MARINE BIOLOGICAL RESEARCH AT INHACA ISLAND, MOZAMBIQUE: An Interim Report

Margaret Kalk

ABSTRACT

The Estação Biologia Maritima was founded in 1951 by the Portuguese Government of Mozambique, largely as a result of proposals made by the late Professor C. J. van der Horst of the Witwatersrand University, who had worked at Inhaca Island since 1933. This paper mentions the different types of biological research now in progress at the Laboratory for few studies have yet been published. It gives the first general account of conclusions reached regarding the different littoral biotopes and the affinities of the faunas. The composition of the faunal belts is discussed and it is shown that the 'universal' zones of a rocky shore can be recognised on the east coast, which is lapped by the Indian Ocean. The fauna has affinities with Natal and with the more tropical northern coast. The west coast, facing Delagoa Bay, is warmer than the east coast and exhibits features that are more nearly tropical and are modified by estuarine conditions. The warm water influence is greatest at the lower horizons on both coasts and a small fringing coral reef is present on the west.

INTRODUCTION

INHACA Island lies about 20 miles due west of Lourenço Marques at the tip of the peninsula that encloses Delagoa Bay. In 1951, largely as a result of pressing representations made by the late Professor C. J. van der Horst, the Government of the Portuguese colony of Mozambique built the Estação Biologia Maritima on the west coast of the island. The station comprises at present a laboratory, library and living quarters sufficient to accommodate 30 people. Equipment has been provided mainly through funds made available by the University of the Witwatersrand, Johannesburg, where Professor van der Horst held the Chair of Zoology until his sudden death in 1951. Scientific work has been carried out principally by staff and students of this University.

From 1933 onwards, when the island was almost inaccessible and lacked every amenity, including available water, van der Horst pursued his pioneer field work at Inhaca, using as his laboratory the shade of a tree, a tent or a reed hut. The vision and generosity of the Portuguese authorities have now led to the provision of adequate facilities for research and the government has graciously opened the laboratory to South African scientists. A marine biologist from Portugal will soon take up permanent residence. It is hoped that the Estação Biologia Maritima will continue to follow the tradition of the famous Zoological Laboratory at Naples[1] and may, in time, come to rival it in international status and importance in biological discovery.

The prerequisite for a modern biological laboratory is a rich endowment of *living* organisms throughout the year and this Inhaca possesses in a profusion surpassing that of Woods Hole, Plymouth and other marine laboratories in temperate climes.

The laboratory is ideally situated on the sheltered shore of the island, facing Delagoa Bay. The climate is equable and healthy, although the island is virtually on the fringe of the tropics. The unfrequented shores exhibit a variety of ecological facies: the tropical coral reef, mangrove swamps and mud flats as well as the sub-tropical rocky shore of the Indian Ocean. Each supports a strikingly different community of animals and plants, rich in numbers as well as species. The geographical position in the Indo-Pacific region fills a gap between Zanzibar and the Cape, which has long remained the biggest blank on zoogeographical world maps.[2] The proximity of the station to fishing sites may well lead to economic benefits for the industry. But long after the

Fig. 1.—The Marine Biological Station, Inhaca Island.

novelty of the fauna and flora has been exhausted and taxonomic knowledge has been completed, physiological and evolutionary questions will still be put to a variety of living organisms, many of which are particularly suitable for the purpose because of their size, their hardiness or the fine grades of adaptation exhibited by closely related species in different ecological niches.

WORK ACCOMPLISHED

Apart from the few beautifully illustrated papers on coral fish[3] and echinoderms[4] from the Lourenço Marques Museum, the earliest paper prompted by Inhaca dealt with new species of the acorn worm, Balanoglossus.[5] It was soon followed by an account of the morphology[6] and distribution[7] of the marine angiosperms, establishing the tropical nature of the west coast with the record of the large intertidal fields of Cymodocea, which mark the southernmost recorded limit of this Red Sea genus. The war interrupted visits to the island but, before the war and since, intensive collections of animals and plants by the staff and students of the Witwatersrand University during winter vacation courses have been studied or have been sent to taxonomic specialists, who have included in their monographs descriptions of many species that were new to science.[8-17]

Because of this preliminary work, although the laboratory at Inhaca has only been open three years, many hundreds of animals have now been identified. Approximately 150 crustacea, 250 fish, 90 corals, 250 molluscs, 60 echinoderms, 30 polychaetes and over 100 birds have been named with certainty, while many more including polychaetes, anemones and many sponges, tunicates, hydroids, bryozoa and sipunculids still remain to be classified.

Species lists of plants and animals are in preparation and will be published fully elsewhere. Particular mention should be made of the work of the late Mrs M. Moss, Miss D. Weintroub and Dr R. L. Davidson, on the inland flora, a catalogue[18] of which has now been prepared on the basis of their collections. The coral reef has been studied[19] in the modern aqualung style as well as from the taxonomic viewpoint. Prof. W. E. Isaac[20] of Cape Town, has extended his studies of S.A. marine algae to the coast of Mozambique. The first study of gene frequencies in a population of molluscs with an inherited variable colour pattern was described by Dr D. J. Nolte[21] at the International Congress of Genetics last year. His data were based on the bivalve *Donax faba* found, in thousands, only along a narrow sandy belt at mean high neap tide along the west coast of the island. Population counts of Donax along five miles of the coast showed that the density was inversely proportional to distance from mangroves. The relation between the purple, brown, rose and white colours of the shells was a simple chemical one of oxidation and reduction of a common base.[22]

A series of ethological studies on marine organisms has been started and a paper on the orientation of a stomatopod shrimp is in the press.[23] The fungi of the mangrove swamp[24] are being described and the cytology of the orchid, Vanilla.[25] The tropical species of sea-urchins have been investigated for experimental embryological purposes.[26] Physiological inquiry into the water relations of beach pioneer plants[27] and into the endocrine control of waterbalance in amphibious crabs[28] has been commenced.

