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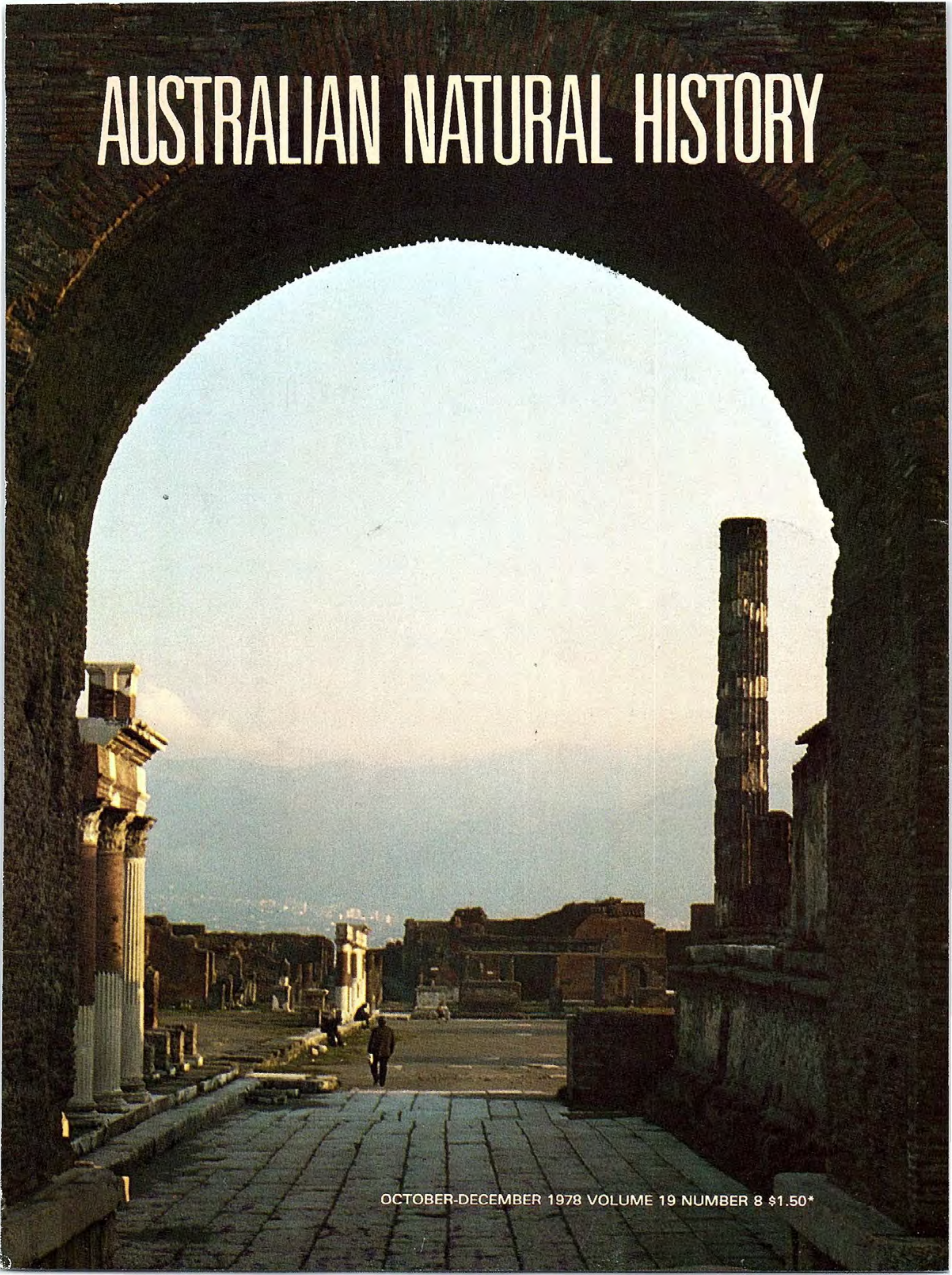

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AUSTRALIAN NATURAL HISTORY

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from THE APE WITHIN US

COVER: A view of the Forum at Pompeii, from the north. (Photo: Jean-Paul Descoeudres)

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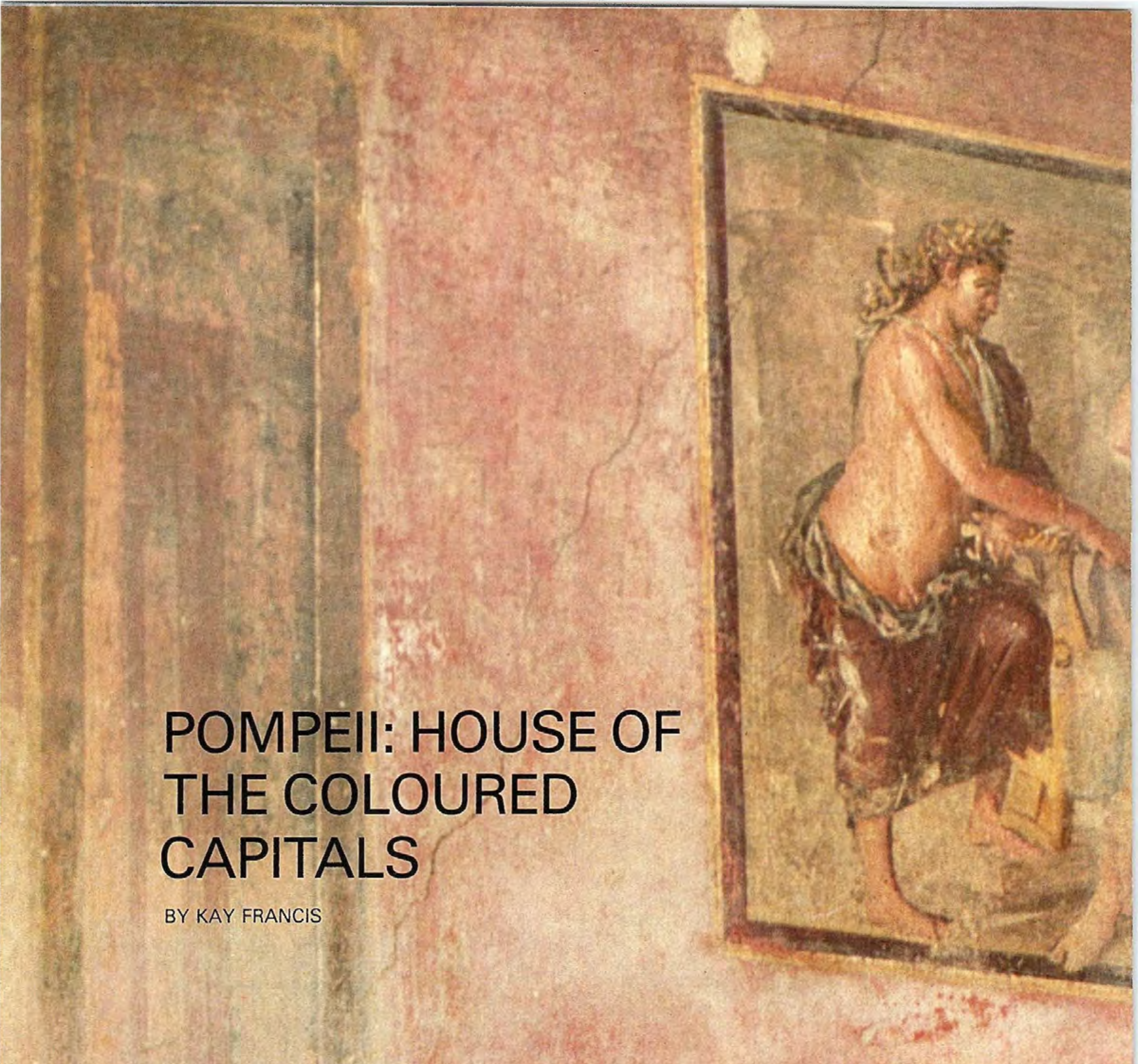

POMPEII: HOUSE OF THE COLOURED CAPITALS

BY KAY FRANCIS

Pompeii, just over twenty kilometres south of Naples, is one of the best known archaeological sites in the world. Buried by the eruption of Vesuvius in 79 AD, the site remained unnoticed and unharmed until regular excavations began in the early eighteenth century. It is not so much the uniqueness surrounding the circumstances of the destruction of the site of Pompeii, as the results of those circumstances that have given it a universal importance for the archaeologist and general public alike. The site offers a rare opportunity to study all aspects of life in a provincial Roman town—houses, temples, shops, markets, baths and streets are preserved, in many cases almost in their original state. Here is a town where one can study in detail the socio-economic, religious and political life of its inhabitants. Many of them are known by name, profession, political or religious convictions and their place in society. In many cases the owners of certain houses or properties within the city are known. Still preserved are the workshops and tools of many small businesses as well as their objects of daily use. In a standard archaeological situation, statements on many of these issues are no more than slender hypotheses and suppositions based on a few remaining traces. At Pompeii, however, the archaeologist has irrefutable evidence at his command to answer many questions that at most sites cannot even be considered:

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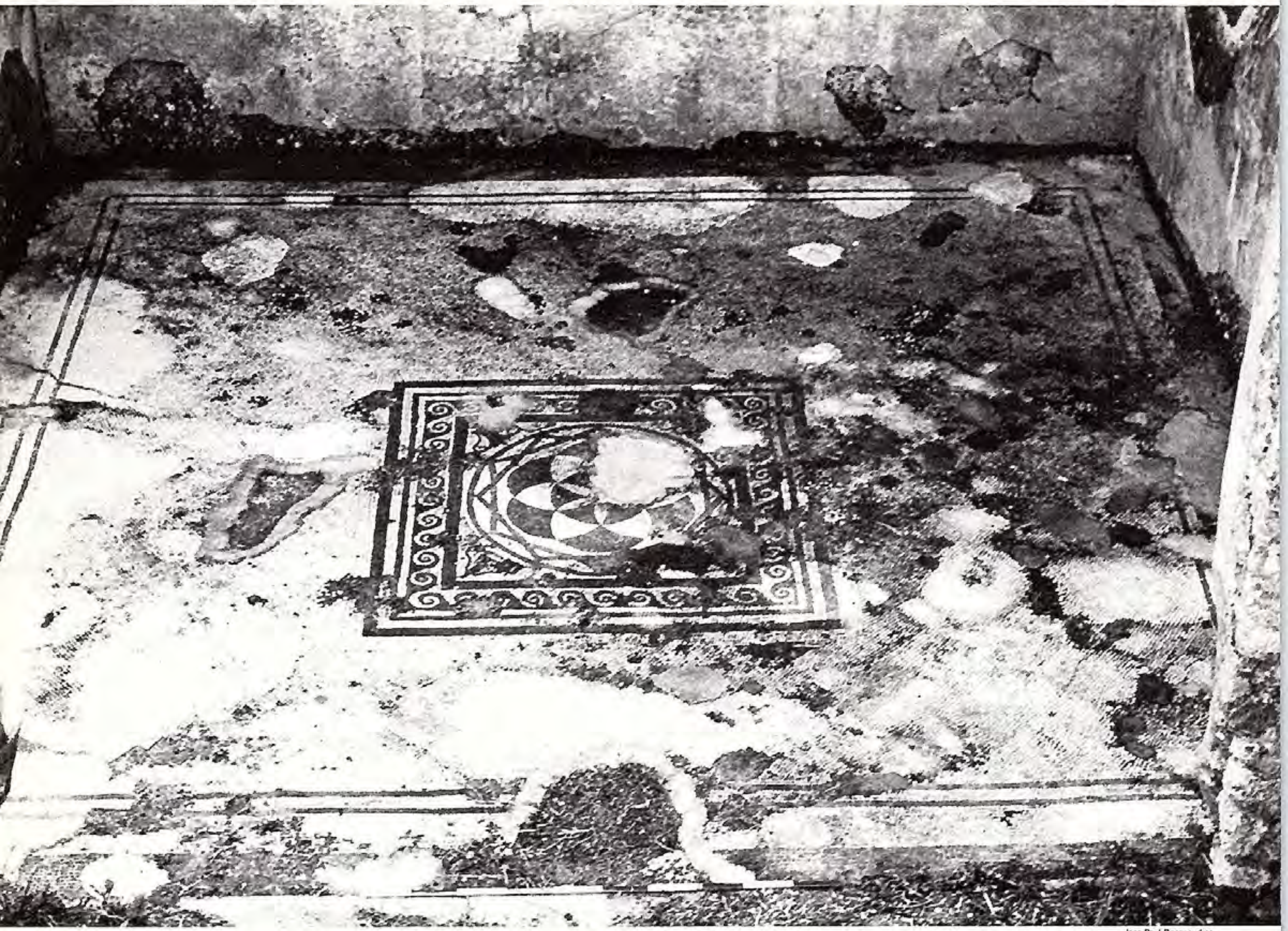
Jean-Paul Descoeudres

such as what was the distribution of wealth? what was the relationship between artists and patrons? and what functions did the various rooms in houses serve? The unique potential which Pompeii offers as a source of archaeological information has been fully acknowledged and frequently stated, but never explored. The site remains, scientifically speaking, largely unknown.

