pools. The waters of Potten End Pool had every appearance of a rich feeding medium.

Many specimens of *B. rubens* were seen swimming freely in

the water on the slide, repeatedly lashing out with their long, flexible foot, while large numbers were attached to specimens of *Daphnia pulex*, *Cyclops serrulatus*, and what appeared to be young specimens of *Cyclops strenuus*. One specimen of *D. pulex* carried a large number of these Rotifers in the manner shown in fig. 3.

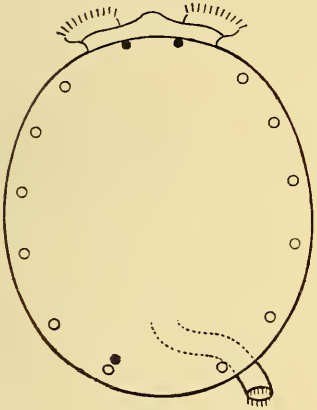

Fig. 1.

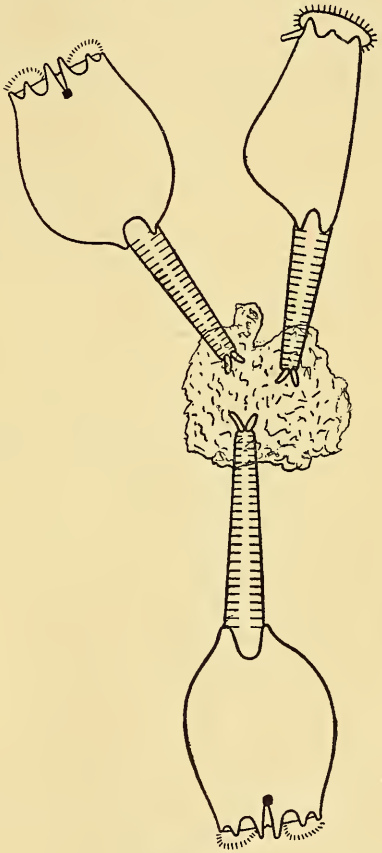

Fig. 2.

They were anchored to a layer of sticky, flocculent matter covering the head and part of the back of the *Daphnia*; this matter had evidently been secreted by the foot-glands of the Rotifers. While the *Daphnia* was in the field, the Rotifers gradually left it, one or more at a time, tugging violently to free themselves and causing their feet to be stretched out to a great length.

Fig. 2 shows three specimens from the Potten End Pool, after they had left the *Daphnia* shown in fig. 3, and still connected by means of a detached portion of the sticky matter. Their bright red eye-spots, like small rubies, were very conspicuous.

By killing the *Daphnia* or other host with a dissecting-needle, the Rotifers at once begin to struggle violently to free themselves, and so they do when a little cocaine solution is put on the slide. It may be mentioned here that the various species of Rotifers differ very much in their ability to resist the action of cocaine. Many of them at once contract considerably under its action, but some are affected somewhat slowly. One of these is *B. rubens*, for, when trying to induce contraction sufficient to allow its oral spines to be seen clearly, I have found it best to add cocaine solution to the water until the strength is nearly two per cent.

5. *Noteus quadricornis*, Ehren.—This well-known Rotifer is to be found more particularly in Parsonage Farm Pool, Abbots Langley, and in the old pool near the side of Chesham Road, opposite Ashlyn's Hall, Berkhamsted; this will be referred to as the Chesham Road Pool.

The specimens of *N. quadricornis* from these pools were all taken during the months of August and September. The most complete records of the appearance and disappearance of this species refer to the Parsonage Farm Pool; for instance, many specimens were obtained there on August 11th, 1912, some being very fine specimens indeed; a few were obtained on September 6th, 1912; on September 18th, 1912, six empty cases or loricas of the same species were obtained, but no living specimens; on September 22nd, 1912, I failed to obtain any trace of *N. quadricornis*. Among many collections of the forms of life in this pool, obtained during the ensuing months, I did not obtain a single *N. quadricornis* until August 18th, 1913. The Chesham Road Pool has yielded specimens as late as the very end of September.

Among the specimens obtained from Parsonage Farm Pool on August 11th, 1912, was a particularly fine one. It was a beautiful object, appearing in side view like a deep purse tobacco-pouch, with two strong spines projecting from its lower edge, and two strap-like projections on the upper or dorsal side of the

mouth of the pouch and curling over a little. The pouch was faceted and transparent, allowing the parts of the animal to be seen. After moving about rather slowly it anchored itself by its foot to the slide, and, swaying to and fro, set its wheels in motion, causing strong currents of water to flow into the mouth of the pouch whereby small protozoa, &c., were carried to its powerful masticatory apparatus.

6. *Rotifer vulgaris*, Schrank.—This species is appropriately named *Rotifer vulgaris*, the "commonplace" Rotifer; in the mud

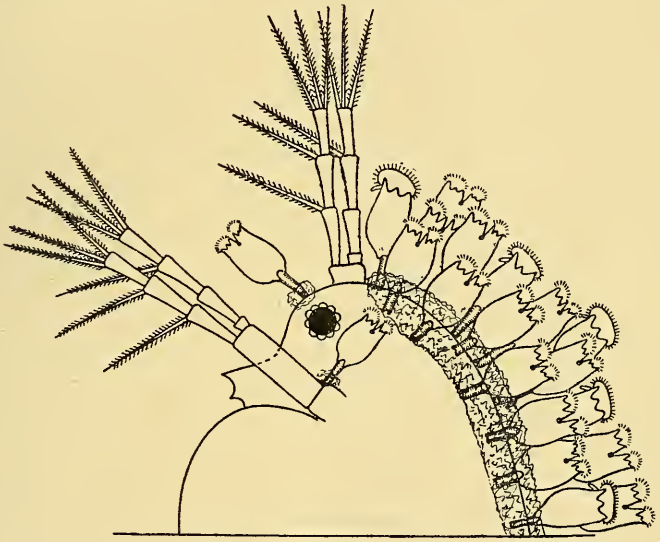

Fig. 3.

of the various streams and pools and of the canal, in samples of their waters, in samples of moss, in damp mould, in the green coverings and the washings of trees and walls, some Rotifers of this species are easily obtained. Sometimes, *e. g.* in washings from a fern-pot saucer in December, 1912, and in washings from moss obtained from Nettleden in June, 1913, they were very numerous and constituted nearly the whole of the rotiferan fauna.

During examination under the microscope, they often moved somewhat slowly in leech-like manner, but soon made their way into small collections of mud and organic matter on the slide, wandered about and through these, and, finally emerging,

started to swim, with expanded wheels, until they met other collections of mud and organic matter which were similarly explored. At other times they remained anchored for a long period.

The specimens of this Rotifer varied much in size, but were usually about $\frac{1}{50}$ in. long. The largest I have seen was, as far as I could measure it, $\frac{1}{30}$ in. long, when fully expanded. This Rotifer was washed from a silk net which had been dragged for a long distance along the canal, below Hunton Bridge, on November 12th, 1913; it was almost the only form of life obtained on this occasion. It was, however, the finest specimen of its species that I have ever examined, and its movements on the slide were all that could be desired to display its form and allow of sketches being made. After moving about on the slide, in water quite free from mud or organic matter by which its movements could be concealed, it anchored itself and scarcely moved out of the field for about half an hour. During this time, the Rotifer repeatedly extended and withdrew itself slowly so as to assume sometimes the form shown in fig. 4, and sometimes that shown in fig. 5, stretching itself so fully that its joints appeared as very fine lines, its external contour being almost unbroken. In these positions, the whole of the foot was not seen, but occasionally the Rotifer threw itself smartly from the position shown in fig. 4 into that shown in fig. 6. At such times, the full length of the Rotifer was seen, but never for more than a second, for it always quickly resumed the position shown in fig. 4 or fig. 5. Its exceedingly well-displayed movements, its elegant tapering form, its small, round red eye-spots, and the beats, about two per second, of its jaws against the anvil, were all well seen. The figures do not, I think, exaggerate the elegance of form of this Rotifer.

7. *Rotifer macrurus*, Schrank.—This large and well-known Rotifer, which is much less common than *R. vulgaris*, has been obtained chiefly from the Chesham Road, Langleybury, and Parsonage Farm Pools. From none of the water samples taken from any of the pools has the number of specimens of this Rotifer been large; in samples, *e. g.*, obtained from the Parsonage Farm Pool, on September 6th, 1912, and yielding fourteen specimens of *Salpina mucronata* and six of *Noteus quadricornis*, only one specimen of *R. macrurus* was obtained.

Every specimen examined exhibited very similar movements. The long foot was often extended so as to allow seven joints to be counted with ease, and occasionally eight joints were readily distinguished. After remaining for some time in an extended form and anchored to the slide, the Rotifer would retract its anterior parts, display its powerful wheels and stout column, and swim rapidly through the water. When travelling in leech-

Fig. 4.

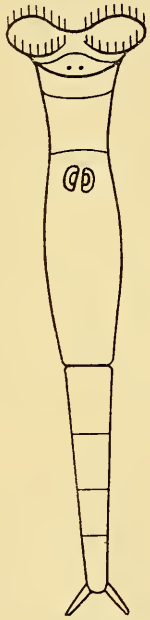

Fig. 5.

Fig. 6.

like manner, *R. macrurus* often showed, what was very rarely shown by *R. vulgaris*, a lateral view of the hinder part of its foot.

8. *Rattulus rattus*, Müller.—From only a few pools have I succeeded in obtaining specimens of this Rotifer. A few were taken from Parsonage Farm Pool, Abbots Langley, on March 24th, 1913. One was carefully examined as it swam about rather rapidly and gracefully, turning itself about its long axis, and swaying its foot to and fro. It was brought to rest by means of a few spots of Rousselet's narcotizing solution, and

its length was found to be about $\frac{1}{70}$ in. Its long and slightly curved toe was approximately as long as the rest of the animal. The very short styles at the base of the toe were seen, but only with difficulty. The central part of the Rotifer was brown, and the rest was almost colourless.

Another specimen, obtained on April 28th, 1913, from a small pool, a little to the east of Hastoe and close to the bend of the Hastoe and Cholesbury Road, measured $\frac{1}{80}$ in. in total length, and presented the features mentioned above. The water of this pool was exceptionally clear and transparent, but a few months ago the pool was completely filled in with clay and gravel.

9. *Synchæta tremula*, Ehren.—This small and very active Rotifer is fairly common in the watercress beds of the Chess and Gade, and in a few pools in which the water is clear. The specimens I have examined have been chiefly from the Cashio watercress beds, near Watford, and from Chipperfield Common Pool. The movements of *S. tremula* are so characteristic that, apart from the conical form of the animal and its small size, they serve at once to identify it. A description of the movements of one very active specimen, obtained on October 3rd, 1912, from the Cashio watercress beds will make this clear.

While examining two specimens of *Amphileptus* in a drop of water from the aforesaid beds, the illumination of the field being very brilliant, the *Synchæta* suddenly shot across the field. Being altogether unprepared for its appearance, the only impression it produced was that of a minute flash of light. Paying no further attention to the specimens of *Amphileptus*, I quickly moved the slide so as to enable me to follow the Rotifer, which was soon found spinning rapidly about its axis, which was vertical and practically stationary. Owing to its rapid rotation, the only impression produced was as shown in fig. 7. After a few seconds, the Rotifer darted across the field, appearing like a cone moving base forwards. Following it again, the Rotifer was found swinging itself in a very tortuous course about a piece of *débris* to which it was anchored by a very fine thread extending from its toes, as shown in fig. 8. This thread, as is well-known, is secreted by the foot-glands of the Rotifer. For

some time, these various movements were repeated in varied succession.

Of the many species of Rotifers examined, *S. tremula*, especially as exemplified in the specimen just described, appears to be the most active. As long as that specimen was disporting itself in the way described, it was practically impossible to make out its characteristic features. A little narcotizing solution, however, soon brought it almost to rest, when its small foot and minute toes, small auricles, and the almost flat base of its conical body were clearly discernible.

10. *Synchæta pectinata*, Ehren.—Most of the specimens of this Rotifer, entered in my notes, were obtained from Chipperfield

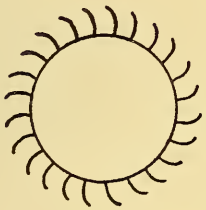

Fig. 7.

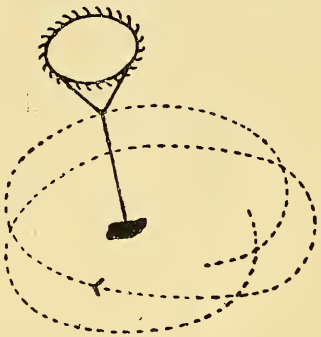

Fig. 8.

Common Pool, which has a very interesting rotiferan fauna. From one side of this pool a narrow plank-walk extends towards its centre, the depth of water near the end of the plank being less than four feet. A dredging net, moved about for some time in the water, from the end of the plank, usually brings up one or more specimens of *S. pectinata*, but dredging during winter and spring has been most successful.

Several specimens of this beautiful and active Rotifer, remarkable for their whiteness and transparency, were obtained in the way described, on May 1st, 1913. One specimen, which was moving about with more energy than the rest, was examined carefully. It was not less that $\frac{1}{80}$ in. long, and swam forward rapidly, then doubled on itself, and swam rapidly in the opposite direction, these movements being repeated time after time. Little more than the curved sides of its conoidal body and its

very convex oral end could be made out while the Rotifer was performing these rapid movements. Its distinctive pair of anterior tufted projections and its large pendent and richly ciliated auricles were, however, very clearly seen after it had been narcotized. Two specimens were obtained by dredging from the end of the plank and beneath the ice which covered the pool on January 27th, 1914. Both were very rapid in their movements, and one of them went through evolutions precisely like those described above; the other, however, went round and round for some seconds in a flat spiral, and then swam in the same manner as the other, repeatedly doubling on itself. These and other specimens obtained during the winter did not seem to be as brilliantly white and transparent as the specimens obtained in the spring.

Quite recently, on April 11th, 1914, I obtained several specimens of *S. pectinata* by dredging in the clear water of Bedmond Pool, which is situated in a deep excavation at the northern end of the village. These specimens and those from Chipperfield Common Pool are the only ones so far obtained.

(To be continued.)

A DIARY OF ORNITHOLOGICAL OBSERVATION MADE IN ICELAND DURING JUNE AND JULY, 1912.

By Edmund Selous.

(Continued from p. 74.)

June 19th.—One of the notes of the Golden Plover is a sad "pee-bier, pee-bier" (I prefer that spelling of the second syllable), and no words can impart any adequate idea of the protracted plaintiveness with which the last syllable is uttered. It is as though the bird's whole spirit were one of sadness—of pensive depression—which, however, it almost certainly is not. Another—generally speaking, one may say *the* other—note at this season is the single, melancholy "peep," equally in consonance with the spirit, to our human senses, of the wild, waste, and desolate scenes amidst which it is usually heard, merry as the bird's heart may be within it at the time.

Some time between 8 and 8.30 a.m. I saw the pair of Grebes, which have not yet laid, far out on the lake. Five or ten minutes later, on reascending the crest of the hill, I found that one of them—the male, I believe—had come into the little nook or corner where lake and stream join; and here he seemed to be waiting, almost stationary, upon the calm water (for it was a still, cloudy morning) for the other to join him. In a few minutes the female came diving up from the outer lake, and the two, meeting, drew close to one another, and began to press eagerly forward in the direction of the creek. It was exactly the way in which they had come up it, before, to the nest, on which coition had then taken place, and I expected a repetition of this. I have little doubt that they had the idea in their minds, but all at once they paused in what seemed their intent advance, floated a little asunder, came close again, and after confronting one another for a little in a hesitating manner, and once more increasing the distance between them, both suddenly dived and

came up almost together, each with a substantial quantity of decaying weed in their bills. With this they began swimming towards the stream, but first one (the female) and then the other dropped it in the water again, and the advance continued *expeditus*. The female led, and seemed more eager than the male, who, as she disappeared into the creek, paused a little before continuing to follow her. I might have augured ill from this, and after having got to my place of observation, commanding the nest of these birds—who were now quite hidden behind the bank and intervening shoulder of the hill—I waited in vain for their reappearance round the bend of the stream, a little above where it enters the lake. The male, as was so often the case with the Great Crested Grebes I watched, had evidently cooled off. Getting on to the lake side of the hill again, I found him waiting alone, as he had been before, and in the same place, just outside the mouth of the rivulet. After some ten or fifteen minutes he dived up the lake again, and very shortly afterwards the female returned from the creek, and, swimming to where he had but lately been, appeared to wait for him in her turn. After some time, however, as he did not come, she went out into the lake herself, diving and swimming, and I lost sight of her too. It seems as if the birds, when they have had enough of the open water of the lake, or feel some special homeward call, are accustomed to repair to this end of it, at the mouth of their stream, where they wait for each other preparatory to swimming up it, to the nest. But what was the meaning of the foregoing incident with the weeds? A reference to my paper on the domestic habits of the Great Crested Grebe* will show that a pair of the latter acted in precisely the same way, but more fully, inasmuch as each of them took hold of the same piece of weed, and, holding it thus between them, and standing upright in the water, like two Penguins, moved backwards and forwards with it, after which, dropping it in the same way, they both swam eagerly to the nest, on which coition was effected. The subsequent conduct of the birds we are now considering will show the same curious apparent relation between two things which one would not suppose were in any way conjoined.

The following took place between 9.10 and 9.55 a.m. The

* 'Zoologist,' 1901, p. 339.

female Grebe, after being for some time out of my sight and knowledge on the lake, reappeared in the little nook or bay of it before-mentioned, which I am sure now is the birds' accustomed trysting-place. Before very long the male appeared far out on the water, and with several long dives was soon at the same spot. He made his last emergence close in at shore, and then swam out again towards the female, with his head and neck held straight out before him in one line on the water, the beak driven through it like a ram. She awaited him in alert, sprightly mood, and when he was a few yards off, suddenly flew away from him over the water, coming down on it again at a little distance. There was now a quiescent interval, the female slowly approaching the male, but undesignedly, as it were, and without anything marked in her manner, till a similar but also less marked advance, on his part, towards her, ended in the mutual flight of both. I think the details were that when the male had reached a certain degree of nearness to the female, she flew at him, coquettishly, and he away from her; but it was so quick and sudden, and so much, in appearance, at the same moment, that I am not sure of this. The pair flew thus into and up the stream, and came down upon it when they had gone a little way, behind the curve of the nearer bank, which quite hid them. I hurried down the hill again to my observatory, and, before I had got into place, had the satisfaction of seeing them rounding the second bend of the stream. They swam in a most purposeful and mind-made-up manner, side by side and close together, pressing on at top speed, and uttering a variety of sounds which I find it impossible to retain in my mind, and cannot therefore transcribe. They were not loud, but not low either—distinctly audible at a fair distance—and not harsh in character. The pair soon came opposite to where I lay concealed amidst the stones on the hillside, pressed through the rushes, and were at the nest. They swam close about it, peered up at it, dived, and then the female, springing on to it, began to arrange the loose-lying materials, and bend down the growing flags amongst them.* Then, assuming the invitatory attitude, she obviously awaited the male. He, however, not ascending

* So far as I remember, I have not seen the Little or Great Crested Grebe do this.

immediately, she came off into the water again, and there was more ministering to the needs of the nest; or, rather, as I should be inclined to say, more secondary sexual activity in regard to it, on the part of both the birds, several pieces of the growing sedge being pulled off by them and laid upon it, especially by the female, who then mounted on to it again, and, standing up, pulled more flags down upon it, and detached and laid down pieces of them in the same way. She then, a second time, invited the male to come up by assuming the appropriate posture, but, being again disappointed, again came off, and they both continued for awhile to add material to the nest; then swam a little away from it, and remained quiet amidst the sedge. In a moment or two, however, they approached the nest again; the female once more ascended and lay along it, and she was now quickly followed by the male. His attitude, as far as I could see, for the rushes, which a little obscured him, was well-nigh upright, and in the considerable pause which preceded coition he uttered a peculiar deep guttural note ("kor-r-r"), which, or something like which, I think I have heard at the end of the long, cat-like mew. During coition both birds were extremely vocal. As before, the notes of either differed, but I cannot keep the odd sounds in my memory distinctly enough to transcribe them. From coition the birds passed immediately to the associated instinct, the female whilst still on the nest. The male, however, did not stay, but, sliding off it, began to busy himself as before. There was then another short retirement, another approach, another ascent and invitation on the part of the female, which was not responded to by the male, after which the birds came out on the water, preened themselves, floated at ease, and finally went to sleep.*

I think the facts here recorded justify me in saying that there is, in the minds of these birds, an intimate association between the marital act and the construction or manipulation of the materials of the nest, and this same bond of connection I

* No case of functional hermaphroditism was observed by me in this species, but I may take this opportunity of recording that this is habitual in the case of the Little Grebe, to go by a pair which I have since watched under conditions rendering mistake impossible. My observations on the Great Crested Grebe, in this particular, are, therefore, more than corroborated.

have made out, with certainty, in the case of three other species, representing altogether three different families and, moreover, all these four species habitually pair on the nest. Now, if it were known with certainty that the structure which we call a nest, and which, in the great majority of birds (as I suppose, or will assume), is put to that use, and that use only, which the word implies for us, had been originally put to the very different one of coition, and that this had come about through that act having been repeatedly performed in one and the same place, so that the female, waiting in that place for the male, had sometimes laid her eggs there, and thus, through the operation of Natural Selection, came, in time, to incubate them, an office which had been previously left to the sun, as in reptiles, and as it still is, with birds, in the case of the Megapodes, which stand lowest and therefore nearest to reptiles*—if these things were known, I think it will be admitted that the above facts would be held to receive a simple and natural explanation in the process of evolution through which the nest had passed. Since birds used to pair on the archaic nest, before they laid their eggs there, no one could wonder that, by inherited association, the ideas of pairing and nest-making were still connected in the minds of many of them, whilst some continued to act like their ancestors. Similarly, it will, I think, be also allowed that if it were known that the actual process of nidification had grown out of the objectless snatching up by birds of sticks, twigs, leaves, &c., from the ground, and dropping them again upon it, when sexually excited, either before, after, or during copulation, it would not then be held strange that they should sometimes now act in this manner, as I have, in fact, observed them to do. If, then, certain facts, *if* known, would be accepted as an explanation of certain other facts which *are* known, the postulation of these unknown facts, to explain the known ones, must be held legitimate, so long as they are not irreconcilable with other facts belonging to the subject. I submit that all the

* "The *Megapodiidæ*, with the *Cracidæ*, morphologically seem to be the lowest of the order, with which apparent fact may perhaps be correlated their singular habit of leaving their eggs to be hatched without incubation," —Prof. A. Newton, 'A Dictionary of Birds,' vol. i. p. 539. A. & C. Black, 1893–1896.

following actions (which I have actually seen) are explicable on the hypothesis here indicated, *viz.*:—(1) The nervously excited seizing of things from the ground, and letting them drop again, by the male bird whilst in a state of sexual frenzy, on account of the female, during the courting period. (2) The taking up and playing with materials similar to those of which the nest is composed, by both the male and female bird, immediately followed either by a visit to the nest and coition upon it, or by a start in that direction, with every appearance of there being the same intention, even though it may not be carried out (3) The further association of these instincts—coition, namely, and nidification—at the nest itself. In some of these cases the addition to or manipulation of the material composing the nest, by the female bird, is immediately followed by the invitatory attitude on her part, and as instantly follows the act of coition upon it. The male also joins in these nidificatory acts, both before and after the rite, so that the two forms of activity seem to be united in the birds' minds, and to make together the purpose of their visit. In other instances the female alone acts thus, after coition only. (4) The taking up and again letting fall by the female of the materials of the nest, whilst actually *in coitu* upon it, so that here we see the two things, as it were, in combination. (5) Habitual coition on the nest, commencing from a period when this word can only be used in relation to place and not structure, and continuing certainly up to the laying of the first egg, and probably afterwards. (6) The remaining of the female on the nest, after coition has taken place there, for an indefinite period, during which the act is repeated. This last, I think, is an important point in my theory, for if it now be asked why the female should remain, for any time, upon a spot or structure which afterwards becomes the nest, for any other reason than such as is connected with the eggs or with nidification, it can be answered that she does so in expectation of the return of the male, and consequent repetition of the act of coition. This helps us greatly in understanding how any place that has once, if only by chance, been made use of for this purpose, might become a more or less permanent pairing-place, through the female bird waiting on upon it, in which case the eggs would sometimes be laid there; and since

incubation by the parent bird must be held to be of benefit to the species, we might expect that, from this point, Natural Selection would have brought it about.

On the above view, the first early acts from which the instincts both of incubation and nidification have been, through Natural Selection, developed, were entirely unintelligent ones, due to the intense state of sexual excitement which birds fall into, every year, on the approach of the breeding-season, and, under the influence of which, they may be actually seen to go through the oddest and most uncouth actions, having no imaginable object, unless the relief of pent-up emotion can be said to be one, and which seem as little the outcome of any process of reason as it is possible for an act to be. This state of overwrought excitement and intense nervous energy of a special kind I have called the sexual frenzy, and if the important main act which arises out of it—coition, namely—may be called an instinct, all those secondary ones which accompany and surround it—rollings, tumblings, springings, prostrations, flutterings, cryings, callings, melodisings, &c., must be pronounced instinctive also. As everybody knows, these storms of desire are either, in themselves, more acute, or, at least, produce a greater crop of strange movements in birds than in any other division of the animal kingdom. Consequently, we have, in their case, a larger output of what one may call waste material for Natural Selection, if possible, to put to some use, so that, far from its being extraordinary, we might have expected, if the principle relied on be a true one, that something very special and particular would have been evolved under its action. And Natural Selection, in my opinion, has answered to the call, for out of this maelstrom of blind, formless animal movement, with nothing but sheer concupiscence behind it, she has, on the one hand, evolved the most elaborate, ordered and beautiful forms of sexual display, and, on the other, the still greater and seemingly wholly dissociated marvels of nest-building. This view of the common origin of both these instincts has the merit of simplicity, and moreover it strikes at the root of various objections which are constantly being brought against the theory of one of them only, namely, sexual display, though logically they should be equally valid against

the other also. The fact that some birds make no nests at all, or do so in such a slovenly fashion that they might just as well not, or that, in some cases, the nest is put to another and totally different use (as I have now shown to be the case) is not urged as an argument against the undeniable relation which it has to egg-laying and incubation in other cases, or in these also; but it is thought that because the sexual antics of some birds make but a poor sort of display, or do not seem designed to that end, or not exclusively so, or are performed by dull-coloured species, therefore the most highly developed and finished exhibitions, carefully gone through by the most beautiful male birds of the world, who thus show off their best points to the best advantage before the females, and may be *seen* actually to win them by so doing, are not real courtships, or real courting displays, either—even though they may have to be called so.* But if it is out of a number of odd, uncouth, violent, and wholly unintelligent movements made by male birds (for the most part) during what I have called the sexual frenzy, that Natural (here called sexual) Selection has, through the consequent excitation of the female, gradually evolved the true nuptial display, this state of things is precisely what we might expect—in fact, *ought* to find, and the argument is quite parallel as applied to the stages of nidification. What the objection to this view is I really do not know. It cannot surely be supposed that here alone we should find the crown of the edifice only, the flower without its stalk. It is in accordance with the principle of evolution that there should be a passage from the simple to the complex, from the generalized to the specialized; and out of what, more naturally, should the movements of sexual display have arisen than out of sexual movements? As to the contention that because a male bird is dull-coloured it cannot, through pose and exhibition, make the best even of its dullness, and thus produce a greater or lesser degree of sexual excitation in the female—or *vice versâ*—I have never been able to follow it. The concupiscent element seems to be forgotten by those who make this objection, and also that æsthetic percep-

* Because they so obviously are. In the case of the Blackcock I have actually *seen* the hen won by the courtship of particular birds, though by far the greater number were resisted. "Resisted" is the right word, for the effect of the display, as such, was always apparent.

tion must necessarily develop within the limits of what there is to perceive. Even so, however, there is not only beauty of form, as well as of colour,* but also a good deal of beauty in colours to which we apply the term dull. In short, in and for the opposite sexes of even the most sober-suited species, there are objects to see and desire, and these objects vary. What more should be wanted for sexual selection to make a foundation † upon? And with all this denial and scepticism, what other even tolerable explanation has ever been given of very beautiful sexual adornment in combination with a very elaborate and careful display of it, by which both the details and the general effect of the beauty are shown forth, or, as it were, insisted upon?

Supposing incubation and nest-building to have originated in the manner suggested, it might seem that we have here two very important instincts with which reason can neither have, nor have ever had, anything to do. But there is another way, as it appears to me, by which intelligence might enter into the composition of an instinct, than through the odd one of lapsing on entry, and that it has done so in the above two instances is a view that seems more in accordance with the whole of the facts than that they are, now, in all cases, entirely devoid of this factor. Why should not reason, in the course of time, have become grafted, so to speak, on to the main stem of unintelligent, motiveless actions?‡ In this I can see no difficulty, for the variations of intelligence must be as much under the dominion of Natural Selection as

* A wing, spread effectively, for instance—still more a pair of wings—is beautiful even though it be brown, of which truth there can be no better proof, outside Nature herself, than in some of the plates in Mr. Howard's masterly work on the Warblers.

† In out-of-the-way parts where there are only a very few women, who happen (*mirabile dictu*) to be plain, these step forth as beauties, and act, and are acted by, as such. Still more is this the case with only one. Is not the law, here, alike for high and low?

‡ "We had a kitten which sucked its mother and when a month old taken to ——, and sucked another cat; then to —— and sucked two other cats, and then its instinct was confounded and became mixed with reason and experience; for it tried repeatedly to suck three or four other kittens of its own age which no one, as far as I am aware, ever saw any other kitten do. Thus born instinct may be modified by experience." (Darwin's MS. notes, quoted in Romanes' 'Mental Evolution in Animals,' ch. ii. p. 172.) And why not in wild nature, on the up-grade?

those of irrational action, nor need they always, that I can see, become instinctive through lapsing. As time went on, it can hardly be questioned that, through individual memory, some conception would have begun to arise in the minds of birds as to the connection of the present building of the nest, for instance, with the future use to which it was to be put, and this must almost necessarily have passed, by degrees, into their having a clear purpose in building it, which they would probably be quite unable to distinguish from the strong instinct to do so, by which they would really be swayed. When once this point had been reached, the most intelligent birds, working, as one may say, perceptively as well as instinctively, might, without introducing any one great modification, have yet made many small improvements, and as the slowly increasing sum of these began to give them an advantage, this general superiority of intelligence, as well as the special results of it, would have been selected through the same agency, *pari passu* with any instinctive—that is to say, non-intelligent—beneficial variation. Thus the two forces would have become mingled in varying degrees, according to the greater or less intelligence of the species (since the general factor would be likely to be reflected in any particular application of it) but with a preponderance more or less marked, and always great, in favour of the latter.

If the nest-building instinct has, in its origin, had nothing to do with the "sexual frenzy," then it is certainly odd that the picking up and letting fall, or laying down again, of objects from the ground, or material from the nest, should, in some birds, be a feature of the paroxysms to which I have given that name, both some time, a little or just before, during and immediately after coition. No act lies more at the very basis of the instinct, is more absolutely essential to it than is this; and, moreover, occurring under these circumstances, it must be deemed a peculiar one. Yet if we do not recognise the connexion here suggested, we must see in it only a mere irrelevant coincidence. Again, it is noticeable that some of the movements by which birds—even such as are fairly advanced in the art—build their nests have an odd sort of resemblance to essentially sexual ones. The Peewit, during early spring, goes through peculiar movements on the ground, as the result of which a

circular depression, closely resembling that in which the eggs are afterwards laid, is produced, and it places in this, moreover, some scanty materials, such as grass-blades. The general idea is that the cock bird alone does this, but I have seen both sexes act so, as a sequel to coition; and also make little pecks at the ground at or beside the places rolled on. The most marked features of these performances, which seem clearly sexual, are the pressing of the breast against the earth, with a sort of rolling motion, and the strong downward pressure of the tail, or rather anal parts generally, with spasmodic movements, such as, in the male, accompany coition. The wings are drooped, extended from the sides and slightly quivered; and with these actions the pecking at things on the ground is also conjoined. The action here noticed with the tail as well as with the wings is a perfectly useless one, (at any rate, as it is practised, for the bird's hinder parts are tilted into the air), in connection with the making of a shallow pit or hollow; but it is effectively employed by the Blackbird in shaping the rim of its well-built and very differently placed nest. There is also here the same pressure and movements of the breast and wings, by which the cup is shaped, and, whilst thus acting, the bird has a very curious appearance, for it seems to be in a sort of ecstatic state rather than exercising a purely mechanical craft. I cannot but think it odd, if nidification has been purely architectural in its beginnings, that any bird should have thought of employing its tail in this way. It may not be beyond the possibilities of intelligent adaptation (though we do not see many such), but I must look at the manner as well as the matter, and find it easier to suppose that one and the same cause lies at the root of these movements in the concupiscent Peewit, the building Blackbird, and the incubating, or fostering, Merlin—*et sic de ceteris*. If the nest, as an adaptation to the needs of the young and the practice of incubation, grew out of the place—at first unmodified and then strewed with some light litter of flung-about materials merely—where birds were accustomed to pair, we can see why, in the case of some species (we do not, by any means, yet know how many), the old habit and the old association of ideas is continued. Otherwise, however, these facts are not easy to explain. Architecture, properly so called, cannot be supposed to flow naturally

out of the primary sexual emotions, and if the nest is the outcome solely of constant small acts of intelligence of a constructive kind, a bird, when building, should be in a very different state of mind from that in which it is when under the influence of passion. The two things, instead of being mentally associated together, through their common origin and consequent habitual concomitancy, might be expected to be cut off from each other; nor would Natural Selection, as far as one can see, have at all tended to favour their union. Nor does she, upon the view which I advocate. On the contrary, she must be looked upon as a differentiating and specialising agency, whilst she at the same time makes use of the force of heredity. She has changed one trifling and wholly irrelevant instinct that arose, rhythmically, as a mere nervous adjunct of the sexual stimulus, into the important one of nidification; and if she has not yet eradicated all traces of the steps by which she has brought this about, yet she is, as it were, constantly striving to do so, since the tendency must be for mere useless actions, representing a waste of energy, to drop out and disappear before useful ones. Again, there seem many reasons against a habit of pairing on the nest, arising, as it were, *per accidens*. If it is continued after the laying of the eggs (as I have reason to think that, in some cases, it still is), these may, in consequence, suffer; nor does an artificial structure seem to offer any particular convenience for the act itself. One must recognise this where pairing begins on the site of the nest, and only comes to be upon it (the actual nest) as the building (or rather heaping) progresses. In the case of the Grebes it may appear otherwise, yet there are generally low and flat shores in the vicinity of their breeding haunts; and, moreover, it is scarcely possible to imagine any species having actually to rear a structure in order to facilitate or make possible this primary physical act, on which its continuance depends. No bird, one must suppose, could have become aquatic beyond its capacity for this functioning, under the new conditions, though an acquired habit might have been transferred from the land to the water. In the case of a non-aquatic bird, the whole surface of the country, according to its habits, is open to it for this purpose, whereas coition on the nest may be attended with more or less of inconvenience. Thus Rooks have this habit, though it is not a

constant one with them; * and, as I have myself observed, they often suffer severely for it, for no sooner are a pair seen to be acting in this way, than as many of the rookery as happen to be there assembled, taking the cue one from another, set violently upon them, and the nest becomes shortly covered up beneath a mass of tumbling, struggling birds. The scene, indeed, is so animated and the main features of it—birds flying from every direction to one particular nest, with a general scrimmage upon it—so marked, that it has occurred to me it may often have been misinterpreted as the destruction of the nest of some couple convicted of pilfering. One would only need not to be there at the beginning, and not to stay till the end, to fall into this error quite easily. There is, however, no doubt as to the true cause in these cases, however established the other one (which I have not myself witnessed) may be. It is, I think, remarkable that the Rooks should cling to a habit attended with such severe penalties. If it has its roots deep down in the sexual instinct, or its concomitant developments arising out of the sexual frenzy, then here is an explanation; but otherwise it is not easy to understand how, in the face of such difficulties and discouragement, it should ever have established itself. To conclude, on the supposition that the nest was originally the pairing-place, we have an explanation of the facts to which I have here referred, but all of which I have not yet fully recorded, nor need their being exceptional (though as to the extent to which they are we are yet in ignorance) surprise us, since the differentiating and specialising process, which is at work everywhere, would be sufficient to account for this. On the other hand, if these two instincts—nidification and the sexual or pairing one—though thus sometimes, as I have shown, combined and intermingled, have yet, so far as the origin and growth of the former are concerned, had nothing to do with one another, the fact of their being so is surprising, and has yet to be accounted for.

* Rooks are not included amongst the four species mentioned by me as pairing habitually on the nest, nor do they belong to any of the families represented by these.

BIRD LIFE ON THE ISLAND OF EIGG.

By J. Kirke Nash, L.D.S. (Ed.), F.Z.S. (Scot.).

Having arranged with my friend Mr. David Hamilton to visit the Island of Eigg for the purpose of observing the Manx Shearwater (*Puffinus anglorum*) at its nesting haunts, we landed there from the s.s. 'Claymore' at the somewhat inconvenient hour of 11.30 p.m. on June 20th last and left again on the 24th, when we crossed over by motor-boat to Arisaig. Anxious to make the most of the few days at our disposal, we called early next morning upon Mr. Glendinning, the factor on the island, to whom we had an introduction, and he kindly gave us any information we required regarding the nesting localities of the "Fachach"—the local name for the Shearwater, and which I believe means "night-bird."

The Island of Eigg is roughly divided into two mountainous portions by a valley which runs from the little bay at Kildonan on the east side to the Bay of Laig on the west. The larger section lying to the south-west of this valley rises to a considerable elevation, attaining a height of over 1300 ft. at the "Scuir of Eigg," which forms a notable feature in the landscape. The other portion of the island runs more directly north, and is really the more interesting part from an ornithologist's point of view. Huge basaltic cliffs on the west side surround the Bay of Laig for over a mile in extent, and from their base a nearly perpendicular slope descends for a great distance to the level ground, on which stands the crofting township of Cleadale. Right at the top of this steep, immediately under the beetling crags, the nesting-burrows of the "Fachachs" are to be found. Walking along the top of these cliffs to their north-western extremity, the immense height of which greatly impresses one, and where a magnificent view of the Island of Rum can be obtained, we slowly made our way down, which required very careful footing owing to the friable nature of the rocks, and

cautiously making our way along the foot of the sheer face we soon came upon the burrows of the Shearwaters, but it took us some little time before we found the birds, and also the best method of getting at them, for being nocturnal in their habits, they are never seen leaving their nests, and they are also very silent. We found over a dozen nests, and took out several of the birds. As they can bite rather severely—sufficient to cut the skin—it is advisable for the "Fachach" hunter to protect his hands with gloves when investigating the holes. If returned to the entrance of the burrow the birds immediately sought the nest again, but wishing to see their flight, we launched one or two of them into the air, when they flew down the declivity at a great pace, with very direct flight, right out into the Sound of Rum. One bird which was beyond our reach in its burrow made a curious crooning or grunting sound whenever we attempted to seize it. I mention this specially, as all the others were quite silent. Owing to the nature of the ground, the burrows only penetrate directly inwards for a short distance, when they run off for several feet, at right angles along the face as it were, and to many of them there was an entrance at either end. Passing in the hand as far as the arm could reach, we never could feel the birds nor the nest containing the single white egg, and it was only by judging the direction of the holes and digging through the face with the aid of a stout walking-stick that we got at them. All the nests we found had eggs, though in most cases they were highly incubated, and the chicks could be heard cheeping inside. The nests were very primitive in structure, a small quantity of dry heather-twigs apparently constituting the whole affair. It would be somewhat difficult to say whether the burrows were made by the birds themselves. Many are probably excavated by Rabbits, but as many of the holes would hardly admit one's hand, I am rather inclined to think they are dug out by the birds. Working on the rock face under a blazing sun proved very laborious, yet so extremely fascinating it was only when the sun began to sink behind the hills of Rum that we thought of leaving the scene.

Having now accomplished the main object of our visit, we devoted the whole of the following day to traversing most of the coast-line round the southern half of the island, from Laig on

the west to Kildonan on the east, besides visiting about a dozen small lochs scattered among the hills around the "Scuir," with a view to discovering what bird life was on the island. On the third and last day of our visit we made an excursion by motor-boat to Muck, which lies between three and four miles to the south, and whilst crossing the Sound of Eigg we had an interesting encounter with a Lesser Rorqual Whale. Sailing close inshore to view the sea-birds which abound on the high cliffs along the south coast, our attention was drawn to the huge dorsal fin of the monster as it swam along near the surface of the water, and bringing the boat round we ran alongside of it, passing between it and the shore. We could see the creature from head to tail, and estimated it to be at least thirty feet long by comparing it with the boat, which measured twenty-eight feet. Mr. Glendinning, who was with us, gave it a prod with one of the heavy oars we had in the boat, when it plunged down and disappeared.

We spent an hour or two on Muck, which is a flat fertile island, forming a strong contrast to Eigg, and also landed on one or two islets, where numerous sea-birds breed.

Although presenting a somewhat barren appearance when viewed from a passing steamer, the Island of Eigg—which lies about ten miles west from Arisaig, the nearest mainland—is so pleasingly diversified by hill and dale, besides possessing a fair share of woodland on the east side, that it is not altogether surprising to find such a large variety of bird-life as abounds. So far as I am aware, no account of the birds of Eigg has appeared since 1892, when an entertaining chapter on Eigg was given by Mr. J. A. Harvie-Brown in his book on the 'Vertebrate Fauna of Argyll and the Inner Hebrides.' The account, however, as the author states, is largely based on a previous one written by Mr. William Evans (published in the 'Proceedings of the Royal Physical Society,' vol. viii., 1884–85), who visited the island in June, 1884. In the 'Zoologist' for 1888 there also appeared an interesting paper on the subject written by A. H. and H. A. Macpherson.

Mr. Evans personally observed fifty species, and from various sources of information he made up a total list of eighty-four. Of these, however, *viz.*, the Bullfinch, the Short-eared Owl, the

Slavonian Grebe, the Great Shearwater, and the Storm Petrel, Mr. Macpherson held that they could not be admitted owing to insufficient evidence. Mr. Macpherson's list numbered ninety-five species, but how many of these were from personal observation he does not state.

Our list, which numbers fifty-three species, only includes those seen by ourselves, and of these several have never before appeared in any published list. It also proves the breeding of some other species suspected or unknown to do so. Had we been able to prolong our stay I have no doubt the number could have been considerably augmented, as the wooded parts entirely escaped our attention. Only a resident ornithologist would be in the position to produce a complete and authentic list of the birds on this island, as several species from higher latitudes are known to pass the winter there, and in addition to these there will doubtless be many birds of passage which could only be seen during the spring and autumn migration.

The subjoined list gives a detailed account of all the species that came under our notice, and every bird mentioned was carefully identified :—

1. Mistle-Thrush (*Turdus viscivorus*). — A few were found near the centre of the island feeding in the open. No previous record of this species has been given.

2. Song-Thrush (*Turdus musicus*).—Very common. Many were seen along the seashore and throughout the bleaker parts of the island quite away from the woods.

3. Blackbird (*Turdus merula*).—Several were seen in localities similar to those in which we met the Mistle-Thrush.

4. Wheatear (*Saxicola œnanthe*).—This was a fairly common species. We observed a good many pairs frequenting the rough ground one usually expects to find this species on.

5. Whinchat (*Pratincola rubetra*).—These were also quite common, especially on the rough ground bordering the roadside on the way to Laig.

6. Robin (*Erithacus rubecula*).—We only encountered one bird, which was evidently feeding young on a wild part south of the Scuir.

7. Whitethroat (*Sylvia cinerea*).—We came on a number of

these at Laig, amongst the rough herbage, brambles, and meadow-sweet bordering the grassland.

8. Willow-Wren (*Phylloscopus trochilus*).—Several observed. In summer, no matter what part of the country you wander in, this species seems ever present.

9. Hedge-Sparrow (*Accentor modularis*).—One bird seen on a very barren part towards the west coast.

10. Wren (*Troglodytes parvulus*).—We were not long on the island before this lively little bird made us aware of its presence with its merry outburst of pleasing song.

11. Meadow-Pipit (*Anthus pratensis*).—This species was frequently seen and heard all over the island.

12. Rock-Pipit (*Anthus obscurus*).—We observed a number on the rocks along the south shore and also on Muck.

13. Swallow (*Hirundo rustica*).—Mr. Macpherson records having seen one bird. We saw several and found them nesting at Laig.

14. House-Sparrow (*Passer domesticus*).—This species does not appear in Mr. Evans's list, though included in Mr. Macpherson's. We saw several on both sides of the island. They were nesting in a barn at Laig House.

15. Twite (*Linota flavirostris*).—We met a number of these birds, particularly on the heather slopes towards the south-west and perching on sallows near a small marsh.

16. Corn-Bunting (*Emberiza miliaria*).—Although said to be one of the most prevalent species on Eigg, we met with but few birds.

17. Yellow Bunting (*Emberiza citrinella*).—These were distinctly more numerous than the previous species.

18. Starling (*Sturnus vulgaris*).—According to previous records, this species seems to vary greatly in number. It was undoubtedly the most numerous of all the smaller birds during our stay; indeed, it was swarming in some parts, and we found several nesting among the ruins of the deserted crofts at Grulin on the south side.

19. Raven (*Corvus corax*).—We saw one bird on the cliffs at Cleadale.

20. Hooded Crow (*Corvus cornix*).—Said to be a regular pest in Eigg, but we only encountered a few birds.

21. Rook (*Corvus frugilegus*).—We noticed several in the centre of the island not far from the schoolhouse, but saw no indications of a rookery as mentioned by Mr. Harvie-Brown (1886).

22. Sky-Lark (*Alauda arvensis*).—The song of these melodious birds could be heard all over the island.

23. Cuckoo (*Cuculus canorus*).—In the vicinity of the Bay of Laig the call of the Cuckoo often broke upon the ear amid the general silence, and these birds were well distributed over the island.

24. Barn-Owl (*Strix flammea*).—In the inn at Laig we saw a stuffed bird taken the previous winter in the barn by the shepherd.

25. Common Buzzard (*Buteo vulgaris*).—When at the Shearwaters on the cliffs at Cleadale, a pair of these birds were circling high overhead, uttering their shrill mewing cry, and next day at the wild rocky headland of Rhuda-an-Aeseid, on the south-west, another pair were seen. One of the birds repeatedly flew to and from the cliff face, whilst the other circled high above the waters of the Sound of Rum. We suspected they had young, but the overhanging nature of the rocks prevented us from obtaining a view of the supposed nesting-site.

26. Peregrine Falcon (*Falco peregrinus*).—Whilst sitting on the top of the cliffs watching the Buzzards and enjoying the beauty of the scene, a pair of Peregrines were noticed dashing along the face of the precipice.

27. Shag (*Phalacrocorax graculus*).—At several points along the sea-cliffs we were able to see some distance along the shore and on the rocks below we could distinguish many of these birds. They nest in the numerous caves that penetrate the cliffs all along the coast.

28. Gannet (*Sula bassana*).—If reliance can be placed on an ancient account by Dean Munro, who visited the Hebrides between 1540 and 1549, it appears these birds at one time nested on the cliffs of Eigg. His quaint description is interesting: "North from Ellan Muchd be foure myles, lyes an iyle called iyle of Egga, foure myle lange and twa myle braid, guid maine land with a Paroch Kirk in it and maney Solane geese." We saw two of these birds diving and fishing in the Sound of Rum, within a mile of the shore.

29. Mallard (*Anas boscas*). — In a reedy pond near Laig House we came across several young birds and also a hatched-out nest on a hill loch.

30. Common Eider (*Somateria mollissima*).—We saw a number of these birds both on the east and west side of the island, and found it nesting on Castle Island.

31. Rock-Dove (*Columba livia*).—A large number of these birds frequent the numerous caves, one of which is known as Pigeon Cave, in the high sea-cliffs that terminate the steep slopes from the Scuir on the south side. It is near here that the famous cave penetrating 300 ft. is situated, in which the McDonalds of Eigg were suffocated by the McLeods of Skye when they raided the island.

32. Red Grouse (*Lagopus scoticus*).—Although the ground is eminently suited for this species, there appeared to be very few of these birds.

33. Pheasant (*Phasianus colchicus*).—We saw several of these among the heather on the hill slopes—a rather unusual situation. No previous record has occurred.

34. Corn-Crake (*Crex pratensis*).—Quite common, especially in the meadows around Laig Bay. During the night the monotonous "crek, crek" was almost incessant.

35. Ringed Plover (*Ægialitis hiaticola*).—One pair on the sandy beach at Kildonan were observed. It seems that never more than the one pair is ever seen here.

36. Lapwing (*Vanellus vulgaris*).—Although informed that this bird had been observed in Eigg, Mr. Evans did not see it during his visit. We saw several birds, and on Muck we found a nest with two eggs.

37. Oystercatcher (*Hæmatopus ostralegus*). — We noticed several on various parts of the coast, and we came on a nest with two eggs close to a colony of Common Gulls.

38. Redshank (*Totanus calidris*).—One bird seen on the south side near the shore.

39. Common Sandpiper (*Totanus hypoleucus*).—Observed one pair near Grulin.

40. Curlew (*Numenius arquata*).—A number seen feeding on the shore at Kildonan, and others flying across the island.

41. Common Tern (*Sterna fluviatilis*).—Two or three birds

came quite close to the boat as we were passing Castle Island, which enabled us to perfectly identify them. We also saw a few near Muck. We did not expect to find this species here, and no previous record of it has been given. We looked for Arctic Terns, but saw none, though I understand they breed irregularly on several of the islets.

42. Common Gull (*Larus canus*). — We noticed individual birds on various parts of the island, but as a nesting species it was by no means numerous. We found a colony of over twenty pairs nesting on some shelving rocks on the south coast.

43. Herring Gull (*Larus argentatus*). — Nesting in small numbers at "Bidein Boidheach." Observed birds all round the coast.

44. Lesser Black-backed Gull (*Larus fuscus*).—The same remarks apply to this as to the previous species.

45. Great Black-backed Gull (*Larus marinus*).—We found these birds here and there over the island. Landing from a small boat under considerable difficulty at the foot of the high sea-cliffs about a mile to the west of the McLeods' Cave, with a view to finding a nest of the Black Guillemot, we came on a nest of this Gull containing one addled egg and a chick a few days old. It was a fine specimen, and even then showed the fierce nature of this species by pecking at and seizing hold of the finger held out to it. We also saw several nests on an adjacent islet.

46. Kittiwake Gull (*Rissa tridactyla*).—On the same islet we saw a number of these birds nesting.

47. Razorbill (*Alca torda*). — We saw one or two birds between Castle Island and Eigg, and several in the Sound of Eigg. We did not find it as a breeding species on the island, but we saw several nesting on a rocky islet a few miles distant.

48. Common Guillemot (*Uria troile*).—Observed several off shore in the Sound of Eigg, and also on the east side of the island. A good many were nesting on the same islet where we found the Razorbill.

49. Black Guillemot (*Uria grylle*). — These birds were numerous. We saw a pair on Castle Island and several on the south coast between Castle Island and the Dubh Sgeir. We met many on the water in the Sound of Eigg, also in Laig Bay, and one bird when crossing to Arisaig. They were mostly

in pairs, from which we concluded they were just starting to breed.

50. Puffin (*Fratercula arctica*).—A number of these birds were seen on the water close to the shore, and on an islet we found a large colony breeding.

51. Red-throated Diver (*Colymbus septentrionalis*).—When descending the steep slopes of Bein Tighe—the second highest point on the island—towards Loch Bein Tighe lying at its base, our attention was drawn to two birds resting on the water. Examining them through our glasses we easily recognized the species, and taking all the available cover we could we got fairly near without disturbing them. Wishing to see how near we could approach, our attention for the moment was taken up with the rough ground we were on, and on looking up again we found they had disappeared with surprising suddenness. This species forms a new addition to the Eigg list, as does also the next one.

52. Black-throated Diver (*Colymbus arcticus*).—We saw this bird in the Sound of Eigg at no great distance from the shore.

53. Manx Shearwater (*Puffinus anglorum*).—"The" bird of Eigg (*facile princeps*).

This completes the list, and the chief points of interest to which I would draw attention are, first, the Mistle-Thrush, the Pheasant, the Common Tern, the Red-throated and the Black-throated Divers form new records for Eigg. Secondly, although an allusion is made in one of the former lists to an unpublished record, the present is the first definite account of the Gannet having been seen at Eigg. Thirdly, only one example of the Common Swallow—a straggler—was observed by the previous recorders. We saw several and found it nesting. Finally, we proved the breeding of the Great Black-backed Gull and the Oystercatcher, and also the following species in the vicinity: the Puffin, the Kittiwake, the Razorbill, the Guillemot, and the Lapwing.

EARLY BREEDING OF THE CRESTED GREBE.

By O. V. Aplin.

There were five pairs of Great Crested Grebes on the lakes at Fawsley Park, Northants, on May 11th, 1914. The cock of one pair carried on his back a single young one, as big, perhaps, as a goose's egg. The cock of another pair carried either one or more (I could only make out one for certain, but think there were more) quite small young ones. Pike in the lakes probably accounted for the small number of the young ones. But Grebes also suffer a good deal from the depredations of the Crow family. When I was walking round the lake at Blenheim (where there were many Grebes) last June I picked up under a tree two Grebes' eggs most obviously sucked, and doubtless by some of the Crow family. The day I was at Fawsley was rather cold, with but little sunshine, and the young might be feeling the cold wind; or they might have been picked up by the old cock to get away from suspected danger as quickly as possible, for I think this is very often the reason for Grebes taking their young on their backs. At all events, I did not see the young on the water on this occasion. I think these were instances of unusually early breeding for this part of the country. There are good beds of old reeds and other water plants of this year's growth on the banks of the lakes in places, in the outside edge of which the Grebes would find ample cover for early nests. And it is the question of the presence or absence of cover, and the early or late growth of this, which determines the date of this bird breeding to a great extent. At Byfield Reservoir, for instance, where the cover is always late in shooting up (largely *Stirpus*), July is in most years the laying month with the Crested Grebe. The Grebes have been at Fawsley for nearly twenty years. Later in the afternoon, when passing one of the large ponds at Canon's Ashby, I noticed a pair of Crested Grebes on it.

NOTES AND QUERIES.

MAMMALIA.

Fecundity of the domestic Cat.—Our Cat is half Chinchilla half Persian, and she came to us just able to lap milk as a kitten. Her kitten record since then has been carefully noted in a book, copy of which is appended. Is not a litter of eight rather unusual? This was her last performance. All her progeny have been healthy and vigorous, and most have been light grey like herself:—

A Cat's Progeny.

	Number in each litter.		Number in each litter.
1909, April 17	5	1911, Aug. 10	4
July 23	6	1912, March 31	5
Date not exactly recorded in Sept.	3	July 26	5
		Nov. 30	4
Dec. 1...	4	1913, March 4	5
1910, Feb.	7	May 19	4
May 23	5	Sept. 2	6
Aug. 10	4	1914, Jan. 29	4
Oct. 27 born dead	2	May 15	8
Nov. 1..	2		—
1911, March 31	5	Total	88

—Edwd. N. Mennell (The Hostel, Shirley, Croydon).

The Decrease of the Squirrel.—I wish to report that on May 8th, while with some friends near Ambresbury Banks in the northern part of Epping Forest, a good view was secured of a Common Squirrel. I missed it, but my wife, who is well acquainted with both species, was confident that it was the British and not the American species; indeed, a lady of the party remarked on its rich red colour. I cannot remember ever seeing a Squirrel in Essex, and certainly not within the past three years, when its absence first began to interest me. Dr. Laver, writing on the Mammalia of Essex in 1881 ('Epping Forest Transactions,' p. 169), stated that "it occurs in all parts of the county in suitable spots—that is, where there are woods"; but I have spent a good deal of time in such localities and

never noticed the animal. Half a century ago it was common in most of the cloughs and valleys of that corner of the Pennines where the four counties of Lancashire, Yorkshire, Cheshire, and Derbyshire meet. There is an established tradition in Longdendale that formerly the woods were so dense that a Squirrel could pass from tree to tree between Staleybridge and Glossop; but this is a commonplace superstition that is applied to many other places which have been stripped of trees. In Longdendale it is also believed that the making of the Woodhead series of reservoirs drove the animal out of the district. It is not uncommon in the Goyt Valley, between Cheshire and Derbyshire, and abundant near Grindleford, which is in the latter county nearer Sheffield. Five years ago I saw a single individual in Bottoms Hall Wood, near Mottram, but this may have been an escaped specimen. Destruction of woodlands as the cause of the decrease of the Squirrel might be studied with greater caution, for reliable observers have described to me that fifty years ago it was well-known as an inhabitant of the scantily-clothed valleys of south-west Yorkshire, and could there be seen running along the stone walls. In other counties in Wales and England I have myself observed it far from any wood that could be termed dense.—F. J. Stubbs (Theydon Bois).

AVES.

Leisurely Nest-building by a Robin.—We all know how very quickly birds can put up a nest when they are in a hurry; but this season I met with an instance of the opposite kind. Observing a Robin carrying building stuff to the upper part of an ivied wall on March 8th, I examined the spot, and found two or three handfuls of material. The bird was seen building once or twice during the rest of the month, but when I went up (I had to use a ladder), the nest was far from finished. On April 12th it appeared at last to be finished, but was empty, and when I next went up on the 18th, it contained five eggs.—O. V. Aplin.

Blackcap wintering in Oxfordshire.—I saw a male *Sylvia atricapilla* in my garden on February 28th. It sang a little, but only got out one good high note. I noticed it at intervals until March 13th, when it sang well with some good high notes at the end of the strain, but not afterwards. It may have gone away, or been killed by a cat. Quite possibly it wintered in the garden, and remained unnoticed until it began to sing. During the time I had it under observation I found it difficult to see, as it generally sang from inside

a yew tree or other evergreen. The weather was wet. Migrant Blackcaps appeared on April 30th, and we have more than we have had for some years. On May 3rd four, if not five, were singing not far from this house.—O. V. Aplin.

Gannet plunging for its Prey.—Perhaps the principal desideratum still remaining in the life-history of the Gannet or Solan Goose is a satisfactory photograph of this singular bird, taken whilst it was in the act of plunging into the sea for its prey, and the writer would be grateful to anyone who could secure him such a snapshot, which ought not to be very difficult to procure in the vicinity of the Bass Rock or Ailsa Craig, where Gannets are plentiful.—J. H. Gurney (Keswick Hall, Norwich).

Supposed Breeding of Tufted Duck and Pochard in Northants.—On May 11th, 1914, I had an opportunity of seeing what birds there were on the lakes at Fawsley Park, Northamptonshire. I was pleased to see, besides ordinary birds, three pairs of Tufted Ducks and a pair of Pochards. The ducks and drakes of the respective pairs of the Tufted Ducks kept close together and did not leave the water. The Pochards got up, and after flying round twice—uttering their loud rattling "carragh" as they flew past—pitched again on the lake. I think, from the presence of these birds at that late date in the spring, there is a strong probability that they intended to breed there, if indeed the ducks had not already begun to lay. Lord Lilford, in his 'Birds of Northamptonshire' (1895), does not give any instance of either of these ducks breeding in that county; but the fact of their doing so may have been noticed and recorded since that date. The Pochard has been suspected of breeding in Northants at Byfield Reservoir for some years past. I saw a pair there in August, 1895. On July 6th, 1900, I saw a drake in the same place. In 1903 the Pochard was believed to have laid eggs there—the keeper reporting a nest containing "brown" duck's eggs mown out on the banks. On June 14th, 1905, there were three drakes and four ducks on the water.—O. V. Aplin (Bloxham, Oxon).

Corn-Crake (Crex pratensis) in Essex.—On May 18th I heard a Corn-Crake in a meadow at Piercing Hill, Theydon Bois; it was there the next morning and the next night, but I have not heard it since. An unfamiliar quality in its note led me to time it, when I found that the "crake" was uttered at the rate of about twenty to twenty-three times a quarter minute. All those I have timed elsewhere have called at the rate of about sixty-two to the minute. A

very funny article on the Corn-Crake in 'Punch' for May 27th, 1914 (obviously from the pen of a writer who knows the bird), describes the rate at ninety-eight to the minute. Judging from my own experience the slower and more familiar rate is decidedly soothing, while the ninety-eight bird threatened to become an intolerable nuisance. I have not previously heard the voice of the Corn-Crake in any of the south-eastern counties.—F. J. Stubbs (Theydon Bois).

London Notes.—One or more Great Spotted Woodpeckers have been frequenting one of the Highgate woods since the end of March, and presumably (if a pair) have nested in the locality. Chiffchaffs were heard at Highgate on April 1st. On the 30th of that month I observed a Lesser Tern on one of the Highgate Ponds. Tufted Ducks, at first a single bird, but ultimately two pair, frequented these ponds until the end of March. Carrion Crows are rather common there. I have observed four or five at once about the lower ponds in Parliament Hill Fields.—H. Kirke Swann (Finchley).

NOTICES OF NEW BOOKS.

Heredity and Sex. By Thomas Hunt Morgan, Ph.D., &c. Humphrey Milford, Oxford University Press, London.

This is an American publication, written by the Professor of Experimental Zoology in Columbia University. It reviews the principal facts, suggestions, and conclusions on the subject contributed by other workers, and gives the results of original study in the same field by the author. Such a volume is bound in its treatment to be more or less argumentative, but Prof. Morgan is unbiassed. He writes:—"It may not be desirable to accept everything that is new, but it is certainly undesirable to reject what is new because of its newness, or because one has failed to keep in touch with the times." To keep oneself in touch with all the novelties in evolutionary speculation, and to judge them by a familiarity with advanced zoological knowledge is now within the province of few indeed, and the excellent bibliography appended to this volume will show the study needed for an up-to-date judgment. Some applications of Natural Selection

are discarded, and sexual selection as proposed by Darwin is given scant recommendation. We are struck with one conclusion enunciated by Prof. Morgan: "The return to Darwin's method rather than to Darwin's opinions marks the beginning of the new era."

This book is very fully and excellently illustrated.

The Care of Home Aquaria. By Raymond C. Osburn, Ph.D. Published by the New York Zoological Society.

All publications on this subject are welcome, for we frequently find a new hint in management, and in an American guide we are introduced to fish and other animals outside our fauna which are not impossible to obtain for our own aquaria. Moreover, this communication is very fully illustrated, so that we can judge what are really desiderata.

