

believed to have been obtained by the collectors of Herr Bruijn, of Ternate. Wandammen is situated on the western coast of the Bay of Geelvink, near the southern extremity<sup>1</sup>.

Mr. Sclater stated that the only Cassowary of the present form known from this locality was the species shortly indicated by Beccari in his "Lettera Ornitologica" (Ann. Mus. Civ. Genova, vii. p. 717) as *Casuarius tricarunculatus*<sup>2</sup>; but there were no traces whatever of a third wattle in the present specimen.

The form of the casque in the present bird was nearly that of *C. australis*, the summit being elevated high above the head, and much compressed laterally, but forming almost a point at the summit instead of a longitudinal ridge (see fig., p. 213). The wattles were two, one on each side of the median line, closely approximating at their bases, but divided down nearly to their origin, and about three inches in length.

The species, which Mr. Sclater considered to be new to science, must, he said, be placed in the first section of his arrangement as given in P. Z. S. 1875, p. 87, next to *C. galeatus*, from which the form of the helmet distinguished it. From *C. beccarii* of the Arru Islands it might be known by the more completely divided neck-wattles.

The whole length of the body of the bird, from the tip of the casque to the tip of the tail, was about five feet; the tarsus measured 12·5 in., the middle toe 8·5 in. The distance from the commissure of the mandible to the top of the casque was 7·5 in., the distance from the gape to the extremity of the bill 7·5 in.<sup>3</sup>

A communication was read from Mr. F. Day, F.Z.S., containing the following remarks on Mr. Whitmee's paper on the manifestation of fear and anger in Fishes, read at the last meeting.

"At the last meeting of the Society (February 5th), Mr. Whitmee read a paper on the manifestation of fear, anger, &c., by Fishes, observing that a recent author, 'On the Expression of the Emotions,' had entirely omitted allusion to this class of Vertebrates, whilst, as regards anger, he believed that no observations had been recorded. I propose offering a few remarks upon the foregoing, as well as upon some other subjects touched upon by Mr. Whitmee.

"The means of expression in animals adverted to by Mr. Darwin (excluding those of the ears, which would be out of place in fishes) are:—sounds, vocally or otherwise produced; the erection

<sup>1</sup> See the chart of Geelvink Bay in 'Cosmos,' vol. viii. tabb. 3 & 10.

<sup>2</sup> The only known specimen of *C. tricarunculatus* was, as Count T. Salvadori kindly informs me, still living in Ternate in July last, where it was seen by M. Laglaize.

<sup>3</sup> [Since these remarks were made I find that an example of this same Cassowary was exhibited by M. Oustalet at a meeting of the Association Scientifique de France on February 23rd, and the species named *C. salvadorii* (see Bull. Ass. Sc. de France, no. 539, vol. xxi. p. 349). I have therefore withdrawn my name in favour of that of M. Oustalet. I think it probable that the Cassowary from Southern New Guinea, formerly living in the Society's Gardens, which I referred (P. Z. S. 1875, p. 527) with some doubt to *C. beccarii*, is a younger individual of this same species.—P. L. S.]

of dermal appendages under the influence of anger or terror, which last would be analogous to the erection of scales and fin-rays in the class Pisces. Regarding special expressions, as those of joy, pain, astonishment, &c., we could hardly expect to find such so well marked in fishes as in some of the higher animals, in which the play of the features often affords us an insight into their internal emotions. Eyes<sup>1</sup> destitute of movable eyelids, cheeks covered with scales, or the head enveloped in dermal plates, can scarcely mantle into a smile or expand into a broad grin. We possess, however, one very distinct expression in fishes, which is absent or but slightly developed in many<sup>2</sup> of the higher animals—namely, change of colour. All are aware that when a fish sickens its brilliant colours fade, but less so how its colour may be augmented by anger, and a loss of it be occasioned by depression the result of being vanquished by a foe. Some forms also emit sounds when actuated by terror, and perhaps in times of anger; but of this last I possess no decided proofs.

“As regards manifestations of anger, Dr. Cantor makes the following remarks on the *Macropodus pugnax*<sup>3</sup>:—‘When the fish is in a state of quiet, with the fins at rest, the dull colours present nothing remarkable. But if two are brought within sight of each other, or if one sees its own image in a looking-glass, the little creature becomes suddenly excited, the raised fins and the whole body shine with metallic colours of dazzling beauty, while the projected gilt membranes, waving like a black frill round the throat, add something grotesque to the general appearance. In this state it makes repeated darts at its real or reflected antagonist. But both, when taken out of each other’s sight, instantly become quiet. . . . The Siamese are as infatuated with the combats as the Malays are with their cock-fights, and stake considerable sums, and sometimes their own persons and their families. The license of exhibiting fish-fights is farmed, and affords a considerable annual revenue to the King of Siam.’