As so much information is now available, it is considered timely that a broad summary of conclusions on the environmental conditions of the island and the distributon of common littoral animals at Inhaca be placed on record.

PHYSICAL FEATURES

Topography of the shores

A narrow strait, 100 yards wide, cuts off Inhaca Island (lat. 26° 0′ S., long. 32° 55′ E.) from the northern tip of the peninsula that encloses Delagoa Bay on the south and east. This geologically very recent island comprises two north-south ridges of buff or white sand, covered with tropical vegetation; one runs for about seven miles along the eastern shore and the other for five miles along the western. Sandstone crops out occasionally at or below sea level. From east to west the island is about four miles wide and the interior is low-lying and swampy. So different are the physical conditions on its shores that the island lends itself uniquely to comparative ecology.

The east coast is exposed to the Indian Ocean. The west faces the shallow Delagoa

Bay and is further protected on the south by Machangulo shoals and on the north by a broad sand shoal connection with the smaller Ihla dos Portuguêses. The northern and southern shores of the island are deeply indented by tidal bays containing dense mangrove around extensive mud flats. The west shore extends for about 400 metres from the cliff to a deep channel that runs parallel to the shoreline. Currents from the Indian Ocean sweep around the island into the western channel, feeding the bay with

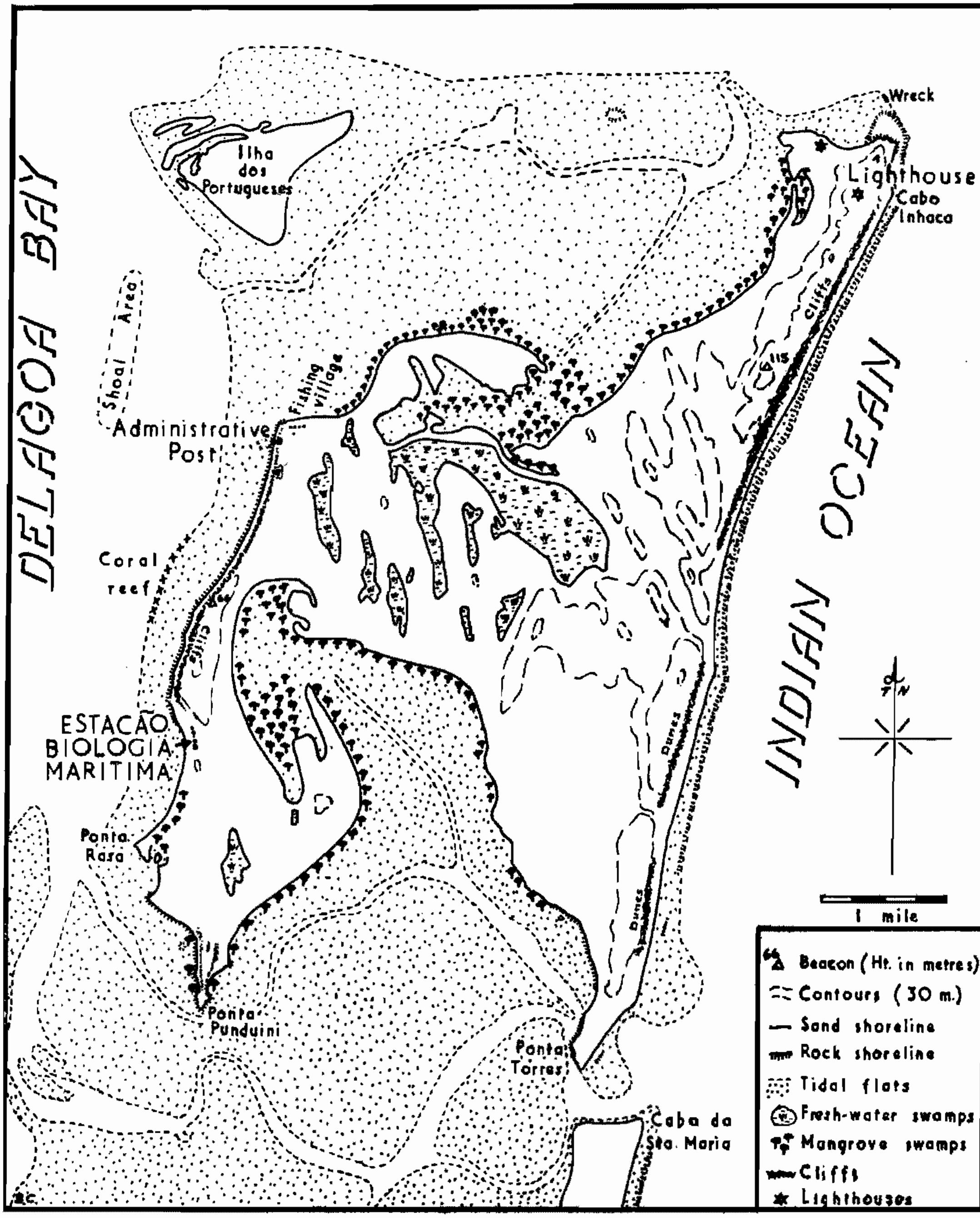

Fig. 2.—Inhaca Island. Based on the map of Delagoa Bay prepared by the Missão Hidrografica da Colonia de Mocambique, 1941-44 and amended by H. B. S. Cooke.

ocean water and seeding it with larvae from the tropics. Along the landward edge of this channel, corals have built small patches of fringing reef about 50 to 100 metres long.