Dr. Osburn states that "it was not until 1850 that the first properly balanced aquarium was described by Mr. Robert Warrington, of Manchester, England, in a paper entitled 'On the Adjustments of the Relations between the Animal and Vegetable Kingdoms by which the Vital Functions of both are permanently maintained.'" It may be well in this notice to supplement that reference. The author's name is to be spelled "Warington," and his paper was published in the 'Zoologist,' vol. viii., p. 2868 (1850), though it may have appeared elsewhere, as in a footnote he writes, "Since the reading of this paper" (which we believe was before the Chemical Society). Warington also published another paper, also referred to by Dr. Osburn, entitled "On Preserving the Balance between the Animal and Vegetable Organisms in Sea Water" ('Zoologist,' vol. xi., p. 4118 (1853), which, however, had been previously read at the Hull Meeting of the British Association, and also printed in the Ann. & Mag. Nat. Hist. for November, 1853.

Dr. Osburn gives some good directions for "clearing the aquarium," but although he refers to Tadpoles and freshwater Snails as scavengers, he does not advocate the use of the freshwater Mussels, one of which (*Unio tumidus*) is used by some keepers of aquaria with great success in this country.

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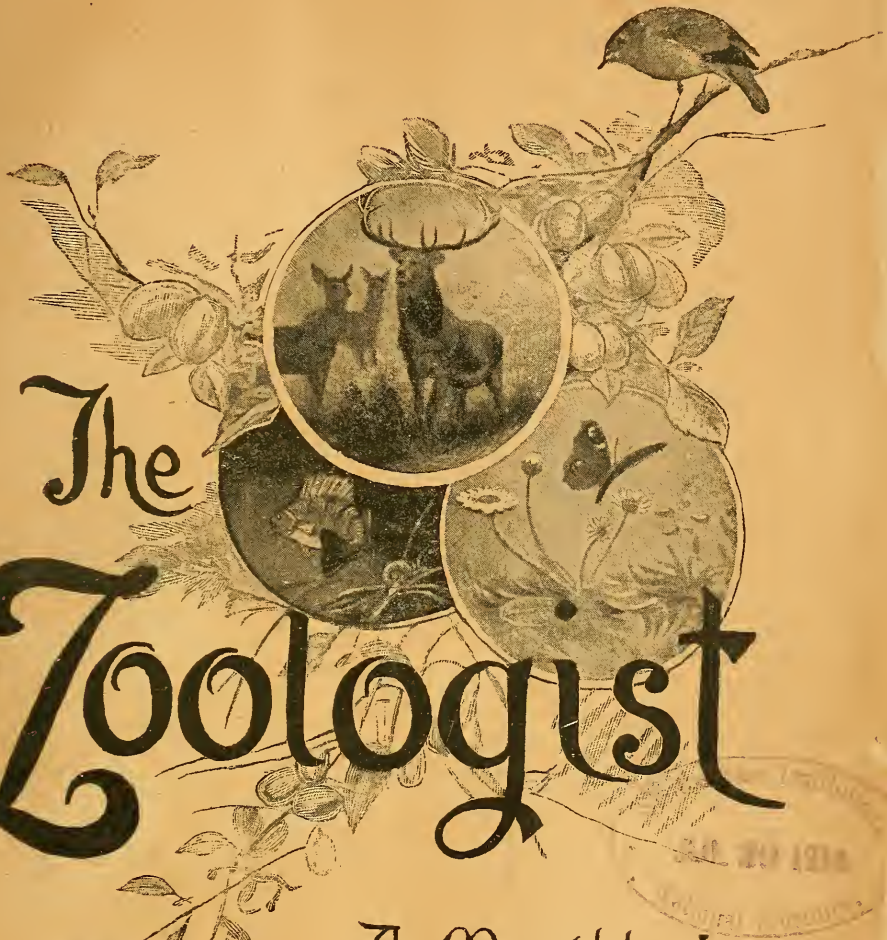

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THE EGYPTIAN DESERT AND ITS BIRDS.

By Robert Gurney.

The ordinary traveller in Upper Egypt has few opportunities of making acquaintance with the desert which fringes the cultivated strip of land along the Nile, and still less of seeing the true Libyan Desert beyond. An excursion to Sakkara from Gizeh will show him something of the former, but only of its less pleasing features. It is only from Dahchour southwards that the fringing desert can be seen at its best. This fringe varies in width from a few hundred yards to two or three miles, and for the most part consists of stretches of absolutely barren, stony, or sandy ground, as at Abydos; but in other places there are long sand-dunes covered with tamarisk and coarse wiry grass, with intervening flats, either covered with grass or quite bare sand.

The fringing desert merges into cultivated land, for the Fellah is always ready to sow his lupine crops so near the limit of the inundation that there is usually a debatable ground where stunted lupines struggle for bare existence against the parched sand, and only the pretty little blue Iris thrives.

The Libyan Desert, on the other hand, lying as it does at a higher level, is sharply marked off from the valley of the Nile either by rising abruptly in great limestone cliffs, or in rolling sandy hills, as at Dahchour. Once on the true desert, the sight of a green thing is a rare treat to the eye; only here and there in a hollow one may come across a patch of plants with succulent

leaves or consisting of little more than thorny twigs. For mile upon mile the way leads over a gently undulating expanse of stony desert, where the only living things are sandy-coloured Lizards and Mantids, darting about with prodigious swiftness, and probably feeding on the few minute flies which somehow contrive to find subsistence here. The view is shut in by the gently rising ground, and though every sky-line gives promise of a changing scene, it is a promise which rarely finds fulfilment.

The desert is not, however, by any means all flat or even undulating, but the level plain may give place to more broken ground with bold rocky cliffs, which often show curious effects of the tremendous weathering power of blowing sand and extremes of heat and cold.

Once out on the true desert, practically all bird life is left behind. Here and there, near the edge of it, a little flight of Pipits passes by seeking the patches of vegetation, and birds of strong flight, such as Ravens, Vultures, and Swifts are occasionally seen. The Swift (*Cypselus pallidus*) may be found nesting in rock crevices in the desert some miles south-west of Dahchour. With these exceptions there appear to be no birds resident in these wastes, in spite of the fact that there is a scanty insect fauna subsisting on one knows not what.

It is only in the immediate neighbourhood of the Nile valley that birds are met with in any numbers, the cliffs that bound the valley being a favourite nesting-haunt of many of the birds of prey. These cliffs are composed of limestone, and their line is broken in various places by deep gorges running in for a considerable distance. These narrow gorges are closed in by precipitous walls of rugged rock terraced by ancient water levels, and often honeycombed with water-worn caves and holes of all sizes, many of which have been the abode of Neolithic man or of persecuted Copts, and some of which may even now be the homes of lawless or outlaw Arabs.

The ledges and holes in these steep and almost inaccessible cliffs make admirable nesting-places for birds of prey, or dens for Jackals. It is here that the Griffon and Egyptian Vultures and Bonelli's Eagle nest, and Ravens and Falcons may be seen in most of these gorges in the spring. The Rock Swallow (*Cotile obsoleta*) flits about the bare rocks in some numbers, and now

and then Wheatears (*Saxicola monacha*) watch the intruder from the top of a boulder. At night the whistling note of the Barn-Owl and the echoing boom of the Eagle Owl (*Bubo ascalaphus*) may be heard, while Jackals steal out to make their way towards the cultivated land. The crevices harbour countless Bats which, silent during the day, fill the air with their twittering as dusk falls, before, as at a concerted signal, they fly out from every cranny in a cloud.

A curious and rather awe-inspiring noise is sometimes heard in these valleys at sunset. A low rumbling is heard which rises to a vibrating roar reverberating from the hollow rocks and lasting some minutes before it gradually dies away again. Apparently this noise is caused by the slipping of the sand on the steep slopes. At all events, the same noise on a small scale is produced if one slides down one of these sand slopes. As one proceeds, the whole face of the slope begins to move, and gradually a vibrating humming sound rises beneath the sand in a most uncanny way. Apparently these gorges at Abydos were noted in ancient times for mysterious sounds, for Abydos is described in an inscription of about 4000 B.C. as "the region of bellowing."

Between these cliffs and the cultivated land which borders the Nile is, as has been said, a fringe of desert, and here there may be a rather rich bird life. Even here, however, in the dry stony wastes there is little to be seen, but where the moisture and other conditions are suitable for the growth of scanty grass, tamarisks, and other semi-desert plants, a number of birds find a home. It is in these places that the Cream-coloured Courser is met with in small flocks. These birds are not uncommon, though perhaps they are often passed unseen—I have seen a piece of desert covered with their footmarks, and yet have seen nothing of the birds. They are somewhat shy, run with great speed, and readily take wing when pressed. In flight they are very conspicuous, owing to the black markings under their wing.

Another most characteristic bird is the Desert Lark (*Certhilauda alaudipes*), which may be found singly or in pairs along this fringing desert. It is a fearless bird, and delights the traveller by its habit of fluttering up a few yards into the air and

then falling headlong to the ground again, singing a sweet little song as it falls. These two are the most striking and interesting birds of this region, but the Sand-Grouse belongs to it too, since it is not a bird of the cultivation and still less of the bare desert. The Sand-Grouse seems to be now a rare bird in middle Egypt. It may be simply bad luck, but in two visits to Egypt, in which I have seen all the varieties of country which Egypt has to offer, I have only once seen Sand-Grouse, though I have occasionally heard them at night.

Of the smaller birds there are the beautiful little Trumpeter Bullfinch (*Erythrospiza githaginea*), and a number of species of Wheatear, Pipit and Lark, which frequent, either constantly or partly, this desert fringe. The Bullfinch is, however, properly a bird of the cultivation, being usually found along the causeways which bound the irrigation basins. The Wheatears are very numerous in Egypt, and while some, such as the Isabelline (*S. isabellina*), the Common, and the Black-eared (*S. albicollis*), seem to prefer the cultivated ground or its immediate edge, all visit the desert and some are rarely seen outside it. These desert forms are *S. deserti* and *S. monacha*. The latter I have only seen in one of the dry valleys penetrating the cliffs, where it apparently had a nest.

Thus it may be said that, so far as Egypt is concerned, the desert itself has no birds resident within it. Such birds as are met with are merely birds of passage, or are making use of its rocks for breeding purposes: but if we extend our definition to include the fringing desert where there is a considerable xerophytic vegetation, there are a number of birds which find here their congenial home.

RELATIONSHIP OF SPECIES.

By H. Panton.

(Concluded from p. 101.)

Let us in our argument term Darwin's slowly evoluting "indefinite variation" a "variant," in opposition to his "definite" or "spontaneous variation," the mutant of De Vries.

The latter great exponent of the mutation theory is of opinion (as above stated) that evolution proceeds from a sudden jump; that a new species is suddenly born; a mutant. What is the difference between the slow changing variant of Darwin and the suddenly evoluted mutant of De Vries? Is it only one of degree? If so, there is no difference. I believe that a mutant is defined as a type that gives inheritable powers, but that a variant does not transmit this power, or hand on its variation to its offspring. This distinction is clear, but is it invariable?

A mutation, I take it, is the result of a power in the germ plasm to give forth suddenly a new form desired by or agreeable to Nature, whether acting through environment or nutriment. It is a natural evoluting process for the manufacture of new forms, and is recognized by Darwin, and although not considered by him to be as effective in evolution as his more graduating variant, is, it is not unreasonable to suppose, apparently like the latter, acted upon by "external conditions affecting the germ-cells." One is therefore forced to the conclusion that a mutant and a variant arise from the same cause.

But some say, as above, that a variant does not transmit its characteristics. Without entering into the argument at all fully, it would appear that there are a large number of cases where variation is hereditary. Nearly all domestic animals are moulded into various forms almost entirely by this means.

And let it not be forgotten that in these domestic forms (or

most of them) the selection is not natural but unnatural, and (as in the case of the long-legged game-fowl, which will drop back in one generation to the short-legged type) these variations do not, therefore, become properly fixed but naturally tend to variate back at once to a normal condition. Most of these forms are monstrosities, and only come into being through unnatural interbreeding (with subsequent sterility), against the tendency through natural evolution to revert back from the monstrous to the correct type.

If unnatural evolution can cause a variant to thus pass on its characteristics, it is not perhaps unreasonable to suppose that selection according to the requirements of Nature (whether Lamarckian or Wallacian) may obtain much better results, and pass on its characteristic as unvaryingly as any mutant.

I do not know if Darwin is right in stating that variation gives rise slowly to species. I cannot see any reason why it should not. The matter appears to be by no means settled. Because species have been proved to arise through mutations, this is no evidence that they may not arise by variation.

Some authorities, among them Professor MacBride,* appear by no means to accept the theory of mutation *in toto*, and state that the celebrated example of De Vries, the evening primrose, and on which the chief arguments in favour of his theory are based, may be an introduced form and is strongly suspected of being a hybrid, and thus appear to discredit the theory of evolution by mutation.

As far as I can gather there do appear to be mutants, causing not merely new varieties, such as the white-bellied type of *Mus rattus*, Long-haired Cavies, &c., but even more, even indeed a species (?), at one bound, infertile with the parent form.

Dr. R. E. Lloyd,† writing on the researches of Mr. W. L. Tower regarding the Potato Beetle of America, states: "Here the origin of a species was actually observed (*Leptinotarsa pallida*)"; and later: "A number of *L. multitæniata* were allowed to breed in captivity under conditions which were nearly normal. The great majority of the offspring raised were of the kind *multitæniata*, like their parents, but both *L. rubicunda* and

* 'Zoology, the Study of Animal Life.'

† 'The Growth of Groups.'

L. melanothorax were born in the same line as sports. . . . The line of *rubicunda*, which was raised directly, both male and female sports of this kind being obtained, was found to be 'almost completely sterile' with the parent species, but quite fertile with specimens of *rubicunda* found at Toluca in natural circumstances."

The noteworthy point in this matter would appear to be the "almost complete sterility" of the sport *rubicunda* with the parent species. It would seem at one jump to have arrived at the "D" stage without any of those intermediate graduating stages, as I have suggested in the Theory of Hybrids. This would appear to give it the appearance of a very extreme mutant, all other mutants that I know of being fertile in the first "A" stage with the parent type. As classed in the "D" stage they become associated with types as divergent as the Horse and Ass, that is, of course, as regards their germ plasm interaction, which, as I have tried to show, by no means is to be gauged by the outward appearance, so far as form is concerned. This would appear to discountenance (as stated before in this paper) if not the theory of hybrids, at any rate the suggestion I have put forward that mutations were confined to the somatic or visible evolution, but that the germinal mutation was more gradual, or rather, the effect on the germ plasm was not marked as regards sterility till a much later stage, *viz.* after two or three mutations, which gives the appearance of a more graduating change in the same. As, however, all these evolutionary matters of varieties, species, and genera, of variants and mutants, appear to be mostly those of degree, it is not incomprehensible to expect more sudden changes at some times than at others, and it would not appear to be any reason that, because some mutations, as far as they are germinal, are sudden, supposition of the general tendency of gradual evolution of germ plasm is unsound, or any theories based on this of no worth whatsoever.

As far as my opinion is of value, this example of the Beetle *L. rubicunda* appears one of the most interesting facts that have been recorded of any mutants, and equalled only by the curious diverse results of those reciprocal hybridizing experiments mentioned by Darwin. Dr. Lloyd makes no special comment on this in his book ('The Growth of Groups'), although his other

examples of mutants, which appear to be chiefly based on variations of *Mus rattus*, are, as usual, quite fertile with the parent form.

I am unable to discover where a variant ends and a mutant begins, although one can understand the difference in the main. It appears probable that this ambiguity may be likened to the difference visible in white and negro, but indefinable in their cross-breeds, and also to the graduating difference between species where no line can be drawn.

If we instance Cebus Monkeys, Roan Antelopes, and Red Deer only, I think it will prove a matter of some difficulty to distinguish the mutants from the variants. There seems evidence to show evolution of these and similar wild forms by variation, as in domestic types.

How does the big ankle of the St. Kilda islanders arise? Also the long legs of the Dinka tribes? As mutations? I should imagine not. And are these not acquired? An argument in favour of acquired characters not being passed on is that of the non-transmission of docked tails in Dogs. This, however, is mere mutilation. Nature would hardly inspire the deprived parent, handicapped in its efforts to balance itself, to transmit such a deformity to its unborn young.

Although where Natural Selection gets a chance to work fairly (as conceived theoretically by the Darwinians), one might expect it to do its work and thus obviate the necessity for sudden mutations, it is possible it does not invariably get this opportunity.

The selection that goes on must depend much on chance, namely, disease, famine, battle, murder, and accident, with the best types perhaps killed off. At the best these must be liable to be modified by crossing with bad types, and thus the race in desperation may have to throw off sudden big jumps (mutations) of much better survival value in order to exist; in fact, to make the jump in spite of the selection it has undergone and not through it. Natural Selection must have a better chance of acting on big jumps (mutations) than on slight differences (variations).

Is it not possible that, whereas we may style such evolutions as change of colour from grey to black, absence of horns in

species previously horned (individual non-merging characteristics) as mutations, such evolutions as those of racial and merging characteristics one may count to be either variation or mutation, according as the difference is great or small, but with an indefinable separation line? In short, that there is but one evolutionary process at work, and that the rate at which this progresses must of necessity (to be in harmony with a more or less urgent environment) be of varying magnitudes, and hence may lead us into classifying these results as separate phenomena.

It may be of interest to mention the phenomenon of Independent Evolution, a possibility somewhat unconsidered. Dr. Lloyd, discussing the origin of the brown white-bellied type of *Mus rattus*,* surmises that they arise independently all over India, and are not due to one evolution which has migrated. I should imagine that this is a very reasonable deduction from the facts he mentions. I have at present some specimens of this brown type in my possession which were bred by Miss Frances Pitt † from black parents. It is impossible, however, to say if these were an original mutation, or whether mutation occurred previously at the place where the parents were caught (a floating hulk), or in the district in general (Plymouth). Moreover, a seaport is hardly a place to expect isolation. The matter, however, is interesting if only from the fact that this brown type is held to be specifically distinct, under the name *M. alexandrinus*.

A more trustworthy example of types separately evoluted is one given previously in connection with *Leptinotarsa rubicunda*, this type being produced independently from *L. multitæniata*, and, while sterile with its parent form, breeding congenially with a similar identical though unrelated (genealogically) species.

As groups or species appear to arise thus in several places, it follows it is not impossible that genera or families may do likewise, that is, the process might be continued, *pari passu*, to a greater extent, and this might account for curious geographical distribution, such as that of the Tapirs. Platyrrhine and Catarrhine Monkeys may be more widely separated than many

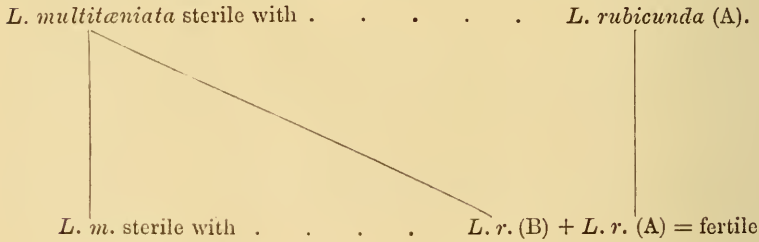
* 'The Growth of Groups.'

† 'National Review,' vol. lix. p. 862.

imagine, and this, judging from their great dissimilarities, may well be the case.

There appears to be no reason why evolution may not, even does not, act in a similar way on types closely allied or even somewhat divergent, and if the process is repeated (and it would be presumptuous to altogether deny the possibility of such a proceeding), one would get parallelism (and even perhaps convergence) carried out to a far greater extent than appears to be credited or even taken into consideration. In fact, the possibilities of this style of evolution are somewhat staggering, that is, if we can admit that there is perhaps an inherent potentiality in more or less similar forms to be affected by the causes of evolution to similar and somewhat similar degrees.

In this way kinship, or even germ plasm resemblance and fertility, need not depend on recent near blood relationship, and members of the same species might be unrelated in origin; to what degree of remoteness, it would be impossible to surmise.



In this way we have seen how one strain (B) of *L. rubicunda* is produced from *L. multitæniata* and sterile (partly) with this form, and on account of this, and also because the former is fertile with another independently evoluted strain (A) of *L. rubicunda*, it may be assumed this "A" strain is also sterile (partly) with *L. multitæniata* (this should be tested).

We have thus a case of convergence in *L. multitæniata* producing a form of *L. rubicunda* indistinguishable from and fertile with the original *L. rubicunda* strain. If this breeding had not taken place under observation in partial confinement, who would have felt inclined to admit the possibility of a genealogical tree similar to the above?

I have mentioned above that the supposed fertility between

E. zebra and *E. asinus* suggests that the former is more nearly related to the latter than to the other Zebras.

Some years ago it was pointed out by Mr. R. I. Pocock* that there were certain markings which are possessed by all the striped forms, generally referred to as Zebras, which are not found in any other of the *Equidæ*.

It has struck me that some such explanation as the following might be as permissible as such alternatives as that of these markings being caused by some peculiarities of the environment (such as are considered by some to induce these parallel cases), or that of being caused by mimicry.

Let us assume instead an evolution of the more specialized (?) rock-haunting forms, *E. zebra* and *E. asinus*, from intermediate types of Equines. Let us admit it as possible, if not probable, that *E. zebra* is a specialized form descended from some ancestral intermediate type, with medium hoofs, ears, tail, mane, &c., akin to the Quaggas, and with stripes and markings peculiar to Zebras in general. That in the course of this evolution there were independent strains from the ancestral type making towards the same goal; that is, that all the present tribe of *E. zebra* are not absolutely descended from one original Adam and Eve pair. This assumption would not be greatly in excess (as probability goes) of the facts noted in regard to the Beetle *Leptinotarsa*.

We shall here admit α and β strains to be one and the same species, for it is impossible to tell the difference between them, or which individuals belong to which strain, or even if there are two strains, or two hundred, or perhaps, in conformity with general opinion, only one. It is also quite easy to admit the probability of sterile hybrids between the specialized and ancestral forms.

Admitting, therefore, independent evolution of this description, we may proceed a stage further and suppose the presence, contemporaneously with the ancestral Quagga-like type, of another intermediate form, also with medium hoofs, ears, tail, and mane, but of uniform coloration and akin to the Onagers; the above two ancestral types being sufficiently allied and congenial to each other to produce fertile hybrids.

* 'Field.'

What is to prevent an evolution of this Onager-like type, under the influence of the same evolutionary duction that has been acting on the striped Zebra line, to specialize into *E. asinus*?

Condition 1 to be a physiological state, in which this condition is so congenial to the germ plasm of nearly related forms passing through it, that they, while under its influence, would so retain their relationship and germ plasm affinity that fertile hybrids would be produced between them.

Condition 2 is a physiological state after the evolution of these forms from Condition 1. One inducing a physiological condition congenial and necessary, let us say, to rock-haunting species, and one causing them to become infertile with the ancestral types left behind in a different physiological environment. These specialized (?) forms resuming their congeniality *inter se*, and again producing fertile young on their arrival at Condition 2, and after their passage through the evolutionary period (congeneric barrier).

We now arrive at the result that, speaking congenially (or even specifically or generically), *E. zebra* is nearly akin to *E. asinus*, and remote from the ancestral types, although retaining the Zebra markings characteristic of this type; and in so much this would meet facts similar to those put forward by Mr. Pocock.

I have said in the above sentence "even specifically or generically" we have admitted we cannot separate the "α" Zebra strain from the "β" strain, notwithstanding that they do not connect genealogically except through the ancestral Quagga-like type, then why should we disconnect *E. asinus* from them? Are we to separate the *E. asinus* type on account of a different coloration from the Zebra type, and classify it with *E. onager*, while we associate the "α" and "β" Zebra strains in one species, although they (the latter) are practically almost as distinct from each other as from the *asinus* strain? Is *E. asinus* to be taken from the evolutionary condition No. 2 and classed with animals of the evolutionary condition No. 1, when it has arrived at the same stage in evolution similar and congenial to the *E. zebra* strains?

I do not wish to imply here, by using the species I have in this illustration, that these Equines have been subjected to or

have gone through any such evolution as that portrayed above; I use them because they seem very aptly to illustrate a process which is not perhaps an impossibility in evolution, and that in some such manner as this it is perhaps permissible to look for the rather baffling discrepancies that arise in estimating nearness of relationship, and which hypothesis may be suggested by such possibilities as those of independent evolution.

There is a tendency to bring forward the discoveries of Mendel as refuting those of Darwin. I do not see any reason for this. One argument (against the latter) appears to be that, while the theory of Natural Selection accounts for the acceptance of the most adaptive form, there is no conceptive building-up principle or resultant in this to account for the new forms being brought into being. Darwin, however, definitely states that the external conditions affect the germ-cells slightly and affect their hereditary potentialities: this very feasible and likely supposition thus clearly producing variations, even if there were no Natural Selection to single out the best, consolidate and mould them.

This view of the case is very clearly put by Professor MacBride, who points out* that Mendel himself refused to investigate those characters which were of a "more or less" description.

It would appear, however, that while Mendel's work consisted in showing how two different races with different characteristics may, when crossed, transmit these qualities in different ratios, and how even new true breeding species or forms might be evolved by crossing these forms, certain followers of Mendel assert that these forms demonstrate the evolution of species. This, as Professor MacBride states, "brings us up against a blank wall"; as very evidently these cross races must be evolved from two already evoluted races.

There may be, of course, some examples of a new united race forming in nature as in artificial types, such as wheat (but then it must be from already evoluted types), but one may be excused if one imagines these instances to be rare, at least in the higher forms.

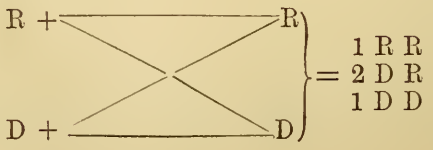
It would seem that the new species of this description are

* 'Zoology, the Study of Animal Life,' pp. 69–72.

very generally an artificially produced race of bastards (an unstaple race suggestive of and a precursor of the infertility of more evoluted crossings), certain forms of which are continually endeavouring to break back into the two parent types; these latter, indeed, being the only staple, true-breeding young of these mongrels. For instance, in what is styled the roan "hybrid" (in cattle), in the first mongrel generation, while all the offspring are of mixed roan type, at the fourth generation the mixed hybrids (roans) have decreased to 1 in 6 as against the pure ancestral types (reds and whites), while in the fifth generation they are 1 in 13, and in the sixth only 1 in 27, and so on. Mendelism in this appears only to no more than touch on the first signs, the fringe of evolution, and (to use a chemical simile) while the extreme form of species, such as Dog and Fox, may be looked upon as different chemical compounds, Mendelian new species may be said in comparison to be no better than mere mechanical mixtures; while as regards the more distinct forms, such as new wheats, as bred from two divergent natural types, there appears only an artificial bastard race which, contrasted with the naturally evoluted parents, can by no means be considered examples of evolution.

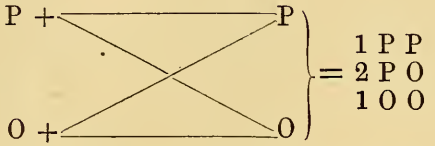
Where do we find in Nature any example amongst mammals of species thus evolving from any such process as the experiments of Mendel? We cannot definitely say. Take that gradually merging group, the Antelopes. Where is the Mendelian new form? Possibly only in the mongrel Cobus at the Zoo, and this perhaps not a true "Mendelian" hybrid. Moreover, those races which lend themselves to Mendelian experiment are chiefly those that (as shown by certain biologists) are deficient in some natural character. Thus the albino Mouse or Rabbit is deficient in colour, the dwarf pea is deficient in size, and so on. And thus, instead of the dominant and recessive characters of Mendel shown by diagram to be as follows :—

R R + D D = 2 R D and



the terms "present" and "absent" are often used, as might be shown by P and O, thus :—

P P + O O = 2 P O and



Several investigators have pointed out a difference in crossing various types ; that in some instances the characters follow the usual Mendelian laws and do not blend but segregate, while in other crosses the characters blend (as in equine Mules).

Whether non-segregating crosses will prove amenable to Mendelian interpretation appears a matter of considerable doubt. At present this difference in result appears of great importance, and it has been suggested that it is the non-segregating characters that one must look to for the conception of species (De Vries *). I do not gather, however, that this theory is accepted by Mendelians in general.

The idea occurs to one that the same Mendelian factors are carried through the generations irrespective of the fact that, let us say, the Horse is becoming more "horsey," or the Ass more asinine ; or whether it is a Horse or an Ass germ that carries them. The colour of an equine Mule, for instance, is perhaps acted on just as truly by the divergent parent factors as would be the case were these combining factors both from Horse (or Ass) parents ; they also no doubt affect such qualities as immunity to certain diseases, sex determination, &c. There appears, however, no factor for "horseness" or "assness," and one therefore inclines to the conclusion that, as Mendelism does not explain the intermediate forms resulting from the inter-breeding of two diverse species, it supplies no evidence of the evolution of these from a common ancestor. Should the formula for such crosses be discovered (if there be one), it would hardly explain evolution.

In reading the works of Professor Bateson † or Professor

* 'Mutationstheorie.' † 'Mendel's Principles of Heredity.'

Punnett,* one appears to get but little information on this point, that is, as regards the why and wherefore, as one does from Darwinism. Neither does one discover much regarding such matters as hybridism and relationship; that is, touching such details as I have raised in this paper.

Considering the abstruse cases which have, when brought forward as antagonistic to Mendelism, proved amenable to its laws, one hesitates to dogmatise unduly; still, there are cases which Mendelism apparently does not solve, and it is possible that, were experiments more general between divergent natural species (animals) instead of between domestic varieties, these incomprehensible (?) cases would be largely increased. As the matter is of considerable importance, I will quote some cases from the writings of Bateson.†

De Vries is stated to have found out that *Œnothera muricata* + *O. biennis* gives hybrids breeding true to the intermediate forms of the first crossed generation. Professor Bateson comments as follows ‡ :—

"The hybrids were partially sterile in a high degree, but the subsequent generations raised from them showed no definite departure from the F_1 type. The evidence as it stands must be taken as constituting a definite exception" [to segregation]. "Nevertheless, in view of the great sterility exhibited by the hybrids, and the fact that all that we know of the *Œnothera* crosses points to the existence of very unusual features in their genetic physiology, the significance of this curious observation is still somewhat problematical."

The fact that the hybrids are partially sterile is to my mind very suggestive, as it will probably prove to be to those who agree with my argument.

Other instances similar or somewhat similar to the above are found in *Homo* (Mulatto), *Lepus* (Lop-eared Rabbit), *Acidalia* (Moth), *Pararge* (Butterfly), and *Anemone* (plant). Want of space must preclude my referring to these cases at any length, except to state that they appear to support my argument.

It is regrettable that more experiments are not tried with the

* 'Mendelism.'

† 'Mendel's Principles of Heredity.'

‡ *Loc. cit.* p. 250.

higher animals (natural species). Most valuable animals for a test of non-segregating characters (and other matters besides) would probably be the hybrid Bears mentioned before in this article (hybrid Brown Polar, London Zoological Society).

It can hardly be denied that the presence of intermediate characters in divergent crosses (extreme species) suggests intermediate, and therefore merging, evolution, such as I have found evidence of in the results of hybridization which I have given on p. 28.

We are obliged to admit two cardinal points :—

(1) Mendelians offer no explanation as to these intermediate characters.

Thus : "In the phenomena of hybridization between the races of mankind the facts (fairly well-authenticated) must be taken as pointing at all events to the existence of special features in them." *

And, again, as regards dimorphisms in Lepidoptera (p. 257) : "The only other suggestion" [to the presence of factors] "which can be made is that these distinctions are ultimately referable to the effects of external conditions."

And, again (p. 285) : "Of the consequences of specific crosses in the stricter sense little is known, and no case has been fully explored. But before any decision at all is pronounced or even contemplated, the laws which govern the incidents of sterility must be most carefully determined."

On the other hand, we have the definite opinion on p. 289 : "The conception of Evolution as proceeding through the gradual transformation of masses of individuals by the accumulation of inpalpable changes is one that the study of genetics shows immediately to be false. Once for all, that burden so gratuitously undertaken in ignorance of genetic physiology by the evolutionist of the last century may be cast into oblivion."

This brings us up against our second cardinal point :—

(2) That we have the evidence of the development of many extreme types of the same domestic (and even wild) animal brought about by gradual divergence quite unconformable with any system of factors, as now propounded.

If I may make the suggestion, it appears to me that we must,

* 'Mendel's Principles of Heredity,' p. 257.

in order to reconcile these apparent contradictions (Mendelian and Darwinian), recognize that we are arguing about two entirely different matters, namely (*a*) the germ plasm evolution; and (*b*) the ornamental accompaniments of that evolution—the colour, hair, &c., of Mendelian investigators.

We must cast aside all endeavour to attach to such superficialities the index of true species (extreme). If we recognize the essential evolution as that of essence and germ, the difficulty of conflicting theories fades into insignificance.

Mendelians appear to suggest (or this is how I understand it) that the Horse and Ass contracting germs should contain certain factors in their Mules, some to account for the Horse points, and some for the Ass points. The inference from this is that otherwise they are to be held inalienable. To limit our view to the differences of factors alone appears to me to obscure the issue. The two combining entities must be considered as of quite divergent composition.

If we disregard this search for problematical factors, we can regard the cells (in all intermediate crosses) as exactly what they very probably are, namely, a composition of equal properties of both parents, entities of mingled physiological combination, and therefore of intermediate aspect. There is a hybrid Zebra-Ass at Regent's Park, and if this animal proves fertile, I cannot imagine that she would throw (to a mate of similar breeding) an Ass, a Zebra, and two impure somethings. Why should she? The answer appears obvious.

Let us assume that there be factors (bio-chemical), as may indeed be the case—there appears no reason why they should of necessity be segregating ones. If such a result is to be proved in all sperms, with no inherent specific diversity, there should apparently be no limit to any monstrous hybrid of any parentage, or how would sterility be accounted for? Chemistry of the organisms has unknown possibilities; it would appear hardly capable, however, of turning an animal whose organism is half Zebra into a homogeneous Ass.

Segregating characters are of necessity more incomprehensible than intermediate ones; there seems no need, therefore, for any assumption that the latter must be conformable to the same biological laws. The "presence and absence" theory

seems quite inapplicable to the evoluted and diverse types of extreme species. One appears able to detect, however, even in extreme crosses, features which suggest Mendelian interpretation, such as an assumption of the hybrid of the *outward appearance* (possibly nothing more) of the male parent. Thus Horse ♂ Ass ♀ cross appears about ¾ Horse, while Ass ♂ Horse ♀ cross seems, on the other hand, approximately ¾ Ass.

This is a well-known characteristic, but it is impossible to say what would eventuate if these forms were fertile. As these Mules are quite common, the matter would no doubt have been investigated but for their sterility. This, however, is unimportant, as there appear to be forms showing this tendency which are fertile, such as the hybrid Bears, Zebra-Ass, &c., mentioned above. It would almost appear that the male carries some factor for "form" which is perhaps absent in the female. The matter should be investigated by zoological societies, as mostly possessing the means and opportunities to carry on these experiments.

Darwin has been criticized for following a false track in advocating the theory of gradual divergence, and it is suggested that, had he known of Mendel's work, he might have altered his opinion. This is mere supposition.

Even if Darwin gave less heed to mutation than variation, the distinction is not important to my argument: a stair is a gradually ascending (or descending) plane, and our ascent is gradual even if, at intervals, we take two or three steps at a time.

Darwinism is said to have overshadowed and hidden Mendelism; the position now appears to be somewhat reversed.

When one remembers that the evolutionary idea was not wanting in the days of Aristotle and the ancients, and that many of the later discoveries are unconsciously fixed in the mind of the cowherd in the barton, it appears possible that the tendency is to apportion too much credit to later investigators than to those of former times.

My own deductions may be held to favour surmise to the detriment of systematism. Both tendencies carried to excess are no doubt undesirable.

While I venture to hope that the examples I have given may

protect me to a certain extent from being held to be merely a theorist, one might claim to find some support from the words of Vigors,* who, criticising the other extremist, writes:—

"It is upon the labours of man that he dwells, and not on the works of Creation. He dwindles, as it were, into a mere compositor of the volume of Nature, artificially putting together the symbolic words that should stand for ideas, while the ideas themselves in their true spirit and meaning escape him. And thus the exertions, which, properly directed, might have tended to explain the laws and elucidate the operations of Nature, which might have been devoted to a study purely intellectual, are lost in a pursuit which is strictly and exclusively mechanical."

I have personally not been able to get beyond the Unknown Power, be it natural or supernatural, in the evolution of species any more than in the evolution of worlds. The chief matters that seem to be definite and not pure supposition are the interesting facts concerning the microscopic discoveries that have been made in the composition of the germ cell as regards its nucleus and chronosmomes, and it is perhaps to further discovery in this direction that one might expect more facts to come to light bearing on the problem of the Relationship of Species.

Summary.

1. That there are practically two evolutions:—
   (*a*) Visible and Corporeal.
   (*b*) Invisible and Essential.

And while they are both never out of harmony, we are by no means always able to estimate from the visible aspect of the former (*a*) the degree of evolutionary progress attained by the latter (*b*).

2. That the blood and germ affinity may change without loss of structural resemblance (*a*).

3. That the form of animals may change without loss of relationship (*b*) [blood and germ affinity].

4. That where these two evolutions cause apparent anomalies, or point to opposite conclusions, habits which are congenerous

* Quotation from 'Cassell's Natural History.'

in any of the forms are of value in probably showing the true relationship, and might be considered important enough to turn the scale in this direction.

5. That parallelism and convergence may take place as regards structure (*a*).

6. But that whether these two tendencies of evolution take place as regards the bringing together of divergent germ plasms (*b*) is perhaps not quite so apparent.

7. That the facts brought to light concerning the separate evolution of similar forms suggest parallelism to a wider extent than has been credited, and may alter our conception (genealogically) of the Relationship of Species.

8. That, while segregating characters in hybrids appear of varietal value, intermediate ones suggest evolution of species.

THE PHARYNGEAL TEETH OF FISHES.

By Colonel C. E. Shepherd (Indian Army).

(Continued from vol. xvii. p. 389.)

Amiidæ.

Amia calva (the Bowfin), found in the rivers and lakes of North America. This fish is one of those that makes a rude nest amidst the roots of swamp vegetation, in which its eggs are deposited, and over which the male fish keeps guard. It has fourteen short upstanding gill-rakers on the first cerato-hypobranchial arch, in length the longest is about half the depth of the gill-lamina below it. There is a set of similar gill-rakers on the inner side of this branchial arch. There are three similar gill-rakers on the first epibranchial, with two rudimentary ones at the top. The gill-rakers on the cerato-hypobranchial arch decrease in size till they become very small at the end near the tongue. The other branchial arches all carry a double row of similar but smaller gill-rakers, and all the gill-rakers bear minute teeth. For the upper pharyngeal teeth there are two very small points at the top of the second epibranchial which carry defined teeth and below these there is a little roughness on the surface of the epibranchial. The third and fourth epibranchials support a triangular shield with the apex upwards, of cardiform teeth. The lower pharyngeal teeth are set in two small elongated triangles.

Lepidosteidæ.

Lepidosteus osseus. A freshwater fish of North America, colloquially known as the "Long-nosed Gar Pike," a voracious fish preying largely on smaller fishes. It has eleven flat tubercle gill-rakers on the first cerato-hypobranchial with six on its epibranchial; and the same kind on the outer sides with smaller and more numerous ones on the inner sides of the second and third arches. The inner side of the first and the outer side of

the fourth arch have tubercles also. Along the top of the hypobranchials where they join the basibranchials and for a short distance there are minute teeth on the four arches, they are so small as to be discovered more by the feel of resistance they give than by sight. At the top of the second epibranchial there is a small group of minute teeth representing the upper pharyngeal teeth.

ELOPIDÆ.

Megalops atlanticus (the Tarpon) frequents the Atlantic Ocean along the south-east coasts of North America and the West Indies. A fish much prized by wealthy fishermen who can afford to go across the ocean for the pleasure and excitement of catching it. It is called the "Cuffum" at Demerara. This fish has forty-four long horny gill-rakers on the first cerato-hypobranchial arch, that decrease in size very gradually as they approach the basibranchials. The longer ones near the angle are about a third longer than the gill-laminæ below them. There are twenty-two on the first epibranchial. All the gill-rakers are toothed on the inner side so that they cling to the finger if it is brought against them from base to tip. The outer sides of the second, third, and fourth arches carry horny gill-rakers of the same pattern as those on the first arch but much shorter. The inner margins of the branchial arches have no gill-rakers except the fourth which has short tubercles which fit into larger tubercles on the outer side of the fifth arch. The top of the branchial arches, and the top of the basibranchials, and the epibranchials and lower pharyngeal bones are all covered with villiform teeth feeling like moderately coarse sandpaper, and these extend on to the tongue.

Elops saurus, found in tropical seas; the specimen examined came from Madras. This fish has twelve long horny gill-rakers on the outer side of the first cerato-hypobranchial, the longest about equal to the depth of the gill-laminæ below it, with eight long horny gill-rakers on the first epibranchial arch. There are no teeth on these gill-rakers. The outer sides of the second, third, and fourth arches carry horny gill-rakers, decreasing in size as they belong to the inner arches. The inner sides of the three inner arches also have small tubercles rather distantly spaced. The head of the second epibranchial and the upper

pharyngeal bones are covered with minute cardiform teeth. The lower pharyngeal bones have similar minute teeth. There is a rough surface on the basibranchials and tongue.

Albulidæ.

Albula conorhynchus, a fish that swims in tropical seas; the specimen obtained came from Java. It has eight tubercle gill-rakers on the first cerato-hypobranchial and four on the first epibranchial. Similar tubercles are on the inner and outer sides of the other arches that bear gills, all these tubercles bear teeth. There are minute teeth in two patches on the heads of the third and fourth epibranchials that run down on the limb of the third and are confluent at the upper part of the arches. The patch on the fourth is fairly large. There are a few minute teeth for the lower pharyngeals. Minute cardiform teeth are found running from the base of the tongue along the surface of the basibranchials, they seem fixed to the skin, some of them have been rubbed off. The hinder larger part of the tongue has granular teeth on it that show very clearly. Fig. I., 1.

Notopteridæ.

Notopterus afer from the Gambia River has seven long horny gill-rakers on the first cerato-hypobranchial arch with one rudimentary one; these are toothed; there are three on the epibranchial. The longest is about one and a quarter times the length of the gill-lamina below it. There are short horny gill-rakers on the other arches. The upper pharyngeal teeth consist of a small group on the head of the fourth epibranchial of villiform teeth. The lower pharyngeal teeth are in two small groups of similar teeth. A long broad plate of minute cardiform teeth extends from the base of the tongue to the junction of the third arch with the basibranchials. The tongue is provided at its extremity with a recurved sharp conical tooth, there is a longitudinal groove in the mucous membrane of the tongue with six side grooves on each side, in each of the side grooves is a similar tooth, and by pressing this mucous membrane down, the teeth can be easily seen. In the illustration this membrane has been cut away to expose the teeth. Fig. I., 2. There is also a group of teeth on the parasphenoid bone.

Notopterus chitala, a fish found in the rivers of India, has eight long horny gill-rakers with two rudimentary ones on the first cerato-hypobranchial and three on its epibranchial. They all bear teeth. The longest equals in its length the depth of the gill-laminæ below it. The one at the angle is very short. Similar but smaller gill-rakers are on the other arches, they get shorter as they belong to the more inward arches. The insides of the arches have short upstanding gill-rakers fitting into the

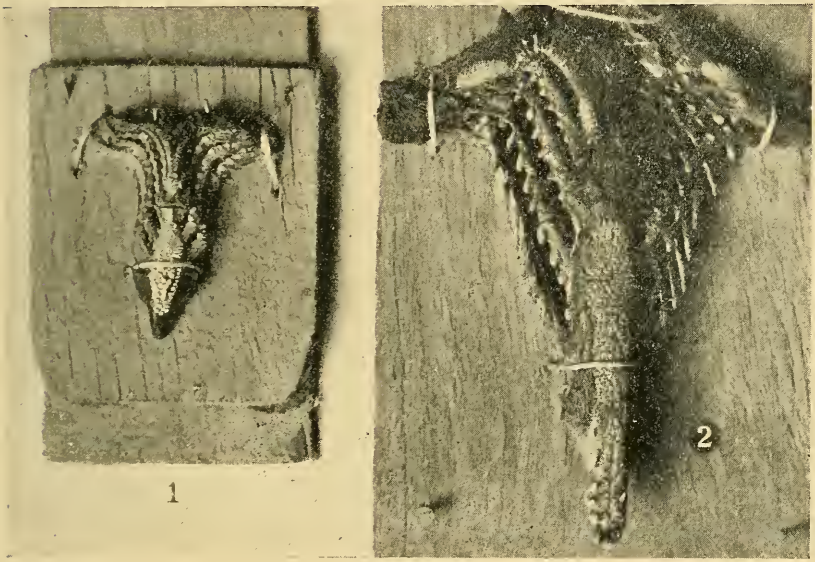


FIG. I.

1.—ALBULA CONORHYNCHUS. 2.—NOTOPTERUS AFER.

opposite ones and making a good filter. The upper pharyngeal teeth are represented by a small group of minute cardiform teeth on the heads of the third and fourth epibranchials. The lower pharyngeal teeth are in two long plates of minute cardiform teeth. A long plate of minute villiform teeth covers the forward basibranchials. There are five backwardly curved teeth along each edge of the tongue, with one at the tip with sharp points. This one and the next two on each side are strong, the other three each side are smaller. At the base of the tongue and lying between the marginal is a group of short but strong

cardiform teeth. The stomach held scales and vertebræ of some fish that had been eaten. No teeth on the parasphenoid. A deep cleft in mucous lining of palate.

Notopterus kapirat, also an Indian river fish, has nine long horny gill-rakers on the cerato-hypo portion of the first branchial arch. The one at the angle is short, about one half the length of the next one to it, which is one of the longest and is one and a half times in length of the depth of the gill-lamina below it. There are three gill-rakers on the first epibranchial. The gill-rakers of the first arch are toothed. The other gill-rakers are short, stout, blunt-ended on the outer sides of the other arches, with smaller blunt-ended ones on the insides. None of them bear any teeth. They fit into each other and form a good filter. On the head of the fourth epibranchial some minute teeth can be felt forming the upper pharyngeal teeth. No lower pharyngeal teeth could be seen or felt. Forward from the junction of the third hypobranchial with the basibranchial, to the base of the tongue, there is a long plate which covers the forward basibranchials bearing minute teeth ; these engage with an elongated group of strong conical teeth on the parasphenoid bone. Five strong curved teeth line each margin of the tongue, with one at the tip. There are no teeth at the root of the tongue, as in *N. chitala*. The stomach of the specimen examined was full of food. Amongst it was a fairly large piece of what looked like the shell of a crustacean, and another piece looking like a fragment of some insect.

Chirocentridæ.

Chirocentrus dorab has fifteen long, thin, horny gill-rakers on the first cerato-hypobranchial arch, which are toothed. The longest, the one at the angle and the one next to it, are about equal to the depth of the gill-laminæ below them; these gill-rakers decrease regularly in size as they get nearer the tongue. There are four similar but smaller gill-rakers on the first epibranchial arch. On the inner sides of the first and of the other arches there are minute teeth. The outer side of the second arch has shorter and flatter horny gill-rakers than those on the first arch; these are also denticulated. The third and fourth arches are bare of gill-rakers. There are small cardiform

teeth on the upper surface of the first four arches. There are two small groups of cardiform teeth on the heads of the third and fourth epibranchials for upper pharyngeal teeth. The lower pharyngeal teeth are in a long, narrow V shape of sharp cardiform teeth. The surface of the basibranchials has small cardiform teeth.

SALMONIDÆ.

Salmo salar (the Salmon) has thirteen short horny gill-rakers on the first cerato-hypobranchial arch, with eight on the epibranchial. The longest about a third the depth of the gill-lamina below it. They all bear teeth. There are only three minute gill-rakers on the inside of the first arch and these are placed at the end near the tongue. The outer edges of the other arches are furnished with similar but smaller gill-rakers to those of the first arch. The second arch has five minute gill-rakers on its inner side at the tongue end. The third and fourth arches have them both sides all along. The upper pharyngeal teeth consist of a very few small cardiform teeth along the upper part of the third epibranchial, and rather more and larger teeth on the upper part of the fourth epibranchial, but even there these teeth are small. In neither case are they arranged in such a dense group as is so common in other fishes. The lower pharyngeal teeth consist of, similarly, a few cardiform teeth, those nearest the œsophagus being fairly large. The tongue has teeth on it.

Thymallus vulgaris (the Grayling), an altogether fresh-water member of the family, living in rivers, has twenty-two long, thin, horny gill-rakers on the first cerato-hypobranchial arch, with thirteen on its epibranchial. All these gill-rakers are toothed. The longest is about half the length of the distance from the angle to the junction with the basibranchials. They decrease in size very quickly but very uniformly to each end from the angle. There are numerous thin horny gill-rakers on the outer edges of the other branchial arches, but none of them have gill-rakers on their inner faces. No pharyngeal teeth could be made out in the specimen examined.

Salvelinus willughbii (the Charr), from Lake Windermere, has fifteen moderately long horny gill-rakers on the first cerato-hypobranchial arch with six on its epibranchial. The longest

about half the depth of the gill-lamina below it. The other arches have short gill-rakers on the outer sides only. The first and second arches show some small papillæ-like excrescences on their inner sides. The upper and lower pharyngeal teeth are very minute and cardiform. There is a small set on the heads of the third and fourth epibranchials, and on the lower pharyngeal bones they require to be looked at with a microscope to be fully realized. A row of teeth runs along the tongue to the opening of the second gill-slit.

SYMBRANCHIDÆ.

Amphipnous cuchia, an eel-like Indian fish, furnished with an air sac on each side of its neck, enabling it to breathe atmospheric air directly and so live comfortably out of water for some time. Has only three branchial arches and no gill-rakers. The upper pharyngeal teeth are in a circular group on the head of the third epibranchial arch. They are so much embedded in mucous membrane as not to be easily seen, but are quite palpable to the touch if a finger-tip is pressed against them. In a similar way cognizance can be taken of the existence of lower pharyngeal teeth.

APODES.

Anguilla vulgaris (the Common Eel) has no gill-rakers. The upper pharyngeal teeth are represented on each side by an oval patch on the head of the fourth epibranchial of minute cardiform teeth. Two long narrow slips of similar teeth form the lower pharyngeal teeth.

Conger vulgaris (the Conger Eel) has no gill-rakers. The upper pharyngeal teeth are in a triangular group on the heads of the third and fourth epibranchials, and are cardiform teeth; the group is broad at the base, narrow at the top. The lower pharyngeal teeth are similar, but set in two elongated plates.

Myrus vulgaris, from the Mediterranean, has cardiform teeth for the upper and lower pharyngeal teeth. The lower on two long broad plates, and the upper in fair-sized groups. Fig. II., 2.

Muræsox talabon (the "Koolarie" of the Tamil fishermen of Madras) has no gill-rakers. The upper pharyngeal teeth in two long narrow plates, 1·1 in. by ·3 in. of small cardiform

teeth, those on the inner edges being a little larger than the others. The lower pharyngeals in two long narrow plates a little longer than those of the upper, but only two-thirds of their breadth.

MURÆNIDÆ.

Muræna helena, common in the Mediterranean and occasionally met with on the south-west coast of England, has no gill-rakers. The upper pharyngeal teeth are on a long narrow plate attached to the head of the fourth epibranchial, and are

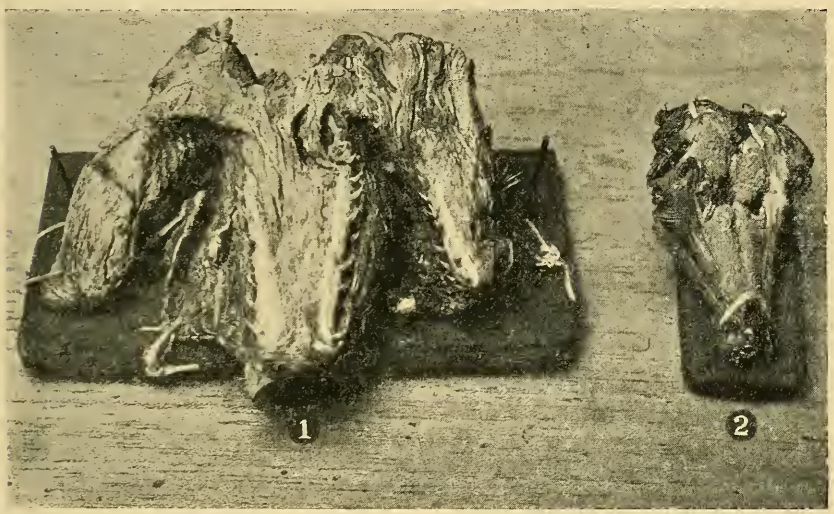


FIG. II.
1.—MURÆNA HELENA. 2.—MYRUS VULGARIS.

strong, sharp, cardiform teeth in a single row. The lower pharyngeal teeth are similarly strong, sharp, cardiform teeth arranged partly in a double, partly in a single row. Fig. II., 1.

ESOCIDÆ.

Esox lucius (the Pike) has no gill-rakers, the surface of the cerato-hypobranchials being covered with minute teeth; a few extend also up the epibranchials. The upper pharyngeals are in two long plates, but sparsely supplied with small cardiform teeth. The lower pharyngeal teeth are in two rather broad patches of similar but smaller teeth. There is a long patch of minute teeth

on the tongue and forward part of the basibranchials, also a small ovoid patch on the junction of the third and fourth hypobranchial with the basibranchials. This fish is a voracious feeder; fish, frogs, young of waterfowl, water rats, &c., form its prey, and the small number of pharyngeal teeth would seem inadequate for disposing of its food, did one not take into account the formidable amount of teeth on its palatines and vomer.

Scopelidæ.

Scopelus punctatus has seventeen long horny gill-rakers on the first cerato-hypobranchial, the longest about twice the length of the gill-lamina below it; there are six gill-rakers on the epibranchial. The other branchial arches have gill-rakers on both sides, those on the outer sides being larger than those on the inner sides, but none are as long as those on the outer side of the first arch. The upper pharyngeal teeth show as two plates with cardiform teeth, with a strip of mucous membrane separating them. The lower pharyngeal teeth are very minute and very scanty.

Cyprinodontidæ.

Haplochilus playfairii has twelve little horny gill-rakers on the first cerato-hypobranchial arch, with two on the epibranchial, the other arches have similar but smaller gill-rakers each side that fit alternately into one another, forming a good filter. The upper pharyngeal teeth show as two circular patches of cardiform teeth. The lower pharyngeal teeth are on two triangular plates.

Anableps tetropthalmus (the "Four eyes" of Demerara) has twenty-one horny gill-rakers on the first cerato-hypobranchial arch, the longest in length about half the depth of the gill-lamina below it. No gill-rakers on the epibranchial. There are horny gill-rakers on the inner and outer sides of the other arches which have a thickening at their roots, they fit in alternately and form a close filter. There are two patches each side, of upper pharyngeal teeth and a small narrow patch on the head of the second epibranchial. The teeth are strong cardiform teeth in the upper patch and on the head of the second epibranchial, the lower patch in its upper portion has small cardiform teeth with villiform teeth in its lower. The lower margin of the lower

patch stands away from the mucous lining of the mouth. The lower pharyngeal teeth are on an arrowhead-shaped patch, the right and left halves touching closely along the middle line where there is a double row of strong conical teeth, the rest of the surface being covered with minute teeth that have black points.

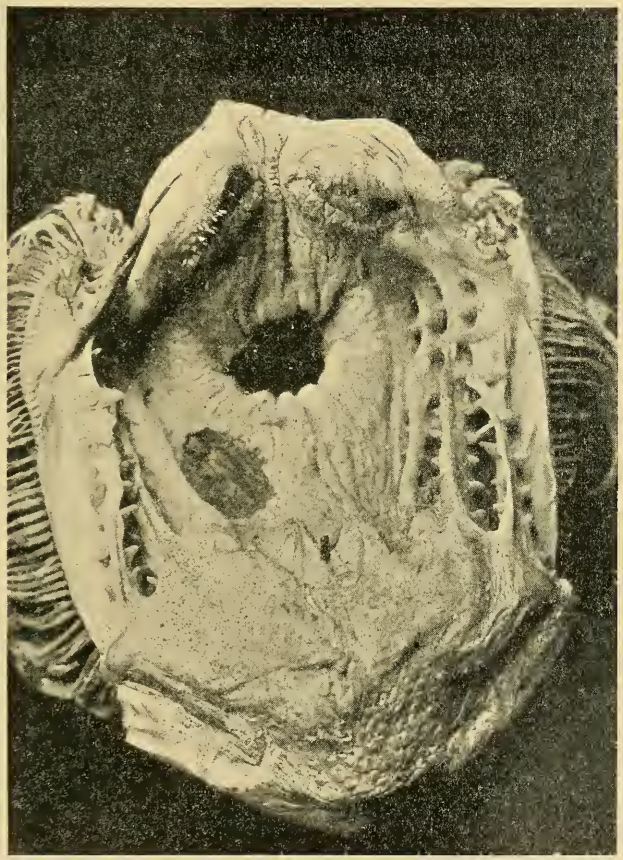


FIG. III.—CYCLOPTERUS LUMPUS.

CYCLOPTERIDÆ.

Cyclopterus lumpus (the "Lumpsucker," also called "Cock and Hen Paddle") has eight tubercular, conical-shaped, soft gill-rakers on the first cerato-hypobranchial arch that are irregularly spaced. The biggest one, at the angle, is in height

about a third of the depth of the gill-lamina below it. The inner side of the first and both sides of the second and third arches have conical tubercle gill-rakers. All these tubercles are soft and distantly spaced from each other, so they do not make a close filter. There are only four branchial arches. The upper pharyngeal teeth are in a long patch, broader at the top than at the bottom; on the second and third epibranchials these teeth are cardiform. The lower pharyngeal teeth are in two small elevated lumps at the forward end of the fourth arch and very far forward from the œsophagus, and are strong cardiform teeth. (Fig. III.) A small piece of black paper was put between the two sets of the lower pharyngeal teeth, before the photograph was taken, to facilitate locating them; they are to be seen to the right and left of this little black mark.

(To be continued.)

NOTES AND QUERIES.

AVES.

Nesting of the Golden-crested Wren (Regulus cristatus).—April 2nd, 7 a.m. A pair commenced nesting in a small Douglas fir-tree in my garden. The nest only 3 ft. 6 in. from the ground.

April 13th. Lining nest with feathers.

April 21st. First egg laid.

April 28th, 3 p.m. Eight eggs and not yet incubating.

April 29th. Clutch of nine eggs and female sitting close, until almost touched with my hand.

May 8th. Eight eggs only now in nest.

May 13th, 7 a.m. Eight eggs. 5.30 p.m. One young, seven eggs.

May 14th, 7 a.m. Three young, five eggs. 7 p.m. Five young, three eggs.

May 15th, 7 a.m. Six young, two eggs. 7 p.m. Seven young, one addled egg.

May 16th. Six young alive, one dead.

May 31st, 12 p.m. Young still in nest.

June 1st, 12 p.m. All have now left the nest.

From the above notes the building of nest takes eighteen days. Incubation fourteen to sixteen days. Young remain in nest sixteen to nineteen days.—J. Steele Elliott (Dowles Manor, Salop).

Nesting of the Reed-Warbler (Acrocephalus streperus).—On June 9th I found a Reed-Warbler's nest with four eggs, and took one for a young friend. It proved to be quite fresh, so I visited the nest again on the 12th for the chance of finding a Cuckoo's egg. The nest then looked like a new one, hardly completed, as some of the material was quite green, and I found two eggs hidden under a fresh lining; the third I could not find. The Reed-Warbler is a curious little bird in its domestic arrangements, and its nests sometimes disappear under conditions which rather convey the idea that the owners have pulled them to pieces and rebuilt them in another place.

P.S.—Referring to the above note posted a few days ago, the birds have completed the nest, which I fear I rather pulled about in getting at the covered-up eggs, and the hen is sitting on four eggs. I have never seen a case like it before.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds).

Curious Nesting-sites of Chaffinch and Blue Tit.—On May 15th last I found a nest and eggs of the Chaffinch in Turvey Park, built on the side of a wheat-straw stack in the rick-yard. The nest had been woven around a number of the straws, which kept it securely in position. The site was purely a matter of choice as there are plenty of trees and bushes in the vicinity. At Southill Park, also in Bedfordshire, on June 2nd, noticing a Blue Tit leave a Wren's nest that had been built in the fork of an elderberry bush alongside the ride of a plantation, I found the former species in occupation and sitting on a small clutch of eggs. Evidently it had deserted some previous nesting-site, as no materials appeared to have been added to the nest whatever, not even for a lining.—J. Steele Elliott (Dowles Manor, Salop).

Starling and Mouse.—On June 19th, while walking along a foot-path dividing a ploughed field from a wood, I noticed, a short distance ahead, a Starling acting in a strange manner. It had possession of some living object of comparatively large size, with which it seemed at a loss to know how to deal. The bird kept taking this up in its beak, putting it down again, and pecking savagely at it, and was apparently in a very excited state. It seemed very loth to leave its prize as I approached, and tried to carry it off, but, finding it too big and heavy, was obliged reluctantly to fly away without it. The object referred to proved to be a young Mouse (*Mus sylvaticus*), at least a fortnight and more probably three weeks old, it being already covered with short fur. In spite of this rough treatment, the little animal appeared to be very little if at all hurt. This is the only instance I have met with of a Starling attacking a mammal.—G. T. Rope.

Food of the Little Owl (Athene noctua).—To show the diversified prey of this species of Owl, I give a list of the contents taken from a nest in a pollard willow tree at Turvey, Bedfordshire, on June 28th last; the nest contained but one young one:—Six adult and two half-grown Common Field Voles (*Microtus agrestis*), four of which were more or less eaten, the head portion of these having been devoured first; one adult and three young Common Shrews (*Sorex araneus*), one partly eaten; five Frogs, which included the hind legs only of three adults with two smaller Frogs; remains of a fully-grown Blackbird and one immature Thrush, probably taken from a nest; with a number of elytra of beetles. In a hollow of the next willow tree was the headless body of a fully-grown Thrush.—W. J. Elliott (Dowles Manor, Bewdley).

The Redshank in Norfolk Marshes. — Writing respecting the increase of the Redshank (*Totanus calidris*) in our marshes, alluded to in the "Ornithological Report for Norfolk" (*ante*, p. 169), Mr. J. Vincent mentions having this spring found thirty-five nests (of which the earliest was on April 15th), which is certainly a very satisfactory state of things. He has never in his long experience found a nest with eggs earlier than April 7th, and consequently expresses some incredulity as to young Redshanks being able to fly by April 25th, as reported last year (*ante*, p. 169) on the authority of Mr. Chasen. Certainly in that case they would have had to be hatched about April 1st, which is unprecedentedly early. May I take this opportunity of correcting my mistake pointed out by the Duchess of Bedford (*ante*, p. 175), where, by an oversight, the name Lesser Tern is made to do duty for a Common Tern feeding its young one. From the principal Norfolk breeding-place of these birds also a very good report came to hand from Sir T. Digby Pigott at the beginning of the month (June 5th), and it is hoped the young will not again die for want of Whitebait as they did last year.—J. H. Gurney (Keswick Hall, Norwich).

