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PAPERS READ.

On the Habits of some Australian Echini.

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In 1877 I published in the Proceedings of this Society a list of the Australian *Echini* known to me. I was not able at that time to add very much about their habits, a defect which in the present paper I propose to remedy to some extent. It may be remarked that not much is known about the habits of most of the species. In the elaborate work of Agassiz on the *Echini* there is a chapter on their habits, but it is very short. What it says may be summarized in a few words. It states that they are gregarious, that some live on the sand, that others bury themselves in cavities of the rocks which they scoop out for themselves, and that a few adhere to the rocks by their powerful suckers. Very little more is added, but probably because facts of a more detailed kind did not come within the scope of the work. I find also on looking through the works of the greatest modern writers on *Echini*, such as Lovén, Verril, Desor, Dujardin, and Hupe, that little is said about the habits of the living species. I regret that I am not able to add very much myself, and my facts will only have reference to the most of our own species, but still I am in hopes that before long I shall be able to add much more. The dredge has been so little used on the Australian coast that a great many of the species whose habitat is far from the land are only known from specimens which have been cast up upon the sea-beach. This is especially the case with *Phyllacanthus annulifera*. *P. dubia*, lives on a sandy bottom at a depth of from six to ten fathoms. Its food or its mode of life are unknown. As far as I know, it prefers tranquil sandy bays and partially enclosed waters. It seems to be very common all round the Australian coast. In Port

Jackson it is very common; Mr. Ramsay dredged up specimens of all ages and sizes from off the sandy bottom. It is equally common in Moreton Bay, and a good number of specimens have been brought down from Port Darwin in North Australia. I cannot notice any difference between the specimens brought from these widely separated localities. Like all the species of *Echini* it is gregarious, and the "flocks" are confined to localities which are often far apart. In a former paper I have given the reasons which induce me to separate *P. dubia* from *P. parvispina* nobis, a species distinguished especially by its more numerous and comparatively smaller spines.

Goniocidaris is a form which has two representatives in Australia Yet very little of its habits is known. The common species is *G. tubaria*, Lamarck. It is occasionally washed up on the beach after storms, and is often covered with *Bryozoa*. It would appear as if it loved sandy situations, and from the fact the specimens come ashore singly we may suppose that it is not gregarious.

Diadema setosum, Gray, is a species that has a very wide range. It is very common on many of the Pacific Islands and in the Indian Archipelago. I have seen specimens from Java. It is common all along the Barrier Reef and on the islands within it. I have always found it in rocky pools at the side of the pillars of dead coral which go by the name of "Nigger Heads." Its delicate spines are so long, slender, and brittle, that I should imagine it must always keep on soft sandy places. But it may be found sometimes adhering by its suckers to the rock under a ledge where there is a wide sweep for its beautiful spines. When in this position it is nearly impossible to obtain the specimen uninjured. The spines break at the least touch, and if the hand is brought incautiously near they penetrate it in all directions, breaking and leaving the fragments in the flesh. Fortunately the serrated edges are turned towards the point of the spine, so that the splinters work themselves out of the skin quite easily. In this genus the anal system is closed by a thin naked membrane

and the anal orifice is prolonged into a fleshy tube which extends like a proboscis beyond the central plates. In the living specimens this tube is swollen out like a large eye, a resemblance which a rim of colour round the centre makes still more striking. It is very difficult to pursuade the fisherman that this is not an eye, and it makes the beauty and singular appearance of the animal much more conspicuous. Small examples of an urchin which looked very much like this species have been found in Port Jackson, and I was disposed to regard them as the young of *Diadema setosum*. But as the species is not found elsewhere in the tropics the Port Jackson urchins may be the young of *Centrostephanus Rodgersii*, which abounds in the harbour. The spines were more slender than in the adult state of *Centrostephanus* but the color and markings of both genera are the same. It is a matter that will require further examination.