The greater part of the work at Pompeii was carried out in the eighteenth and nineteenth centuries. This age of treasure-hunting cared little for systematic excavation, scientific publication, or the questions of conservation. This age saw the wholesale excavation of structure after structure on the site in search of valuable 'objets d'art', including the expected dazzling array of mosaics, sculptures, paintings, jewellery, coins and bronze objects. No detailed excavation reports were produced; small finds, such as objects of daily use were rarely published and then only in lists with no record of their context or provenance. Today most are lost or cannot be identified. This age saw the destruction of a large portion of the mosaic floorings and painted wall decorations from the structures, as the paintings were not considered for their own unique value, but were thought to reflect lost masterpieces of Greek painting. For this reason, many of the mythological panels were cut out of the rooms and sent to grace the walls of museums throughout the world. Not only were those paintings robbed of their context without any record of their provenance, but the remaining sections of the painted decorations in which they originally occurred were considered to be of no importance and were left to fade or crumble. Consequently, despite the enormous amount of material the site pro-

One of the walls showing a well-preserved decoration, in the process of being cleaned.



Jean-Paul Descoeudres

A fairly well-preserved mosaic floor from an unroofed room that has suffered from the combined action of water and plant life.

vides, Pompeian wall painting remains a largely unexplored field of research. Only in recent times have altered research priorities led toward a re-assessment of the basic classification of Pompeian wall painting that was created in 1882.

Pompeii has been the victim of the fallacious conception that the archaeologist's role consists merely of excavation. The situation is such that archaeologists in many fields could be fully occupied for a generation or more, examining, processing and publishing previously excavated material without opening another excavation. It is difficult to believe that after almost 250 years of excavation we know so little about the archaeological nature of Pompeii. There has never been a systematic study of the site's wall paintings, mosaics, sculptures, stucco decorations or architecture. In fact an accurate plan of the site is still not available. In 1957, the first systematic record of Pompeian wall painting was made by Karl Schefold of the University of Basel. Twenty years later a survey carried out by Jean-Paul Descoeudres and the author showed that almost two-thirds of the painted decorations had been destroyed since the initial survey. Similarly, in the process of the last two hundred years of archaeological activity, approximately seven hundred houses have been uncovered. About ten of these are adequately published. Today only one hundred houses remain in a state of preservation that would allow their full recording and publication by an archaeologist.

A rapid pace of destruction is symptomatic of the entire site of Pompeii. The deterioration and the resulting loss of evidence has escalated in this century to such a degree that the greater part of the wall-decorations and mosaics of this unique site will be lost in the near future. The deterioration, destruction and loss of evidence from Pompeii has proceeded on many levels since the eighteenth century. In the early years of work on the site, archaeologists finding nothing of importance in one room of a house would re-fill that room with recently excavated ash. However, in the first decades of the nineteenth century, excavations were rarely filled in again and the immediate areas might be abandoned if valuable objects were not found. It was only later, with the introduction of more systematic excavations that remains were left uncovered. Many were restored, with stone blocks re-set or secured and fallen slabs of painted plaster replaced in their original positions. Although many of these buildings were left unroofed or were only partially roofed, protective slabs were placed over certain areas of the wall decorations. Unfortunately, such measures have proved only partially effective. As many floors, walls, painted plaster decorations and mosaics remained exposed they were thereby open to destruction by natural elements. Consequently, this caused many of the mosaics to loosen or break up, the naked masonry to crack and crumble, and the painted plaster and stuccoes to fade or fall from the walls.

One of the conservation problems that has arisen in conjunction with this natural destruction is a phenomenon commonly encountered with ancient fresco painting. The walls of ancient structures attract moisture that reacts with the alkaline elements in the masonry composition to produce soluble salts. During dry periods these salts migrate to the evaporation surface of the wall pushing through the paint layer as they crystallise out as a white snowy crust obliterating surface detail. In time the action of these salts causes the paint to flake off followed by severe crumbling and erosion of the underlying masonry.

Today, excavation in the Campanian zone, as elsewhere in Italy is limited and controlled. While more extensive long-term conservation measures are now used, such as the erection of roofs over excavated structures or the covering of mosaics with sand, it has not always been possible to cope with the enormity and variety of the problems inherited from earlier generations. Pompeii is one of a limited number of sites across the world where the general public are allowed almost complete freedom to explore the remains of an ancient environment. Hence, like all its sister sites, Pompeii has suffered for its accessibility and tourist interest. Despite extensive security both petty robbery and acts of vandalism are common. Similarly, the black-market antiquities trade has increased both the temptations and the rewards of theft.

It would be beyond the scope of the archaeologist to halt the process of destruction of the site of Pompeii. In an effort to salvage as much as possible of the archaeological record of the site, various international archaeological teams from Italy, Germany, Holland and Australia are at present working on a variety of rescue projects. The work of the Australian Expedition to Pompeii is comparable to that of the other international teams. The expedition is part of a long term programme that aims to examine, record and publish in detail all aspects of the remaining houses still available for study. During a three or four week period each year the team works on the site to complete the full documentation of a single house, including its architectural features, painted decoration, mosaics, sculptures, inscriptions, graffiti and small finds. While the programme is conceived as a rescue project, it aims to establish a basic body of material from which further detailed analyses of single houses from architectural, artistic and sociological points of view, can proceed in the future.

In May 1978, the Australian team began work on the so-called House of the Coloured Capitals, otherwise known as the House of Ariadne. Although the House was excavated in the 1830s, it has never been fully or scientifically published. Certain portions of the House's record are now lost; however, there is enough remaining of its many wall paintings, mosaics and unusual architectural structure to warrant swift, concerted action before further destruction can take place. As the House contains over fifty rooms, work will be resumed in May 1979.

The Australian Expedition as an independent team, works alongside the German team from the Archaeological Institute in Berlin. The Germans have been working on a similar project since 1975 and have completed work on three houses in Pompeii. Not only have they allowed the Australian team an opportunity to observe their recording procedures, they have also offered the assistance of their technicians, including their photographer and conservator. Through such cooperation, it is hoped that the recording of Pompeian houses will, for the first time, become a systematised process.

The work began with the creation of a complete

Jean-Paul Descoeudres

Although the *opus signinum* floor of this room was uncovered in a fair state of preservation, the wall decorations had deteriorated badly.

Jean-Paul Descoeudres

A typical view of one of the many rooms that have lost their painted plaster facings, leaving the structure of the walls exposed. It is shown here before clearing.

dossier of all prior research or work on the House. This included the original excavation reports, lists of finds, the location of any illustrations (sketches, etchings and water colours) that were executed at various times since the House's discovery, the location and recording of paintings or mosaics that have been removed from the house and are housed in the collection of the National Museum in Naples. In many cases, this involves the difficult task of sifting through unindexed works or collections where no indication of provenance is given and, in some cases, material that can no longer be identified with certainty.

Before work could proceed on site, the House had to be cleared of the heavy undergrowth that has engulfed so many of the structures that are not open to the public. Moreover, in many rooms the floors were covered by an accumulation of modern debris and earth, in some cases up to a depth of twenty centimetres. This had to be removed carefully in order to study the pavements and mosaics beneath. It was necessary to open small soundings to understand various aspects of the House's structure as it changed through time, such as the thresholds. At present, all the areas that were uncovered are protected by plastic sheeting and in the rooms remaining to be examined, the same problems are anticipated.

With the house cleared, the architect, R. Apperly, was able to complete a plan of the house. A separate plan for all the decorated floors or mosaics is also to be produced. This is to be used in conjunction with the standard mosaic density counts made this year. (A mosaic density count involves the taking of ten centimetre square sample counts of the number of tessarae — the small pieces of stone or glass that make up a mosaic. This standard procedure for the recording of mosaics is a criterion used to classify mosaics and can also be used to date them and to assess their quality.)

Traditional recording procedures are used in the project, such as detailed written descriptions of every architectural or decorative feature of each room. However, more recent objective methods for recording have also been put into practice. The House of the Coloured Capitals is a typical Pompeian structure. Built in the second century BC, it saw continued use until 79 AD. During the long period of usage, the structure of the house saw many changes, alterations and reconstructions. In order to clearly establish the nature of these changes through time, a systematic examination of the building materials, including the taking of plaster and mortar samples was made by the conservator, R. Meyer-Graft. For those walls with no remaining plaster facings, photographs and section drawings were made. Moreover, the conservator carried out examinations of the painted wall decorations in damaged or faded areas of the walls to accurately record all original colours and the relationships in time between the decorations and the architectural features in certain rooms.

The most exciting aspect of the team's work relates to the recording of the wall paintings. Until now, the methods of recording and publishing the paintings have been highly unsatisfactory. During the earlier part of work on the site, this was by means of sketches or drawings that often resulted in highly subjective and inaccurate records. In more recent years, the tendency has been to use black and white photography. These give no indication of the colour schemes and fail to reproduce any details in damaged or faded areas of the wall; however, the German team has devised a systematic and relatively objective method for recording wall paintings that has also been used by the Australian team.

To begin with, the walls are cleaned, a procedure in itself that allows one to record much more than was previously possible. A recent breakthrough devised by Meyer is a particular spray mixture that when applied to the walls, makes visible, paintings that have faded or that are almost invisible. Sprayed onto the walls, the solution temporarily clarifies the underlying detail. Before the solution has dried, the walls are photographed in a manner similar to photogrammetry (that is to say they are photographed in a technique which eliminates distortion almost completely). If necessary, infra-red photographs are taken of details. As certain details are so faded or damaged they would not reproduce clearly in the black and white photographs, they are recorded in tracings and additional colour photographs. Then a photo-montage of each wall is produced and traced by the draughtswoman, J. Slatyer. Her drawing indicates the lost portions of the wall and those that can be reconstructed from the remaining traces. At the same time, additions of details are made from the tracings taken *in situ,* photographs and old illustrative sources. Also included in the final drawings are those parts of the walls that were removed to the Naples Museum. In the final publication, the colours will be rendered in various shades of grey and the drawings are to be accompanied by coloured photographs of specific details.

The conservation and maintenance of the site of Pompeii is now an impossible task. The Italian authorities are engaged in continual partial restoration work directed at the most immediate problem areas as they occur all over the site. The Australian programme is at present unable to finance any conservation activity other than the basic clearing and cleaning of certain parts of the houses so that they can be fully recorded. However, it is hoped that with increased financial support, conservation will become part of the programme.

The House of the Coloured Capitals is but one of a limited number of houses on the site of Pompeii that can be studied in detail, if there is time. In the same way, Pompeii is but one of many sites across the world endangered by modern circumstances of destruction. These sites demand that the archaeologist radically alter his priorities in the field from excavation towards rescue.

The 'Australian Expedition to Pompeii' is funded by a grant from the Australian Research Grants Committee. The programme was initiated and is directed by Dr Jean-Paul Descoeudres, Department of Archaeology, University of Sydney. Dr Ian McPhee of La Trobe University and Dr Frank Sear of Adelaide University are co-directors. The team includes an architect, Mr Richard Apperly, of the University of New South Wales and a draughtswoman, Jenny Slatyer. The Australian Team works alongside a team of German scholars from the Archaeological Institute of Berlin, led by Professor V.M. Strocka. The House of the Coloured Capitals will eventually be published in an international series to be edited by the German Institute.

Jean Paul Descoeudres

A general view of a portion of the House of the Coloured Capitals, looking to the south.

SERPENTS OF AUSTRALIAN SEAS

BY HAROLD COGGER AND HAROLD HEATWOLE

Sea snakes are found mainly in tropical and subtropical waters. Very few species enter cooler regions, and then only because they are carried there accidentally by currents. Australian waters and the adjacent seas of Southeast Asia are the richest in the world for sea snakes. There are approximately fifty species known, of which more than half occur in tropical Australia. As one proceeds west along the Indo-Asian coast, or northeast to Japan, the number of sea snake species decreases markedly. Only one, the Yellow-Bellied Sea Snake, has a habitat range which extends completely across the Indian Ocean to East Africa and across the Pacific to the west coast of the Americas. There are no sea snakes in the Atlantic Ocean or the Caribbean Sea. Thus, Australasia can be considered the 'headquarters' of sea snakes. Indeed it was probably the area in which they originated and from which they spread.

There are two main groups of sea snakes. One is believed to have originated from an Australian group of land snakes of the family Elapidae, and came to form what are known as true sea snakes (family Hydrophiidae). The other, known as sea kraits (family Laticaudidae), probably evolved independently from a different section of the elapids in Southeast Asia. These two groups, although they lack a common marine ancestor, share some similar aquatic adaptations such as a flattened, paddle-shaped tail which assists swimming. True sea snakes also have nostril valves which can be closed underwater. Sea kraits and true sea snakes differ in one very important aspect, however. The sea kraits are egg-layers and must come ashore to reproduce. Some species come ashore during daylight hours and seek shelter in rock crevices on land. By contrast, the true sea snakes are completely aquatic; they bear live young in the water, and never voluntarily come out on land.

The Turtle-Headed Sea Snake, *Emydocephalus annulatus*, is virtually confined to Australian waters.

In addition to the above two groups, there are a few species of otherwise predominantly freshwater groups which occasionally occupy brackish or marine habitats: file snakes, family Acrochordidae, and colubrid snakes of the subfamilies Homalopsinae and Natricinae.

How do sea snakes and sea kraits cope with the salinity of the marine environment? Most land snakes will die if kept in sea water for prolonged periods because their kidneys cannot excrete concentrated urine and they are unable to get rid of excess salts. Sea snakes, however, have a small gland called the sublingual gland which is situated on the floor of the mouth below the tongue sheath. The gland excretes a concentrated brine into the tongue sheath, and each time the snake protrudes its tongue, the brine with its contained salt is discharged back into the sea. No land snakes possess such a gland.