Destruction of Vermin in Bedfordshire.—It is evident that, with the continued increase in game preserving, the destruction of so-called "vermin" will considerably alter the present status of many species, and it would be of interest if "vermin accounts" from any considerable areas of shooting could be published. The following list is from an estate of 2000 acres in the parish of Turvey, Bedfordshire. Previous to 1912 no strict preserving had been carried on for several years, and this accounts for the unusual number of vermin accounted for on so small an acreage:—

1912.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Stoats			2	5	1	9	7	4				4	32
Weasels ..		7	13	5	7	13	20	12	3	3		2	85
Cats.....			5	4	2			5				2	18
Rats.....		5		13		7	12	9	1	4		13	64
Hedgehogs		1		3	5	1	3	3				1	17
Hawks ..			1	1	4	1	2	1	1	1			12
Owls			4	8	2	2	11	7	3	4			41
Crows				2	3								5
Rooks				4									4
Jackdaws .				1	6	2	1						10
Magpies ..				13	9	10	3						35
Jays.....		7	3	7		7							24
													347

1913.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Stoats		1					3	2	1	1	2	4	14
Weasels ..		3	5	2	5	5	6	11	13	7	3	1	61
Cats.....		5	8	5	3	1	1			2	2		27
Rats.....		18	6	8	6	3	3	3	7	9	3	4	70
Hedgehogs				3	2		1	2	3	11	4		26
Hawks....				1				1	2				4
Owls*			2				2	4	5	8	3		24
Crows													
Rooks													
Jackdaws .					2								2
Magpies ..			3		3	3		1					10
Jays.....				1	1	4							6
													244

In 1913 an assistant keeper was also employed, but a detailed list was not retained, but an additional one hundred and sixty-two "vermin" were destroyed by him. The considerable destruction of Owls is regrettable, probably three-fourths of those killed being Little Owls. Tawny Owls, Barn Owls, and Long-eared Owls all met a similar fate. Of the Hawks, the Kestrel and Sparrow-Hawks would be about equal in the numbers destroyed. These accounts I know are often difficult to procure, as it is very seldom on shooting estates that the law is strictly adhered to, and many protected species are wilfully slaughtered, and I regret to think that that abominable and illegal means of destruction, the "pole-trap," is still freely used.—J. Steele Elliott (Dowles Manor, Salop).

Notes on Nest-boxes.—The Tawny Owls which have nested in our church-tower for several years past deserted the place this year after the second egg was laid, but I have every reason to believe that they hatched off successfully on the property adjoining the churchyard, where they are strictly protected. Our own pair occupied an old cask in an elm close to the house, and brought off three young ones. One of these when in the down was much more yellow than the others. An old kettle was twice occupied by Robins, but the second brood were destroyed by a Rat or other marauder. In our boxes we had the Great Tit, Blue Tit, Coal Tit (one), Marsh Tit (one,

* I have a note, May 4th, 1913, counting nineteen Little Owls and twenty-six Magpies, all recently killed, hanging on one of the "keeper's gibbets," and on a later date four Tawny Owls and one Barn-Owl hanging alongside the ride opposite a pole-trap.

and only the second nest of this species we ever had in a box), Nuthatch (one), Tree-Sparrow (many), Starling, and Stock-Dove. The last-named bird seems on the increase here, as they have occupied four boxes. One sitting bird I think came to grief, as I found a great many feathers in the box one day, and two deserted eggs about half incubated. Possibly a Tawny Owl was the aggressor, but our pair here have always been very peaceable with human beings. When spring-cleaning the boxes early in the year, I found in one which had been occupied two or three times over by Stock-Doves last year enough "guano" to give a dressing to a bed of aquilegias, which did remarkably well on it. On June 10th I was looking at a box and heard a humming inside, which I put down to a bee. However, the tenant proved to be a large queen Hornet, which had begun a nest there, and made it up to about the size of an oyster-shell. It is needless to add that both nest and owner were promptly destroyed. To find a Bat in a box is not uncommon, and one which we found one evening was a source of great delight to some young friends who had never seen one in the hand before. He was, I think, a Pipistrelle; we put him back in his retreat, and I believe I found him again in another box about a month later. We used often to find Great Bats in boxes, but have not seen one for some years. This year we had hoped to add the Jackdaw to our list of box-breeders, but the two pairs which nested about the place both preferred hollow beeches. As for several years past, Redstarts and Wrynecks have been absent; Swallows and Martins more abundant than usual.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

NOTICES OF NEW BOOKS.

Field-Studies of some Rarer British Birds. By John Walpole-Bond. Witherby & Co.

This is one of the most interesting of all recent books on the birds of the British Archipelago. As we read these pages we are with live birds themselves in their natural environment, the intricacies of a revised nomenclature are quite unimportant, classification is forgotten, we are not out for skins but for facts in avian economy, eggs are observed—not clutched. Some of the records, of course, are not unfamiliar to field ornithologists, but very many are quite original and hitherto unrecorded, while *en masse* they will greatly encourage and enrich the annals of "bird-watching." The suggestion that Crossbills may in some instances be triple-brooded will be new to many, and so also will be the fact "that in *hard* springs (or rather late winters) Ravens are apt to be forward with their domestic affairs, in *open* seasons, backward."

Seventeen birds afford the material for eighteen chapters, and we hope that Mr. Walpole-Bond will publish some more of his notes (which he undoubtedly possesses) on other British birds.

The Naturalist at the Sea-Shore. By Richard Elmhirst, F.L.S., Superintendent of the Marine Biological Station, Millport. Adam & Charles Black.

This is a recent volume of the series of books published under the comprehensive title of "Peeps at Nature," and is written by one who, as superintendent of a Scottish marine biological station, is master of his subject. Such a book is very opportune at this season of the year, and should be in vogue among seaside visitors who feel an interest in the plant and animal life of the coast line they may frequent. These pages contain a great deal of zoological information, which is not only

realiable but may be readily understood by the ordinary beach reader, and contains thirty-seven illustrations, of which eight are coloured full-page plates. At the small price charged for the volumes of this series nothing more can well be desired or expected.

EDITORIAL GLEANINGS.

"Enquiries made by Mr. Dudley Le Souef, Director of the Zoological Gardens in Melbourne, in regard to Eels in New Zealand have brought several notes from correspondents. Mr. Le Souef expressed a wish that those who accused Eels of eating Trout had found Trout inside the Eels caught, as otherwise the evidence against the Eels could hardly be regarded as conclusive. Mr. J. Finlay, of Tokaora, Hawera, writing on March 17th, now supplies the evidence Mr. Le Souef asks for. 'My farm,' Mr. Finlay states, 'has a frontage of about fifty chains on to the beach in the South Taranaki Bight, and is close to the mouth of the Waingongoro River. Complaints reached the custodian of the South Taranaki fishponds that the lower reaches of this river were nearly depleted of Trout, although only a few years previously large quantities of Trout had been liberated in it. The custodian, Mr. Moorehouse, came to my house one forenoon with an Eel he had caught. It was 4 ft. 9 in. long and weighed 10½ lb. When we opened it we found a whole Trout, quite fresh, which turned the scale at 1 lb. 15 oz. The Eel also contained about half another Trout, partly digested, which probably would have weighed about 2 lb. Each Trout had been swallowed head first.' Mr. Finlay adds that it is admitted on the South Taranaki coast that large Eels swallow Trout. About the same time two men who were fencing for him fished for Eels in the same river one night. They caught twenty-six Eels, weighing from 2 lb. to 5 lb. each. The Eels were opened in order to discover if small Eels as well as large ones eat Trout, but no Trout were found in any of them.

"An adjoining farmer constructed a farm about seven acres in area. It was stocked with young Trout, which thrived for a time, but then gradually disappeared. One day the farmer's sons caught in the dam an Eel that weighed 32 lb. As it was given to Maoris, Mr.

Finlay was not able to discover what was inside it. The evidence against it, therefore, is inconclusive. The dam was stocked with Perch, which were very successful. Later on, as land in the district, being used for dairying, became very valuable, reaching from £70 to £80 an acre, the water was let out of the dam, and the custodian of the local hatcheries was able to rescue a large number of yearlings and large fish, up to 6 lb., for stripping. But when the water was released not a single Eel was caught in the dam or seen in it. If Eels eat Trout, Mr. Finlay asks, do Perch eat Eels?

"Further evidence is supplied by Mr. A. W. Babbage, of Hauturu, Kawhia. He states that about seven years ago an Eel weighing 7 lb. was caught in the Kaimango stream by Mr. F. Pearson. Inside there were two Trout, one 10 in. long and the other 12 in. The smaller one was slightly digested, but the larger one was quite fresh, and, evidently, had been swallowed only a short time previously. Mr. H. P. Washbourn, of Port Nelson, has entered with great vigour into the discussion in regard to the breeding of Eels. He has sent to Maoris and Europeans in the dominion a circular containing a number of questions. All the men to whom the circular has been addressed have had many opportunities for observing the habits of Eels. Mr. Washbourn feels that their replies will be at least interesting records, and he believes that they will show that the lives and habits of New Zealand Eels are not settled by the lives and habits of Eels in the Old Country."—'Lyttleton Times,' April, 1914.

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THE ZOOLOGIST

No. 878.—August 15th, 1914.

GENERAL REMARKS ON SOME POINTS IN THE LIFE-HISTORY OF THE SALMON, AND A CONTRAST OF ITS OVIPOSITION WITH THAT OF A FEW OTHER TYPES OF TELEOSTEANS.

By Prof. McIntosh, M.D., LL.D., F.R.SS. L. & E., Gatty Marine Laboratory, University St. Andrews.

Few fishes, either now or formerly, have attracted more attention than the Salmon, for it is conspicuous alike by the beauty and symmetry of its form and the celerity of its movements, which are seen to advantage in the clear currents of the rivers which it periodically haunts. But both the naturalist and the anatomist might have celebrated its physical perfection in vain if there had not been other qualities which enhanced it in the estimation of man, such as the rich nature of its muscle as food, its high price, and the zest with which it is followed for sport—all which have brought it continually under the eyes of experienced observers, and thus information concerning it has been extended in a remarkable degree.

The Salmon is essentially a fish of the present waters, for it goes no further back than the Pleistocene times, and, as a bony fish, it is characterised by the occurrence of fins with soft rays and of one (the adipose or "fatty" fin) without any, its simple large air-bladder has an open pneumatic duct, and its scales are cycloid, like those of the Eel, Herring, and Pilchard. Its bones, as becomes a fish which partly frequents fresh water, are lighter or less ossified than such as the Cod or the Plaice; and its skull has much cartilage in its composition. Its lateral

muscles are of great power, a provision which enables it to overcome the cataracts and cascades of rivers, for, curving itself, it suddenly contracts the muscles of the convex side and throws its weighty body out of the water to a considerable height. When fancy held its sway in natural history, the older authors suggested that it rested its body on a rock, or in other cases put its tail in its mouth so as to get full benefit of the sudden muscular contraction in its leaps. This muscle has a characteristic tint from the oil, and the same hue is present in the globules which occur below the blastoderm in the developing egg. As in other fishes these great muscles long retain their irritability, so that by making slits and immersing the fish in cold water a stale fish is rendered firm.

Like most fishes the Salmon is a predatory form, yet little or no food has been found in its stomach in fresh water, a fact which has led to various explanations by the public and by scientific men. Thus Prof. Owen at one time thought that, in common with many other fishes when hooked or netted, it emptied its stomach by an instinctive act of fear or to facilitate escape by lightening its load, leaving only minute animalcules in the gastric mucus. But, as pointed out long ago, if this were the rule, the intestine would be well filled, since the Salmon cannot eject its food after it passes the pylorus; moreover, the very terror which impels the action in one fish may paralyze the efforts in another. Investigations in the Tay below Perth from the Tents Moor upward show that many Sand-Eels, Sprats, Herrings, crustaceans, disintegrating muscular tissue, lime-crystals, and the ordinary chymous mass occur in the stomach of certain Salmon which probably fed in the sea or in the estuary. Sand-Eels, indeed, form a favourite bait in the sea for Salmon, and it is stated that in Sutherland hooks baited with this fish are attached to a bladder which is allowed to float up a narrow firth for its capture. The contrast with such as the Sparling and the Salmon-Trout, which are both caught by nets, is marked, for their stomachs are generally well filled. The Salmon, indeed, does not feed in fresh water, the fat and other materials stored in its muscles and viscera sufficing for the full development of its reproductive organs in the rivers in which it spawns.

It is noteworthy that within the last thirty years, probably less, our notions of the life-history of this fish have been greatly modified, especially as to its sojourn in the sea. Thus during the twenty-three years—from 1860 to 1882—the prevailing opinion was that some of the young (called Parr) became silvery fishes (Smolts) at the end of the first year, which Dahl still holds is the rule for Norway, and that all became so at the end of the second year, and migrated to the sea. Further, that after a sojourn in the sea of a few months they returned as Grilse of some pounds weight ($1\frac{1}{2}$ to 5) to their native rivers. This view (as to the speedy return from the sea) was held to be proved by the capture of those from which the "fatty" fin had been removed on their issue from Stormontfield ponds. There can be no doubt that my old friends, Mr. Robert Buist and Mr. William Brown, were quite right in holding that the "fatty" fin is not reproduced; but, on the other hand, it may be asserted that other agencies than scissors might have bereft a few of this organ. The modern method of placing a loop of silver wire in the dorsal fin admits of no doubt, and it has now been shown that the young Smolts remain a year or more (three) in the sea before returning to their early haunts to spawn. It is held, indeed, that some are fishes of considerable size before leaving the sea—where, of course, it is impossible for them to spawn, and these constitute the various runs of Salmon so well-known to tacksmen and to careful observers like Mr. Calderwood, Mr. Moreton Frewer, Mr. Malloch, the late Mr. John Dickson, of Perth, and others.

Quite recently, also, the intimate structure of the scales of the Salmon at various ages has facilitated more accurate knowledge of its age and habits. When dealing more than fifty years ago with the Salmon of the Tay and figuring the scales of Salmon and of Smolt, it was pointed out and figured that the concentric rings in the latter were few, and that there was scarcely a blank at the free end; whereas in the former the rings greatly increased in number, and the smooth portion at the free edge was of considerable size. The question of grouping the rings into annual series had not then been inquired into, and the spawning mark was unknown. (Figs. 1 and 2.)

Recently many writers have devoted special attention to

these scales as an index to the age and spawning periods of the fishes, such as W. Calderwood, A. T. Masterman, H. W. Johnston, Eisdale, Dahl, Malloch, and others. No communication, however, deals with the subject in a more thorough manner than that of Dr. A. T. Masterman, Superintending Inspector for Fishery Investigations.* His observations are illustrated by excellent figures. He concludes that the scales are retained

Figs. 1 and 2.—Scales of Smolt and Salmon from the Tay, reduced from two lecture-drawings made in 1862 from life. I am indebted to the Carnegie Trust for the reduction of these figures.

throughout life and grow in a differential manner correlative with the seasons; the small number of the ridges in the Smolt-scale remain unaltered in the centre of the adult scale; cessation of growth takes place on return to the river, and on the attainment and the duration of a condition of physiological repletion, usually at the commencement of the second, third, or subsequent winter in the sea. He holds that the scale is not available for estimation of the period of time spent in the river after the

* 'Board of Agriculture and Fisheries Investigations,' series i. vol. i., "Salmon and Freshwater Fisheries," 1913.

return. During development of the reproductive organs the scales suffer deterioration—producing the "spawning mark."

Though the Salmon is chiefly known as a freshwater fish, yet it is as much, if not more, an inhabitant of the sea, and to this habit there can be little doubt its safety is mainly due. It seeks the fresh waters for the most part to reproduce its species, for it does not enter them to feed. In the stomach of those caught off Tentsmuir and at the entrance to the Tay, as already stated, Sprats, Herrings and Sand-Eels occur, but after they have fairly entered fresh water no food of note is taken.

Whilst the Salmon feeds freely in the sea it also becomes a prey to larger forms, such as Seals, toothed Whales of various kinds, even a Cachalot occasionally taking one. Groups of Seals at the estuaries of Salmon-rivers, such as the Tay, cause considerable loss to the tacksmen, who wage war againt them. Ca'ing Whales (*Globiocephalus melas*) appear to search for Salmon in their course round the various stake-nets in a bay, and the fishermen think the Porbeagle Sharks and Porpoises captured in these nets likewise seek the Salmon, but no fragments of Salmon have ever occurred in either at St. Andrews.

As a rule Salmon are captured in the sea by stake-nets (or fly-nets) on sandy beaches, and by bag-nets off rocky shores. The principle in both is similar. At St. Andrews the stake-net, in use for generations on the west sands,* consists of a vertical leader (a single stretch of net) run out from the shore, supported on stakes or poles, and terminating seawards in two chambers; the first opening freely on each side of the leader, but otherwise closed, so that a fish passing in either direction parallel with the shore is guided into it, then into the second chamber by a narrow defile, and lastly into the "trap" by a similar defile. Entrance is easy, but the acuteness of the fish is seldom sufficient for escape. The retiring tide carries many other fishes into the netted chambers, such as Flounders (*P. flesus*), young Turbot, Brill, Plaice, Sturgeon, Dog-Fishes, Frog-Fishes, young Sharks and Skate; whilst Porpoises, young Ca'ing Whales, or even a *Regalecus* and a Great Northern Diver are some-

* A water-colour drawing of which (by R. M.) is in the Gatty Marine Laboratory. The net is usually erected in May after the heavy surf of early spring disappears.

times procured. The small size of the valuable young Turbot so often captured has frequently been noticed, especially as they are only utilised as bait for Crabs. Such ought to be liberated as soon as the "trap" is exposed at low water. To save trouble, the stakes to which the poles of the leader are fixed are left permanently in the sand, and are usually favourite sites for the borings of *Limnoria*.

The bag-nets are similar in structure, only they are anchored off the rocky shores all round Great Britain and Ireland, and also have an inner and an outer chamber distended by poles, and a trap to which the leader guides the Salmon. These nets appear to be most successful in August, and, in addition to capturing Salmon, their ropes and floats afford a favourite site for the fixation of the planulæ of *Obelia*, the larvæ of *Balani*, and myriads of the young of the Mussel after their pelagic stage. The fishermen row from the shore at intervals, release the outermost stake, and then hauling the net (trap) up to the side of the cable "a lacing at the side of the inner court is opened, and the fish allowed to slide into the boat." * It is said that few other fishes than Salmon are captured in these nets, but this needs qualification, for from early times the fishermen on the north-eastern coasts of Scotland fed their Pigs on the swarms of Lump-Suckers thus secured, and the same is found at St. Andrews, where many an interesting fish such as Mackerel, Rock-Herring, Horse-Mackerel, Conger, Sea-Perch, Frog-Fishes, Skate, Piked Dog-Fishes, Sharks, Mullet, besides Guillemots, young and old Porpoises, and even the long bands of tough mucus holding the eggs of the Frog-Fish have been procured from these nets.

The life of the Salmon in the sea is still more or less shrouded in mystery, for it is rarely captured in the off-shore waters. Yet trawlers occasionally secure fine examples in deep water in their nets, and so do the inshore fishermen with their trammel-nets. Reports as to the nature of the food found in these examples are still desiderata. During several months' observations off shore in 1884, only one fine Salmon was seen leaping above the surface many miles from land.

* *Vide* recent description by Mr. Calderwood, 'S. F. B. Report, Salmon Fisheries,' 1913, pp. 3–4.

Young Salmonoids, about a foot in length or somewhat less, the size of a Herring,* however, were caught in the Herring nets in August, and this fifty miles from shore. Such an occurrence affords little information, however, as to the numbers in an area, for only those of a suitable size are meshed; and in many cases the capture of the adults by liners and trawlers is not reported. Mr. Calderwood,† H.M. Inspector of Salmon Fisheries, alludes to several captures at sea by trawlers, and the experiments which are being carried out by him in marking Salmon obtained in bag-nets at sea will, it is hoped, considerably add to our knowledge in the near future. Salmonoids considerably larger than Smolts are occasionally captured in numbers in the estuary of the Tay, so that such forms must linger now and then inshore.

Whilst food is thus generally absent from the alimentary canal of the Salmon, parasites are plentiful. Numerous tape-worms occupy the pyloric cæca, and threadworms crawl forward into the stomach on the death of the host, or are coiled on the surface of the viscera and mesentery. Distomes press their soft bodies amongst the mucus, their pale fluid passing backward and forward, becomes stationary and again proceeds. *Echinorhynchi* are attached to the wall of the stomach by their proboscides. In the duodenum are many larval Distomes, which move actively in the mucus.

In connection with the circulation and respiration there is little differentiation from the ordinary Teleostean. It is worthy of note, however, that in the young fish the first vessels to leave the line of the body are those passing into the "fatty" fin; whilst in fresh water the gills have the parasite *Lernæopoda salmonea*, which is killed when it enters the sea, just as the external parasite *Lepeophtheirus salmonis* disappears in fresh water. No young fish is better adapted for experiments on the circulation than the Salmon, whether in connection with the effect of drugs and poisons, or the behaviour of the capillaries after operations. The presence of a dilatation on the caudal

* There may have been many larger and smaller accompanying the forms caught, the heads of the former being too large for entering the mesh, whilst the smaller heads might slip out.

† *Vide* 'S. F. B. Salmon Fisheries,' 1913, No. 1, pp. 4 *et seq.* (1914).

vein (so-called "heart") is another feature of interest, and the impulse of the heart causes a slight jerk in it on each contraction. In Shaw's figure in the Trans. Roy. Soc., Edinburgh, the vitelline vein runs behind instead of in front of the large oil-globules. The vessels of the yolk-sac do not branch very minutely, but enter the venous system by a current two or three discs broad.

Sooner or later, then, the Salmon leaves the sea and enters the mouths of certain rivers for the purpose of spawning, and so strong is the instinct which impells it, that, using the term Salmon in its widest sense, it sweeps through the whole length of the largest rivers, and, as is well known, reaches Bohemia by the Elbe, Switzerland by the Rhine, and the Cordilleras of America by the Amazon—the course of which is more than 2000 miles; and it has been stated that it reaches the sources of the river in about three months, but this appears to need verification, for Mr. Calderwood lately found that his marked fishes took ten days to cover sixty-eight miles, though of course it is unknown whether a straight course was followed. No country, however, shows on a more gigantic scale the impulse just mentioned than Canada, where the work of Dr. Edward E. Prince, the Dominion Commissioner of Fisheries, has lately thrown a flood of light both in regard to investigation and legislation.* The vast hordes of the various species of Salmon, for instance, which pour round Vancouver Island from the North Pacific to enter the clear, cold waters of the Fraser River, defies computation, and the phenomenon is still more remarkable when it is remembered that the majority in this instance perish after spawning. Even in our own waters the mortality after spawning is considerable.

In its course up a river to the pure rills and streamlets which form its source, the Salmon encounters many obstacles, such as precipitous falls, cascades and artificial obstructions, some of which can only be passed in high flood, whilst a few are impassable except by salmon-passes, early introduced by Mr. Smith of Deanston, and by Messrs. Ashworth in their Galway fishings. Moreover, it has to run the gauntlet of the endless

* The extent of these fisheries is well shown by a communication by Prof. Prince to the International Fisheries Congress at Rome in 1911.

series of legitimate trammel-nets and of poaching devices, especially at weirs; the attacks of Seals at the estuary and of Otters higher up, and the use of trained Dogs which endeavour to drive it into nets, and nothing terrifies a Salmon more than a Dog. Thus when the water was turned aside from a pass for examination on an Irish river, a Salmon of about 20 lb. floundered amongst the water in the shallows, and a terrier rushed at it, causing the fish in frantic terror to dash itself hither and thither until it gained a pool of some depth, where it lay alongside and parallel with the concrete wall in perfect quietude, permitting the point of a stick to rest on its back rather than move from its shelter and run the risk of meeting its enemy.

In former days before the syndicate took the fishings of the river Tay into their hands, one might well have doubts as to the safety of a sufficient number of fishes to stock the river. Thus, on looking down from Kinnoull Hill during the season, each bank of the river was dotted with the little huts for the fishermen, and the coble, as a black speck, pushed out everywhere into the stream—now from this bank and again from the other—the ripple of the boats' wake concealing the gradual falling of the net. The convexity of the boat's course, which was in the form of a loop, was directed downward (toward the mouth of the river) during ebb-tide, and the reverse during the flow of the tide. One end of the net was fastened to the boat, the other on shore to a stationary windlass, by which, at the end of the loop formed by the boat, the net was drawn to the bank, and the fishes removed from the bag or trap of the net and killed by blows from a stick. Now all this is changed, and the reduction of the number of the fishing stations has been found to be no disadvantage financially, though the lively and picturesque features of old can no more be seen. Yet, if the Salmon is persecuted by stake and bag-nets, by trawlers and by trammel-nets in the sea, it is pursued with tenfold avidity in fresh waters legitimately by nets of various kinds, sometimes with the aid of Dogs, by traps termed "cruives" in dam-dykes (now, it is to be hoped, almost in abeyance), by spears, and by anglers.

It was formerly held, and with good reason, that early or

late Salmon-rivers, as they were called, owed this feature to the temperature of their waters. Thus, in Britain, certain rivers arising from lochs are earlier than some which do not; Yarrell, for instance, quoting Sir William Jardine's case of the Oikel and the Shin in Sutherlandshire. The Oikel springs form a small alpine lake about half a mile in breadth, whereas the Shin, a tributary of the Oikel, takes its origin from Loch Shin, a large and deep loch connected to a chain of other deep lochs. Early in spring all Salmon entering the common estuary diverge up the Shin, and do not pass into the Oikel until later.

The eggs in the ovaries of the Salmon are developed so as to form a mass of several pounds, varying according to the size of the fish, on each side by the utilization of the nutriment stored up in the muscular and other tissues, as indeed had long been suspected, but more clearly demonstrated by Meischer Ruesch and Noel Paton.*

In the ovary, as in that of the Wolf-Fish (*Anarrhichas*), the eggs attain a comparatively large size, and, moreover, all reach maturity about the same time, so that they are shed within a limited period—a condition very different, for instance, from that in the Cod or Haddock. On entering a river some pass upward to the spawning-ground with considerable rapidity, whilst others, especially in the larger rivers, or in those with lakes, may remain many months before spawning, and their perseverance in overcoming natural obstacles in their ascent to suitable spawning-grounds is well known. Fishes are usually credited with small intelligence, but as a matter of fact their intelligence is keen. Both intelligence and instinct, and in some cases memory, come into play in the selection of a good spawning-bed of clean gravel—as at the Boat (now the Bridge) of Caputh. Few sights are more interesting to the naturalist than to watch the fishes swarming on such a spawning-bed in November. The quiet stretch of shallow water (for it is out of the main current) is alive with the dorsal fins of the males as

* It may be noted that before Dr. (now Professor) Noel Paton began his researches the late Mr. James Johnston, of Montrose, my colleague on the Fishery Board, agreed to present two Salmon per week for this purpose, and he loyally carried out his promise. Mr. Johnston deserves grateful remembrance for his generosity.

they rush after each other in their fight for the females, and here and there the surface is broken by the splash of a combat. The sight from the Bridge at Galway as the fishes pass up to their spawning-ground is also striking, but at a given moment they are far fewer than those collected on such a spawning-ground as that just mentioned. There the female stirs up the gravel with her tail, sheds the eggs in batches, probably during several days, and covers them over, the area being, as it were, sown with them, whilst the attendant male emits milt for fertilization. The newly extruded ova are covered with viscid mucus, which to some extent causes them to roll less readily on the stones, and prevents the current carrying them down-stream. Their specific gravity, moreover, is greater than that of the water, the reverse being the case in the pelagic eggs of the Cod and many others. Moreover, the eggs of the Salmon are shed into the cœlom, and thence out by the genital pore behind the vent, whereas the Cod has oviducts.

The developing egg remains in the gravel for 120 to 130 days or more, according to temperature, when the young fish is extruded. In a private apparatus in a bedroom (fig. 3) the young were hatched in sixty days.

The larval Salmon keeps to its gravelly bed for a month or six weeks, until its store of yolk is more or less exhausted; and then it swims freely as a little fish about an inch in length (called a Parr), though at first it keeps to hollows in the bed of the stream where the currents are less strong.

The destruction of ova in their natural spawning-beds is considerable by floods, Trout, Salmon-Trout, larvæ, beetles, birds, and other forms. Hence the basis on which hatcheries were advocated, and there is no doubt great benefit in many cases has resulted from the artificial rearing of Salmon to a certain stage. Yet if the adults are sufficiently protected on their spawning-beds (which unfortunately they are not in certain cases, *e.g.* Ireland), the need for hatcheries would be restricted. It is the serious obstruction by weirs or impassable falls and the too-severe netting, together with the interference with the fishes on their spawning-beds, which reduces the numbers in many fine rivers.

As the breeding-ponds at Stormontfield-on-the-Tay were

amongst the earliest and best known, it may not be out of place briefly to record the impression of a first inspection in May, 1861. They are situated on the ground of the Earl of Mansfield, and were constructed in 1854 by subsidies from the leading proprietors of the Salmon-fishings on the Tay, each paying in proportion to the extent of his fishings. They are economically constructed, the chief expense, indeed, being the

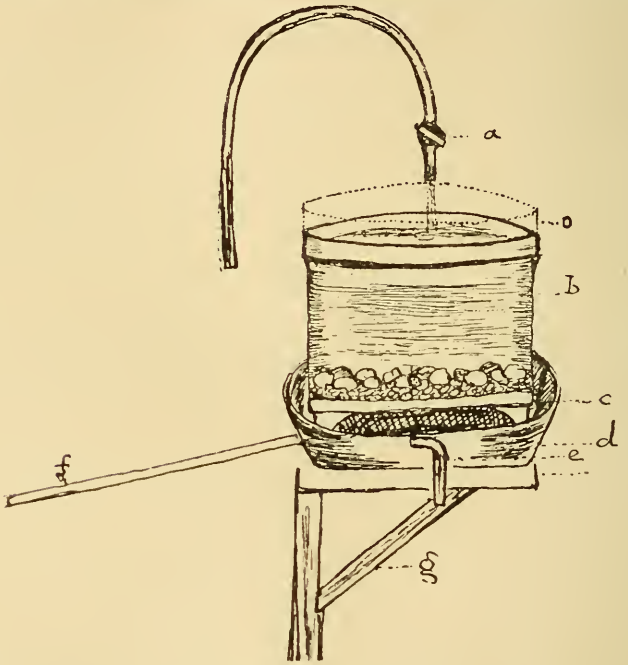

Fig. 3.—Apparatus fitted up in connection with a bath for hatching Salmon: *a*. small block-tin supply-pipe, with brass nozzle and stop-cock; *b*. green glass vessel about 11 in. in diameter; *c*. wooden rest for vessel; *d*. basin of zinc into which the water overflows from glass vessel; *e*. overflow pipe into fixed basin; *f*. escape-pipe leading out of a small hole in window-pane to a leaden roof; *g*. bracket supporting apparatus; *o*. dotted lines indicating the perforated zinc band for retaining the young fishes.

furnishing of the clay wherewith to make the porous sandy soil of the ponds impermeable. There is ample ground for extension, and the supply of pure water from Stormontfield mill-lade above them is abundant. These features have subsequently been taken advantage of by considerable additions since the period mentioned.

In a space 72 ft. square 300 wooden boxes are placed in twenty-five rows, each containing twelve boxes, on a gentle slope. In the bottom of each is placed a layer of fine gravel, with an upper loose coating of larger stones. A full supply of water is brought from the mill-lade just mentioned by a sluice and pipe, so that it bubbles up through a thick layer of sand and gravel in the filtering pond, whilst on each side of the aperture of exit is a wooden trough for collecting superfluous mud. The sole inhabitants of this pond are Minnows and Eels. From the filtering-pond the water passes by two wide pipes to the northern canal which laves the upper end of the breeding-boxes, bubbling up at the fourth box from each end, the water then rushing into each of the wide notches at the ends of the twenty-five boxes, streams longitudinally through, passing on to the next, and finally plunging from the last into the lower canal at the southern end of the boxes. A double sluice at the western corner of this canal carries the stream to the large rearing-pond further down the slope.

The gravel and stones in the boxes are carefully cleaned before collecting the ova during the spawning season, which usually is between the middle of November and the middle of December; the Salmon being captured near the mouth of the river Almond as it joins the Tay. The Salmon are gently held, and the hand passed from before backward along the belly, when the ripe ova or milt pass out by the genital aperture and drop into a vessel and then the fishes are returned to the river.* Fertilization being effected, the ova are removed to Stormont-field the same evening. It was found in 1859 that the milt of a Parr twenty months old was equally effective with that of an adult male, and no difference was observed in the growth or aspect of the young fishes subsequently reared.

Having reached the hatching-boxes, the fisherman in charge commences at one side of the rows and literally sows the ova

* This method of dealing with ripe fishes should be borne in mind. On one occasion an expert and an official were greatly perturbed as to certain ripe Turbot which would not discharge their eggs and milt; yet it was only necessary to capture the fishes with a hand-net, gently manipulate the abdomen, and a stream of ripe eggs issued at once, and were fertilized by milt from the males.

gently into each, and if they should appear too much exposed, by waving his hand in the water they readily sink under cover of the larger stones as if by instinct. The labour for a time is now over, and the water-supply of the boxes alone requires attention.

During severe winters various precautions are necessary; thus the ice on the mill-lade may block the current to the filtering-pond, and boards and straw may be required to protect the hatching-boxes from consolidation, which, in the case of the pelagic eggs of marine fishes in a tank, is so fatal. The fisherman feared that similar effects would ensue in the instance of the ova of the Salmon, but actual experiments cannot at this date be recalled. Moreover, a flock of ducks has been known during severe weather to devour all the eggs they could secure —just as Scoters and other forms at sea people a long line of floating organisms and greedily swallow the pelagic eggs of fishes.

Toward the middle of January the eyes of the embryos are visible, and about the 8th of April the earliest are hatched, the larvæ with the large yolk-sac keeping the protection of the stones in the boxes. Those which, after struggling inside the transparent capsule, emerge head first, with a few wriggles shake off the capsule and are free, represent the normal births. On the other hand, those which emerge with the tail first are less fortunate, for the egg-capsule clings round the yolk-sac and the head, and may cause the death of the young fish. In mild winters hatching occurs about thirty days sooner than in a severe one.

At this stage the little Salmon is in a rather helpless condition, though its mouth is open and it is capable of wriggling, and in its native rivers must be liable to many mishaps from spates in the mud, predatory birds, fishes and invertebrates. In the boxes they remain quiescent for six weeks longer until the large yolk-sac is absorbed, and then the tiny Parr * swim freely; and, passing the small rapids from box to box, reach the lower canal, where they do not stay long, but voluntarily seek the larger pond below by the streamlets. In the rearing-pond they are fed chiefly on boiled liver, besides such food as they can obtain amidst the water and water-plants. Next year,

* Parr are readily distinguished by the bold pigment-bars along the sides.

about the middle of May, those which become Smolts are restless and sportive, even leaping out of the pond in their endeavour to reach the river. The sluice at the east corner of the rearing-pond is then left open, and those so inclined pass down a wooden aqueduct to a small enclosure with perforated zinc, close to the river, and congregate there overnight. They are then marked by cutting off the adipose fin, and liberated into the Tay. Other methods of marking formerly adopted were "punching" out a triangular portion of the operculum, and putting rings in fins (the present method) and tail. Those which exhibit the migratory instinct generally show the silvery hue of the Smolt, and very few Parr find their way into the "trap." The rest of the young fishes remain for another year before assuming the silvery coating of the Smolt and the migratory instinct. There is thus a marked difference between such and the Pacific Salmon which passes to the sea shortly after absorption of the yolk-sac. Its scale, Dr. Masterman points out, is devoid of the primitive annular ridges.

The little fish of about an inch in length (Parr) feeds readily on minute organisms, such as copepods, in the water, gradually gains strength to encounter the currents, and at the end of the first year is about $2\frac{1}{2}$–3 in. long, a few reared at Stormontfield being larger and assuming the silvery dress of the Smolt (about eight per cent.), these manifesting a desire to migrate to the river.

In the early sixties of last century the sight from the margin of the pond in August, when the vegetation had recovered from the annual clearing, was both interesting and beautiful, and the same remarks will equally apply to the present time. The bright green pond-weeds had spread in truly tropical luxuriance, transforming the pond into an enchanting sub-aqueous forest, under the shade of which the Parr, together with shoals of the three-spined Stickleback, found both shelter and food; whilst, on a lower level, numerous Loaches and a few Eels shared the same retreat. Threading their way through the sub-aqueous thickets the little Salmon keep in companies, rising readily to artificial food in good weather, or hunt the minute animals which swarmed on all sides. Larvæ of insects climbed the pond-weeds or formed their tubes on the stones. Pond-snails

glided over the sand, glistened on the stones, or fringed the green branches with their multitudes; whilst the *Confervæ* afforded lurking places for Water-beetles, Cyprides, Leeches, Worms and other invertebrates which preyed on the more minute infusoria, diatoms, and desmids. From the platform on the southern side, indeed, the sight of all this natural beauty and luxuriance, as well as the shoals of sportive fishes, involuntarily recalled the coral reefs of the South Pacific, with their gaily tinted polyps and the brightly coloured fishes which frequented them.

Since the foregoing period a new rearing-ground has been made and trees planted by the border; and it is a noteworthy feature that the young fishes thrive best in the pond fringed by the young trees—apparently since insect-life has thus been materially increased.

At the end of the second year most become Smolts, assume the silvery dress and migrate to the sea, apparently passing at once to deep water, for very few small examples (7 in.) have been captured.

It is in the sea that the Salmon obtains the abundant and rich nourishment (Herrings, Sand Eels, &c.) which enables it to increase rapidly in length and weight; so that next year it returns to its native river as a Grilse of 2–5 or more pounds; or if it remains a year longer it enters the river as a small Salmon in spring. Similar results were obtained by marking Kelts, or spent fishes, the short and the long sojourns in the sea in Scotland being respectively five months and fifteen and three-quarter months.

Its food in the sea was long a source of dubiety. Thus Knox, Huxley, Queckett and others thought that it fed on the eggs of various kinds of Echinodermata, small crustacea, and Sand Eels, apparently linking on the colour of the food with that of the muscle of the Salmon.

The Salmon is a type of a fish having demersal eggs—that is, they are deposited on the bottom; and in such fishes the eggs, while they are far larger in size, are less numerous than in those having floating or pelagic eggs. Thus the Salmon has about 28,000 eggs, the Cod from three to nine millions. The young of the Salmon is not only much larger than in the case

of pelagic eggs, its mouth is open at its birth, and its store of yolk is sufficient to nourish it for five or six weeks; whereas the young hatched from a pelagic egg, as a rule, is devoid of a mouth, has a small quantity of yolk, which in the Cod lasts only nine days, and is a minute transparent speck scarcely visible in the water except for the shimmer it makes when moving. It has at first no definite circulation, whereas the young Salmon has on its first day a most complex and complete series of arteries and veins.

The Wolf-Fish, amongst marine fishes perhaps, most nearly approaches the Salmon in the demersal condition of its eggs and in their comparatively large size, but it differs in having oviducts to convey the eggs to the exterior, and in the fact that the eggs are firmly agglutinated into a mass, and contain a single large oil-globule. The fishes on hatching are readily distinguished thus:—

	Wolf-Fish.	*Salmon.*
1.	Yolk, and contained oil-globule of inconspicuous colour, and yolk-sac spheroidal.	Yolk of reddish orange colour, and elongated in outline.
2.	Single large oil-globule, anterior in position.	Many small oil-globules in upper part of yolk-sac.
3.	Snout blunt, so that eyes at the most anterior part of head.	Snout protrudes well in front of eyes.
4.	Marginal fin continuous.	Marginal fin forming separate median fins.

Neither the Wolf-Fish nor the Salmon pays the slightest attention to its eggs after deposition, and thus they form a contrast with the next species, *viz.* the Lump-Sucker (155,000 eggs). In this form the eggs in the ovaries agree with those of the two former fishes in ripening nearly simultaneously, and they form large amethystine masses attached to the rocks between tide-marks; but, instead of being forsaken after deposition, they are jealously guarded by the male, a smaller and more brightly-coloured fish than the female. So faithfully does the male discharge this duty that at extreme low water it may happen that most of his body is exposed, so that carrion crows destroy the eyes and even puncture the abdomen for the liver of the resolute guardian.

The Gunnel is about as careful of its eggs as the foregoing,

though they are comparatively few in number, for it deposits them, as Mr. Holt found at St. Andrews, in holes (such as a large burrow of *Pholas crispata*), and the parent coils her ribbon-like body around them, after the manner of a Boa.

Space would fail, however, if the details of those having demersal eggs were entered into at length, for they are numerous, ranging from the Sea-Scorpion (*Cottus*) with its roseate masses of eggs, the Gobies with their separate eggs fixed by an elegantly reticulated series of strands, the disc-shaped eggs of the Bimaculated Sucker, the globular eggs of the Shanny with their soft adhesive rims; the golden eggs of the Armed Bull-head, the greenish yellow eggs of the Sand-Eel, and of the curious eggs of the Garfish and Saury Pike, with their external filaments resembling magnified *Globigerinæ* surrounded by their protoplasmic filaments. Yet there is one demersal form which cannot be passed by—*viz.* the Herring (25,000 eggs), which has a small egg with a tough capsule glued to its neighbours, so as to form masses adhering to a gravelly bottom in countless myriads and covering, it may be, square miles. As the Herring is often captured at the spawning season, the eggs adhere to the nets and ropes and form a coating on the deck of the boats, but so hardy and firm are they that after sixteen hours' exposure to the air they are readily hatched. Moreover, it is a curious check to theories concerning the safety of fishes having pelagic eggs to find that here is a fish, the vast multitudes of which surpass every other produced from a demersal egg, and which as time rolls on, and as methods of capture increase in intensity, seems by its undiminished shoals to set man's influence at defiance. Yet its closely related brethren, the Sprat, Pilchard, and Anchovy all have pelagic eggs, and the countless masses of the former sometimes vie with those of the Herring; indeed, as a fragment of the captures in the Forth, seventeen truckloads have been sent in a day to the Carse of Gowrie to be utilized as manure. Truly the country has not hitherto utilized all its marine sources of food-supply.

But some fishes exhibit great ingenuity by fashioning nests for the protection of their eggs—such as the 2-, 3-, and 15-spined Sticklebacks—and, moreover, they jealously guard them. The Gourami of the Malay Archipelago (*Osphromenus gouramy*)

makes a nest of floating weeds and attaches it to other water-plants; others, such as *Macropodus* (Paradise Fish), use the buccal secretion and air bubbles to float it, and in both cases keep guard over the eggs. Many of the *Centrarchidæ* (the group which contains the Black Bass) make nests, and so with the American *Amiurus nebulosus* (a Cat-Fish), and in the latter case the male guards. *Doras*, *Corydoras* and *Callichthys* of South America make nests of grass and leaves, and both male and female guard. *Gymnarchus* of the Gambia constructs a floating nest and the male guards; whilst *Heterotis niloticus* makes enormous nests in the swamps of the same region. The curious little *Antennarius* fashions a nest of the floating *Sargassum*, fixing, by aid of the same secretion as in the 15-spined Stickleback, the weeds to protect the eggs—which are like bunches of grapes.

Still more curious is the habit of *Rhodeus amarus*, the Bitterling of Europe (allied to the Dace, Chub, and Minnow), the female of which with its long ovipositor inserts the eggs into the mantle-cavities of *Unio* or *Anodon*, where they are duly hatched and reared. *Aspredo platystacus* (a Cat-Fish), however, is a better nurse, since the female attaches the eggs to the spongy papillose surface of the abdomen; and so are the males of the Pipe-Fishes, which carry the eggs in a long groove or pouch on the under surface. Moreover, as if to demonstrate the illimitability of Nature's resources, the mouth and pharynx are used as brood-pouches in the male Siluroids *Arius*, *Galeichthys*, and in the male *Osteogenissus*, the females more rarely performing the same functions; and in *Arius commersonii* the eggs are from 17–18 mm. in diameter. No food occurred in the stomachs of those in this condition.* *Malapterurus*, again, is said to shelter its fry in its mouth. But these do not exhaust the remarkable variations met with in Teleostean reproduction, for not a few are viviparous. Thus in our own country the viviparous Blenny is a familiar instance, with its large young; and the Norway Haddock is another less common form, with its small embryos. Abroad, the viviparous forms range from Mud-Minnows

* A vertebrate parallel to the condition of *Asterias mülleri* in the rock-pools at St. Andrews, the female of which carries a mass of ova over the mouth.

(*Umbridæ*), Killi-Fishes (Cyprinodonts), in which the anal fin is modified into a long intermittent organ in the male, to Surf-Fishes (*Embiotocidæ-Labyrinthieci*), such as the White Surf-Fish (*Cymatogaster aggregatus*) with very large young. Even the blind Brotula (*Lucifuga subterranea*) of Cuba, one of the Blennies, is in this condition.

Whilst the previous methods of reproduction are both important and interesting, they hold but a minor position when contrasted with the striking and far-reaching influence of the discharge of pelagic eggs—a method so prevalent in the marine food-fishes; for, strange to say, almost the entire series comes under this category—only the Herring, the Wolf-Fish, and the Norway Haddock being the exceptions. It is this pelagic condition of the vast swarms of the minute eggs which has preserved these valuable fishes from serious diminution by man, whose fishing apparatus—often on a gigantic scale—searches the seas in every clime and especially in the much-frequented North Sea and the coasts of Europe, the American shores, those of Asia, Africa, Japan, Australia and New Zealand. Fears, it is true, are ever present with those whose scientific knowledge of the subject is limited, and new methods of fishing have not always been welcome, yet both conditions have existed for many centuries and will, in all probability, continue. Some may remember the general clamour on the introduction of steam-trawling into Scottish waters, and the resolute opposition it met with on every side from members of Parliament to line- and net-fishermen, yet in some instances the same method had been practised by the liners in their sailing boats for many years, and it was only the appearance of powerful steam vessels to compete with them in their own areas which roused opposition. Yet, after all, there is little difference, for instance, between capturing tons of Plaice by aid of hundreds of nets hung thickly throughout a bay, and sweeping them from the bottom by either beam or other trawl; indeed, many adult Plaice escape the two latter by sinking in the sand. But capture persistently as man may, the pelagic eggs and larvæ spread each species widely over the sea, many by-and-by having a definite drift as larval or post-larval forms—irrespective of those diverse currents, salinities and temperature of which we hear so much from recent investiga-

tors. Hydrographically, all these observations are of great interest and merit respect, but as an international method of solving the fisheries' problems they have not been a success. It is fruitless to ask these to explain why the larval and young Plaice year after year invariably seek the margin of the sandy beach, why the young Cod keeps to deep water till it is an inch in length and then comes to the margin of the rocks, going out again as it gets older, why the young Haddock, on the other hand, remains in deep water till it is four to five inches in length, when it passes to the inshore waters. The laws that guide these and similar cases are beyond the influences of currents, temperatures, or salinities.

The international investigators, who promised results of importance within two years, after fully eleven years' labours have at last narrowed and focussed their recommendations to the protection of the Plaice, chiefly by a size limit, an idea long known, and indeed put in force by certain nations about a quarter of a century ago; this and the *camaraderie* of the fisheries' representatives, scientific and otherwise, is perhaps the main result of an expenditure of more than £100,000 by our own country! Yet it is only fair to add that the Danish ship, with Dr. Johs. Schmidt on board, has notably extended our knowledge of the life-history of the Common Eel which spawns only in mid-Atlantic, the young thereafter traversing the entire length of the Mediterranean, besides supplying the whole of the western border of Europe.

A calm survey of the reproduction of fishes thus opens up a vast field for reflection, and impresses the observer at once with the illimitability of Nature's resources and the fine adjustment in every case to the needs of the species. Whether conditions so remarkable were the result of gradual evolution or formed by more or less sudden leaps has not been fully investigated. Yet there cannot be a doubt that through all the mazes of those wonderful complexities a Master Mind has ruled what was best for each, so that not one of the recent species has failed to preserve its existence under the most diverse circumstances, and with the increasing drain on its numbers by the cupidity of man.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AUSTRALIA, 1914.

Address by Professor William Bateson, M.A., F.R.S., *President.*

Part I.—Melbourne.

The outstanding feature of this Meeting must be the fact that we are here—in Australia. It is the function of a President to tell the Association of advances in science, to speak of the universal rather than of the particular or the temporary. There will be other opportunities of expressing the thoughts which this event must excite in the dullest heart, but it is right that my first words should take account of those achievements of organisation and those acts of national generosity by which it has come to pass that we are assembled in this country. Let us, too, on this occasion, remember that all the effort, and all the goodwill, that binds Australia to Britain would have been powerless to bring about such a result had it not been for those advances in science which have given man a control of the forces of Nature. For we are here by virtue of the feats of genius of individual men of science, giant-variations from the common level of our species; and since I am going soon to speak of the significance of individual variation, I cannot introduce that subject better than by calling to remembrance the line of pioneers in chemistry, in physics, and in engineering, by the working of whose rare—or, if you will, abnormal—intellects a meeting of the British Association on this side of the globe has been made physically possible.

I have next to refer to the loss within the year of Sir David Gill, a former President of this Association, himself one of the outstanding great. His greatness lay in the power of making big foundations. He built up the Cape Observatory; he organised international geodesy; he conceived and carried through the plans for the photography of the whole sky, a work in which Australia is bearing a conspicuous part. Astronomical observation is now organised on an international scale, and of this great scheme Gill was the heart and soul. His labours have ensured a base from which others will proceed to discovery otherwise impossible. His name will be long remembered with veneration and gratitude.

As the subject of the addresses which I am to deliver here and in Sydney I take Heredity. I shall attempt to give the essence of the discoveries made by Mendelian or analytical methods of study, and I shall ask you to contemplate the deductions which these physiological facts suggest in application both to evolutionary theory at large and to the special case of the natural history of human society.

Recognition of the significance of heredity is modern. The term itself in its scientific sense is no older than Herbert Spencer. Animals

and plants are formed as pieces of living material split from the body of the parent organisms. Their powers and faculties are fixed in their physiological origin. They are the consequence of a genetic process, and yet it is only lately that this genetic process has become the subject of systematic research and experiment. The curiosity of naturalists has of course always been attracted to such problems; but that accurate knowlege of genetics is of paramount importance in any attempt to understand the nature of living things has only been realised quite lately even by naturalists, and with casual exceptions the laity still know nothing of the matter. Historians debate the past of the human species, and statesmen order its present or profess to guide its future as if the animal Man, the unit of their calculations, with his vast diversity of powers, were a homogeneous material, which can be multiplied like shot.

The reason for this neglect lies in ignorance and misunderstanding of the nature of Variation; for not until the fact of congenital diversity is grasped, with all that it imports, does knowledge of the system of hereditary transmission stand out as a primary necessity in the construction of any theory of Evolution, or any scheme of human polity.

The first full perception of the significance of variation we owe to Darwin. The present generation of evolutionists realises perhaps more fully than did the scientific world in the last century that the theory of evolution had occupied the thoughts of many and found acceptance with not a few before ever the 'Origin' appeared. We have come also to the conviction that the principle of Natural Selection cannot have been the chief factor in delimiting the species of animals and plants, such as we now with fuller knowledge see them actually to be. We are even more sceptical as to the validity of that appeal to changes in the conditions of life as direct causes of modification, upon which latterly at all events Darwin laid much emphasis. But that he was the first to provide a body of fact demonstrating the variability of living things, whatever be its causation, can never be questioned.

There are some older collections of evidence, chiefly the work of the French school, especially of Godron *—and I would mention also the almost forgotten essay of Wollaston †—these, however, are only fragments in comparison. Darwin regarded variability as a property inherent in living things, and eventually we must consider whether this conception is well founded; but postponing that inquiry for the present, we may declare that with him began a general recognition of variation as a phenomenon widely occurring in Nature.

If a population consists of members which are not alike but differentiated, how will their characteristics be distributed among their offspring? This is the problem which the modern student of heredity sets out to investigate. Formerly it was hoped that by the simple inspection of embryological processes the modes of heredity

* 'De l'Espèce et des Races dans les Êtres Organisés,' 1859.
† 'On the Variation of Species,' 1856.

might be ascertained, the actual mechanism by which the offspring is formed from the body of the parent. In that endeavour a noble pile of evidence has been accumulated. All that can be made visible by existing methods has been seen, but we come little, if at all, nearer to the central mystery. We see nothing that we can analyse further—nothing that can be translated into terms less inscrutable than the physiological events themselves. Not only does embryology give no direct aid, but the failure of cytology is, so far as I can judge, equally complete. The chromosomes of nearly related creatures may be utterly different both in number, size, and form. Only one piece of evidence encourages the old hope that a connection might be traceable between the visible characteristics of the body and those of the chromosomes. I refer of course to the accessory chromosome, which in many animals distinguishes the spermatozoon about to form a female in fertilization. Even it, however, cannot be claimed as the cause of sexual differentiation, for it may be paired in forms closely allied to those in which it is unpaired or accessory. The distinction may be present or wanting, like any other secondary sexual character. Indeed, so long as no one can show consistent distinctions between the cytological characters of somatic tissues in the same individual we can scarcely expect to perceive such distinctions between the chromosomes of the various types.

For these methods of attack we now substitute another, less ambitious, perhaps, because less comprehensive, but not less direct. If we cannot see how a fowl by its egg and its sperm gives rise to a chicken or how a Sweet Pea from its ovule and its pollen grain produces another Sweet Pea, we at least can watch the system by which the differences between the various kinds of fowls or between the various kinds of Sweet Peas are distributed among the offspring. By thus breaking the main problem up into its parts we give ourselves fresh chances. This analytical study we call Mendelian, because Mendel was the first to apply it. To be sure, he did not approach the problem by any such line of reasoning as I have sketched. His object was to determine the genetic definiteness of species; but though in his writings he makes no mention of inheritance it is clear that he had the extension in view. By cross-breeding he combined the characters of varieties in mongrel individuals, and set himself to see how these characters would be distributed among the individuals of subsequent generations. Until he began this analysis nothing but the vaguest answers to such a question had been attempted. The existence of any orderly system of descent was never even suspected. In their manifold complexity human characteristics seemed to follow no obvious system, and the fact was taken as a fair sample of the working of heredity.

Misconception was especially brought in by describing descent in terms of "blood." The common speech uses expressions such as consanguinity, pure-blooded, half-blood, and the like, which call up a misleading picture to the mind. Blood is in some respects a fluid, and thus it is supposed that this fluid can be both quantitatively and qualitatively diluted with other bloods, just as treacle can be diluted

with water. Blood in primitive physiology being the peculiar vehicle of life, at once its essence and its corporeal abode, these ideas of dilution and compounding of characters in the commingling of bloods inevitably suggest that the ingredients of the mixture once combined are inseparable, that they can be brought together in any relative amounts, and in short that in heredity we are concerned mainly with a quantitative problem. Truer notions of genetic physiology are given by the Hebrew expression "seed." If we speak of a man as "of the blood-royal" we think at once of plebeian dilution, and we wonder how much of the royal fluid is likely to be "in his veins"; but if we say he is "of the seed of Abraham" we feel something of the permanence and indestructibility of that germ which can be divided and scattered among all nations, but remains recognisable in type and characteristics after 4000 years.

I knew a breeder who had a chest containing bottles of coloured liquids by which he used to illustrate the relationships of his dogs, pouring from one to another and titrating them quantitatively to illustrate their pedigrees. Galton was beset by the same kind of mistake when he promulgated his "Law of Ancestral Heredity." With modern research all this has been cleared away. The allotment of characteristics among offspring is not accomplished by the exudation of drops of a tincture representing the sum of the characteristics of the parent organism, but by a process of cell-division, in which numbers of these characters, or rather the elements upon which they depend, are sorted out among the resulting germ-cells in an orderly fashion. What these elements, or factors as we call them, are we do not know. That they are in some way directly transmitted by the material of the ovum and of the spermatozoon is obvious, but it seems to me unlikely that they are in any simple or literal sense material particles. I suspect rather that their properties depend on some phenomenon of arrangement. However that may be, analytical breeding proves that it is according to the distribution of these genetic factors, to use a non-committal term, that the characters of the offspring are decided. The first business of experimental genetics is to determine their number and interactions, and then to make an analysis of the various types of life.

Now the ordinary genealogical trees, such as those which the stud-books provide in the case of the domestic animals, or the Heralds' College provides in the case of man, tell nothing of all this. Such methods of depicting descent cannot even show the one thing they are devised to show—purity of "blood." For at last we know the physiological meaning of that expression. An organism is pure-bred when it has been formed by the union in fertilization of two germ-cells which are alike in the factors they bear; and since the factors for the several characteristics are independent of each other, this question of purity must be separately considered for each of them. A man, for example, may be pure-bred in respect of his musical ability and cross-bred in respect of the colour of his eyes or the shape of his mouth. Though we know nothing of the essential nature of these factors, we know a good deal of their powers. They

may confer height, colour, shape, instincts, powers both of mind and body; indeed, so many of the attributes which animals and plants possess that we feel justified in the expectation that with continued analysis they will be proved to be responsible for most if not all of the differences by which the varying individuals of any species are distinguished from each other. I will not assert that the greater differences which characterize distinct species are due generally to such independent factors, but that is the conclusion to which the available evidence points. All this is now so well understood, and has been so often demonstrated and expounded, that details of evidence are now superfluous.

But for the benefit of those who are unfamiliar with such work let me briefly epitomise its main features and consequences. Since genetic factors are definite things, either present in or absent from any germ-cell, the individual may be either "pure-bred" for any particular factor, or its absence, if he is constituted by the union of two germ-cells both possessing or both destitute of that factor. If the individual is thus pure, all his germ-cells will in that respect be identical, for they are simply bits of the similar germ-cells which united in fertilization to produce the parent organism. We thus reach the essential principle, that an organism cannot pass on to offspring a factor which it did not itself receive in fertilization. Parents, therefore, which are both destitute of a given factor can only produce offspring equally destitute of it; and, on the contrary, parents both pure-bred for the presence of a factor produce offspring equally pure-bred for its presence. Whereas the germ-cells of the pure-bred are all alike, those of the cross-bred, which results from the union of dissimilar germ-cells, are mixed in character. Each positive factor segregates from its negative opposite, so that some germ-cells carry the factor and some do not. Once the factors have been identified by their effects, the average composition of the several kinds of families formed from the various matings can be predicted.

Only those who have themselves witnessed the fixed operations of these simple rules can feel their full significance. We come to look behind the simulacrum of the individual body, and we endeavour to disintegrate its features into the genetic elements by whose union the body was formed. Set out in cold general phrases such discoveries may seem remote from ordinary life. Become familiar with them and you will find your outlook on the world has changed. Watch the effects of segregation among the living things with which you have to do—Plants, Fowls, Dogs, Horses, that mixed concourse of humanity we call the English race, your friends' children, your own children, yourself—and however firmly imagination be restrained to the bounds of the known and the proved, you will feel something of that range of insight into nature which Mendelism has begun to give. The question is often asked whether there are not also in operation systems of descent quite other than those contemplated by the Mendelian rules. I myself have expected such discoveries, but hitherto none have been plainly demonstrated. It is true we are often puzzled by the

failure of a parental type to reappear in its completeness after a cross—the merino sheep or the fantail pigeon, for example. These exceptions may still be plausibly ascribed to the interference of a multitude of factors, a suggestion not easy to disprove; though it seems to me equally likely that segregation has been in reality imperfect. Of the descent of quantitative characters we still know practically nothing. These and hosts of difficult cases remain almost untouched. In particular the discovery of E. Baur, and the evidence of Winkler in regard to his "graft hybrids," both showing that the sub-epidermal layer of a plant—the layer from which the germ-cells are derived—may bear exclusively the characters of a part only of the soma, give hints of curious complications, and suggest that in plants at least the interrelations between soma and gamete may be far less simple than we have supposed. Nevertheless, speaking generally, we see nothing to indicate that qualitative characters descend, whether in plants or animals, according to systems which are incapable of factorial representation.

The body of evidence accumulated by this method of analysis is now very large, and is still growing fast by the labours of many workers. Progress is also beginning along many novel and curious lines. The details are too technical for inclusion here. Suffice it to say that not only have we proof that segregation affects a vast range of characteristics, but in the course of our analysis phenomena of most unexpected kinds have been encountered. Some of these things twenty years ago must have seemed inconceivable. For example, the two sets of sex organs, male and female, of the same plant may not be carrying the same characteristics; in some animals characteristics, quite independent of sex, may be distributed solely or predominantly to one sex; in certain species the male may be breeding true to its own type, while the female is permanently mongrel, throwing off eggs of a distinct variety in addition to those of its own type; characteristics, essentially independent, may be associated in special combinations which are largely retained in the next generation, so that among the grandchildren there is numerical preponderance of those combinations which existed in the grandparents—a discovery which introduces us to a new phenomenon of polarity in the organism.

We are accustomed to the fact that the fertilised egg has a polarity, a front and hind end for example; but we have now to recognise that it, or the primitive germinal cells formed from it, may have another polarity shown in the groupings of the parental elements. I am entirely sceptical as to the occurrence of segregation solely in the maturation of the germ-cells,* preferring at present to regard it as a special case of that patch-work condition we see in so many plants. These mosaics may break up, emitting bud-sports at various cell-divisions, and I suspect that the great regularity seen in the F_2 ratios of the cereals, for example, is a consequence of very late segregation, whereas the excessive irregularity found in other cases

* The fact that in certain plants the male and female organs respectively carry distinct factors may be quoted as almost decisively negativing the suggestion that segregation is confined to the reduction division.

may be taken to indicate that segregation can happen at earlier stages of differentiation.

The paradoxical descent of colour-blindness and other sex-limited conditions—formerly regarded as an inscrutable caprice of nature—has been represented with approximate correctness, and we already know something as to the way, or, perhaps, I should say ways, in which the determination of sex is accomplished in some of the forms of life—though, I hasten to add, we have no inkling as to any method by which that determination may be influenced or directed. It is obvious that such discoveries have bearings on most of the problems, whether theoretical or practical, in which animals and plants are concerned. Permanence or change of type, perfection of type, purity or mixture of race, "racial development," the succession of forms, from being vague phrases expressing matters of degree, are now seen to be capable of acquiring physiological meanings, already to some extent assigned with precision. For the naturalist—and it is to him that I am especially addressing myself to-day—these things are chiefly significant as relating to the history of organic beings—the theory of Evolution, to use our modern name. They have, as I shall endeavour to show in my second address to be given in Sydney, an immediate reference to the conduct of human society.