Echinothrix calamaris, A. Agassiz, is rarely found on the Australian coast and only so far as is known on the north-east within the tropics. The specimens found by me were obtained in turning over dead blocks of coral on the inner edge of the Barrier Reef, and on the coral islands. I never saw it adhering by its suckers to anything. When exposed by turning over the stone which sheltered it, the spines were spread equally in all directions around it and moved slowly away. The spines are of two kinds. Those attached to the primary tubercles are rather stout and long with blunt points. They are of pale sea green colour with bands of purple-brown. The other spines are of various lengths, some equalling the primaries and as fine as hair, of a golden lustre with bands of darker colour. These are terrible as weapons of defence. Fine as they are they penetrate the flesh at the least touch. The first *Echinothrix* I ever handled sent its hair spines right through some of my fingers. I cannot help thinking that it has some way of striking with the spines, as I thought I approached the animal quite gently, and had scarcely more than touched it when my hands were wounded.

None of the wounds bled as the puncture is so very fine. It is useless to try to extract the fragments as they break into pieces as soon as they enter the flesh. I suffered no inconvenience from them after a day or so, and don't know what became of them.

Centrostephanus Rodgersii, A. Agassiz, is one of the few species which appears to have a very restricted habitat. It is common at Port Jackson and Botany Heads, and on the coast between, but I do not know of any other place where it is found on the east coast. Doubtless this is only because we know so very little of the coast fauna. When a closer examination is made other habitats will surely be found. It is a very handsome urchin of the deepest purple, or almost black colour. The spines seem all of one kind, and being rather stout are closely packed, besides being long and gracefully tapering. They are grooved with transverse rings or serrations, hollow and so thin that a very slight touch breaks them. The test also is very thin and easily destroyed. The animal generally lives in rocky crevices or overhanging ledges. It clings to the rock with its powerful suckers with the surface free. It is very careful to select as a place of repose a very narrow cell with just room enough for its body. The projecting spines can be seen, but it is only on the rarest occasions that it can be drawn from its recess uninjured. It adheres with great tenacity, and any attempt to detach it crushes the spines and the test. It emerges from these fastnesses to feed on the sandy bottom when the tide is in. It can then be easily captured and is often overtaken by storms and thrown up on the beach in a nearly perfect condition.

Astropyga radiata, Leske, has a very soft thin test and a few short thin spines. It seems to feed on the mud, but I know nothing more of its habits. Its only Australian habitat is in Torres Straits, and then few specimens were found together.

Heterocentrotus mammillatus, Klein., does not seem to be rare on the Australian coast wherever coral reefs are found. Its habits are much the same as *Echinothrix calamaris*. It lives among the

blocks of dead coral or at least searches for its food amongst them. Though the spines are stout and the test is uncommonly strong, it is very difficult to detach it from the crevice in which it wedges itself. The only specimen seen by me in this way was in a narrow groove or furrow on the side of a *Solenastræa*. Its beautiful brown spines with their bands of white and orange made it a conspicuous object, the water was too deep for anything but a long boat-hook, and then with every effort I could not detach it. The species has a very wide range throughout the Pacific.

Echinometra lucuntur, Leske. This is certainly the most common urchin throughout the tropics, and I believe it is as common in the Pacific as it is in Australia. I always found it under stones or blocks of dead coral upon the reefs. I never saw it attach itself to any object, but it moves rather quickly for an urchin when its hiding place is discovered. Hundreds can be gathered at every low tide upon the reefs. Sometimes as many as half a dozen will be found under a single block of stone. The colour is very variable, and guite different from the appearance presented by dried specimens in cabinets. The younger individuals are a delicate fawn colour, and then there is every variation from pale grey to black, or black and white. It is seldom that in a group two urchins are of the same colour. I don't know of any species which offers greater facilities for the study of the habits of sea urchins. Its abundance on places where it can be easily observed and its habits all favour remarks on its life history. In this and the preceding species, it does not seem to me, that there are any suckers around the actinosome, or at least that they do not attach themselves to any object by means of them. In all those urchins which attach themseles I notice a great flatness about the actinosome and the ambulacral pores are spread out over a much wider surface, I presume it is by means of the tubes of these areas, that the animal fixed itself firmly to the surfaces of the rock. In *Heterocentrotus mammillatus* and *Echinometra lucunter*, the region round the actinosome is rounded.