Temperature

The climate of the island is determined by the warm Mozambique and south equatorial currents that merge at this latitude,[29] but there is a distinct difference in temperature between east and west coasts. The east coast is subject to an erratic cooler inshore current due to the south wind that is characteristic of a fair proportion of winter days. The west, south and north are sheltered from cool winds and currents, and the large intertidal area where the sea is always shallow is exposed to direct sunshine, so that the temperature of inshore water on the west has, on occasion, been found to be about 5°C higher than on the east coast. The highest temperature recorded in shallow water on the west has been 32°C and the lowest 20°C, so that from the criterion of temperature, one would expect a tropical fauna on the west coast and sub-tropical on the east.

Tides and wave action

The extreme tidal range[30] is 3·3 m. on these coasts and, taking the level of mean low spring tide as zero, the rise to mean high spring water is 3·0 m., and to mean high neap water is 2·3 m. These figures may be contrasted with the corresponding figures at Durban,[31] namely 1·8m. and 1·1m. respectively. Wave action on the sheltered west shore is minimal throughout the year, while on the east coast, although wave action is not as severe as on the Natal coast, yet erosion of the steep sandy slopes causes a strong scouring action on the rocks below.

As a result of these factors only 30-40 m. of littoral on the east coast is exposed and it either rises steeply from the sea if the beach is sandy or, when rocky, forms a series of wave-cut terraces. On the three flat shores the tide recedes from 1-3 K. at spring tides. There is only about 0·5 m. difference between the highest low and lowest high neap tides, so that for a few days in every cycle the tide appears not to ebb at all on the mud flats.

Salinity

Estimations of salinity of the sea were made from samples, at the laboratory within one hour of collection, using silver nitrate standardised against 'normal' sea water from the Laboratoire Hydrographique pour l'Exploration de la Mer, Copenhagen. For east coast tidal water, for the open sea north of Ilha dos Portugêsés and the ocean current in the channel off the west coast, the value was in each case 35·47 parts per thousand. This figure agrees with the gradient for this latitude (between 35·3 and 35·6) given in Clowes[32] recent analysis of reliable available data, although it is much lower than the figure quoted by Stephenson[33] from Marchand[34] for Natal.*

For west coast tidal water the value varied from 30·0 to 33·9 parts per thousand. Delagoa Bay receives a large body of fresh water from its three navigable rivers, but the effect of this at Inhaca is modified by the incoming ocean currents in the channel near the island, mingling saline water with that of the bay. The slightly depressed salinity of the west coast is due rather to drainage of fresh water on to the flats from the water table beneath the dunes. Wells can be dug anywhere on the west side of the island yielding fresh water at a depth of about 3 m. The line of fresh water drainage on to the beach lies at the base of the sandy strip just below mean high neap tide level and is demonstrated by the occurrence of a band of Convoluta-like Turbellarians containing symbiotic green algae. The band reappears each day as the tide recedes and is most marked after rainfall. It is only at and below this line that the influence of a lower salinity would be felt.

The mangrove channels and pools varied in salinity from 19·2 to 42 parts per thousand. Water drains from the hills of the hinterland into the central channels and the mangrove mud becomes brackish, especially after rain, but evaporation after spring tides during the heat of the day leaves the mud more salty. The diurnal changes in salinity may, according to Day's[35] general principles of estuarine ecology, qualify the mangroves as estuarine, although strictly speaking, there are no rivers.

Other factors

Oxygen content, pH and excess base vary within normal limits for the sea,[36] except in the mangroves where the rapid

* Marchand's figure of 36·89 parts per thousand has been omitted from Clowes' hydrographical analysis, probably because, in the early days, samples were kept too long before estimations were made.