I suppose that everyone is familiar in outline with the theory of the Origin of Species which Darwin promulgated. Through the last fifty years this theme of the Natural Selection of favoured races has been developed and expounded in writings innumerable. Favoured races certainly can replace others. The argument is sound, but we are doubtful of its value. For us that debate stands adjourned. We go to Darwin for his incomparable collection of facts. We would fain emulate his scholarship, his width and his power of exposition, but to us he speaks no more with philosophical authority. We read his scheme of Evolution as we would those of Lucretius or of Lamarck, delighting in their simplicity and their courage. The practical and experimental study of Variation and Heredity has not merely opened a new field; it has given a new point of view and new standards of criticism. Naturalists may still be found expounding teleological systems* which would have delighted Dr. Pangloss

* I take the following from the Abstract of a recent Croonian Lecture "On the Origin of Mammals" delivered to the Royal Society:—"In Upper Triassic times the larger Cynodonts preyed upon the large Anomodont, *Kannemeyeria*, and carried on their existence so long as these Anomodonts survived, but died out with them about the end of the Trias or in Rhætic times. The small Cynodonts, having neither small Anomodonts nor small Cotylosaurs to feed on, were forced to hunt the very active long-limbed Thecodonts. The greatly increased activity brought about that series of changes which formed the mammals—the flexible skin with hair, the four-chambered heart and warm blood, the loose jaw with teeth for mastication, an increased development of tactile sensation and a great increase of cerebrum. Not improbably the attacks of the newly-evolved Cynodont or mammalian type brought about a corresponding evolution in the Pseudosuchian Thecodonts which ultimately resulted in the formation of Dinosaurs and Birds." Broom, R., Proc. Roy. Soc. B., 87, p. 88.

himself, but at the present time few are misled. The student of genetics knows that the time for the development of theory is not yet. He would rather stick to the seed-pan and the incubator.

In face of what we now know of the distribution of variability in nature the scope claimed for Natural Selection in determining the fixity of species must be greatly reduced. The doctrine of the survival of the fittest is undeniable so long as it is applied to the organism as a whole, but to attempt by this principle to find value in all definiteness of parts and functions, and in the name of Science to see fitness everywhere is mere eighteenth-century optimism. Yet it was in application to the parts, to the details of specific difference, to the spots on the Peacock's tail, to the colouring of an Orchid flower, and hosts of such examples, that the potency of Natural Selection was urged with the strongest emphasis. Shorn of these pretensions the doctrine of the survival of favoured races is a truism, helping scarcely at all to account for the diversity of species. Tolerance plays almost as considerable a part. By these admissions almost the last shred of that teleological fustian with which Victorian philosophy loved to clothe the theory of Evolution is destroyed. Those who would proclaim that whatever is is right will be wise henceforth to base this faith frankly on the impregnable rock of superstition and to abstain from direct appeals to natural fact.

My predecessor said last year that in physics the age is one of rapid progress and profound scepticism. In at least as high a degree this is true of Biology, and as a chief characteristic of modern evolutionary thought we must confess also to a deep but irksome humility in presence of great vital problems. Every theory of Evolution must be such as to accord with the facts of physics and chemistry, a primary necessity to which our predecessors paid small heed. For them the unknown was a rich mine of possibilities on which they could freely draw. For us it is rather an impenetrable mountain out of which the truth can be chipped in rare and isolated fragments. Of the physics and chemistry of life we know next to nothing. Somehow the characters of living things are bound up in properties of colloids, and are largely determined by the chemical powers of enzymes, but the study of these classes of matter have only just begun. Living things are found by a simple experiment to have powers undreamt of, and who knows what may be behind?

Naturally we turn aside from generalities. It is no time to discuss the origin of the Mollusca or of Dicotyledons, while we are not even sure how it came to pass that *Primula obconica* has in twenty-five years produced its abundant new forms almost under our eyes. Knowledge of heredity has so reacted on our conceptions of variation that very competent men are even denying that variation in the old sense is a genuine occurrence at all. Variation is postulated as the basis of all evolutionary change. Do we then as a matter of fact find in the world about us variations occurring of such a kind as to warrant faith in a contemporary progressive Evolution? Till lately most of us would have said "yes" without misgiving. We should have pointed, as Darwin did, to the immense

range of diversity seen in many wild species, so commonly that the difficulty is to define the types themselves. Still more conclusive seemed the profusion of forms in the various domesticated animals and plants, most of them incapable of existing even for a generation in the wild state, and therefore fixed unquestionably by human selection. These, at least, for certain, are new forms, often distinct enough to pass for species, which have arisen by variation. But when analysis is applied to this mass of variation the matter wears a different aspect. Closely examined, what is the "variability" of wild species? What is the natural fact which is denoted by the statement that a given species exhibits much variation? Generally one of two things: either that the individuals collected in one locality differ among themselves; or perhaps more often that samples from separate localities differ from each other. As direct evidence of variation it is clearly to the first of these phenomena that we must have recourse—the heterogeneity of a population breeding together in one area. This heterogeneity may be in any degree, ranging from slight differences that systematists would disregard, to a complex variability such as we find in some moths, where there is an abundance of varieties so distinct that many would be classified as specific forms but for the fact that all are freely breeding together. Naturalists formerly supposed that any of these varieties might be bred from any of the others. Just as the reader of novels is prepared to find that any kind of parents might have any kind of children in the course of the story, so was the evolutionist ready to believe that any pair of moths might produce any of the varieties included in the species. Genetic analysis has disposed of all these mistakes. We have no longer the smallest doubt that in all these examples the varieties stand in a regular descending order, and that they are simply terms in a series of combinations of factors separately transmitted, of which each may be present or absent.

The appearance of contemporary variability proves to be an illusion. Variation from step to step in the series must occur either by the addition or by the loss of a factor. Now, of the origin of new forms *by loss* there seems to me to be fairly clear evidence, but of the *contemporary acquisition* of any new factor I see no satisfactory proof, though I admit there are rare examples which may be so interpreted. We are left with a picture of variation utterly different from that which we saw at first. Variation now stands out as a definite physiological event. We have done with the notion that Darwin came latterly to favour, that large differences can arise by accumulation of small differences. Such small differences are often mere ephemeral effects of conditions of life, and as such are not transmissible; but even small differences, when truly genetic, are factorial like the larger ones, and there is not the slightest reason for supposing that they are capable of summation. As to the origin or source of these positive separable factors, we are without any indication or surmise. By their effects we know them to be definite, as definite, say, as the organisms which produce diseases; but how they arise and how they come to take part in the composition of the

living creature so that when present they are treated in cell-division as constituents of the germs, we cannot conjecture.

It was a commonplace of evolutionary theory that at least the domestic animals have been developed from a few wild types. Their origin was supposed to present no difficulty. The various races of Fowl, for instance, all came from *Gallus bankiva*, the Indian Jungle-Fowl. So we are taught; but try to reconstruct the steps in their evolution and you realise your hopeless ignorance. To be sure there are breeds, such as Black-red Game and Brown Leghorns, which have the colours of the Jungle-Fowl, though they differ in shape and other respects. As we know so little as yet of the genetics of shape, let us assume that those transitions could be got over. Suppose, further, as is probable, that the absence of the maternal instinct in the Leghorn is due to loss of one factor which the Jungle-Fowl possesses. So far we are on fairly safe ground. But how about White Leghorns? Their origin may seem easy to imagine, since white varieties have often arisen in well-authenticated cases. But the white of White Leghorns is not, as white in nature often is, due to the loss of the colour-elements, but to the action of something which inhibits their expression. Whence did that something come? The same question may be asked respecting the heavy breeds, such as Malays or Indian Game. Each of these is a separate introduction from the East. To suppose that these, with their peculiar combs and close feathering, could have been developed from pre-existing European breeds is very difficult. On the other hand, there is no wild species now living any more like them. We may, of course, postulate that there was once such a species, now lost. That is quite conceivable, though the suggestion is purely speculative. I might thus go through the list of domesticated animals and plants of ancient origin and again and again we should be driven to this suggestion, that many of their distinctive characters must have been derived from some wild original now lost. Indeed, to this unsatisfying conclusion almost every careful writer on such subjects is now reduced. If we turn to modern evidence the case looks even worse. The new breeds of domestic animals made in recent times are the carefully selected products of recombination of pre-existing breeds. Most of the new varieties of cultivated plants are the outcome of deliberate crossing. There is generally no doubt in the matter. We have pretty full histories of these crosses in Gladiolus, Orchids, Cineraria, Begonia, Calceolaria, Pelargonium, &c. A very few certainly arise from a single origin. The Sweet Pea is the clearest case, and there are others which I should name with hesitation. The Cyclamen is one of them, but we know that efforts to cross Cyclamens were made early in the cultural history of the plant, and they may very well have been successful. Several plants for which single origins are alleged, such as the Chinese Primrose, the Dahlia, and Tobacco, came to us in an already domesticated state, and their origins remain altogether mysterious. Formerly single origins were generally presumed, but at the present time numbers of the chief products of domestication, Dogs, Horses, Cattle,

Sheep, Poultry, Wheat, Oats, Rice, Plums, Cherries, have in turn been accepted as "polyphyletic" or, in other words, derived from several distinct forms. The reason that has led to these judgments is that the distinctions between the chief varieties can be traced as far back as the evidence reaches, and that these distinctions are so great, so far transcending anything that we actually know variation capable of effecting, that it seems pleasanter to postpone the difficulty, relegating the critical differentiation to some misty antiquity into which we shall not be asked to penetrate. For it need scarcely be said that this is mere procrastination. If the origin of a form under domestication is hard to imagine, it becomes no easier to conceive of such enormous deviations from type coming to pass in the wild state. Examine any two thoroughly distinct species which meet each other in their distribution, as, for instance, *Lychnis diurna* and *vespertina* do. In areas of overlap are many intermediate forms. These used to be taken to be transitional steps, and the specific distinctness of *vespertina* and *diurna* was on that account questioned. Once it is known that these supposed intergrades are merely mongrels between the two species the transition from one to the other is practically beyond our powers of imagination to conceive. If both these can survive, why has their common parent perished? Why when they cross do they not reconstruct it instead of producing partially sterile hybrids? I take this example to show how entirely the facts were formerly misinterpreted.

When once the idea of a true-breeding—or, as we say, homozygous—type is grasped, the problem of variation becomes an insistent oppression. What can make such a type vary? We know, of course, one way by which novelty can be introduced—by crossing. Cross two well-marked varieties—for instance, of Chinese Primula—each breeding true, and in the second generation by mere recombination of the various factors which the two parental types severally introduced, there will be a profusion of forms, utterly unlike each other, distinct also from the original parents. Many of these can be bred true, and if found wild would certainly be described as good species. Confronted by the difficulty I have put before you, and contemplating such amazing polymorphism in the second generation from a cross in *Antirrhinum*, Lotsy has lately with great courage suggested to us that all variation may be due to such crossing. I do not disguise my sympathy with this effort. After the blind complacency of conventional evolutionists it is refreshing to meet so frank an acknowledgment of the hardness of the problem. Lotsy's utterance will at least do something to expose the artificiality of systematic zoology and botany. Whatever might or might not be revealed by experimental breeding, it is certain that without such tests we are merely guessing when we profess to distinguish specific limits and to declare that this is a species and that a variety. The only definable unit in classification is the homozygous form which breeds true. When we presume to say that such and such differences are trivial and such others valid, we are commonly embarking on a course for which there is no physiological warrant. Who could have

foreseen that the Apple and the Pear—so like each other that their botanical differences are evasive—could not be crossed together, though species of Antirrhinum so totally unlike each other as *majus* and *molle* can be hybridized, as Baur has shown, without a sign of impaired fertility? Jordan was perfectly right. The true-breeding forms which he distinguished in such multitudes are real entities, though the great systematists, dispensing with such laborious analysis, have pooled them into arbitrary Linnean species, for the convenience of collectors and for the simplification of catalogues. Such pragmatical considerations may mean much in the museum, but with them the student of the physiology of variation has nothing to do. These "little species," finely cut, true-breeding, and innumerable mongrels between them, are what he finds when he examines any so-called variable type. On analysis the semblance of variability disappears, and the illusion is shown to be due to segregation and recombination of series of factors on pre-determined lines. As soon as the "little species" are separated out they are found to be fixed. In face of such a result we may well ask with Lotsy, is there such a thing as spontaneous variation anywhere? His answer is that there is not.

Abandoning the attempt to show that positive factors can be added to the original stock, we have further to confess that we cannot often actually prove variation by loss of factor to be a real phenomenon. Lotsy doubts whether even this phenomenon occurs. The sole source of variation, in his view, is crossing. But here I think he is on unsafe ground. When a well-established variety like "Crimson King" Primula, bred by Messrs. Sutton in thousands of individuals, gives off, as it did a few years since, a salmon-coloured variety, "Coral King," we might claim this as a genuine example of variation by loss. The new variety is a simple recessive. It differs from "Crimson King" only in one respect, the loss of a single colour-factor, and, of course, bred true from its origin. To account for the appearance of such a new form by any process of crossing is exceedingly difficult. From the nature of the case there can have been no cross since "Crimson King" was established, and hence the salmon must have been concealed as a recessive from the first origin of that variety, even when it was represented by very few individuals, probably only by a single one. Surely, if any of these had been heterozygous for salmon this recessive could hardly have failed to appear during the process of self-fertilisation by which the stock would be multiplied, even though that selfing may not have been strictly carried out. Examples like this seem to me practically conclusive.* They can be challenged, but not, I think, successfully. Then again in regard to those variations in number and division of parts which we call meristic, the reference of these to original cross-breeding is surely barred by the circumstances in which they often occur. There remain also the rare examples mentioned already in

* The numerous and most interesting "mutations" recorded by Professor T. H. Morgan and his colleagues in the fly, *Drosophila*, may also be cited as unexceptionable cases.

which a single wild origin may with much confidence be assumed. In spite of repeated trials, no one has yet succeeded in crossing the Sweet Pea with any other leguminous species. We know that early in its cultivated history it produced at least two marked varieties which I can only conceive of as spontaneously arising, though, no doubt, the profusion of forms we now have was made by the crossing of those original varieties. I mention the Sweet Pea thus prominently for another reason, that it introduces us to another though subsidiary form of variation, which may be described as a *fractionation* of factors. Some of my Mendelian colleagues have spoken of genetic factors as permanent and indestructible. Relative permanence in a sense they have, for they commonly come out unchanged after segregation. But I am satisfied that they may occasionally undergo a quantitative disintegration, with the consequence that varieties are produced intermediate between the integral varieties from which they were derived. These disintegrated conditions I have spoken of as subtraction—or reduction—stages. For example, the Picotee Sweet Pea, with its purple edges, can surely be nothing but a condition produced by the factor which ordinarily makes the fully purple flower, quantitatively diminished. The pied animal, such as the Dutch Rabbit, must similarly be regarded as the result of partial defect of the chromogen from which the pigment is formed, or conceivably of the factor which effects its oxidation. On such lines I think we may with great confidence interpret all those intergrading forms which breed true and are not produced by factorial interference.

It is to be inferred that these fractional degradations are the consequence of irregularities in segregation. We constantly see irregularities in the ordinary meristic processes, and in the distribution of somatic differentiation. We are familiar with half segments, with imperfect twinning, with leaves partially petaloid, with petals partially sepaloid. All these are evidences of departures from the normal regularity in the rhythms of repetition, or in those waves of differentiation by which the qualities are sorted out among the parts of the body. Similarly, when in segregation the qualities are sorted out among the germ-cells in certain critical cell-divisions, we cannot expect these differentiating divisions to be exempt from the imperfections and irregularities which are found in all the grosser divisions that we can observe. If I am right, we shall find evidence of these irregularities in the association of unconformable numbers with the appearance of the novelties which I have called fractional. In passing, let us note how the history of the Sweet Pea belies those ideas of a continuous evolution with which we had formerly to contend. The big varieties came first. The little ones have arisen later, as I suggest by fractionation. Presented with a collection of modern Sweet Peas, how prettily would the devotees of Continuity have arranged them in a graduated series, showing how every intergrade could be found, passing from the full colour of the wild Sicilian species in one direction to white, in the other to the deep purple of "Black Prince," though happily we know these two to be among the earliest to have appeared.

Having in view these and other considerations which might be developed, I feel no reasonable doubt that though we may have to forgo a claim to variations by addition of factors, yet variation both by loss of factors and by fractionation of factors is a genuine phenomenon of contemporary nature. If then we have to dispense, as seems likely, with any addition from without we must begin seriously to consider whether the course of Evolution can at all reasonably be represented as an unpacking of an original complex which contained within itself the whole range of diversity which living things present. I do not suggest that we should come to a judgment as to what is or is not probable in these respects. As I have said already, this is no time for devising theories of Evolution, and I propound none. But as we have got to recognise that there has been an Evolution, that somehow or other the forms of life have arisen from fewer forms, we may as well see whether we are limited to the old view that evolutionary progress is from the simple to the complex, and whether after all it is conceivable that the process was the other way about. When the facts of genetic discovery became familiarly known to biologists, and cease to be the preoccupation of a few, as they still are, many and long discussions must inevitably arise on the question, and I offer these remarks to prepare the ground. I ask you simply to open your minds to this possibility. It involves a certain effort. We have to reverse our habitual modes of thought. At first it may seem rank absurdity to suppose that the primordial form or forms of protoplasm could have contained complexity enough to produce the divers types of life. But is it easier to imagine that these powers could have been conveyed by extrinsic additions? Of what nature could these additions be? Additions of material cannot surely be in question. We are told that salts of iron in the soil may turn a pink hydrangea blue. The iron cannot be passed on to the next generation. How can the iron multiply itself? The power to assimilate the iron is all that can be transmitted. A disease-producing organism like the pebrine of silkworms can in a very few cases be passed on through the germ-cells. Such an organism can multiply and can produce its characteristic effects in the next generation. But it does not become part of the invaded host, and we cannot conceive it taking part in the geometrically ordered processes of segregation. These illustrations may seem too gross; but what refinement will meet the requirements of the problem, that the thing introduced must be, as the living organism itself is, capable of multiplication and of subordinating itself in a definite system of segregation? That which is conferred in variation must rather itself be a change, not of material, but of arrangement, or of motion. The invocation of additions extrinsic to the organism does not seriously help us to imagine how the power to change can be conferred, and if it proves that hope in that direction must be abandoned, I think we lose very little. By the re-arrangement of a very moderate number of things we soon reach a number of possibilities practically infinite.

That primordial life may have been of small dimensions need not

disturb us. Quantity is of no account in these considerations. Shakespeare once existed as a speck of protoplasm not so big as a small pin's head. To this nothing was added that would not equally well have served to build up a baboon or a rat. Let us consider how far we can get by the process of removal of what we call "epistatic" factors, in other words those that control, mask, or suppress underlying powers and faculties. I have spoken of the vast range of colours exhibited by modern Sweet Peas. There is no question that these have been derived from the one wild bi-colour form by a process of successive removals. When the vast range of form, size, and flavour to be found among the cultivated apples is considered it seems difficult to suppose that all this variety is hidden in the wild crab-apple. I cannot positively assert that this is so, but I think all familiar with Mendelian analysis would agree with me that it is probable, and that the wild crab contains presumably inhibiting elements which the cultivated kinds have lost. The legend that the seedlings of cultivated apples become crabs is often repeated. After many inquiries among the raisers of apple seedlings I have never found an authentic case—once only even an alleged case, and this on inquiry proved to be unfounded. I have confidence that the artistic gifts of mankind will prove to be due not to something added to the make-up of an ordinary man, but to the absence of factors which in the normal person inhibit the development of these gifts. They are almost beyond doubt to be looked upon as *releases* of powers normally suppressed. The instrument is there, but it is "stopped down." The scents of flowers or fruits, the finely repeated divisions that give its quality to the wool of the Merino, or in an analogous case the multiplicity of quills to the tail of the fantail pigeon, are in all probability other examples of such releases. You may ask what guides us in the discrimination of the positive factors and how we can satisfy ourselves that the appearance of a quality is due to loss. It must be conceded that in these determinations we have as yet recourse only to the effects of dominance. When the tall pea is crossed with the dwarf, since the offspring is tall we say that the tall parent passed a factor into the cross-bred which makes it tall. The pure tall parent had two doses of this factor; the dwarf had none; and since the cross-bred is tall we say that one dose of the dominant tallness is enough to give the full height. The reasoning seems unanswerable. But the commoner result of crossing is the production of a form intermediate between the two pure parental types. In such examples we see clearly enough that the full parental characteristics can only appear when they are homozygous—formed from similar germ-cells, and that one dose is insufficient to produce either effect fully. When this is so we can never be sure which side is positive and which negative. Since, then, when dominance is incomplete we find ourselves in this difficulty, we perceive that the amount of the effect is our only criterion in distinguishing the positive from the negative, and when we return even to the example of the tall and dwarf peas the matter is not so certain as it seemed. Professor Cockerell lately found among thousands of yellow sun-

flowers one which was partly red. By breeding he raised from this a form wholly red. Evidently the yellow and the wholly red are the pure forms, and the partially red is the heterozygote. We may then say that the yellow is *YY* with two doses of a positive factor which inhibits the development of pigment; the red is *yy*, with no dose of the inhibitor; and the partially red are *Yy*, with only one dose of it. But we might be tempted to think the red was a positive characteristic, and invert the expressions, representing the red as *RR*, the partly red as *Rr*, and the yellow as *rr*. According as we adopt the one or the other system of expression we shall interpret the evolutionary change as one of loss or as one of addition. May we not interpret the other apparent new dominants in the same way? The white dominant in the fowl or in the Chinese Primula can inhibit colour. But may it not be that the original coloured fowl or Primula had two doses of a factor which inhibited this inhibitor. The Pepper Moth, *Amphidasys betularia*, produced in England about 1840 a black variety, then a novelty, now common in certain areas, which behaves as a full dominant. The pure blacks are no blacker than the cross-bred. Though at first sight it seems that the black *must* have been something added, we can without absurdity suggest that the normal is the term in which two doses of inhibitor are present, and that in the absence of one of them the black appears.

In spite of seeming perversity, therefore, we have to admit that there is no evolutionary change which in the present state of our knowledge we can positively declare to be not due to loss. When this has been conceded it is natural to ask whether the removal of inhibiting factors may not be invoked in alleviation of the necessity which has driven students of the domestic breeds to refer their diversities to multiple origins. Something, no doubt, is to be hoped for in that direction, but not until much better and more extensive knowledge of what variation by loss may effect in the living body can we have any real assurance that this difficulty has been obviated. We should be greatly helped by some indication as to whether the origin of life has been single or multiple. Modern opinion is, perhaps, inclining to the multiple theory, but we have no real evidence. Indeed, the problem still stands outside the range of scientific investigation, and when we hear the spontaneous formation of formaldehyde mentioned as a possible first step in the origin of life, we think of Harry Lauder in the character of a Glasgow schoolboy pulling out his treasures from his pocket—"That's a wassher—for makkin' motor cars"!

As the evidence stands at present all that can be safely added in amplification of the evolutionary creed may be summed up in the statement that variation occurs as a definite event often producing a sensibly discontinuous result; that the succession of varieties comes to pass by the elevation and establishment of sporadic groups of individuals owing their origin to such isolated events; and that the change which we see as a nascent variation is often, perhaps always, one of loss. Modern research lends not the smallest encouragement or sanction to the view that gradual evolution occurs by the transformation of masses of individuals, though that fancy has fixed itself

on popular imagination. The isolated events to which variation is due are evidently changes in the germinal tissues, probably in the manner in which they divide. It is likely that the occurrence of these variations is wholly irregular, and as to their causation we are absolutely without surmise or even plausible speculation. Distinct types once arisen, no doubt a profusion of the forms called species have been derived from them by simple crossing and subsequent recombination. New species may be now in course of creation by this means, but the limits of the process are obviously narrow. On the other hand, we see no changes in progress around us in the contemporary world which we can imagine likely to culminate in the evolution of forms distinct in the larger sense. By intercrossing Dogs, Jackals, and Wolves, new forms of these types can be made, some of which may be species, but I see no reason to think that from such material a Fox could be bred in indefinite time, or that Dogs could be bred from Foxes.

Whether Science will hereafter discover that certain groups can by peculiarities in their genetic physiology be declared to have a prerogative quality justifying their recognition as species in the old sense, and that the differences of others are of such a subordinate degree that they may in contrast be termed varieties, further genetic research alone can show. I myself anticipate that such a discovery will be made, but I cannot defend the opinion with positive conviction.

Somewhat reluctantly, and rather from a sense of duty, I have devoted most of this Address to the evolutionary aspects of genetic research. We cannot keep these things out of our heads, though sometimes we wish we could. The outcome, as you will have seen, is negative, destroying much that till lately passed for gospel. Destruction may be useful, but it is a low kind of work. We are just about where Boyle was in the seventeenth century. We can dispose of Alchemy, but we cannot make more than a quasi-chemistry. We are awaiting our Priestley and our Mendeléeff. In truth it is not these wider aspects of genetics that are at present our chief concern. They will come in their time. The great advances of science are made like those of evolution, not by imperceptible mass-improvement, but by the sporadic birth of penetrative genius. The journeymen follow after him, widening and clearing up, as we are doing along the track that Mendel found.

NOTES AND QUERIES.

AVES.

Norfolk Redshanks.—Reference was made in the July number of the 'Zoologist' (*ante*, p. 275) to the early appearance of some young Redshanks (*Totanus calidris*) in the east of Norfolk. As I was the actual observer, some further facts concerning this record may be appreciated by ornithologists. I found the birds under question frequenting the shore of a small, still, piece of water close to Breydon. They were foolishly tame, and on the afternoon of April 25th (1913) gave me ample opportunity for close observation. With other signs of immaturity, I then particularly noticed the *yellowish legs*. These Redshanks remained in the same locality for some few days after the 25th. Curiously enough, it was not until Mr. Gurney had noticed the entry concerning them in my diary that I realized how premature the date was for the occurrence, and now I really cannot remember whether there were three or four of them.—F. N. Chasen (North Denes Road, Great Yarmouth).

Thrush Swimming.—As is well known, most birds can swim, at least when in peril. At Dorking one September day I saw a Thrush fall into the water about forty yards from the opposite bank, and flapping its wings on the surface and *apparently* using its legs as propellers, safely reached the bushes on the other side of the river.—W. L. Distant.

PISCES.

Notes by an Angler.—The following notes refer to fishing days on the River Mole, on a stretch from Gatwick to Dorking. Pliny the younger in one of his letters confesses to have turned sportsman, and writes, "I advise you whenever you hunt in future to take your tablets with you as well as your casket and flask." Substitute the words "angling" and "note-book," and this is a good angler's exhortation. The following are some of my jottings on happy days with the rod.

Gudgeon (*Gobio fluviatilis*).—This small fish is generally described as found on the bottom where the current is not too strong

and the water moderately shallow, which in a general way is true for the Mole. But there is a great exception in the broader and deeper parts of the river. For about an hour in the afternoon an angler may derive some surprise if he fishes with a line near the surface of some deep hole, say twelve to fourteen feet in depth, such a one as is in my mind at this moment. A number of small fish, Roach, Chubb, Rudd, and also Gudgeon, may then be caught, and with ease and rapidity, about two feet or less below the surface. The first Gudgeon that I took from this deep hole I thought, to my surprise, must have come from the bottom, but subsequent experience showed me that it must have followed the bait from the surface, and I have tried the experiment of shallow fishing (in the afternoon) many times since, and took Gudgeon among the other fishes. Where the stream is shallow the Gudgeon frequents the bottom in the Mole as elsewhere, but in the deeper parts it becomes a surface fish towards the afternoon.

Butterflies eaten by Bream.—I had long wondered whether lepidopterous insects could be added to the prey of our freshwater fishes, but during a long angling experience had never been able to make such an observation. On one fine morning at Dorking, and within half a hour of each other, I saw two common white butterflies fall in the river, and at once seized and swallowed by patrolling Bream.—W. L. Distant.

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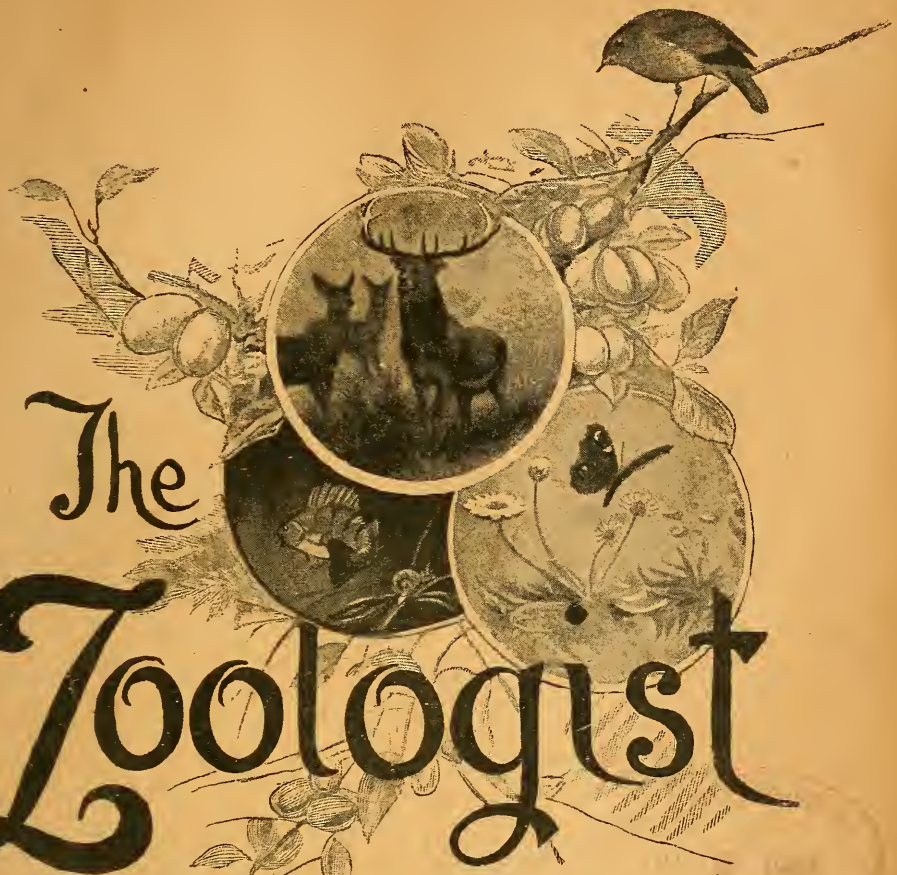

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THE ZOOLOGIST

No. 879.—September 15th, 1914.

MIGRATORY AND OTHER ORNITHOLOGICAL NOTES FROM LOWESTOFT.

By F. C. Cook.

The following observations were made in the neighbourhood of Lowestoft from June, 1913, to June, 1914:—

June 1st.—A Swan was seen flying southwards uttering harsh cries, to which it was keeping time with its wings.

5th.—Swifts were passing southwards almost continuously during the afternoon. A Curlew was seen making southwards, and a Ringed Plover had arrived on the Denes. Large numbers of Swifts were again seen passing southward on the 7th.

8th.—Three Ringed Plovers flying south along the shore.

14th.—I visited the nesting-places of the Terns between Kessingland and Southwold. There about twenty-five to thirty pairs of Lesser Terns nesting, but I could not find the Common Tern actually nesting, although several were seen. At Benacre we flushed a Nightjar off her two eggs, which were laid on the bare sand in the midst of a number of yellow-horned poppies. Several pairs of Ringed Plovers were seen which had evidently got young ones. A Grey Wagtail (*Motacilla melanope*) seen busily feeding at the tide-mark. Nesting in the sand-cliffs were a large number of Sand-Martins; and below, under the nest-holes, we found some dozens of the young birds lying dead in all stages of plumage. Query—Had these young birds perished in the nest and been ejected by their parents, or had they by their own endeavours got to the entrance of the hole and fallen out?

16th.—Several flocks of Starlings were noted going south; each flock contained from ten to thirty birds. A pair of Red-backed Shrikes seen. More Starlings were going south on the 17th.

22nd.—A large number of Curlews were heard over the town at night.

29th.—Cockchafers swarming the hedgerows on the outskirts of the town, upon which a number of Noctule Bats were feeding. There were several Swifts "hawking" in the vicinity, but it is, I should imagine, impossible that they were catching Cockchafers.

July 1st.—Two Wheatears in immature plumage were seen on the shore.

The weather during the early part of the month was very cold and dull, the wind being northerly. The nights were made weird by the cries of numerous waders; Ringed Plovers, Dunlins, and Curlews being heard among others.

Several Goldfinches frequented the coarse thistle-patches on the Denes for a week or so during the month.

16th.—Four Lesser Redpolls were seen on the Denes.

August 4th.—One Grey Wagtail seen at Beccles.

9th.—An immature Cuckoo, a Red-backed Shrike, a Wheatear, and a flock of Common Terns had appeared. There was also a considerable increase in the number of Goldfinches.

13th.—Six Wheatears, a young Red-backed Shrike, a Willow-Wren, and a common Whitethroat had arrived. A large number of Common Terns were also seen.

Three Wheatears and fewer Terns were seen on the 14th.

16th.—By swimming boldly into the harbour, and away up the river, a Guillemot caused some considerable diversion among the visitors.

During the past week or so numbers of Curlews were heard passing over the town at night. On nights when the moon was up, the notes of these waders were heard less frequently and appeared to be from a greater altitude.

17th.—A considerable increase was noted in the number of Stonechats, Wheatears, Common Whitethroats, and Terns. A flock of seven Curlews were observed flying south.

18th.—A very strong north wind. Two Oystercatchers, two

flocks of Ducks, and several Terns and Gulls flying north along the shore. About fifty Common Terns on the beach.

20th.—Two large straggling flocks of Sand-Martins flying south fairly high. An increase was noted in the number of Terns. While feeding peacefully on the tide-mark two Rooks were attacked by a Common Tern, which darted down at them from a height, and eventually drove them off the beach.

21st.—A Land-Rail came to hand, having struck the telegraph wires the night previous.

24th.—An increase in the number of Meadow-Pipits was noted, while a number of Sand-Martins were going south in large flocks.

26th.—A great movement of Sand-Martins was seen, the air seemed at times alive with them, all going south; a few Swallows and House-Martins were also with them. Several Common Whitethroats and two Lesser Whitethroats seen, also two Wheatears and two Willow-Wrens; a few small flocks of Linnets, one flock of Greenfinches, and two Ray's Wagtails were observed going southwards.

27th.—A Pied Flycatcher and a Lesser Whitethroat appeared. A few Sand-Martins were observed going south.

28th.—A considerable number of Wheatears and Meadow-Pipits had arrived; three Common Whitethroats and a Willow-Wren were also seen.

30th.—A decrease was noted in the number of Wheatears, while Meadow-Pipits were observed in about the same numbers. One Pied Flycatcher and a number of Mistle-Thrushes were seen. At night the notes of Redshanks, Ringed Plovers, and Curlews were almost incessantly heard.

September 1st.—An immature female Ferruginous Duck (*Fuligula nyroca*) was shot at Hopton by Mr. Knight.

2nd.—A Pied Flycatcher and a Willow-Wren seen. A Whimbrel was heard passing over the town at night.

3rd.—A number of Wheatears, several Pied Wagtails, four Pied Flycatchers, and a Willow-Wren were noted. Redstarts and Pied Flycatchers were seen also further inland later in the day.

Dr. Ticehurst received a batch of about forty birds from a fishing-smack just in from sea; among them were an Ortolan

Bunting, a Golden Plover, Pied Flycatchers, Willow-Wrens, Whitethroats, Tree-Pipits, and Meadow-Pipits.

4th.—A great increase of Wheatears and Redstarts. A Wryneck, two Whinchats, a Common Whitethroat, a Tree-Pipit, and a Pied Flycatcher had also appeared. Six Kestrels were observed hovering within a few yards of each other; a flock of fourteen Whimbrel seen flying south. Several Sand-Martins, Swallows, and House-Martins seen.

A Honey-Buzzard was taken at sea, and came into the possession of Dr. Ticehurst.

5th.—I had a splendid view of a Bluethroat (*Cyanecula suecica*) that was skulking in the paths of a garden which overlooks the sea, and on one occasion it alighted on a tree within a yard or so of where I was standing. Wheatears, Whinchats, and Swallows were observed in about the same numbers as the 4th, while an increase was noted in Redstarts, Pied Flycatchers, Common Whitethroats, and Lesser Whitethroats. Two Kestrels and a Sparrow-Hawk seen.

6th.—Three Bluethroats were observed on the North Denes; they were exceedingly shy, and were it not for the fact that I was watching closely for this species they undoubtedly would have escaped detection, for practically the only view one can get of them is the flash of the red rump as they disappear round a bend of one of the paths that form a network among the furze covering parts of the Denes, though on one occasion I came upon one so suddenly that it stood facing me for several seconds, being evidently too frightened to move, thereby giving me a most satisfactory view of itself.

A Golden Plover and a Common Sandpiper were brought to me from a fishing-boat, having been taken at sea. A local taxidermist has had nine Kestrels brought in from sea recently; Dr. Ticehurst has also had three.

7th.—Two Bluethroats seen; the number of Pied Flycatchers, Redstarts, and Whitethroats had considerably decreased.

A number of migrants having been observed by our fishermen at sea, I decided to spend a week out with one of the fishing-smacks, but was most unfortunate in not seeing a single migrant during the whole week, the weather having become too fine for them to come on board. A few notes on the fishes, &c., that I

observed have been included with Mr. Patterson's notes (*ante*, p. 17).

15th.—Linnets, Meadow-Pipits, and Starlings were noted in fairly large numbers, while a few flocks of Linnets and Meadow-Pipits were seen to drop in from the north. A Garden-Warbler and a Lesser Whitethroat seen, also several Wheatears. An increase in the number of Blue-Tits and Hedge-Sparrows was noticed. Numbers of Swallows and House-Martins observed.

17th.—A large number of Swallows and Martins and two Pied Wagtails passing southwards. Linnets were observed in great numbers. Several Wheatears, a Willow-Wren, a few Meadow-Pipits, and six Pied Wagtails seen; while Song-Thrushes, Blackbirds, Sky-Larks, and Hedge-Sparrows were observed where previously none had been seen.

18th.—A great decrease noted in the number of Linnets. An increase of Meadow-Pipits, several flocks dropping in from the north. A great mustering of Starlings was observed. About the same number of Wheatears and Pied Wagtails, Swallows, House- and Sand-Martins seen.

19th.—Still more Linnets; Starlings and Pipits appear to be in same numbers as yesterday. I heard a Starling mimic the Curlew's note almost to perfection. A flock of Greenfinches had appeared, while a decrease of Wheatears and Pied Wagtails was noted. A Willow-Wren and a few Swallows and House-Martins seen.

21st.—Several Reed-Buntings had arrived on the Denes, and a small flock was observed going north. A number of Sky-Larks and Linnets had appeared, while several flocks of each were going north, as were also a number of Pied Wagtails. Meadow-Pipits were observed in fair numbers, a few making southwards. Starlings were still common. Two Mistle-Thrushes and two Song-Thrushes moving south together. A few Wheatears, one Willow-Wren, numbers of Swallows and House-Martins seen.

23rd.—Still several Reed-Buntings; a flock was seen to drop in from the north, while on the Denes this species frequents the marram, upon the seed-heads of which several were observed feeding. Great numbers of Linnets and Starlings had arrived, flocks of both species going south, also several flocks of Linnets

going north. A few flocks of Sky-Larks going north, and several flocks of Tree-Sparrows were noted going south. A flock of Great Tits was seen to drop in from the south, and two Coal-Tits had arrived. A Willow-Wren, a few Wheatears, and hundreds of Swallows and House-Martins were seen.

24th.—A great number of Wheatears had arrived, among them were several of the Greenland form. Two Grey Wagtails, a Chiffchaff, and a few Pied Wagtails were seen. The number of Linnets and Meadow-Pipits had decreased; several flocks of Linnets flying southwards. A few Swallows and House-Martins seen.

27th.—Several flocks of Greenfinches, large numbers of Meadow-Pipits, and a few flocks of Linnets moving southwards, a few Linnets were also noted going north. Three Grey Wagtails seen flying south; several Pied Wagtails had arrived. Sky-Larks and Reed-Buntings were dropping in from the north; Goldcrests, Blue Tits, and Great Tits had arrived in fair numbers, and an increase of Mistle-Thrushes, Song-Thrushes and Hedge-Sparrows was also noted. A few Swallows and House-Martins making southwards, one Sparrow-Hawk seen; still large numbers of Wheatears.

28th.—Linnets were moving in flocks both north and south; Meadow-Pipits seen in fairly large numbers. A decrease in the number of Wheatears was noted; several Pied Wagtails, Swallows and House-Martins seen.

30th.—Still large numbers of Pipits, a few going south in flocks, as were also several Linnets. Only two Wheatears and very few Pied Wagtails seen. Greenfinches, Yellow Buntings, Swallows and House-Martins seen in small numbers.

October 1st.—No movement of birds was noted; numbers of Sky-Larks and Meadow-Pipits on the Denes. Two Wheatears, a Pied Wagtail, and a few House-Martins seen.

2nd.—Picked up a Hooded Crow on the tide-mark at Corton.

3rd.—Long-tailed Tits and Goldcrests were observed in fair numbers in the gardens overlooking the sea.

5th.—Linnets, Greenfinches, Mistle-Thrushes, and Meadow-Pipits were moving southwards in flocks; Linnets and Pipits were also noted going north in fair numbers. Two Bramblings observed flying south, and a Golden Plover was seen making

northwards, as was also a small flock of Pied Wagtails. Larks, Starlings, and Reed-Buntings were also moving north, while a few Larks were also going south. A considerable increase in the number of Robins and Hedge-Sparrows was noted; more Goldcrests and several Goldfinches seen. Swallows and House-Martins in large numbers. A number of Redwings were heard passing over the town at night.

8th. — The southward movement consisted of Linnets, Chaffinches, Starlings, Greenfinches and Meadow-Pipits. A flock of Ducks seen going south at sea. Mistle-Thrushes, Goldcrests and a few Goldfinches seen.

9th.—Moving southwards were observed a flock of Hooded Crows, one Brambling, a flock of Tree-Sparrows, and numbers of Linnets and Greenfinches; Linnets were also going north in fair numbers, and hundreds had dropped in upon the Denes. One Reed-Bunting, a Wheatear, several Mistle-Thrushes, Goldcrests, and Chaffinches seen. A flock of about twenty Pied Wagtails and eight Grey Wagtails observed at Oulton.

11th.—Sky-Larks the only species moving; a number of flocks flying south very low along the shore, and some a short way out at sea; the wind was very strong from E.S.E. Two flocks of Larks also arrived in from sea. A great number of Goldcrests had appeared; three Pied Wagtails and one Swallow seen.

13th.—Linnets, Greenfinches, and Larks were going south, while Larks and Tree-Sparrows were also going north. A flock of House-Martins and one Swallow seen. Lapwings were heard passing over at night.

14th.—Larks, Linnets, Greenfinches, Pipits and two Blue Tits were noted going south, while a large flock of Linnets were also passing north. A flock of Reed-Buntings dropped in from the north.

15th.—A flock of seven Hooded Crows came in from sea, and one was observed coasting south. Linnets, Larks and Greenfinches going south; Mistle-Thurshes, Tree-Sparrows and Hedge-Sparrows in two flocks were noted going north. Four Rock-Pipits had arrived. Several young cock Blackbirds seen.

18th.—One Rock-Pipit seen; flocks of Linnets passing both north and south; one flock of Starlings going north.

20th.—The southward movement consisted of Larks, Linnets, Pipits, Chaffinches and Greenfinches, while to the north Tree-Sparrows and Linnets were passing; the notes of House-Sparrows were heard among the migrating flocks of Linnets. Three Reed-Buntings, a Goldfinch, and several Great and Blue Tits had appeared.

23rd.—Linnets, Greenfinches and Chaffinches moving south, and a few flocks of Pipits and Linnets going north. A few flocks of Larks arriving in from sea. A number of Linnets and Starlings on the Denes, also a few Blue Tits and Yellow Buntings, a Grey Wagtail and a Goldfinch seen. In the evening a flock of several hundred Rooks came in from sea at Gorleston.

24th.—The movement of Finches, Larks and Starlings was still in progress, the flocks going both north and south. A Sheld-Duck was seen to come in from sea, as were also several Rooks; a Hooded Crow was also seen on the beach. Redwings were heard passing over the town at night.

26th.—Several flocks of Starlings, Larks and Rooks were observed coming in from over the sea; several flocks of each were also noted coasting south along with Linnets, Greenfinches, Chaffinches and Pipits. A few Siskins were heard among the flocks of Linnets; a flock of Mistle-Thrushes and a few Pied Wagtails making southwards.

28th.—I observed a large flock of Starlings rise from one of the coastal fields, and make away out to sea, flying S.E. Flocks of Larks, Linnets, Pipits and Starlings, and a Curlew noted passing south. An increase in the number of Blackbirds was noticed. The call notes of Redwings were heard at night.

29th.—A great inpouring of Larks and Starlings from sea; flocks of both passing south along with Lapwings and Linnets. A flock of Rooks arrived in at noon. Two Kestrels, several Hooded Crows, Mistle-Thrushes, Goldfinches and Greenfinches on the Denes.

30th.—A large movement of Larks to the south was noted; while Rooks, Linnets, Chaffinches and Greenfinches and Hooded Crows were also observed coasting south. A fairly large flock of Hooded Crows came in from over the sea. Rooks were also coming in on the 31st.

November 1st.—While walking in a quiet lane at Oulton I

observed quite a large number of Linnets, all singing together in the topmost branches of a large tree; this incident appeared to me to be most unusual.

2nd.—No migration was in progress; two Grey Wagtails seen.

3rd.—A Shore Lark was observed feeding among the marram-grass. Linnets, Greenfinches, Rooks, Jackdaws, and Hooded Crows were passing southwards; a few flocks of Larks were also arriving from over the sea.

6th.—I saw four House-Martins flying very feebly round an old mill at Corton. Redwings were heard passing over at night.

8th.—At daybreak about forty Hooded Crows were seen on the beach; they had apparently arrived during the night. Odd lots of Greenfinches, Linnets, Pipits, and Starlings and a flock of Wood-Pigeons going south. A bunch of Scoters seen a short distance out at sea; two Dunlins feeding at the tide-mark.

9th.—Rooks, Hooded Crows, and Sky-Larks were arriving in from sea; a Starling was picked up on the tide-mark; Curlews and Redwings were heard passing over at night.

16th.—Several small bunches of Scoters have stationed themselves just off Corton. Mr. Patterson informs me that in this quiet Corton bay a great bed of Radiated Trough-shells (*Mactra stultorum*) and a considerable number of other forms of marine life upon which the Scoters feed lie on the sea-floor.

18th.—Three Snow-Buntings were observed on the shore and another making southwards.

23rd.—The notes of a great number of Waders and Redwings were heard over the town at night.

26th.—A great many Hooded Crows had arrived, also one Snow-Bunting seen. There was a slight southward movement of Linnets, Starlings, and Greenfinches.

28th.—A batch of about fifty Snow-Buntings had arrived; a fair number of Rock-Pipits and a flock of Ringed Plovers also appeared.

29th.—I was surprised to see a belated House-Martin, which was making southwards just on the outskirts of the town.

December 26th.—At Kessingland I picked up a Little Auk on

the tide-mark; a few Snow-Buntings were seen, and a bunch of Scoters were busily diving a few yards from the shore.

January 3rd, 1914.—Six Waxwings were shot at Oulton a few days since, three of which were shown to me in the flesh. A Little Auk found on the shore.

I am informed by Mr. Hunt that a flock of about ten Waxwings frequented a garden in the town for several weeks from December 17th.

17th.—Snow-Buntings and Rock-Pipits were still to be seen on the Denes in fair numbers; a Mistle-Thrush was heard singing quite in the centre of the town.

February 7th.—A Woodcock, flying east over this town in the early morning, struck a window in one of the highest buildings overlooking the sea; the bird fell injured into the road, and was secured by a lad, eventually coming into my possession; it succumbed a few hours after to its injuries.

12th.—A great many Fieldfares were noted at Oulton. A Chaffinch was heard in almost full song.

24th.—A movement of Starlings seen, one flock going out to sea in a direction S.E., and another flock coasting south. The following birds were heard singing:—Chaffinch, Blackbird, Coal-Tit, Mistle-Thrushes, Hedge-Sparrows, and Robins. Considerable numbers of Redwings were heard passing over on the night of the 25th.

27th.—A flock of Lapwings went away over the sea, flying due east; a short time after another flock came from the west, but on reaching the sea they turned inland again. Two flocks of Larks were noted coasting north.

28th.—I found the half-built nest of a Redbreast; it was undoubtedly the exceptionally mild weather that had induced the birds to build so early, for I was informed that a Redbreast's nest was found at Carlton containing the full complement of eggs on March 8th, and a Thrush's nest containing one egg was found at the same place on March 1st.

March 1st.—I observed a Partridge perched in a most unusual situation, namely, on the roof of a building in the main street. A small party of Coal-Tits had appeared; a large flock of Jackdaws were observed making northwards over Corton.

5th.—Four large flocks of Rooks came from the west, and after much circling and thinning out departed over sea due east.

During a heavy shower of rain on the night of the 8th I heard the notes of Redwings over the town.

10th.—A great mustering of Rooks, Jackdaws, Hooded Crows, and Starlings in the coastal fields; a flock of Rooks was observed making north a short distance out at sea, and a flock of Starlings was noted coasting north. A few flocks of Finches were moving southward.

14th.—A vast flock of Rooks seen flying south-east; later in the day another flock was seen flying to the west, apparently having come in from the sea.

22nd.—One flock of Rooks coasting north; numbers of Linnets and Meadow-Pipits were noted.

29th.—A few flocks of Linnets were passing southwards; a fair number of Larks had dropped in on to the Denes. On the 30th a great many Redwings passed over the town to the north.

31st.—A few flocks of Linnets, Chaffinches, and Greenfinches were noted going south.

April 1st.—A fairly large movement of Linnets, among which were a few Chaffinches and Greenfinches, all going southwards. I watched one flock of Greenfinches fly away out to sea due east; a flock of Jackdaws followed the same course a short time after.

4th.—Only a very slight movement of Finches was noted.

6th.—A Wheatear and a Willow-Wren had arrived. Three flocks of Rooks were noted coming in from sea S.E., and then coasting along north; one flock put out to sea going due east. A few Linnets passed to the south.

8th.—A large flock of Rooks and Jackdaws wheeling round just out at sea, evidently shirking the journey over the water. Several lots of Rooks were seen coming in from sea, singly and in small groups; it may have been that these were returning from a flock that had made its departure before we arrived on the spot. A fair number of Linnets, a few Greenfinches, and a Chaffinch or two going north.

9th.—A Cormorant was observed flying south along the shore. A few flocks of Linnets going both north and south, a

flock of Chaffinches making south and a few Greenfinches north.

10th.—Several flocks of Linnets and a few Greenfinches and Chaffinches moving both north and south. A flock of Rooks and two Hooded Crows coasting south. A Willow-Wren and a Wheatear seen; first Swallow seen at Oulton, and two others on the 11th.

12th.—Three Swallows, two Wheatears, a Willow-Wren, and three Ringed Plovers noted. While cycling a few miles inland I heard a great number of Willow-Wrens and saw several Swallows.

14th.—Linnets going north in great numbers, as were also a few Greenfinches, a flock of Tree-Sparrows, a Sand-Martin, and ten Swallows. A flock of Rooks and Jackdaws, with one Hooded Crow, coasting south.

15th.—Two Willow-Wrens and a House-Martin were noted. Only a few Linnets and Greenfinches passing north; large numbers of both species on the Denes.

16th.—Two Wheatears, two Willow-Wrens, a Swallow, and a House-Martin seen. Linnets and Greenfinches going north in fair numbers.

17th.—A flock of Starlings and a few Linnets passing south, while going north was a fair number of Linnets and a flock of Greenfinches.

19th.—A Nightingale, a Lesser Whitethroat, and a Willow-Wren seen; also three Swallows. Coasting south were a few bunches of Linnets.

22nd.—I observed a Merlin going northward a short distance out at sea. A Nightingale and two Willow-Wrens had arrived, and a Cuckoo was heard for the first time at Carlton. A few flocks of Linnets and a flock of Rooks going to the north.

23rd.—Two Tree-Pipits, four Common Whitethroats, two Nightingales, and four Willow-Wrens had appeared; a Swallow was also seen.

28th.—Three Cormorants were observed making southwards, and the following migrants were noted:—A Wryneck, Cuckoo, several Common Whitethroats and Willow-Wrens, a Nightingale, and a few Swallows.

May 6th.—Five Common Terns had arrived, and an increase

in the number of Common Whitethroats was noted; also a brood of young Stonechats able to fly.

7th.—Three Swifts were seen.

8th.—The number of Terns had increased considerably, as had also the number of Swallows and House-Martins. A Turtle-Dove appeared.

10th.—An arrival of Swifts was noted, a fair number being seen.

14th.—Swifts had arrived at their breeding-haunts in the town. While walking through a quiet lane my attention was drawn to the most unusual antics of a Starling, which was fluttering head downwards on the branch of a young sycamore tree. On examining it closer I discovered its legs to be securely fastened to the branch with a length of fairly stout string, and it was not without some difficulty that I was able to release it.

While sailing through the Channel on their voyage home from the West of England, some friends on board the Lowestoft trawler 'Giralda' inform me that a Wheatear came on board, and Swallows and Martins were crossing toward the English coast in small parties.

NOTES ON THE FAUNA OF THE COUNTRY OF THE CHESS AND GADE.

By T. E. Lones, M.A., LL.D., B.Sc.

(Continued from p. 212.)

Specimens of four species of *Metopidia* have so far been obtained by me; these species are *M. solidus*, Gosse, *M. oxysternum*, Gosse, *M. lepadella*, Ehren., and *M. acuminata*, Ehren. Of these species, *M. solidus* was the most generally distributed and furnished the largest number of specimens, the specimens of *M. oxysternum* were somewhat more numerous than those of *M. lepadella*, and only three specimens of *M. acuminata* have been obtained. These statements give some idea of the relative frequency of occurrence of these four species in the country of the Chess and Gade, for it has been my practice to obtain samples of water from the various localities of the district at all seasons of the year and exhaust these samples as completely as possible. Notes have been made of all forms of life seen, including some I have been unable to identify, and, in some cases, the numbers have been counted. In this way, if there is any preponderance of a species, the notes indicate this, and, in some cases, give an idea of the relative numbers of specimens.

11. *Metopidia solidus*, Gosse. The specimens of this species were usually obtained by dredging at or near the surface, where aquatic plants were plentiful. When on the slide and not engaged amongst the vegetable matter which happened to be there, they swam about rather slowly, often turning sideways and swimming on their backs, and occasionally assuming an upright position so as to show their bodies in end view. In this position, the lorica was seen to be somewhat flat, convex on both dorsal and ventral sides, and with the central part of the dorsal side arched. The jointed foot was always extended, and carried two tapering and pointed toes, which were often closed

tightly together, like the jaws of a pair of pliers. The foot was often moved to the right or left and allowed the rounded notch at the hinder end of the lorica to be seen distinctly. When swimming with their dorsal surfaces fully exposed, the characteristic marks or milling, a little within and round the edge of the nearly circular lorica, could be easily seen in some specimens, but in others the milling was less distinct. The lorica itself was colorless and very transparent, and, when the Rotifer was seen in side view, its hook-shaped frontal hood was a conspicuous object. The length of the lorica was about $\frac{1}{160}$ in.

All the specimens were obtained in spring, summer, or early autumn, chiefly from the Berkhamsted Castle moats, and the pools of Langleybury and Parsonage Farm, Abbots Langley. On July 21st, 1913, many specimens of this species were obtained from the inner moat at Berkhamsted Castle. Many loricas and numerous living specimens were obtained on May 12th, 1913, from Langleybury Pool, and about the same time this year, May 2nd, 1914, five specimens were taken from the same pool. On March 24th, 1913, Parsonage Farm Pool yielded some empty loricas only, some with remains of the foot attached, but many living specimens were obtained from the same pool on August 18th, 1913. There are parts of the water-cress-beds, temporarily or permanently out of use and containing a miscellaneous series of aquatic plants, which yield some interesting forms of life. In one of these disused parts near Watford, a few specimens of *M. solidus* were obtained on September 16th, 1913. A solitary specimen was obtained from Chesham Road Pool on May 26th, 1914. This specimen was not as clear and healthy looking as the specimens obtained from the moat and the other pools mentioned above.

12. *Metopidia oxysternum*, Gosse. This species has been obtained from Berkhamsted Castle moats and Kings Langley Lodge Pool. So well-defined and peculiar is the form of *M. oxysternum* that it can be identified at once. The specimens which, owing to their free and energetic movements, best showed the characteristic features of the species were obtained on July 21st, 1913, from the inner moat, and on April 13th, 1914, from Kings Langley; in the moat they were found together with a much larger number of specimens of *M. solidus*.

In dorsal and ventral views, the lorica was somewhat oval, but it was in side and end views that its most striking peculiarities were seen. Fig. 9 is a side view of one of the specimens, seen most conveniently when moving in and out among the small quantity of vegetable matter that was on the slide; its arched back, and its sinuous ventral outline, due to the presence of a keel, aptly compared by Messrs. Hudson and Gosse to the sternum of a bird, were clearly seen. Fig. 10 is an end view of the Rotifer, drawn while it was anchored to the slide and had its body inclined to the vertical for a short time, but not inclined sufficiently to show the maximum height of

Fig. 9.

Fig. 10.

the central ridge. In consequence of the possession of these structual features and also of curved facets on parts of the lorica, the Rotifers presented all kinds of angular and curved outlines as they swarm about on the slide.

13. *Metopidia lepadella*, Ehren. The various specimens of this species examined were usually engaged in moving slowly over the *débris* on the slide, their jointed and freely movable hoods being used to rake about amongst the material. When swimming freely they often turned sideways or on end so as to show clearly the peculiar form of the somewhat oval lorica, which was nearly flat on its ventral and arched on its dorsal side, its form in end view being very nearly that of a segment of a circle. Like other species of *Metopidia*, *M. lepadella* always kept the foot extended.

On going over my notes to collect the material for the genus *Metopidia*, I expected to find the records of *M. lepadella* to be more frequent. With the exception of some doubtful finds in 1912, chiefly in waters connected with the lower Gade, the only time at which a good number of specimens was obtained was on July 21st, 1913, when about ten specimens were taken from the inner moat at Berkhamsted Castle. At that time the water in the moat was up to the level of the culvert at the south-eastern part, a great quantity of fresh and green weeds was present, and the forms of life, from infusorians to Water Newts, were numerous. Since that time, with the exception of a few Floscularias and some specimens of *Stephanops lamellaris*, no Rotifers of any importance have been obtained by me from the moats. During the dry weather of the ensuing months, evaporation and percolation into the underlying chalk caused the water to disappear until, at the end of September, many parts were dry. In October and November the moats were drier still; on January 27th, 1914, they were quite dry, and it was not until the spring of this year that I again found much water in the moats. It was much the same with many of the pools. The evaporation and percolation no doubt vary greatly in the different pools, and small springs may compensate, in some of the pools, for part of the loss by these agencies. However this may be, the water level of every pool sank, and, in particular, the pools of Langleybury, Parsonage Farm, Chesham Road, Cholesbury Common, and Wigginton became very low, while less permanent pools, such as those at Leverstock Green, became dry. Chipperfield Common Pool, which usually maintains its level very well, was also low; on April 13th last, for instance, its water-level was a foot below the normal.

Not only were the pools low, but their weeds, at other times so fresh and green, were in a state of decomposition, and what water there was had a decidedly pungent and unpleasant smell. It seemed to be natural that, under such conditions, important finds of *Metopidia* or of most other Rotifers could not be obtained. These remarks on the way in which the Rotiferan fauna of the country of the Chess and Gade is liable to be impoverished will not, I trust, be considered uninteresting.

Reference has already been made to some doubtful records,

in 1912, of species of *Metopidia*. If these are neglected, the notes give only one instance of the occurrence of *M. lepadella* in company with *M. solidus*. Herr L. Bilfinger, collecting from many localities in Wurtemberg, says ('Jahreshefte Ver. vaterländ. Naturkunde in Württ. Stuttgart, 1892,' p. 117) that the two species were almost always found together, *M. lepadella* being very common and *M. solidus* abundant. In the country of the Chess and Gade, *M. lepadella* seems to be decidedly less common than *M. solidus*, and, during the years 1913 and 1914 at least, I found *M. solidus* on many occasions without finding any specimens of *M. lepadella*.

14. *Metopidia acuminata*, Ehren.—The only specimens of this small Rotifer were obtained from Langleybury Pool on May 12th, 1913. Their loricas were of elegant form, somewhat oval, with a deep median notch at the oral end, and a gracefully curved terminal point, which was conspicuously shown when the Rotifer swung its foot to the right or the left, as it frequently did. The short jointed foot carried two acicular toes, which opened and closed as it were by a snap. The length of the specimens, three in number, was less than $\frac{1}{200}$ in.

15. *Anuraea brevispina*, Gosse.—This Rotifer, very common in the country of the Chess and Gade, is considered by some to be a variety of *A. aculeata*, Ehren. It will be more convenient here to describe it as if it were a distinct species, more particularly because there is no record in my notes of its being found together with specimens of Ehrenberg's *A. aculeata*. On going through these notes a short time ago I was expecting to find that these two Rotifers had sometimes been found together, or, at least, in the same pool at different times, but there was no record of a single instance of the kind.

Many specimens were obtained from Chipperfield Common Pool on August 4th, 1913, by dredging at a depth of about three feet. They swam somewhat slowly, at the same time performing a succession of rolling and dipping movements which allowed the structural features to be well seen, such as the convex dorsal and concave ventral surfaces of the lorica, its short posterior spines, its curved sides, and its sickle-shaped antlers. A rather large number of specimens was also obtained from the same pool on January 27th, 1914, some carrying eggs;

and again, on April 13th, 1914, when the pool was comparatively very low and its fauna unusually poor, several specimens were obtained.

Between Hastoe and Shire Lane (part of the boundary between Herts and Bucks) is a muddy pool which maintains its water level fairly well. The largest number of specimens of *A. brevispina* obtained by me on a single occasion was the result of a careful dredging of the pool on May 26th, 1914. I had dredged the same pool in October of the previous year, but did not obtain any Rotifers of interest. On May 26th, 1914, however, a very large number of forms of life was obtained, and of these the specimens of *A. brevispina* constituted a large proportion. Most of the specimens were carrying an oval egg of a pale pink colour, the general colour of the body of the Rotifer being light yellow. Some empty cases were also seen and these showed the polygonal facets very clearly. It was astonishing to notice how large a proportion of the specimens were attached to one another, not only in pairs, but occasionally in threes. They were, in some cases, firmly connected, for one pair, attached laterally with their oral parts close together, went right through the space between the valves of a vigorous *Daphnia pulex*, and, after being literally kicked out, remained attached together. The various pairs were attached in all kinds of relative positions, parallel, crosswise, and inclined.

On the same day, May 26th, 1914, numerous specimens, exactly like those from Hastoe Pool, in form, colour of body, and colour of eggs, were taken from Chesham Road Pool, which was, it may be said, dirtier than I had seen it before, considering that it was fairly full. The phenomena of life of the specimens were different from those at Hastoe Pool, for comparatively few were carrying eggs, and all the specimens seen were swimming quite independently.