Stomopneustes atropurpurea, nobis. This species is very like *S. variolaris*, Lamarck, found both in the Indian Ocean and in the Pacific. When I made my first list of the Australian *Echini* the only Australian species known to me was in the Australian Museum and there was no record as to its habitat. Since then I have found a large number of specimens at Port Douglas, Trinity Bay, in about Lat. 16° N. All that were obtained by me lived on one small patch of rocky shore fronting a peninsula called Island Point, which is not more than a mile in extent. Had I not found a fragment of a broken test upon the beach I should never have known that it could be found in that locality. I don't know of any urchin which hides itself more skilfully. It chooses a large immoveable boulder for its shelter, and buries itself in the deepest recess it can find underneath, and only those recesses which are almost closed in on every side. It was only after a lengthened search made by stooping low down and peering under every boulder that at last I was rewarded by seeing a few dark spines projecting out of a dark crevice. It was far out of reach of my hands so I had to content myself then with knowing that I had found the sort of hiding place I had to look for. I then procured a stout iron pot-hook which I fastened to the end of a bamboo. With this I imagined I could easily get them out of the crevices. But I was entirely mistaken. Some of them would not yield to all the force I could employ, and some after a prolonged effort were got out and entirely destroyed. There was no scarcity of specimens. Once I knew where to look for them I discovered them on every side, but only to renew my disappointment in trying to dislodge them. In four or five instance I was able to move the stones on which they were, and I found that they were so firmly attached by their suckers as not to be pulled away by the hand. Any attempt in this way only broke the spines. But by passing a knife underneath they were easily lifted up, and then they would commence to move off slowly on the tips of their spines, which throughout the whole order serve the purpose

of locomotion. In all I was able to get about two dozen specimens, but a good many of them more or less damaged. Altogether it is a most disagreeable kind of fishing. The rocks are covered with oysters and balani, and one requires strong leather gloves to avoid being seriously cut by the thin edges of the shells which project from the surface. In my first attempt to capture a *Stomopneustes* my hands were covered with blood in a few minutes.

I believe the same species occur in Port Denison, and I dare say in many other places along the coast, because it may be so easily overlooked in its hiding place, and so much of the coast has been so slightly examined, that I should not be surprised to find that it is very abundant. It is I think nearly certain that the species we have in Australia is not the same as that described as *S. variolaris*, by Lamarck, and figured by Agassiz in his "Revision of the Echini" In the first place our Australian specimens are much larger, sometimes twice the size of any figured or described. Then the colour is entirely different. The spines and test except the tubercles are of a very deep purple-black colour, while in the Mauritius and Indian specimens they are green and purple. The peculiar groove at the vertical suture which belongs to the genus is much less waved. The arrangement of the tubercles is slightly different, and the shape of the madreporiform body which is moreover studded with small glossy milliary tubercles. Yet with all these differences the points of resemblance with *S. variolaris*, are many. In this species, and in fact with nearly every urchin known to me, when plunged into fresh cold water a purplish fluid is seen to exude abundantly from the test, and I have sometimes thought that these animals might have a colour bag such as *Dolabella Rumphii*, *Scalaria australis*, and many species of *Sepia*.

Strongylocentrotus eurythrogrammus, Valenciennes. Though we are said to have three species of this genus in Australia, yet this appears to me to be the only one usually met with. It has a very wide range, and like *Echinometra lucunter* varies a good deal in the colour of the spines. Its habitat is in the clefts and crevices

of rocks to which it adheres by its suckers. It is very common on the rocks near Bondi, outside the Heads, but difficult to obtain from the way in which it wedges itself into crevices. All the specimens are of a light chocolate-brown. The spines are long and sharp and require to be very carefully handled.