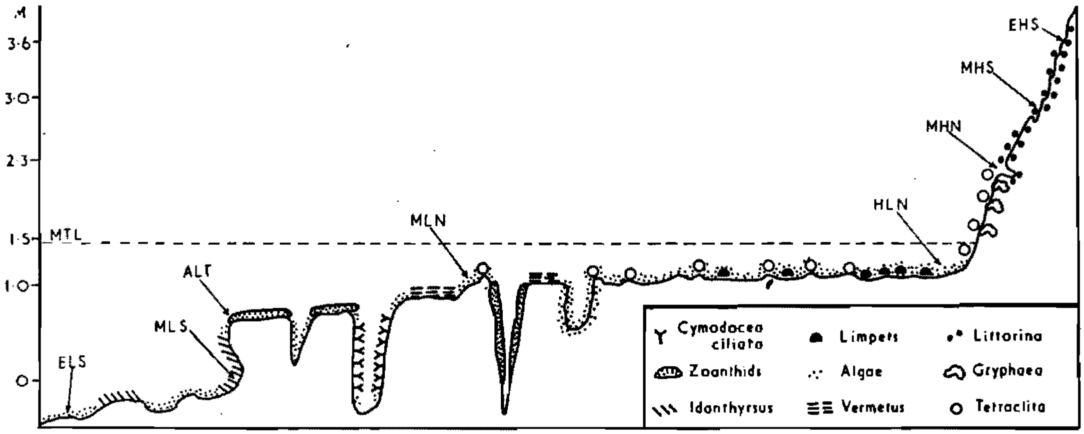

Fig. 3.—A diagrammatic representation of a section of the east coast, showing the arrangement of organisms on the vertical face of the upper platform, the middle and lower platforms. Horizontal distance, 40m. E.H.S., Extreme Spring High Tide; M.H.S., Mean High Spring; M.H.N., Mean High Neap; M.T.L., Mean Tidal Level; M.L.N., Mean Low Neap; M.L.S., Mean Low Springs; E.L.S., Extreme Low Springs; H.L.N., Highest Low Neap Tide; A.L.T., Average Low Tide.

organic decay and free sulphide lower the oxygen content and make the water only slightly acid (pH 6·8). Turbidity of the waters has not been measured accurately, but it is obvious that it varies. The coral reef can easily be seen through 3 m. of water on a summer's day, unless there is an off-shore breeze that stirs up the mud, but in the mangrove channels the water is intensely muddy, no light penetrates and no plant plankton can be found.

BIOTOPES

The physical differences between various regions on Inhaca shores lead to the recognition of four major divisions: the east coast, the west coast rocks (including the coral reef), the mud flats and the mangroves. They are best described briefly by comparison with Natal.

The East Coast

Around the northern point beneath the lighthouse the soft sandstone rock has been eroded into three platforms. On analogy with Natal[37] this would date back to pleistocene fluctuations of sea level. The upper platform (above high tide) is about 4·5—6 m. above the middle one. The latter extends seawards for about 30—40 m. and its landward part is almost level except for very shallow pools bounded by small raised ridges. The seaward part is traversed by deep clefts and hollowed into round deep pools with sandy bottoms. The lower platform is 0·6—1 m. below the middle one and is even more riddled with large pools and channels.

The upper rock levels become obliterated further south by coarse sand eroded from the dunes, until at the extreme south-east, no rock is exposed at all. The sandy slopes are devoid of life except for occasional swarms of *Bullia natalensis* at the water's edge. But high above the churning of the waves, holes and mounds of *Ocypode kuhlii* are visible. In summer hordes of these pink ghost crabs run in and out of the advancing tide in the sunlight, but in winter there are very few. Stray green *O. ceratophthalmus*, that are common on the west shore but only at night, mingle with them and, strangely, adopt the diurnal habit of the species that is dominant on the East Coast.

The 'universal' zones[38] of a rocky shore can easily be recognized and at the upper levels the organisms are largely identical in kind with those on the Natal coast, but they vary in size and frequency. *Littorina glabrata* (syn: *obesa*, *ziczac*, *pintado*) is more plentiful and reaches a higher level at Inhaca because of the greater tidal changes. *Oxystele tabularis* is small and few in number, probably near the end of its range. *Grapsus maculatus* that is fairly scarce in Natal is as common as *Grapsus strigosus* and much bigger. *Octomeris angulosa*, such a feature of the surf-swept rocks of Natal, is absent, while *Mytilus perna* is sparsely represented.

The middle levels exhibit a preponderance of algae which usually mask the few *Patella barbara* and *P. variabilis*. Large patches of blue calcareous Vermetus tubes, about 5 cm high, appear instead of the masses of Pomatoleios familiar in Natal at this level. Extremely small *Asterina exigua* are occasionally found and the only Xanthid crab of any size is *Eriphia smithi*. Among sea-urchins, the South African south coast Parechinus is absent, *Stomopneustes varolii* and *Echinometra mathaei* are locally common. In rock crevices there is a large brown and yellow sea-cucumber, *Actinopyga miliaris*.

The lower horizons have a similar belt of Zoanthids with which many anemones are associated, but the infra-littoral fringe is coated with a different, tropical community of the Sabellarid worm, *Idanthyrsus pennatus*. Vast mats of the sandy worm tubes cover the rocks to the exclusion of all algae on certain boulders, while others are clothed in Sargassum or red algae. This worm occurs only singly in the cryptofauna in Natal.

These examples, chosen because they are most striking, illustrate the transition to a more tropical fauna on the East Coast. It is apparent that the greatest change in species is at the lowest horizon; mainly the size, spread and frequency of individuals are affected at the higher levels. Reef-building corals have not appeared although isolated pools are lined with Anomastraea and other non-reef-building forms.

West Coast

The first sign of the effect of warmer sheltered waters is shown on the high level rocks, in the sparsity of periwinkles and barnacles. *Littorina glabrata*, *Tectarius natalensis* and *Chthamalus dentatus* are still present, but *L. africana* and *Tetraclita serrata* are missing. *Balanus amphitrite* var. *communis* the barnacle of the cryptofauna of Natal, is prominent on exposed rocks and on corals in the reef, but reaches its largest size on wooden posts as *B. amphitrite* var. *denticulata*.