“The foregoing extract shows anger in fishes demonstrated by change in colour and the erection of the fins and gill-membranes. I will now give an observation respecting the three-spined Stickle-back<sup>4</sup>. After a fight between two examples ‘a strange alteration takes place almost immediately in the defeated party: his gallant bearing forsakes him; his gay colours fade away; he becomes again speckled and ugly; and he hides his disgrace amongst his peaceable companions, who occupy together that part of the tub which their tyrants have not taken possession of; he is, moreover, for some time the constant object of his conqueror’s persecution.’ In fact we here perceive how the disgrace of defeat affects the spirits of the

<sup>1</sup> Couch (Illustrations, &c., p. 305) says, “The faculty of giving forth brilliant light from the eyes, as in a cat, is said to have been observed by fishermen in the Blue Shark.”

<sup>2</sup> Numerous examples of the Saurians are exceptions.

<sup>3</sup> Cantor, Catal. Mal. Fish, 1850, p. 87. Sir J. Bowring, in his account of Siam, p. 155, gives a very similar account of the battles of these fishes.

<sup>4</sup> Couch, ‘British Fishes,’ 1865, vol. iv. p. 172.

vanquished; this reacts on his health, and as a result his brilliant hues fade away. The conqueror, on the other hand, exulting in his victory becomes more resplendent; he does not forget his former triumph, and considers it no disgrace to occasionally lord it over his beaten foe.

"Fear is shown by fish in many ways. 'When hooked or netted they sometimes empty their stomachs by an instinctive act of fear, or to facilitate escape by lightening their load' (Owen, Comp. Anat. i. p. 419). There is not an angler unacquainted with the natural timidity of fishes, nor a keeper in charge of a salmon-pass, who does not know how easy it is for poachers to deter the salmon from venturing along the path raised expressly for his use.

"Amongst the coral-reefs of the Andaman Islands I found the little *Heliastes lepidurus* abundant. As soon as the water was splashed they appeared to retire for safety to the branching coral, where no large fish could follow them; so frightened did they become, that on an Andamanese diving from the side of the boat, they at once sought shelter in the coral, in which they remained until it was removed from the sea. In Burma I observed, in 1869, that when weirs are not allowed to stretch across the rivers (which would impede navigation), the open side as far as the bank, is studded with reeds; these, as the water passes over them, cause vibration, and occasion a curious sound alarming the fishes, which, crossing to the weired side of the river, become captured.

"Under the influence of fear or anger the well-known Climbing Perch of India (*Anabas scandens*) not only erects its spiny-rayed fins and its gill-covers, but also the scales on its body, even down to those along the base of the caudal fin<sup>1</sup>; this to a less extent, perhaps, appears common to spiny-rayed forms.

"Hooker, alluding to Gulls, Terns, Wild Geese and Pelicans in the Ganges valley, observes, 'These birds congregate by the sides of pools and beat the water with violence, so as to scare the fish, which then become an easy prey—a fact which was, I believe, first indicated by Pallas during his residence on the banks of the Caspian Sea'<sup>2</sup>. Fishes, under the influence of terror, dash about with their fins expanded, and often run into places which must destroy them. Thus droves and droves of Sardines in the East, impelled by the terror of pursuing Sharks, Bonitoes, Seir, and other voracious fishes, frequently throw themselves on the shores in enormous quantities. Friar Odoric, who visited Ceylon about 1320, says, 'There are fishes in those seas that come swimming towards the said country in such abundance, that for a great distance into the sea nothing can be seen but the backs of fishes, which, casting themselves on the shore, do suffer men for the space of three daies to come, and to take as many of them as they please, and then they return again into the sea'<sup>3</sup>.

"Fishes frequently show distinct signs of affection. Yarrell ('British Fishes') mentions how a person who had kept two

<sup>1</sup> 'Fishes of Malabar' (1865), p. 133.

<sup>2</sup> Himalayan Journals, vol. i. p. 80.

