BILLABONG FILM NARRATIVE

Forty-four scientists from 11 states and eight foreign countries conducted sophisticated research on tropical mangroves, reef corals, and sea and land animals in an eight-month, scientific expedition to Australia's Great Barrier Reef in 1966.

The expedition was funded by the National Science Foundation and conducted by the University of California, San Diego's Scripps Institution of Oceanography. Organizer of the expedition, Dr. P.F. Scholander, of Scripps Institution, described it as an ambitious international program of experimental biology.

Twenty of the participating scientists were from Australia, New Zealand, England, Sweden, and Japan.

The scientists worked aboard the ALPHA HELIX, an ocean-going laboratory vessel equipped as a modern, fully-equipped biological station for work in any part of the world.

She, too, was financed by the National Science Foundation and is dedicated to the quest for biological and medical knowledge through the study of life in the sea. Her name honors the discovery of the helical configuration of protein and genetic material.

This is a map showing the track of the ALPHA HELIX going from the San Diego - La Jolla area to the Great Barrier Reef.

The 300-ton, 133-foot ALPHA HELIX traveled 28 days between San Diego and Australia. She reached her destination at Princess Charlotte Bay in March. She was anchored among a group of islands known as the Flinders Group, about 20 miles from the shore. The scientists who participated in the expedition reached the ship by commercial and chartered plane service to this small flying field in the cattle country in northeastern Australia.

They left from the North Queensland city of Cairns, flying over the Great Barrier Reef, which shows up here merely as a wave-covered area of submerged coral reef. This Reef stretches for 1200 miles from central Australia all the way to the northeastern tip. At low tide it is exposed, and at high tide it constitutes a major barrier to shipping and sea transportation. It was charted in 1770 by Captain Cook.

Under this mass of ocean froth lies one of the most actively productive coral reefs in the world. The surprising part of the situation is that the seawater in this area is remarkably low in nutrients and that the animals and plants living in the Barrier Reef have succeeded in developing very efficient biological processes for growth. Certainly a major clue to this success lies in the widespread occurrence within animal tissues, notably in the crabs and giant clams, of photosynthetic algae or zooxanthellae. Studies of the physiological and biochemical interrelationships between plants and animal in these symbiotic associations constituted a major part of the expeditions scientific program. A number of the clam zooxanthellae were isolated in pure culture by Dr. Luigi Provasoli and are currently under study in his laboratories in New York.

Over the Lizard Island to the Flinders group at the edge of Princess Charlotte Bay flies Dr. Shirley Jefferys of the Australian Commonwealth Marine Laboratory.

The mountains of northeastern Australia resemble those of Baja California very much, except that the trees are eucalyptus and acacia instead of the cactus and pines of North America. Compared to Cairns, the northern-most port at the edge of a rain forest, the Flinders group is in an arid area characteristic of the cattle country of the inland plains.

Here is one of the islands of the Flinders group, rocky Stanley Island. In the distance, one sees the ALPHA HELIX anchored in the channel between Flinders Island and Stanley Island.

A shore camp was established with prefabricated, air-conditioned laboratories which had been constructed in La Jolla. These laboratories were powered by electrical current from the ship and its auxiliary generators.

A winding coastal river of Australia, the Kennedy, with its cattle landing for small-boats, was the main avenue of approach to the ALPHA HELIX.

The ALPHA HELIX intrepid explorers as they arrived from the chartered airplane.

This is Vince Blasoff, the local manager of the shore camp, and Dr. Leonard Muscatine, Zoologist from the University of California, Los Angeles.

The Kennedy River, as you see, is fringed on its shores by mangrove forests, growing in the tidal seawater. The flat country beyond is inhabited by commercial cattle herds.

Besides the ALPHA HELIX itself, there is a small fleet of motor boats and others. The WALTZING MATILDA, of course, is a typically Australian name for the San Diego-born vessel.