The most conspicuous feature is *Gryphaea cucullata* which smothers the vertical and horizontal faces of rock in a metre high belt. Not a millimetre is left for the anchoring of another animal or plant. True limpets are completely absent, but a species of Siphonaria is common. In the pools of this level, large numbers of *Planaxis sulcata* congregate and, on the stone debris just below, *Cerithium morus*, *C. caeruleum* and *Nerita albicilla* are prominent. These animals are suggestive of estuarine conditions, although there is a sprinkling of the marine *Turbo coronatus*, *Monodonta obscura*, *Thais intermedia* and *Clibanarius virescens* as well.

Tropical features are again characteristic of the lower part of the shore. Most of it is sand or mud flat with large flags of dead coral, strewn at random, and sheltering a cryptofauna of cowries, nudibranchs xanthid crabs, encrusting colonial tunicates, worm tubes of Sabellidae, the black-tentacled cucumber *Thyone sacellus*, and the brittle stars *Opiothrix longipeda*, *Ophiactis savignyi* and *O. carnea*. Gastrochaena, Lithophaga and Sipunculid worms burrow into the calcareous stone; giant nemertines (*Baseodiscus hemprichii*) and bristly polychaetes (Eurythoe sp.) *Gonadactylus glabrous* and *Alpheus crassimanus* live in pools beneath the dead coral slabs, while *Septifer bilocularis*, Barbatia species, Stomatella, Urosalpinx and other molluscs of protected shores attach themselves under rocks in small numbers.

Finally, at the level of the infra-littoral fringe in some places at the edge of the channel, there are large patches (90 m. by 10 m.) of coral reef which are accessible only at exceptionally low equinoxial spring tides. The main reef-builders, Acropora, Porites, Montipora and Turbinaria are represented by many species, as well as the more isolated species that have been found in Natal. Algae, apart from encrusting corallines, hardly occur at all whereas, in cooler waters at this level, communities of algae always compete with colonial animals. The reef supports an even wider variety of

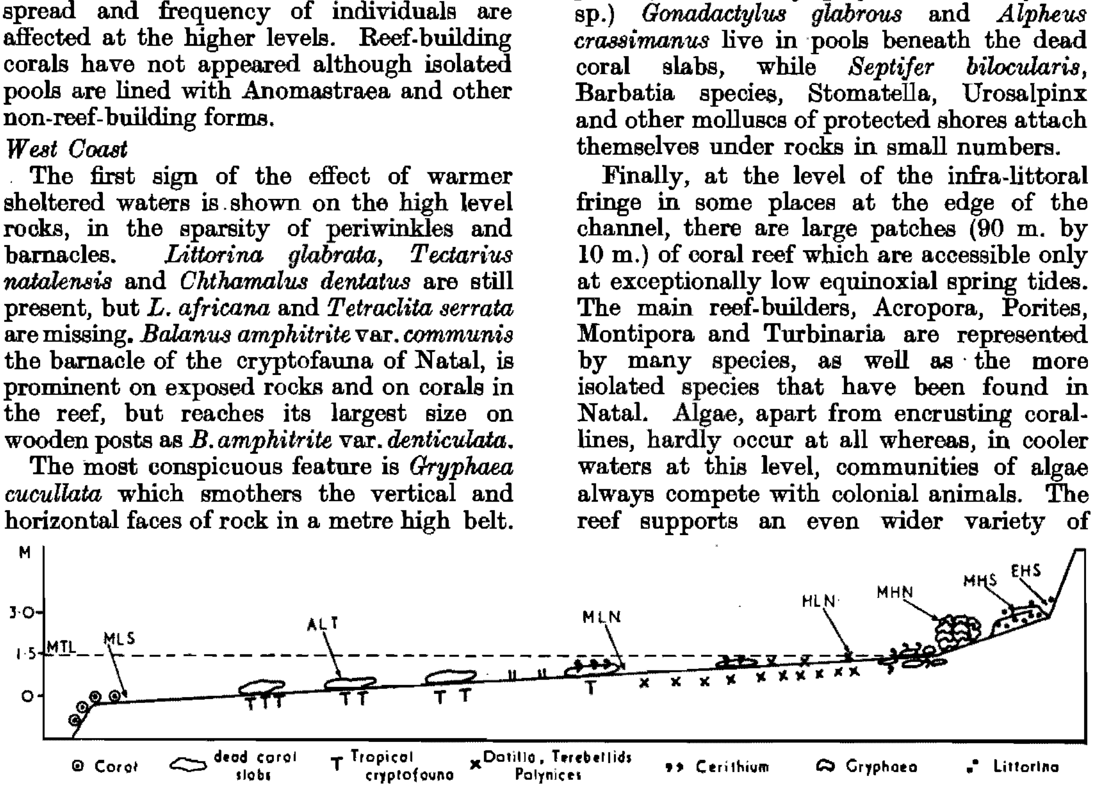

Fig. 4.—A diagrammatic representation of a section of the sand flats of the west coast, showing the arrangement of organisms on the high level rocks, dead coral slabs strewn on the flats and the coral reef at the edge of the channel. Horizontal distance 450m.

Xanthid crabs, sea-cucumbers, brittle stars and worms than the dead coral does, and coral fish, crayfish, giant clams, eels and octopus blend exotic colour with the pastel shades of the living coral.