<sup>3</sup> Hakluyt, vol. ii. p. 37.



small ones together in a glass vessel gave one away; the other refused to eat, and showed evident symptoms of unhappiness until his companion was restored: Pennant, how the River-Bullhead "deposits its spawn in a hole it forms in the gravel, and quits it with great reluctance:" General Hardwicke, how the Gouramy (*Osphromenus olfax*), in the Mauritius, forms a nest amongst the herbage growing in the shallow water in the sides of tanks. Here the parents continue to watch the place with the greatest vigilance, driving away any interloping fish. The amphibious walking fish of Mysore (*Ophiocephalus striatus*) appears to make a nest very similar to that of the Gouramy, and over it the male keeps guard; but should he be killed or captured, the vacant post is filled by his partner (Colonel Puckle). When very young the fishes keep with, and are defended by their parents, but so soon as they are sufficiently strong to capture prey for themselves they are driven away to seek their own subsistence (see 'Fishes of India,' p. 362). But it is not only these monogamous amphibious fishes which show an affection for their eggs and also for their fry, but even the little *Etroplus maculatus* has been observed to be equally fond of its ova. 'The eggs are not very numerous, and are deposited in the mud at the bottom of the stream, and, when hatched, both parents guard their young for many days, vigorously attacking any large fish that passes near them'<sup>1</sup>.

"Although the proceedings of the members of the marine and estuary genus *Arius* and its allies show not quite so distinctly signs of affection, still it must be a well-developed instinct which induces the male to carry about the eggs in his mouth until hatched, and to remove them in this manner when danger is imminent. I have taken the ova just ready for the young to come forth out of the mouth and fauces of the parent (male) fish; and in every example dissected there was no trace of food in the intestinal tract.

"At many temples in India fishes are called to receive food by means of ringing bells or musical sounds. Carew, in Cornwall, is said to have called his Grey Mullet together by making a noise like chopping with a cleaver. Lacépède relates that some fishes, which had been kept in the basins of the Tuileries for more than a century, would come when called by their names, and that, in many parts of Germany, Trout, Carp, and Tench are summoned to their food by the sound of a bell. These instances are doubtless mostly due to the fishes having learnt by experience that on the hearing certain sounds they may expect food. But Lacépède mentions that some were able to distinguish their individual names; and the same occurs in India. Lieutenant Conolly remarked upon seeing numerous fishes coming to the Ghaut at Sidhnath to be fed when called; and on 'expressing our admiration of the size of the fish, "Wait," said a bystander, "until you have seen *Raghu*." The Brahmin called out his name in a peculiar tone of voice; but he would not hear. I threw in handful after handful of ottah (flour) with the same success, and was just leaving the ghaut, despairing and doubting,

<sup>1</sup> Jerdon, 'Madras Journal of Literature and Science,' 1849, p. 143.

when a loud plunge startled me. I thought somebody had jumped off the bastion of the ghaut into the river, but was soon undeceived by the general shout of "Raghu, Raghu," and by the fishes, large and small, darting away in every direction. Raghu made two or three plunges, but was so quick in his motions that I was unable to guess at his species<sup>1</sup>.

"Although I have alluded to an increased brilliancy of colour being caused by anger, and a dull hue occasioned by terror or illness, there appears to be still another cause at work. During the breeding-season some species, such as *Periophthalmus schlosseri*, appear to become more brilliant, especially the males, as I have observed in my report on the freshwater fishes of Burma.

"Pallegoix states that in Siam the Dog's-tongue is a fish shaped like a Sole; it attaches itself to the bottom of boats, and makes a sonorous noise, which is more musical when several are stuck to the same boat and act in concert (vol. i. p. 193). These noises can scarcely be due to anger or fear. Sir J. Bowring (vol. ii. p. 276) also remarks upon having heard this fish, 'which sticks to the bottoms of the boats, and produces a sound something like that of a Jew's harp struck slowly, though sometimes it increases in loudness, so as to resemble the full sound and tones of an organ. My men have pointed me out a fish about four inches long as the author of the music.'

"Some years since, at Madras, I obtained several specimens of a freshwater Siluroid fish (*Macrones vittatus*) which is termed 'the fiddler' in Mysore. I touched one which was on the wet ground, at which it appeared to become very irate, erecting its dorsal fin, making a noise resembling the buzzing of a bee, evidently a sign of anger or terror. Having put some small Carp into an aquarium containing one of these fishes, it rushed at a small example, seized it by the middle of its back, and shook it like a dog killing a rat; at this time its barbels were stiffened out laterally like a cat's whiskers<sup>2</sup>.