16. *Anuraea aculeata*, Ehren.—It may be mentioned, at the outset, that I had obtained numerous specimens of *A. brevispina* before any specimens of *A. aculeata* were found. These were first obtained on April 11th, 1914, by dredging in water three feet deep in Bedmond Pool. Many specimens were also obtained by dredging in shallow water and among the sedges of Kings Langley Lodge Pool on April 13th, 1914. A few

specimens, some carrying eggs, were dredged on May 26th, 1914, from the clear water of the Cholesbury Common Pool, which is on the side of the Common farthest from Hawridge; a few empty loricas were also obtained at the same time.

Before passing on to describe the next species, it may be pointed out that so far *A. brevispina* has been found in the pools of Chipperfield Common, Hastoe, and Chesham Road, while *A. aculeata* has been found in the pools of Bedmond, Kings Langley Lodge, and Cholesbury Common, as already set forth. The two sets of pools named evidently have characteristics favouring the presence of *A. brevispina*, in one case, and of *A. aculeata* in the other. What these characteristics really are I am unable to say, but it may be given as a statement of fact that I have found the waters of the said pools of Bedmond, Kings Langley Lodge, and Cholesbury Common to be decidedly clearer and fresher than those of Chipperfield Common, Hastoe, and Chesham Road. Hastoe Pool, which yielded such a vast number of specimens of *A. brevispina* on May 26th, 1914, was much less clear than any of the other pools mentioned.

17. *Anuraea cochlearis*, Ehren.—This small Rotifer has been obtained from the Grand Junction Canal and Kings Langley Lodge Pool. On October 15th, 1913, a few specimens were obtained by dredging in the canal at a part about one-quarter of a mile south of Tring Station, and from the same part of the canal numerous living specimens and several loricas were dredged on May 26th, 1914. Many specimens were obtained on April 13th, 1914, from Kings Langley Lodge Pool. They swam forward rapidly, at the same time rolling over or from side to side. The main feature of the specimens, that to which the specific name owes its origin, was the spoon-shaped lorica, the "handle" of the spoon being a stout spine, the whole resembling some forms of the old Roman *cochlear*, which was used not only for eating eggs but also shell-fish.

Dr. Lauterborn made a detailed study of the variations of *A. cochlearis* in size and form, paying particular attention to variations in the length of the posterior spine. He examined a large number of specimens from pools and parts of the Rhine near Neuhofen, Rosheim, Ludwigshafen, and other places, and gave his results in several papers. In one of these (Verh.

Naturhist-Med. Ver. Heidelberg, vol. 7, 1903, pp. 529–621, of which I have seen extracts only) he concluded that these variations are mainly due to differences in the nature of the waters and to seasonal variations of temperature. He found, *e.g.* that, during the winter months, the long-spined forms were obtained, and, during the late spring and summer months, the short-spined and spineless forms. The specimens so far examined by me had posterior spines about as long as that of the type-form, and showed only trifling differences in length. They were obtained, as above stated, in the months of April, May, and October, but the observations made are insufficient to decide to what extent the species varies in the country of the Chess and Gade.

18. *Brachionus pala*, Ehren.—This species has been found in the pools of Chipperfield Common and Kings Langley Lodge, and, quite recently, in vast numbers in Coxpond, between Leverstock Green and the Saracen's Head, on the way to Hemel Hempstead. The specimens examined usually swarm forwards rapidly, turning slowly about the long axis of the lorica, but some remained anchored for a long time. They differed greatly in the frequency with which they extended their flexible feet and lashed out with these. Most of them swam about for a long time without extending their feet, others did so occasionally, and only a few frequently; a very little cocaine solution soon caused frequent extension. The structural features of this Rotifer were always well seen, its four, strong, tapering, and sharp oral spines, cervical bright red eye, and powerful masticatory apparatus being especially conspicuous. In some specimens, obtained from Kings Langley Lodge Pool on April 13th, 1914, the eye-spot was exceptionally bright, and there appeared to be a faint pink coloration in the neighbouring oral parts of the Rotifers.

By far the greatest number of specimens of *B. pala* was obtained from Coxpond on July 14th, 1914. There have been other occasions on which an exceptionally large number of specimens of a species has been obtained, *e.g.* on October 3rd, 1913, when a vast number of *B. rubens* was found in the pool on the eastern side of Potten End, and on May 26th, 1914, when a great number of *Anuraea brevispina* was dredged from Hastoe

Pool. On all such occasions the numbers of specimens obtained were less than the number of specimens of *B. pala* from Coxpond. It would not be an exaggeration to say that, in the last case, every cubic millimetre of water in the sample bottles contained a dozen or more specimens, some being especially fine and large. The lorica of one of the largest examined was $\frac{1}{65}$ in. long. Many of them were carrying eggs, some a single one, and others two. In most of the specimens the mastax was of exceptionally large size.

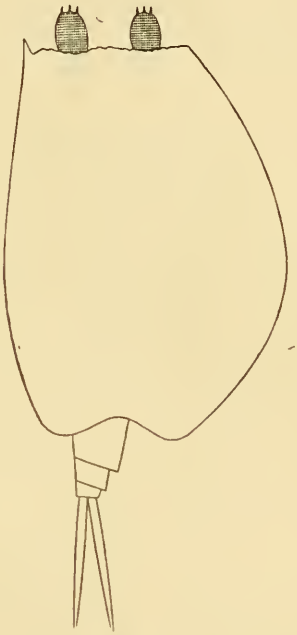

Fig. 11.

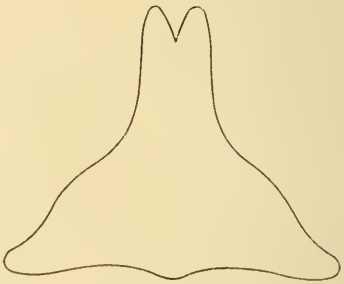

Fig. 12.

19. *Diplax trigona*, Gosse.—This Rotifer was not obtained until March 26th, 1914, when two specimens were seen during a careful examination of the washings from a fine silk net through which about two quarts of water from Langleybury Pool had been passed. One of the specimens was being examined, and was swimming about slowly, occasionally turning on its side or plunging so as to show its somewhat triangular outline, when it was very suddenly attacked by a young *Cyclops*, which abandoned it after a few seconds. So

violent was the attack that it seemed likely that the Rotifer would have its foot and toes torn off, and its lorica so mutilated as not to be worth sketching. When found again the Rotifer was lying in a somewhat tilted position on its side quite dead, and with its oral part injured, this being bitten or broken so as to present jagged edges. Immediately after the attack two of the numerous specimens of infusorians (*Coleps hirtus*, Ehren.), which had been swimming about without attempting to molest the Rotifer while living, buried themselves to some extent in its injured oral parts. Fig. 11 represents the Rotifer and its assailants at this time. Other specimens of the same infusorians did the same, so that, at different times, there were three, five, six, and eight of them attacking the dead Rotifer. The total length of the Rotifer was nearly $\frac{1}{70}$ in.; that of the infusorians was about $\frac{1}{600}$ in. The only other specimens of *D. trigona* obtained were dredged from Kings Langley Lodge Pool on April 13th, 1914.

20. *Eretmia cubeutes*, Gosse.—In the year 1913 specimens of this Rotifer were obtained from the pools of Parsonage Farm and Chipperfield Common. Usually the numbers obtained were small, but on one occasion, March 24th, 1913, the Rotifer was exceptionally common in Parsonage Farm Pool. The lorica was ellipsoidal, but with the oral part truncated and presenting a toothed edge, with the teeth regular in size and shape. A most striking feature of this Rotifer is the mosaic-like pattern of its lorica, the elements which correspond to the squares of an ordinary mosaic being arranged diagonally and having little pyramids built upon them. With this arrangement of the elements the surface of the lorica presents a large number of pointed knobs, and the oral teeth are simply the pointed corners of the foremost row of elements.

The specimens usually swam about rapidly, at the same time rotating about their long axis; the dorsal and ventral processes and the four posterior spines could not be counted while these rapid movements were going on, the effect being usually to produce an impression of two well-defined spines, always in focus more or less distinctly. Sometimes the Rotifers assumed a vertical position, remaining practically in the same place and appearing like rotating toothed wheels.

21. *Triarthra longiseta*, Ehren.—Specimens of this Rotifer can almost always be obtained by dredging the deeper parts of Chipperfield Common Pool; on one occasion, April 13th, 1914, no specimens were obtained, but this is the only record I have of failure to obtain *T. longiseta*, and it may be said that the pool presented a peculiarly lifeless aspect on the date mentioned, and very few forms of life of any kind were obtained from it. On August 4th, 1913, many specimens were obtained, and one of them was carrying an oval egg near the hinder end of its bag-shaped body. The two small red eye-spots near the oral end were clearly seen, and the three long oar-like processes were very conspicuous. The Rotifers often swam rapidly forwards, and at the same time turned about their long axes. Sometimes they darted suddenly across the field of view, or even quite out of it. This sudden movement seemed to be due mainly to the action of the two lateral processes, but the movement was always so sudden and swift that I could never decide what really happened, or to what extent the median process assisted. When the Rotifers were swimming about steadily, the processes, either the two lateral ones or all three, were swung forwards and brandished vigorously. By far the greatest number of specimens obtained at one time was dredged from beneath the ice, on January 27th, 1914, and very many of them were carrying eggs.

22. *Furcularia molaris*, Gosse. — Between the beautifully situated little village of Ashley Green and Chesham are several small pools, and in one of these, near the Chesham Road, not far from 'The Thorn,' was found, on March 11th, 1913, a single specimen of *F. molaris*. The Rotifer was first detected creeping along a specimen of *Daphnia pulex*. Its main distinctive features were very clearly seen: its stout, somewhat oval body and thick truncated head; its long jointed foot, ending in two rather long, divergent, blade-like toes; its bright red eye-spot, and its large alimentary canal filling its body cavity to a large extent; several parts of the alimentary canal were of a brown colour. No attempt was made to draw the Rotifer until it had been narcotized, for it was quite

Fig. 13.

restless and its movements were too quick to enable its structure to be fairly seen. Fig. 13 represents the Rotifer as it appeared, partly contracted, after narcotization.

23. *Hydatina senta*, Ehren.—This also is a Rotifer obtained by me from one pool only, but while the single specimen of *F. molaris*, above described, seemed to be in the collecting bottle by accident, there is no doubt that *H. senta* was plentiful and could scarcely be missed in the pool whence it was obtained. This was a small, shallow pool on Boxmoor Common, in process of being filled with rubbish, and containing water of a very dirty appearance, although not muddy. In order to economize in the use of my limited supply of collecting bottles, for I was going as far as Dagnall, in the extreme north-eastern part of the country of the Gade, the smallest collecting-bottle was used. Examining the contents of this bottle a day or two afterwards, a splendid specimen of *H. senta* was found and served excellently for all purposes of microscopic examination of the species. Although the water in which the Rotifer lived was repulsive to a degree, the Rotifer itself was a beautiful object beneath the microscope. The rounded prominences on its oral end carried a number of styles which vibrated rapidly and, appearing like so many flashing rays of light, produced quite a dazzling effect on the eyes. The Rotifer often anchored itself, and sometimes swam about slowly, constantly twisting about or doubling upon itself. A large part of its alimentary canal was yellow or greenish-yellow, but with a dark-coloured central part, and, after narcotization, bright green *Euglenæ* were discharged in large numbers from the cloaca.

In the autumn of 1912 the above-mentioned pool swarmed with Turbellarian and other worms, and no Rotifers were obtained from it. On June 3rd, 1913, when the specimen described above was obtained, the pool must have contained very many specimens of *H. senta*. At the present time (July 14th, 1914), the pool is absolutely dry, and is so far filled in that in the wettest season it will scarcely hold more than six inches of water. As long as a pool forms there, however, this Rotifer will probably be found, especially in spring and early summer. In his account of the Rotiferan fauna of the region of Lake Geneva, Mons. E. F. Weber says (Revue Suisse de

Zool., &c., vol. v., Geneva, 1898, p. 420): "This species is rather rare in our district, but when we have the fortune to come across a pool which is suitable for it we may be certain of finding it again every year and always in abundance, especially in spring. Unfortunately, the localities where it can be met with are very scarce, and, at the Jonction, the pool whence I used to obtain specimens is now filled up." The pool on Boxmoor Common will soon share, I think, the same fate as M. Weber's pool.

24. *Œcistes stygis*, Gosse.—This seems to be a very rare Rotifer. One solitary specimen is all that I have seen from the numerous water samples taken during three years from a large number of the pools, and from the streams and Canal in the Chess and Gade country. This solitary specimen was obtained from Parsonage Farm Pool, Abbots Langley, on September 6th, 1912. It was embedded in a little mass of fine brown fibres, extending up the stem of the Rotifer for about two-thirds of its length. This mass of fibres was, as far as my memory serves me, from a large stone at one corner of the pool, having its submerged parts covered with a thin coating of similar vegetable matter, so that *Œcistes* had a very firm support. The specimen itself might be said to have been a nearly straight trumpet, with a magnificent circular and richly ciliated mouth or corona. When extended, the Rotifer swayed slowly about its foot, and its corona turned slowly in various directions, so that the inclination of its plane to the axis of the stem varied. A slight disturbance at once caused it to spring back into its casing, and when the disturbance ceased the Rotifer soon extended itself slowly.

(To be continued.)

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AUSTRALIA, 1914.

Address by Professor William Bateson, M.A., F.R.S., *President*.

(Continued from p. 318.)

Part II.—Sydney.

At Melbourne I spoke of the new knowledge of the properties of living things which Mendelian analysis has brought us. I indicated how these discoveries are affecting our outlook on that old problem of natural history, the origin and nature of Species, and the chief conclusion I drew was the negative one, that, though we must hold to our faith in the Evolution of Species, there is little evidence as to how it has come about, and no clear proof that the process is continuing in any considerable degree at the present time. The thought uppermost in our minds is that knowledge of the nature of life is altogether too slender to warrant speculation on these fundamental subjects. Did we presume to offer such speculations they would have no more value than those which alchemists might have made as to the nature of the elements. But though in regard to these theoretical aspects we must confess to such deep ignorance, enough has been learnt of the general course of heredity within a single species to justify many practical conclusions which cannot in the main be shaken. I propose now to develop some of these conclusions in regard to our own species, Man.

In my former Address I mentioned the condition of certain animals and plants which are what we call "polymorphic." Their populations consist of individuals of many types, though they breed freely together with perfect fertility. In cases of this kind which have been sufficiently investigated it has been found that these distinctions—sometimes very great and affecting most diverse features of organization—are due to the presence or absence of elements, or factors as we call them, which are treated in heredity as separate entities. These factors and their combinations produce the characteristics which we perceive. No individual can acquire a particular characteristic unless the requisite factors entered into the composition of that individual at fertilization, being received either from the father or from the mother or from both, and consequently no individual can pass on to his offspring positive characters which he does not himself possess. Rules of this kind have already been traced in operation in the human species; and though I admit that an assumption of some magnitude is involved when we extend the application of the same system to human characteristics in general, yet the assumption is one which I believe we are fully justified in making. With little hesitation we can now declare that the potentialities and aptitudes, physical as well as mental, sex, colours, powers of work or invention, liability to diseases, possible duration of life, and the other features by which the members of a mixed

population differ from each other, are determined from the moment of fertilization; and by all that we know of heredity in the forms of life with which we can experiment we are compelled to believe that these qualities are in the main distributed on a factorial system. By changes in the outward conditions of life the expression of some of these powers and features may be excited or restrained. For the development of some an external opportunity is needed, and if that be withheld the character is never seen, any more than if the body be starved can the full height be attained; but such influences are superficial and do not alter the genetic constitution.

The factors which the individual receives from his parents and no others are those which he can transmit to his offspring; and if a factor was received from one parent only, not more than half the offspring, on an average, will inherit it. What is it that has so long prevented mankind from discovering such simple facts? Primarily the circumstance that as man must have *two* parents it is not possible quite easily to detect the contributions of each. The individual body is a *double* structure, whereas the germ-cells are *single*. Two germ-cells unite to produce each individual body, and the ingredients they respectively contribute interact in ways that leave the ultimate product a medley in which it is difficult to identify the several ingredients. When, however, their effects are conspicuous the task is by no means impossible. In part also even physiologists have been blinded by the survival of ancient and obscurantist conceptions of the nature of man by which they were discouraged from the application of any rigorous analysis. Medical literature still abounds with traces of these archaisms, and, indeed, it is only quite recently that prominent horse-breeders have come to see that the dam matters as much as the sire. For them, though vast pecuniary considerations were involved, the old "homunculus" theory was good enough. We were amazed at the notions of genetic physiology which Professor Baldwin Spencer encountered in his wonderful researches among the natives of Central Australia; but in truth, if we reflect that these problems have engaged the attention of civilised man for ages, the fact that he, with all his powers of recording and deduction, failed to discover any part of the Mendelian system is almost as amazing. The popular notion that any parents can have any kind of children within the racial limits is contrary to all experience, yet we have gravely entertained such ideas. As I have said elsewhere, the truth might have been found out at any period in the world's history if only pedigrees had been drawn the right way up. If, instead of exhibiting the successive pairs of progenitors who have contributed to the making of an ultimate individual, some one had had the idea of setting out the posterity of a single ancestor who possessed a marked feature such as the Habsburg lip, and showing the transmission of this feature along some of the descending branches and the permanent loss of the feature in collaterals, the essential truth that heredity can be expressed in terms of presence and absence must have at once become apparent. For the descendant is not, as he appears in the conventional pedigree, a sort of pool into which each

tributary ancestral stream has poured something, but rather a conglomerate of ingredient-characters taken from his progenitors in such a way that some ingredients are represented and others are omitted.

Let me not, however, give the impression that the unravelling of such descents is easy. Even with fairly full details, which in the case of man are very rarely to be had, many complications occur, often preventing us from obtaining more than a rough general indication of the system of descent. The nature of these complications we partly understand from our experience of animals and plants which are amenable to breeding under careful restrictions, and we know that they are mostly referable to various effects of interaction between factors by which the presence of some is masked.

Necessarily the clearest evidence of regularity in the inheritance of human characteristics has been obtained in regard to the descent of marked abnormalities of structure and congenital diseases. Of the descent of ordinary distinctions such as are met with in the normal healthy population we know little for certain. Hurst's evidence, that two parents both with light-coloured eyes—in the strict sense, meaning that no pigment is present on the front of the iris—do not have dark-eyed children, still stands almost alone in this respect. With regard to the inheritance of other colour-characteristics some advance has been made, but everything points to the inference that the genetics of colour and many other features in man will prove exceptionally complex. There are, however, plenty of indications of system comparable with those which we trace in various animals and plants, and we are assured that to extend and clarify such evidence is only a matter of careful analysis. For the present, in asserting almost any general rules for human descent, we do right to make large reservations for possible exceptions. It is tantalising to have to wait, but of the ultimate result there can be no doubt.

I spoke of complications. Two of these are worth illustrating here, for probably both of them play a great part in human genetics. It was discovered by Nilsson-Ehle, in the course of experiments with certain wheats, that several factors having the same power may co-exist in the same individual. These cumulative factors do not necessarily produce a cumulative effect, for any one of them may suffice to give the full result. Just as the pure-bred tall pea with its two factors for tallness is no taller than the cross-bred with a single factor, so these wheats with three pairs of factors for red colour are no redder than the ordinary reds of the same family. Similar observations have been made by East and others. In some cases, as in the *Primulus* studied by Gregory, the effect is cumulative. These results have been used with plausibility by Davenport and the American workers to elucidate the curious case of the mulatto. If the descent of colour in the cross between the negro and the white man followed the simplest rule, the offspring of two first-cross mulattos would be, on an average, one black : two mulattos : one white, but this is notoriously not so. Evidence of some segregation is fairly clear, and the deficiency of real whites may perhaps be accounted for on the hypothesis of cumulative factors, though by the

nature of the case strict proof is not to be had. But at present I own to a preference for regarding such examples as instances of imperfect segregation. The series of germ-cells produced by the cross-bred consists of some with no black, some with full black, and others with intermediate quantities of black. No statistical tests of the condition of the gametes in such cases exist, and it is likely that by choosing suitable crosses all sorts of conditions may be found, ranging from the simplest case of total segregation, in which there are only two forms of gametes, up to those in which there are all intermediates in various proportions. This at least is what general experience of hybrid products leads me to anticipate. Segregation is somehow effected by the rhythms of cell-division, if such an expression may be permitted. In some cases the whole factor is so easily separated that it is swept out at once; in others it is so intermixed that gametes of all degrees of purity may result. That is admittedly a crude metaphor, but as yet we cannot substitute a better. Be all this as it may, there are many signs that in human heredity phenomena of this kind are common, whether they indicate a multiplicity of cumulative factors or imperfections in segregation. Such phenomena, however, in no way detract from the essential truths that segregation occurs, and that the organism cannot pass on a factor which it has not itself received.

In human heredity we have found some examples, and I believe that we shall find many more, in which the descent of factors is limited by sex. The classical instances are those of colour-blindness and hæmophilia. Both these conditions occur with much greater frequency in males than in females. Of colour-blindness at least we know that the *sons* of the colour-blind man do not inherit it (unless the mother is a transmitter) and do not transmit it to their children of either sex. Some, probably all, of the daughters of the colour-blind father inherit the character, and though not themselves colour-blind, they transmit it to some (probably, on an average, half) of their offspring of both sexes. For since these normal-sighted women have only received the colour-blindness from one side of their parentage, only half their offspring, on an average, can inherit it. The sons who inherit the colour-blindness will be colour-blind, and the inheriting daughters become themselves again transmitters. Males with normal colour-vision, whatever their own parentage, do not have colour-blind descendants, unless they marry transmitting women. There are points still doubtful in the interpretation, but the critical fact is clear, that the germ-cells of the colour-blind man are of two kinds: (i) those which do not carry on the affection and are destined to take part in the formation of sons; and (ii) those which do carry on the colour-blindness and are destined to form daughters. There is evidence that the ova also are similarly predestined to form one or other of the sexes, but to discuss the whole question of sex-determination is beyond my present scope. The descent of these sex-limited affections nevertheless calls for mention here, because it is an admirable illustration of factorial predestination. It moreover exemplifies that *parental polarity* of the zygote to which

I alluded in my first Address, a phenomenon which we suspect to be at the bottom of various anomalies of heredity, and suggests that there may be truth in the popular notion that in some respects sons resemble their mothers and daughters their fathers.

As to the descent of hereditary diseases and malformations, however, we have abundant data for deciding that many are transmitted as dominants and a few as recessives. The most remarkable collection of these data is to be found in family histories of diseases of the eye. Neurology and dermatology have also contributed many very instructive pedigrees. In great measure the opthalmological material was collected by Edward Nettleship, for whose death we so lately grieved. After retiring from practice as an oculist he devoted several years to this most laborious task. He was not content with hearsay evidence, but travelled incessantly, personally examining all accessible members of the families concerned, working in such a way that his pedigrees are models of orderly observation and recording. His zeal stimulated many younger men to take part in the work, and it will now go on, with the result that the systems of descent of all the common hereditary diseases of the eye will soon be known with approximate accuracy.

Give a little imagination to considering the chief deduction from this work. Technical details apart, and granting that we cannot wholly interpret the numerical results, sometimes noticeably more and sometimes fewer descendants of these patients being affected than Mendelian formulæ would indicate, the expectation is that in the case of many diseases of the eye a large proportion of the children, grandchildren, and remoter descendants of the patients will be affected with the disease. Sometimes it is only defective sight that is transmitted; in other cases it is blindness, either from birth or coming on at some later age. The most striking example perhaps is that of a form of night-blindness still prevalent in a district near Montpellier, which has affected at least one hundred and thirty persons, all descending from a single affected individual* who came into the country in the seventeeth century. The transmission is in every case through an affected parent, and no normal has been known to pass on the condition. Such an example well serves to illustrate the fixity of the rules of descent. Similar instances might be recited relating to a great variety of other conditions, some trivial, others grave.

At various times it has been declared that men are born equal, and that the inequality is brought about by unequal opportunities. Acquaintance with the pedigrees of disease soon shows the fatuity of such fancies. The same conclusion, we may be sure, would result from the true representation of the descent of any human faculty. Never since Galton's publications can the matter have been in any doubt. At the time he began to study family histories even the broad

* The first human descent proved to follow Mendelian rules was that of a serious malformation of the hand studied by Farabee in America. Drinkwater subsequently worked out pedigrees for the same malformation in England. After many attempts, he now tells me that he has succeeded in proving that the American family and one of his own had an abnormal ancestor in common, five generations ago.

significance of heredity was frequently denied, and resemblances to parents or ancestors were looked on as interesting curiosities. Inveighing against hereditary political institutions, Tom Paine remarks that the idea is as absurd as that of an "hereditary wise man," or an "hereditary mathematician," and to this day I suppose many people are not aware that he is saying anything more than commonly foolish. We, on the contrary, would feel it something of a puzzle if two parents, both mathematically gifted, had any children *not* mathematicians. Galton first demonstrated the overwhelming importance of these considerations, and had he not been misled, partly by the theory of pangenesis, but more by his mathematical instincts and training, which prompted him to apply statistical treatment rather than qualitative analysis, he might, not improbably, have discovered the essential facts of Mendelism.

It happens rarely that science has anything to offer to the common stock of ideas at once so comprehensive and so simple that the courses of our thoughts are changed. Contributions to the material progress of mankind are comparatively frequent. They result at once in application. Transit is quickened; communication is made easier; the food-supply is increased and population multiplied. By direct application to the breeding of animals and plants such results must even flow from Mendel's work. But I imagine the greatest practical change likely to ensue from modern genetic discovery will be a quickening of interest in the true nature of man and in the biology of races. I have spoken cautiously as to the evidence for the operation of any simple Mendelian system in the descent of human faculty; yet the certainty that systems which differ from the simpler schemes only in degree of complexity are at work in the distribution of characters among the human population cannot fail to influence our conceptions of life and of ethics, leading perhaps ultimately to modification of social usage. That change cannot but be in the main one of simplification. The eighteenth century made great pretence of a return to nature, but it did not occur to those philosophers first to enquire what nature is; and perhaps not even the patristic writings contain fantasies much further from physiological truth than those which the rationalists of the 'Encyclopædia' adopted as the basis of their social schemes. For men are so far from being born equal or similar that to the naturalist they stand as the very type of a polymorphic species. Even most of our local 'races consist of many distinct strains and individual types. From the population of any ordinary English town as many distinct human breeds could in a few generations be isolated as there are now breeds of dogs, and indeed such a population in its present state is much what the dogs of Europe would be in ten years' time but for the interference of the fanciers. Even as at present constituted, owing to the isolating effects of instinct, fashion, occupation, and social class, many incipient strains already exist.

In one respect civilized man differs from all other species of animal or plant in that, having prodigious and ever-increasing power over nature, he invokes these powers for the preservation and main-

tenance of many of the inferior and all the defective members of his species. The inferior freely multiply, and the defective, if their defects be not so grave as to lead to their detention in prisons or asylums, multiply also without restraint. Heredity being strict in its action, the consequences are in civilized countries much what they would be in the kennels of the dog-breeder who continued to preserve all his puppies, good and bad: the proportion of defectives increases. The increase is so considerable that outside every great city there is a smaller town inhabited by defectives and those who wait on them. Round London we have a ring of such towns with some 30,000 inhabitants, of whom about 28,000 are defective, largely, though of course by no means entirely, bred from previous generations of defectives. Now, it is not for us to consider practical measures. As men of science we observe natural events and deduce conclusions from them. I may perhaps be allowed to say that the remedies proposed in America, in so far as they aim at the eugenic regulation of marriage on a comprehensive scale, strike me as devised without regard to the needs either of individuals or of a modern State. Undoubtedly if they decide to breed their population of one uniform puritan grey, they can do it in a few generations; but I doubt if timid respectability will make a nation happy, and I am sure that qualities of a different sort are needed if it is to compete with more vigorous and more varied communities. Everyone must have a preliminary sympathy with the aims of eugenists both abroad and at home. Their efforts at the least are doing something to discover and spread truth as to the physiological structure of society. The spirit of such organizations, however, almost of necessity suffers from a bias towards the accepted and the ordinary, and if they had power it would go hard with many ingredients of Society that could be ill-spared. I notice an ominous passage in which even Galton, the founder of eugenics, feeling perhaps some twinge of his Quaker ancestry, remarks that "as the Bohemianism in the nature of our race is destined to perish, the sooner it goes, the happier for mankind." It is not the eugenists who will give us what Plato has called divine releases from the common ways. If some fancier with the catholicity of Shakespeare would take us in hand, well and good; but I would not trust even Shakespeares meeting as a committee. Let us remember that Beethoven's father was an habitual drunkard and that his mother died of consumption. From the genealogy of the patriarchs also we learn—what may very well be the truth—that the fathers of such as dwell in tents, and of all such as handle the harp or organ, and the instructor of every artificer in brass and iron—the founders, that is to say, of the arts and the sciences—came in direct descent from Cain, and not in the posterity of the irreproachable Seth, who is to us, as he probably was also in the narrow circle of his own contemporaries, what naturalists call a *nomen nudum*.

Genetic research will make it possible for a nation to elect by what sort of beings it will be represented not very many generations hence, much as a farmer can decide whether his byres shall be full of shorthorns or Herefords. It will be very surprising indeed if

some nation does not make trial of this new power. They may make awful mistakes, but I think they will try.

Whether we like it or not, extraordinary and far-reaching changes in public opinion are coming to pass. Man is just beginning to know himself for what he is—a rather long-lived animal, with great powers of enjoyment if he does not deliberately forgo them. Hitherto superstition and mythical ideas of sin have predominantly controlled these powers. Mysticism will not die out; for those strange fancies knowledge is no cure; but their forms may change, and mysticism as a force for the suppression of joy is happily losing its hold on the modern world. As in the decay of earlier religions Ushabti dolls were substituted for human victims, so telepathy, necromancy, and other harmless toys take the place of eschatology and the inculcation of a ferocious moral code. Among the civilized races of Europe we are witnessing an emancipation from traditional control in thought, in art, and in conduct which is likely to have prolonged and wonderful influences. Returning to freer or, if you will, simpler conceptions of life and death, the coming generations are determined to get more out of this world than their forefathers did. Is it then to be supposed that when science puts into their hand means for the alleviation of suffering immeasurable, and for making this world a happier place, that they will demur to using those powers? The intenser struggle between communities is only now beginning, and with the approaching exhaustion of that capital of energy stored in the earth before man began it must soon become still more fierce. In England some of our great-grandchildren will see the end of the easily accessible coal, and, failing some miraculous discovery of available energy, a wholesale reduction in population. There are races who have shown themselves able at a word to throw off all tradition and take into their service every power that science has yet offered them. Can we expect that they, when they see how to rid themselves of the ever-increasing weight of a defective population, will hesitate? The time cannot be far distant when both individuals and communities will begin to think in terms of biological fact, and it behoves those who lead scientific thought carefully to consider whither action should lead. At present I ask you merely to observe the facts. The powers of science to preserve the defective are now enormous. Every year these powers increase. This course of action must reach a limit. To the deliberate intervention of civilization for the preservation of inferior strains there must sooner or later come an end, and before long nations will realize the responsibility they have assumed in multiplying these "cankers of a calm world and a long peace."

The definitely feeble-minded we may with propriety restrain, as we are beginning to do even in England, and we may safely prevent unions in which both parties are defective, for the evidence shows that as a rule such marriages, though often prolific, commonly produce no normal children at all. The union of such social vermin we should no more permit than we would allow parasites to breed on our own bodies. Further than that in restraint of marriage we ought not to go, at least not yet. Something too may be done by a reform

of medical ethics. Medical students are taught that it is their duty to prolong life at whatever cost in suffering. This may have been right when diagnosis was uncertain and interference usually of small effect; but deliberately to interfere now for the preservation of an infant so gravely diseased that it can never be happy or come to any good is very like wanton cruelty. In private few men defend such interference. Most who have seen these cases lingering on agree that the system is deplorable, but ask where can any line be drawn. The biologist would reply that in all ages such decisions have been made by civilised communities with fair success both in regard to crime and in the closely analogous case of lunacy. The real reason why these things are done is because the world collectively cherishes occult views of the nature of life, because the facts are realised by few, and because between the legal mind—to which society has become accustomed to defer—and the seeing eye, there is such physiological antithesis that hardly can they be combined in the same body. So soon as scientific knowledge becomes common property, views more reasonable and, I may add, more humane, are likely to prevail.

To all these great biological problems that modern society must sooner or later face there are many aspects besides the obvious ones. Infant mortality we are asked to lament without the slightest thought of what the world would be like if the majority of these infants were to survive. The decline in the birth-rate in countries already over-populated is often deplored, and we are told that a nation in which population is not rapidly increasing must be in a decline. The slightest acquaintance with biology, or even school-boy natural history, shows that this inference may be entirely wrong, and that before such a question can be decided in one way or the other, hosts of considerations must be taken into account. In normal stable conditions population is stationary. The laity never appreciates, what is so clear to a biologist, that the last century and a quarter, corresponding with the great rise in population, has been an altogether exceptional period. To our species this period has been what its early years in Australia were to the rabbit. The exploitation of energy-capital of the earth in coal, development of the new countries, and the consequent pouring of food into Europe, the application of antiseptics, these are the things that have enabled the human population to increase. I do not doubt that if population were more evenly spread over the earth it might increase very much more; but the essential fact is that under any stable conditions a limit must be reached. A pair of wrens will bring off a dozen young every year, but each year you will find the same number of pairs in your garden. In England the limit beyond which under present conditions of distribution increase of population is a source of suffering rather than of happiness has been reached already. Younger communities living in territories largely vacant are very probably right in desiring and encouraging more population. Increase may, for some temporary reason, be essential to their prosperity. But those who live, as I do, among thousands of creatures in a state of semi-starvation will realise that too few is better than too many,

and will acknowledge the wisdom of Ecclesiasticus who said, "Desire not a multitude of unprofitable children."

But at least it is often urged that the decline in the birth-rate of the intelligent and successful sections of the population—I am speaking of the older communities—is to be regretted. Even this cannot be granted without qualification. As the biologist knows, differentiation is indispensable to progress. If population were homogeneous, civilisation would stop. In every army the officers must be comparatively few. Consequently, if the upper strata of the community produce more children than will recruit their numbers some must fall into the lower strata and increase the pressure there. Statisticians tell us that an average of four children under present conditions is sufficient to keep the number constant, and as the expectation of life is steadily improving we may perhaps contemplate some diminution of that number without alarm.

In the study of history biological treatment is only beginning to be applied. For us the causes of the success and failure of races are physiological events, and the progress of man has depended upon a chain of these events, like those which have resulted in the "improvement" of the domesticated animals and plants. It is obvious, for example, that had the cereals never been domesticated cities could scarcely have existed. But we may go further, and say that in temperate countries of the Old World (having neither rice nor maize) populations concentrated in large cities have been made possible by the appearance of a "thrashable" wheat. The ears of the wild wheats break easily to pieces, and the grain remains in the thick husk. Such wheat can be used for food, but not readily. Ages before written history began, in some unknown place, plants, or more likely a plant, of wheat lost the dominant factor to which this brittleness is due, and the recessive, thrashable wheat resulted. Some man noticed this wonderful novelty, and it has been disseminated over the earth. The original variation may well have occurred once only, in a single germ-cell.

So must it have been with Man. Translated into terms of factors, how has that progress in control of nature which we call civilization been achieved? By the sporadic appearance of variations, mostly, perhaps all, consisting in a loss of elements, which inhibit the free working of the mind. The members of civilized communities, when they think about such things at all, imagine the process a gradual one, and that they themselves are active agents in it. Few, however, contribute anything but their labour; and except in so far as they have freedom to adopt and imitate, their physiological composition is that of an earlier order of beings. Annul the work of a few hundreds—I might say scores—of men, and on what plane of civilisation should we be? We should not have advanced beyond the mediæval stage without printing, chemistry, steam, electricity, or surgery worthy the name. These things are the contributions of a few excessively rare minds. Galton reckoned those to whom the term "illustrious" might be applied as one in a million, but in that number he is, of course, reckoning men famous in ways which add

nothing to universal progress. To improve by subordinate invention, to discover details missed, even to apply knowledge never before applied, all these things need genius in some degree, and are far beyond the powers of the average man of our race; but the true pioneer, the man whose penetration creates a new world, as did that of Newton and of Pasteur, is inconceivably rare. But for a few thousands of such men, we should perhaps be in the Palæolithic era, knowing neither metals, writing, arithmetic, weaving, nor pottery.

In the history of Art the same is true, but with this remarkable difference, that not only are gifts of artistic creation very rare, but even the faculty of artistic enjoyment, not to speak of higher powers of appreciation, is not attained without variation from the common type. I am speaking, of course, of the non-Semitic races of modern Europe, among whom the power whether of making or enjoying works of art is confined to an insignificant number of individuals. Appreciation can in some degree be simulated, but in our population there is no widespread physiological appetite for such things. When detached from the centres where they are made by others most of us pass our time in great contentment, making nothing that is beautiful, and quite unconscious of any deprivation. Musical taste is the most notable exception, for in certain races—for example, the Welsh and some of the Germans—it is almost universal. Otherwise artistic faculty is still sporadic in its occurrence. The case of music well illustrates the application of genetic analysis to human faculty. No one disputes that musical ability is congenital. In its fuller manifestation it demands sense of rhythm, ear, and special nervous and muscular powers. Each of these is separable and doubtless genetically distinct. Each is the consequence of a special departure from the common type. Teaching and external influences are powerless to evoke these faculties, though their development may be assisted. The only conceivable way in which the people of England, for example, could become a musical nation would be by the gradual rise in the proportional numbers of a musical strain or strains until the present type became so rare as to be negligible. It by no means follows that in any other respect the resulting population would be disguishable from the present one. Difficulties of this kind beset the efforts of anthropologists to trace racial origins. It must continually be remembered that most characters are independently transmitted and capable of such recombination. In the light of Mendelian knowledge the discussion whether a race is pure or mixed loses almost all significance. A race is pure if it breeds pure and not otherwise. Historically we may know that a race like our own was, as a matter of fact, of mixed origin. But a character may have been introduced by a single individual, though subsequently it becomes common to the race. This is merely a variant on the familiar paradox that in the course of time if registration is accurate we shall all have the same surname. In the case of music, for instance, the gift, originally perhaps from a Welsh source, might permeate the nation, and the question would then arise whether the nation, so changed, was the English nation or not.

(To be continued.)

NOTES AND QUERIES.

REPTILIA.

Enemies of Young Grass Snakes.—On August 15th, when entering a conservatory where I keep a number of reptiles and amphibians, I discovered a large female Toad (*Bufo vulgaris*) engaged in swallowing a young Grass Snake (*Tropidonotus natrix*). The Snake had coiled its tail round the left fore limb of the Toad, which gave the latter some little difficulty to overcome, but in about three minutes the last twitching bit of Snake's tail had disappeared. The Snake had emerged from one of two clutches (together making sixty eggs) which I had placed in a bed of dry moss and decaying vegetable matter on the floor a fortnight before. Though the conservatory is not artificially heated, and the spot where the eggs were placed gets no sun, these Snakes emerged more than a fortnight before the usual time. To return to the Toad, it was at 9.30 a.m. that I interrupted its meal, and I immediately removed the remaining eggs to a vivarium for safety; noticing that several eggs had hatched but the Snakes were not to be seen. At 3 p.m. I chloroformed the Toad, and the following week dissected it, when, to my surprise, I found no fewer than four young Snakes in the stomach and the tail of a fifth protruding from the intestine. The Snakes in the stomach were coiled and packed in a most wonderful manner, and the stomach appeared to be distended to its utmost, and was forced well to the left side of the body. The Snakes were from seven to seven and a half inches in length, giving a total length of three feet, nearly as thick as an ordinary pencil. None of the Snakes in the stomach or the visible tail of the fifth showed any signs of digestion, so I think it only reasonable to assume that the Snake in the intestine was the first swallowed, and, having room, sought to escape from its tomb by forcing its way through the pyloric valve into the duodenum. Data as to the enemies of young Snakes are badly needed. For some time past I have been trying to ascertain what becomes of the vast numbers of young Snakes that are hatched every year. Eggs are common enough, yet young

Snakes are rarely seen, adults or half-grown specimens being comparatively scarce.

On November 1st and 15th of last year I collected just over 550 egg-shells (*T. natrix*) from one manure-heap at Hensot. At least 500 of these had produced Snakes, yet there were only three young Snakes, and one Toad in the heap. What had become of the 500? (I refrain from suggesting the solitary Toad had accommodated them.) Not one was observed on the surrounding hedge-banks during the following spring or summer. Climate and animal enemies must have accounted for the majority—birds are no doubt largely responsible. If any of your readers have any notes on the enemies of young Snakes or Adders I should be glad to hear of them.—Arthur Loveridge (Kilternan, Llandaff).

PISCES.

Notes by an Angler.*—Bream.—Two species of this fish are found in the Mole—the White Bream (*Blicca bjoernka* †) and the Common or Carp Bream (*Abramis brama*). Some local anglers aver that there are three kinds of this fish to be found, and instance what they call the Golden Bream, a variety of *A. brama*. The white or silvery species is found in the shallower waters, in the deeper holes *A. brama* is dominant. Large shoals of the latter species are to be seen on fine summer days swimming at or near the surface, but always near or above the deeper holes or water they frequent. I have seen them on some few occasions thus patrol their haunts from 10 a.m. to 6 p.m., but this is unusual and their time for this appearance is, as a rule, from about midday to near 4 p.m. As they sail about in battalions (not aimlessly but above their haunts) their ranks are frequently joined by a large Roach, much larger than I ever hooked, who keeps in the ranks and accompanies the Bream patrol. At times a great splash is heard, as a whole cohort suddenly dives, their greatest fright, so far as I have observed and apart from a man on the bank, being the flight over them of some large bird—that of a water-hen is sufficient to cause a stampede. When

* Continued from p. 320.

† In the sixties of last century, when angling was pursued in the timber basins of the Surrey Commercial Docks at Rotherhithe, this fish was abundant in those resorts as I well remember, and also in the old Surrey Canal, which then ran through flourishing market gardens, the entomological features of which were well known to the late Edward Newman, who founded this Journal. These regions are now commercial wastes.

swimming near the surface only the black backs and paler snouts of the Bream are seen and the great depth of body is not appreciated.

The Common Carp (*Cyprinus carpio*).—This fish is at least not plentiful in the parts of the Mole which I frequent. I have never seen a specimen at Dorking, though John Timb, who wrote in 1822, refers to the 'Red Lion Inn' in the High Street of that town as "a noted house for Water-soncey, Carp, and Perch, which were here served up in great perfection during the season."* On June 17th, 1912, I captured my only Carp from the Mole at Gatwick, in moderately shallow water, and where the stream is little wider than a brook; other fish were not feeding. The same circumstances were reported elsewhere:—"June 16th was remarkable for some curious angling happenings. For instance, although a heavy thunderstorm threatened for most of the day, Carp were feeding well in the hard-fished Hampstead Ponds, and many a youthful Waltonian there caught the fish of his life up to that time."† Similar reports were received from other parts of the country on those days, a curious and unexplained episode in the habits of this fish.—W. L. Distant.

* 'A Picturesque Promenade round Dorking, in Surrey,' p. 77.

† 'The Fishing Gazette,' July 6th, 1912.

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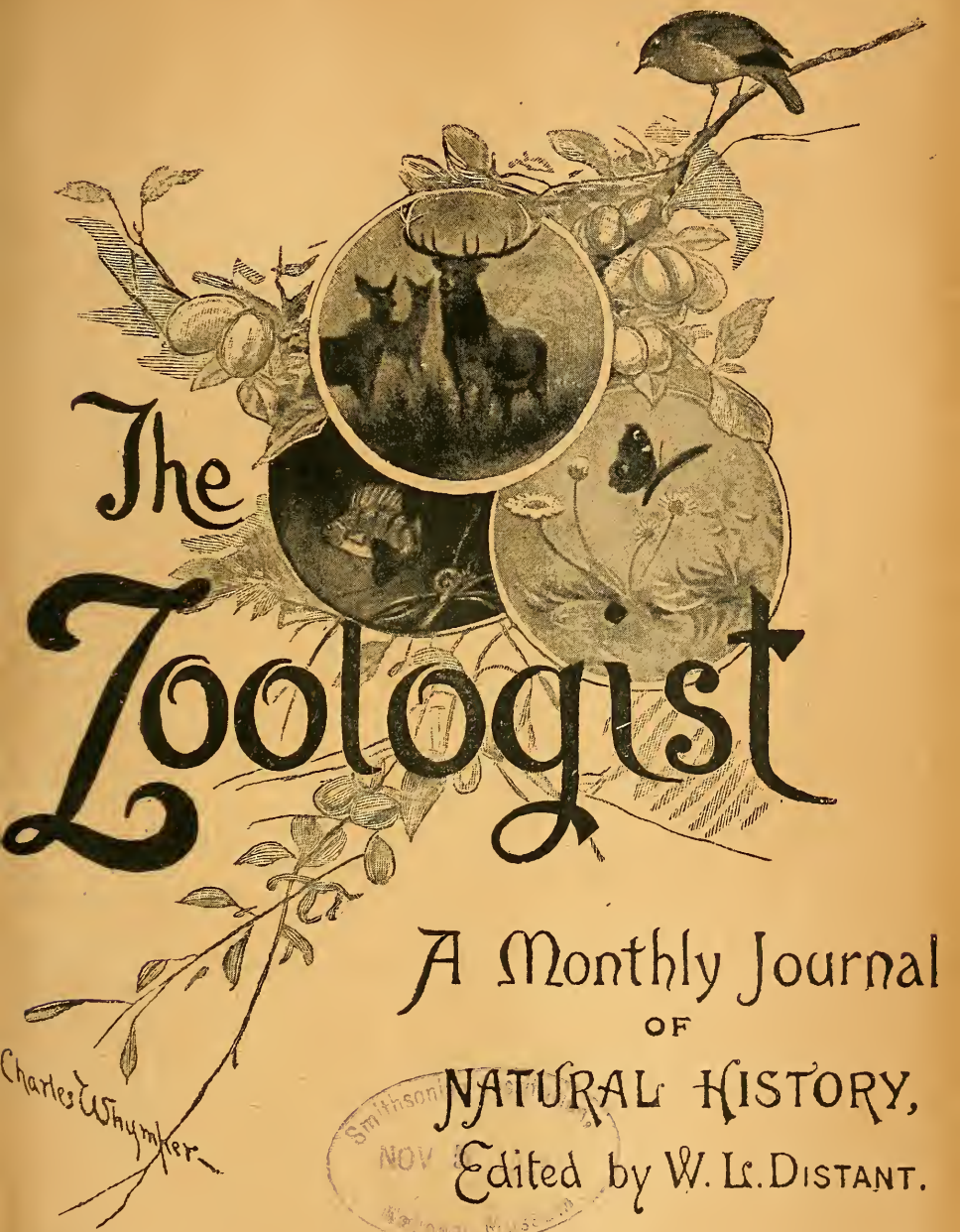

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No. 880.—October 15th, 1914.

ZOOLOGICAL NOTES ON A COLLECTING EXPEDITION IN BORNEO.

By J. C. Moulton, F.Z.S., Curator of the Sarawak Museum.

The naturalist who wishes to inflict his tale on a patient reader ought to have one at least of these three excuses :—(i) a real gift for observing and recording the wonders of Nature; (ii) a comparatively unknown or distant country to write about; or (iii) a region of some historic interest.

I claim these last two as my excuses for this paper :—(i) on the grounds that Borneo is a month's journey from Piccadilly, and (ii) that the journey I describe is almost identical with that undertaken by the great naturalist, A. R. Wallace, nearly sixty years ago.

Wallace's 'Malay Archipelago,' justly regarded as a classic among English books of travel, describes many an interesting excursion into the hidden recesses of these wonderful Malayan islands. Some fifty or sixty years have now elapsed since Wallace travelled in the Malay islands, and the dread march of civilization has wrought sweeping changes in some of them, although others still remain much as then. I have already described two places * made famous by the great naturalist in the 'Malay Archipelago,' and now offer to readers of the 'Zoologist' a brief account of a journey in the interior of Sarawak, over

* "Where Wallace Trod," being some account of an entomological trip to Mt. Serambu, Sarawak, Borneo, 'Entomologist,' 1912, pp. 213 and 246. "A Brief Visit to Malacca," 'Entomologist,' 1913, p. 278.

almost exactly the identical route followed by Wallace nearly sixty years ago.

Perhaps I should remind the reader of Wallace's stay in Borneo; this lasted from November 1st, 1854, to January 25th, 1856. His travels were confined to the western portion of Sarawak, the first four months being occupied with excursions from Kuching, the capital, to various places on the Sarawak river. His essay "On the Law which has Regulated the Introduction of New Species" (which preceded the historic essay of 1858, from Ternate) was written at Santubong in February, 1855. In March, 1855,* he went to Sadong, where a coal mine was being opened up. This is situated near the river of that name, which lies some twenty miles east of the Sarawak river. Here he remained nine months, returning to Kuching at the end of the year 1855 by a route through the interior, which took him to the source of the Sadong river, through the country of the Land- or Hill-Dayaks, and thence across the watershed to the source of the Sarawak river; down this to Kuching is a bare two days' journey. The whole excursion, fully described in Chapter V. of the 'Malay Archipelago' (pp. 101–116, 1st ed.), occupied some nine days (November 27th, 1855, to about December 5). The journey described in the present paper covered nearly the same route, and took place in May, 1914.

On Wallace's return to Kuching he made one more expedition up-river, this time to Mt. Serambu, where he spent some four weeks in all before returning to Singapore in January, 1856.

The accompanying sketch-map shows the places visited by Wallace, and the circular tour made by us in 1914.

The small Government launch steamed down the river, leaving Kuching, the capital, punctually at 8 a.m. on May 8th with our party all on board—six Dayak collectors, a Malay collector, Chinese cook, and two Europeans (B. in search of Coleoptera and the writer). An hour-and-a-half to the mouth of the river, three hours across a glassy sea to the east, and then up the Sadong river for two hours brought us to Simunjan, a Government station, where C., the Resident in charge, received us for the night.

* In the first edition of the 'Malay Archipelago' the date appears as 1865.

Author's route 1914 – – – – – –
Wallace's route 1855, the same from Simunjan to Borotoi, and from Bugu to Kuching
Wallace's route from Borotoi to Bugu .....

A small railway runs out three miles from the right bank to a neighbouring hill, where coal has been worked since Wallace's day. We walked out in the evening and met the manager. He had kindly made enquiries for me of the oldest inhabitants, but none remembered Wallace. It was interesting, however, to hear that someone had heard a *mias* (Orang Utan, *Simia satyrus*) that very morning near by. The writer had the privilege of meeting the great naturalist at Broadstone just a year before his death; one of the first things he asked was about the numbers of the *mias* to be seen at Sadong now. Dr. Wallace told me he used to meet with three or four, or more, every day. Nowadays they are very much scarcer, though a strict Government Order is now in force to prevent their extermination. It occasionally happens that one of these huge apes starts ravaging the natives' fruit trees, and then the Government does not prohibit retaliation; but on no account may the Orang Utan be hunted in his natural haunts. A more recent Order extends a wide protection over the fauna and flora of Sarawak in general, so that the naturalist-dealer and would-be exporter of thousands finds he has come to the wrong country. As a result of this protection one can follow up the Simunjan river and find in the upper reaches troupes of the curious Long-nosed Monkey (*Nasalis larvatus*) (which, by the way, is only found in Borneo) disporting themselves unconcernedly on the banks, and little disturbed by the passing of a boat within a few yards of them.

Next day we waited for the incoming tide before starting up-river in boats. At this time of the month a fairly large bore comes rushing up the river, swamping any unwary boats. The neighbouring river, called the Batang Lupar, also has a dangerous bore, but others in Sarawak are free from this curious wave.

The Resident, the Native Officer (a Malay Hadji), and a policeman helped to swell our numbers, their objective being the Land-Dayak country in the Upper Sadong, to collect the annual tax.

Paddling for some six hours brought us to the small Malay village of Gedong, where we stayed the night. About the only frequent sign of life was the big Nymphaline butterfly *Parthenos*

sylvia, which appeared to be abundant most of the way up the river.

May 10th.—Started early in the morning, the next tide again helping us on up the river for some four hours to the Malay village of Tanah Putih. From this point our progress was considerably slower, paddling against the stream for another five hours, and eventually arriving at Ampungan, where we passed the night in a comfortable Malay house. Another day's paddling brought us to the large village of Tabekang, which is picturesquely spread along both banks amid close plantations of cocoanut and pinang palms. The Land-Dayak village and some half-dozen Chinese shops occupy the left bank, while the Malay houses are built on the right; a spacious Government rest-house stands on a high bank at a bend above the village.

The river journey thus far offers little of zoological interest. A Bronze-winged Dove (*Chalcophaps indica*) was shot crossing the river; the common Atlas Moth (*Attacus atlas*) was seen with wings outspread on a shrub by the water's edge, but the combination of a collapsible net and a Malay boatman saved its life.

Our course had been in a general southerly direction. From this point a belt of country, extending to the border of Dutch Borneo some ten miles further south, stretches west to the head of the Sarawak river; this is thickly populated with Land-Dayaks—an interesting race who have kept much to themselves, living a quiet, sedentary life. Up till some seventy-five years ago they formed the natural prey of grasping Malay rulers and wandering Sea-Dayak head-hunters. One of the principal objects of Sir James Brooke, the first Rajah of Sarawak, was the protection of these Land-Dayaks. He was made Rajah in 1842, and from that time on peace reigned in this portion of Sarawak, though other parts further to the north-east took many years to pacify. From an ethnologist's point of view, the Land-Dayaks are of much interest. Alone of all the Sarawak tribes they preserve customs which indicate a former Hindu influence, and this, no doubt, is due to their Javanese origin. Even to-day the up-river chiefs preserve traditions of their journey from Java to South Borneo, and thence through the island to their present position. Talking about this one day, a Land-Dayak told me that a Javanese stayed in his village and

expressed his surprise at finding the customs and language of his hosts so like his own. The Sea-Dayak are, of course, a very different race, more nearly akin to the Malays. They are of a more restless, go-ahead disposition, and in the early days of the Brooke rule gave much trouble.

We had hoped to stay some days at Tabekang collecting natural history specimens while C. collected the tax, but a view from a neighbouring hill soon showed us that it would be mere waste of time. With the exception of one or two steep limestone crags supporting a thin scrub, the whole country had been cleared by the Dayaks for their paddi farms. Portions which were not then in use had reverted to jungle, but so far only a useless secondary growth had appeared.

It takes years for this to give way to big "primeval" jungle again, although in course of time it becomes impossible to tell whether such land had ever been cleared or not. On the west coast of British North Borneo there are big stretches of coarse grassland, where the soil seems too poor to support any luxuriant vegetation. I doubt whether it ever has, although I have been told that it is land that has never recovered from native clearing.

In the palm groves we found the common Fulgorid *Aphana farinosa*; its colouring was certainly procryptic, as it continually chose the light trunk of a coconut or nibong palm for its usual resting-place. One could catch them in the hand on such places, though they often jumped clear in time.

Among other insects taken at Tabekang were the bright little Cassidæ, *Aspidomorpha fuscopunctata*, *Metriona catenata*—both common species—and the rare *Chirida scalaris*, the big Elaterid *Alaus putridus*, while two uncommon Passalids, *Tæniocerus bicanthatus*, were about the only other beetles of any size or colour. Stripping off the bark of an old stump disclosed a family of flat brown Rhynchota, which Mr. Distant kindly identifies as *Acantharadus giganteus*, Banks; their colour and flatness made them particularly hard to distinguish. With them was a pretty little Tenebrionid, metallic purple and green.

The only Odonata obtained here were the two small Agrionids identified by Dr. Laidlaw as *Agriocnemis* sp. and *Aciagrion borneense*, the rather rare *Amphilestes macrocephala* (Agrionid), and a big Æschnine *Gynacantha*, sp.

After three nights at Tabekang, one of which was devoted to revelry and the next to recovery, B. and I moved on up-river in search of better country. We arranged with C. to meet again at another village further up in four days' time.

May 14*th*.—Our cheerful Malay crew, who had paddled us up from Simunyan, going on gently for hours on end to the accompaniment of topical songs, were replaced by Dayaks, and we distributed ourselves and our baggage over some half-dozen small boats suitable for the shallows of the upper part of the river. Paddling was no use now, and our crew stood up, two in the bow, two in the stern, poleing us along, now and again dragging the boat over some particularly shallow place. We followed the main Sadong river past the village of Krosin, and further up turned into a little stream on our right, which brought us to the village of Retuh. The sunny spots on this stream showed more signs of insect life, the beautiful brown *Papilio payeni* being one of the first to attract attention; this is a great rarity in Sarawak. Dragonflies appeared in great abundance, the beautiful green *Neurobasis chinensis*, the small Calopterygids *Euphœa tricolor* and *E. inœquipa* all adding beauty to the scene. On the sand we found the little Cicindelid *C. discreta*, and on the bushes above another little Cicindelid (*C. filigera*) was common.

Like most native villages (other than Malay) in Sarawak the inhabitants build one or two long houses, which are divided down the middle by a partition shutting off the living-rooms on one side and a long common verandah on the other. The living-room side is divided into small compartments by partitions at right-angles to the long central wall; each compartment is the home of one family; the number of families thus living in one row varies from three or four to ninety. In the Land-Dayak villages ten to twenty is the average number. A raised flap in the roof gives light and air. The whole house is raised on stilts some 10 ft. from the ground, wood, of course, being the only material used, stone houses being absolutely unknown. One of the distinguishing features of the Land-Dayak villages is the head-house, or *pancha*, as they call it. This is more like an overgrown Pigeon-cote than anything else —a large room, 30 ft. square, raised on wooden posts some 20 ft. off the ground, and protected by a high conical roof. In this

place the councils of the village are held, heads are preserved hanging from the roof, women are usually forbidden to enter, and here strangers are entertained. At Retuh our baggage was taken up to a very rickety head-house, whose supporting posts inclined delicately towards the river. We magnanimously gave this up to our followers and baggage, preferring for ourselves a little hut a few feet off the ground by the river-bank. Here we stayed quite comfortably for three days.

At the back of our hut rose a sharp limestone hill some 800 ft., up which we struggled painfully and to no purpose. Half-way up, however, we found a small clearing which produced some good insects—a Buprestid (*Epidelus wallacei*), which is covered with bright yellow powder when fresh; the big Longicorn (Lamiid) *Anhammus daleni*, with antennæ 5 in. long; six species of *Glenea*; the little green Cetoniid *Glycyphana pygmæa*, and the more common species *Macronata saturalis*. The extraordinary little black ant-like Longicorn (Cerambycid) *Clytellus westwoodi* was obtained here on the 15th, and the next day the collectors brought in the little black Anthicid *Formicomus corvinus*, which is wonderfully like this Longicorn, and the two together excellent mimics of a small black ant. Another small Cerambycid obtained belonging to this group was the little black Clerid mimic *Halme cleriformis*. In the next group we also secured a small species, *Cleomenes dihammaphoroides*.

One of the most interesting beetles obtained here was the big Cassid *Aspidomorpha dorsata*, collected in Borneo for the first time two years before by Mr. J. M. Bryan. Another smaller species, *Metriona obtiva*, was also brought in.

The collector secured a Bat in his butterfly net; it seems to be *Vesperugo tylopus*, a common Sarawak species. The only birds shot here were the Flycatcher (*Philentoma pyrrhopterum*) and the Green Barbet (*Chotorhea mystacophanes*), a common low-country bird in Sarawak.

Three snakes were also obtained, the rather scarce *Coluber tæniurus*, *Simotes purpurascens*, and the very common *Dryophis prasinus*. Like the Dusuns in North Borneo, these Dayaks seemed adepts at Frog-hunting; we saw the boys roasting them over a fire. One victim was identified as *Rana glandulosa*.

The small boys of the village were temporarily attached

to the collecting department, and good work they did. One day we wandered up the stream for an hour or two, chiefly after dragonflies and beetles. Some small fish were disturbed as we paddled along, enjoying the cold clear water seldom above our knees, and hoping they might be of use I offered our small friends a cent for every fish they caught. With the aid of a small stick 18 in. long, and a small loop of fibre at the end, they proceeded to stalk these fish, and succeeded in catching seven or eight in about half-an-hour! The fish appear to be a species of *Crossochilus vittatus*, Blgr. They also secured some prawns (*Atya moluccensis*, De Haan). The big Gasteropod *Ampullaria ampullacea* was found here; it is common all over Sarawak. A small bivalve (*Corbicula moussonii*) was plentiful in the river; it seems to be a local species.

At one spot on the bank we came across some little Vespids flying up and down in the sun; they appear to be *Ischnogaster ornatifrons*.

The Rhynchota were not of much interest, except perhaps a black Cercopid *Ectemnonotum nitidicolle*, a little yellow-spotted species named by Mr. Distant as *Lora inclyta*, Walk., a rather rare Pentatomid, *Hypencha ophthalmica*, Stäl, and the Reduviid *Sminthocoris singularis*.

As is usual in such localities, dragonflies were the most attractive insects, and many good species were secured.

Among the *Agrionidæ* obtained was an example of *Amphilestes macrocephala*, which appears to be always rather rare, and only found some way inland. The others obtained here have been identified by Dr. F. F. Laidlaw as follows:—*Disparoneura verticalis*, *Aciagrion crinorubellum*, and *Pseudagrion* sp. n.?

Collecting in the stream at this place produced several lovely Calopterygids—the beautiful green *Neurobasis chinensis* and the common *Vestalis amœna*, which also frequents the jungle away from streams; the black-winged *Dysphœa dimidiata* was noted as scarce; only two specimens of *Euphœa inæquipa*, which I have taken on similar mountain streams in different places in Sarawak. Another pretty *Euphœa* taken was *E. tricolor*, a beautiful insect with greenish-blue patch on wings flashing brightly in the sun.

The other Calopterygids Dr. Laidlaw kindly identifies as:—

Rhinocypha biseriata, which was hard to catch, as it kept so close to the water, and *Micromerus* (? new). The commonest was a beautiful semi-metallic species, *Ictinus melanops*.

A pond of muddy water near the Dayak village was gay with many common Libellulines, of which *Orthetrum sabina* and *O. testaceum* were most in evidence. The pretty *Raphisma inermis*, with basal portion of wing bright azure blue, was noticed; the lilac-pink *Trithemis aurora*, a local species in Sarawak; *Tyriobapta torrida*, *Cratilla metallica*, *Hydrobasileus extraneus* (or *croceus* ?), always scarce, and the little *Nannophya pygmæa* all added to the gaiety of the scene. Two more Dr. Laidlaw has not yet identified for me.

The Dayak boys of the village were responsible for five males (?) of the big Corduline *Epopthalmia australis*, caught (I think) flying up and down the Retuh stream.

They also assisted to catch another showy dragonfly which raced up and down the stream. This was a fine Gomphine, *Heterogomphus*, sp., new to Borneo, allied to *H. sumatranus*, with bright brown-red body, contrasting sharply with bright green thorax, eyes and face, both colours, alas! fading soon after death.