Mud flats

Apart from the rocks, stones and coral reef just described, the west shore is mainly mud flats with patches of sand. Above the lowest high tide there are only the nocturnal *Ocypode ceratophthalmus* and the wedge shell, *Donax faba*. Then, down to mean low neap tide level, the mud flats are much like estuarine flats in northern Natal with *Dotilla fenestrata* in the sandy parts and terebellid worms; *Macrophthalmus grandidieri* and *M. bosci*; swimming crabs that retire into holes when the tide ebbs, such as species of Thalamita, Scylla, Charybdis and Lupa. Bivalves do not appear to be very common, but species of the gastropods Nassarius, Polynices and Natica abound.

The number of species of crabs and worms appear to be greater than is the case further south in Natal and the Cape, and certain vertical narrow sandy worm tubes are so numerous as to bind the sand together into low hillocks.

On the lower levels, again, tropical species predominate, but this time they are marine angiosperms. Three zones of 'sea-grass' succeed one another towards extreme low spring tide level. Associated with the first (*Halophila ovalis* and *Diplanthera uninervis*) is the large grey *Holothuria scabra*, with the second (*Cymodocea rotundata* and *C. serrulata*) the black *Holothuria atra*, and with the lowest (*C. ciliata* and *C. isoetifolia*), at the same level as the coral reef, but not encroaching on it, this broad-leaved Cymodocea zone is sprinkled with many Indo-Pacific sea urchins of which *Salmacis bicolor*, *Temnopleuris toreumaticus*, *Diadema setosa*, Prionocidaris and Echinodiscus species, that appear to be rare in Natal and are recorded there only from deep water. In addition there are quite large numbers of the brilliantly coloured tropical starfish *Pentaceraster mammillatus* and *Protoreaster linckii*, as well as the tawny *Astropecten granulatus* and *Linckia multifora* of the flats. Strange spider crabs and pycnogonids have been found in these fields, as well as Synapta, Pinna, Phoronis colonies symbiotic in an anemone and with Stoichactis its commensal prawns and fish, etc.

The fish that swarm in the shallow water of these flats are an unusual mixture of estuarine and coral reef inhabitants. As the flats approach the mangroves in the north and south tidal bays, however, coral associates drop out and there remain those capable of withstanding salinity changes like gobies, pipefish, blennies and, finally, only Periophthalmus, the mud-skipping goby.

It is mainly in the flats of the tidal bays that mud-dwelling bivalves live, e.g. species of Tellina, Cardium, Tapes, Dosinia, Mactra, Tivela, Solen, Psammobia, etc.

Mangroves

The north and south tidal bays are bounded by broad areas of mangrove swamp through which narrow channels run towards a broader tidal stream in the middle of the mud flats. A third mangrove stream reaches the west shore immediately south of Ponta Rasa.

Avicennia officinalis lines the dry landward and the wet seaward edges of the swamps that extend from extreme high spring tide level to the highest low neap tide (just below mean tidal level). Edging the channels that penetrate the swamp, *Rhizophora mucronata* spreads its buttress roots. Between these two species, *Brugieria gymnorhiza* and *Ceriops candolleana* are closely intermingled, with a tendency for Ceriops to occur on the drier ground. The fauna is much the same