"Many fish, when captured, make noises, perhaps due to terror. Thus the *Caranx hippos*, *Tetrodon*, and others grunt like a pig. Darwin (Nat. Journ. vol. vii.) remarks on a *Silurus* found in the Rio Parana, and called the Armado, which is remarkable for a harsh grating noise when caught by hook and line; this noise can be distinctly heard when the fish is beneath the water.

"Aristotle and Ælian were aware of this faculty in some of the fishes of the Mediterranean<sup>3</sup>.

"The Cuckoo-Gurnard (*Trigla pini*) and the Maigre (*Sciæna aquila*) utter sounds when taken out of the water<sup>4</sup>; and Herrings, when the net has been drawn over them, have been observed to do

<sup>1</sup> "Observations on the Past and Present Condition of Onjein," 'Journal of the Asiatic Society of Bengal,' vi. p. 820.

<sup>2</sup> 'Fishes of India,' p. 449.

<sup>3</sup> See 'De Animal.' lib. iv. cap. ix.; Ælian, lib. x. cap. xi.; Pliny, lib. ix. cap. viii. and lib. xi. cap. xviii.; Athenæus, lib. vii. cap. iii. & vi.

<sup>4</sup> Yarrell, 'British Fishes,' i. pp. 44-107.

the same: 'this effect has been attributed to an escape of air from the air-bladder; but no air-bladder has been found in the *Cottus*, which makes a similar noise.'

"The Lesser Weaver buries itself in the loose soil at the bottom of the water, leaving only its head exposed, and awaits its prey. If touched, it strikes upwards or sideways; and Pennant says it directs its blows with as much judgment as a fighting-cock (Yarrell, vol. i. p. 26). Fishermen assert that wounds from its anterior dorsal spines are more venomous than those caused by the spines on its gill-covers.

"As regards fighting, I should suppose that, unless some portion of the body is peculiarly adapted for this purpose, as the rostrum of the Sword-fish, or the spine on the side of the tail in the Lancet-fishes, we must chiefly look to the armature or covering of the jaws for weapons of offence.

"And this naturally leads us on to ask if, as suggested by Mr. Whitmee, 'the chief purpose served by fishes' spines is protection against the attacks of those of the class which are carnivorous.' The first inquiry is, Do the carnivorous forms most abound amongst *Acanthopterygians* or *Malacopterygians*? The spiny-rayed forms (speaking as a whole) have the teething far better developed than the soft-rayed Carps of the fresh waters, or the Herrings of the sea, the former (spiny-rayed forms) being the most carnivorous, the latter (or soft-rayed fish) being preyed upon by the former, and by the *Elasmobranchii*.

"I observed<sup>1</sup>, 'It may not be amiss to point out that the Acanthopterygian or spiny-rayed fishes appear to be most numerous in the ocean (preying upon their articulated-rayed neighbours, the Clupeidæ, &c.); but as we examine waters more inland, the Salmonidæ or Cyprinidæ usurp their place, these latter not being possessed of spinate, but merely articulated rays. A maritime residence appears most adapted for the Acanthopterygian or spiny-rayed fishes, a fresh-water inland one to the Malacopterygians or spineless forms.'

"Spinate dorsal and anal fins being much more frequent in the carnivorous and voracious forms than in their weaker neighbours leads me to suppose that they must have some other function than protection of the fish from its enemies. One of these is probably to guard the fin-membrane from injury, for which purpose spines are much better adapted than rays in fast-swimming species. One has only to witness how commonly the spineless anal fins of Clupeoids and Siluroids are found injured in the tropics, to feel sure that much of this is owing to the absence of spinate protection. We do not see the same injury existing to any thing like a similar extent in Teleosteans whose fins are armed with strong spines; but in the intermediate forms, as the first dorsals of Sier-fishes (*Cybius*), the weak spines of the fins are frequently injured.

"Mr. Whitmee remarked that in serious attacks fish 'always turned suddenly round and lashed at one another with the caudal fin;' and he continued that he believed *serious fighting is always*

<sup>1</sup> 'Journal of the Linnean Society, Zoology,' vol. xiii. p. 111.



*done with the tail.* Here I am unable to concur. Fish, the same as other animals, when they commence to fight, employ that portion of the body most suited to such a purpose. Thus the Perch will employ his teeth, the Sword-fish his elongated snout, the Lancet-fish the spine at the side of its tail, the Siluroid may use his dorsal or pectoral spine. Instances of all these modes of attack may be referred to.

"Continuing Couch's illustration of the Stickleback, he observes, 'The bite of these little furies is so severe that I have frequently known it, when inflicted on the tail, produce mortification and, consequently, death. They also use their lateral spines (ventral fins) with such fatal effect that, incredible as it may appear, I have seen one during a battle absolutely rip his opponent quite open, so that he sank to the bottom and died.'