A number of reptiles that live in habitats where salt excretion is a problem because of the excessively high salt content in the water have evolved a variety of salt

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Ron Taylor

Of the sea snakes encountered in the underwater landscape of the Great Barrier Reef, the Olive Sea Snake, *Aipysurus laevis*, predominates.

secreting glands. For example, the granulated file snake which sometimes lives in the sea, has a similar gland; sea turtles have a salt secreting gland in the eye socket; and some lizards, including a marine species have one emptying into the nasal passage.

Another important gland for true sea snakes and sea kraits is the venom gland. All members of both groups are venomous. Since they lack limbs to hold or subdue their prey, venom is a distinct advantage. Venom also has a digestive function. Except for the Yellow-Bellied Sea Snake which lives at the water surface and often catches small fish seeking shade under it, sea snakes catch their food on the sea floor. They usually forage over the bottom, examining crevices or burrows with the tongue which serves as an organ of smell. When they detect a fish they bite, inject venom and hold onto it for the short period required for the prey to become paralysed or to die. Often they then move around and examine it with their tongue as though measuring to see if it is small enough to be swallowed. They begin at the head end, swallowing it head first, bending the fins backward in the process in a manner reducing the danger of injury from fin spines. Almost all sea snake species are fish eaters, although each species has its own preference of prey species, some for example feeding almost exclusively on eels. Like land snakes, sea snakes can swallow food larger in diameter than their own head and in some cases have been observed to swallow eels nearly their own length. There are some exceptions to a fish diet among sea snakes. A few species feed entirely on fish eggs which they find in the sand; they have reduced fangs and venom glands.

Although venom probably arose primarily as an aid to feeding and digestion, it secondarily serves in defence and many are potentially lethal to man. Some species are extremely gentle and have never been known to attempt to bite a human, even when roughly handled, and most have to be handled or severely provoked to bite. However, some species are very quick to bite when molested and kill hundreds of fishermen each year in Southeast Asia. Bites usually occur when the snakes are trodden on during seining (fishing using a long, weighted net called a 'seine') in shallow, muddy water, or when they are being extracted from nets. Only two fatalities have ever been reported in Australia, due to the small numbers of humans in tropical areas and because of different fishing methods in Australia and Southeast Asia.

The venom of most sea snakes is extremely toxic to humans and a number of species have venom many times more potent than the most toxic land snakes. The action of the venom is mainly upon the muscles, causing breakdown of the fibres and leading to complete paralysis and eventually to death. Early symptoms of severe poisoning are the passing of red urine (due to products of muscle breakdown) and drooping of the eyelids. This is followed by a severe muscular pain when a limb is even passively moved; should a person recover there is often permanent damage to the muscles, heart or kidney. Effective antivenenes are available and even tiger snake antivenene can result in a cure.

Sea snakes have only one lung, but it begins in the neck and extends all the way to the far end of the body cavity. The front part has many blood vessels and is used in the exchange of oxygen for carbon dioxide. The back part is a membraneous sac and could not be used for that purpose. It may be a storage area—snakes which have had it surgically tied off cannot remain submerged as long as those with it intact.

H.G. Cogger

The Yellow-Bellied Sea Snake, *Pelamis platurus*, is the best known and most widely distributed sea snake found in Australian waters.

Perhaps the most amazing characteristic of sea snakes is their diving ability. Although different species dive to different depths and stay submerged for different lengths of time, the maximum capacity seems to be a depth of one hundred metres and a voluntary submergence time of two hours. Sea snakes commonly stay down for half an hour, and not uncommonly for an hour. Being air-breathing animals, how can they perform such feats? One of the main factors responsible is their ability to also breathe through their skin. Land snakes can absorb some oxygen from the water through their skin but sea snakes are much more effective, with some species obtaining up to one third of their total oxygen requirements and releasing nearly all their carbon dioxide by this means. When they do take a breath at the surface their heart speeds up and aids in a rapid oxygen intake from the lung. Normally they do not build up an 'oxygen debt' as do most other air-breathing divers such as ducks, seals, penguins and whales.

The permeability of the skin to dissolved gases also means that sea snakes never get the bends. As they dive, the nitrogen in the air compressed in their lungs probably dissolves in their blood but it passes out through the skin to the sea water rather than accumulating in the blood stream. Consequently, when they surface there is no excess nitrogen to come out of the blood as bubbles and cause the bends. There may be additional, as yet undiscovered, adaptations of a respiratory nature, which aid in preventing the bends.

What kinds of sea snakes are likely to be encountered in Australian waters? Fortunately, the majority of the thirty-two species recorded from Australian waters are restricted to the tropics and are rarely seen by anyone but prawn trawlermen and divers; indeed, some species are known from only a handful of specimens collected over the last century.

Undoubtedly the best known of all sea snakes is the Yellow-Bellied Sea Snake *Pelamis platurus.* It is the most widely distributed and most frequently encountered sea snake, often found off the beaches around Sydney. Its black or dark brown upper half is sharply delineated from the bright yellow to pale brown lower half, while the yellow paddle tail is barred and spotted with black. This striking colour pattern is unique; also unusual is this species' greater abundance, at least in the Australian region, in temperate rather than in tropical waters.

Except for the occasional summer stray, other sea snakes are virtually unknown along the southern coast of Australia, for most species are more or less confined to the tropics. In the clear offshore waters of the Great Barrier Reef, one species usually dominates the underwater landscape — the Olive Sea Snake *Aipysurus laevis,* which varies in colour from dark brown to pale olive, sometimes with patches of cream and white scales. It is also found on coral reefs across northern Australia to the reefs of the Northwest Shelf, and prefers those clear and relatively shallow reef waters chosen by divers. Although not aggressive, it is large (up to two metres), and being curious will readily approach divers and twine around them and their gear. Not surprisingly, it is feared by divers because there is a high risk of being bitten when they try to disentangle themselves from the snake coils. A close relative of the Olive Sea Snake is the small, colourful *Aipysurus duboisii.* Ranging from dark chocolate brown to rich salmon in colour this species is also found in clearer reef waters from northwestern Australia to New Caledonia but is more timid and secretive than the Olive Sea Snake.

Probably the most remarkable of all sea snake populations is that which occurs on a complex of reefs on the outer Sahul Shelf of northwestern Australia. On these reefs, of which Ashmore Reef is the most extensive, are found more than a dozen sea snake species including five different species of *Aipysurus.* Not only is there a great variety, but they occur in such large numbers that whenever one cares to dive overboard from a dinghy on the reef, several snakes can be seen foraging within the area of one's immediate vision.

Closely allied to *Aipysurus* is the Turtle-Headed Sea Snake, *Emydocephalus annulatus,* which is a moderate-sized species (up to one metre long) virtually confined to Australian seas. Its teeth, including the fangs, are vestigial and this snake has adopted the highly specialised habit of preying solely on the eggs of bottom-dwelling fishes—especially gobies which lay their eggs in sandy burrows. One interesting feature of this sea snake is the presence, in males only, of a large spine on the tip of the snout. The spine function is unknown.

H.G. Cogger

Sea krait, *Laticauda colubrina,* found off Kadavu, Fiji.

Some sea snakes prefer deeper water than that which occurs over a reef or at the reef edge. One such group is found most abundantly in turbid inshore waters over muddy bottoms, or further offshore when the same conditions extend over large areas, such as in the lower end of the Gulf of Carpentaria. In these situations, two species are especially abundant. One, *Lapemis hardwickii,* is a heavily-built snake in which the male develops grossly enlarged tubercles and spines on the belly scales. Although it is sometimes found in clear reef waters it seems to prefer turbid conditions and is commonly trawled in the Gulf of Carpentaria or the inshore waters along the Great Barrier Reef.

The Elegant Sea Snake *Hydrophis elegans* is found in similar conditions but looks very different. It reaches more than two metres in length, has a relatively small

H.G. Cogger

Emydocephalus annulatus, close-up. Note the large spine on the tip of the snout. This appears in males only; its function is still unknown.

head and slender upper trunk, while the rear half of the body is expanded to several times the diameter of the front half. The Elegant Sea Snake is widely distributed in northern Australian waters, but late summer strays are often found along the coast of New South Wales, presumably riding the East Australian Current which carries Barrier Reef waters far south at that time of year.

Another group of deeper water species prefers the clearer oceanic waters which bathe many coral reefs. Several of these, like the Elegant Sea Snake, have the forward half of the body much more slender than the rear half. Most are known to feed on eels which live in burrows on the sandy bottom. Their tiny heads and slender necks are believed to be an adaptation which

enables them to penetrate the eel's narrow burrows to quickly immobilise the fish with their potent venom.

Equalling the Olive Sea Snake in length, but greatly exceeding its bulk, is *Astrotia stokesii.* Nowhere especially abundant, it ranges widely through a variety of habitats, including turbid shallow coastal waters where it is often seen 'basking' or swimming lazily on the surface. Usually grey to black above, it has a massive body and head with large venom glands which yield large quantities of venom, comparable in volume to those produced by the larger venomous land snakes.

Finally, there is a group of small sea snakes—individuals rarely exceeding half a metre in length—which are usually found in mangrove-lined estuaries or coastal mud flats. These snakes are rarely seen, probably because not many people spend time in this uncomfortable environment, but the few existing records are widely scattered along the north coast of Australia. Sea snakes in this group are members of the genera *Hydrelaps* and *Ephalophis.*

H.G. Cogger

Aipysurus laevis, is here shown blinded by goose-necked barnacles. Eventually the outer skin is shed, and vision returns.

As mentioned earlier, the group of banded sea snakes known as sea kraits are usually regarded as a separate family which originated independently of the true sea snakes. Although stray specimens occasionally reach the east coast of Australia, records are few and most sea kraits occur on the islands of the southwest Pacific and on the eastern and northern coasts of New Guinea and Asia. On islands such as New Caledonia and Fiji, sea kraits occur in enormous numbers and large colonies are found in rocky and coral crevices well away from the sea. Two species are recorded from Australian waters—*Laticauda laticaudata* and *Laticauda colubrina.* They are similar in appearance, with alternate bands of pale blue-grey and black.

Little is known of the natural history of individual species in Australia's rich sea snake fauna. The factors influencing their distribution and abundance are poorly understood while their venomous nature and specialised habits make them unattractive subjects for field research to all but a handful of enthusiastic herpetologists.

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EXPLORING SOFT BOTTOMS IN ANT

BY JOHN OLIVER

Edmund F. O'Connor

Crinoids perched on a volcano sponge, which is one metre tall.

Antarctica is a cold, quiet continent covered with a thick crust of snow and ice. Its frozen blanket conceals ninety-five percent of the land surface and is about three kilometres deep at the South Pole. The few rocky outcrops are located along the coastal borderlands, where giant ice streams flow into the surrounding sea. The edges of these floating glaciers split and metamorphose into drifting icebergs. Antarctic contrasts among rock, ice, snow, sea and sky are awesome and beautiful.

No other continent in the world supports so few biological organisms. Only some bacteria, lichens, mosses, mites, and a handful of beetles live on the ice-free patches of land. Several algae have escaped the harsh, dry climate by living deep in the interior of porous rocks. Temporary ponds also harbour a few tiny plants and animals. Vertebrate visitors are totally dependent upon the sea and are common only during the warmer summer months. These include seabirds, penguins, and seals. Even in the presence of these fantastic creatures, the land appears rugged and lifeless.

The coastal sea life, unlike the terrestrial communities, is amazingly abundant and diverse. A short plunge into the chilly nearshore waters reveals a rich marine invertebrate fauna. Antarctic diving is quite different from diving elsewhere. Conventional wet suits are replaced by dry suits that use an insulating layer of air between the skin and suit. The greatest source of potential discomfort, a cold hand, is avoided by wearing two gloves filled with hot water. Each diver also carries double scuba tanks on his back and a small pony tank on his arm.

JOHN OLIVER is a graduate student at Scripps Institution of Oceanography and has spent a total of twenty months involved in ecological research in the Antarctic during the last four years. He is currently studying the processes affecting larval dispersal, habitat selection, and recruitment of benthic invertebrates at the Moss Landing Marine Laboratories in central California.

RCTICA

Although single-hose regulators freeze open in the cold antarctic waters (−2°), the older double-hose regulators are essentially immune from malfunction because water does not contact the critical mechanical parts.

The most significant antarctic diving problem is not the cold water: it is the two-metre thick layer of sea ice. At least forty sticks of dynamite are required to blast an entrance hole large enough for several divers and a friendly Weddell seal. These seals are immediately attracted to a new breathing hole, but never disrupt the diving operations. The behaviour of the Weddell seals is quite different from the aggressive leopard seals that have terrorised divers in northern pack-ice habitats.

