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XXIII.—Natural History notes from H.M. Indian Marine survey steamer 'Investigator,' Lieut. Gordon S. Gunn, R. N., commanding.—Series II., No. 6. A case of commensalism between a Gymnoblastic Anthomedusoid (Stylactis minoi) and a Scorpœnoid fish (Minous inermis)

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XXIII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Lieut. Gordon S. Gunn, R.N., commanding.*—Series II., No. 6. *A case of Commensalism between a Gymnoblastic Anthomedusoid* (Stylactis minoi) *and a Scorpœnoid Fish* (Minous inermis). By A. ALCOCK, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

CONTENTS.

§ 1. *Introductory: some Illustrations of Symbiosis already reported from among the Gymnoblastic Hydroida.*

MANY observers have remarked upon the existence of life-associations between Gymnoblastic Hydrozoa and other animals. Such associations may be classed as (1) accidental, (2) commensal, and (3) parasitic; and though it is not easy always to be sure into which of these classes any given case shall fall, yet for the purposes of this paper it will be convenient to consider the three classes separately.

What may be regarded as instances of accidental association are too numerous to mention. Such most probably are many of those related or quoted by Professor Allman in his beautiful monograph on the Gymnoblastic Hydroids; of *Antigonium pusillum* found by Professor Van Beneden attached to crabs (and to various other bodies); of *Dicoryne conferta* investing shells of various Gastropod mollusks; of *Perigonimus muscoides*, *P. repens*, *P. palliatus*, and *P. linearis*, all occasionally found on tests of ascidians, on crustaceans, and on shells of living mollusks; of *Eudendrium capillare*, sometimes found upon ascidians; of *Hydractinia echinata* and *H. polyclina*, sometimes attached to hermit-crabs; and of *Ectopleura Dumortieri* found on crabs and on *Flustra* among other objects. Accidental, probably, too are the attachments noted by Professor Van Beneden in his "Animal Parasites and Messmates" of a *Tubularia* to a Cephalopod (observed by Gwyn Jeffreys) and of a *Tubularia* sometimes growing on a living sponge.

There seems, however, to be something more than a mere chance association in the cases recorded by Professor Allman of *Corynitis Agassizii* found by M'Grady growing only on

sponges, and of *Hydranthea margarica* found by the Rev. T. Hincks only on *Flustra*. Even the cases of *Lar sabellarum*, found by Gosse, as reported by Allman, only on the tubes of *Sabella*, and of *Stylactis vermicola* found by the 'Challenger' only upon a bathybial annelid (Allman, 'Challenger' Hydroida, part ii. p. 2, pl. i. fig. 2), may come under the head of accidental association, though they far more probably are examples of a definitely established symbiosis.

Among the best of the cases of undoubted commensalism, in which one of the associates is a Gymnoblastic Hydroid, are those discovered by Professor Hæckel ('Challenger' Deep-sea Keratosa, pp. 75–81, pl. ii. figs. 5, 6, and 7, pl. iv. fig. 4), of *Stylactis* (*Stylactella*) *spongicola* and *abyssicola*, and *Eudendrium*? sp., always found symbiotic with certain deep-sea horny sponges. Here the ramifying hydrorhiza of the polyp, which is greatly developed, affords by its chitinous perisarc a solid supporting framework for the sponge, and determines the form of the latter. The trophosome, on the other hand, is represented by significantly small hydranths.

Another instance of mutual relations almost as intimate is that reported by Korotneff (Zeitschr. für wiss. Zool. Bd. xlv. p. 486, Taf. xxiii. figs. 18–22), of a *Tubularia* (*T. parasitica*) living with a *Gorgonia*, the latter having no axis of its own, but using the stem of the *Tubularia* for a support.

Professor Allman, in his beautiful Monograph, quotes several cases that can hardly be regarded but as exemplifying definite associations for mutual benefit. He himself found *Perigonimus minutus* entirely confined to the living shells of a gastropod mollusk (*Turritella communis*), the polyp-colonies forming a fringe round the operculum of the mollusk in all of about thirty shells dredged. He also quotes the records of other observers, of which the two most remarkable are that of Canon Norman (of *Merona cornucopiæ* found only on living shells of *Astarte sulcata* and *Dentalium entalis* from 80 to 100 fathoms) and that of Professor Gegenbaur (of *Campaniclava cleodoræ* confined to living shells of the pelagic *Cleodora tricuspidata* in thirty-two out of forty specimens of the latter examined).