Commuting between the laboratories of the ship and the shore laboratories was usually a simple matter when the wind wasn't too great. But lying out some distance from the mainland, the Flinders Group was often in a windy situation and commuting could be a dripping experience.

Some transportation problems were a little difficult, as, for example, the arrival of the refrigerator for the shore camp.

About ten scientists were housed on the ALPHA HELIX itself, while an equal number lived and worked on the shore. A total of three or four native Aboriginal helpers had been engaged by Mr. Vlasoff. These men proved of tremendous value in both the scientific and cultural activities of the expedition.

Here Peggy McNally, a biological technician and secretary, prepares a report. She and Dee Bradstreet, medical technician, participated in the first phase of the expedition. Three women scientists conducted research during the second half.

Baxter O'Brien, the expedition's Australian chef, and Pisonia, the mascot of the expedition shared the shore kitchen. Both American and Australian delicacies were available for the Fourth of July and impromptu holiday moments.

Mr. Nelson Fuller from Scripps Institution of Oceanography on the scene.

The raincoats seem a bit strange out in the sun, but they protect men and instruments from salt spray during the small boat operations between ship and shore.

Spearing turtles had been one of the major occupations of the Aboriginies for centuries. Here Fred succeeds in spearing one of the local animals. And Jake pulls him in and drops him in the boat.

These natives have a marvellous understanding of Nature and behavior of animals and people alike.

This beach seems of sand, but actually it is made up of the skeletons of foraminifera, small, coral, single-celled animals which thrive in the area in the shallow waters and accumulate with the wind.

The Australian blue-tongued skink was the subject for investigations in temperature regulation of cold-blooded animals.

Jake captures one of these skinks which, although it is a cold-blooded animal has adapted its behavioral pattern for regulating its body temperature. These animals were selected for study because of their size and ease of handling.

Another subject for investigation was the remarkable mudskipper fish. Here the president of the American Society of Plant Physiologists, Dr. Robert Bandurski, of Michigan State University, is very deeply engrossed in the capture of the hard-to-get-at mudskipper.

These animals usually lie on the shore near the water where they can skipover it like a flying stone. They have their homes in deep holes, if one can reach the chamber where they are lying, it's no great problem to capture them. This chamber seems to get deeper and deeper; there seems to be certain danger of losing Dr. Bandurski. With a gleam in his eye, he succeeds in capturing four of these elusive animals.

We must admit that on return to the ship he opened his box to see if they were all there. When he reached in to admire them, three of them escaped.

These fish have a remarkable capability for living most of their lives outside of the water.

If these fish are forced to stay under water they will drown. They have large gills, are extremely agile, and are able to exert themselves for long periods of time.

Their circulation and metabolic patterns, could give clues to mans own function in the marine environment.

Here the neurophysiological scientists of the expedition examine the nerve centers of the suprisingly swift ghost crabs.

One of the subjects of the neurophysiological studies of the expedition was the cerebral function of the mudskipper fish.

Modern neurophysiology requires very sophisticated electronic and microscopic electrodes in single nerve cells.

One of the complicating factors in walking through the Australian bush are the green leaf ants. They pull leaves together and tie them with silk from their larvae, with which they lace their nests. The first person walking past these ants has no problem at all, but the others walking along the trail are attacked by the frenzied insects.

Bent Schmidt-Nielsen opens a mangrove tree to determine the sap pressure in its interior. He does this by taking vapor tension measurements, using an electronic apparatus to measure the evaporation of a water sample in the hole. This large Avicennia tree extracts fresh water from the salt water below.

It is obvious that reasonably sophisticated experiments like this can only be done out in the field provided there is a nearby ship with machine shops and storerooms available to maintain and develop equipment.

The measurements of sap pressure in mangroves showed that there is a tremendous tension as the evaporation of water from the leaves pulls water through the vascular system from the roots. Here Professor Scholander demonstrates his apparatus for measuring this suprisingly great water tension, or negative pressure, inside of the mangrove branch. He measures it by increasing the pressure inside of this aluminum bottle. At the balancing pressure, the sap inside of the plant, is forced from the exposed stem. The recorded pressure is measure of the negative water pressure inside the plant.