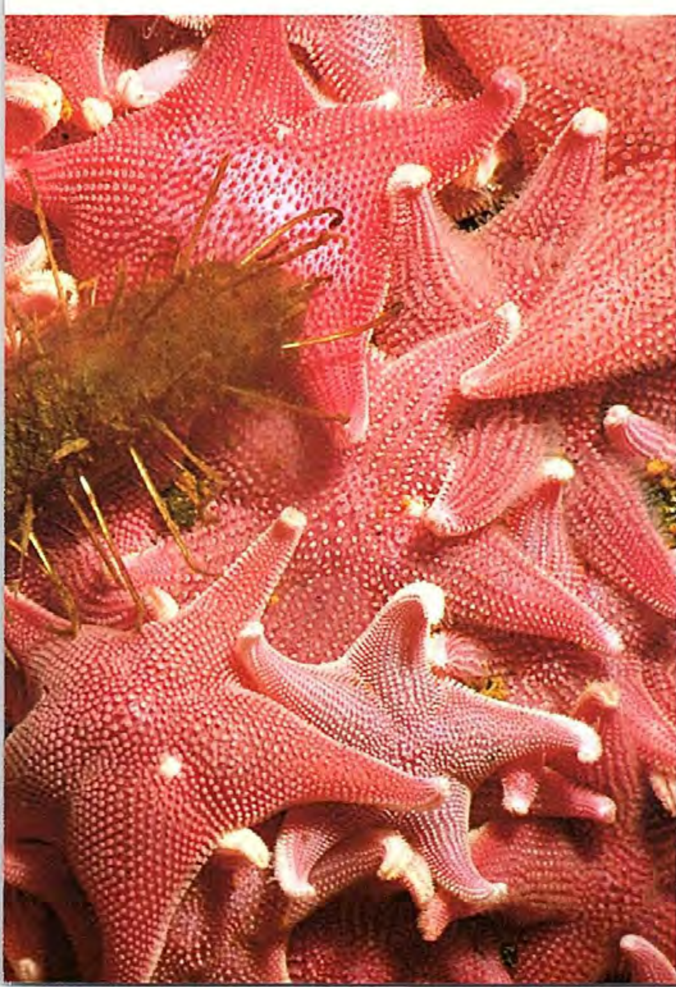
After descending through a blasted dive hole, an omnipresent reality emerges. This is the ony way out! Happily, the water clarity is excellent (greater than 200 metres) and the dive hole is as bright as a torch in a dark room. The heavy sea ice cover makes it essential that every dive is thoroughly planned and executed with constant thought to safety. As a result, no diving accidents have occurred in several thousand man-dives into the Ross Sea.

Edmund F. O'Connor

Large sea anemone with a starfish perched on the base. It is not eating the anemone.

The shallow-water antarctic environment is well known for its similarity to deep-water habitats. Water temperature is extremely cold, the physical and chemical environment is relatively constant, and physical disruptions are mild (for example, wave disturbances are dampened by the heavy sea ice). The frozen continent also prevents strong terrestrial influences such as river runoff. The great dissimilarity between the deep-sea and shallow-water antarctic environments is the large summer bloom of phytoplankton in the Southern Ocean. As a result, antarctic sea bottoms are usually well fed and thus contain a large number and mass of animals. The primary food sources are tiny algae (diatoms) that have high growth rates during the bright summer months.

Several unique marine biological communities are found only in the Antarctic. Our studies have focused on



Edmund F. O'Connor

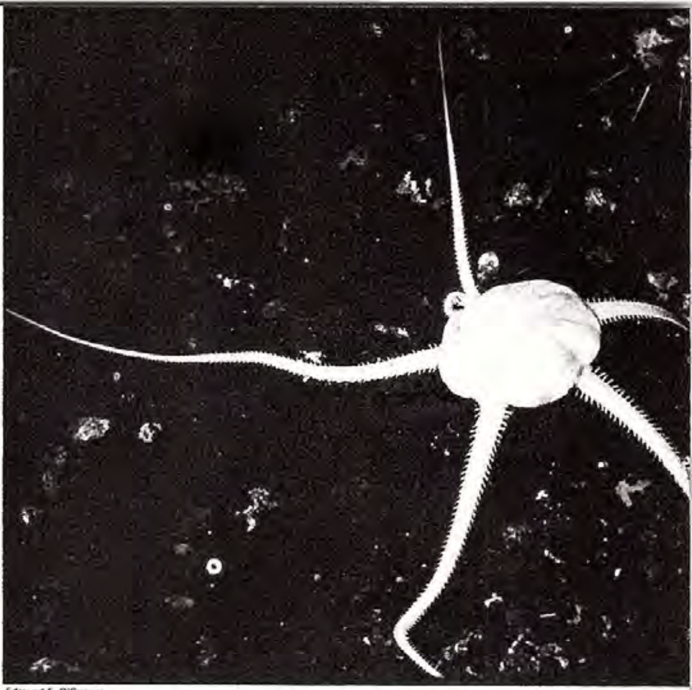
Patch of starfish with a flabelligerid polychaete on top. In well-fed areas this starfish covers the shallow sea bottom.

Edmund F. O'Connor

The face of Hobbs Glacier. It is about 25 metres tall.

three of these. Perhaps the most bizarre animals live in the silicious sponge community. The large volcano sponges, typifying this assemblage, can be more than two metres tall. Silicious sponges are primarily restricted to cold marine waters, found in the deep oceans and in the Antarctic. Because light does not penetrate into deep water, little primary plant food is available and deep sea sponges are rare. In contrast, antarctic sponges are well fed and extremely abundant. The insoluble and indigestible silicious spicules, rod-like structures which form the internal framework of sponges, accumulate on the sea bottom and form a thick mat over the basement rock. This porous layer has a complex micro-structure and supports a heavy growth of diatoms and a tremendous number of protozoans, worms, and crustaceans. Almost every major group of marine invertebrate is found in the sponge spicule community.

Most ocean bottoms are covered by soft sediments such as mud and sand. This is true also in the Antarctic, where the sponge spicule substrate covers only a small fraction of the shallow sea bottom. The common shallow-water Antarctic soft-bottom community is the densest in the world, containing up to 150,000 animals per square metre. It differs from all other dense infaunal assemblages in having many abundant species rather than just one or two numerical dominants. Polychaete worms, crustaceans, and a few bivalves are the major inhabitants, most of which are smaller than a centimetre.



Edmund F. O'Connor

The worm populations living in this dense assemblage have a distinct age-class structure. These populations contain many large adults, whereas younger individuals are rare. The age-class structure is maintained by high juvenile death rates that are especially pronounced in the soft-bodied polychaete worms. On the other hand, few significant predators feed on the larger worms and adult death rates are low. Much of the juvenile death rate is caused by a relatively large amphipod (five millimetres long) which consumes and tramples the smaller individuals of the soft-bodied species. The few surviving young, however, grow much larger than the crustaceans and reach an effective size refuge from the intensive sources of early mortality. One of the most abundant polychaete worms reproduces primarily by asexual fission, creating two large animals that are unaffected by the hungry-trampling rampage of the crustaceans.

Two other factors are important to the survival of the dense soft-bottom community. It is best developed in areas that are protected from scour by icebergs, the only important physical process that regularly perturbs the sea bottom below the depth of bottom ice growth (about ten metres). Iceberg scouring also restricts the development of the sponge spicule community.

J.S. Oliver

Peter N. Slattery, of the Moss Landing Marine Laboratories, standing next to a large volcano sponge in 30 metres of water at Cape Roberta.

A deep-sea like ophiuroid from the poorly fed area of the McMurdo Sound.

The second factor is the absence of disruptive bottom-feeding fishes and mammals. Only a few fishes can resist the extremely low temperatures of antarctic waters (−2°). These fish have an organic antifreeze that interrupts ice crystallisation. Freezing is not a problem among invertebrates because their body fluids have the same salt concentration as the surrounding water. The antarctic fishes that live on the bottom are small sculpin-like creatures that do not grovel into the sediment. They feed at the bottom surface and in the water above the bottom. More disruptive fishes, such as skates, rays, flatfish, and perch (to name a few), disturb large bottom areas by their feeding activities. This is also true of mammals such as the grey whale and the walrus. None of these highly disruptive bottom-feeding animals live in the Antarctic. If they did, the dense soft-bottom community would not exist.

Another unique soft-bottom community occurs in the southwestern part of the McMurdo Sound, a region that does not have a seasonal bloom of water column or bottom plant growth which characterises most Antarctic coasts. The bloom does not develop because the area is bathed by a current that comes from under the permanently thick Ross Ice Shelf and because the temporary sea-ice cover does not break out each year. Both situations restrict plant growth by reducing the incoming light. Consequently, the sea bottom is poorly fed and the invertebrate communities resemble those found in much deeper water. This soft-bottom community is more similar to deep-water assemblages than any other shallow-water community in the world. Although the antarctic animals are clearly shallow-water species, they show striking ecological parallels to deep-water species. The large ophiuroids, the dominant surface-dwelling invertebrate, are almost indistinguishable in density, morphology, and spatial patterns from the common deep-slope species. Both habitats are also characterised by large arborescent foams, infaunal tunicates, pterobranchs, lysianassid amphipods, and paraonid, cirratulid, and orbiniid polychaetes.

These three unique sea-bottom communities—the sponge spicule community, the dense soft-bottom assemblage, and the deep-sea-like soft-bottom community—are all found in a small corner of the Ross Sea in the McMurdo Sound. Studying the communities from this remote region is helping to unravel the many processes responsible for the complex organisation of sea bottom communities throughout the world.

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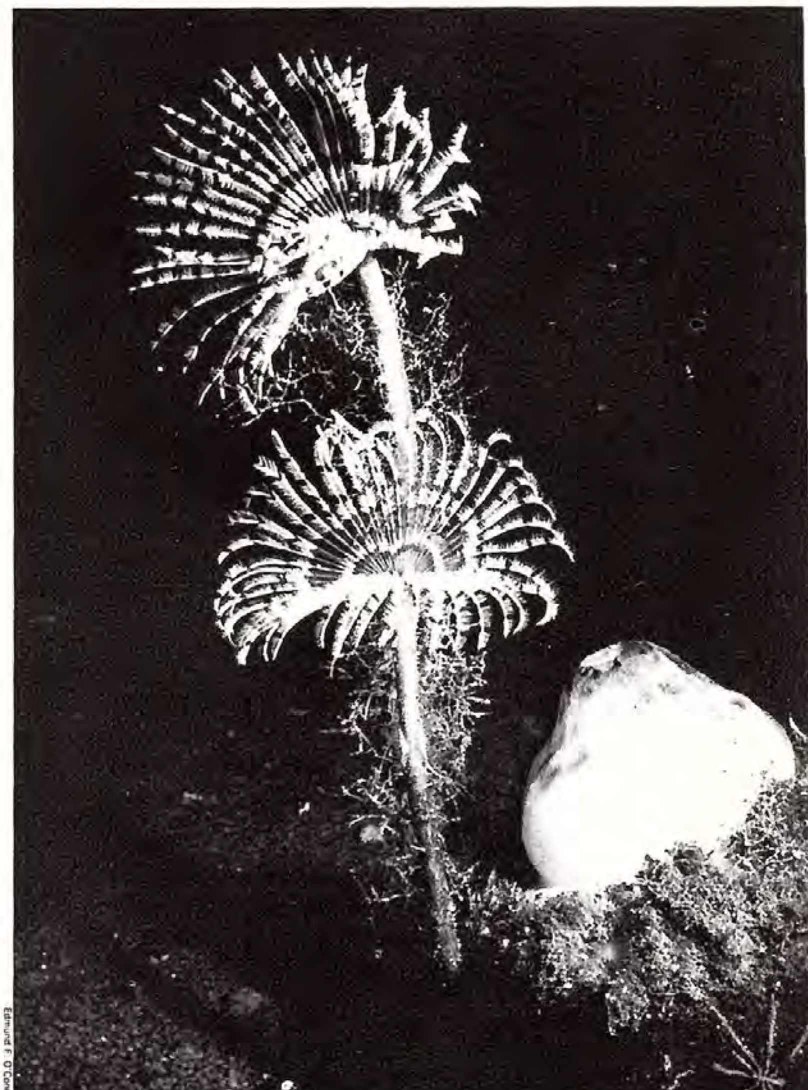

Edmund F. O'Connor

Two sabellid polychaetes and a cone sponge being scaled by a sea spider

All of our work was made possible by grants from the United States National Science Foundation, Division of Polar Programmes to Paul K. Dayton of the Scripps Institution of Oceanography, California. Most of the photographs are the artistry of Edmund F. O'Connor.

TO SPY ON A DESERT SKINK

BY PAUL WEBBER

Rosèn's Desert Skink *Egernia inornata* was first described by Nils Rosèn of Lund, Sweden, in 1905. As was unfortunately rather common in those days, the locality of the specimen was given vaguely as "Western Australia". Seventy-four years later, casual observations on the lizard have added little to the general knowledge of either its behaviour or ecology. It is a medium-sized lizard, the adult averaging 160mm total length. Generally thought to be solitary, it lives in a burrow system from which it feeds on passing insects. It inhabits a variety of arid habitats from western NSW to the coast of Western Australia. The burrow entrance may be found at the base of vegetation, fallen timber or rocks; at least one burrow mouth is thought to face in an easterly direction, and the terminal end of the burrow extends to just below the soil crust, the lizard effecting an escape through this if pursued by a predator. Supposedly the skink gives birth to two live young, and is unable to withstand temperatures below about 9.5-10°C or above 41.5-42.8°C.

These observations raise a number of questions. If it is a solitary animal, how does mating occur? In its known environment, the temperatures vary both above and below its critical maximum and minimum body temperatures—how does it thermoregulate and what happens to the young? The burrow is an integral part of its existence; what are the parameters necessary for its position and structure? Finally, are the casual observations correct, or were atypical specimens observed?

Trying to answer some of these questions a study trip was made to a fairly remote mallee/spinifex area in NSW on the far eastern edge of the lizards' known range where they occur in reasonable numbers. The first problem was to locate a fairly typical burrow system in their natural habitat, thereby ignoring a number of active burrows made in the spoil of a passing road grader! The burrow system selected had three main entrances (some have only one, others up to four or even five). As these lizards are wary and shy a hide was established as close

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H.G. Cogger

Rosèn's Desert Skink, *Egernia inornata*, at Round Hill, NSW.