Sphærechinus australiæ, A. Agassiz. This is one of the most beautiful sea urchins, from the brilliancy of the colouring of the spines. I believe it has been found near Port Jackson, but as I have only seen a very few species and never obtained one alive, I know nothing of its habits.

Temnopleurus toreumaticus, Klein. This is not only one of the oldest known urchins, but it is one of the most widely diffused. It is very common on all sandy beaches in the tropics, but probably extends all round Australia. Professor Tate of Adelaide sent me a specimen which came from South Australian waters. On the north bank of the Endeavour River there is a long sandy beach outside the bar, on which a surf is always beating. This I found strewn for miles with the same species in September 1879, and I think there was seldom any beach I visited within the tropics where I did not obtain specimens. At Townsville I used to get a good many living individuals, washed up by the surf. It evidently lives on sandy ground and will bear a considerable amount of tossing by the waves without injury. In the full grown urchins the test is of a dull yellow colour, and the spines of a dark green intermingled with colorless ones. They are very sparingly scattered over the test. From the fact of finding so many in one place I should think it went about on the sea bottom in herds. I never saw any on the coral reefs nor near a rocky coast.

Salmacis. I am of opinion that all our Australian species of *Salmacis* will need a thorough revision. The one I considered as *S. bicolor*, Agassiz, varies very much from the diagnosis and figures in the "Revision," I think we may certainly say that we have another species besides those enumerated by Mr. Agassiz,

and there may be more. With regard to *S. rarispina*, Agas., there is little to add to its known habits. It is rather common and always found upon a sandy bottom. I obtained it recently from Port Denison, and in many places as far south as Moreton Bay.

Mespilia globulus, Agass. In my list given last year in the Proceedings of this Society, I expressed a doubt as to the genuineness of the Australian habitat for this species. I have now no doubt on the matter as I have found a specimen on a sandy beach in Trinity Bay.

Amblypneustes ovum, Lamarck. This is the most common of all the Australian urchins on the southern coasts, but I do not know if it extends either to the west or north side of the continent. Some stress has been laid on the shape of the test for specific distinction. Nothing of this kind can be relied upon. In some specimens of *A. ovum* you have a marked pentagonal outline and every gradation from depressed orbicular, to perfectly oval and egg-shaped. The pentagonal form is very common in young individuals. Among about 200 specimens picked up after a gale of wind on the beach at Wollongong, I was able to arrange a perfect series of shape and colour, the tints in extreme cases giving bright blue, red and yellow shades. It is a gregarious species and is found only upon sandy coasts. At Guichen Bay in South Australia, and Lacepede Bay, which is the next bay to the north, I have seen the beach strewn for miles with the tests of this urchin, of all sizes up to nearly three inches in length. It has a very thin shell and is easily broken. It is common on all the South Australian coast as far as Spencer's Gulf, and is often strung like beads for ornamental purposes. The color of the test varies exceedingly, almost every shade may be met with, but grey-green is the prevailing tint. I cannot help thinking that *A. griseus* and *A. pallidus* may only be varieties of this species.

With regard to all the species of *Holopneustes*, I am still obliged to state that I have seen none on the Australian coast, though I

have been taking an interest in our *Echini* for many years. There is no species known to me in any of our Museums in any of the colonies.

Echinus Darnleyensis, nobis. Since I described this species I have seen other specimens from different parts of the East Australian coast. It is very gregarious and goes, I should imagine in shoals on sandy bottoms. I sent specimens to Professor Alexander Agassiz, of Cambridge Mass., and he tells me that the species was known to him and he always regarded it as a variety of the South American *E. magellanicus*. But as that species differs from mine in some important particulars, is not known to occur outside American waters, we may perhaps regard ours as distinct.

