

TE VEGA EXPEDITIONS

MAIDEN VOYAGE--GENERAL NARRATIVE

July 14, 1963. In the prospectus for Cruise 1, TE VEGA was scheduled to sail "on or about June 17." Toward the first of June, it became clear that there would be a short delay and the students were notified that they should await further orders before joining the ship. As time went on, all hope of having the ship leave from Monterey was abandoned, and the students were finally instructed to join the ship in San Diego on June 30th, in time for a simple dedication ceremony on July 1st, whereupon the vessel would sail immediately.

The dedication ceremony went off on schedule with a goodly crowd of well-wishers present. The ship went to the B Street Pier where brief remarks were offered by Dean Frederick Terman, Provost of Stanford University, Dr. Harve Carlson of the National Science Foundation, Dr. John Ryther representing the International Indian Ocean Expeditions, Dr. L. R. Blinks, Director of the Hopkins Marine Station, Dr. R. L. Bolin, Chief Scientist of the Expedition, and Capt. E. B. Olsen, Master of TE VEGA. After the ship was signified to be recommissioned by the raising of a burgee showing a red dolphin on a white field, visitors inspected her under the guidance of the students, and later there was a reception at the San Diego Yacht Club. The only thing wrong with the whole affair was that, instead of sailing past the Yacht Club into the golden sunset while the party toasted her departure on an exciting adventure, TE VEGA later returned to the shipyard for further work.

There followed almost two weeks of burnt out rectifiers and coils in the generator, failure of delivery of

promised parts that were essential, malfunction of the winch on sea trials so that we had to pull in a mile of hydrographic cable by hand, underproduction of fresh water by the evaporators, failure of the heads to flush properly, leaky drains, cables, newly arrived packages, workmen and tools cluttering the entire ship so that it was impossible to stow anything properly, etc., etc. ad infinitum. In spite of assurances that all this and the attendant delays are normal in ship conversions, the period will long be a well-remembered nightmare.

Both the crew and the students took the whole affair fairly well, but at last lectures against the scream of drills boring holes in steel plates, trips to the Zoo, to Scripps Institution of Oceanography, to Point Loma for low-tide collection of plants and animals that could not be properly examined in the riot on board ship and an evening expedition to the desert were not enough to prevent a continuing and accelerating drop in morale. It was the concensus that the longer we stayed at the dock, the worse things would get with the ship and her personnel, and finally in desperation, we cast off at 2205 on July 13th and headed down the Bay. By midnight, we were on a westerly course through gentle swells, and the spirits of everyone on board perked up. Next landfall--Oahu!

During the night, the wind picked up to about 16 knots and by morning there was a moderate sea. Most of the scientific party felt a bit squeamish, but only one student has been really sick. Dr. Thompson delivered a lecture on the structure of the Earth and the configuration of the

ocean basins, and a little work was done in securing gear, but in general, it has been a day of trying to get used to the motion. Our efficiency will not be up to anywhere near normal until we get our sea legs.

During the night three flying fish, Cypselurus californiensis, flew aboard and were picked up in the scuppers at dawn. They became the first biological specimens of the cruise and have been recorded as from Station 1. This evening a 1-m plankton net was lowered to an estimated depth of 220 m, and the students were given their first introduction to the pelagic life of the sea. It was the first time that most of them had seen pelagic tunicates (Salpa fusiformis and Thalia democratica) of members of the phylum Chaetognatha. The most appreciated organisms were the very iridescent copepods of the genus Saphirina and the grotesque amphipods Streetsia and Phronima. The catch was not spectacular, but adequate as a taste of things to come.

July 15, 1963. A biological watch has been kept during daylight hours since we left, and information on drifting kelp, barnacle-covered wood, sea birds and marine mammals is building up. The most interesting record was a single frigate bird, Fregata magnificans, noted yesterday very close to the northern limit of its range. Shortly after noon today, we left the opaque greenish coastal waters and entered the clear blue water characteristic of the open Pacific. It was not long before "by-the-wind-sailors," Vellela vellela appeared sparsely scattered on the surface, indicating by their presence our entrance into a new habitat.

Dr. Thompson gave another morning lecture, and this afternoon we sent out an unweighted 1-m plankton net, intending to pay out almost all of the hydrographic wire (which had not been properly spooled) and to lay it back on the drum in neat coils. With 3000 m of wire out, the strain seemed to be rather great and we decided to reel it in again. The catch differed markedly from the one of yesterday, and was much more interesting. It was not so cluttered with salps, and the presence of the small deep-sea fish Cyclothone signata in goodly numbers indicated that the net had gone deeper than 500 m. Lantern fishes, live and actively swimming heteropods (Carinaria carinata) and chocolate colored deep-sea medusae of the genus Atolla, were new and strange to almost everyone on board, and evoked considerable interest.