In cases where a hydroid allies itself with a locomotive animal the advantages that the polyps derive from the partnership are very clear; for, as previous observers have pointed out, the polyps, instead of being entirely dependent on chance movements of the sea for uncertain supplies of food and air (as when attached to fixed objects), or for uncertain driftings towards food (as when attached to floating bodies), are rapidly

conveyed from one certain feeding-ground to another by intelligent and deeply self-interested agents. The locomotive agents on their part may be supposed to benefit either by the concealment or protection that a coat of urticating polyps affords, or by the disguise, that it facilitates in the search for prey.

Well-known cases of Hydroida undoubtedly parasitic—not here to refer to *Cunina*, as only the Gymnoblastic Hydrozoa are under consideration—are those of *Polypodium hydriforme*, Ussow, parasitic in the eggs of the sterlet fish, and of *Hydrichthys mirus*, Fewkes, parasitic on the Carangoid fish *Seriola zonata*, Cuv.

Polypodium hydriforme (Ussow, "A new Form of Fresh-water Cœlenterate," Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 110, pl. iv., translated by W. S. Dallas from Morphol. Jahrb. Bd. xii.) begins its existence as a vermiform body within the ovarian eggs of a species of sturgeon. Upon this vermiform body primary and secondary buds appear which, after five or six months of parasitic life, when the sterlet's eggs escape from the ovary into the water, give rise to thirty-two hydriform organisms that live free in the Volga.

The case of *Hydrichthys mirus* parasitic on *Seriola zonata* is reported by Fewkes (Proc. Boston Nat. Hist. Soc. vol. xxiii.; Bull. Mus. Comp. Zool. vol. xiii. p. 224, pls. iv. and v.; Ann. & Mag. Nat. Hist. ser. 6, vol. i. p. 362; 'Nature,' vol. xxxvi. p. 604). The *Hydrichthys* colony, which consists of botroidal gonosomes and filiform bodies (hydranths?), is attached to its fish host by a basal plate with ramifying tubes.

The filiform bodies, which are regarded as degenerate hydranths, are destitute of tentacles, and the absence of tentacles is believed to be the obverse expression of the fact that the hydranths cannot catch food for themselves, and so draw upon the fish as parasites.

Mention must also be made of *Corydendrium parasiticum*, Cavolini, supposed by Cavolini, as quoted in Professor Allman's monograph, to be a parasite living at the expense of another Gymnoblastic Hydroid—*Eudendrium racemosum*. But the parasitism here is doubtful.

In the present paper I have to record a case of symbiosis between a fixed gymnoblastic Hydroid (a species of *Stylactis*) and a high locomotive animal (a fish of the genus *Minous*), in which it appears to me that the association is neither accidental

nor parasitic. It seems indeed on better grounds than those of mere exclusion to be a very complete and unequivocal instance of commensalism—complete because the reciprocal benefits appear to be very clearly defined, and unequivocal because it has been observed three times in places widely distant from one another.

§ 2. *An Account of a Species of* Stylactis *always found associated with a* Minous.

On March 26th, 1889, there were trawled from 70 fathoms off the Godávari Delta, on the Coromandel coast, on a bottom of river-borne mud, two specimens of a small fish of the Scorpænoid genus *Minous*, one of which was covered with a fleshy colony of small polyps, which I then thought to be a species of *Podocoryne*. The fish was described in the 'Journal of the Asiatic Society of Bengal,' pt. ii. of vol. lviii. for 1889, as *Minous inermis*, sp. n.

There occurred in the trawl at the same time ten specimens of the Leucosine crab *Parilia Alcocki*, W.-M.; five specimens of the Portunid crab *Goniosoma hoplites*, W.-M., var.; many specimens of the Penæid *Solenocera Hextii*, W.-M.; and about two dozen specimens of the gastropod mollusk *Rostellaria delicatula*, Nevill.

The fleshy polyp found on *Minous inermis* was not present on any of these; and although most of the specimens of *Parilia* were a good deal incrusted with foreign growths, the only gymnoblastic Hydroid found on any of them was a *Perigonimus* very closely related to, if not identical with, *Perigonimus vestitus*, Allman.

Minous inermis was not again met with until November 4, 1891, when in a trawl hauled in 45 fathoms off the Malabar coast, on a bottom of sand mixed with a shingle of broken shells and echinoderm tests, nine specimens were taken, of which all but one were thickly beset, especially round the gill-opening and on the throat and in the axilla, with the same fleshy colonies of the same polyp as was found incrusting the type specimen of 1889. The haul was a big and varied one, including among fishes similar in habitat to *Minous inermis* (ground lovers), *Minous coccineus*, *Pterois brachyptera*, Cuv. & Val., *Uranoscopus crassiceps*, *Champsodon vorax*, Gthr., and two species of *Platycephalus*; among ground-living Crustacea several species of Leucosine crabs and two species of Raninoids; and several hundred living specimens of six species of gastropod mollusks.