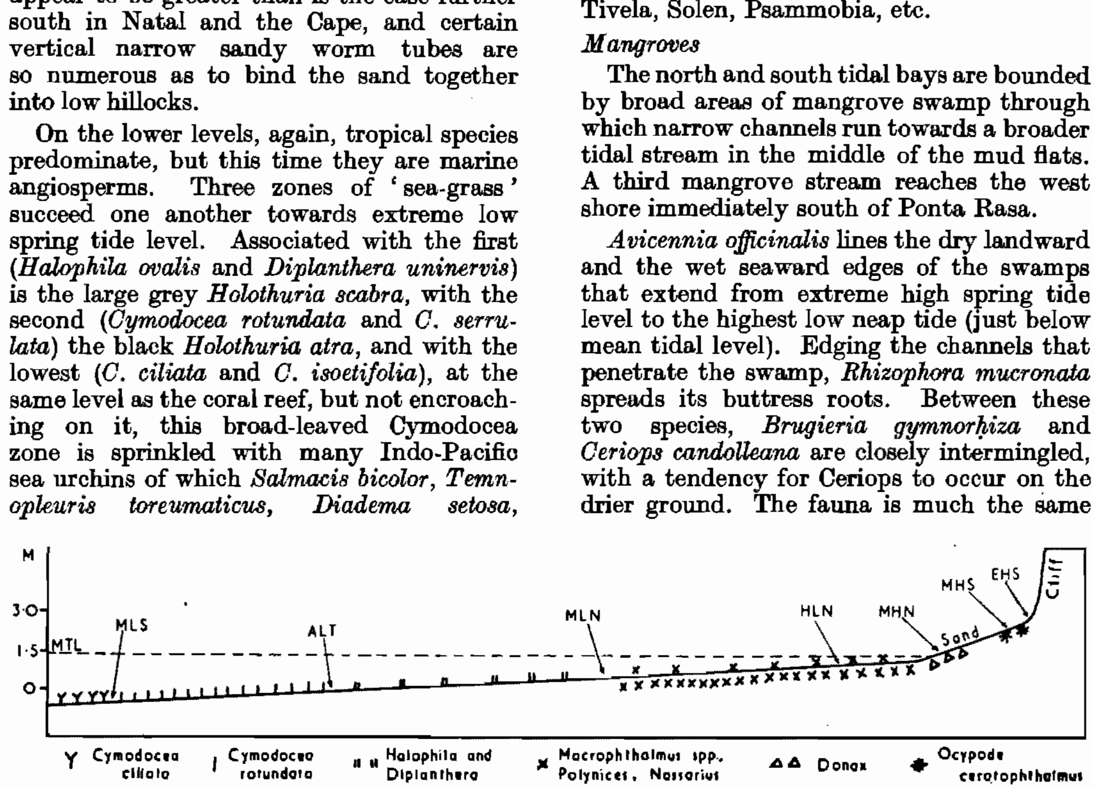

Fig. 5.—A diagrammatic representation of a section of the mud flats on the west shore, showing the distribution of organisms. Horizontal distance 450m.

as in mangroves north of Durban.[39-40] The crabs *Sesarma meinerti*, *S. guttata*, and *S. eulimene* and *Uca annulipes*, *U. inversa*, *U. chlorophthalmus*, *U. marionis*, *U. urvillei* seem to dig their burrows along a gradient for each genus from wet to dry ground. The spread of the species of one genus up the shore is a common phenomenon. The molluscs *Cerithidium decollata*, *Terebralia palustris* and *Littorina scabra* are usual inhabitants. *L. scabra* does extend from the mangrove to the open west shore, but is found mostly on wood and rarely on rock in a much darker form, with a stronger radula.

This preliminary account of the kind of reservoir of animal life that exists at Inhaca perhaps does not emphasize enough the richness of the species. T. A. Stephenson[41] has said that the population of any shore was, on the average, good collecting if it yielded about 100 species. Taking the complete shore line of Inhaca, the number is closer to a thousand. Although a detailed comparison of species with Natal's and those of tropical East Africa is not yet possible without the publication of complete species lists, it can still be stated here that nearly all the species listed by Stephenson[42] as comprising the tropical component of Natal have been found at Inhaca on the upper levels of the shores. Different tropical species are found at the lower levels as was to be anticipated from Allee's[43] early generalization for the North American Atlantic coast that 'near the extremes of their geographic range animals can live in deeper water more readily than along the shallow margins where the temperature changes are greater.'

ACKNOWLEDGMENTS

I should like to thank all those who have assisted me in many ways with the study of Inhaca: the Portuguese officials and employees; the staff and students of the Zoology Department of the University of the Witwatersrand; Dr K. H. Barnard of the S.A. Museum, Cape Town, and Prof. W. E. Isaac of Cape Town University.

I am much indebted to the Council for Scientific Industrial Research, which has contributed towards the expenses incurred in these investigations.

REFERENCES

1. Dohrn, R. *Endeavour*, 13 (1954), No. 49.
2. Ekman, S. *Zoogeography of the Sea*. London, Sidgwick & Jackson (1953).
3. Lopes, A. P. *Documentario Mocambique*, 9 (1937), 16 (1938).
4. Lopes, A. P. *Documentario Mocambique*, 20 (1939), 71–84.
5. Van der Horst, C. J. *Ann. S.Afr. Mus.* 32 (1940) 22–380.
6. Moss, M. *S.A. Journ. Sci.* 33 (1937) 344–345.
7. Cohen, E. *S.A. Journ. Sci.* 36 (1939) 246–256.
8. Barnard, K. H. *Ann. S.Afr. Mus.* 38 (1950) 1–837.
8a. Barnard, K. H. *Ann. S.Afr. Mus.* 21 (1925–1927).
8b. Barnard, K. H. *South African Shells*, Cape Town, Maskew Miller (1950).
9. Smith, J. L. B. *The Sea Fishes of Southern Africa.* South Africa, Central News Agency (1949).
10. Crossland, C. *Ann. Natal Mus.* 11 (1947) 169–206.
11. Carlgren, O. *Kungl. Svenska Vet. Akad. Handl.* 8 (1938) 1–148.
12. Roberts, A. *The Birds of South Africa.* Johannesburg, Central News Agency (1953).
13. Clarke, H. L. *Ann. S.Afr. Mus.* 13 (1923) 221–433.
14. Mortensen, T. Pap. Mortensen's Pacific Exped., 1914–16. *Vidensk. Medd. fra. Dansk. naturh. Foren.* 93 (1933) 215–400.
15. Fauvel, P. *Faune de France*, 5 (1923) 1–488, and 6 (1927) 1–494.
16. Day, J. H. *Journ. Linn. Soc. Lon.* 39 (1934) 15–82.
16a. Day, J. H. *Ann. Natal Mus.* 12 (1951) 1–67; 12 (1953) 397–441.
17. Stephen, A. C. *Ann. Natal Mus.* 10 (1942) 245–259.
18. Gilliland, H. B. *Records of the Inhaca Flora.* Roneod list. Botany Department, University of the Witwatersrand (1954).
19. Boshoff, P. H. *South African Corals* (in progress).
20. Isaac, W. E. *Marine Algae at Inhaca* (in progress).
21. Nolte, D. J. Proc. *9th Inter. Cong. Gen* (1953) (in the press).
22. Kalk, M., and Nolte, D. J. *A chromatographical and spectrographical analysis of shell pigments in Donax faba.* (unpublished).
23. Bolwig, N. *Brit. Journ. Animal Behav.* (in the press).
24. Swart, H. *The Fungi of Inhaca Mangrove Mud.* (Thesis in preparation).
25. Krupko, S., Israelstam, G., and Martinovic, B. Embryosac Development and Chromosome Number in Vanilla roscheri. (*This Journal*). pp. 115-117.
26. Balinsky, B. I. *Experiments in Artificial Fertilisation of Sea-urchin Eggs* (work in progress).
27. Badenhuizen, N. P. *The anatomy, water uptake, transpiration and osmotic value of some beach pioneers in relation to their ecology* (in progress).
28. Kalk, M. *Endocrine control of normal water balance in Ocypode spp. Sesarma spp. and Uca spp.* (in progress).
29. *The Africa Pilot*, Part III, London, H.M.S.O. (1929) 1–515.
30. *Tabela de Marés.* Lourenço Marques, Impressa Nacional de Moçambique (1952, 1953, 1954), 1–59.