Here Professor Maurice Atkinson of Flinders University, Adeliade is removing the excreted salt from the surface of mangrove leaves. By measuring this salt, which every leaf secretes, day and night, he showed that the process is not dependent upon daylight or temperature, but is a metabolic function of the leaves themselves.

Small groups of cells in the mangrove leaves act as green kidneys which excrete salt that has found its way into the plants circulation system.

Here the leaves are being carefully removed, prior to laboratory measurements of salt excretion. The stems were immersed in radioactive salt so that the excreted salt could be measured very accurately.

Salt excreted from the surface of the leaves is being analyzed quantitatively.

Here the sodium concentration in the water samples is being recorded.

Professor Bandurski is preparing to grind up some of the leaves of these remarkable mangrove plants in order to examine the enzymes which function in concentrating the salt from their sap.

The rains and dew of the tropical climate normally clean the salt from the surface of the leaves and free the plant of its salt burden.

The green solution of the chopped up leaves contains the enzymes responsible for the metabolism of the plant.

The biochemical laboratories of the ALPHA HELIX are surprisingly well-equipped and efficient for all types of biochemical and physiological research.

The concentration of salt in the sap of the leaf is measured by determining the freezing point. A cold bath and a microscope are used to observe the ice crystal formation. From the freezing temperature one may calculate the salt concentration of the sap.

A group of explorers are on their way to the exposed parts of the Barrier Reef to examine coral growths. Thousands of turtles often congregate in the warm waters of the Barrier Reef. One of the expedition members enjoys a free ride in the surf. Of course these waters are populated by sharks as well, so it's wise to keep an eye on the situation.

Professor T.H. Bullock of the University of California, San Diego's School of Medicine, measures the neural interrelations of the various animals in a coral colony. By stimulating the colony at one point and measuring the rate of communication between these animals, he is examining one of the most rudimentary of nervous systems among cells in Nature.

Here are the polyps of a coral colony which are in constant motion, gathering small animals for food from the seawater. Many of these coral populations are open like this only at night time.

We see a number of nudibranchs which are shell-less shellfish, or shell-less molluscs. These are some of the more exotic-colored inhabitants of the coral reef. Their nervous systems are of special interest to neurophysiologists because of their extreme simplicity. It was also possible to study some of the simplest behavior patterns in the echinoderms like this chrinoid.

This basket star looks like a walking bush, if anything. They, too, have very simple nervous systems, the communication between their parts and individual cells are of immense interest. Notice the circular discs of the formanifera sand in the foreground.

A swimming sea anenome has managed to escape the hard way.

Some of the better directed and more agile members of the coral reef population are the small squid, or cuttlefish, which can swim at will in almost any direction.

Many species of crabs live in the Barrier Reef waters. Here are two sea cucumbers with their gills sticking out. The bright purple and red colors are certainly attractive.

The cow fish and a little box fish share the ship's aquarium with a seahorse. The animals of this type are usually found near the bottom in coral reef waters.

One of the most exciting inhabitants of the coral reef is the Tridacna, or giant clam. Here one opens and exposes its mantle.

These giant clams weigh as much as 600 pounds. The heavy ones are difficult enough to lift from the floor of the reef, and even more so to get out of the water, and especially into a small boat. Four men would have a hard time.

The contractile strength of the giant clam muscle is about three times that of a man's muscle. Tremendous in size and diameter, the clam would appear to consitute a frightening mantrap, gaping and waiting for anyone to put his foot in. Actually accidents are rare and these animals try to remove anything that finds its way into their shell, rather than to hold it.

The dark surface of the mantle of the giant clam is inhabited by symbiotic algae.

ALPHA HELIX provided a remarkably stable platform for studies in neurophysiology involving insertion of microelectrodes into single cells. Here Professor Bullock examines the ganglia of the ghostcrab.