The only other species collected here Dr. Laidlaw identifies as *Ictinus melanops*.

One evening we were invited by the Orang Kaya, or chief of the village, to the usual entertainment of dance and music. This took place in the long common room of one of the long houses; a broad raised bench had been prepared for B. and myself against the outer wall, some gay cloth stretched on the roof above our heads, and the seat well covered with neat home-made mats. In front were three large brass stands heaped up with rice and a few eggs on top. Besides these were several bamboo lengths containing cooked rice. Behind, and facing us, sat the two chiefs of the house, the Orang Kaya and Pengara, and behind them, and on each side, were ranged a large gathering of some hundred natives, men, women and children, a couple of shaky lamps shedding an uncertain light over the scene.

The first item on the programme was a lengthy overture by the brass band, which consisted of some dozen gongs, beaten slowly and in some tune by as many men and boys. After this

the village priest or doctor blessed the food, invoking the help of the gods for general prosperity to the village and to us their guests. The cooked rice was then eaten, each taking a bite off the peeled bamboo, and wishing luck to the giver and to the village generally. Chinese arrack was passed round, tongues loosened, the gongs were turned on again, and then three over-dressed males stepped in before us, shook hands, and proceeded to dance. This was a slow and stately performance, which rather lost its impressiveness from the curious costume of the dancers. This consisted of a cloth wound round the head, a coat ornamented with three belts of silver coins, two worn across the shoulders and one round the waist; below this a skirt which stuck out some four or five inches on a bamboo crinoline; on their ankles a string of small bells. With feet close together, arms extended, hands and body gently curving this way, now that, slowly these three figures gyrated before us. On conclusion they shook hands again, and disappeared among the audience.

It was now the turn of the ladies. The four prettiest had paid us a preliminary call in our hut on the river bank. Their dress is soon described: a coil of brass wire on each fore-arm, more on each leg from the knee to the ankle; several thin rings of red and black rotan round the waist, and a belt of silver coins holding up a short skirt of dark blue cloth, which reached the knee; hair done up in a knot on the back of the head, and—of all horrors—their faces covered with powder! This was quite a new fashion, which I thought should be nipped in the bud at once, so my handkerchief was produced to remove the obnoxious powder from the dusky cheek of one fair girl, and the others then wiped it off themselves. The chief, who watched this proceeding with some amusement, agreed that they were now greatly improved.

Their dance was very similar to that of the men, but made more graceful by continual half curtseys and by the absence of the absurd crinoline. The only addition to their attire needed for the dance was a thin red scarf worn round the neck, and hanging gracefully over their outstretched arms. After the dance they came and sat by us, now talking, now singing some gentle droning song in Dayak.

We had seen all this at Tabekang, and so were not interested

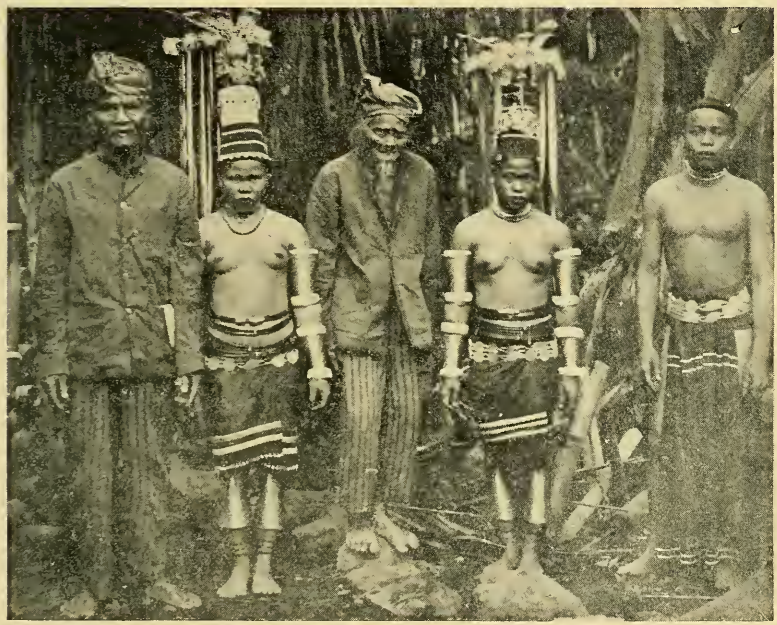
for long; however, a Fowl got loose from somewhere, and fluttered noisily through the assembly, then a late-comer arrived with a large Python (*P. curtus*, the short tailed species) which he had brought home to eat, provided I had no use for it. Then we had a new "turn," provided by our young friends the boy collectors. They were the jolliest little kids imaginable,

LAND-DAYAKS OF SADONG DISTRICT, SARAWAK. Photo by H. W. Smith.

happy and bright as the day; we got them to give us the curious concert described by Wallace. This consisted of a variety of clapping noises, produced by the boys clapping hands and body together in time, while two with their left hands under their armpits produced "a deep trumpet note"—to quote Wallace, who continues thus: "As they all kept time very well, the effect was by no means unpleasing."

We left them about 11 p.m., but the more energetic spirits kept it up till daylight.

May 17*th*.—Left Retuh in the morning, a small flotilla of dug-outs taking us down the Retuh stream and then up the main Sadong river for some two hours to the village of Temah. Here we stopped for a meal and to change the crew, the custom being for the traveller to be passed on from village to village. The Pengara, or sub-chief of this village, was an old man getting on for eighty; he told us he was a young man at the



LAND-DAYAKS OF SADONG DISTRICT, SARAWAK. Photo by H. W. Smith.

time of the Chinese insurrection, which took place in Sarawak in 1857. He, if anyone, should have remembered Wallace, but his memory failed him. We left a little after mid-day and entered the Suhuh stream, a branch of the Sadong emerging on the right bank just opposite the village of Temah. Into this stream, quite close to the mouth, runs another little stream called the Borotoi, where the Dayak village was in Wallace's day. Now there is no habitation there.

From here Wallace continued his boat journey up the main Sadong river (or Kayan river as it is known by the Dayaks in

this part) to the village of Budut ("Budu" in the 'Malay Archipelago'). We preferred to make a detour to the south by following up the Sutu stream to the village of Tebedu, and thence to its source in Mt. Merinjak, which was reported to be a large climbable mountain covered with virgin jungle.

We reached Tebedu that evening, and endured the dance performance once more before turning in. Next day we set out for Mt. Merinjak, intending to choose a suitable spot for a camp before moving there next day. The Tebedu Dayaks said we should get there in half an hour. Two hours' hot trudge through shadeless secondary growth brought us to Temong, a large village where welcome coconuts fortified us for the remainder of that "half hour" to the mountain. A good hour's walk brought us to the foot, and as the Temong Dayaks told us there was good water some way up the hill, we took their word for it and started on the three hours' return journey. The Resident turned up shortly after our arrival there, having taken eight hours to come up from Tabekang in a boat. His arrival served as an excuse for another dance in the evening.

May 19th.—We all set out for Temong in the morning, followed by a long train of Dayaks carrying our baggage. At Temong they tried hard to persuade us to stop the night, but B. and I were determined to waste no more time. This was our twelfth day out from Kuching, and beyond the three days at Retuh we had done no serious collecting. After a time new bearers were produced, and we set out for Mt. Merinjak, having said good-bye to C., who had to return to Tebedu and thence down-river to his headquarters at Sadong.

The first hour's walk led through the usual secondary growth as far as the foot of the mountain, and then a steep climb up brought us to the welcome shade of fine big jungle. After an up-and-down walk we camped by the side of a small stream 620 ft. above the sea-level. The Dayaks built us a little shelter, roofed with our two oiled canvas sheets, and then returned to Temong.

We stayed there for eleven days, returning to Temong on May 30th.

(To be continued.)

SOME MISCELLANEOUS NOTES FROM GREAT YARMOUTH (1913–14).

By Arthur H. Patterson.

My notes published in this Journal in October, 1913, ended somewhat abruptly in early September. Those in the present number cover a period of some twelve months, and relate in a great measure to observations made in the neighbourhood of St. Olaves, a church-less little village in North Suffolk, on the River Waveney, some four or five miles beyond Breydon water. My week-ends, nowadays, are usually spent in the marshlands in the vicinity of my houseboat ('Moorhen II.'). Breydon still retains some charms for me, although the gradual but ceaseless growing-up of the mudflats and the elimination of many smaller and once punt-navigable "drains" make negotiation almost impossible, except on the higher tides, and circumscribe one's movements very considerably. We have luxuriant acres of *Zostera*, where two or three decades since the mud was bare and oozy, and full of the low forms of life on which small waders chiefly subsist. This *Zostera* holds the silt and flotsam which help to raise the flats; then comes the jointed glasswort (*Salicornea herbacea*), and finally the harsh semi-marine marsh grasses, which now give the historic "Lumps" a rond-like appearance. I cannot but feel a sort of 'Last of the Mohicans' pessimism when alone, lying in my punt at the "Lumps," watching the great hordes of Gulls, the little flocks of Dunlins and their chums the Ringed Plovers, prowling about in search of food, with not another fellow-creature in sight; and calling to mind my youth, when at one time a dozen Eel-catchers might be seen at work over the flats and at the "Fleet" with "pick" or "bab," and as many punt-gunners gliding around in search of Duck and rarer birds, with here and there a trio of smelters hauling in their prey, and a crew of mulleters, or "butters," seeking Flounders or the cunning Grey Mullet. One can go

thither many days in the finer months and, but for the bird-watcher in his hut, in the midst of this waste of mud and waters be alone with the birds. The "close" season, the highly-drained marshes, and the altered flats tempt no new generation of Breydoners; and but two or three, feeble and aged, now survive the sturdy fellows whom, as a lad, I knew so well.*

In the autumn of 1913 a well-known Lowestoft ornithologist sent me the carcases of two or three Pallas's Sand-Grouse (*Syrrhaptes paradoxus*) that had been received, in the skin, from a Far East consignment, in cold storage. I was not particularly smitten with the flavour, which was a bad cross between Pigeon and Partridge. From the gizzards I turned out several seeds, mixed with a quantity of small white stones, which I planted, and with very little trouble raised a number of small plants. Mr. W. A. Nicholson, of Norwich, kindly forwarded them to Kew, and shortly wrote: "I sent them . . . and they named one of them, the others were in much too young a state to admit of certainty even as to the genus . . . one may probably be a *Desmodium*, and the other a *Medicago*. The full-grown one with pods is *Glycine ussuriensis*, Regel & Maack."

On October 17th, 1913, I received a small box containing a number of walnuts from Norwich, the sender informing me that they fell from a tree in his garden. "I have had," he wrote, "a great many more like them during the past few days, but never before until this year. The tree is about forty-six or forty-seven years old; I planted it myself from a nut. It did not bear any fruit until twenty years old, but they are very small, more so than usual this year, for some reason."

I suggested Nuthatches had been helping themselves, for this species, according to Stevenson ('Birds of Norfolk'), is common in that part of Norwich [Earlham], but the writer insisted they must have been damaged by Starlings, having seen them on the tree—an inconclusive assumption. The nuts were never found in bark-chinks, but invariably on the ground. The depressed end of the shell had been always attacked, and a marble-sized hole had been pecked. Surely a Starling's longer

* The changes on Breydon during the past fifty years are largely referred to in my 'Nature in Eastern Norfolk' and 'Wild Life on a Norfolk Estuary.'

bill would have been scarcely strong enough to split the shell, and, had it been, the kernel would have been more deeply indented. Mr. J. H. Gurney suggested that as it seemed impossible Starlings could have attacked them, he thought Nuthatches had done so; or, peradventure, Squirrels, which seems to me unlikely. Mr. Gurney also remarked, "I never knew a case of Nuthatches eating walnuts before, although I have watched Rooks eating them."

The first recorded Waxwing (*Ampelis garrulus*) of the latest invasion of that species came into my hands on November 15th from St. Olaves, having been sent to me by a farmer who had observed it bustling about in his trees. Numbers were afterwards seen in the neighbourhood, small tame flocks appearing in back gardens of well-populated localities. Several were brought to market, where one of the best old birds I ever saw was procured for a few pence. It had wax tips to the tail feathers, as well as on the wings, and a ruddy tint was observable well up the feather shafts. A friend writing to me from Sheringham on January 11th, 1914, noticed their partiality for the "haws of the brier roses," and their seemingly very thirsty natures—they were constantly sipping at a fountain in the garden.

Six Waxwings came to the garden of a Gorleston gentleman, where the berries of the privet hedge were eagerly seized by them; so tame and confiding were they that both he and his wife observed the minutest details of their plumage, and graphically described their colours as well as actions.

January 3rd.—A short snap of cold weather early in January accounted for a display of very small birds in the Saturday's market, mostly Blackbirds, a species esteemed delicate eating in East Norfolk. A live freshly-trapped Hawfinch was also on sale. A few Teal, Goldeneyes, and Woodcocks were observed in a game-dealer's shop.

January 24th.—I observed that the Gulls haunting the beach were still terrified at the movements of the locally herded aeroplanes, but later in the year the usual hordes of Greater Black-backs then frequenting Breydon had become somewhat less astonished at their flight, which so much resembles the movements of some great Falcon.

Wrens (*Troglodytes parvulus*) appeared to be most plentifully distributed, late in January, in the well-wooded neighbourhood east of St. Olaves.

January 31*st*.—Saw a Slavonian Grebe (*Podicipes auritus*) in the market on this date; and a number of Ducks, including Pochards and Wigeon, with plenty of Moorhens and Coots.

Mr. F. C. Cook, of Lowestoft, sent me word that on January 21st an Otter, weighing 12 lb., had been shot at Carlton, near that town. How this large animal still manages to avoid extermination in the Broadland districts can only be accounted for by its marvellous cunning and extreme secretiveness of habit.

February 10*th*.—*Mus rattus*. Two women in a back street were doubtfully peering into a screw of paper, which a small boy was very complacently yet cautiously holding in his extended hands. On going up to see, I found his parcel contained two Rats that he was about to take to the Town Hall, for the penny apiece reward offered for the animals. The scare of two or three years ago that prompted the suppressive measures still provides a "Rat-bin" at the Sanitary Inspector's office; and any Rat found or taken by any possible means is purchased and thrown in, for ultimate cremation at the destructor. One was a half-grown Black Rat (*Mus rattus*), the other a well-grown example of the Alexandrine variety, *Mus r. alexandrinus*. I immediately secured both by offering a more tempting reward, and popped them into my pocket. The larger example was of a greyish colour, with brownish black hairs freely sprinkled along the back and on the rump; the breast, throat, and under parts being yellowish white; ears large and naked; soles of the feet naked and yellowish. The length of the body was six inches; the tail measuring eight inches.

February 7*th*.—The Jackdaws had come back to the Parish Church steeple, and by their actions several would seem to have paired. It was odd to see the birds excitedly wheeling round and round the spire, one and another doubling in its flight, dropping with Pigeon-like movement, then suddenly halting and quivering, as if throwing water from its plumage. The birds' presence in the town has become so familiar that no one seems to heed them alighting and chattering upon the chimney-pots.

Same date. Four White-fronted Geese (*Anser albifrons*) had been seen on Breydon, three being killed.

Cats living in the country, as is well known, often develop their hunting instincts to a high degree. In an adjoining village there is a commonplace black-and-white feline, some six years old, and frequently having kittens, which spends much of her time stalking among the lush herbage in the wetter portion of a market garden. I have observed her creeping along at the edge of the small ditches that drain the lower end, eagerly searching for Water Voles, tracking down one now and again with marvellous dexterity; and I have known her to actually plunge bodily into the water to secure her prey. She creeps into hiding close by the gardener's young chickens, or wild ducklings (of which he rears many), and springs therefrom upon the Sparrows lured down by the food provided for the fowls. Puss makes no pretence to injure the downiest chicken, nor even makes eyes at the Canaries nesting in the shed within easy reach, seeming to know the limits of her liberty. Not a day passes but Lizards, Sparrows, Field Voles, or other game is brought into the house and laid before the kittens. Among her victims figure also Goldfinch, Linnet, Frog, Woodcock, Rabbit, Snipe (one of the latter was brought in alive on February 17th), and other creatures. A nest of Great Tits discovered on the top of a bee-hive was emptied by her, and all the young devoured.

February 26th.—Saw a Redshank, with an upturned bill very like a Godwit's.

Rooks to the number of twenty on this date passed over seawards and disappeared in the distance north-eastward.

The shrimpers on the west side of the river, where the timber-sheds and shipping stores are situated, usually catch the cod-end of their dredges and run them up to the mast-head, taking care to empty the meshes of every Shrimp or small fish, owing to the attentions of the Common Rat (*M. decumanus*), which would otherwise be attracted at night by the phosphorescent glow given off by dead victims; for the rodents are adepts at climbing up and gnawing holes in the net to get at them, thus giving the men unnecessary labour in mending. Rats are often disturbed in the early hours when at their depredations by the irate shrimpers: it is odd to see them scuttling to the quays along the

mooring-ropes. If they slip, they do not fall but cling and scamper along like acrobats, and usually manage to end their performances satisfactorily to themselves. These Rats find much to examine in the marine creatures that fall into the billage; whilst by day Sparrows and Starlings are occasionally observed picking small crustaceans from the drying nets. I might remark that the shrimpers work by the tides, dropping out to sea on the first of the ebb-tide and returning on the top of the flood.

Pigeon shoots were instituted all over the county in March, the destructiveness of the Wood-Pigeon having called for repressive measures. I was informed that at the "big shoot" organized by Sir Savile Crossley at Somerleyton the guns averaged nine birds apiece; my informant having been stationed in a likely corner bagged fourteen. Two birds which he sent me were empty, "early shot birds," he said, "that had not had time to breakfast." A third bird's crop contained half a cupful of clover leaves; it had managed to begin breakfast! An old gamekeeper friend assured me he once shot, on the Lacon estate at Ormesby, a Pigeon from whose crop he counted two hundred and eighty-two large peas; another closely packed crop disclosed a solid, hard-compressed ball of clover leaves that filled his two hands, and which, when loosely shaken up, nearly filled a quarter-peck measure.

A strange movement of small birds attracted much attention in the neighbourhood, more particularly in Gorleston. The flight was described to me as taking place in the early morning of March 11th, the birds flying at an elevation of some three hundred feet; the flock extended over a mile and a half, and was of considerable breadth, sufficient to make an appreciable darkening of the sky in passing. No bird fell out, and the species seemed to remain in doubt. Mr. J. H. Gurney wrote me that he had obtained evidence from Mr. J. Vincent, a Broadland gamekeeper, that many flocks of Starlings flew over in a *westerly* direction at the same time at Horsey. The conclusion Mr. Gurney came to was that the Yarmouth birds were also Starlings. There was nothing abnormal in the wind or weather; so that the direction of the birds' flight may be also looked upon as something of an enigma.

A Mistle-Thrush, nesting in the heart of the town, day after

day perched itself on a tall tree-top in the busiest street, much interesting passing crowds by its bold cheery song.

April 4th.—During a sail round Breydon in my punt I was much interested in the evolutions of a parcel of sixty Wigeon that wheeled around and manœuvred, evidently for the very fun of it, like so many frolicsome Dunlins. Observed six Hooded Crows still with us; and four as late as the 11th.

When sitting in the cabin of 'Moorhen II.' on April 13th with Miss L. Medland, the bird artist, we were discussing birds, and hoping for the coming of the Swallows. I may say that during the afternoon we had noticed a number of St. Mark's Fly (*Bibio marci*) gyrating around the orchard at the farm hard by, a circumstance that called for my remark, "Look! there's *the* fly; the Swallows won't be far off." And sure enough, as we sat chatting, I observed a couple of Swallows dash past the cabin doors. We rushed out just in time to see a whole concourse steadily flying in, passing westward, undoubtedly just from oversea. We watched the majority disappear beyond the St. Olaves railway bridge; eight fell out, and returning to the farm, immediately commenced, as if with a good appetite, to seize many of the insects that had not yet wearied of dancing in the warmth of the lowering sun.

Early in April a French Partridge, wearily crossing the river from the eastward, fell in, and was fished out by a man who brought it to me alive. It was a very wild bird, and for weeks refused even to tolerate my company, so I let it go again.

Observed a Bearded Tit flying among the dense reeds beside the Waveney River on April 26th, and have reason to believe that this species nested there this season. Nightingales nested in the vicinity of my houseboat, and one fine fellow came nightly in May to the fir clump at the back of the farmhouse, treating us to most delightful solos; one of the farmer's sons, however, complained to me "that the row the bahd kicks up prevents him sleepin'."

From Coltishall I received a post-card dated May 6th stating "the Swifts had arrived this morning; one pair generally turn up a day or two before the others."

During May the Euonymus shrubs were terribly devastated by the caterpillars of the Magpie Moth. A quick way to get rid

of these pests is to place a white cloth on the ground and roughly shake the shrubs, when the much-surprised larvæ will fall off, and are then easily despatched. I have fed tame Natterjack Toads with this caterpillar, upon which they eagerly prey, the contortions of the caterpillar being curiously overcome by the reptile using its fore feet as hands. I can never watch the comical twinkle in the Toad's eye as the squirming larva tickles him without being amused.

I observed my first Sand-Martin on May 12th. I did not consider this species quite so locally abundant as in some other years.

During May and June the Nightjars appeared to be somewhat numerous, the bracken-covered uplands above the valley of the Waveney being well suited to their habits. One or more came nightly to "churn" in a tall old elm at the farm, making delightful music between the times of their onslaughts upon the night-loving insects. The V-shaped flight makes the bird look excessively uncanny in the gloaming.

A pair of Kingfishers nested in a red-sandy corner near the 'Moorhen II.' The tunnel seems to have been bored by the birds themselves, for no Coney, Stoat, or Rat would have chosen such an exposed and cliff-like location; and the bore was so small that my arm stuck when half-way up. The floor of the tunnel was filthy black, with strong-smelling moisture, large blow-flies being attracted to it. It was odd to see these insects gyrating around and crawling well into the shadow to sip at this obnoxious matter. The young birds kept up a queer, scissor-wheel kind of churning noise, which stopped at the least unfamiliar sound from without, even the hum of a venturesome fly causing a break in it. One old bird cunningly remained inside all the time I stood at the entrance, but as soon as I had shifted my position a trifle, out she came; and a short while after her mate came home with a small Roach in his mandibles; with it he passed through the entrance as neatly and as swiftly as a Swallow dashes through a hole in a marsh-mill window-pane.

One might have thought the brightly-plumaged birds had an eye for beauty when choosing this site—a few yellow furze-sprays were dependent from above, with several wild flowers littering the broken soil at the cliff-base, around which flitted a Tortoise-

shell and some small blue butterflies. Big heaps of flowering brambles and furze-bushes flanked the little slope, and some firs brought up the rear.

On May 22nd when travelling by a Great Northern train I passed, near Hemsby, a long line of clover growing inside the rail fencing, from which sprang thousands of small garden white butterflies, their numbers and movements suggesting a snow-storm falling upwards! I heard next day that great numbers of these butterflies had been observed near the sea coast, suggesting an immigration. Whilst observing these I saw a beautiful male Shoveller rise from the corner of a wheatfield. It kept pace for some distance with the train, flying abreast of the next carriage.

May 23rd.—A flock of some twenty Turtle-Doves observed flying from over sea across the town.

"Reed-Sparrows" haunt the reed-bed the other side of my ditch. The male has a curious habit of perching on an out-standing reed, flicking his tail and balancing himself simultaneously in a half-dancing manner, opening and shutting his tail-feathers with a quick fan-like movement.

For the past six or seven years in some trees overlooking the market place in the centre of the town a flourishing colony of Rooks has existed. This spring nearly a score of nests were built. Two years ago a branch colony was established in a clump of trees at the rear of the parish church, a couple of birds succeeding, after some bullying by the older colony, in rearing a family. Some eight nests were built there this spring.

Redshanks.—On May 20th a pair of Redshanks chose for their nesting place the centre of an adjoining marsh covered with dense reeds, which later yields a very large crop of litter. The birds for some time had been very much in evidence, the male bird being extremely vociferous and constantly pirouetting around. He has been much addicted to perching on a rude bench beside the path on the other side of the marsh, clamouring frequently. He flew around often in an erratic manner, occasionally stopping in his flight for a second or two and quivering vigorously, at the same time piping querulously. A Carrion-Crow daily scouring the neighbourhood, I have reason to believe, discovered the unhatched eggs, which a prowling juvenile egg-collector had failed, after much searching, to do;

and a second batch must have been laid, as a couple of young birds (I observed no more) flew much later than ordinarily. I have noticed this species both on the Bure (Norfolk) and Waveney (Suffolk) marshes for nearly forty years, but do not remember observing young ones on the wing so early as April 25th. It is a weakness of youth to jump to conclusions, although an objectionable practice; I think Mr. Chasen has made a mistake in the species, and rather ambiguously refers to his record as "premature." I am never surprised at not seeing the bulk of our local Redshanks before March 20th; I noticed my earliest arrivals on March 7th this year (1914). They do not nest directly they come. A few odd birds appear to remain in this country all the winter, moving about locally when compelled by the exigencies of the weather. I have observed dead birds on the late Mr. Durrant's game stall in December, January, and February. June 26th is the almost stereotyped date for their deserting the marshes (those of the Waveney, in particular) and resorting to the vicinity of Breydon. The late Mr. W. S. Everett, a noted Suffolk sportsman of the old school, always insisted that "on this date they left the Oulton Marshes for Breydon."

When taking a walk by the side of the Haddiscoe Canal I observed that the *nemoralis* Snails haunted the bottoms of the dank grasses and rushes on the slopes of the bank. Many broken shells lay around, and I notice that in very dry weather the Thrushes and Blackbirds constantly flit across the marsh, more especially towards "mist-rising" at eventide, when molluscs come out to feed, fetching and carrying these Snails home to their youngsters.

Carrion-Crows.—I am glad that a pair of Carrion-Crows still appear to nest in a moist bottomed wood in a village lane three miles away, where I discovered a nest in 1905. Had I then not been almost as keen-eyed as the sable head of the establishment I had not noticed him, for he simply "slid" off the nest noiselessly and cunningly, and, spiriting round the tree trunk, vanished. On June 1st it was probably the same old fellow who winnowed his way into my neighbourhood and caught my attention by his measured scouting, and day after day went through the self-same tactics,

beating along the edges of the reed-beds beside the river, vol-planing over the marshes, and hunting around the outskirts of the farm and the orchard where many fowls are kept and chickens reared. Any dropped egg is speedily spotted and promptly appropriated. Mr. Meen (my neighbour at the farm) and several others who allege they have suffered through Master Crow tried in vain for weeks to get within gunshot of the bird, but without success. Early each morning his coming was made known to me by the clamour of the Redshanks, which dashed at and around him with the audacity of a Lapwing, a procedure utterly ignored by him. One Moorhen hard by lost the whole of its clutch of eggs; and the farmer pointed out to me the remains of the egg-shells, including the addled ones of a Turkey whence he had drawn out and afterwards devoured the dead chickens. I laid out some shells containing fragments of boiled egg: these he discovered and ate up entirely, but a china egg laid in the middle of the marsh, although he sailed round it once or twice, he did not even stop in his flight to test. Later on I saw the whole family party of six; and I think I am correct in believing I saw more than one on Breydon mudflats in August.

June 3rd.—Saw a White Java Dove still in excellent feather, that had just completed its twenty-sixth year: last year it laid two eggs. I have a stuffed one that had reached its thirtieth year.

During a walk along Breydon "walls" on June 3rd I noticed a Common Sandpiper (was it locally nesting?) and a dozen Ringed Plovers, rather late for a flocking of this species. I was also delighted to observe for some time no fewer than four Spoonbills feeding on the flats at the rear of the Watcher's house-boat. They were very restless and active, following each other, sheep fashion, now walking and spooning, now running down the flat edge into the shallow drains (it was low water), and then suddenly breaking into a flight of a few yards. They were exceedingly conspicuous in their pure white against the sombre tints of the mudflats. I feel sure that their principal quest was Sand Shrimps (*Crangon vulgaris*) and Ditch Prawns (*Palæmonetes varians*), both of which are plentiful in the shallows after the tide has drawn off the muds; occasionally this species repairs

to the marsh ditches where *Gammarus* and probably small Sticklebacks have attractions for them. Off and on, all the summer, two or three Spoonbills were generally to be seen.

At 8.15 p.m. a Swift and a Bat were flying around together.

Sixteen Geese were observed to fly over the town on June 18th. Having seen Bernacle-Geese moving aforetime in the second and third weeks of this month (*vide* 'Zoologist,' 1913, p. 364), I am inclined to place these down to the same species.

Several hundred Rooks passed over, coming from the east, on June 18th, a rather unusual date.

A pair of Blue-Tits nesting in a well-used letter-box; a pair of Coal-Tits nesting in the top of a beehive.

The Water-Voles have a flourishing colony in my ditch at St. Olaves: they are the jolliest of little fellows, and are perfectly reconciled to my society. They tumble out of their holes when the tide falls, both early morning and later in the day, spending the hottest part of the day in their snug retreats burrowed well upwards in the bank. At high water their front doors are a yard below the surface. They come out for scraps and appear to appreciate a nibble at apple parings and tomato skins as a change of diet from succulent grass stems and tender reeds. Everything is passed, Squirrel-fashion, by the fore-paws to the mouth. One day in June a splash at the stern of my boat announced the tumbling in of a young Water-Vole. I looked out and saw the old lady with what I took to be an elder son—half-grown. It may be the farmer's dog Mike had bereaved the old Voles of the others in the family, or a Jack that often frequents the ditch. Mother Vole began to swim, the old male sat on the opposite bank breakfasting on moist sweet grass-stems. The younger followed her, and came up with her in the middle of the ditch, when she dived: he swam back to the spot where he started. The dam popped up again and returned to him, evidently giving instructions as well as orders. The youngster seemed petulant and frisked a bit. Then out she swam again, the young one following, his teeth fast to the fur on the lower part of her back. When in the middle she dived, but the youth did not, but turned back and swam to the mud. Again she decoyed him into the middle of the ditch, when suddenly turning, she seized him by the fur at the back of the

shoulders and deliberately dived with him, not leaving hold of him until both emerged in the shallow, where the old male still sat nibbling the grasses. Evidently it was a necessary lesson.

At tea-time the youngster came forth from the burrow alone, and in foraging discovered a bread-crust I had thrown out on the grass above his burrow. He made a sorry climb up the clayey incline, falling back into the water twice, landing therein seemingly with some show of irritation; on the third fall the crust tumbled in with him.

When passing a marine store warehouse in one of the Yarmouth Rows early in June I heard the clamour of the hunt, and naturally turned in to see the "fun." The hands were vigorously turning over bales of old rope and heaps of bones, whereamong a number of Black Rats were in hiding. Two massive bull terriers were in the thick of the *mêlée* with ivory-studded jaws. The Rats had bred all too freely, and were much at home in the byeways and bridle-paths among the stuff. It was queer to observe odd fugitives that had escaped the dogs clambering along a gaspipe near the ceiling that led to another known hiding place, but these, in every instance, were promptly knocked down with a stick. The hunt accounted for some half-score of old, young, and half-grown rodents, and two or three tattered carcases were discovered later on in the day; these had been killed by the dogs unobserved. The Rats were typical *Mus rattus*.

July (?).—A great peculiarity attached to the Natterjack (*Bufo calamita*) or "Running" Toad is the fact that thousands may be discovered in one village, whilst scarcely one may be met with in the adjoining one. Early one Sunday morning I visited a village lying south of the town expressly to see if I could obtain a few specimens. The village referred to combines, with its level of wet marsh and luxuriant weeds and rising sandy common land covered with furze, to make just the most favourable habitat of the species. The majority that had been catching the unhappy *Harpalus* and other beetles, "sows" (woodlice), and other small fry that haunt the strawberry beds, were scrambling home to a sandy bank at the edge of my friend's garden, where in the ragged sand and among the half-exposed

roots of the furze, they had made their lines of cave-dwellings. It was odd to see rows of Toads, with heads protruding, philosophising on the previous night's raid; and funnier still to observe the late home-comers toddling from their hunt under the strawberry leaves, with protuberant bellies, bandy legs, and glistening eyes. These reptiles must eat largely, for when captured and placed in a box, they vomit pellets of wingcases and the indigestible parts of the harder beetles. When affrighted, freshly caught examples will eject from their hides an unpleasant, cold liquid. They will very speedily become tame, and make interesting pets.

Owing presumably to the greater number of fir trees grown to-day, the Great Sawfly (*Sirex gigas*) would seem to be on the increase. Several were captured in July. Up till August 24th Wasps had not been nearly so abundant this autumn. Two nests I discovered near my houseboat I promptly destroyed by pouring into their entrances a mixture of paraffin, methylated spirits and naphtha, sending a running fire into the interior by applying a match. I had previously marked down the entrances during the day. But there must be (August 30th) a very formidable colony somewhere in the neighbourhood, for during the past two days' oppressive heat the houseboat has been besieged by Wasps of a very lively and offensive tribe, that buzzed around the doors and over my writing paper until I have had to make and use a small bat in self-defence, knocking them down continuously.

On July 25th when sitting in the police-court making a sketch of a very eccentric individual, a Sexton Beetle (*Necrophorus vespillo*), that had by some mischance found its way into this hall of justice, alighted on my drawing, and was promptly secured by me, to the amusement of the reporters who thought the insect's choice of my company rather appropriate!

One July evening I visited a country friend who was looking, with no great delight, upon a ruined beehive. The colony had either died or become bankrupt, and the dry comb left inside the hive had been ruined by the larvæ of the Wax Moth (*Galleria mellonella*). It was odd to see fat inch-long Caterpillars exploring the empty cells, now creeping along the tent-lined hollows where the midrib had been eaten away, now emerging from one

cell and suddenly descending into the adjoining one with remarkable celerity. A few odd Bees crawled disconsolately among the wrecked comb, as if looting in their own fallen city. The inch-long white cylindrical pupa-cases were exceedingly tough, requiring some force to tear them. The "ripe" larvæ must have overlapped continuously those that had metamorphosed before them, for they lay end across end, like tiles, as regularly as leaves in a laurel wreath. Placing some sections of comb, with the insects in every stage, into a wrapper of brown paper, I observed next day that the larvæ had eaten holes in it. I sent my prize to my keeper-son at the insect house in the Zoological Gardens, where he said it made an interesting exhibit. I think it would be desirable that any entomologist who may come across interesting insect episodes of a like nature should send them to this popular and educational institution.

I may add that my Bee friend assured me this was his only hive that had so suffered; and he thought that it was as well that the Moths had founded up a sickly colony and left the healthy ones to take care of themselves.

My friend the Bee-man afterwards took me to see a bed of peas, and complained to me that the numerous empty torn pods had been emptied by Jays that came in the early morning from an adjoining small wood. Certainly he had cause for complaint, and may have correctly adjudged the culprits. One side only had been pecked into ribbons and the peas extracted. He asserted that the birds were so cunning he could not get a shot at them.

July 28th.—Observed a couple of men mowing grass with a machine on a marsh. Around and behind them flew many scores of Swallows and Martins, greedily snapping up the disturbed insects that had been in hiding during the short cold spell that just then obtained.

On August 16th a young White Wyandotte Cockerel came along my ditch bank with a nearly full-grown Field Vole (*Microtus agrestis*) depending from his mandibles, struggling feebly. Once or twice he banged it on the clayey soil, shaking it vigorously, but was too wise to let it loose for a moment. It was only after a chase and a vigorous thwacking with my felt hat that the fowl dropped the rodent, unfortunately quite at the

entrance of a burrow, down which the terrified animal promptly disappeared. I find it is a usual thing for these powerful young fowls to perambulate the marsh and banks in search of such prey; and not infrequently do they capture and devour variously sized Field Voles.

August 21*st*.—Went up Breydon on the top of the flood-tide. Everywhere, except the "Lumps" (the highest of the flats), was covered. Among the rough "rond-grass" were flocks of Ringed Plovers and Dunlins. The adult Ringed Plovers in some instances were magnificent birds, and a few Dunlins still retained the black nuptial vest. A number of very tame young Plovers had the "collar" of light grey, and a bare patch of white where it had not yet met. Several Turnstones, old and young, had joined the other waders, as had some half dozen Curlew-Sandpipers; one or two of the latter were on change, a light brick colour still distinguishing them. A number of Redshanks piped here and there, but were not so numerous, the Watcher assured me, as they were at the end of June, "when they came to Breydon by hundreds"—a rather inflated figure, undoubtedly. Several Greenshanks flew around, unhappy till tide-fall, when their favourite creeks ran low. As the tide fell, the Curlews came from their siesta on the marshes, knowing by instinct when the tide had turned. As the flats bared, several young Lesser Terns came to them, and were well fed by their parents with young Herrings (*local*, "Whitebait"). The old birds clicked when returning with a fish to one particular young one, the latter answering with a shrill clattering note. The fish was snatched from the old birds' bill and promptly swallowed. Many Black-headed Gulls flocked to the *Zostera* directly the water drew off, and began their search for small Herrings entangled among the fronds.

On this same date a number of Starlings this sultry afternoon flew around like so many Swallows, about fifty yards above head, capturing insects that appeared to be swarming at that elevation. From the fact that odd winged Ants alighted on my coat, I judged this to be the species so eagerly captured by the birds. It was curious to see how, with stiffened, well-spread flight feathers, the Starlings glided around and to and fro, their

heads occasionally turned to snatch at prey they had missed when flying end-on at it.

Owing to the outbreak of war, and all the fishing vessels running into port, the larger Gulls would seem to have been hard pressed. One day in August the Watcher assured me there must have been from 10,000 to 12,000 Gulls of all sorts on the mudflats, where they must have done great execution among, and accounted for, every Shore-Crab and stranded fish or Shrimp that came within reach of keen eyes and strong mandibles. I have seldom seen groups of more beautiful adult Greater Black-backed Gulls than on recent days. The Lesser Black-backed Gull I have not seen at all this summer, and deem it rarer year by year. For some unaccountable reason "Grey" Gulls in the second year plumage have been markedly absent, although third and fourth year birds in the conspicuous blotched state have been freely sprinkled among the adult birds. Common Gulls have been scarce also.

On the last day of the "close" season (August 31st) I saw a crowd of Gulls, a number of Curlews and other waders, scattered all over the vast area of uncovered flats, the tides being so poor they had no need to collect at the "Lumps." A party of nearly a dozen Lapwings, a comparatively scarce visitor to the mudflats, joined other waders upon the muds rendering themselves conspicuous by their rollicking ways and restless movements, one or another rising continually and tumbling about, showing the white under parts. The marshes are extremely dry; hence their resorting to the mudflats.

Dr. H. Wyllys, of this town, when sailing on Wroxham Broad, observed a Tortoise-like creature upon a grassy margin. He secured it, brought it home, and turned it into his garden. After missing it for some days he discovered it in a pit or pool at the lower end of his garden. I went round to see it, and observed its head sticking up out of a weedy corner. With the aid of a rake and a quick snatch of the hand I secured the agile creature and brought it to land. I identified it as the European Pond Tortoise (*Emys orbicularis*). It was healthy and vigorous, and had undoubtedly been living upon the insects and other creatures in the grass-margined pit, with such Worms

and the like it might find on the waste ground surrounding it. It measured 7½ in. I have since discovered that some peripatetic naturalist had early in the summer travelled from town to town with a barrow-load of Land Tortoises, with a few of the specimens of the Pond Tortoise. Mr. F. C. Cook knows of one that wandered into a relative's back garden and has lived there since, moistening itself in a gutter in the vicinity of a water-tap.

Knots came to Breydon in some numbers on September 1st; and, thanks to their innocence and tameness, quite a considerable number have been shot by "shoulder-gunners" who haunt Breydon walls or creep around the flats in punts directly a few waders are reported coming in.

September 3rd.—A few immature Sheld-Ducks on Breydon.

Wheatears during the first weeks of September had gathered in some numbers on the outskirts of the town.

September 14th.—Several flocks of Starlings, some of them containing numerous birds, have been lately coming in from the east, flying from east to west from over sea. It has occurred to me that this premature immigration may be due to the disturbing factors of battle, which have probably driven them in terror from their Continental marshes. I make this suggestion for what it is worth. I have on one or two occasions observed Gulls flying in from the North Sea in so wild and erratic a fashion as to suggest that the explosions at sea may have disturbed them; their coming curiously synchronized with reported sea-fights.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AUSTRALIA, 1914.

Address by Professor William Bateson, M.A., F.R.S., *President.*

(Concluded from p. 357.)

Part II.—Sydney.

Such a problem is raised in a striking form by the population of modern Greece, and especially of Athens. The racial characteristics of the Athenian of the fifth century B.C. are vividly described by Galton in "Hereditary Genius." The fact that in that period a population, numbering many thousands, should have existed, capable of following the great plays at a first hearing, revelling in subtleties of speech, and thrilling with passionate delight in beautiful things, is physiologically a most singular phenomenon. On the basis of the number of illustrious men produced by that age Galton estimated the average intelligence as at least two of his degrees above our own, differing from us as much as we do from the negro. A few generations later the display was over. The origin of that constellation of human genius which then blazed out is as yet beyond all biological analysis, but I think we are not altogether without suspicion of the sequence of the biological events. If I visit a poultry-breeder who has a fine stock of thoroughbred game fowls breeding true, and ten years later—that is to say, ten fowl-generations later—I go again and find scarcely a recognisable game-fowl on the place, I know exactly what has happened. One or two birds of some other or of no breed must have strayed in and their progeny been left undestroyed. Now in Athens we have many indications that up to the beginning of the fifth century, so long as the phratries and gentes were maintained in their integrity there was rather close endogamy, a condition giving the best chance of producing a homogeneous population. There was no lack of material from which intelligence and artistic power might be derived. Sporadically these qualities existed throughout the ancient Greek world from the dawn of history, and, for example, the vase-painters, the makers of the Tanagra figurines, and the gem-cutters were presumably pursuing family crafts, much as are the actor-families* of England or the professorial families of Germany at the present day. How the intellectual strains should have acquired predominance we cannot tell, but in an inbreeding community homogeneity at least is not surprising. At the end of the sixth century came the "reforms" of Cleisthenes (507 B.C.), which sanctioned foreign marriages and admitted to citizenship a number not

* For tables of these families, see the Supplement to *Who's Who in the Theatre.*

only of resident aliens but also of manumitted slaves. As Aristotle says, Cleisthenes legislated with the deliberate purpose of breaking up the phratries and gentes, in order that the various sections of the population might be mixed up as much as possible, and the old tribal associations abolished. The "reform" was probably a recognition and extension of a process already begun; but is it too much to suppose that we have here the effective beginning of a series of genetic changes which in a few generations so greatly altered the character of the people? Under Pericles the old law was restored (451 B.C.), but losses in the great wars led to further laxity in practice, and though at the end of the fifth century the strict rule was re-enacted that a citizen must be of citizen-birth on both sides, the population by that time may well have become largely mongrelised.

Let me not be construed as arguing that mixture of races is an evil: far from it. A population like our own, indeed, owes much of its strength to the extreme diversity of its components, for they contribute a corresponding abundance of aptitudes. Everything turns on the nature of the ingredients brought in, and I am concerned solely with the observation that these genetic disturbances lead ultimately to great and usually unforeseen changes in the nature of the population.

Some experiments of this kind are going on at the present time, in the United States, for example, on a very large scale. Our grandchildren may live to see the characteristics of the American population entirely altered by the vast invasion of Italian and other South European elements. We may expect that the Eastern States, and especially New England, whose people still exhibit the fine Puritan qualities with their appropriate limitations, absorbing little of the alien elements, will before long be in feelings and aptitudes very notably differentiated from the rest. In Japan, also, with the abolition of the feudal system and the rise of commercialism, a change in population has begun which may be worthy of the attention of naturalists in that country. Till the revolution the Samurai almost always married within their own class, with the result, as I am informed, that the caste had fairly recognisable features. The changes of 1868 and the consequent impoverishment of the Samurai have brought about a beginning of disintegration which may not improbably have perceptible effects.

How many genetic vicissitudes has our own peerage undergone! Into the hard-fighting stock of mediæval and Plantagenet times have successively been crossed the cunning shrewdness of Tudor statesmen and courtiers, the numerous contributions of Charles II. and his concubines, reinforcing peculiar and persistent attributes which popular imagination especially regards as the characteristic of peers, ultimately the heroes of finance and industrialism. Definitely intellectual elements have been sporadically added, with rare exceptions, however, from the ranks of lawyers and politicians. To this aristocracy art, learning, and science have contributed sparse ingredients, but these mostly chosen for celibacy or childlessness. A remarkable body of men, nevertheless; with an average "horse-power,"

as Samuel Butler would have said, far exceeding that of any random sample of the middle-class. If only man could be reproduced by budding, what a simplification it would be! In vegetative reproduction heredity is usually complete. The Washington plum can be divided to produce as many identical individuals as are required. If, say, Washington, the statesman, or preferably King Solomon, could similarly have been propagated, all the nations of the earth could have been supplied with ideal rulers.

Historians commonly ascribe such changes as occurred in Athens, and will almost certainly come to pass in the United States, to conditions of life and especially to political institutions. These agencies, however, do little unless they are such as to change the breed. External changes may indeed give an opportunity to special strains, which then acquire ascendency. The industrial developments which began at the end of the eighteenth century, for instance, gave a chance to strains till then submerged, and their success involved the decay of most of the old aristocratic families. But the demagogue who would argue from the rise of the one and the fall of the other that the original relative positions were not justifiable altogether mistakes the facts.

Conditions give opportunities but cause no variations. For example, in Athens, to which I just referred, the universality of cultivated discernment could never have come to pass but for the institution of slavery which provided the opportunity, but slavery was in no sense a cause of that development, for many other populations have lived on slaves and remained altogether inconspicuous.

The long-standing controversy as to the relative importance of nature and nurture, to use Galton's "convenient jingle of words," is drawing to an end, and of the overwhelmingly greater significance of nature there is no longer any possibility of doubt. It may be well briefly to recapitulate the arguments on which naturalists rely in coming to this decision both as regards races and individuals. First as regards human individuals, there is the common experience that children of the same parents reared under conditions sensibly identical may develop quite differently, exhibiting in character and aptitudes a segregation just as great as in their colours or hair-forms. Conversely, all the more marked aptitudes have at various times appeared and not rarely reached perfection in circumstances the least favourable for their development. Next, appeal can be made to the universal experience of the breeder, whether of animals or plants, that strain is absolutely essential, that though bad conditions may easily enough spoil a good strain, yet that under the best conditions a bad strain will never give a fine result. It is faith, not evidence, which encourages educationists and economists to hope so greatly in the ameliorating effects of the conditions of life. Let us consider what they can do and what they cannot. By reference to some sentences in a charming though pathetic book, 'What Is, and What Might Be,' by Mr. Edmond Holmes, which will be well known in the Educational Section, I may make the point of view of us naturalists clear. I take Mr. Holmes's pronouncement partly

because he is an enthusiastic believer in the efficacy of nurture as opposed to nature, and also because he illustrates his views by frequent appeals to biological analogies which help us to a common ground. Wheat badly cultivated will give a bad yield, though, as Mr. Holmes truly says, wheat of the same strain in similar soil well cultivated may give a good harvest. But, having witnessed the success of a great natural teacher in helping unpromising peasant children to develop their natural powers, he gives us another botanical parallel. Assuming that the wild bullace is the origin of domesticated plums, he tells us that by cultivation the bullace can no doubt be improved so far as to become a better bullace, but by no means can the bullace be made to bear plums. All this is sound biology; but translating these facts into the human analogy, he declares that the work of the successful teacher shows that with man the facts are otherwise, and that the *average* rustic child, whose normal ideal is "bullace-hood," can become the rare exception, developing to a stage corresponding with that of the plum. But the naturalist knows exactly where the parallel is at fault. For the wheat and the bullace are both breeding approximately true, whereas the human crop, like jute and various cottons, is in a state of polymorphic mixture. The population of many English villages may be compared with the crop which would result from sowing a bushel of kernels gathered mostly from the hedges, with an occasional few from an orchard. If anyone asks how it happens that there are any plum-kernels in the sample at all, he may find the answer perhaps in spontaneous variation, but more probably in the appearance of a long-hidden recessive. For the want of that genetic variation, consisting probably, as I have argued, in loss of inhibiting factors, by which the plum arose from the wild form, neither food, nor education, nor hygiene can in any way atone. Many wild plants are half-starved through competition, and transferred to garden soil they grow much bigger; so good conditions might certainly enable the bullace population to develop beyond the stunted physical and mental stature they commonly attain, but plums they can never be. Modern statesmanship aims rightly at helping those who have got sown as wildings to come into their proper class; but let not anyone suppose such a policy democratic in its ultimate effects, for no course of action can be more effective in strengthening the upper classes whilst weakening the lower.

In all practical schemes for social reform the congenital diversity, the essential polymorphism of all civilised communities must be recognised as a fundamental fact, and reformers should rather direct their efforts to facilitating and rectifying class-distinctions than to any futile attempt to abolish them. The teaching of biology is perfectly clear. We are what we are by virtue of our differentiation. The value of civilization has in all ages been doubted. Since, however, the first variations were not strangled in their birth, we are launched on that course of variability of which civilization is the consequence. We cannot go back to homogeneity again, and differentiated we are likely to continue. For a period measures designed

to create a spurious homogeneity may be applied. Such attempts will, I anticipate, be made when the present unstable social state reaches a climax of instability, which may not be long hence. Their effects can be but evanescent. The instability is due not to inequality, which is inherent and congenital, but rather to the fact that in periods of rapid change like the present, convection-currents are set up such that the elements of the strata get intermixed and the apparent stratification corresponds only roughly with the genetic. In a few generations under uniform conditions these elements settle in their true levels once more.

In such equilibrium is content most surely to be expected. To the naturalist the broad lines of solution of the problems of social discontent are evident. They lie neither in vain dreams of a mystical and disintegrating equality, nor in the promotion of that malignant individualism which in older civilizations has threatened mortification of the humbler organs, but rather in a psysiological co-ordination of the constituent parts of the social organism. The rewards of commerce are grossly out of proportion to those attainable by intellect or industry. Even regarded as compensation for a dull life, they far exceed the value of the services rendered to the community. Such disparity is an incident of the abnormally rapid growth of population and is quite indefensible as a permanent social condition. Nevertheless capital, distinguished as a provision for offspring, is a eugenic institution; and unless human instinct undergoes some profound and improbable variation, abolition of capital means the abolition of effort; but as in the body the power of independent growth of the parts is limited and subordinated to the whole, similarly in the community we may limit the powers of capital, preserving so much inequality of privilege as corresponds with physiological fact.

At every turn the student of political science is confronted with problems that demand biological knowledge for their solution. Most obviously is this true in regard to education, the criminal law, and all those numerous branches of policy and administration which are directly concerned with the physiological capacities of mankind. Assumptions as to what can be done and what cannot be done to modify individuals and races have continually to be made, and the basis of fact on which such decisions are founded can be drawn only from biological study.

A knowledge of the facts of nature is not yet deemed an essential part of the mental equipment of politicians; but as the priest, who began in other ages as medicine-man, has been obliged to abandon the medical parts of his practice, so will the future behold the schoolmaster, the magistrate, the lawyer, and ultimately the statesman, compelled to share with the naturalist those functions which are concerned with the physiology of race.

NOTES AND QUERIES.

AVES.

Fieldfare in Captivity.—About a year ago a Fieldfare came into my possession which had been caught by a friend of mine, the bird having evidently flown against the telegraph wires beneath which it was caught, and brought to me for identification. I kept it for some time, and had no difficulty in providing suitable food until well into December. It was very fond of elderberries, of which there was a plentiful supply until well into November, but haws were a complete failure in this district last year, and hips did not appeal to its taste. It would eat currants but was not very fond of them. When the supply of berries was exhausted I was agreeably surprised to find it would eat apples when cut into small pieces. Blackberries it would eat, but was not at all fond of this fruit, as I expected it would be, but still I was finding this fruit up to the first week in December. I used to vary its diet occasionally by finding worms in the garden. It would also eat dates, and I attribute its death to one of my children having given this food, and found that it had swallowed the fruit without rejecting the stones. Its gizzard distended previous to its sudden death to an extraordinary degree. It is often asserted that this species sleeps on the ground, but from the first day of its captivity my bird when retiring for the night manifested a strong desire to perch.—E. P. Butterfield.

Relative Abundance of the Garden-Warbler and Blackcap.—Referring to the correspondence under this head in the current volume of the 'Zoologist,' from the limited reply to my enquiries, it would be hard to say which of the above species was the more common. Speaking generally, I think it will be found that the Garden-Warbler in the northern portions of England is the commoner species, but in the southern portions, particularly the western side, the Blackcap may be the dominant species; but before any definite statement can be formulated as to the exact status of these two species, more observations from different districts should be sent in. This distri-

bution of birds is a very interesting and complex question. The sudden irruption of the Hawfinch as a breeding species a few years ago into Yorkshire raises a curious question.—E. P. Butterfield.

A Luminous Owl.—Two years ago, while walking along the flank of an Essex woodland an hour or so after sunset, I had a momentary glimpse of a luminous patch moving in the air at my right hand, some fifty or sixty yards away. Turning my head, I recognized the object as a Barn-Owl; my wife was with me, but by the time I had called her attention to the bird it was invisible. The then recent discussions of "luminous Owls" came to my mind, and before leaving the spot I made one or two observations and simple experiments which served to throw light on this particular instance of the phenomenon, and may perhaps be of more general application. Our path was across a pasture, parallel with the woodland a hundred yards away; and exactly opposite a full moon was just clearing the mists on the horizon. The trees were quite dark, for their almost bare twigs reflected little light. The Barn-Owl in life is extremely sleek and even glossy in plumage, and the under parts of this bird were not only white against the dark trees, but probably acted also as a mirror reflecting the moonlight. When I first detected it, the Owl was overtaking us, so that I saw it sideways, at a wide angle. (From this position the eye is very sensible to such objects as faint stars.) My first impression was that I had seen a moving light, but this was a very momentary feeling, for when I turned my head and looked directly at the bird, it was merely whitish, with little suggestion of luminosity. In a few yards it came opposite a more distant and therefore greyer background, and was not nearly so striking; and a second later the Owl was against the sky—too inconspicuous for my wife to pick up, but visible to me for some further time. The experiments were made by means of handkerchiefs and white paper against various backgrounds, and were repeated on a subsequent occasion. I can sum up by saying that I saw a Barn-Owl luminous against a dark background, decidedly *not* luminous while still visible against the paler distant trees, and invisible against the sky. Here one could hardly entertain any idea of phosphorescence or other similar source of light; but had the circumstances provided an unbroken and very dark background, with appropriate conditions of moonlight, there would have been less confidence in dismissing the theory of the bird being actually the source and the carrier of the light. The Barn-Owl often strikes me as being exceedingly white when it is on the wing in the

early evening or in moonlight; and the moon herself, we may remind ourselves, is light-reflecting and not phosphorescent. So far I have not read of "luminosity" in any other species of Owl, and my theory would break down should one of the brown-plumaged birds prove to be "phosphorescent."—F. J. Stubbs.

Notes on Nest-Boxes.—Referring to my note (*ante*, p. 276), I had a look at some of the boxes to-day (October 6th), and found one occupied by three flourishing young Stock-Doves, perhaps two-thirds grown. Whether the eggs were all laid by one bird, of course one cannot say. Another box contained four Bats; I think they were all Pipistrelles, but did not take them out.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

Evolution at the recent Meeting of the British Association (Australia, 1914).—Of course, natural selection plays its part, as it must in all cases, even in the inorganic world, and I believe that in many cases—as, for example, in protective resemblance and mimicry—that part has been an extremely important one. But much more important than natural selection appears to me what Baldwin * has termed "Functional Selection," selection by the organism itself, out of a number of possible reactions, of just those that are required to meet any emergency. As Baldwin puts it, "It is the organism which secures from all its overproduced movements those which are adaptive and beneficial." Natural selection is here replaced by intelligent selection, for I think we must agree with Jennings † that we cannot make a distinction between the higher and the lower organisms in this respect, and that all purposive reactions, or adjustments, are essentially intelligent.

Surely that much-abused philosopher, Lamarck, was not far from the truth when he said, "The production of a new organ in an animal body results from a new requirement which continues to make itself felt, and from a new movement which this requirement begets and maintains." ‡ Is not this merely another way of saying that the individual makes adaptive responses to environmental stimuli? Where so many people fall foul of Lamarck is with regard to his belief in the inheritance of acquired characters. But in speaking of acquired characters Lamarck did not refer to such modifications as mutilations; he was obviously talking of the gradual self-adjustment of the organism to its environment.—Prof. Arthur Dendy, D.Sc., &c.

* 'Development and Evolution' (New York, 1902), p. 87.
† 'Behaviour of the Lower Organisms' (New York, 1906), pp. 334, 335.
‡ 'Histoire naturelle des Animaux sans Vertèbres,' tom. i., 1815, p. 185.

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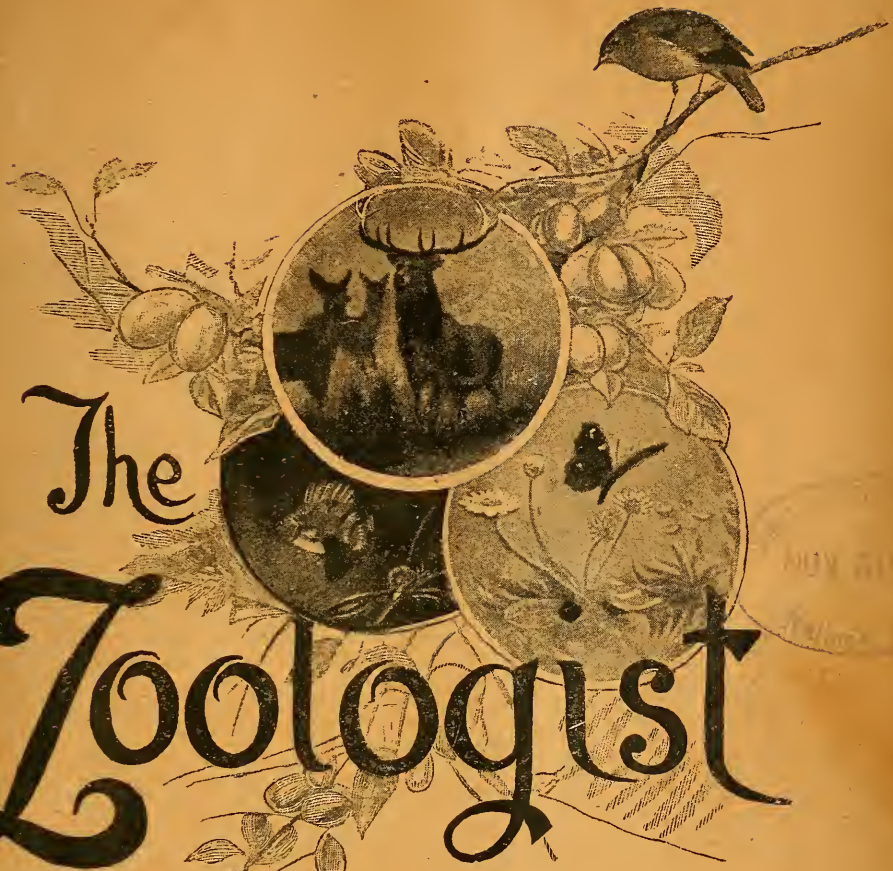

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THE ZOOLOGIST

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NOTES ON THE ORNITHOLOGY OF OXFORDSHIRE, 1913.

By O. V. Aplin, F.L.S.

January 9th.—Heard Geese "honking" in the early hours this morning. Mr. Bartlett told me later that three were seen flying over Banbury a day or two ago.

11th.—Snow. Mild up to now, and birds singing.

20th.—Blackbird sang a little in a low tone.

21st.—Song-Thrushes singing again.

25th.—Chaffinch sang.

February 3rd.—Blackbird and Chaffinch are now singing well.

6th.—We have had some number of Song-Thrushes all the winter, and more have come back now, I think. Blackbirds are very numerous.

7th.—News from Mr. Fowler of a flock of Golden Plovers and a single one at Kingham.

8th.—When out with the Basset hounds I noticed a few Golden Plovers on the flat high-lying arable and pasture land north of Wroxton, which was heath land not very long ago; also a flock on the wing. The soft, but wild, call-notes of the "Whistling" Plovers, "plee" or "plee-wee," sound well in this open country. Two Larks sang.

12th.—An early season, many spring flowers, and a daffodil almost out.

16th.—Apricot blossom nearly expanded, and the myrobella plum a mass of white.

19th.—Frosts lately. Mistle-Thrush sang in a bitterly cold wind (31°), but no Song-Thrushes or Blackbirds.

20th.—A bunch of Golden Plovers in a shop in Banbury.

22nd.—A Nuthatch "trilling" at Bodicote.

March 4th.—Yellow Bunting singing. Peewits on the fallows with breeding notes.

5th.—Greenfinch singing. Bramblings have failed to visit us in North Oxon this winter; perhaps they stayed in the Chiltern beech woods, feeding on the remains of the enormous crop of beech mast of last autumn. Where there are beech trees here the ground was thickly strewn with mast, which crackled underfoot; and I saw one day sheep being fed on it under the trees by the roadside near Tew. But I had no report of Bramblings from the Chilterns.

13th.—Saw a Chiffchaff as I was getting up; there was another (in song) at the back of the house. This is very early. Examined a Crane shot at Adderbury (*vide* 'Zoologist,' 1913, p. 276) and a Red-necked Grebe in winter dress shot in a flooded meadow between the river and the canal at Hardwick, near Banbury, on January 18th. This Grebe is a very rare visitor to Oxfordshire, and I think to any inland part of this country.

14th.—Saw a Grey Wagtail in the brook at Horley, below the Mill.

16th.—A few Fieldfares here the latter end of the winter, and some flocks now.

17th.—A cold spell and heavy snowstorm—melted.

18th.—Walking up the Cherwell valley from Heyford to a little above Somerton, I saw nine pairs of Wild Ducks—two on the river bank and the rest on flood water. Breeding Ducks have greatly increased of late years. Besides the many pairs of Peewits on the uplands, there was a flock of about one hundred (perhaps migrants) on a shallow flood.

27th.—A flock of between one and two hundred Wood-Pigeons—probably migrants—rose with Rooks from a field drilled a short time before.

29th.—Rooks did not build much before the middle of the month.

31st.—Song-Thrush's nest with young hatched. A Long-tailed Tit's nest lined.

A wet March, nearly four inches of rain.

April 2nd.—About fifty Fieldfares flew over—north-west.

9th.—Flock of Fieldfares passed north-west; and a large number assembled in some trees. Little parties of Meadow-Pipits about.

10th.—Young Song-Thrushes flown.

11th.—Snowed nearly all day, but most of it melted at night.

12th.—Hedges getting green, but migrants almost absent.

14th.—A clutch of five Crows' eggs brought in.

17th.—Two Swallows.