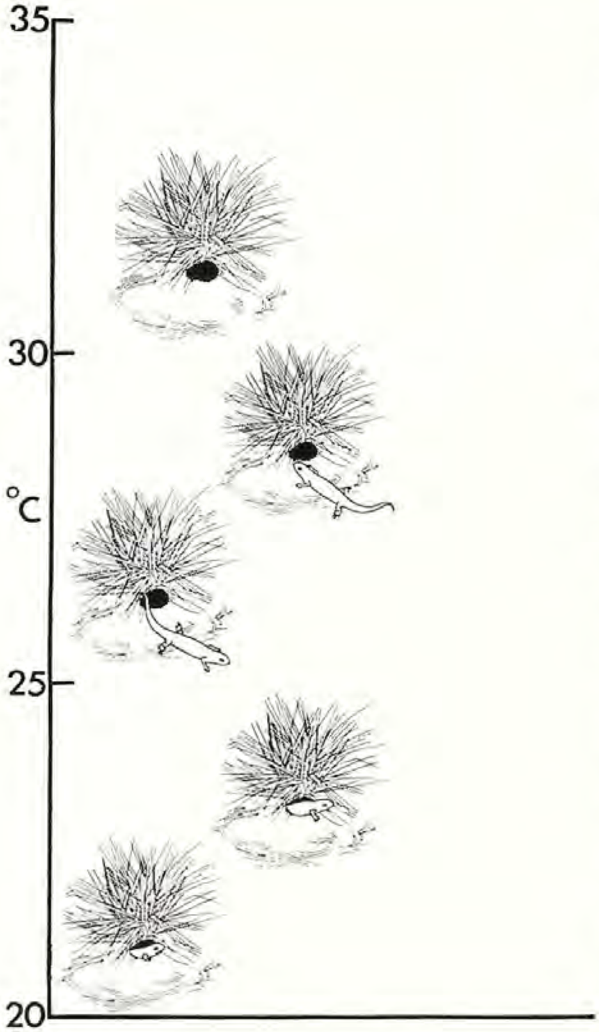
as was considered feasible, within about two metres of the burrow. Envisaging a prolonged period of observation, the hessian front of the hide had a series of holes cut into it to enable free observation, facilitate photography and provide some flexibility in viewing positions. Spinifex is sharp and sand can get very hard, so a camp stretcher was incorporated and, as flies are always a nuisance, a mosquito net was used as a cover.

Having decided that by now the lizard was probably thoroughly disturbed, the area was vacated and reapproached about an hour later near dusk, when a desert skink was observed outside its burrow apparently oblivious to the crude structure which had suddenly 'grown' only two metres away. Deciding to leave well alone, the hide was again vacated after about ten minutes.

It seemed likely that a whole range of temperature variables would have a marked effect on the activity of the animal. To monitor these a series of thermocouples (remote temperature sensing devices) were positioned so that the temperatures at the bottom of the burrow and at the three openings could be taken. Air (shade) temperature, and soil surface temperature were taken with a mercury thermometer every half hour, and relative humidity was assessed using a whirling psychrometer. These monitors were set up just after dawn while the lizard was presumably still asleep in its burrow. Then the waiting period began.

The diel or activity cycle of diurnal reptiles in arid areas generally climatically stable is correspondingly stable within each species for any particular period of the year, but it must be emphasised that reptiles will readily respond to daily variations in climate by modifying their general behaviour.

In many lizards, there is marked pre-emergent activity, where the animal raises its body temperature by posturing toward the sun while still remaining in the protective cover of vegetation during the early morning cool, until a sufficiently high temperature to achieve full locomotor ability is maintained. With *E. inornata,* however, the burrow temperature never dropped below 18.3°C at which, under captive conditions, it will still burrow and feed, and no such posturing was observed. Generally, as the air temperature exceeded 20°C, the lizards emerged



Daily cycle of *E. inornata:* pre-emergent activity at 20°-25°C; feeding and general activity at 25°-32°C; retreat into burrow at 32°C.

gradually until at about 25°C they were basking at, or slightly away from the burrow. While basking, the lizard was extremely susceptible to any form of disturbance, retreating down the burrow at the slightest provocation, such as birds flying overhead. This is undoubtedly a response mechanism to compensate for reduced locomotor activity while its body temperature is below optimum. As the shade temperature increased, the lizard, although alert, exhibited increasing tolerance to disturbance—close approach of birds, hands and arms waved outside the hide and even the approach of a dog to within five metres illicited no retreat response. Similarly, a reduced reaction to sound was also observed.

Several strategies for raising or lowering body temperature above that of the ambient have been observed in various lizard species. Many lizards, especially those of the family Agamidae, possess melanophores enabling the lizard to absorb more of the available heat by becoming darker at low temperatures. As body temperature rises, the lizard becomes paler until, when optimum temperature has been reached, the lizard reflects heat. This has not been observed for *E. inornata,* and it can be fairly confidently stated that the strategy is not used by this species. Many lizards will climb into low vegetation during the morning to position their body so that they can achieve a plane at right angles to that of the sun, thus maximising the available energy per unit area of body surface. This enables them to avoid loss of heat to the ground or substrate, although usually the only contact made is by the feet. This behaviour was not observed in this species. Various members of the family Agamidae seek shade, analagous with burrow retreat, whilst others may hold their bodies well off the soil. This allows air circulation, and probably more importantly, stops the ventral surface touching the hot substrate. Although *E. inornata* is able to raise its body marginally

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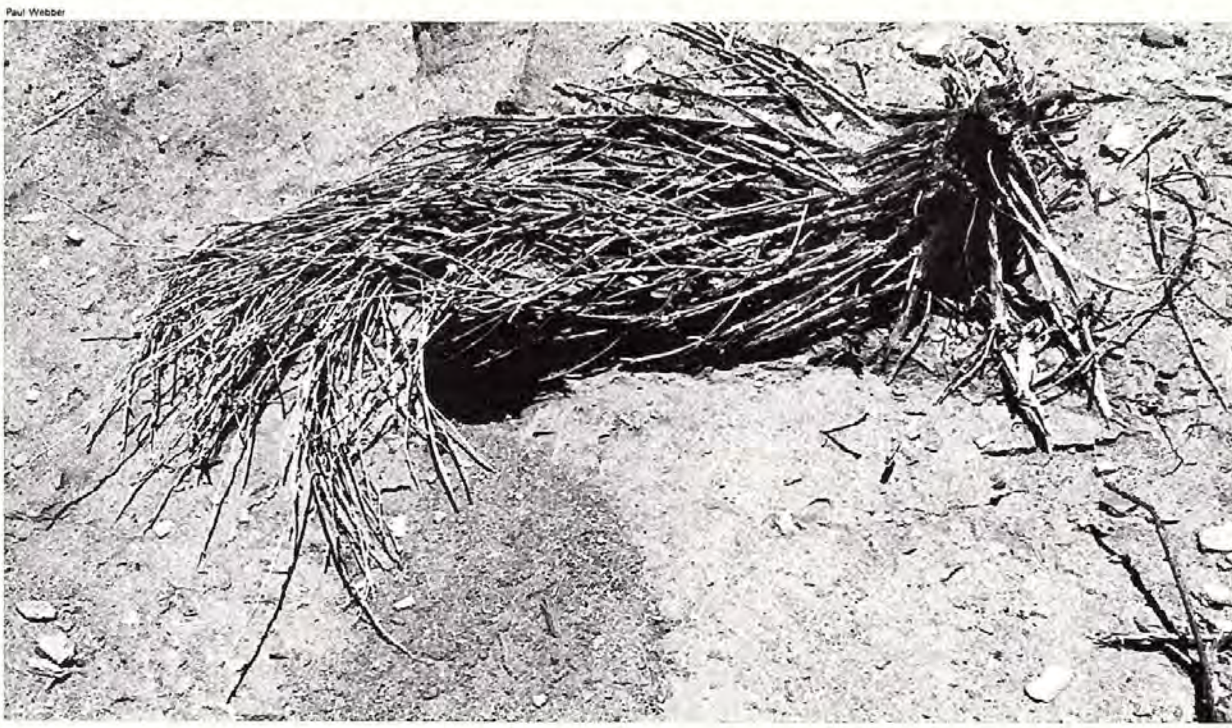


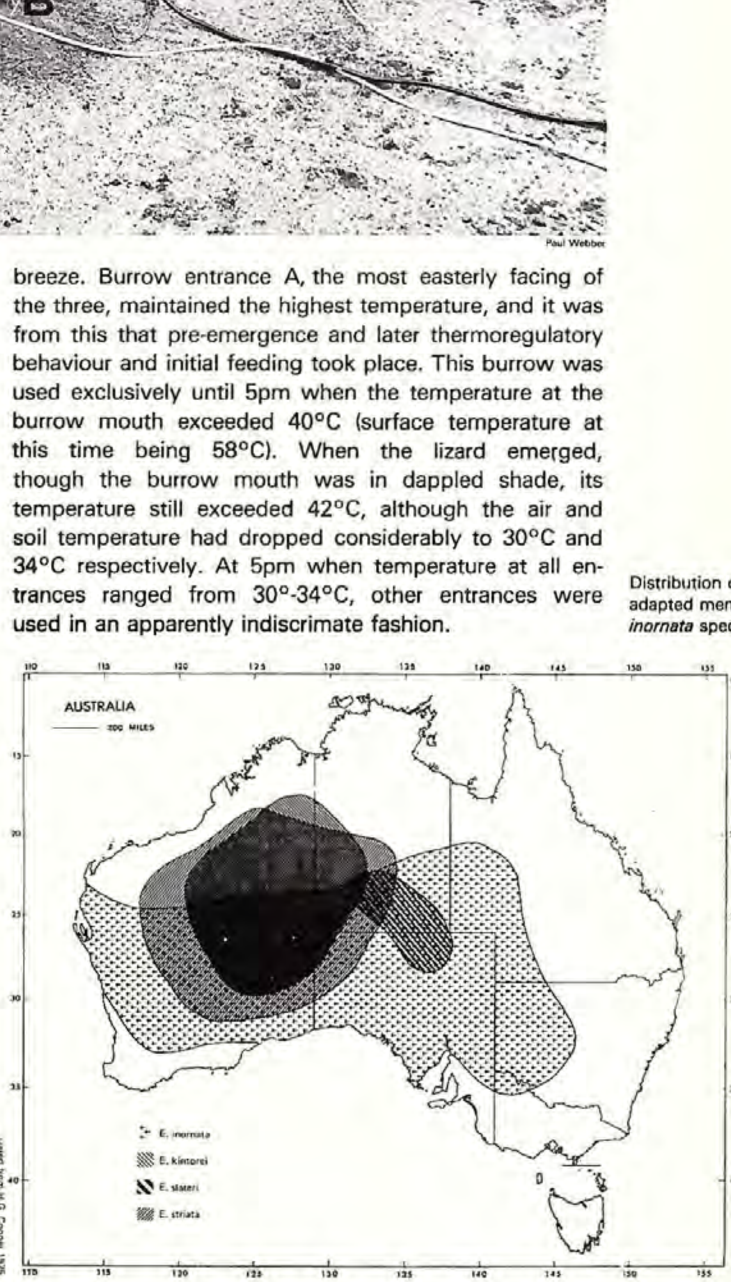
An active burrow showing typical use of vegetation for the initial construction.

The burrow entrances show the female at A, the male at C, and thermocouple leads used to monitor temperatures.

from the ground, it is probably insufficient to be as effective as in lizards with proportionally longer legs.

It appears that *E. inornata* has no mechanism, other than by retreat into the burrow, for lowering its body temperature when conditions exceed the optimum. An additional advantage is supplied by the spoil dug from the burrow which provides an inclined surface or ramp at the burrow opening in an otherwise flat environment. This area was actively used by the lizard when it was sufficiently warm to emerge totally from the burrow. Two distinct postures were adopted on the ramp. The first immediately after emergence, when the lizard faced away from the entrance with head raised above the substrate, gaining heat by conduction from it and by radiation reflection from the sand to the buccal or throat area. Disturbance at this stage, when the lizard had not completely emerged from the entrance, resulted in a reverse retreat into the burrow. As ambient temperature increased, or when the lizard ran from the ramp to secure prey, posture attitude was reversed and the head pointed towards the entrance. At this stage, the head was variously held off or rested on the substrate. Retreat into the burrow at this time was made head first and, depending upon the extent of disturbance, the lizard might turn and re-emerge at the burrow mouth, or retreat into the depths, to emerge later. When the air temperature exceeded 30°C and the substrate temperature reached 58°C the lizard retreated into the burrow, only to re-emerge as the air temperature dropped below 30°C. Shuttling between shade (or burrow) and sunlit areas was not observed during this study.

A brief summary of temperature variations over the two-day study period clearly demonstrated a correlated behaviour variation. Day 1 was a typical day at this season, with practically no cloud, and only a slight breeze. Burrow entrance A, the most easterly facing of the three, maintained the highest temperature, and it was from this that pre-emergence and later thermoregulatory behaviour and initial feeding took place. This burrow was used exclusively until 5pm when the temperature at the burrow mouth exceeded 40°C (surface temperature at this time being 58°C). When the lizard emerged, though the burrow mouth was in dappled shade, its temperature still exceeded 42°C, although the air and soil temperature had dropped considerably to 30°C and 34°C respectively. At 5pm when temperature at all entrances ranged from 30°-34°C, other entrances were used in an apparently indiscrimate fashion.