31. EYRE, J., and STEPHENSON, T. A. *Ann. Natal Mus.* 9 (1938) 21–46.
32. CLOWES, A. J. *Fish. Mar. Biol. Surv. Investig. Rep.* 12 (1950) 1–42.
33. STEPHENSON, T. A. *Ann. Natal Mus.* 11 (1947) 207–324.
34. MARCHAND, J. M. *Fish. Mar. Biol. Surv.*, Cape Town, 7 (1929), *spec. rep.* 4, 1–19.
35. DAY, J. H. *Trans. Roy. Soc. S.Afr.* 33 (1951) 51–91.
36. HARVEY, H. W. *The Biological Chemistry and Physics of Sea Water.* Camb. Univ. Press (1928).
37. KRIGE, L. J. *S.A. Journ. Sci.* 29 (1932) 25–40.
38. STEPHENSON, T. A. *J. Ecol.* 37 (1949) 289-305.
39. DAY, J. H., MILLARD, N. A. H., and BROEKHUYSEN, G. J. *Trans. Roy. Soc. S.Afr.* 34 (1953) 129–156.
40. MILLARD, N. A. H., and HARRISON, A. D. *Trans. Roy. Soc. S.Afr.* 34 (1953) 157–179.
41. STEPHENSON, T. A. *Journ. Ecol.* 40 (1952) 1–49.
42. STEPHENSON, T. A. *Ann. Natal. Mus.* 8 (1944) 261–358.
43. ALLEE, W. C. *Ecology* 4 (1923) 341–354.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF THE WITWATERSRAND,
JOHANNESBURG, SOUTH AFRICA.
(Accepted for publication, 17th September, 1954)

EMBRYOSAC DEVELOPMENT AND CHROMOSOME NUMBER IN VANILLA ROSCHERI FROM INHACA ISLAND

S. Krupko, G. F. Israelstam and Miss B. Martinovic

Preliminary Report

VANILLA ROSCHERI is an orchid of liana habit that grows on the island, on its west shore, facing Delagoa Bay. About 500 plants occur in close proximity. They have leafless green stems climbing on different trees and shrubs, aerial roots and large, beautiful flowers with a white corolla and a pink spot on the labellum.

Our investigation concerns only embryological and cytological features. Only one species of this genus has been previously investigated, *Vanilla planifolia* by Swamy.[1]

The megaspore mother cell develops from a subepidermal cell of the nucellus. The tetrads usually have a linear arrangement. The early megasporogenesis is peculiar in that the nucellus epidermis is soon destroyed and from the early stages the megaspores are not covered by any layer of the nucellus (Figs. 1 and 3). Therefore the mature embryosac even protrudes slightly above the level of the nucellus. The inner integument develops simultaneously with the megaspore mother cell. It covers the micropyle at the stage of the 2-nucleated embryosac (Fig. 2) and remains two cells thick. The external integument develops a little later. So far the development resembles that of *V. planifolia*.

In *V. roscheri*, as in many tropical orchids, the pollen grain tubes appear and grow long before the embryosac becomes mature, namely from m.m. cell stage.

The shape of the 8-nucleated embryo sac is rather irregular and tends to elongate towards the micropyle (Fig. 4). It has 8 nuclei at maturity, and thereby differs from *V. planifolia*, which according to Swamy has 6 nuclei. In *V. roscheri* only one 6-nucleated embryosac was found for every 15 embryosacs with 8 nuclei. A normal Polygonum type of development follows.

It is well known that seeds of the family Orchidaceae are the smallest among Angiosperms. At maturity the seeds are enclosed loosely by the integuments which are transparent and not specially thickened. There are only a few exceptions to this rule in the family and one of them is Vanilla. In both species mentioned, the seeds are dark brown or blackish. The thick seed coat develops from the external layer of the external integument and it is heavily lignified (Fig. 5). The remainder of the internal tegument is still present. The micropyle is still evident as a split between the integuments.

When the embryosac reaches maturity the cavity of the ovary is completely filled up with numerous thin-walled hairs (Fig. 5). Similar hairs, according to Swamy, produce and excrete vanillin in *Vanilla planifolia*. We have not yet tested our species for vanillin.