19th.—A Peewit's nest on a very "stale" ploughing, placed in a furrow at the lower edge of a "land," was set up high, and was conspicuous from a distance. It was a substantial nest of stubble, grass, and squitch stems, eight inches across all over,—a bed of material, an inch thick in the middle, and the lower side of the nest (field on a hill side) built up to fully three inches high; the upper side a little lower. The land is stiff and the weather this month has been very wet. The four eggs were smeared all over with mud, being thus the same colour as the ground and the nest. They were hard set. Of two other nests (empty), one was hollowed out in the soil, the other a neat nest of stubble, &c., smaller than the one with eggs. Six pairs of birds about, and some young may have been hatched, for one bird settled close to me and staggered a little.

20th.—Tree-Pipit. Six Swallows.

21st.—About a dozen Willow-Wrens and five Chiffchaffs.

22nd.—Cuckoo.

23rd.—Redstart.

24th.—A Grey Wagtail's nest with eggs found at the old spot on the Evenlode. Lesser Whitethroat.

25th.—One House-Martin and five Sand-Martins flying with Swallows over a good meadow, now a rush-grown swamp and apparently full of Moorhens. News from the Rev. E. Peake, of Oxford, that he saw a Pied Flycatcher at Shotover yesterday.

29th.—Went to Heyford in the Cherwell valley and walked to Adderbury. Of new migrants noted, there were ten or twelve Sedge-Warblers, Whinchat, Nightingale, Garden-Warbler, two Whitethroats, and two Sandpipers; also two Redstarts. Migrants are earlier in this valley than with us, although Heyford is within a walk. A thunderstorm raged from about 7 p.m. until

9.30. The water ran down off the hill, and we had the greatest flood in the village that has been known. Fall 1·9 inches.

30th.—Two Whitethroats here. Rainfall for the month over four inches.

May 1st.—Very big flood in the Cherwell valley.

2nd.—A clutch of five Starling's eggs taken from an old Woodpecker's hole—*no* nest—some were quite white and the rest only shaded with colour. Garden-Warbler here. Swifts in the forenoon.

3rd.—Blackcap (very scarce of late years) in the garden.

6th.—The country is a quagmire, or a "gog" as they would call it here. Some young Rooks could fly a little. A wet spring often means early young Rooks.

9th.—The month so far wet, foggy, dull, and cold, with one white frost. I had seen no Swifts since the 2nd until this morning, a little milder, when twenty or thirty in a thick flock were flying over the garden (*vide* 'Zoologist,' 1913, p. 329). Very few Cuckoos yet. Three young Starlings about this date were in a nesting-box with no nest at all.

11th.—The song of the two Chiffchaffs in the garden is incessant. One pair have tried to build in a thick juniper.

13th.—The mild damp winter and damp spring have produced, or helped to produce, the most glorious show of gorse blossom on the hill here that I have seen in this district.

14th.—In a walk from Heyford, by the uplands, back here, noted twelve or fifteen Chiffchaffs, unusually common here this year. Two Redstarts and Nightingales at Dean Hill cover and Deddington. Holly Blue here. A Moorhen breeding in a small pond outside a now disused cattle-shed had placed her good cup of a nest, quite exposed, on the top of a stump in the water. The bird pretended to be wounded, trying to dive as if with a broken-looking wing and much splashing. Then, in a most transparent way, made a sham attempt to hide, which was an absurd failure. No bird of course can hide better when it really wants to.

19th.—Heard Whimbrel passing north at 9.15 p.m.; from the cries there might have been three or four birds, and low down. Full moon on the 20th. Whimbrel passed on August 24th last. Turtle-Dove.

20th.—On a roughly cultivated ploughed field, with stone

walls, near Rollright, I saw a Wheatear; rare in N. Oxon in the breeding season. Between there and Hook Norton I listened to the song of the Cirl-Bunting but could not get a clear view of the bird, the trees being very thick.

23rd.—A Brimstone butterfly, the first seen this spring. Holly Blue at Wroxton. There were only four occupied Sand-Martins' holes in the sand-pit at Tadmarton, the pit having been heavily worked lately. This bird has little nesting accommodation about here; consequently it is not at all common, and is driven to nesting in various unusual situations.

24th.—Very few Cuckoos noticed so far; but more were heard later on.

26th.—Young Starlings flocked. A pair of Flycatchers at the Grove, the first I have seen this year.

27th.—Visited Otmoor and found it in a very wet condition, having been under water as late as the first of the month. The drainage ditches were full, and there was a good deal of water in the "flits," "pills," and "lakes." These are shallow depressions in the moor, with spongy or boggy bottoms. They fill up with the first autumn rains and stay full all the winter, when there is (especially early in the winter) often good "flighting"—the fowl coming from Boarstall Decoy only a short distance away. These depressions in some cases meander like sinuous river-beds about the moor, turning about and ending abruptly or going on for some distance for no apparent reason. I think they may have been partly formed by the extra shrinkage of what were once the wettest parts when the (only partially successful) drainage operations took place. But some of the hollows seem to hold permanent water, if one may judge by the presence therein (in "Fowls' Pill," for instance) of the water violet (*Hottonia palustris*) and the frog-bit (*Hydrocharis morsus-ranæ*). Snipe frequent the moor in some numbers all the summer, and no doubt a good many breed. I noticed three birds "drumming" to-day, and heard others calling "wit-tuck" in the grass (ankle-deep). Mr. E. Colegrave, who rents land on the moor, told me at the end of June that from the amount of "calling" in the long grass he thought numbers of Snipe had young at the Beckley end of the moor. Three pairs of Redshanks seemed to have young hatched. I noticed two Meadow Pipits

singing. One was perched on a bushy thorn stick stuck in the ground among the long grass, and, from the marks, had frequented it a long time. The other male perched for a minute on the top twig of a hedge. Both these birds had probably got mates sitting near at hand. This is the only place in Oxfordshire, where, so far as I know, this bird is found now as a breeding species. Other birds noticed included a good many pairs of Peewits scattered about, three Redstarts about the pollard willows by the Roman Way, Little Grebes and Moorhens in the New River, and a few Herons. Mr. Colegrave tells me that in 1912 a pair of Herons nested in a tree surrounded by water, but some boys waded over and took the eggs. He also told me later on that early in June this year he saw three Black Terns over the moor, and that in the previous winter seventy Wild Geese frequented it for some time; they made, he said, as much noise as a pack of hounds—to which the noise made by Wild Geese has often been compared. None were killed. They could have been reached by a rifle. But Otmoor has always been haunted by a few keen gunners from Charlton, or one of the other "Seven Towns" which lie round it on the slightly rising ground; and a rifle-bullet was not unlikely to find out one of these worthies laid up for a shot and hidden in some place. It was a Charlton gunner who shot the Oxfordshire Black Stork many years ago. Curiously enough, he died on the moor, quite suddenly it is supposed, one night when out with his gun; I think about ten years ago.

An adult Greenshank (which I examined later on), in nearly full summer plumage, was shot in the parish of Mixbury on the 16th of this month. It had been seen in the neighbourhood several times, and was finally shot at an old pond. The last Oxfordshire Greenshank I had seen was shot in 1890; in immature plumage.

June.—Starlings are very abundant here this spring. I hoped that they were permanently decreasing. There are quite six times as many breeding pairs about the village as there were last year. There is a nest in a small dead apple tree I had left for the benefit of Blue Tits. The entrance is some five feet up, but the hole goes a long way down. The young come up if you tap the tree. Every possible hole in fact is occupied, many

birds breeding in holes under thatched eaves usually used by Sparrows, and sometimes by Swifts. To-day I saw a Jackdaw come from a hole in the big Wyken Pippin tree here with a young one in his beak; the old Starlings were furious! One pair, occupying a box, made no nest at all, and I found the young (only three) on the bare floor of the box.

2nd.—Bullfinch singing lately "whee-tee-tir" over and over again.

3rd.—Heard a Quail calling here.

7th.—Two Quails calling to the south of the village, one towards Barford and the other near Milcomb. A late clutch of four Peewit's eggs taken from an arable field being worked.

11th.—A boy who takes Crow's eggs for me found two pigeon's eggs in a hollow in the limb of an ash tree with no nest; but the eggs are large, even for Ring Dove's, and pure white, not tinged with cream colour like Stock Dove's eggs.

13th.—Visited the place where I found Reed-Warblers breeding last year ('Zoologist, 1913, p. 329) but found none; the growth of reeds was scanty. A pair of Ray's Wagtails appeared to be breeding in a clover field being cut near Clifton. They were flying about, much distressed, and the nest was probably covered by a swath of clover. This is the only breeding pair of this once common bird I have seen this year. A clutch of four fresh Peewit's eggs brought from another arable field.

14th.—Went down to the meadows at night to find a Corn-Crake reported as heard there a day or two ago; it seemed to have passed on and I feel sure we did not have a breeding pair in the parish this summer.

17th.—Visited Blenheim and walked round the lake. There were many pairs of Great Crested Grebes; I saw a nest in some thin rushes (*Stirpus*) and two young following the old birds. It is probable that the Pike take many of the young on this water. I also picked up under a tree two eggs evidently sucked by one of the Crow tribe. I was glad to see or hear several Nut-hatches, for we have none here now, and a few Redstarts about the ancient oaks. Many House-Martins were breeding on the great bridge over the lake, where there is plenty of food to be got. In the "Description of Blenheim" (not dated, but an edition as early as 1806) there is a footnote mentioning the rough apart-

ments in this bridge: "In some of these dark and unexplored recesses it is not improbable that one or more species of the Swallow tribe find a winter retreat, and live in a torpid state till the return of spring. This is certain, that they have been noticed skimming the lake as early as any have been discovered on the sea coasts. [Probably Sand-Martins.] One season a *white* Swallow was seen for a considerable time."

This author, describing the freezing rain on the night of November 29th, 1797, which by encrusting vegetation with ice brought down nearly one thousand loads of wood in Blenheim, says, "The very Rooks had their wings frozen, and fell from their perches."

July 1st.—The drought is getting severe. There is very little evening Thrush song now, and many birds have already left the garden. The nesting of these birds and Blackbirds has ended early.

2nd.—Some thin misty rain at night, and moths came out in swarms.

5th.—A Blackbird's nest in the garden contained only two young; short clutches, generally, are frequent this year.

6th.—The Flycatcher perches high and hawks for flies high up as the evening cools; just as Swifts go up high in the evenings of warm days.

18th.—A pair of Stonechats, noticed on the 16th on the hedge of a clover field on the hill here, had young out to-day. There is a lot of gorse on the hill, but the birds have not been seen in it, and must have reared this late brood in the second crop of clover. I feel sure they were not on the hill in the spring. Although this gorse is almost connected by scattered patches with Milcomb bushes and Wiggington Heath, where the Stonechat used to breed regularly and does now occasionally, this is the first time I have seen the bird in this parish in summer.

19th.—We have had Otters in the parish all the summer, and to-day the hounds killed one. Eight Wild Ducks at Wickham Bridge, and others lower down, could fly well.

21st.—Heard Whimbrel passing over about 6 p.m. Perhaps only one, and certainly very few, but the sound was very high up and the sky cloudy. The date is very early.

23rd.—A cold July, although so dry. Only 55° at noon to-day.

28th.—Willow-Wren singing; an early resumption of the song.

31st.—Mr. Fowler reports from Kingham the curious abundance there of the Grasshopper-Warbler in this month. He heard one close to the road to the station, and his dog put one up in a bean field, and he thought others also. Other birds had been reported from the Marsh-Warbler's osier-bed, &c. The Grasshopper-Warbler has been rare in my neighbourhood for several years past. Mr. Calvert reports about forty pairs of Sand-Martins in the sand-pit on the left of the railway near Bruern level crossing.

August 13th.—Swifts all here. Hardly any birds about the garden. No Starlings, for there is no fruit ripe just now! Drought most severe.

14th.—Half-a-dozen Swifts.

15th.—Greater Titmice destructive to peas now, and Blue Tits to apples. One Swift.

16th.—Two Swifts. Wheat in splendid condition.

20th.—A Clouded Yellow butterfly on potato flower. Chiffchaff sang; an early resumption of song. Goldfinch sings; there was a family party of them in my garden on the 15th.

22nd.—News from Mr. Calvert that he had recently heard a Quail on two occasions in pea and barley fields on the Witney and Burford road.

23rd.—A few Ray's Wagtails on a ploughing; passing migrants, I think.

24th.—Blackbirds and Starlings have returned now that the Victoria plums and "soft" apples are ripening. The damage these two birds do gets greater year by year, if possible—and I remember when both were practically harmless (except with cherries).

26th.—A female Clouded Yellow on potato bloom. Swarms of House-Martins came off this roof at 6.15 a.m., and I could see many on another roof facing east.

27th.—A Ray's Wagtail by the railway at Milcomb. Near Ascott-under-Wychwood four immature Black-headed Gulls were on a wheat-stubble which had been newly ploughed this morning. When I was in the train (slow) between Shipton and Kingham, I saw two Hobbies flying up the Evenlode valley

towards Bruern Abbey wood, for which they were doubtless making, and where they were perhaps breeding. They passed within a short distance of the train, and I had a good view of them. The Hobby in flight is a curious-looking and striking bird. It has been likened to a Swift, but to my mind the long narrow tail takes away much of the resemblance, though the long narrow curved wings are much alike. The Hobby breeds, it is believed, annually, in or about the woods lying between the valleys of the Evenlode and the Windrush. Eggs were found in 1902, and young were found hatching in 1906; while from the latter year to 1912 inclusive the eggs have been found every year. Some of them I have seen. These were (except in one case when they were of the plain brown hawk type and much worn from incubation) more distinctly marked and less yellow or warm buff-coloured than many Continental eggs—a colder and greyer shade. The birds are seen in May, but do not have eggs until well on in June, generally the latter half of the month. Some eggs have not been hatched at the beginning of July. The Hobby lays in old Crow's nests (of the same year) on the edge of a wood or in a detached tree close to it. When the observer is at the nest the birds fly round and over him and are very noisy, looking (says an informant who knows them well) like great Swifts. Hobbies have been observed also (as I have mentioned in former notes) nearly every year lately in a wood south-east of Oxford. Old birds have been shot there on several occasions, but this year, I heard later in the season, young were hatched and seen about the wood. A Hobby was shot this year at Yarnton on June 9th.

The severe drought lasted until the end of the month. The total rainfall for the three months (June, July and August) only amounted to 2·12 in. at Bloxham Grove; and at Banbury (three miles away) to 1·96 in. The dry weather, I believe, put a stop to many birds rearing second broods. Although early coveys of Partridges were seen in summer, we did not meet with many very strong birds in early September, the coveys being for the most part composed of rather small birds in the first part of the season; the inference being that the early broods died.

September 1st.—The drought broke to-day, of all days in the year! One of the wettest and, I think, quite the coldest

"First" I ever knew. 56°; wind north. On this day and the 2nd 1·80 in. of rain fell at the Grove, nearly as much as we had in the previous three months. The rest of September was fine and warm.

5th.—A few Meadow Pipits. A pair of Red-backed Shrikes, accompanied by two full-grown young, about their old breeding haunt near Milcomb. They must have come and bred late in the season, for they were not there when I searched the place in June.

6th.—A Land-Rail shot at Milcomb. There are hardly any this autumn, despite suitable bits of standing barley. Have had news from Mr. Calvert of a Green Sandpiper, shot as it rose from a pond-side on the 4th inst. Also of a Land-Rail, shot the same day.

8th.—The Shrikes still in the same place.

10th.—Two Clouded Yellow butterflies in a clover field.

12th.—A great congregation of Martins on the roof. Chiff-chaff singing all this month.

13th.—A few Pipits in roots.

14th.—The flowers on a tree-ivy covered with flies and some wasps.

15th.—Again many Martins.

19th.—A great gathering of Swallows on telegraph-wires.

20th.—A smaller congregation of Martins.

26th.—Larks sang. A Song-Thrush sang a little and badly.

27th.—One of the warmest days of the summer; 72°.

28th.—Starlings destructive to apples. Most of the Black-birds gone into the fields. Nearly all the Swallows and Martins have been gone a day or two.

[A small number on October 3rd were the last seen here.]

30th.—A Brimstone butterfly and a Meadow Brown; some Red Admirals earlier in the month. Two or three Snipe in turnips. Many Meadow-Pipits both in roots and other fields on the hills about Wiggington. Numbers of migrating Pied Wagtails about—as many as twenty or thirty in one field being ploughed.

October 2nd.—A thunderstorm and lots of rain. Since the great storm of April until to-day I do not think there has been any thunder. A Red Admiral in the garden.

5th.—Mistle-Thrush back in garden and noisy.

6th.—A Clouded Yellow butterfly. Two young Red-legged

Partridges could not have been hatched more than six weeks. Report of about thirty Wild Geese, calling loudly, flying over Holywell Farm in the daytime on the 4th inst. Holywell is on high ground on Wiggington Heath (over 600 ft.), and I have often remarked that birds crossing us do not trouble to rise high over these highlands, but cross them at a low elevation.

Early last month two Partridges were killed, which prove that the white horseshoe is carried for two years at least. They were shot on the 1st and 8th respectively, and the condition of their wing-quills, &c., showed they were hatched in 1912. They were (I almost wrote " of course ") both females. The horseshoe was white, and in course of being moulted. The old feathers white and the new ones—partly developed — were all coming white.

18th.—A good many Pipits about the fields.

24th.—First frost.

26th.—Practically no *autumn* song from Song-Thrushes. They did not return to the garden in September, for that month, except the two first days, was dry.

27th.—Redwings scattered about the hedges. A brown Merlin came nearly up to the hedge behind which I was standing, in some stubble-fields at Wiggington. A good many Meadow-Pipits. In several places there were Goldfinches on the thistles, in lots of twos and threes or threes and fours.

31st—Very few Redwings yet; there are practically no haws. Rain this month no less than 5·12 in. (at the Grove).

November 1st.—Song-Thrush sang well.

2nd.—Thrush tribe scarce; few, I think, were bred, except early in the season.

3rd.—Hardly any leaf down yet.

8th.—Grey Wagtail near Horley.

9th.—Frost, and leaves came down in heaps.

13th.—Floods in Cherwell valley.

14th.—Six Fieldfares. A big flock (" thousands ") of " Norway Pigeons " reported flying over, south, 7.30 a.m. Lots of Pipits between swede-heaps. Country beautiful with autumn leaves. Land-Rails very scarce this autumn; I have heard of only one near here. A big Badger killed on the Grove estate lately.

22nd.—Still much leaf on, and colours glorious. Average

crop of acorns; no beech mast; the biggest crop of holly-berries I ever saw.

24th.—Fieldfares and Redwings very scarce.

29th.—Lark sang to-day, but they have hardly sung at all since the early days of the month. A fine, really hot day. Some fine, warm weather this month.

30th.—Mistle-Thrush sang.

December 4th.—Falls of snow (melted), but this bird sang. Many "foreign" Pigeons, and an arrival of Snipe and Jack-Snipe in the Chipping Norton district lately.

10th.—One aconite in flower.

13th.—A few scattered Fieldfares; the first seen since the end of November.

16th.—Country very dry, and many flowers in bloom.

18th.—Many Wood-Pigeons at poulterer's. Small, dusky birds, tinged brownish on upper parts, darker generally than the native birds and less pink underneath. A few of the latter were present for comparison, as also several Stock-Doves and three Jack-Snipe.

19th.—News from Mr. Fowler that a week before three or four Swallows flew over the school gardens at Kingham, going south-west; also of nests of young Sparrows and Starlings. Nests with eggs of some birds have been reported here.

20th.—Examined, at Mr. Darbey's, a Leach's Petrel, picked up dead at Tackley, after the storm about the middle of November; and a nearly white Partridge (with a few small patches of brown) shot at Nuneham in October. I have lately had news of a Hoopoe, shot near Chipping Norton, about the end of April, 1912.

22nd.—A Blackbird's nest with three eggs reported, in the garden of the "Guardian" office, Banbury. Two or three Fieldfares.

25th.—Frosts and cold days have stopped the Song-Thrushes singing; but the Hedge-Sparrow continues.

26th.—Winter jasmine in full bloom, also *Chimonanthus* and *Galanthus elwesi*; while various summer flowers linger.

28th–31st.—Snow and frost; about three inches of snow on the ground, and Hedge-Sparrow the only bird that sings. A dry month. Rainfall for the year at Bloxham Grove amounted to 29·73 in., notwithstanding the dry summer. The fall, however, varied a great deal in different places.

ZOOLOGICAL NOTES ON A COLLECTING EXPEDITION IN BORNEO.

By J. C. Moulton, F.Z.S., Curator of the Sarawak Museum.

(Concluded from p. 374.)

Mt. Merinjak.

As far as I know, Merinjak is not to be found on any map of Borneo, and this is probably the first time that its name has appeared in print. It was in fact—till our visit—an unknown mountain, in the heart of Borneo, on the very border between Sarawak and Dutch Borneo, and, according to the natives of Temong, *never before visited by white men*! Our natural thrill of exploring pride was somewhat lessened when we came to consider that, after all, there was no particular reason why any white man *should* take the trouble to visit the mountain, except to collect natural history specimens, for which purpose, moreover, there are plenty of more likely mountains in Sarawak, and those more easily reached. The height too could be no great attraction, being but 2220 ft., which compares unfavourably with its near neighbour, Mt. Penrissen (4180 ft.). We ought also to confess that the Dutch border in this part of Sarawak is not much more than sixty miles from the north coast, so we were not really so very far in the interior.

However, that flat top, the comparatively easy slopes, all clothed in fine tall jungle, with here and there a small plateau whereon one might ramble without great risk of accident, looked promising for collecting, and so we were well content to forget our diminished fame as explorers and attend to business.

The first thing to do was to fell the jungle round our hut and so make a small clearing, where we could catch insects and dry clothes. Into the depths of this old jungle the sun never penetrates, but once you find a small open space caused by the fall of some monarch of the forest, there one may be sure of finding a variety of insects disporting themselves in the sun,

and attracted by the smell of new felled jungle and rotting vegetation.

Across this clearing, as I write, a pretty green bird flies, probably the Green Broadbill (*Calyptomena viridis*), which has already been brought in by a Dayak collector. An hour ago two Great Hornbills flew across, high above the tree-tops, uttering their harsh cries. They belonged to the curious solid casqued species, *Rhinoplax vigil*, peculiar to Borneo and Sumatra. The Sea-Dayaks call them "tajak" (onomatopœtic); they and other Sarawak tribes value them highly for their casque, from which they make earrings, and for their long tail feathers which they use to adorn their war-caps.

Then, to go to the other extreme, one of those exquisite gems of colour, the little Red Sun-bird (*Æthopyga temmincki* or *siparaja*) darts into the sunlight for a moment and disappears again into the forest depths.

Now a big lazy Papilio, the dark grey *P. memnon* (a male), flaunts across; the pretty green spotted *Papilio agamemnon* bustles up to the entrance of the hut for a brief inspection of the kitchen refuse. The yellow *Terias hecabe* (or it may belong to one of those other forms to which lepidopterists devote so many argumentative pages) has already spent an hour or two after these choice remains, accompanied by the rarer *Catophaga plana*. Lower down I see the slow flying Danaid, *Ideopsis daos*, the easiest prey to any bird foolish enough to taste so unpleasant a morsel. Yesterday two of the giant Danaids, *Hestia lynceus*, floated down from the tree-tops. The male, when caught and held between the fingers, extruded its anal brushes, but I could detect no smell. He flapped lazily away, apparently unmoved by his brief detention in my hand.

The clearing as a whole is singularly poor for butterflies, possibly too shut in by the steep hillsides. The commonest butterfly is the brown Nymphaline, *Cupha erymanthis*, of which I noticed four circling round together this morning. They look a bit worn, and have evidently been out some time. The red-brown *Cethosia hypsea* turned up one morning, rather out of place up here, as they usually like lower ground and nearer cultivation. The Danaid, *D. plexippus* and the Nymphaline mimic, *Hypolimnas misippus*, which are so like this *Cethosia*

in colouring and pattern, do not occur in Sarawak, although all three are found together in North Borneo.

Lycænids are disappointingly scarce; an occasional *Curetis*, silvery white below and coppery red above, gives a touch of colour, as do the brass-green *Arhopala eumolphus*, which, however, keeps to the shady edge of the clearing rather than face the full sunlight. Two males (the female is dull violet) have been seen circling round one another above the stream. I caught one; the "widowed mate" tried to arouse the iridescent green Dragonfly, *Vestalis amœnus*, for a game. Down by this shady stream the big blue-banded Amathusiine, *Zeuxidia aurelia*, fell a victim to a Dayak collector. This is a much prized rarity, of which the Sarawak Museum had but four specimens, raked in singly from various mountains.

The white-banded Hesperid, *Notocrypta feisthamelii*, is a regular visitor in the morning about 8 a.m.; its rapid flight makes it difficult to catch. A pretty Arctiid Moth is another occasional visitor, of which I obtained a couple. At night a few Pyralids come to the lamp, chiefly the white *Glyphodes laticostalis*, but hardly anything else. A "Rosy Footman," *Miltochrista*, sp., was annexed one evening. Coleoptera are more conspicuous, though none too plentiful. The fine handsome Buprestid, *Catoxantha opulenta*, circles round the clearing, with cream-white abdomen glistening in the sun. Unfortunately, it is common in most clearings in Sarawak, and so is allowed to circle on unmolested. It seems to settle always on leaves, and especially on young leaves. Longicorns are naturally more in evidence than others, especially the common Lamiids, *Agelasta newmani*, and the pink-barred *Syrrhopeus agelastoides*, Pasc. Their favourite place is a long streamer hanging down some 50 ft. from a branch; there are nearly always half a dozen on this—a smart tap jerks them off, not always into the net below; more often they fall a short way and then fly off comfortably out of reach. Other streamers—really long roots from some parasite which has lodged in the tree perhaps a 100 ft. above—usually harbour one or two Longicorns.

The little Chalcid (probably) *Oncochalcis apicicornis*, Cam., swarms round the cook's department; the common Wasp, *Vespa dorylloides*, Sauss., is a frequent and unwelcome visitor to our

hut, as is a big Dung-Beetle, *Copris molossus*, who buzzes in every evening. Ants of course everywhere, including B.'s boots, where a nest was found one morning! Occasionally a pretty red-winged Phasmid flies feebly from one tree to another, a helpless looking object on the wing, with legs outspread, though, of course, wonderfully protected as soon as it comes to rest. One dark brown species was seen on the bark of a tree, fore legs and long antennæ stretched out in one line in front of the head continuing the straight line of the body, middle legs out on each side, hind legs pressed close to the side of the body, and hardly distinguishable therefrom; the whole insect pressed close to the bark (thus making no shadow), exactly like a piece of stick that one may often see caught up on the trunk of a tree.

The actual felling round our camp awoke several strange insects; one huge Phasmid, nearly a foot long, had to be trussed like a fowl while the large killing-bottle was searched for and unpacked. Three freshly emerged Gryllacrids were found in the herbage on the ground.

To our disappointment this clearing grew less productive as time went on, and we were driven to the greater exertion of collecting higher up the hill. From our camp a rough jungle path led up to an undulating plateau 1000 ft. higher; above this a scramble of some 600 ft. more brought us to the summit, another large triangular plateau, broad towards the north, narrowing to a point at the southern end. My aneroid gave this as 2220 ft. above the sea-level.

Immense trees of hard wood of different kinds shot their way up through a thick growth of young trees, rotans, &c. Many of them were held in firm embrace by those curious parasites which, taking root high up in the tree, send down great roots which eventually strangle the supporting tree altogether. So great is their growth that in some cases the original tree is killed and rots away altogether, the great roots of the parasite fuse together and form a solid trunk, entirely replacing the original tree in girth and height. They produce a fruit which is very attractive to many birds, and a patient wait beneath one in fruit is often productive of some good species; Hornbills are particularly fond of them.

The path upwards, like any jungle track, is full of interest to

the naturalist; something to be noted at every yard; something fresh every day.

Mammals are scarce; no doubt due to the proximity of the Dayak village at the foot of the mountain. For them all is meat for the pot, except the Sambur Deer (*Cervus equinus*),* from Monkeys, Pigs and Squirrels to Snakes and Crocodiles. Our Dayak collectors brought in the large Squirrel, *Sciurus ephippium*, one day, and the two common species *S. hippurus* and *S. tenuis*.

Among the more striking birds, Hornbills were seen or heard every day; they were probably the *Anthracoceros malayanus* or *Anorhinus galeritus*. Their raucous cries are quite startling sometimes. The solid-casqued *Rhinoplax vigil* was only seen on one occasion, mentioned before.

The following were obtained by the Dayak collectors, whose energies, it should be noted, were for the most part directed to insect-collecting during our stay on the mountain. The Crested Partridge (*Rollulus roulroul*), reported as often heard by the Dayaks, was the only galliform bird obtained.

In the village below the natives had shown us feathers of the Argus Pheasant, and they told us that the Firebacks were often caught there. Too often, I expect. Eagles, Hawks, and Owls were not obtained, though an occasional Eagle was seen soaring above us, well out of reach. Two pretty Kingfishers were shot some way above the camp; they were the brown-collared *Halcyon concretus* and the speckled *Carcineutes melanops*, both rather rare species in Sarawak; the latter specimen, a male, had a curious twisted beak, the upper mandible curving to the left, the lower to the right, so that only the basal portion of the two met. The bird seemed in good condition, in spite of this deformity, which ought to have inconvenienced it in obtaining food.

Two Green Barbets had an unfortunate attraction for a new collector, who was responsible for the rather scarce mountain species, *Chotorhea chrysopsis*, which Mr. Shelford found on the

* The Land-Dayaks of this district are also forbidden to eat the Scaly Ant-eater (*Manis javanica*), the Porcupine (*Hystrix crassispinis*), and certain species of Hornbill. The reasons for these restrictions are always hard to get at, and one usually has to be satisfied with the answer that such restrictions have been in force with them from time immemorial.

neighbouring Mt. Penrissen at 4000 ft., and the common species *C. mystacophanes*, which was not wanted for the Museum. The ideal "collecting," of course, is with a pencil and notebook or camera; but, unfortunately, with the great majority of "good" birds, it is almost impossible to distinguish them at the top of a tree and against the light. The deadly gun has to help us to satisfy our curiosity. An experienced collector, of course, can recognize a distinctive bird like a Green Barbet without any difficulty, but with some of the more obscurely coloured Fly-catchers and Babblers, of which there are a great many species in Borneo, this is impossible.

The only other "obvious" birds unnecessarily obtained were the beautiful Red Trogon (*Pyrotrogon diardi*), the Green Broad-bill (*Calyptomena viridis*), and a female Bluebird (*Irena crinigera*). With the exception of a Small-Barred Woodpecker (*Miglyptes grammithorax*), the rest were all Passerine birds and, I am glad to say, nearly all of use to the Museum.

The beautiful red-breasted *Pitta arculata*, confined to Bornean mountains, was among the first obtained; Flycatchers were represented by *Rhipidura perlata*, *Cyornis nigrigularis*, *Rhinomyias umbratile*, and *Culicicapa ceylonensis*; Bulbuls by the beautiful green *Chloropsis viridinucha*, the olive-streaked *Hemixus malaccensis*, and *Criniger tephrogenys*. The Babblers obtained were *Pomatorhinus borneensis*, always scarce, though well distributed over Sarawak from the coast up to 5000 ft., *Setaria cinerea*, *Turdinus atrigularis*, and *Kenopia striata*; the rare Wood-Shrike (*Tephrodornis frenatus*), and the pretty Yellow Oriole (*Oriolus xanthonotus*), complete our list.

The above twenty-three species were represented by twenty-five specimens, so that with hardly an exception we obtained no more than one of each species. The Sarawak Museum Collection of Bornean birds is now so fine, thanks to the energies of former Curators (the late Dr. G. D. Haviland, Messrs. Bartlett and Shelford) that the gain of a new locality record is usually more welcome than the gain of another specimen. On the other hand, the birds of Borneo are by no means worked out, even in the collecting line, as the Museum has been responsible for two new records for Borneo in the last three years (*Asio acipitrinus*, taken in 1911, and *Pseudoglottis guttifer*, in 1913).

Reptiles, as usual, were conspicuous by their absence, not because Borneo is particularly deficient in them—some 125 different species of Snakes have been recorded—but because they make full use of the dense jungle to hide themselves from the eyes of prospective enemies or prey. B. secured a gorgeous Snake (*Gonyophis margaritatus*), which he saw wound round a tree-trunk, a fine sight in its marvellous colouring of light blue banded with yellow. On our way up the hill we found a small brown Snake coiled up on a leaf; it turned out to be *Doliophis bivirgatus*, quite a common Sarawak Snake, especially in this particular region. The only other Snake obtained on the mountain was *Ablabes baliodirus*, also not uncommon in Sarawak.

Descending the hill one day, I was startled by a sudden rustling of leaves in a tree quite close to the path as I passed. Wondering what sort of beast was going to attack me, I looked up and saw a huge Monitor Lizard (*Varanus* sp.) about five feet long, scuttling out of some dead leaves and then slowly climb the bare tree-trunk; it no doubt wondered what sort of animal was after *it* on the path below! Beating for insects, we occasionally disturbed one of those pretty little parachuting Lizards (*Draco*) which are able to "fly" quite a distance from one tree to another, of course only on a downward slant, though they alight head upwards on a tree-trunk.

A few land-shells were annexed, one or two small species being found on leaves. One of the commonest objects of the "country-side" was a big orange-coloured Myriapod (*Glomeridæ*), which was seen crawling about the path pretty well all the way up from our camp to the higher plateau. Ants, of course, innumerable and ubiquitous. A detailed account of all the insects we saw or obtained on the mountain is beyond the scope of this article (and, incidentally, beyond the power of the writer!), so a brief report on the more obvious Orders must suffice. B.'s peculiar weakness was the family of *Pselaphidæ*, and those who have had anything to do with Coleoptera will know that the majority are hardly big enough to excite great interest on the part of the layman. An account of them and other "Micro-Coleoptera" I hope will emerge some time from the more experienced hands of B. himself.

The *Blattidæ* obtained were: two examples of the rare

mountain species described by Shelford as *Pseudothyrsocera bicolor*, an apparently allied species, brick-red and black in colouring, new to our collection, the big chestnut-brown *Epilampra goliath*, Shelford, which measures over $2\frac{1}{2}$ in. in length, and two more examples of an Epilamprine new to the Museum.

The common little *Pseudophyllodromia pulcherrima*, Shelford, was noted on tree-trunks on the path up from our camp, but not above 1000 ft.

The Hymenoptera did not get the attention they deserved, in fact, only the more obvious were annexed. Of these, the big black *Salius princeps*, Smith, with conspicuous white subapical band, comes first. I noticed one run under a log, possibly to take shelter from a storm just then beginning; it was a fearsome object, and well worth mimicking for protection. This species has orange-coloured antennæ, but another occurs in Sarawak with black antennæ. Mr. Meade-Waldo kindly identifies this as *Salius ducalis*, Smith. The extraordinary Longicorn (Cerambycid) *Nothopeus fasciatipennis*, Waterh., figured by Pryer and described by Waterhouse,* Wallace,† and Shelford,‡ is a better mimic of this latter species, though no doubt both serve as a model of this conspicuous warning pattern. Two more fairly common species of *Salius*—quite different in appearance to *S. aviculus*—serve as models for two other species of *Nothopeus*; these are *S. anthracinus*, Sm., a transparent black-winged species, mimicked by N. sp. nr. *hemipterus*, Fab., and the golden-winged *S. aureosericeus*, Guér., which is mimicked by *N. intermedius*, Gahan.

The Batesian theory of mimicry demands that the model should be plentiful, the mimic scarce. Twenty years' collecting in Sarawak has produced a good series of each of the three Hymenopterous models, but of the Coleopterous mimics only a single specimen of *N. fasciatipennis*, a pair of N. sp. nr. *hemipterus* and a single specimen of *N. intermedius*. On this

* Trans. Ent. Soc. Lond. 1885, p. 369, pl. x. (*Coloborhombus*).

† 'World of Life,' 1911, p. 157, fig. 23. "As one rather extreme example of mimicry I give the figure of a black wasp with white-banded wings, which is closely imitated by a heteromerous beetle. These I captured myself in the Forest of Borneo, flying together near the ground."

‡ Proc. Zool. Soc. Lond. 1902, pp. 239–241.

collecting trip we were not fortunate enough to add any more to our series of these mimics; a disappointment, seeing that the last-named Longicorn was discovered on the neighbouring Mt. Penrissen, by Mr. Shelford.

The little Ichneumons, *Cœnostoma pilicornis*, Cam., and *Cyanoxorides cœruleus*, Cam., the latter a beautiful little insect with blue body, contrasting with the rather swollen orange-yellow femora were taken. The following single specimens have been identified for me by Mr. Meade-Waldo: three *Braconidæ*, two of them black *Iphiaulax* species, the third an orange-winged, unidentified; two *Ichneumonidæ*, *Hemipimpla rugosa*, De Geer; a little green Chrysidid, *Chrysis* (*Hexachrysis*), and a species of *Tenthredinidæ* (*Hylotoma* sp.).

Among the Earwigs collected were *Allodahlia scabriuscula*, Serv., a common species in Sarawak, and *A. coriacea*, Borm., a rarer species, of which we had odd specimens from Mts. Matang and Penrissen; two large *Pygidicrama* species were kindly identified for me by Dr. Burr as *Kalocrania guttata*, Kirby, and *Cranopygia*, sp. n. He also identifies five other specimens as *Timomenus vicinus*, Burr., female (two), *T. vicinus*, Burr., male (two), and *Timomenus*, sp. n. (one). Several interesting species of Homoptera were gathered. Chief among them were five very curious Membracids, quite unlike anything we had collected before. The first was a large Hypsaucheniariad species, *Gigantorhabdus enderleini* (of which we have a very broken fragment of one collected by Shelford on Penrissen); I caught the first on my first descent from the summit, having noticed it fly across the path and alight on a tree-trunk; the second I annexed in exactly the same place and manner seven days later. They were the only two seen. They are much larger than the ordinary *Membracidæ* in Sarawak, and in their tortoiseshell colouring suggest some of the *Cercopidæ*. The pronotum is developed into two processes, one extending right over the body, the other into a more or less erect horn nearly an inch high and forked at the tip. Mr. Distant kindly reports on these five species as follows: *Hybanda bulbosa*, Buckt., *H. anodonta*, Buckt., *Gigantorhabdus enderleini*, Schmidt, *Ebhul tessellatus*, Dist., sp. n., and one still unidentified.

Several Cercopids were caught; the pretty black-spotted,

orange-yellow species *Gynopygoplax submaculata*, Wlk., var. *borneensis*, Bredd., and *Opistharsostheus simulans*, Schmidt, the common *Suracarta tricolor basinotata*, Butl., which is also found in Sarawak, and is different to the northern subspecies, *niobe*, Bredd., and *borneensis*, Schmidt (both of which, by the way, were found together on Kinabalu, and therefore refute the ordinarily accepted meaning of the term subspecies or local race), *Phymatostetha hilaris*, Wlk., a mountain species, *P. moultoni*, Dist., and *P. borneensis*, Butl., two *Cosmoscarta* species, *C. roborea*, Dist., *C. guttata*, St. F. & S.

Only a few *Jassidæ* were seen, the small Tettigoniellas being particularly scarce. The large *Tituria borneensis*, Dist., was taken on the summit; others have been identified by Mr. Distant as *Ledra* sp. and *Bhandara picturata*, Dist.

The big *Fulgoridæ*, *F. gigantea*, Butl., and *F. stellata*, Butl., were seen on two or three occasions flying about our clearings, and usually settled on tree-trunks well out of our reach. The collectors brought in one *Scamandra lachesis* from the summit.*

The *Pentatomidæ* produced some rarities, one a pretty green-blue species which I had lately taken on Kinabalu in some quantity from 3000 to 4500 ft. On this occasion, however, I only found one, which I caught at 1600 ft.; Mr. Distant has identified it as *Hyrmine chlorina*, Stål. Of the others, *Pœcilocoris pulcher*, Dall., a typical mountain species, *Tolumnia maxima*, Dist., *Anaca florens*, Wlk., a fine big species with strong lateral horns, *Pygoplatys merinjakensis*, Dist., sp. n., and the big *Eusthenes robustus*, L. & S., another species we had found to be common on Kinabalu, though on cultivated land instead of old jungle.

The curious subfamily *Plataspidinæ* was represented by the jet-black *Heterocrates marginatus*, Thunb., which I caught by our camp after bathing one day; it emitted a foul-smelling brown juice which stained my fingers for some days. Others of this subfamily were *Merinjakia typica*, Dist., gen. and sp. n. (two),

* In the fam. *Fulgoridæ*, subfam. *Issinæ*, I obtained a fine species, which required the foundation of a new genus—*Neodelia moultoni*, Dist. The new species of Rhynchota obtained from Mt. Merinjak have been described by Mr. Distant (Ann. Mag. Nat. Hist. (8), xiv. p. 333 (1914)).

Brachyplatys flavosparsas, Bergr., *Brachyplatys* sp., and *Coptosoma nigrosignatum*, Dist.

Among the few Orthoptera obtained was the leaf-like Acridian, *Chorœtypus mutilatus*, Br., caught by the cook.

Coleoptera, as usual, provided the most interesting captures in the insects, and no doubt B.'s presence helped considerably to stimulate our attention to this Order, rather to the exclusion of others.

The following list shows some of those collected for the Museum, and named by comparison with those we had already. B. obtained many more, which he hopes to work out in England as soon as possible :—

Cassidæ.—*Aspidomorpha miliaris*, Fab., common everywhere in Sarawak; *A. sarawacensis*, Spaeth; *A. dorsata*, Fab., another single specimen (we had already obtained one at Retuh); *Thalaspidosoma dohrni*, Spaeth, var. *limbata*, Spaeth, a rare form hitherto only known from Mt. Penrissen, where I obtained three in 1909; *Prionoptera sarawacensis*, Spaeth, a common species; and a small black *Hoplionota* species.

Cerambycidæ.—*Strangalia virescens*, Auriv., a pretty green species, superficially very like the smaller *Chloridolum* species, which are placed in another group of this family; *Ephies dilaticornis*, Pasc., a little red and black species forming a good mimic of the big Lycid combination—both these species were only known to us from Matang before; *Nœmia flavicornis*, Pasc.; *Leptura conicollis*, Auriv.; *Zonopterus imitans*, Auriv., of which only two specimens were hitherto known; *Euryphagus lundii*, Fab., and *E. cardinalis*, Thoms., were both common; the little bee-mimicker. *Epania singaporensis*, Thoms., was taken several times in company with its hymenopterous model. Other Cerambycids were *Demonax mustela*, Pasc., the little *Halme cleriformis*, Pasc., and, as its name implies, very like a Clerid, *Pyrestes eximius*, Pasc., and *P. virgatus*, Pasc., *Caloclytus seclusus*, Pasc., and *C. sumatrensis*, L. & G.

Lamiidæ.—Gleneas were prominent as usual. The following species were taken: *G. funerula*, Thoms., remarkable for its long antennæ—we found it at 1600 ft., and on the summit; *G. udetera*, Thoms., and half a dozen others as yet unidentified. *Serixia modesta*, Pasc.; *Entelopes amœna*, Pasc.; *Monochamus*

fistulator, Germ., a common species; the long-necked *Gnoma longitarsis*, Pasc.; *Psectorocera plumosa*, Westw., and *Himantocera plumosa*, Oliv., both large brown species with plumed antennæ—several of each were taken. *Leprodera fimbriata*, Chev., a big brown-spotted Lamiid walking about our clearing in the morning near the hut. *Tanylecta brevicaudata*, Gahan, a rare species, only known from Mt. Matang hitherto; it mimics a Brenthid.

Endomychidæ.—Besides the common *Eumorphus* found on one tree in plenty each day, the collectors brought in *Engonius rubropictus*, Gerst., a rare species.

Buprestidæ.—*Catoxantha opulenta*, Gory, common round the clearings, circling round and round in the bright sun, and alighting on young leaves; [*C. lacordairei*, Thoms., obtained by B., a rare mountain species known from Mts. Kinabalu and Poi]; *Chrysochroa fulminans*, Fab., always a common species; *Philocteanus flammeus*, Thoms., rather a rarity; *Epidelus wallacei*, Thoms., covered with bright yellow powder when freshly caught; *Iridotænia chrysogramma*, Deyr., also a scarce species; *Lampra leoparda*, Deyr., and *L. psilopteroides*, Deyr., both from the summit clearing, which also produced the following species of *Chrysobothris*; *C. superba*, Deyr., *C. æneicollis*, Deyr., and *C. cyanipennis*, Deyr.; these alight on logs or trunks of trees very like some big fly, and they are quick to fly off, thus being rather difficult to catch. The little *Lampra* species are slower and allow one to catch them by hand; *Belionota vuillifroyi*, Deyr.; *Mundaria brooksi*, Kerrem., a curious species described not long ago as the type of a new genus by Mons. Kerremans; *Agrilus acutus*, Thunb., and *A. albogaster*, Deyr.

Cucujionidæ.—On the summit the big yellowish *Poteriophorus fuscovarius*, Waterh. (lately turned quite black); *Dyscerus sexpunctata*, Harth. One of the commonest was *Aclees borneensis*, covered always with some bright pink powder when fresh, which unfortunately soon rubs off, leaving the insect an uninteresting dirty brown-black.

Cleridæ.—*Tillus birmamicus*, Gorh., a *Tillicera* sp. mimicking a Mutillid, *Ommadius clytiformis*, Westw., and *Stigmatium dilatum*, Kuw.

Strolling slowly up the hill from our camp each day always brought to light something fresh. Small Galerucids were always in evidence; close to the camp a tree was covered with some black fungus (?) growth, which appeared very attractive to some two hundred black and yellow *Endomychidæ*, *Eumorphus consobrinus*, Gerst. (or *E. quadriguttatus*, Fab.), easy to catch and well protected by a most offensive smell. With these were a few *Anthribidæ*, very active and on the alert as soon as one approached with a net; they proved to be *Cedus tuberculatus*, Pasc.

Round this same spot were to be seen some examples of the big grey-brown Nymphaline butterfly, *Euthalia dunya*. Two or three individuals were seen here throughout our stay on the mountain. Butterflies as a whole were very scarce on this path; *Amnosia baluana* was seen in the low undergrowth occasionally together with *Xanthotænia busiris* and a species of the allied genus *Faunis* (=*Clerome*). One day we disturbed a magnificent Amathusiine, *Thauria aliris*, Westw.

The little Lycænid, *Neopithecops zalmora*, was noticed further up; *Cupha erymanthis* not uncommon, the fritillary-like *Atella alcippe*, Cr., and the beautiful velvety purple *Terinos*, probably *T. clarissa*. The big brown Nymphaline *Cynthia erota* occasionally flew high overhead, a conspicuous object, but it appeared to be more common on the stream below. Our "White Admiral," *Limenitis procris*, was seen several times. Blue-margined Euthalias, as usual, were noted on the path, settled on the upper side of leaves with wings outspread. In similar places we found the little reddish Cicindelids, *Therates batesi*, Thoms., and *T. erinys*, Bates.

Further up the path a great tree had fallen down, making a little clearing, which was much frequented by the big green Buprestid *Catoxantha opulenta*; I saw over a dozen buzzing about at the same time. In the net they were most alarming, redoubling their efforts to proclaim themselves noxious Hymenoptera instead of harmless Coleoptera. The under surface of this great fallen trunk proved a happy hunting-ground for beetles; four species of *Carabidæ* and two *Cleridæ* being the most abundant.

Among the few butterflies observed on the summit were the

common Euplœines, *E. claudius mulciber* and *E. diocletianus lowi*, neither of them represented by more than two or three individuals. The big yellow hind winged Papilio, *P. amphrysus* (or possibly *P. helena*), occasionally flew up and away again at once. On the felled trees a little *Arhopala* (probably *A. apidanus*) was a frequent visitor, with one or two other Lycænids, among which was the rare Thecline, *Bindahara phocides*.

Our Dayaks made a small clearing on the summit plateau across the southern end, which there tapers to a point. Each man armed himself with an extra long stick, about fifteen feet long, to which a butterfly net was attached; great was the excitement on the approach of some great buzzing insect, which more often than not succeeded in evading the four or five nets waving clumsily after it. Big Swifts, *Chætura gigantea* and *C. leucopygialis*, hawked insects up and down in front of the clearing, accompanied by some big dragonflies on the same work. The ascent to this spot from the next plateau immediately below was very steep, and, in descending, one or two places were particularly nasty; however, the ever-ready hand of an attentive Dayak helped one to overcome these difficulties, and certainly the magnificent view, not to mention the excitement of annexing new species every two minutes, more than repaid one for the exertion.

On one side we could see for miles into Dutch Borneo—great stretches of untouched jungle, with here and there a little patch of lighter colour indicating some native village and paddi farm. On the Sarawak side we could see the whole of our course from the Sadong; but to the immediate north and north-west Mt. Sepedang and the eastern slopes of Mt. Penrissen obstructed further view.

The weather was particularly kind to us throughout our stay, nearly every morning being fine; in the afternoon, however, we usually had some rain—one or two nights we had a heavy storm, which brought down trees and branches in the neighbourhood, besides pointing out a few leaks in our hut. The little stream near by afforded us beautiful drinking water and a very refreshing cold bath; this latter a much-appreciated luxury in the tropics, where cold baths are usually inclined to be lukewarm.

All good things have to come to an end and early in the

morning of May 30th the Temong Dayaks arrived to take us down the mountain. After breakfast the task of breaking camp was soon accomplished; one last tap at the creeper for a longicorn and we set off for the descent. On arriving at the village we were led to the house of the Panglima, as that of the Orang Kaya or chief, was closed ("pantang") to strangers for eight days, owing to the birth of a child.

The head-house was strong and roomy here; in the evening we were treated to the usual entertainment. The Temong Dayaks went one better than their neighbours in producing a beverage called *tuach*, not an unpleasant intoxicant made from fermented rice. Some dozen ladies of various ages assailed us in the evening, each armed with a bottle of this in one hand and a glass or cup in the other. These latter had seen cleaner days, and the health of each fair offerer *had* to be drunk! A trading Chinaman happened to have arrived that afternoon, and from him we obtained some beads, rings and bracelets, with which we rewarded the dancers as the evening proceeded.

Next day requests for old trousers, coats, shoes, tobacco, empty tins and bottles were good-naturedly offered and attended to as far as possible. Some 30 ft. of dark purple cloth were divided between the two head men, and small quantities of tobacco portioned out to some of the others. Most of the men wear two "garments" only, *viz.* the head-cloth and loin-cloth; in one or two instances we noticed the latter was made from bark-cloth.

We took some time getting off, but eventually started about 9 a.m., and after some two hours' walking struck the Sadong river again and later stopped at the Dayak house of Bugu. This was built near the river at the foot of Mt. Sepedang, a big hilly mass rising to about 2000 ft. and more or less joined to Mt. Penrissen, which rises to over 4000 ft. slightly to the south-west of Sepedang. We stayed here for a meal and change of carriers. Some doubts were entertained as to the extent of the whiteness of B's. skin, and some amusement was caused by an enquiring female turning down the collar of his coat to make sure for herself. This was fully in accord with Wallace's experiences, so no doubt B. would not have wished it otherwise.

While we were waiting there, a little deputation of six Land Dayaks arrived on their way from Sarawak to Dutch Borneo. They had been to Kuching to inquire about moving under the Sarawak flag, as they found the taxes imposed on them by the Dutch were too heavy to bear. The whole tribe, fifteen thousand people, wanted to move in, or rather pay tax to the Sarawak Government instead of the Dutch. But as they proposed to stay in Dutch territory, it was explained to them that in Kuching such an arrangement would not exactly work.

The men of this village relieved the Temong Dayaks of their burdens and took us up the hill-side, following a wonderful path of never-ending stairs cut in the rock or earth up one spur and down the other side, across a stream, then up again and so for some two hours to the village of Simunti picturesquely situated on the watershed of the Sarawak and Sadong rivers, branches of each rising on either side of the ridge occupied by this village. We were once again on the route followed by Wallace, who had kept to the Sadong river from Temah (Borotoi in his day) as far as Bugu (Budw). From there he walked to Senankan, Menyerry and Sodos, all villages apparently built on the road across Mt. Sepedang, but no longer in existence; their places have been taken by small villages moved to different places. Thus Bugu at the foot of the hill on the Sadong river, Budu some way up the hill, and then Simunti further on; all call themselves Dayaks of Sodos, originating from Sennah in the Sarawak district, as opposed to the Dayaks of the Sadong district who come from the village of Taup. Both sections, however, belong to the one tribe which we know now as Land-Dayaks.

We slept the night at Simunti and next day continued our land journey across to the head-waters of the Sarawak river. The path led through some wonderful scenery, up and down steep spurs and along narrow razor-backed ridges, which fell away abruptly some hundreds of feet on each side of the narrow track; no country for paddi farming and we enjoyed the welcome shade of fine tall trees in consequence. An occasional butterfly woke up as we passed, but otherwise hardly a sign of life to be seen in this great fastness of Nature. And yet that huge tangle of vegetation above and below us hummed with strange noises indicative of teeming life. Perhaps the in-

dividual insect, reptile or bird, feels it would be impudence to intrude his or her insignificant self on the grandeur of such a scene. The vegetable kingdom is owner here; the animal kingdom takes the more humble station—a never-silent chorus.

Wallace describes this part in these words (p. 114):—"The descent from this point was very fine. A stream, deep in a rocky gorge, rushed on each side of us, to one of which we gradually descended, passing over many lateral gulleys and along the faces of some precipices by means of native bamboo bridges. Some of these were several hundred feet long and fifty or sixty feet high, a single smooth bamboo four inches in diameter forming the only pathway, while a slender handrail of the same material was often so shaky that it could only be used as a guide rather than a support."

About eleven that morning we finished the last descent of Mt. Sepedang and came to a broad though shallow stream of the Sarawak river, up which our guide led us a short way to point out a hot spring. This came bubbling out of the sand near the bank and we found it boiling hot; there was a distinct smell of sulphur. I asked the Dayaks if they used it for any medicinal purpose, but they said they did not.

We reached the large village of Sennah about an hour or so later and spent the night there. This is the starting point for the ascent of Mt. Penrissen, which rises close by, forming the principal source of the Sarawak river. Some big plateaux between 3000 ft. and 4000 ft. high have been recommended as sites for a sanatorium or hill-station; the whole distance from Kuching is about forty miles, half of which is already traversed by a broad metalled road.

The late Mr. Shelford made some interesting collections on the mountain in 1899, and the present writer ten years later (in 1909). Several forms hitherto only known from Mt. Kinabalu (the great mountain in British North Borneo, six hundred miles to the north-east of Penrissen) were found here. Subsequent expeditions in the interior of Sarawak and Dutch Borneo have shown that no doubt there is a more or less continuous mountain fauna running right through Borneo from north to west, and to a certain extent prolonged into the mountains of Sumatra and the Malay Peninsula.

Next morning we walked to a place called Pangkalen Ampat, where we obtained two boats from a Chinese trader; three Dayaks from Sennah and one from Temong, assisted by our collectors, sufficed for a crew, and we gently poled down the river all the afternoon; slept the night at the Dayak village of Danau and started again next morning at six. The river soon became too deep for poleing and we paddled on for some eight hours comfortably with the stream, occasionally shooting a mild rapid by way of a change. At Ledah Tanah the river divides, a westerly branch going up to the gold mines at Bau. We waited at the mouth of this branch for the Borneo Company's launch to come down and pick us up. About 3.30 she came round the bend; we scrambled on board, baggage and followers, leaving our boats to the care of a Malay there. Two hours later we landed in Kuching, after an absence of twenty-seven days. Flags were flying in honour of the Rajah's birthday, which happens to be on June 3rd, the same day as that of King George.

By the expenditure of a few dollars we enabled our Dayak friends to celebrate the occasion, while B. and I accepted an invitation to join a cheery dinner party near by. Chairs and tables, not to mention the fare of the metropolis of Kuching, afforded a novel change after some four weeks of jungle fare devoured on the floor. To our relief we were not given *tuach* to drink the health of H.H. the Rajah and that of H.M. the King.

NOTES AND QUERIES.

AVES.

Nesting of Troglodytes parvulus.—On my return home after a short holiday, last June, one of my sons informed me that he had seen the nest of a Wren in a curious place, *viz.* in a hole in the wall of my poultry run. On going to the place I had a very difficult task to find the nest, even when my son placed me within a few feet of it. I have not infrequently found the nest of the Wren built in walls in a dilapidated condition, where a stone has been missing, thus exposing a large portion of the nest; but the entrance to this one was by a very small orifice, and the nest being domeless, its detection by those who passed and repassed was reduced to a minimun. I had found a cock nest in early spring near this nest, but this one was used only as a dormitory, and was not subsequently utilized for the incubation and rearing of young or temporary sleeping quarters for fledged young, as is sometimes done on rare occasions.—E. P. Butterfield (Wilsden, Yorks).

The Grey Wagtail (Motacilla melanope) in Sussex. — Last year ('Zoologist,' 1913, p. 314) I expressed the opinion that the Grey Wagtail had nested in this district, and I am now pleased to record an increase in the number of birds frequenting this neighbourhood during the spring and summer of the present year. I have met with the bird at four different places during the nesting season, at two of which they were accompanied by young. I first saw young birds abroad during the first week in June, when they appeared to be fully grown; but on the 25th of that month I met with a female with two young which could not long have left the nest, judging by their short tails.—Robert Morris (Uckfield, Sussex).

Ampelis garrulus in Yorkshire.—A party of Waxwings visited this neighbourhood last year. It is over forty years since the last irruption occurred in this district, a few specimens of which fell into the hands of our local birdstuffers. A friend wrote me last spring from the neighbourhood of Halifax, stating that he had seen for the first time

the Blue-headed Wagtail, and my son Rosse informs me of the occurrence of a Bittern near Keighley, and the probable nesting of the Woodcock. Notwithstanding the beautiful weather we had last summer, very few Cuckoos were in evidence, but were much commoner in some places further north.—E. P. Butterfield (Wilsden, Yorks).

Young Sand-Martins found dead outside their Nest.—Referring to the query of Mr. F. C. Cook in his "Ornithological Notes" (*ante*, p. 321) as to the cause of the death of a number of young Sand-Martins (*Cotile riparia*) which he had found at the foot of sand-cliffs, I should have attributed the cause to the young being infested with parasites, had not Mr. Cook stated that the young dead birds were in all stages of plumage. This species is very much infested with parasites, and the young, when about a week or ten days old, are sometimes found dead at the foot of the cliffs where this species usually breed.—E. P. Butterfield (Wilsden, Yorks).

Linnets Singing from Trees.—In the 'Zoologist' (*ante*, p. 329) Mr. F. C. Cook relates the incident of numbers of *Linota cannabina* singing together in the topmost branches of a large tree at Oulton, which appeared to him most unusual. Here, in Somerset, Linnets are numerous, and many times I have observed parties of them singing together from the branches of an elm or lime tree; I have noticed this incident twice during the present month of October, perhaps they are young males having just finished their moult. It would appear likely that Mr. Hall Caine has also noticed this incident, for when reading his book 'The Woman Thou Gavest Me,' I admired the likeness he made to the young ladies' boudoir scene at Rome, their voices resembling "a tree full of Linnets in spring."—Stanley Lewis.

Osprey in Sussex.—I saw last week in Chichester a fine specimen of an immature Osprey (*Pandion haliaëtus*) which they told me was picked up by a farmer in a turnip field down Pagham way. The bird had recently been shot.—(Rev.) H. Marmaduke Langdale (Compton House, Compton, Petersfield).

United Broods of Teal.—Early last June I was walking with a gamekeeper in a lovely part of our West Country where *Nettion crecca* breeds plentifully, when we observed on a very small piece of water two united broods of Teal; there were nineteen youngsters with the two females. I conclude the two birds incubated closely together in the ling and heath which well overhung the edge of the water.—Stanley Lewis.

Lesser Black-backed Gulls (Larus fuscus) in Suffolk.—Referring to Mr. Patterson's interesting notes (*ante*, p. 391), I may say that at Lowestoft about mid-September these birds were seen daily. They were often to be seen near the pier, and I believe used to work between this locality and Easton Broad, always a favourite resort. Many of them were fine old birds, very black on the back. Terns were to be seen daily till I left on September 24th, and one rather rough day I counted seven on a wharf to the north of the pier pavilion. They were very tame, and when fishing in the harbour would often come within a few yards of where people were standing. Most of them were Common Terns, but I was able to identify one young Arctic Tern by the short bill and pinkish legs. This bird was walking about so near to me that, with the aid of glasses, every detail was visible.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds).

Home Colony of Birds.—Whilst looking over the earlier volumes of the 'Zoologist,' I found in the volume for 1897 some "local lists of birds" recorded. These were of considerable interest to me, as I have often wondered if there are many more favoured inland nesting haunts than the immediate vicinity around my house. My property covers an area of under twenty-three acres, situated in the Dowles valley adjoining Wyre Forest. Dowles brook intersects my grounds; there are two small plantations of about six acres in all, the remainder being old orchard and grassland. The following is a list of the nesting species:—

Tawny Owl
Red-backed Shrike
Spotted Flycatcher
Dipper
Mistle-Thrush
Thrush
Blackbird
Hedge-Sparrow
Robin
Redstart
Grasshopper Warbler*
Whitethroat
Lesser Whitethroat
Blackcap
Garden-Warbler
Wood-Warbler
Willow-Warbler
Chiff-chaff
Gold-crest
Great Tit
Blue Tit
Coal Tit
Marsh Tit
Long-tailed Tit
Pied Wagtail
Grey Wagtail
Tree-Pipit
Yellow-Hammer
Chaffinch
Tree-Sparrow
Common Sparrow
Hawfinch
Greenfinch
Goldfinch*
Linnet
Bullfinch
Starling
Green Woodpecker
Greater Spotted Woodpecker
Wryneck
Tree-creeper
Wren
Swallow
Sand-Martin
Nightjar*
Cuckoo
Kingfisher
Ring-Dove
Turtle-Dove
Pheasant
Moorhen

* These species have only nested in a single instance.

A total of fifty-one, none of which are included through the means of nesting-boxes, &c. Sparrow-Hawk, Nightingale,* Stone-Chat, Sky-Lark, Jay, House-Martin, Partridge, Red-legged Partridge, Lapwing, and Woodcock also nest immediately beyond my boundaries. And an additional twenty-eight species of birds have come under my personal observation, making a total of eighty-nine different birds seen during my residence here of eleven years.—J. Steele Elliott (Dowles Manor, Shropshire).

CRUSTACEA.

Distribution of the Crayfish in Bedfordshire. — The Crayfish (*Potamobius pallipes*) is first recorded for this county by the Lysons ('Magna Britannia,' p. 21) in 1806, they including some in a list of the "fish" that are taken in the river Ouse; and, secondly, by G. C. Gorham ('History of St. Neots,' p. 140) in 1820, who refers to such as one of the "fish" which ordinarily occur in this river. Whether the Crayfish was then of really common occurrence neither authorities enlighten us, and not improbably the latter writer took his information from the Lysons' work. In recent years, so far as the river Ouse is concerned, it must at least be very rare. I have never heard of it being taken from that waterway. It is recorded by J. Saunders ('Victoria History, County of Beds,' vol. i. p. 91) in 1904 as abundant in the river Lea, south of Luton Hoo—a very restricted locality, as only about a mile of this stream is within the county. It has also been reported to me as found not infrequently in the river Ivel below Shefford. I can now further extend its distribution, as one measuring $5\frac{3}{4}$ in. from tail-fan to top of the antennæ I took on October 25th last from the eel-trap at my mill at Blunham.—J. Steele Elliott (Dowles Manor, Salop).