He studied fundamental relationships between nerve cells in these simple animals. The recordings on the oscilliscope show the shape of the electrical impulses being transmitted by these nerves.

Miles of recording tape brought the records of these exotic animals to University laboratories for detailed analysis.

Fred spears a dugong, one of the large mammals inhabiting these tropical waters. Dr. Robert Elsner, associate research physiologist at Scripps, hopes they can capture one in good condition, in order to measure the respiratory and temperature adaptations of these huge herbiverous creatures.

The dugong is the Australian counterpart of the American manatee and is related to the elephant. They weigh about a thousand pounds and are somewhat difficult to manage. The problem of how they control their body temperature in warm waters is perplexing.

A small dugong has been born, but mouth-to-mouth recuscitation failed to revive it.

The physiological objective of the dugong study was to determine how an animal with such effective heat insulation can maintain a reasonable body temperature in tropical waters.

This respiration chamber measured the oxygen consumption by the captive dugong. Apparatus like this was built in the shops of the ALPHA HELIX.

Australian plains are often filled with these tremendous termite mounds.

We see here gala cockatoos that live in the trees of Marina Plains. Countless white herons and ibises inhabit the billabongs of the Australian outback. Billabongs are blind channels leading from river beds. This is fed by rainwater.

Thousands of cocktoos fly through the blue skies and the borolga cranes search for food.

Here on a rocky promontory of Stanley Island was discovered the home of earlier Aborigine tribes.

Here with a marvelous views from their living room, dwelled Aboriginal natives of Australias east coast.

After six months at the anchorage, Fred and Joe happened upon abandoned native caves. The wall paintings depicted the animals the natives had captured and the ships they had seen sailing the channels along the Great Barrier Reef. Here are turtles, starfish, dugongs, footprints of the giant emu birds, crabs and the dreadful crocodile which inhabits the mangrove swamps. The dugong lives in the shallow waters. All of these animals served as their food and, at times, their enemies.

Another objective of the expedition was to look at the microbial inhabitants of isolated waters that had never been contaminated with commercial detergents of the wastes of human civilization. Henry DeKlerk of the University of Paris discovered in almost every sample new, photosynthetic bacteria which are never found in any water near civilization. This is not a microbiologist but one of the local crocodiles.

In the laboratory, DeKlerk has a collection of beautiful pink, red and purple photosynthetic bacteria which grew from almost every sample he took in northern Australia. These organisms are now being studied in his laboratories in Paris and California.

Another inhabitant of Flinders Island was a friendly python that proved more photogenic than almost anything else. Fred and Joe go out to "capture" this previously captured python. Joe, who knows exactly what to do when snakes are involved, traps the animal for neurophysiological research.

Its brain was later examined by Professor Bullock who used the curare drug and electronic apparatus.

It seems that Fred isn't too sure of this procedure. Joe, of course, has handled snakes before. These men have an uncanny appreciation of Nature. They have a seventh sense for predicting what their fellow man or fellow animals are going to do under almost any circumstances.

Here Professor Scholander and Professor Bullock, who is more interested in the personality of the snake, than its aggressiveness. With a shot of curare the snake's muscle control is reduced to a low level and it becomes a docile creature ready for physiological research.

After the experiments were finished, this animal served as the entree for a feast. Baxter O'Brien has baked the remaining ten feet of the animal for one of the greatest banquets of the expedition.

A slice of python meat for dinner is almost more than anyone can stand. Actually, it tasted much like a dry chicken back - ten feet long. Here Nelson Fuller of Scripps Institution has his try at the main course.

Slicing python from a backbone this long is quite a problem in logistics. Actually, with tropical fruits and all sorts of other delicacies a python dinner is not the worst thing that can happen to one on a scientific expedition.

From the slopes of Flinders Island over the mangrove thickets and the electrified and air conditioned shore laboratories we see the research vessel ALPHA HELIX, nerve center and scientific laboratory for cooperative international effort dedicated to the quest for biological and medical knowledge through study of life in the sea.