Distribution of arid-adapted members of *E. inornata* species group.

Day 2 on the other hand, contrasted markedly. The initial early morning temperature rise of the air and burrow mouths followed the same pattern as on Day 1. However, overcast weather accompanied by two brief, light falls of rain caused noticeable temperature fluctuations. Correspondingly, activity also changed. Again burrow A was used initially, but by 9am when all temperatures were practically equal, and no direct sunlight was available, burrow entrances were used indiscriminately. As the shade temperature did not exceed 32°C, and the highest burrow mouth temperature recorded (again A) only marginally exceeded this, no retreat was made into the burrows, and activity was maintained until dusk. As may be expected, thermoregulatory activity increased during Day 2, but this was not measured quantitatively.

The most striking phenomenon was the relatively constant temperature at the depth of the burrow, only some 25cm beneath the surface. Total range during this study was only 2.2°C, with an average temperature during the monitoring periods of 19.2°C. The drop in burrow temperature during periods of maximum daily temperature is undoubtedly due to cooling by light breezes, whilst the overnight rise is most likely due to the combination of lack of air movement and radiation from the heated sand above the burrow.

Due to the brevity of the observation period, it would be presumptuous to describe *E. inornata* as being territorial. However, it is totally restricted to one area of *Triodia* or spinifex, and the failure to move more than short distances from the burrow and allied *Triodia* clump exhibited by the female studied, may indicate a certain degree of territoriality.

Two factors cast doubt on this, however. During observation of the burrow, a male headed towards the spinifex clump and approached from directly behind the hide which obscured the position of the female. Passing below the hide, the male lizard moved to within one metre of the female, lowered its head to the substrate and basked in dappled shade. Although not obviously responding in any way either by increased alertness or other observable change in behaviour, the female entered burrow C, shortly followed by the male. Twelve minutes later, a third lizard (another female, recognisable by a short regenerated tail) approached the burrow from the same direction as the male via the hide, and entered the burrow system. Apart from mating, there was no indication of any aggressive behaviour.

Unobserved, the second female left the burrow, as subsequent observations and capture of remaining lizards proved. The male, on the other hand, remained and shared the burrow system, although it seems unlikely that this would be for a prolonged period, as burrows investigated were generally found to contain only a single individual in each burrow system. The short period of this study precluded monitoring the duration of this association.

Mating was observed in the field on two occasions after the male's arrival at the burrow. After only about four minutes of its approach, the male entered the burrow entrance after the female from which she immediately left followed by the male to a site approximately 40cm from the cover of the spinifex. The male seized the female flank in his jaws just in front of the left hind leg, and slowly moved his position to the shoulder area, with his forelegs across the back of the female. The only response from the female at this stage was occasional tongue flickering. Having reached this position, the male straddled the female with his hind legs and began a series of slow but jerky lateral head movements, at which time the tongue flickering of the female increased in intensity. Cloacas were brought into contact and mating initiated by a quick sideways scissor grip action of the male's hind legs around the female. During copulation, the female's tongue became highly active,

A hide to enable closer observation of these shy animals was constructed two metres from the burrows.

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flicking in and out of the mouth whilst her head 'vibrated' in a vertical plane. The male continued the lateral head movement at an increased rate. Copulation observed during this mating lasted twenty-three seconds and the total duration of the mating about five minutes. The lizards remained outside the burrow after mating. A subsequent mating eighty minutes later followed a period of about forty minutes during which time the two lizards exhibited a marked increase in activity, a general sensitivity to disturbance, which may have been due to cooling, and an increased approach response distance. Mating followed the same basic pattern, although it lasted only three minutes. Copulation lasted twenty-one seconds. (Mating behaviour in captivity of these two specimens followed this same pattern, although one mating was preceded by extremely aggressive biting and grasping of tails and bodies, by both lizards.)

These observations seem to imply that during the mating period at least, both male and female *E. inornata* are likely to leave their burrow systems in search of a mate. The factors governing the movements are still obscure, but as the nearest other burrow system located was some fourteen metres away, it seems quite possible that large distances may be covered during this period. Unfortunately, the nearest burrows were not excavated during the time of this study and the origin of both the

male and female that entered the observed burrow is thus uncertain.

This mallee-spinifex area of NSW is occupied by several members of other lizard families: Agamidae, Scincidae and Gekkonidae. The only other species that was seen to approach the burrow was a male Mallee Dragon *Amphibolurus fordi.* This occurred one morning when the air temperature had just reached 31°C, a temperature at which it was assumed that both species had reached suitably high body temperature for normal activity. The Mallee Dragon remained within the area for just over twenty minutes, and was repelled by both lizards on several occasions. After being chased away, and occasionally if near either of the *E. inornata,* it would go into a series of behavioural displays—the 'bicycling' foreleg action, head bobbing, etc. Three responses were made by *E. inornata* to the approach of this lizard to the burrow system:

1) If the fast moving *A. fordi* suddenly approached *E. inornata,* the latter would retreat into the burrow, shortly to emerge from another entrance. This occurred only when *A. fordi's* presence was unobserved beforehand.
2) If *A. fordi* approached a female *E. inornata* closer than an estimated 30-40cm the female rapidly ran from her position towards the *A. fordi* chasing it away, and postured for several seconds before returning to the immediate area of the spinifex.
3) If *A. fordi* approached a male *E. inornata* closer than one metre, the subsequent 'charge' was identical to that of the female, but no posturing was observed. On return to the burrow however, the male made alternate scratching motions with its forelegs until it reached the burrow ramp, when this activity ceased, and basking took over.

It has been observed that both male and female *E. inornata* feed from the burrow mouth, rushing out to capture passing insects. In addition, a certain amount of foraging around the spinifex clump took place, although the lizards in either case never moved more than about one metre from any of the burrow entrances. Feeding would thus seem to be largely opportunistic. In captivity they will take most insects including mealworm *(Tenebrio)* larvae, and there seems no reason to doubt that this is also the case under natural conditions. No evidence of a single defecation spot (recorded for *E. kintorei,* a close relative) was observed in the field during the short study period. However defecation was observed in captive specimens and is discrete, and away from frequented basking areas.

Under somewhat adverse conditions—a wide range of temperatures at the burrow mouth (7.3°C-52.5°C during this study), low humidity, and general lack of available surface water—the development and positioning of a burrow system confers a definite advantage by providing a more constant environment than that available to non-burrowing species. The burrow has limited in this skink, behavioural strategies necessary in some other lizards for efficient thermoregulation. Utilisation of the burrow ramp as an inclined surface to maximise available energy per unit area of body surface, and the orientation of the burrow entrance or entrances towards, or away from the sun, make such posturing as body flattening, presence of variable pigmentation etc. redundant in this species. A burrow system with escape holes provides not only double protection from predators, but also reduces the pre-emergence period thus extending the time available for foraging and other activities.

Perhaps the most gratifying result of this relatively short study was the birth by the captured female, of four rather than two young. While the study answered many of our initial queries, others have been raised which will need to be answered by a longer and broader study of these lizards.

IN REVIEW

THE APE WITHIN US

REVIEWED BY COLIN GROVES

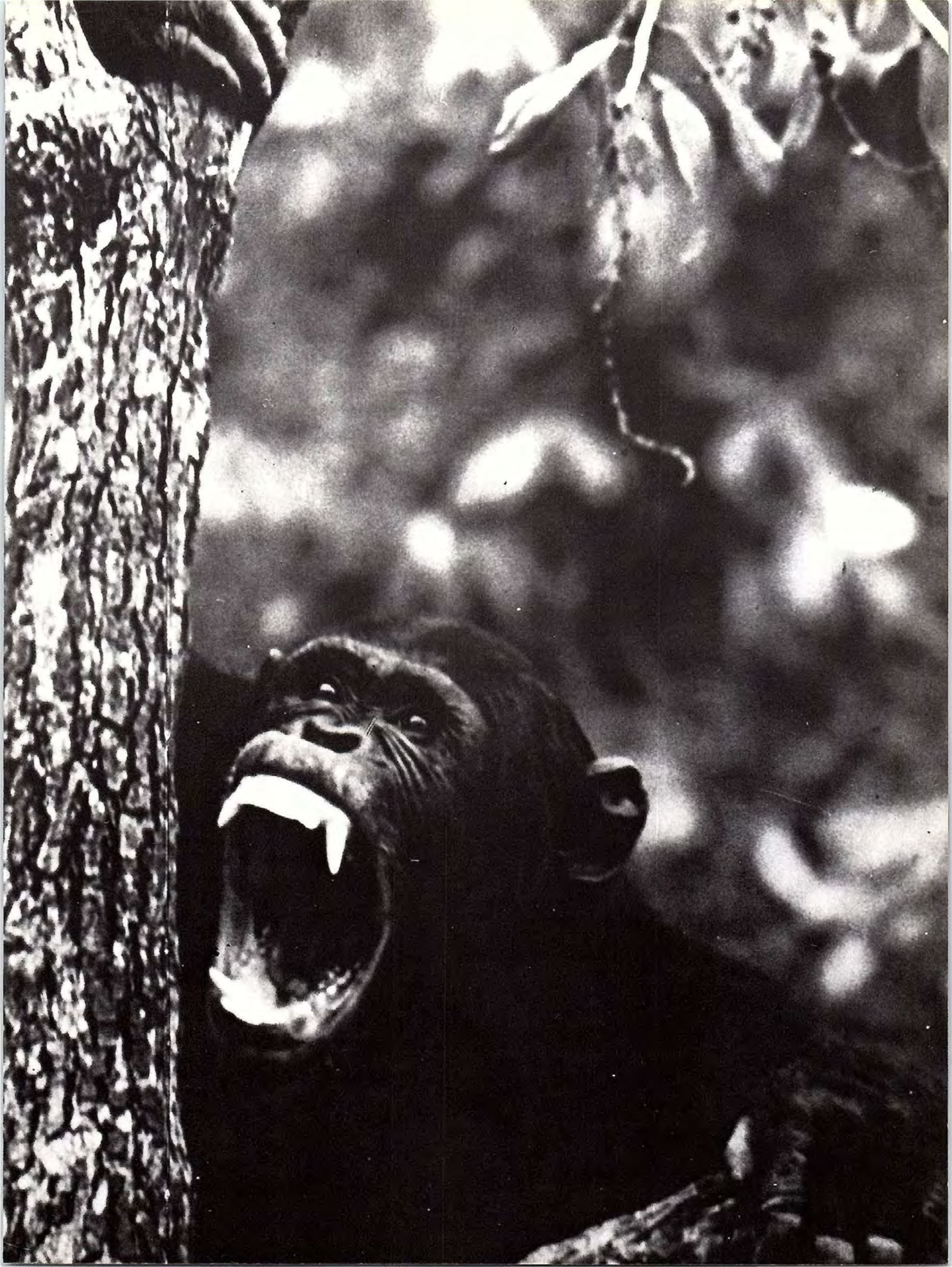
THE APE WITHIN US, by John MacKinnon, *Collins, Great Britain, 1978, 287 pages, illustrated, $16.20*

John MacKinnon is a well known primatologist, one of the first to make a success of field observations on the orang-utan, and author of a very pleasant popular book, *In search of the Red Ape.* His new book, summarising research on all the living apes and extrapolating to human behaviour would, if promise is fulfilled, be a most stimulating and exciting piece of work. So—is it?

We excuse the author his statement in the Introduction, that "the real driving force behind my interest [in the apes] has been the desire to gain a better understanding of myself"; it sounds like a piece of blarney to me, and I don't believe for a moment that anybody who wrote about orang-utans with John MacKinnon's evident enthusiasm could have studied them with anything in prospect beyond a love for the animals themselves. But let it be; presumably here is another cryptic zoophile feeling, unnecessarily, the need to justify himself with the

Chimpanzee

Photo courtesy Collins, Publishers



great anthropocentric standby.

The apes are described, one by one, from the author's own experience of them. He has taken pains to visit the natural home of gibbons, orang-utans, gorillas and chimpanzees, and has much to communicate to the reader not only about the apes' way of life but also about the methods of studying them; he took great pains and underwent amazing hardships to visit the habitat of the little-known bonobo (so-called Pygmy Chimpanzee), and this chapter itself makes fascinating reading. A photo of each of the apes in its natural environment, bonobo included, accompanies the text.

He asks himself why gibbons should be monogamous; gives a graphic description of the male gorilla's terrifying bluff charge; describes the behavioural differences between gorillas on Mt. Kahuzi and in the Virunga volcanoes, and between orang-utans in Borneo and in Sumatra; notes the striking individuality of chimpanzees; and draws attention to the phenomenal memory and planning ability of the orang-utan. If I have a criticism of this part, it would be that he is *too* reliant on personal experience, and fails to put the apes in their perspective: one would like to know a little more of their place among the living primates, for example, and of their capabilities as shown by psychological experiments.