The sails are all set, jib, staysails and main, the main engine has been secured and we are rolling westward at about 8 knots over a sparkling blue sea, with a broken sky overhead and the wind almost directly from the north. Things are much more pleasant on board under sail than under power; there is not so much noise and the ship is much steadier.

July 16, 1953. Dr. Thompson lectured this morning about the materials on the ocean floor. These lectures take up considerable time, but they are very well organized and delivered, and the students are getting an excellent physical basis on which we biologists can build later on.

Feeling that it was necessary to get the hydrographic cable spooled properly, we began to pay it out this morning

with only a swiveled 5-lb. weight on the end to trail it properly. At thousand meter intervals or so, the ship was brought up into the wind, the speed reduced to a knot, and a little was reeled in, in order to make sure that the winch would function satisfactorily. We reached the point where the wire was wound regularly on the drum when we had reeled out 8544 m. At this point, with the ship headed into the wind, the wire parted as we started to reel in. The chief engineer, who was operating the winch, states that the indicator showed a strain of only 1500 lbs. It is our belief that this is well below the rated breaking strength of the wire and we are at a loss to explain the cause of the disaster. Until we can get the wire replaced, we shall have to limit our hydrographic work to the more superficial layers. Fortunately, we do have enough left to get well below the thermocline, but we want more than this.

The afternoon was spent in readying the lab and gear and equipment for full scale work.

July 17, 1963. There were two lectures today, Dr. Thompson on water chemistry in the morning and Miss Bennett on sea birds in the evening, the latter accompanied by an excellent series of Kodachrome slides. Miss Bennett's lecture was interjected to counter any feeling on the part of the students that they were being given too heavy doses of the physical sciences to the exclusion of biology.

Most of the afternoon was given over to study of material dipnetted from the surface while cruising along at about five knots (the wind has decreased), and in getting

the large Tucker trawl in order. A number of students were also checked out on the bathythermograph, several casts being made for practice to depths of about 700 feet.

July 18, 1963. We are beginning to shake down into ever more effective routine. Our study of dipnetted surface organisms has been most interesting, and we have learned to really appreciate Vellela. Those of us who were acquainted with it previously had considered it to be a pretty blue blob floating on the ocean surface and sometimes drifting in on shore to form untidy messes along the drift line. Now we recognize it as the dominant member of a well defined community.

We have taken a large number of specimens and noted that when oriented with the long axis to the north the sail always extends from NW to SE. We intend to see if the sail extends from NE to SW in other areas. It has been reported that populations of right- and left-handed individuals are dispersed by the wind into different areas.

Underneath the colonies we found masses of small golden brown Vellela medusae, which were liberated without agitation by some specimens. A good many zoologists have not had the fun of seeing this stage of Vellela alive; it is unmistakably the medusa of a hydrozoan, even though totally devoid of tentacles.

Most of the specimens turned out to be the hosts of other organisms. Almost all of them carried individuals of the pelagic snail Janthina. Yesterday these were all of a species that we were unable to determine, but today we began

to get specimens of Janthina globosa, differing markedly from the other one in the deeper blue of the shell, in having a deep notch in the body whorl, and in building a much more elongate float of mucus-covered air bubbles and laying its eggs on the float in a different pattern. On occasion these snails liberated a reddish purple ink, said to be used to anesthetize the Vellela before eating it. We could detect no narcotization, but plenty of evidence that Janthina gobbled up the Vellela zooids with gusto. Also present on some of the Vellela were nudibranchs of the genus Fiona. These were voracious enough to pretty well clean up a Vellela, leaving only the shell, whereupon they would commit the final indignity of depositing egg masses on the skeleton that remained. Another, but not so common predator was a small crab about the size of my little finger nail. We have been unable to classify this with our limited literature. With this number of animals exploiting Vellela for food, it is easy to see the need for the production of huge swarms of medusae; it must be a job to keep ahead of the predators. The only guest on Vellela that did not appear to be eating it was a small gooseneck barnacle that appears to be either Alepas pacifica or small Lepas fasciculatus.

All of the organisms associated with Vellela were a beautiful blue in color, matching not only the host species, but also the water itself. It is interesting that two of them were also found on a stick of drifting wood that was half covered with gooseneck barnacles of the species Lepas anatifera. These were the crab and the nudibranch.