* This species has only nested in a single instance.

NOTICES OF NEW BOOKS.

Indian Forest Insects of Economic Importance: Coleoptera. By Edward Percy Stebbing (of the Indian Forest Service, &c.). Agents for Indian Government Publications.

This large and excellently illustrated volume will take its place by the side of Prof. Maxwell-Lefroy's 'Indian Insect Life,' published in 1909, and is an example of the work now being done by the Indian Forest Service in the domain of economic entomology. Gamble is quoted for the statement that "the Indian forests contain some five thousand different species of trees, shrubs, climbers, and bamboos, covering about one-third of the Indian flora." It was thought at first by Mr. Stebbing that the forest tracks might be divided into climatal districts, and that the injurious insects might fall somewhat into a similar distribution; but this was found to be inexact in application, though in general features suggestive. A large number of Coleoptera are figured, and their depredations described, so that the book, although primarily of economic value, will also add largely to a knowledge of the beetles themselves, for the Coleopteral portion of the Insecta in the 'Fauna of British India' is still only in process of publication. Economic entomology is now fostered and supported in a manner beyond the dreams of entomologists a few years ago. We have an Imperial Entomological Governmental Bureau in London, and young men are being distributed as economic entomologists in all our colonies. The United States of America were first and are still foremost in this field; the next decade should produce enormous results.

This volume has been produced with care; we notice, however, that one large order of insects is referred to as "Rhynchota" (p. 20), and as "Hemiptera" (p. 632). Both names are available, as both are employed in preference by different writers; but one only should be used in the same volume.

The Philosophy of Biology. By James Johnstone, D.Sc. Cambridge, at the University Press.

This is a very difficult book for notice in 'The Zoologist,' our mission being a bionomical one and our standpoint of an observational character. Our evolutionary conceptions are still, in this country, largely based on those of Huxley and Darwin, the clear and direct biological thinkers of the nineteenth century, who first attuned our thoughts on these questions. They did this with such a lucidity and directness that even the "man in the street," without much understanding or knowledge of the evidence, caught the crisp sentences and conclusions of these great thinkers, like a jury in a complicated legal case which they do not understand give their verdict solely on the summing up of the judge. Much has happened since the time of the enunciation of the evolutionary hypothesis, and the ordinary naturalist is much less sure that he understands the argument. It is now almost a consideration for experts; not that the cardinal necessity of evolution has become obscured, but because its advocacy has passed into realms of metaphysic and philosophy which only few can follow, and at some future time another Darwin will be required to unravel and explain the ramifications of the present evolutionary Vedânta.

To follow Dr. Johnstone, his book must be closely read and also pondered. It is full of facts and suggestions, but the theory or conclusion of the author is not always apparent. Where we would desiderate direct conclusion or advocacy the reader will frequently find himself still in the meshes of the law. Many of the pages are too scholastic for the ordinary enquirer.

EDITORIAL GLEANINGS.

The following interesting correspondence is taken from a recent issue of the 'Fishing Gazette':—

Names of Carp.—Dear Sir,—Having noticed in the 'Fishing Gazette' on several occasions the mention of the Spiegel Carp, Leather Carp, Mirror Carp, and King Carp, I should feel greatly obliged if the chief differences could be explained. I have heard several arguments, but have not been clear in my imagination.—Yours truly, Perplexed.

[The Carp was introduced into Europe from Asia many hundreds of years ago. It has been cultivated and crossed, and now there are different varieties, all probably the descendants of the true Carp, which is covered with large scales. On the Continent, especially in Germany and Austria, a very favourite cultivated variety of the Carp is one with comparatively few large and almost isolated scales, which are often iridescent and look like little mirrors. The German for mirror is "Spiegel," and "Der Spiegel Karpfen" is the same as "the Mirror Carp"; in French, "Carpe à Miroir" (*Cyprinus specularis*). When the Carp has been cultivated until it has lost nearly all its scales, and its skin has the appearance and feel of brown leather, the Germans call it "Leder Karpfen" (Leather Carp), and the French "Carpe à cuir" (*Cyprinus nudus*). King Carp, or Queen Carp, is merely a title of honour given to the Leather or Mirror Carp, which fish have been produced from the common Carp by a process of selection and breeding. If left to themselves, after some generations these so-called improved fish gradually revert to their original form and become more or less covered with scales. Just as racehorses and great Clydesdales have been produced from the common Horse, also special breeds of cattle, Dogs, &c., in the same way fish, by selection and breeding for points, can be made to appear quite different from their common ancestor.—Ed.—(R. B. Marston.)]

Speed of Dogs.—Comparatively few people (says 'Forest and Stream') realize of what remarkable speed Dogs are capable. Some remarkable statistics in regard to this have been gathered by M. Dusolier, a French scientist. After pointing out the marvellous endurance shown by little Fox-terriers, who follow their masters patiently for hours while the latter are riding on bicycles or in

carriages, he says that even greater endurance is shown by certain wild animals that are akin to Dogs. Thus the Wolf can run between fifty and sixty miles in one night, and an Arctic Fox can do quite as well, if not better. Nansen met one of these Foxes on the ice at a point more than seventy miles north-west of the Sanikow territory, which is 480 miles from the Asiatic coast. Eskimo and Siberian Dogs can travel forty-five miles on the ice in five hours, and there is one case on record in which a team of Eskimo Dogs travelled six and one-half miles in twenty-eight minutes. According to M. Dusolier, the speed of shepherd Dogs and hunting Dogs ranges from ten to fifteen yards a second. Foxhounds are extraordinarily swift, as is proved by the fact that a Dog of this breed once beat a thoroughbred horse, covering four miles in six and one-half minutes, which was at the rate of nearly eighteen yards a second. Greyhounds are the swiftest of all four-footed creatures, and their speed may be regarded as equal to that of carrier Pigeons. English Greyhounds, which are carefully selected, and which are used for coursing in Nebraska and other States, are able to cover at full gallop a space between eighteen and twenty-three yards every second.

The Council of the London Natural History Society invites any Belgian or French refugees to attend the meetings of the Society, and offers them the use of the Society's library and collections. The Central Society meets at Hall 20, Salisbury House, London Wall, E.C., at 7 p.m., on the first and third Tuesdays of the month. Further particulars can be obtained of J. Ross, 18, Queen's Grove Road, Chingford, N.E.

Mr. E. G. Boulenger, F.Z.S., who has charge of the unrivalled collection of lower vertebrates in the Zoological Society's Gardens in Regent's Park has just produced a monograph on 'Reptiles and Batrachians,' unique in the fact that it is a comprehensive treatise devoted entirely to the study of this particular branch of Natural History. The author gives a complete account of the general classification of the groups dealt with, and a detailed description of the commoner and more interesting types: he also deals very fully with the habits of the animals in captivity, for observing which he has had special opportunities, and much that is included is the result of his direct observation, and has not previously been recorded.

The book is illustrated by two hundred photographs, mostly from living specimens, and by numerous figures in the text.

Messrs. J. M. Dent & Sons issue the book.

Major G. E. H. Barrett-Hamilton's Expedition to South Georgia to Investigate the Position of the Antarctic Whaling Industry.—By kind permission of the Trustees of the British Museum the Committee arranged for Mr. P. Stammwitz, a taxidermist employed at the Natural History Museum, South Kensington, to accompany Major Barrett-Hamilton to South Georgia; and the greater part of the grant placed at the disposal of the Committee has been expended in paying his salary and in making certain preliminary payments. He sailed with Major Barrett-Hamilton on October 6th, 1913, and work was commenced at South Georgia immediately after their arrival on November 10th.

Early in the new year news was received that Major Barrett-Hamilton had died suddenly at South Georgia on January 17th, while his inquiries were in full progress. This unlooked-for event, which the Committee record with profound sorrow, naturally altered the entire prospects of the expedition. Mr. Stammwitz had no alternative but to return at once, and, after making arrangements for the despatch of the specimens which had been collected, he took the first opportunity of leaving South Georgia, bringing with him the notebooks containing Major Barrett-Hamilton's observations. At the request of the Colonial Office, and with the approval of the Trustees of the British Museum, these notebooks have been placed in the hands of Mr. Martin A. C. Hinton for examination. It is hoped that the results of the work which Major Barrett-Hamilton had done before his death will thus not be entirely lost. The collections brought home comprise a very valuable series of specimens—in particular, flippers, complete sets of baleen, and other anatomical material from the Blue Whale, the Common Rorqual, and the Humpback Whale. These specimens have been presented to the Natural History Museum by Messrs. Chr. Salvesen & Co., at whose whaling station they were obtained, and they should be of service in helping to decide the much-debated question whether these Antarctic Whales are specifically identical with their northern representatives.

A few birds were obtained at South Trinidad on the outward journey, and a certain amount of dredging and shore-collecting was done at South Georgia. The collection made includes marine invertebrates and fishes, bird-skins, plants, and a few insects and rock-specimens. These have been handed over to the Natural History Museum, where arrangements are being made to have them determined, and if necessary reported on, by specialists.—"Report of Committee," British Association, Australia, 1914.

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THE ZOOLOGIST

No. 882.—December 15th, 1914.

SOME EXTRACTS FROM A SHOOTER'S NOTE-BOOK.

From January 6th, 1866, to January 23rd, 1867, including the Great Frost of the Latter Year.

By Robert Warren.

January 6th, 1866.—The weather has been incessantly wet and stormy since December 21st, and the country is very much flooded, water seen lying in most of the pasture-fields. To-day I shot a fine specimen of the Iceland Gull, in the lodge field, where for some days past it had been feeding after the plough with the Black-headed Gulls. From its stage of plumage it is a bird apparently in its second year. As is usual with most Iceland Gulls, it was very tame, allowing me to walk up close within shot.

12th.—Yesterday, on the shore near Roserk Abbey, I noticed a small Sandpiper, in the company of Greenshanks. On flying off it uttered a peculiar, loud cry, which I recognized as the cry of the bird that I saw on two occasions at Roserk, and once, when returning from hunting near Kilglass, it was flying very high, frequently uttering its loud and very peculiar cry.

This evening it was seen on the Moy View shore, but being too late to look after it, I was obliged to postpone my search until next morning.

13th.—Early this morning, went in search of the Sandpiper, but saw nothing of it along the shore. However, before returning, I thought of looking at a little pond, situated just inside the shore fence, but quite surrounded by bushes and trees. Cautiously looking over the wall, I saw the little stranger

running along the edge of the water, quickly snapping up the insects it was feeding on. After a few moments watching it, I thought it better not to delay and perhaps lose my chance of obtaining it, so I fired, knocking it over dead, and on picking it up recognized it as the Green Sandpiper, so rare in this locality that I have known of only one other specimen, obtained by a friend and, by a strange coincidence, shot in the very same pond at Moy View. In its flight and appearance when slowly flying along the shores it gives one the idea of a small Greenshank; the colour and shape of the wings are very similar.

February 19th.—This morning, as I was riding along the sands at Enniscrone, on the look-out for any rare birds that might turn up, I observed an Iceland Gull by the river, among a lot of Herring-Gulls. It was much darker in colour than the bird shot on January 6th, and though wilder than this species usually is, was evidently in its first year's plumage. We had some snow on the 16th and 17th, but it is all off to-day. The barometer for some days past has stood at 30°, weather looking as if going to hold fine for a few days.

March 22nd.—Barometer still high; weather fine.

April 11th.—The Sandwich-Terns have arrived, and were seen and heard, very noisy, as they usually are on their arrival. They are rather late this season. One year I observed them as early as March 25th, and another year on the 28th, when snow was lying on the ground and the thermometer indicating six degrees of frost, and they were as lively and noisy as if it was the middle of May.

16th.—Swallows seen flying about the river near Belleck Manor to-day.

20th.—Willow-Wrens heard at Moy View.

21st.—Cuckoo and Land-Rails heard at Moy View, the latter being numerous this season.

29th.—A pair of Spotted Flycatchers on trees of garden and farmyard.

June 2nd.—Saw a large flock of Bar-tailed Godwits on the sands just off the shore here; two of the Godwits were dark on the back and had very red breasts and very dark legs, but whether they were black-tailed or bar-tailed, assuming their summer plumage, I cannot say. However, all the others (at

least a hundred) appeared in the winter grey plumage. It is a strange and remarkable fact that of the hundreds of Bar-tailed Godwits continuing on the sands of the estuary, perhaps not one in a hundred of the birds when leaving for their northern haunts ever exhibit their breeding plumage.

July 4th.—A pair of Spotted Flycatchers have had a nest in the garden, but reared only one young bird, leaving two addled eggs in the nest.

August 14th.—To-day, in the bog at Castletown, saw what I think was a male Hen-Harrier flying about the bog; it appeared of the grey colour of the male, but the ends of the wings appeared darkish. However, from its mode of flight being low and its flying backwards and forwards like a setter, it certainly was some species of Harrier.

September 28th.—Wigeon have arrived; to-day I fired at and wounded one, but without securing it.

October 28th.—For the first time, to-day I saw a flock of Long-tailed Tits, in the Fort Field plantation, the only time that I ever met this species at Moy View. They had probably wandered down from the woods of Belleck Manor, the demesne of Sir Arthur Knox Gore.

January 1st, 1867.—The greater part of November and December was very wet and stormy, but with a mild temperature, there being only one night's hoar frost early in December; but the 30th and 31st were very wild and cold. On the morning of January 1st heavy hailstorms began, and about 11 a.m. a fearful gale of wind set in from the north, with snow-showers. This continued all day, but the wind fell during the night, leaving the ground covered with snow to a depth of three inches, accompanied by a sharp frost.

2nd.—A very hard frost last night, with snow.

3rd.—Frost very severe last night, with some snow-showers, and being very calm the snow froze in beautiful crystals on the branches of the trees, giving an ideal snow-scene. The birds looked very miserable, having no place to feed, for, owing to the calm, the snow drifting under the bushes covered their ordinary feeding-grounds, so for the two days past they had to take to the shore and search for sandhoppers and such food among the seaweed and along high-water mark, as soon as the

tide left the shore, when Rooks, Blackbirds, Thrushes, Sky-Larks, Chaffinches, and other small birds were enabled to keep alive. But the long-billed waders were in a bad plight also, in consequence of the short time they had for feeding during the ebbing of the tide, before the sands were hard frozen and quite impervious to their soft, slender bills, probing the sand in search of Sand-eels and Lug-worms. Owing to the snow on the ground under the furze and other bushes in the plantations, very few Woodcocks were to be seen; going through the plantations to-day I only met five birds, one couple of which I shot, being unlucky with the others.

4th.—A very hard frost last night, and held all day, accompanied by a dense fog, as usual, forming beautiful crystals on the trees and bushes. The birds are very weak, and still keep to the shores. Some parts of the shore are coverd by ice left by the ebb tides, while Kilanly Bay is one sheet of unbroken ice; there are also quantities among the islands near Reserk Abbey and in many places connecting the islands with the Abbey land, the channels between many of them being closed by fixed ice, and no place left open for either Ducks or Wigeon to feed.

5th.—Very little frost last night, but a bitter east wind blowing this morning, and the birds are suffering very much from this intense cold, as well as from want of food. The increased cold caused by this was severely felt by the birds, especially by the Starlings, many making attempts to enter the house in search of warmth through the windows, wherever open, and even going down the chimneys; while others got into holes under the eaves for shelter, and into the stables and cattle-houses. Many were found dead in the places they went for shelter. I found a Blackbird and Rook dead, and met many Curlews very weak, some being scarcely able to fly off when approached, and in consequence of not being able to feed on the sands, or in the open fields, they frequented the plantations, searching for food, and along the hedges and sides of fences.

6th.—A thaw has set in very rapidly, melting the snow, but it will take a long time before this heavy snowfall disappears.

7th.—Thaw still continues, with rain, and large quantities of sheet-ice are floating down with the ebb-tide from the upper

reaches of the river; but there is a great deal of snow still lying on the level fields and sheltered hollows.

11th.—Some more hail-showers last night, and this morning the ground is well covered. Frost again set in this evening, with wind from north-east.

12th.—More snow and hail-showers from north-east last night and at intervals during the day, while the wind has risen, and some frost with every appearance of its continuing, the birds again beginning to suffer and resorting to the shores. A large flock of Wild Geese came down from inland, flying low and evidently going to pitch in the shore field, when something alarmed them and, rising higher, they resumed their flight towards Bartragh.

13th.—A large quantity of hail and snow fell last night, covering the ground to a depth of seven inches, but it has drifted very deep in some places.

14th.—More snow last night, covering the ground much deeper in the level fields, as well as increasing the drifts, which are three feet deep right across the middle avenue, stopping all car traffic. I went out to-day and shot two couple of Cocks, missing some others that so deftly dodged me between the snow-covered trees. However, I afterwards went to Halliday's and Wright's fields, to search the open, unfrozen drains for Snipe. I shot three brace: a brace of Quail that rose from a bunch of briars alongside a fence; a brace of Water-Rails, a Water-Hen, and two others caught by my Water-Spaniel "Floss." In the evening I went to the little marsh at Kilanly, but seeing nothing there I returned along the shore. While passing the little muddy bay (just cleared of ice by the ebbing tide), I observed a Redshank some distance off, feeding on the mud, and though a long way off, as I wanted to discharge my gun previous to washing, I fired and, to my surprise, knocked it over dead. My Water-Spaniel "Floss" fetched it in, and on taking it from her I remarked that the bill and legs appeared longer and slighter than those of the Common Redshank. However, in the bad light I took no farther notice, but on my return, taking the birds out of the game-bag to hang up for the night, I again examined the stranger, when to my great surprise and delight it proved to be a specimen, in winter plumage, of the rare

Spotted Redshank, and the second specimen known at that date to have been captured in Ireland, the first being obtained by the late William Thompson, of Belfast, the well-known author of the 'Natural History of Ireland.' In his second volume, page 200, he describes its capture:—"When a very young sportsman, and out shooting on Holywood Rabbit Warren, bordering on Belfast Bay, on the morning of August 22nd, 1823, I perceived at a distance a solitary bird, whose call resembled that of the Redshank but somewhat different, winging its way over the sea towards Belfast. To my surprise and delight, however, the stranger made a sudden turn and alighted on the beach at a short distance, which was scarcely done until it became my victim. Immediately on lifting the bird, though I had never seen one before, I knew it to be the Spotted Redshank, from recollection of Bewick's beautiful figure of the species."

15th.—Heavy frost last night and some snow, with a dense fog, freezing on the trees in beautiful crystals, affording an ideal Arctic scene of great beauty. The frost became very severe at three o'clock, and poor "Floss" is very uncomfortable, covered by all over the frozen snow and fog. This morning the sands were covered with a sheet of frozen snow and ice which, rising with the flood tide, was thrown up on the shore, covering all the feeding-grounds of Ducks and Wigeon, which were obliged to resort to the shores of the islands and feed on the sloak or laver growing on the stones below tide-mark, before they were frozen after the tide ebbed.

To-day I shot one Cock, and along the unfrozen drains in Wright's field three brace of Snipe and a Jack; also, along the shore, some Ringed Plovers and a Redshank; and found a Redwing and Rook starved to death. All the birds becoming very weak, it is difficult to understand how they are able to exist, with the ground so long covered by the frozen snow.

16th.—To-day I shot one Cock and four brace of Snipe in the unfrozen drains. The ice has broken up on the estuary and tidal parts of the river as far as Killanly and Roserk, but is closed from those places up to the shipping quay, a distance of one and a-half miles. To-day a boat rowed up the river, but was stopped by the barrier of ice and obliged to return to Enniscrone. The starving Rooks have been attacking the weaker

birds, like Hooded Crows, and destroying numbers; to-day I saw a Rook attack a poor weakly Fieldfare and tear it to pieces in a short time. The Magpies are also feasting on the unfortunate starving birds and committing great destruction.

17th.—The frost still continues with great severity, with no sign of change. To-day I shot one Cock, three brace of Snipe, and a Grey Plover. The ice is still closed across the river at Killanly and Roserk, though quite broken up below those places, and being lifted by the rising spring tides, is left by the ebb tide in large quantities along the shore, some sheets being over three inches thick. With a fall of the barometer and a cloudy sky, about 11 a.m., the snow began to soften, as if indicating a change. But about 9 p.m. the frost returned and set in with its usual severity.

18th.—The heavy frost still continues, but the rising tides are breaking up the ice, and to-day the river is clear as far as Castleconnor, the ebb tide drifting down large quantities, some sheets being three and four inches thick. As I was coming out of the shore field, at the end of the double fence, I saw a splendid Wild Swan flying down the river and pitching on the water just opposite, then looking about and uttering low-toned calls resembling the words "hong, hong, awe," afterwards swimming down the estuary until lost to sight in the dense fog. The bird, by its calls, was evidently a Bewick's Swan, and since then, having frequently heard the calls of other Swans from time to time, have no doubt of its species. To-day I shot three brace of Snipe in the drains of Wright's field, and a Duck in the drain of Goodwin's Hill, losing a wounded Mallard.

19th.—The frost still continues, with a bitterly cold easterly wind, but as yet no sign of change, though the ice on the tidal part of the river is being rapidly broken up by the spring tides, and the river is now clear up to Castleconnor Point; but neither steamer nor sailing ship can pass that barrier of ice. A schooner to-day attempted to force her way up to the shipping quay, and although with a fair wind and all sails set, when meeting the icy barrier she was brought to with a shock that almost brought the masts out of her, and recoiling from the shock she was brought to anchor, her commander, thinking discretion the better part of valour, sitting down quietly and waiting for the

final break-up of the ice before attempting to reach the shipping quay. To-day I shot one couple of Cocks, and at the drains three brace of Snipe, while in the morning four Wigeon, as they fed near the shore, and in the evening a Duck and Mallard, as they were feeding in the little muddy bay at this side of the Point.

20th.—There was but little frost last night, the snow still covering the fields without any appearance of thawing. I have heard of great numbers of Cocks shot along the shores of Easkey and Enniscrone, as they were lying among the rocks and stones, after feeding among the seaweed when the tide was out. I even heard of boys knocking down with sticks a good many as they rose from behind the rocks near which they were lying.

21st.—A heavy gale last night, which has collected the snow into great drifts across many of the roads, that between Castleconnor and Ballina being quite impassable for either cars or horses.

22nd.—This is the first day that a general thaw has set in, and is proceeding rapidly, a great relief to the poor sheep and cattle, which have been without a bite of grass for twelve days.

23rd.—The ground is at last clear of snow, having been covered for twelve days, and the navigation of the river and estuary closed for six days.

And so ended the great snowstorm and severe frost of January, 1867, that will be long remembered.

BIRDS TRAVELLING NORTH IN OCTOBER.

By J. H. Gurney, F.Z.S.

On October 7th, with a gentle wind from the north, from earliest dawn continual flocks of Lapwings, Starlings, Herring-Gulls and, I believe, Lesser Black-backed Gulls, accompanied by Redwings, Sky-Larks, Chaffinches, and Rooks, singly or in small parties, and a few detachments of Black-headed Gulls and Wild Ducks, and two skeins of Geese were seen by Mr. Henry Cole and the writer, and others as well, passing over the adjacent parishes of Overstrand, Northrepps, and Cromer, which are all on the coast. Estimates of numbers are proverbially untrustworthy, but undoubtedly a great mass of birds went by altogether.

The birds were high overhead, and for some hours every flock was proceeding due north, but after 11 a.m. they inclined to north north-west, and their numbers slackened, and by 1 o'clock the migration was practically over.

I have seen similar northward passages of birds on a much smaller scale near the coast before in October, and believe it to be almost an annual movement, and the same has been remarked by Mr. B. B. Riviere (*see* 'Norwich Naturalists' Transactions,' 1913–14, p. 772), and at Lowestoft by Mr. C. B. Ticehurst.

At this time of the year north or north-west is not quite the direction in which one expects birds to travel, but the movement is probably attributable to wind which, when even quite of moderate strength (force 2 or 3), may be seen to exercise a great influence over birds on the East Coast, and against which they may be usually observed to fly. On this point see Hele's 'Notes about Aldeburgh,' p. 122, and 'The Field' of November 6th, 1875, and October 14th, 1876, where the experience of the writer confirms this observation.

On the present occasion, on the morning that they were seen at Cromer, the same flocks or similar ones were reported at

Cley and Blakeney—where they were flying west—by Mr. R. Pinchen.

Flocks were also viewed by Mr. F. A. Quibb at Winterton, which is on the coast, and by Mr. Caton Haigh in North Lincolnshire, where the direction of their flight was registered as north-west.

It is, therefore, quite evident that they were following the Norfolk and Lincolnshire coasts, and in all probability the sea-line of Suffolk and Yorkshire as well. One cannot but feel a great curiosity to know where bands of migrants such as these start from; probably they begin with only a few birds, and their ranks receive additions as the army goes along. That these feathered travellers eventually turn south again seems pretty obvious.

NOTES ON THE FAUNA OF THE COUNTRY OF THE CHESS AND GADE.

By T. E. Lones, M.A., LL.D., B.Sc.

(Continued from p. 346.)

The Rotiferan fauna of most parts of the canal, in the country of the Chess and Gade, is comparatively very poor. On many occasions samples of water, representing the results of dredgings over long lengths of the canal, have yielded very little. One reason for this is that the boat traffic being considerable, and a large number of the boats being drawn by screw steamers, the waters of the canal are often thoroughly stirred up and rendered very muddy. In such waters but few species of Rotifers would be likely to thrive. Still, several species obtained from the canal have been more than usually interesting. The finest specimen of *Rotifer vulgaris*, as already stated, was from a section of the canal between Watford and King's Langley; the best specimen, to be described later, of *Philodina citrina*, was from the canal at Boxmoor, and a few species of Rotifers, so far not obtained elsewhere in the country of the Chess and Gade, or only very sparingly, have been taken from the section of the canal between Berkhamsted and Tring Station. Not only is this true of the Rotifers, but, as far as my notes show, a corresponding statement is true also of some other forms of life, *e. g.* Entomostracans. This question of the peculiar *facies* of the fauna of the northern section of the canal will be dealt with again when the Entomostracans of the country of the Chess and Gade are considered.

On October 15th, 1913, a sample of water obtained by dredging to the south of Tring Station appeared to contain nothing but *Anuræa cochlearis*, *Chydorus sphæricus*, and a few immature specimens of *Cyclops*. In order to facilitate examination of the various specimens some narcotizing fluid was added

to the water, and some time afterwards the greater part of it was poured off. The residue was then examined by means of the microscope, and an *Asplachna* of great transparency was noticed, but it was by no means in a suitable state for specific identification, contraction having taken place. Within it was a small Rotifer, apparently a *Brachionus*. This *Asplachna* is the only one so far obtained, and is conveniently mentioned here because it was found in the northern section of the canal, the peculiarities of the Rotiferan fauna of which are being considered. It seemed to be a specimen of Gosse's *A. brightwellii*. Beyond this it will serve no useful purpose to say anything further, but I hope to obtain specimens of *Asplachna* under conditions favourable for satisfactory identification, in which event the species so determined can be fully described. For the present three species of special interest from various parts of the canal will be described, viz. *Brachionus quadratus*, Rouss., *Dinocharis tetractis*, Ehren., and *Philodina citrina*, Ehren.

25. *Brachionus quadratus*, Rouss.—A fine specimen of this species was obtained by dredging along a distance of about one-eighth of a mile in the canal south of Tring Station on May 26th, 1914. The surface of the lorica presented a peculiar appearance; it was somewhat opaque, but, reflecting from many minute areas numerous pencils of light, the whole effect was similar to that obtained by reflecting light from a dark coloured plate of crackled or frosted glass. The length of the lorica was about $\frac{1}{100}$ in. Its six oral spines, of characteristic form and arrangement, were very conspicuous. A brilliant red eye-spot was seen situated rather far back from the oral end, and on or near the central line of the lorica. The Rotifer was very prone to anchor itself after the manner of *Noteus quadricornis*, keeping its foot and the hinder part of its body out of sight. When in this position the trapezoidal form of its lorica was well seen. Occasionally the Rotifer exposed to full view its dorsal surface, remarkable for its large size and somewhat square form. On account of its peculiar movements it was difficult to obtain a good view of the foot, which was seen, however, to be long and unusually thick and strong.

26. *Dinocharis tetractis*, Ehren.—From the water which yielded the single specimen of *B. quadratus*, just described,

were obtained seven specimens of *D. tetractis*. Their chief features were easily seen, *viz.* a vase-shaped faceted lorica; a very movable head which seemed as if set in a cup and moved to and fro, a movement rendered the more striking by the corresponding movement of the brilliant red eye-spot; a very long, jointed foot with two well-marked curved spurs, as shown in figs. 14 and 15; and two long toes of nearly equal width throughout. One specimen, from which figs. 14, 15 and 16 were drawn, was watched for a long time. It often remained anchored, and its toes assumed all possible positions from A to B, fig. 16, owing to the Rotifer moving slowly in the direction of the length of its lorica, while this maintained a somewhat

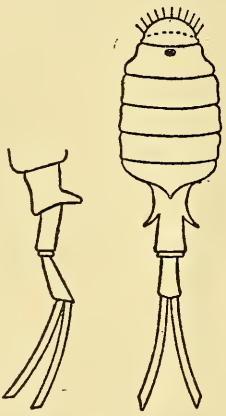

Fig. 15. Fig. 14.

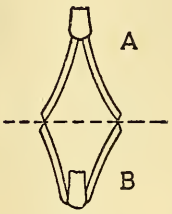

Fig. 16.

horizontal position. Occasionally the Rotifer burrowed into organic matter on the slide or swam directly forwards, and, when swimming, it often turned on its side and remained so for a few seconds. It was while the Rotifer was in this position that fig. 15 was drawn to show the peculiar bent arrangement of the foot and toes, and also the form of the spurs, of which one is shown, the other being hidden by it.

27. *Philodina citrina*, Ehren.—The bdelloid Rotifers are, generally speaking, the most difficult to examine and identify. A good procedure, I have found, is first to examine the specimens in the water of the collecting bottle containing them, not attempting to get rid of the organic or other sediment which

is usually in such water. This examination enables the movements of the Rotifers to be seen under sufficiently fair and natural conditions. Since, however, the bdelloid Rotifers will usually be burrowing in or becoming entangled with the sediment on the slide, it will be, in most cases, practically impossible to examine their anatomical features advantageously. To do this the Rotifers should next be transferred by one or more pipette operations to a little distilled or very clear water, so that finally there is no particle of sediment present. If, owing to the vigorous movements of the Rotifers, it becomes necessary to narcotize them, this should be done cautiously so as not to produce too violent a contraction. With this precaution the Rotifers often recover somewhat, especially if a little pure water is added on the slide, and finally move about sufficiently slowly to enable their anatomical features to be examined. A compressor is useful, but so far I have had no need to use it. Another point is worth mentioning. It never seems to be worth while to spend much time in examining inferior specimens of a species. Rotifers are very small animals, but, like much larger ones, they seem to present great differences in vigour and development. Some of them show to the fullest extent the peculiarities of the species, as regards size, form and movements. The examination of such specimens with every care always repays for the time spent on them.

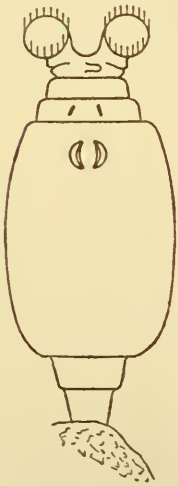

Fig. 17.

The Rotifer, *P. citrina*, under consideration, exemplifies some of the above remarks. Although not a common species in the country of the Chess and Gade, it is occasionally found in the pools, especially those of Chipperfield Common and Langleybury, and in the little streams near the canal, as well as the canal itself. Altogether a score or more specimens had been examined at various times, but it was not until July 14th, 1914, that an exceptionally good specimen, both as regards form and colour, was obtained. This, the only one procured on that date, was from the canal at Boxmoor. Further, there happened to be only a small quantity of sediment in the water, and examination of the Rotifer was

therefore easy. This specimen is shown in fig. 17, in a position in which it remained for a long time, with its foot embedded and partly hidden in a small quantity of sediment on the slide. The separation of the trunk from the foot was abrupt, and the nearly horizontal antenna and the well-expanded wheels were clearly seen. Two features of the Rotifer were particularly attractive, *viz.* its two elongated, brilliant red eye-spots, which were inclined towards each other, and the clear, bright amber colour of the greater part of its body. I do not expect to obtain a finer specimen of the species, and it seems remarkable that it was obtained from the canal, and also that the finest specimen of *Rotifer vulgaris* was obtained from the same canal, although not from the same section of it.

28. *Colurus caudatus*, Ehren.—This Rotifer was obtained, on July 21st, 1913, from the inner moat at Berkhamsted Castle. Its lorica was stout and pear-shaped, the large part being towards the hinder end, which terminated in two short points. From the anterior end of a ventral slit in the lorica proceeded a long, jointed foot, tapering to a fine extremity and carrying two thin toes. The Rotifer was almost incessantly on the move, and its movements were too complicated to allow its parts to be seen to advantage. After a time it was narcotized, and the structural features mentioned above were much better seen, while the peculiar hood of the Rotifer, appearing in side-view like a curved and strong spine, was very conspicuous.

29. *Pedetes saltator*, Gosse.—This, one of the skipping or leaping Rotifers, has usually been obtained from Chipperfield Common Pool, which is particularly rich in specimens of skipping Rotifers. The body, seen in dorsal or in ventral view, was not unlike a bag with the middle of the bottom of the bag pulled out somewhat, and with the mouth of the bag moderately drawn in or constricted. Two red eye-spots, close together, were always seen near the oral end; but the most striking features were the two leaping processes, which were much longer than the body and extended from the anterior part of its ventral surface. By the rapid movement of these processes the Rotifer was suddenly propelled across the field of view, or sometimes quite out of it; at other times it swam leisurely along, at the same time turning about its long axis.

30. *Rotifer tardus*, Ehren.—This Rotifer is easily identified. The swollen segments of its body, its ungainly shape, rendered dirty-looking by mud and other foreign matter adhering to its sticky surface, and its clumsy movements are alone almost sufficient to distinguish it from other bdelloids. So far, specimens have been found in Chipperfield Common Pool and in moss from Shire Lane, near Hastoe. On September 15th, 1913, a specimen was obtained from Chipperfield Common Pool by dredging at the bottom near the end of the plank walk. This specimen was so thickly covered with foreign matter that the longitudinal ribbing, which is a marked feature of the species, was not at all clearly seen; on the other hand, its dorsal antenna, its thick foot passing into its body without any sign of an abrupt juncture, and its rather stout and long rostrum were conspicuous. On this rostrum were the eye-spots; at first sight these seemed to be elongated single spots, but closer examination showed that each consisted of two separate spots. On October 16th, 1913, a specimen of *R. tardus* was obtained from the damp and luxuriant growth of moss in the ditch on the Bucks side of Shire Lane, near Hastoe. The more central parts of the specimen were brown and the extremities colourless; and, although there was a quantity of foreign matter on its sticky surface, its longitudinal ribbing was well shown. The eye-spots were not so well seen as those of the specimen from Chipperfield Common Pool, nor did they seem to be made up of separate small ones.

Except when these specimens of *R. tardus* expanded their wheels and frontal column and swam about, their movements were quite sluggish and clumsy.

31. *Rhinops vitrea*, Hudson. — This is another Rotifer of ungainly form. Several specimens of the species were obtained from Bedmond Pool on April 11th, 1914, and from Hastoe Pool on May 26th, 1914. When seen in dorsal or in ventral view, they presented a symmetrical form, with the dorsal proboscis widening out into the " shoulders " of the Rotifer, and the rest of the animal narrowing gradually and passing without an apparent break into the short conical and flabby foot which, as well as the peripheral parts of the body of the Rotifer, was of hyaline transparency. The foot, indistinctly jointed, carried

two small toes, which were never seen separated. When seen in side view, the Rotifer was very unsymmetrical, mainly because of the dorsal position of the forwardly extending proboscis. Two bright red eye-spots near the end of the proboscis were very conspicuous objects.

The movements of these Rotifers were usually clumsy. Sometimes they swam forwards moderately quickly, occasionally turning and doubling, but more frequently they remained anchored to the slide, at the same time twisting and turning into all kinds of irregular forms. This was especially noticeable when the lateral parts of the corona—called above "the shoulders"—were drawn towards each other, a movement considered to be due to the efforts of the Rotifer to swallow an unusually large food particle.

32. *Diglena biraphis*, Gosse.—On September 18th, 1913, a few specimens of this Rotifer were taken from Parsonage Farm Pool, Abbot's Langley. The water in the pool was low, and had a pungent smell due to the presence of a large quantity of decomposing vegetable matter. The Rotifers had an elongated body, somewhat spindle-shaped in dorsal view, and a retractile oral part with two eye-spots close together and near the oral end. During examination of the water of the sample bottles under the microscope, they were the first forms of life to attract attention, on account of the large amount of green food-material filling the exceptionally large alimentary canal. The oral parts of the Rotifers were repeatedly protruded and retracted, but during these movements I did not obtain a clear view of the curved pincers of the mastax. The foot was short, stout, and quite flexible, but was never seen more than partially retracted; it carried two long toes of nearly equal width throughout, which were often seen crossed over each other. Their movements were of a simple kind, and usually consisted in swimming forwards. The total length of the Rotifers was about $\frac{1}{100}$-in. Two specimens of the same species were obtained from Hastoe Pool on May 26th, 1914. They were found in the muddy sediment which remained after the clear water had been poured from the collecting bottle. These specimens swam forwards rather slowly, but were not seen to cross their toes; in other respects, they behaved exactly like the specimens from Abbot's Langley.

33. *Mastigocerca bicornis*, Ehren.—Three specimens of this elegant Rattulid were obtained from Chesham Road Pool on May 26th, 1914. Their oral spines, from which the specific name is derived, were very conspicuous—one a long, curved, and strong spine, and the other close to it and short. In form, the body was a long, truncated ellipsoid, for the most part of a uniform light brown, presenting a pretty contrast to the ruby-red eye-spot near the oral end. The toe, about two-thirds as long as the body, including the long oral spine, was curved slightly, and, like the toes of Rattulids generally, was like a needle or awl. The total length of one of the specimens was $\frac{1}{50}$-in. Occasionally, they burrowed through the vegetable matter on the slide, but at other times their movements were graceful, swimming forwards slowly and turning over and swaying their toes quite leisurely.

34. *Floscularia campanulata*, Dobie.—Among the very large number of specimens of Rotifers so far obtained in the country of the Chess and Gade, a few have belonged to the Rhizota. Among these have been some Floscularias from the inner moat at Berkhamsted Castle. On many occasions I have examined collections of water-plants from several localities for the purpose of finding specimens of these beautiful Rotifers, but have been successful on only a few occasions. On July 14th, 1914, a fine specimen of *F. campanulata* was obtained from the aforesaid moat. When expanded, its five broad lobes, one of which was larger than the rest, bearing at and along their curved tips radiating bundles of long setæ, were easily seen, one, two, or more of the lobes being fairly in focus at various times. A single, oval egg of dark colour was close to the upper end of the stem, which was surrounded by the usual hyaline casing, rendered visible by small specks of matter adhering to its outer surface. The cup of the Floscule was a fairly regular bell-shaped body, the middle and lower parts of which were of a light brown colour. By varying the illumination, an eye-spot of bright-red colour was seen in the cervical region of the Rotifer. The length of the Rotifer, when extended, was $\frac{1}{35}$-inch.

35. *Floscularia coronetta*, Cubitt.—On September 30th, 1913, a small Floscule of this species was obtained from the inner moat. It was attached to an angulated part of a leaf of duck-

weed. When disturbed it withdrew itself into its casing, and presented a compact rounded body, the end of which was truncated, the setæ having been neatly gathered together into a compact brush projecting from the centre of the truncated surface. Very soon afterwards the body would slowly expand itself, the pedicel being at the same time straightened, and the brush of setæ would open out into series of tufts projecting from the knobbed ends of the five thin lobes of the corona. These knobbed ends were turned slightly outwards, and the whole corona presented a striking resemblance to a little crown, fully justifying its scientific name. When fully expanded in this way, the Rotifer was a beautiful microscopic object, its beauty being enhanced by the bright contrast of colours, green and yellow, of parts of its body, while all other parts were clear and colourless.

36. *Stephanops lamellaris*, Ehren.—This remarkable Rotifer has been found in Chesham Road Pool and the inner moat of Berkhamsted Castle. On September 30th, 1913, when, like many other pools in the district, Chesham Road Pool was very low, a few specimens were obtained. One of these is represented in fig. 18. The specimens from the moat were numerous, and were taken near the outlet at its south-eastern corner on July 14th, 1914.

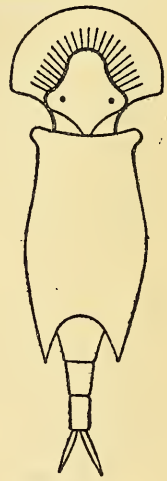

Fig. 18.

These Rotifers often moved about among the small quantity of starwort and duckweed on the slide, and only occasionally swam freely; at other times they anchored themselves to the slide, when they twisted and turned in a manner quite ungainly, showing the dorsal spines on the lorica, and the spine on the last joint of the foot. The most striking feature, however, was the conoidal head fringed by cilia and surmounted by a beautiful halo-like shield. The two bright red eye-spots, although quite small, were clearly seen, one in each corner of the base of the conoidal head. During the varied movements of the Rotifers the neck was seen to be quite flexible, and the foot was not only flexible but seemed to be of a flabby nature.

37. *Euchlanis triquetra*, Ehren.—Four specimens of this

Rotifer were obtained from Chesham Road Pool on May 26th, 1914. They were very prone to burrow amongst the organic and other matter on the slide, but often swam about energetically and turned into all possible positions so as to show the peculiar form of the lorica. This was somewhat oval in dorsal or in ventral view, with a notch at the anterior and another at the posterior end. From this notch extended a jointed foot having a wavy outline and carrying two blade-like toes. The two setæ of the foot were not seen. In end view the lorica was not unlike a beech nut, and, as the illumination was varied, the "wings" of the lorica and its upstanding dorsal ridge or plate were seen to be brilliantly transparent and clear.

38. *Proales parasita*, Ehren.—This Rotifer is particularly interesting because it is usually found within *Volvox globator*, the well-known alga, which is one of the most beautiful microscopic objects known. Compared with its host, the Rotifer is a dull and unattractive form of life. It is very readily detected within the particular specimen of Volvox in which it happens to reside, its slightly bent cylindrical body of a dull coloration, usually relieved only by a little green patch of food material and a bright red eye-spot, being in marked contrast to the almost perfect geometrical symmetry and the brilliant colouring of its host.

On only two occasions have I succeeded in finding specimens of *P. parasita* in the country of the Chess and Gade, although a very large number of specimens of Volvox have been examined from numerous localities, especially the pools of Bedmond, Berkhamsted Common, Chesham Road, Cholesbury Common, and Hastoe.

The largest number of specimens of Volvox so far seen was in water from Bedmond Pool on July 14th, 1914. They were apparently all dead; in fact, excepting a small Cypris, nothing was found alive in the water, which had a decidedly sickly and unpleasant smell. Usually the water in Bedmond Pool is clear and fairly fresh, but on this occasion there was a quantity of oily and evil-smelling material on the lee side of the pool. Many of the specimens of Volox, and there must have been at least a hundred in every cubic millimetre of water, were examined, but not a single specimen of *P. parasita* was detected.

Another occasion on which a large number of specimens of Volvox was examined was on October 3rd, 1913, in water from a small weedy pool near the southern end of Berkhamsted Common, and close to a part of the golf course. Here, also, almost all forms of life were apparently dead; the water was of a purplish colour, and, after inquiry, it seemed probable that worm-killing fluid used on the course had found its way into the pool. However, in one of the specimens of Volvox a *P. parasita* was found. It was alive, but by no means lively, and when set free, by rupturing the Volvox, did no more than extend and contract itself by turns, the anterior parts of its body being decidedly wrinkled at each contraction. On May 26th, 1914, an especially fine specimen of Volvox from Chesham Road Pool was found to contain a specimen of *P. parasita*. Strange to say, the contained Rotifer was sluggish and the Volvox was quite motionless. A few large and vigorous specimens of Volvox have been found occasionally in the collecting bottles from other localities in the district, but no specimen of *P. parasita* was detected.

(To be continued.)

NOTES AND QUERIES.

AVES.

Grey Wagtail breeding in Sussex.—An instance of this came under my notice a short time ago from an unexpected source. Some "Bird and Tree Essays," written for the Society for the Protection of Birds, passed into my hands, one of which was on "The Wagtail." This was the work of a village school-girl in Sussex, whose home is near the west bank of the River Arun. Her description of the Grey Wagtail and also of its nest, which she found last spring with five eggs, was so accurate that there could be no doubt as to the species.—Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

Hooded Crow in Bedfordshire: Effects of the War on Bird Life.—Although the Hooded Crow (*Corvus cornix*) is a fairly common winter visitant to Bedfordshire, it is seldom seen other than solitary or a pair together and scattered more or less generally over the county. During the present autumn immigration they have certainly been far more abundant than usual, and in one instance, on Nov. 8th, I counted no fewer than thirty together on the Sewage Farm at Newnham. Such occurrences may possibly be attributable to the abnormal conditions on the Continent, and it would be of interest to place on record any such observations on bird life from other localities.—J. Steele Elliott (Dowles Manor, Salop).

Courtship Habits of the Great Crested Grebe (Podicipes cristatus).—In his interesting paper on "The Courtship Habits of the Great Crested Grebe" which appeared in the last September issue of the Zoological Society's 'Proceedings,' Professor Julian S. Huxley gives an abstract of my own observations, published in the 'Zoologist,' on the pairing and nesting habits of this species. On this, various comments suggest themselves to me, but perhaps you can allow me space for the following, *viz.*:—

(1) "Selous observed numerous *bouts of shaking*, which he refers to in various ways, &c." (p. 532). I cannot quite endorse this. It would appear that I never saw "shaking bouts" in the sense that

this feature was sufficiently marked to suggest the word to me. I however mention the birds touching each other's bills. "Nebbing" and "billing" are the two English words; but, not liking either of them, I inadvisedly used a French one, thinking it expressed a little more than our "touch." At the least, therefore, this action must have appeared the most important one to me—the central act, so to speak—and adds (I think) another to those recorded in the paper in question. But if this be so, the question arises as to what is its value in the philosophy of the whole—of the shaking bout, that is to say, whether accompanied by this action or not. May it not, as being far more widely extended amongst birds than this very specialised form of nuptial enjoyment, have been the root feature, out of which the latter grew, and at last became overgrown? If so, the case, I think, does not want parallels. The fact that, when I witnessed the equivalent (in this I am inclined to agree with Professor Huxley) of these shaking bouts, it was later in the season, and the birds were satisfying their sexual instincts, through a fuller channel, may have tended to reduce them to something more like what they originally were, before they became thus exaggerated. The question involved is whether the singularities of the courtship habits of the Great Crested Grebe may not be due to various subsidiary causes, not essentially or unmixedly belonging to sexual selection, or else have been evolved *pari passu* with the more ordinary manifestations of this principle, or through a combination of these two factors, in which case they need not represent any essential addition to such a course of procedure as, in many birds, during the love season, seems exactly in accordance with the requirements of the Darwinian theory.* It may, I think, be asked whether "mutual" or "double selection," as between the sexes, constitutes such an addition. Darwin considered the likelihood of this principle obtaining in Nature, and though he concluded against it, yet he evidently regarded it as comprised potentially in his views. His opinion, however, was based rather upon general considerations than actual evidence, of which there was little or none at the time. During a visit to the Shetlands, in 1900, I came to the conclusion that there was some amount of reciprocation, in display and choice amongst birds, and in a chapter of the book† in which

* I have recorded very salient examples of this, in the case of the Redshank, Ruff, and Blackcock, in 'Zoologist,' 1906, pp. 201, 285, and 419; 1907, pp. 60, 161, and 367; 1909, p. 401; 1910, pp. 33, 51, 176, and 248.

† 'The Bird Watcher in the Shetlands.'

my observations to this effect were recorded, headed "Intersexual Selection" (which perhaps is not a good term), I discuss the evidence for this. I did indeed, in the case of the Fulmar Petrel, see something a good deal resembling these shaking bouts of the Grebes, but the development of the habit along æsthetic lines was more than suggested by the way in which the pair opened their bills at each other, thereby displaying a handsomely coloured buccal cavity—which it was equally open to them to conceal. Yet the shaking (or swaying) seemed to be enjoyed for its own sake. Since the Grebes have their crests, as well as the habit of "nebbing," this part of the ceremony may, in either case, represent a bye-product.

(2) "The hen took hold of the dangling end of the weed, which the cock was carrying, and then they 'chasséd, with little waddling steps' from side to side. I think Selous is mistaken; such an action as he describes would be impossible on open water" (p. 532). This is not quite exactly what I say, though my use of the word *chassé* lends itself, almost unavoidably, to such a recollection of my meaning. But the "little waddling steps" were "now forwards, now backwards, but not going more than a few inches either way," and then I continue, "I would say that they *chasséd*—for it had that effect—but the motion was as described, and not from side to side" (Zool., 1901, p. 344). My subsequent observations on the Red-throated Diver (a heavier bird) prove that there is no impossibility in such an action as this on water absolutely open. Consequently there is no reason why I should have been mistaken, and the vivid mental picture which I retain of the birds thus moving will not allow me to think that I was.

(3) "More light is needed on the habit" (of sexual sporting with weed). "It is perhaps connected with the arranging of the weeds on the nest by both birds together" (p. 533). My observations go to show that there is an association of ideas in the minds of various species of birds between the *mandibulation* of materials composing, or proper to compose, the nest, and coition on the nest. The long holding up of an article of mine keeps back some of my most striking evidence in this direction, but I may refer to the last instalment of my Icelandic diary (Zool., 1914, p. 213), to "Wild Life," April, 1914 (p. 212), and also, for examples of such association, in the case of the Great Crested Grebe itself, when the bird is on the nest, and mandibulates the materials of which it is composed, to Zool., 1901 (pp. 342–344).

(4) "The cock of course uses his special platform to rest on, so it

is possible that the pairing-platform is used by the hen as a corresponding resting-place" (p. 538, par. 3). This assumes two special structures besides the nest, but, from my own observations, I cannot yet admit even one, built with a consciousness of its being such. Briefly, the evidence is not yet sufficient to allow us to say with certainty that these platforms are not, by the bird's first intention, nests, either begun and then abandoned, or imperfectly made. Their being put to a subsequent use, along the line of the birds' habits, would not, in itself, prove that they were specially made for this purpose alone. Were it proved, however, as it may be on further evidence, I may point out that "aberrant nests" (as, in their origin, Professor Huxley, like myself, would consider them), now become resting or pairing platforms, very much favour my suggestion as to the possible origin of the so-called "bower," "run," "garden," &c., of the "Bower Birds" (Zool., 1901, pp. 177, 178); "Bird Life Glimpses" (pp. 60–67).—Edmund Selous.

NOTICES OF NEW BOOKS.

Some South Indian Insects and other Animals of Importance Considered especially from an Economic Point of View. By T. Bainbrigge Fletcher, R.N., &c. Government Press, Madras.

In our last issue we called attention to a massive publication on "Indian Forest Insects" by Mr. Stebbing; we have now received the above equally large and handsome volume on a similar subject. The introductory chapters deal with general entomological topics, those on "Means of Defence in Insects" and "Communication amongst Insects" being based on facts and very suggestive, while the author concludes "that the majority of even the most complex of the actions of insects are regulated by instinct, and that cases of reasoning are very rare and confined solely to the most highly-organized of the social insects." The subject of "Control of Insect Pests of Crops" is very exhaustively treated, and agriculturists in Britain may find many hints by studying the processes as used in India. Referring to the well-known Dynastid Beetle, *Oryctes rhinoceros*, Mr. Fletcher reports that it "occasionally bores into sugar-cane stems." It is satisfactory to hear this qualified accusation in S. India; the beetle used to be more destructive some forty-five years ago in the cane-fields of the Malay Peninsula, where a few Malays were employed to search for and cut out the injured canes with their coleopteral enemies. In the Rhynchota many of the smaller species have lately been found to be widely distributed, owing probably to the artificial dispersion of plants. Thus *Pundaluoya simplicia*, Dist., originally described from Ceylon, and here recorded by Mr. Fletcher as found throughout the plains of Southern India, has now also been received from S. Nigeria and the Hawaiian and Seychelles Islands, and probably, despite mistaken identification, from Fiji, Java, and Australia.

This book is excellently illustrated, and will be found indispensable to all students of Indian economic entomology.

The Indian Museum, 1814–1914. Trustees of the Indian Museum, Calcutta.

We are told in the Preface that this volume has been prepared in commemoration of the hundredth anniversary of the foundation of the Asiatic Society's Museum, which subsequently developed into the Indian Museum as it now exists. Sir William Jones founded the Asiatic Society in 1784, but it was not till 1814 that the project of a Museum was actually or efficiently made to be under the Honorary Curatorship of Dr. Wallich. In 1856 a memorial was submitted to the Government of India for the establishment of an Imperial Museum, and in 1862 the proposal was actually taken into consideration with regard to its practical realization, and it was in 1875 that the Museum building, one of the largest in Calcutta, became ready for occupation. In its early days it was organized by Dr. Anderson, assisted by Mr. Wood-Mason, and since then under successive able superintendents it has become the recognized Museum of the Orient.

Some of the most valuable zoological collections have been made by the biological workers of the Marine Survey of India, and the name of the R.I.M.S.S. 'Investigator' has become to biologists as well-known in Indian seas as that of the 'Challenger' over a much wider area. The institution has grown and is still growing, its publications are standard and well-known, while it now publishes more or less regularly its own 'Memoirs' and 'Records.' Of the valuable collections we have not the space to adequately refer to. There is, however, one effort which we think a matter for question, and that is the preservation of "types," of which so much has recently been heard. When these are of a delicate and perishable nature, an Indian climate is not their best environment, and they, when other representatives are obtained, would perhaps be safer and more durable in our British Museum.

EDITORIAL GLEANINGS.

"Taxonomy and Evolution."—Under this title ('American Naturalist,' xlviii., p. 369) an anonymous writer "X" has lately been repeating some truisms as to the method of classifying animals for museum purposes and for reference in bionomical, distributional and even in evolutionary literature. The argument seems somewhat Laboratory *v.* Museum. We quote the following paragraphs:—

"Linnæus bestowing Latin names upon animals and plants was simply tripping gaily across the back of a half-submerged Behemoth and mistaking it for dry land. Now the beast is careering around, and in spite of zoological congresses and international rules nobody quite knows what to do with him. No doubt when some zoological czar arises and issues his fiat a uniform system of nomenclature will be adopted and things will begin to straighten themselves out. This can only be a matter of time—the past cannot be altered. On systematists to-day necessarily devolves the dull, difficult and important duty of going through the descriptive work of the early naturalists and emending it; so that Spallanzani's derisive sobriquet of 'nomenclature naturalists' was a little unjust, even in his time.

"We assume that the principal object of systematic work is to discover the *phylogenetic classification* of animals, for which it is surely necessary that every animal as it passes through the systematist's hands should be, as far as possible, thoroughly examined and described, no dependence being placed upon a few superficial characters usually selected from the external parts? That the systematist should concern himself, as he does, with the external parts, leaving the anatomy to other workers, we consider is as bad for the systematist himself as it is bad for the science; for himself, he is doing work which can only keep his soul alive with difficulty—superficial clerical work which can be 'prompted by no real curiosity and attempts to answer no scientific questions,' and the results of the work itself is often invalidated by the arrival of the destroying angel in the person of the anatomist. For a superficial description often means a wrong classification; whence it follows that any zoogeographical deductions therefrom are invalidated; while a careless description usually ignores the possibilities of variation and shows no evidence of pains having been taken to make identification easy.

"Systematic work, then, is concerned with classification, geographical distribution, variation and identification, and there would be no need for this paper, if it were more generally realized that one thorough examination and description of the whole animal assists those branches of the inquiry more than twenty loose and superficial ones.

"On the other hand, the minor systems—the families, genera and species—the realm of the 'systematist'—too frequently consist of haphazard combination of a few characters selected because of their convenience in not entailing any anatomical work, or selected on account of the ignorance existing of any other—particularly internal—important characters. Ignorance of their morphology has been the main reason for the difficulty in classifying the Coleoptera. Entomologists are especially prone to give their whole attention to what is visible without the aid of dissection. In the Polyzoa the majority of forms are only known by their external appearance and their classification is proportionally unsatisfactory. In the Mollusca reliance is placed on the shell; in mammals the skull and the skin, in birds the plumage, are the articles of faith.

"Single character classification, or diagnosis by one or two characters, as zoological history shows, has proved inadequate—that it is unphilosophical is patent to all.

"Such single character classification even when practised by the great morphologists—men who, being acquainted with the whole of the anatomy of the forms they were classifying, deliberately selected one or two characters after a survey of the whole—was rarely a success. Huxley set out unabashed to classify birds by their palate, and Agassiz fish by their scales—systems which have now shared the fate of most others which set out to erect a classification on the modifications of a single organ alone. Alfred Newton said that there was no part of a bird's organization that by a proper study would not help to settle the great question of its affinities.

"The systematist who deals with the minor subdivisions of the animal kingdom—families and genera—should be as much a morphologist as the one who deals with the larger—the phyla and classes.

"The descriptive papers on Mollusca usually consist of short descriptions of the shells, even written in a dead language. This is conchology. Conchologists confine themselves to the patterns and shapes of shells—Nature's medallions—numismatics! Much of this work—along with similar productions in entomology and carcinology—we regard as positively flagitious.

"The advent of the morphologist into the particular sphere of systematics or the metamorphosis of the systematist into a morphologist (it matters not how we put this desirable event) will result in the annexation not only of classification, but also of questions of geographical distribution, by anatomy and morphology. How many pretty theories in geographical distribution have collapsed because they were built on the sands of an incorrect classification? The similarity between the faunas of South America and Madagascar is supported by many facts, but the value of *Solenodon* in Cuba and *Centetes* in Madagascar has been lessened by the recognition that the two genera resemble each other by convergence, and should now be classified in different families.

"The Dendrobatinæ also are considered by Dr. Gadow as an unnatural group, the two divisions—South American and Mascarene—having, according to him, lost their teeth independently. Again, Dr. Gadow refers to the Ratitæ as a heterogeneous assemblage of birds which is 'absolutely worthless' for the zoogeographer. There are scores of such artificial groupings—the work of the systematist—which have led zoogeographers astray.

"The result is that systematic work as at present pursued is of very little use to us in the study of geographical distribution. It is hopeless nowadays for a zoologist to sit down with a list of species and their range and trusting implicitly in systematic work to make maps of distribution and, as he so often does, to draw deductions therefrom, for the validity of such deductions must ultimately depend upon the anatomical and morphological data. Moreover, the study of geographical distribution is developing new methods of tackling its problems.

"We do not consider it necessary to touch on the other remedies that might be applied with a view to redeeming zoological taxonomy from its present artificial state and to bringing it into line with the rest of biology.

"Such remedies—for instance, testing the validity of species by genetic experiment and the intensive study of variation—have been advocated many times before, although with little success. We believe, however, that the reforms in descriptive zoology we have advocated above are the more urgent."

Most zoologists will agree with the general drift of these criticisms, but we now await, with much interest, the publication of some faunistic paper by "X," showing us how the work should be done.

Mr. J. Drummond, in his weekly contributions, "In touch with Nature," appearing in the 'Lyttelton Times,' has recently written on the New Zealand Merganser (*Mergus australis*), from which the following extracts are taken :—

"Very little is known of the New Zealand Merganser, and those who go down to the Auckland Islands, where this bird lives, would do good service to the Dominion by observing and recording its habits. It is seldom seen in the coastal and open waters around the Auckland Islands, but spends most of its time in the sheltered harbours and the streams and creeks where it obtains its food.

"The southern Merganser has been protected for many years, but even when it might be killed with impunity few specimens found their way into public or private bird collections. The first specimen was taken to Europe by the naturalists on Dumont D'Urville's Antarctic Expedition, which touched at the Auckland Islands nearly seventy-five years ago. The skin they brought back was placed in the Museum of Paris and for many years was the only one known. About thirty years ago Baron Von Hugel bought a pair of skins in Invercargill from a man who had returned from a surveying trip to the Auckland Islands. When the Earl of Ranfurly visited the islands in 1904, he obtained several very beautiful specimens, which now are in the British Museum. There are specimens in the Otago, Canterbury, and Wellington Museums. The Hon. W. Rothschild has three in his famous museum at Tring, England, there is one specimen in the University Museum at Cambridge, and there are two in the Imperial Museum at Vienna.

"Recent reports show that the bird now is rare even in places it delights to haunt. It is some time since news was received of a living specimen having been seen. The Flightless Duck (*Nesonetta aucklandica*) of the Auckland Islands, on the other hand, seems still to be fairly plentiful. This is a true Duck, but its wings are so short that it can fly only a very short distance. There was a belief for many years that it was absolutely flightless, but Captain Bollons, of the 'Tukanekai,' who has had many opportunities of observing these Ducks, states that they can fly to their nests, which are made in holes. These holes, sometimes, are in the face of a cliff, often between fifteen and twenty feet above sea-level. He has seen the Ducks rise from the ground at the foot of a cliff, and, with the use of their wings, go into the holes, a performance which an absolutely flightless bird could not attempt. He has tried to reach the nests with a ladder, but has been unsuccessful. To compensate for the

partial loss of flight, the Auckland Islands Duck has learned to climb very skilfully. Captive specimens in Sir Walter Buller's possession never tried to use their wings, although they had ample opportunity to do so. A male regularly climbed back and forth over a netting wall, going out in the morning and returning to its mate inside the enclosure in the evening.

"Men never regarded the bleak, wind-swept Auckland Islands as a very suitable place of abode. The southern Merganser, consequently, has been given no place in folk-lore, legend, or fairy tale, and, unlike its congener of the Far North, the Goosander, has not entered into the lives of human beings."

'Australian Zoologist.'—We are informed in the last number of 'The Emu' that the first part of the first volume of 'The Australian Zoologist' has appeared. It is issued by the Royal Zoological Society of New South Wales, and edited by Allan R. M'Culloch, Zoologist, Australian Museum, Sydney.

Aviculture in Borneo and Java.—Mynahs (*Eulabes javanensis*) are often kept as pets by natives, and in a Sultan's palace in Java, at Djocjakarta, I saw several kept in cages, and his wives apparently took great interest in them; some had been taught to speak and whistle.—B. B. Williams, 'The Sarawak Museum Journal,' II., p. 97.

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