Chimpanzee

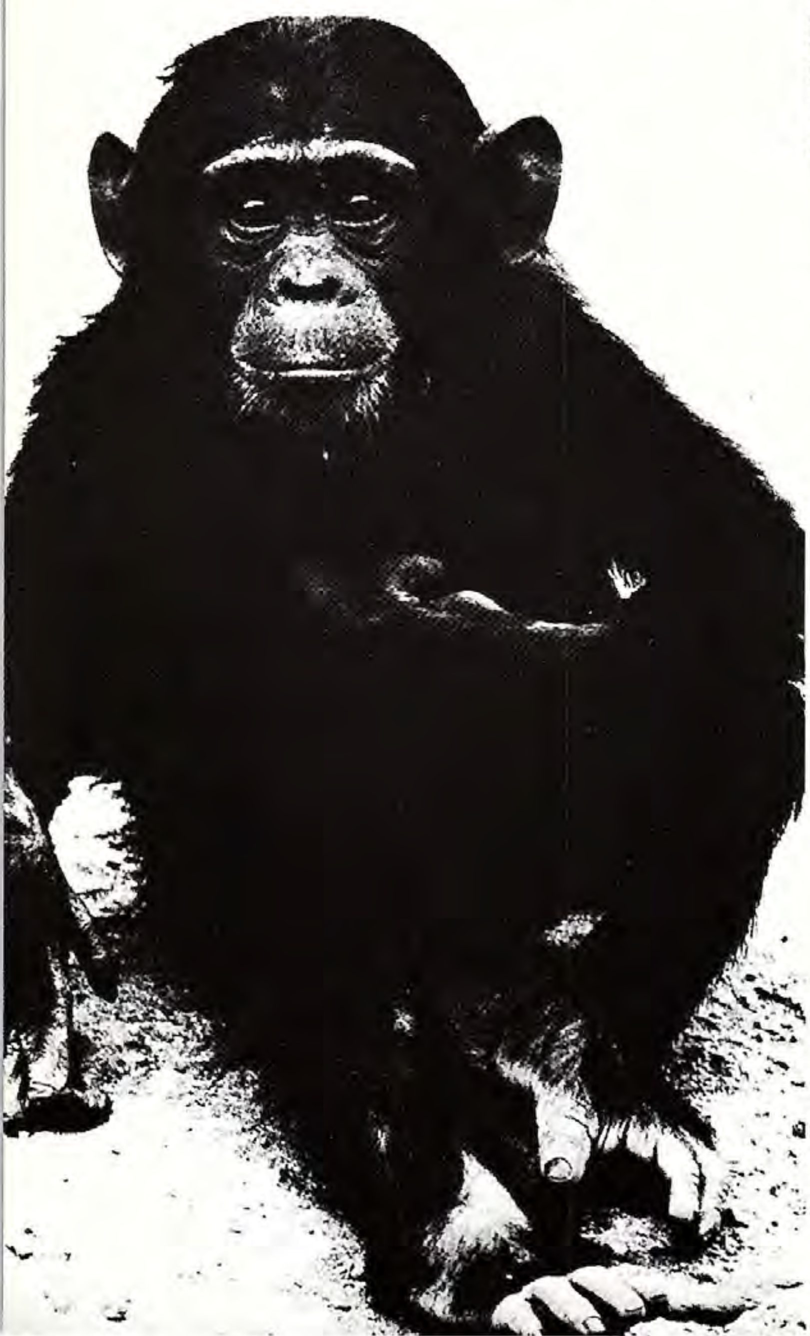


Photo courtesy Collins, Publishers

There are some interesting ideas put forward about the evolution of Hominoid (ape and human) social organisation. MacKinnon sees the type of grouping shown by the Sumatran orang-utan as the best common model for derivation of all the other systems—a loose, essentially individualistic system with long-lasting consortships and the male continuing to associate with the female long after the birth of the infant. With gibbons, the pair bonds have become permanent, and the resulting families are territorial rather than range-sharing. With the gorilla, the whole community has become group-living. With the chimpanzee, the community is more tight-knit than with the Sumatran orang, and individuals associate more; the bonobo has returned somewhat towards the Sumatran orang condition, having gone back to the dense forest and become more arboreal than the chimpanzee. Bornean orangs have a completely solitary mode of living with no lengthy consortships. Humans have, by contrast, developed the consortship into a family akin to that of the gibbon but unlike the latter, the larger community structure remains as the basic unit of society incorporating the families. An important point, this: the idea that the family is the 'basic unit' of human society is, in an evolutionary sense, highly dubious and very hard to eradicate from the popular mind.

However, I must point out that H.D. Rijksen, in his field study of the Sumatran orang-utan published this year,[1] found only a single, arguable case of consort behaviour between a male and a female. It may well be another instance where the great adaptability of apes which MacKinnon stresses extends even to differences in social organisation within a single subspecies.

I must also take issue with the author's rather brusque and cavalier treatment of monkeys. Without ever really saying what monkeys are or where they stand, evolutionarily speaking, in relation to apes, he is continually referring to them as a kind of brutish backdrop against which to display the flexibility, nobility and intellectual achievements of the apes. "In monkey groups", he says on page 78, "there is competition between males for status or dominance, and the pay-off for being top of the hierarchy is more easy access to the females so that it is the dominant males who father most of the infants". Again on page 202 we read that monkey troops have "rigid social hierarchies" and that vary though they do, "overall their structure is remarkably uniform". That a professional primatologist should write this is simply astounding. Fifteen years of teasing out the complexities of social behaviour of monkeys in Africa, Asia and Latin America, and of extended theoretical analysis of the meaning of hierarchies—and even whether they exist at all, at least outside baboons and macaques, except as a social pathology!—has just passed him by.

Thus ends the first part of the book, Apes. The second

[1]RIJKSEN, H.D. *A field study on Sumatran Orang Utans;* H. Veenan and Zonen B.V., M. Wageningen, 1978.

part, Men-Apes to Ape-Men, which is just one chapter, reviews the evidence for the sequence and timing of the evolutionary separations of the different hominoid splits. He sees no serious discrepancy between the biochemical and the palaeontological answers to the problem: generation length, he suggests (and he is not the first to have done so) slows down evolutionary rates, so accounting for the biochemical closeness of chimpanzee, gorilla and human. His review of the fossils is really rather good; it bears the stamp of Peter Andrews, the leading British authority on primate evolution, whose help is acknowledged at the front of the book. When he gets to 'reasons why', it deteriorates considerably: the proto-ape lost its tail because it was "no longer needed"; the gorilla must have increased in size as "his longevity, period of gestation, surface-area-to-weight ratio and brain size are all characteristic of a smaller animal"; *Paranthropus,* the robust ape-man, must have had weapons for social and sexual competition because its canines were so small, but no stone tools have been found with its bones, so "we must assume that these weapons were perishable wooden clubs", which explains why the creatures' skulls were so massive and solid! These are three examples, among quite a number in the second half of the chapter, which reveal a combination of naiveté, ignorance of anatomy, sheer invention as far as I can see, and special pleading. His final explanation, at the end of the chapter, that memories of *Paranthropus* are the source of horrible hairy giants in mythology seems to me to sum up this kind of speculation—or perhaps I have missed the humorous intent.

And now to the third part, headed Men. This is the part that is presumably the rationale of the book; and this is the part which I would far rather have done without. There are ever so many worthwhile issues that demand attention in considering the ape heritage in humanity: language, its form and function and its origins; the question of consciousness and self-awareness; abstract thought and logical reasoning; patterns of association; the kin selection/sociobiology controversy. Ten pages of loosely argued speculation on language origins are hardly enough to scratch the surface. We need to have some hard data and tightly-knit argument on whether any of our behavioural attributes are 'species-specific', as is so glibly assumed by so many people. I do not find this in MacKinnon's writing. I find some bright ideas from time to time; but even such initially off-beat concepts as that language is "designed to conceal meaning from outsiders and so restrict comprehension of the message to an exclusive few" are not in fact original and should not in any case be put forward as the answer without discussion of alternatives. The brief discourse on language comes hard on the heels of speculations about the discovery of fire and the opinion that rope is the handiest type of artefact, and leads without pause into some thoughts on the origin of agriculture, the danger of crocodiles, and the nature of music; the whole arrangement reminds me of a psychoanalytic technique where the couch-bound victim says the first thing that comes into her or his head and goes on from there by word-association.

The chapter on Technology and Culture is succeeded

Photo courtesy Collins, Publishers

Gibbon

of social cooperation rather than to get protein, as "Protein never ousted carbohydrate as our species' staple Movement. After a confused argument about how human consortships are necessary to increase the survival chances of offspring but women can in fact raise offspring on their own so that it's alright for men to roam, we come to some really priceless passsages. On page 223 we read:

> "Evolution has not only selected those females who could accept a subordinate role but has favoured females who actually enjoyed such a role,"

and again

> "Female monkeys and chimps enjoy a temporary boost in their status only when they are sexually receptive, but a woman's sexual interest never wanes . . . Although the male sex usually manages to dominate affairs at the community level, within their own families womenfolk are not so subordinate and are well able to get their own way."

This may tell us about the author's own family, but lacks logic as an argument for 'women's role is as wives and mothers' and relies heavily on the spurious 'was implies ought' way of arguing.

The next chapter, Man and his Community, begins by making the very reasonable proposal that chimpanzee communities are similar to human ones, then continues with the advantages of cooperative behaviour: "Males could band together to fight off any threat"; hunting (in men, chimpanzees and baboons alike) arises as an affair

Photo courtesy Collins, Publishers

Gorilla

by one on Man and the Family. This is where MacKinnon has his first brush with the Women's Liberation diet." I will overlook the unfounded equation of vegetable with carbohydrate, and pass on to a matter which in this context is rather more serious: a little matter of the word 'man'. A rose by any other name would be just as much of a cliché, but when a single word is used to denote both the species *Homo sapiens,* and the male of the species, things are a little different. Does this matter? Yes; because when MacKinnon and almost every other author who discusses human behavioural origins talks of "Man's need for cooperation", "Man's diet" or whatever, the very use of the word Man calls forth, however unintentionally, the image of the male, so that in the Evolution of Man, cooperation is quite naturally the result of a male activity, hunting; tools arose as male implements, weapons; and so on. The use of Man for the species as a whole is not only sexist but also 'species-ist': human chauvinist as well as male chauvinist: *the* gorilla, *the* chimpanzee, but just 'man', giving our species a special status as if we were not a species of animal but somehow released from the laws of nature and only a law unto ourselves.

MacKinnon goes right ahead and talks about 'man', and falls into both these traps. In Chapter 11 he begins by condemning destruction of the environment, overpopulation, pollution. So he's on the side of the angels; but without an attempt to examine these ills biologically, his protestations fall into the category of platitudes. Do other animals, such as apes, pollute and destroy their environment? Do their populations ever run out of control? If so, under what circumstances? The book is supposed to be about the animal nature of the human species.

And then, not content with his brush with Women's Liberation, MacKinnon tackles the Race Relations Board. The "Western Caucasian races" the Europeans, I suppose have behaved over the last few decades in a really exemplary manner which everyone else should try to copy: believe it or not, they've given up making war. (Did you know that, dear reader?). Yes, we've seen (page 225) "a voluntary abstention and progressive withdrawal from active warfare by the Western Caucasian races"; (page 256):

> "I am sure that if other countries could break down their isolationism, as the Caucasian races have done . . . the incidence of large-scale ethnic wars would be cut enormously."

As for overpopulation, his solution is not to restrict each family to two children but (page 261):

> "There are drawbacks to a policy of small families for all. If we want cooperative, socially responsible citizens, we are more likely to rear them in large families than in small ones where selfish attitudes are more easily fostered. It would probably be more satisfactory, and more efficient, to have half as many families breeding but with twice as many children in each."

Note that no argument is offered about the "selfish attitudes". There is plenty of information—sociological, psychological, biosocial—about the attributes of large versus small families; if MacKinnon is going to make statements in a manner implying that there is evidence to back him up, then he ought at least to quote some of that evidence.

Finally, what of the poor old apes remaining today? They will be preserved only in small areas, unable to "advance" evolutionarily, but they have a good future in captivity: "Apes are already used extensively in medical research", and "The possibility of breeding races of subhuman apes to perform a variety of useful tasks is only too real and too probable". The ethics of all this are not discussed. The whole theme of the book is that one should not expect to find qualitative differences between ape and human, and on page 183 it is stated outright, at least as far as the brain is concerned. This being so are we justified in treating apes as 'things', using them as dispensable items in the search for cures for our ailments, or envisaging their use as slaves in the future? I wonder that the author seems not to turn a hair at this:

perhaps he does not share the resentment common among primate fieldworkers that the creatures that so fascinate and inspire them should be regarded as mere experimental models by others under the largely phoney cloak of 'betterment of humanity'. I fear that for MacKinnon, Man without the definite article is interposing between his consciousness and his conscience.