Hipponöe variegata, Leske. I have already remarked the very variable character of this species, but I am more disposed than ever to regard the large individuals which are found occasionally in Port Jackson as distinct species. The described light violet or blue variety is not at all uncommon inside the Barrier Reef. Every specimen met by me was denuded of spines and cast high and dry amid the debris on the sand and coral shingle, which is found on one side of every reef. It is always a most conspicuous object of light violet or lilac colour. The white tubercles and the markings of the coronal sutures giving it a most elegant appearance. These features and the very deep actinal cuts easily distinguish it.

Evechinus chloroticus, Vernl. This seems to be rather a common species in New Zealand, judging from the facility with which specimens are obtained. The spines are short and stout, and of a uniform green colour. I know nothing of its habits, but should be inclined to think that it took in New Zealand the place which is occupied by *Strongylocentrotus eurythrogrammus* in Australia. Two small and young specimens were found near Port Jackson.

Echinanthus testudinarius. In my list of *Echini* I have stated that this species is found fossil in the Murray River beds, but

Prof. McCoy has shown that the living form is distinct, though resembling it in many respects. It has a very wide range and is rather common. Prof. Agassiz called my attention to the variability of the species and has suggested that my *E. tumidus* may be one of the varieties. But the two species are so entirely different that the matter will not bear discussion. I intend to publish a figure of *E. tumidus*, and then this will I think be put beyond a doubt. I have found *E. testitudinarius* all along the East Australian coast, both within and outside the tropics and have not noticed any great variability in its character, in fact I should have said that it is one of the exceptionally constant species in Australia. I obtained one small example from Moreton Bay, which I presented to the National Museum Melbourne, which had a remarkable depression in one of the petals, but this arises clearly from a malformation. The specimen is dwarfed and depressed, but not otherwise different from the normal type.

Laganum depressum, Lesson, and *L. Bonami*, Klein, are both rather common on sandy situations, but the species of this genus and *Peronella* are so extremely alike that unless the interior of the test is examined they cannot be referred with certainty to any genus or species.

Peronella decagonalis, Lesson, is found of large size at Port Denison and on sandy places all along the inside of the Barrier Reef. It extends to Port Jackson, but there it is only very small. Within the tropics it is very large and of a blood red colour. Though very much depressed at the edges, and seemingly thin and fragile it has a very strong test, and is seldom found broken. It lies on the sea bottom covered with sand, so that without a dredge specimens are not easily obtained.

Clypeaster humilis, Leske. A very fine specimen of this urchin was obtained by Messrs. Haswell and Morton, in Port Denison. This is the first time it has been found on the Australian coasts.

Echinarachnius parma, Klein, is not so common on the northern coast as I supposed, but *Arachnoides placenta*, Linn., is very

plentiful. At the mouth of the Endeavour River the coast was strewn with dead and broken tests of the species. Using a very small dredge at about ten fathoms one can obtain hundreds or thousands of specimens anywhere between Cape Grenville and Port Denison.

Maretia planulata, Leske, is also a very common species and is found on a sandy bottom at moderate depths from about five fathoms. We know very little about the *Spatangidæ*, but their habits might be easily studied in Sydney with even a small aquarium. The peculiar smooth actinal plastron points no doubt to some distinct habits and modes of getting its food, which would be very interesting to study. Though it is not at all rare on the east coast, yet because the test is very brittle it is never found on the beach. Any specimens that are washed up must be broken to pieces. This shows how nothing but the dredge will reveal what urchins we have in Australia.

Echinocardium australe, Gray. This species is abundant on sandy shores, from Port Jackson to East Tasmania. Like all the clypeastroid urchins it seems to feed on Foraminifera.

Breynia australasiæ, Gray, is extremely abundant in the sandy shallow bays about Port Denison.

Rhynobrissus apicalis, nobis. Small specimens of this urchin have lately been found in Port Jackson at sixteen fathoms. They were not one-fourth the size of the type specimen obtained by me from Moreton Bay.

Descriptions of Australian Micro-Lepidoptera.

By E. Meyrick, B.A.

IV. TINEINA, (Continued).

The present instalment treats of the families *Glyphipterygidæ* and *Erechthiadæ*, giving descriptions of fifty-three species, of which