On not one of these was the polyp of *Minous inermis* seen though upon some specimens of a *Leucosia* crab I have since found, in a condition too bad for accurate determination, colonies of a Hydroid with a conspicuous perisarc continued up to the tentacles, and with pedunculated sporosacs (?), that may be a *Bimeria*, or a *Garveia*, or perhaps *Eudendrium vestitum*, Allman.

Minous inermis was found a third time in a small but valuable collection of fishes presented to the Indian Museum by Mr. H. I. Row, a gentleman who has lately been attracted to the still but little appreciated Indian sea-fisheries. In January of this year Mr. Row dredged a single specimen, in about 70 fathoms of water, somewhere between the delta of the Ganges and that of the Máhánaddi, and along with it numerous specimens of *Minous coccineus*, *Lophius indicus*, *Trigla hemisticta*, Schleg., *Lepidotrigla spiloptera*, Gthr., and *Læops Guentheri*, all of which undoubtedly share the habitat of *Minous inermis*. Now, though no epizoon of any sort can be found upon any of these fishes last named, yet the single specimen of *Minous inermis* is coated with the same fleshy polyp-colonies as were found upon this fish on the two previous occasions of its capture.

It may be stated in anticipation that in the January specimen the reproductive elements of the colony are particularly well and extensively developed, and that there is now good evidence that the Hydroid is not *Podocoryne*, as was supposed at first, but a *Stylactis* of a species that seems to be undescribed. In the sequel it is described as *Stylactis minoi*.

From the foregoing accounts it will, I think, be admitted that we have proved the existence of a definite symbiosis between the polyp and the fish. Accident will hardly account for the facts, (1) that we never find the *Minous* without the *Stylactis* or the *Stylactis* without the *Minous*; (2) that in two instances where two species of the genus occur together the polyp selects *Minous inermis*; and (3) that the association holds good for the northern half of the Bay of Bengal, for the southern half of the Bay of Bengal, and for the Laccadive or Malabar Sea.

The next question to be decided is, Is the symbiosis parasitic or commensal?

On general principles it is hardly justifiable to infer that an animal is a parasite unless it presents some evidences of degeneration, at any rate of some of the organs of nutrition. *Stylactis minoi*, however, is fully equipped for self-maintenance, the nutritive hydranths having a prominent hypo-

stome, a mouth capable of complete eversion, and long and very numerous tentacles. But beyond negative inference we have positive grounds for believing, not that the polyps live on the fish, but that the polyp-colony aids the fish quite as much as the fish aids the polyp-colony in a common competition for food.

The value of the association to the polyps has already, in the introduction, been suggested, and it only remains to state that their usual position upon the throat and round the gill-opening of the fish seems particularly to enhance the value of the alliance.

The following considerations lead to the belief that an equivalent benefit is enjoyed by the fish. Many of the Scorpænidæ—especially *Scorpæna*, *Pterois*, *Synancidium*, and *Pelor*, and to a limited degree *Minous*—have the body and fins capriciously covered with long, wavy, often tufted cutaneous filaments; and no one who has watched such a fish as *Pterois volitans* in a reef-pool can doubt that these filaments serve what Mr. E. B. Poulton, in his book on 'The Colours of Animals,' calls a "special anticryptic" purpose. That is to say, they assist in giving the fish a deceitful resemblance to the incrusted rocks of its environment, in order to allure, or at any rate not to scare, prey. And it appears probable that *Stylactis minoi* enables its companion, *Minous inermis*, in the very same way to assume the same convenient and successful disguise.

§ 3. *Description of the* Stylactis.