I have taken a lot of space to bring out some of the good points and the bad of the book. I have tried to show how it starts at the apex and slowly descends to the nadir. As solid observation and fact recedes, cliché takes hold, and the eloquence which distinguished *In Search of the Red Ape* vanishes never to rise again. Logic is dispensed with, and half-digested facts are the basis for half-baked arguments. Come home, Desmond Morris, all is forgiven.—*Colin P. Groves, Senior Lecturer in Biological Anthropology, Australian National University.*

MORE REVIEWS

SCIENCE FIELD GUIDES: BARNACLES by A.J. Underwood, *Reed. Education, 1977, 32 pages, illustrated, $2.95.*

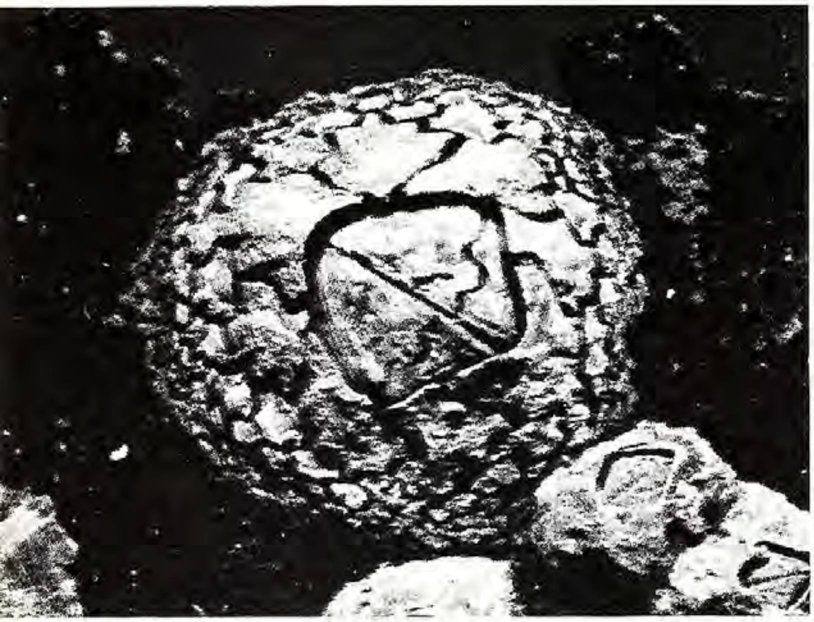
Barnacles are eminently suitable subjects for experimentation or for ecological investigations because they grow fixed to a substratum and are therefore easily available for study. There is a great need for a reliable guide which enables newcomers to identify accurately species in the field without destroying or dissecting them. To produce such a key is more difficult than one would imagine and requires both intimate knowledge of barnacle systematics, and experience of their distribution and field occurrence. They have long been recognised as a very difficult group to identify. This is true even within a limited geographic area such as New South Wales. The present guide fails to achieve its object in several respects.

From the references quoted, it becomes apparent that the author has not kept abreast of recent changes in barnacle nomenclature over the last decade. During the course of world-wide revisions of barnacle phylogeny and palaeontological studies, overseas workers have made some interesting changes within the Tetraclitid family. Four new genera have replaced *Tetraclita* and subdivisions within the old genus *Elminius* have been created so that names of members of this group occurring in Australia must be changed. Studies by J.P. Harding (1962), M. Henry and Patricia McLaughlan (1975) on Darwin's *Balanus amphitrite* complex have led to the recognition and acceptance of several species and to the consequent name changes and realignment of Darwin's former 'varieties' with new names. This means that only nine of the fourteen names used in the guide satisfy current usage by zoologists.

However, more serious are the misidentifications and the totally misleading choice of illustrations of the most important fouling species—those most in need of investigation and research. There is no illustration (captions to the contrary) of *Balanus trigonus.* The photos so labelled on pages 15 and 25 and the line drawing on page 14 depict *Balanus amphitrite amphitrite* (sensu Harding, 1962). Also the colour illustrations on pages 15 and 25 (except for the light-coloured shell, centre bottom of the illustration on page 15), labelled as *Balanus amphitrite* depict *Balanus variegatus,* a species not listed by the author, though it is probably one of the two commonest barnacles fouling boats and harbour structures along the

Orang-utan

Photo courtesy Collins, Publishers



Catophragmus polymerus.

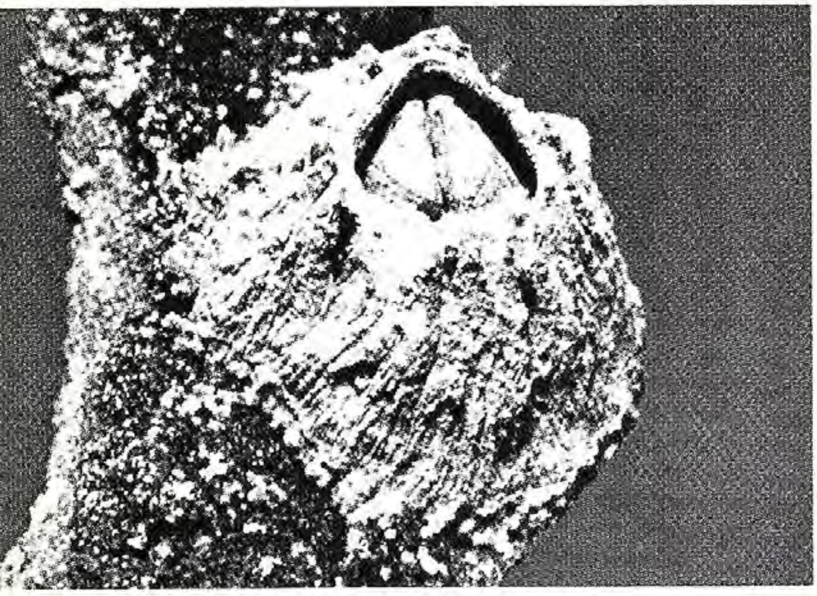
coast of New South Wales. Using this field guide there is no reliable way of recognising *Balanus trigonus* as both the illustrations and the written key refer to another species. Its correct colour is not given and no mention is made of distinctive features such as its characteristic low profile or its markedly triangular shell orifice. Even the facts about its field occurrence tend to be confusing. It is not rare, occurs in oceanic waters as well as in inlets and is frequently found attached to the shells of trawled animals.

Some of the vertical ranges and remarks on exposure tolerances for other species do not tally with the reviewer's experience and are very misleading in a so-called field guide. There are also some surprising omissions which can be confusing to anyone unfamiliar with the group. Most serious of the omissions are *Balanus variegatus* and *Balanus amaryllis* among the sessile barnacles; and the stalked species *Lepas hilli* which is so externally similar to *Lepas anatifera* that using the present key would confuse the two and could lead to the inclusion of two species in an experiment where only one was desired. Other stalked species which occur regularly in New South Wales are *Lepas pectinata* and the fragile *Lepas fascicularis.* Mention should also be made—if only to alert the user of the guide to the additional barnacles not included in it—of the smaller, common stalked genera which often attach to crustaceans and molluscs (*Heteralepas, Poecilasma, Octolasmis,* etc.) and the four or five species of barnacles that live embedded in sponges or attached to algae.

It is regrettable that errors and omissions in labelling in the basic diagram on page 4 may cause great confusion when the reader tries to reconcile this account with the mainstream of barnacle literature. The presence of a stalk (not even drawn in dotted lines) makes this illustration unique! The attempt to make the guide easy for the non-specialist to use has led to cumbersome duplication of species in different parts of the key and it is surprising that where this occurs, opportunity was not taken to illustrate two differing growth forms of the species. Colour rendition in several photos—notably in *Balanus imperator*—is definitely misleading.

The above criticisms are by no means exhaustive but they should be sufficiently serious for any naturalist to hesitate before buying or using the guide until it has been corrected and revised. A field guide should lead rather than tag along behind in enabling its users to recognise and apply the correct name to the animals with which it deals—*E.C. Pope, Research Associate, The Australian Museum.*

Tetraclita rosea.



A FIELD GUIDE TO AUSTRALIAN MARINE LIFE, by Neville Coleman, *Rigby, 1977, 223 pages, illustrated; $16.95.*

This book includes 200 colour photographs, each illustrating a species of marine animal found in Australian waters. The groups covered are Porifera (3 species), Coelenterata (49 species), Platyhelminthes (1 species), Nemertina (1 species), Annelida (7 species), Phoronida (1 species), Bryozoa (7 species), Mollusca (33 species), Crustacea (28 species), Pycnogonida (1 species), Echinodermata (36 species), Ascidiacea (10 species), Pisces (21 species) and Reptilia (2 species). Each photograph is accompanied by the scientific name for the species illustrated, together with the describer and date, the family name, a common name, data on habitat, depth range of the species, size, geographical range and prevalence. Also, there are 2-3 paragraphs

Top: *Elminius modestus.*
Centre: *Lepas anatifera.*
Bottom: *Chamaesipho columna.*

Photos courtesy Reed, Publishers

relating to the author's field observations and some biological notes added by the author. The photographs are preceded by an impressive acknowledgments list, a preface, introduction and glossary of terms used in the text. An index of scientific names and an index of common names are found at the end of the book.

This book is no mean achievement by Neville Coleman, and is a measure of the dedication and enthusiasm he exhibits, not only in his efforts to seek out and record on film so much of the Australian marine fauna, but also to ensure that the identification of the animals photographed is made, as far as possible, by recognised scientific authorities. Mr Coleman is to be thoroughly congratulated.

There are, however, some points of criticism. The title seems hard to justify. The accepted function of 'field guides' is to provide comprehensive accounts including identification keys, to the known local faunas or floras. This book illustrates only a small fraction of Australian marine fauna, covering 14 groups of animals, and cannot possibly be considered comprehensive. It is also obviously directed towards the diver since 65% of the species are recorded as occurring subtidally. In order to identify the species the diver would have to photograph, memorise or collect the animal for direct comparison (points not made in the book). The book, therefore, appears in general to give merely a *glimpse of the diversity of Australian marine life.*

The use of common names for the invertebrates, the majority coined by the author, are counter-productive to the 'education' of the expected wide range of readers, who should, hopefully, become more familiar with the scientific names. Some common names may vary for the same species, e.g., Pine-apple Sea-cucumber/Prickly Redfish (p. 179), or several species may look externally similar: e.g., *Pentacta quadrangularis* and *P. crassa* (not illustrated) are both quadrangular in cross-section, so too is *Stichopus chloronotus* (pp. 180 & 182).

The glossary is uneven e.g. Invertebrate: animals without backbone or internal skeleton (what about the endoskeleton of sponges (Porifera) and echinoderms for instance!); why not include Commensalism and Endoecism (I have failed to find this term in any texts I have seen, but the definition given on p. 120 would ally it to Inquilinism) in the glossary instead of the text?; why include terms like Ovulid and not others based on abbreviated family names? There are also some mistakes in the text e.g. genetic for generic, pp. 13 & 18; Amphiuridae for Ophiactidae, p. 165 (not the author's fault!), and a few outdated terms like univalve for gastropod (e.g. p. 103) and the inclusion of the platyhelminth and nemertine with the Annelida under the general heading 'Worms'.

Mr Coleman is probably justified in drawing attention to the lack of facilities in Australia to study its marine life (p. 9). In a later article, however, (*Australian Fisheries,* August, 1978, p. 22) he claims to own some 25-30,000 transparencies illustrating *6,000 species,* of which he has had more than *1,500 published.* This, alone, must indicate that a fair amount *is* known of the Australian fauna. These, together with photographs published by other dedicated marine photographers (e.g. Gillett, Healey, Deas etc.) with collector's notes on the habits of the species illustrated, are undoubtedly leading to a greater awareness by both scientists and non-scientists of the beauty and intricacies of the living marine fauna around the shores and adjacent shallow waters of Australia.

It must be hoped that Mr Coleman will realise his ambition to complete the publication of his collection of excellent photographs and notes on Australian marine life. He certainly has a lot to offer which will prove immensely valuable to scientists studying the minute details of both preserved and living animals in the laboratory.

The price of the book, $16.95, though it looks excessive, would appear to be very reasonable for the effort put into its research — *Frank W.E. Rowe, Curator of Marine Invertebrates (Echinodermata, Tunicata, Porifera), The Australian Museum.*

Black-blotched reef eel, *Gymnothorax favagineus.*

Photos by Neville Coleman Courtesy Rigby, Publishers

Armed sea anemone, *Dofleina armata.*

Painted dancing shrimp, *Hymenocera picta.*

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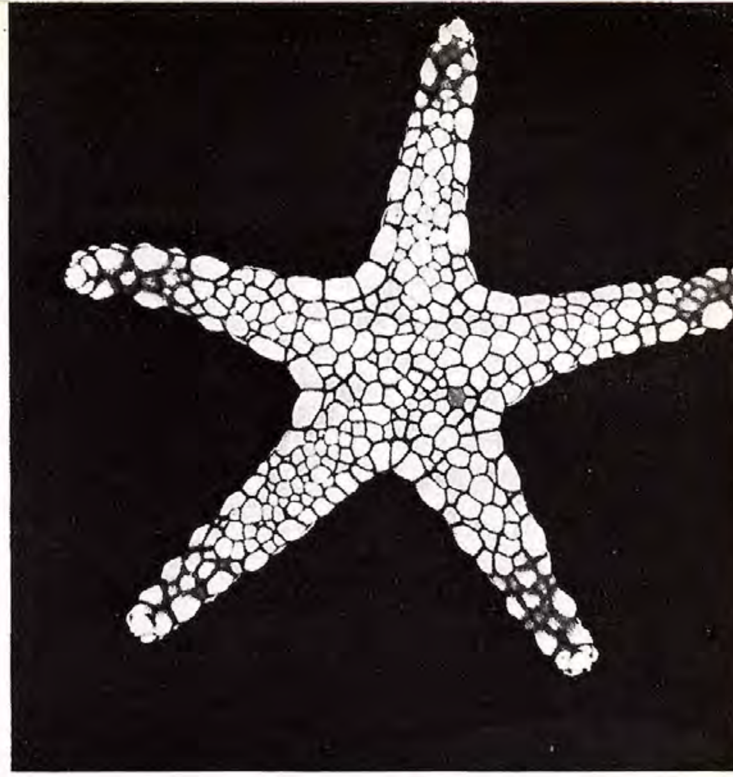

Necklace sea star, *Fromia monilis.*

Ragged-finned scorpian fish, *Pterois antennata.*