"That the Sword-fish employs his sword-like projection for this purpose is well known; frequent examples occur of his driving that formidable weapon into ships, whilst, according to Swainson, he is very fierce, and attacks a Whale whenever he encounters one; other observers, however, represent the Sword-fish as gentle and inoffensive except to Whales.

"The Lancet-fish as it swims past its enemy tears up an open wound.

"As regards the Siluroids we have more than one mode of attack; but I do not know of any Siluroid that employs its tail for this purpose. In one of the Siluroids of the Ohio 'the first ray of the dorsal is formed of a very strong, sharp spine, which the animal uses to kill others of a smaller size; for this purpose it gets beneath the fish it intends to attack, and then, suddenly rising, wounds it repeatedly in the belly.'

"Mr. Whitmee supposes that most carnivorous fish capture their prey by outswimming them; but to this there are numerous exceptions. The Angler, or Fishing Frog (*Lophius piscatorius*), 'while crouching close to the ground, by the action of its ventral and pectoral fins, stirs up the sand and mud; hidden by the obscurity thus produced, it elevates its appendages (situated on the upper surface of the head), moves them in various directions by way of attraction as a bait, and the small fishes approaching either to examine or to seize them, immediately become the prey of the Fisher' (Yarrell). In India we find a freshwater Siluroid (*Chacalophioides*) which 'conceals itself among the mud, from which, by its lurid appearance, and a number of loose filamentous substances on its skin, it is scarcely distinguishable; and with an immense open mouth it is ready to seize any small prey that is passing along' (Ham. Buchanan). In March 1868 I obtained a fine example of *Ichthyscopus inermis* ('Fishes of India' p. 261), which I placed in water having a bed of mud: into this it rapidly worked itself, first depressing one side and then the other, until only the top of its head and mouth remained above the mud, whilst a constant current was kept up through its gills. It made a noise, half snapping and half croaking, when removed from its native element. This sound I consider most probably due to fear. Some fish, in

short, invariably seize their prey with their mouths, and that without calling the caudal fin into play. In fact, a stroke with the tail appears sometimes to denote contempt in fishes; it is not rare that anglers find fishes sometimes swim up to their bait, which they not only refuse, but, giving it a lash with their tail, decline to rise any more. This may, however, be a symptom of curiosity, which is largely developed in the finny tribe.

"I might multiply instances from many authors, but consider those adverted to are sufficient to show that various ichthyologists have remarked upon the emotions of anger and terror in fishes being shown by the erection of their dermal appendages and gill-covers, as well as by changes of colour, whilst terror induces some species to emit sounds that are not commonly perceived; that fishes sometimes show affection for their partners in captivity, mourning their removal; that they may be tamed sufficiently to come to a recognized sound, even to individual names that have been bestowed upon them; and that some species have an instinctive affection for their eggs and young, which they guard against intruders with the greatest determination.

"At the present time, in the Royal Westminster Aquarium, is a live example of the Electric Eel (*Gymnotus electricus*) which has in its electric organs the means of showing when it is affected by anger or terror. Some consider this curious property is for protection against Alligators; it is certainly used against fishes for the purpose of obtaining food; but when we remember how, when the Indians drive in horses and mules to the waters infested by the Eels, they immediately attack them, we must admit that such cannot be for the purpose of preying upon them, but is due to anger or terror at being disturbed."

Mr. Whitmee being unable to attend, the Secretary read the subjoined reply to Mr. Day's remarks.

"By the courtesy of the Secretary I have seen Mr. Day's comments on my paper. As I cannot attend the meeting to-morrow evening, I crave the liberty of presenting two or three written observations.

"1. My paper was written in Samoa in 1875; and my position there, of course, prevented me from having access to the whole literature of this subject. I was aware of the conduct of the Stickleback in guarding its nest, and also of similar conduct in some other fishes. But my object was to show, in opposition to a view quoted, that fishes, as a class, manifest as much feeling as most other animals. In stating that I had not met with observations showing this, I did so as an excuse for presenting a paper which I feared possessed little intrinsic value. I am glad the paper has led Mr. Day to bring forward so much evidence in confirmation of the view I advocated.

"2. Mr. Day gives a more general application than I intended to my observations about the mode of fighting with the tail. I stated an observed fact, viz. that certain fishes in my aquarium, when fighting, lashed at each other with their tails. From this I inferred