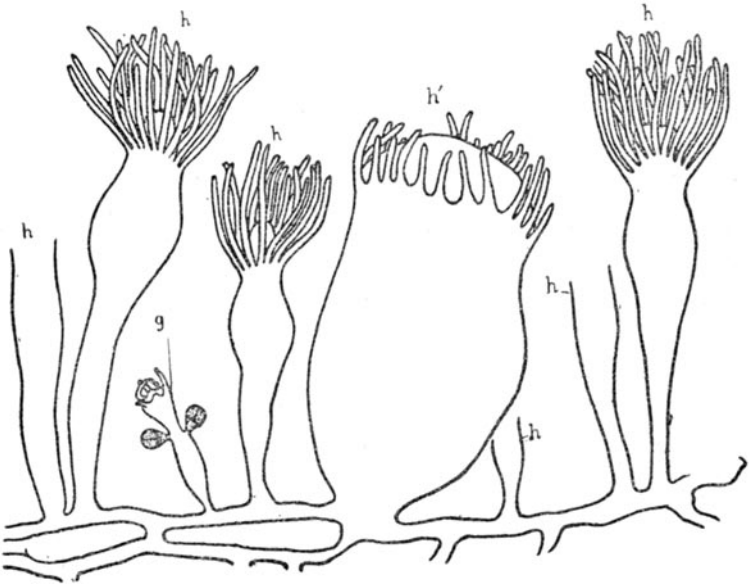
Stylactis, Allman.

Stylactis, Allman, Monograph of the Gymnoblastic Hydroids, pt. ii., 1872, p. 302.

Stylactis minoi, sp. n.

The polyps, which are of two forms, sterile and proliferous, are all sessile upon a hydrorhiza that consists of a network of close-set ramifying and anastomosing tubes bounded by a flexible, extremely delicate, pellicular perisarc. The sterile polyps are of an elegant caryophyllaceous shape, and terminate in a conical hypostome, the base of which is encircled by a single crowded series of long filiform tentacles, to the number of twenty to twenty-four. In every colony a few large urn-shaped polyps are seen with broadened hypostome and more or less shortened tentacles; they appear to be merely sterile forms gorged with food. The average length

of the sterile polyps is about 2 millim. The proliferous polyps are very much smaller than the others, being on an average hardly one third of their length; they further differ in possessing but few—at most six—tentacles, and those short, slender, and fragile. Near the middle of their body they are



A small portion of a colony of *Stylactis minoi* detached from its fish commensal, × 42. *h*, ordinary nutritive hydranths, some of which are not completely represented; *h'*, a nutritive hydranth gorged with food; *g*, a single proliferous person with two sporosacs.

much constricted, and here either two or three closed grape-stone-shaped sporosacs arise on very short peduncles. The proliferous polyps are very numerous in the specimens obtained in January, very few in those obtained in November, and apparently absent in those obtained in March.

§ 4. *Note on* Minous inermis, *Alcock*.

This small Scorpænoid fish was described and figured in J. A. S. B. vol. lviii. pt. ii., 1889, p. 299, pl. xxii. fig. 4. It differs from the other Indian species of the genus in having a thinner skin and in having the fin-spines and other spiny armature of the head (which are usually conspicuously well developed in Scorpænoid fishes) feeble.

It appears more than probable that this lack of defensive armature stands in some sort of direct relation with the presence of the polyps, for the latter would disguise the fish from its enemies no less than from its prey.

In conclusion I have to thank my friend Professor Wood-Mason for much friendly criticism and for directions to likely sources of information in zoological literature.

XXIV.—*Descriptions of Two new Bornean Squirrels.*

By Oldfield Thomas.

The extraordinary richness of the Bornean fauna in squirrels is again exemplified by the discovery of the two following new species sent home from North Borneo, the one by Mr. Everett and the other by Mr. C. Hose, both collectors well known for their many contributions to the fauna of the island.

Of the first species two specimens were obtained in 1880 in Sandakan by the late Mr. W. B. Pryer; but as neither was quite perfect, I have not previously described them. Now, however, that Mr. Everett has sent home a perfect specimen of the same form, I take the opportunity of describing it. It may be named, in honour of its original discoverer,

Sciurus Pryeri, sp. n.

Strongly resembling *Sciurus hippurus*, Geoff., in general appearance, although slightly smaller and more slenderly built, and agreeing precisely with that animal in the grizzled yellow colour of the back and the grey of the head and fore quarters, and their relative distributions on the anterior part of the body, but distinguished, firstly, by its wholly white instead of rich rufous belly; secondly, by its hips being yellowish like the back, instead of grey like the head; thirdly, by its feet being grizzled grey instead of black; and, finally, by its tail-hairs being broadly and conspicuously annulated with black and white, with white tips, instead of being wholly black. Premolars $\frac{2}{1}$; incisors orange-yellow, not darker above than below.

Dimensions of the type (an adult male in skin):—Head and body 260 millim.; tail 250; hind foot 54.

Hab. Of the type (B. M. 92. 7. 19. 1), Sapugaia River,