Although we could detect no morphological difference between the specimens taken from the two different substrates, they both differed markedly in color. Instead of being blue, they matched the brown of the wood and barnacles with which they were associated.

The students are eating this stuff up, and when we get time to lecture about such things as pelagic communities, trophic levels or the importance of coloration, we shall be able to draw our examples from experience. It is my opinion that this cruise, in spite of serving as a shake-down, is going to be a very stimulating experience for all.

This afternoon we shot the 21-ft. Tucker trawl twice and found it a bear to handle. The first time we had to bring it in for modification, the second time the depressor got tangled in the net and choked it off, so both hauls were failures. However, we are learning the techniques, and tangled in the meshes from the second haul we did find a couple of specimens of the pelagic nudibranch Phyllirhoe. This had the two nudibranch specialists among the students stopped. They were trying to classify it as a heteropod. When Miss Bennett told them what it was, they were at first dumbfounded and then wildly excited. So it goes on TE VEGA.

July 25, 1963. The days have been rolling by with what I presume to be the usual trials and tribulations of a shake-down cruise. There is too heavy usage of water. There have been clogged sewage lines. The cold room is not cold enough. The winch has given us trouble a couple of times. Certain supplies that should be aboard cannot be found. Repeated

attempts to get the Tucker trawl functioning properly have only demonstrated that the pipes for the top and bottom are too light and that the job of hanging the depressor is a delicate one. The bars have bent and been straightened again, and rebent; the depressor has insisted on twisting the entire gear and tangling it up, and we have suffered a tear in the net. I finally decided that we had better wait until we get some unbendable bars in Honolulu before we try to rig it again. Bottom trawling has not been attempted since we want to put a good strain on the big winch in much shallower water than the 2000 to 3000 fathoms that we have under the keel now before we try it for real deep hauls. As a result, we have been entirely limited to plankton work.

This has not been too bad since, while each catch looks pretty much the same at first glance, new and exciting things are constantly turning up. We have taken several of the beautiful surface nudibranch Glauca, a fairy-like creature decked in blue, green and silver, with finger-like cerrata on the ends of stubby arm-like projections. A cranchid squid looks like a tiny transparent football with ridiculously large eyes and short stubby arms glued to one end. A fantastically attenuated amphipod, Rhabdosoma, is about 4 inches long and measures only about one mm in cross section, illustrating beautifully one type of adaptation for flotation that is used by widely varied organisms. A small translucent creature, shaped like a watermelon, shows eight longitudinal stripes of reddish brown, a mass of oil droplets on each side of each stripe and an opening at one

end with the hint of an introvert, or tentacles, or something. No other details can be made out, and it has us all stopped; we cannot even place it to phylum. Guesses range all the way from a coelenterate through an echiuroid (which group has no pelagic members so far as I know) to a holothurian. Careful examination of a bit of material from the mouth region showed some nematocysts, but we do not know if these came from the animal itself or from its food.

Several of the students have begun work on projects of their own interest. Robert Beeman is deep in the systematics of the heteropods. Richard Conrad, who brought his own sophisticated equipment along, has been measuring the luminescence of dinoflagellates. They are pumped in a small stream of water through a tube in a device towed behind the ship. Agitated by the passage, they flash, and the light is sensed by a sensitive photocell hooked to a photomultiplier; the impulse is transferred to a recorder on deck. Preliminary results look promising. Joan Gerdts, who has been working for some time on the taxonomy and zoogeography of the pteropods (a group of pelagic molluscs) without ever seeing a live one, now has more than 10 species to work with. Richard Mariscal is accumulating and preparing for later detailed study the nematocysts of the various coelenterates we encounter. Donald Thompson is showing signs of becoming enamored with the lantern fishes. It will probably not be long before each student has his own special project.

Today, after long drawn out efforts to get the laboratory fully organized and the chemical techniques perfected by making determinations on surface samples, we

occupied our first hydrographic station. It went off very well. Each time we carry out any operation, the ship's crew and the scientific personnel work together more and more smoothly. Today, when the vessel was brought up into the wind, we came to a virtual stop, and the wire angle on the hydrographic cast was, I believe, less than it would have been in a motor vessel just drifting. It appears that we are really learning by doing, and that soon we shall form a very efficient team.

Occasionally, the biological watch spots things that brings out everyone within the reach of a shout. The other evening, when we were about half-way across, it was a pod of about a dozen dolphins, Delphinus delphis, that played about our bow for about a quarter of an hour. Identification of them was made easy by the striking dark streak extending through the eye. Only a single whale has been spotted, and although this passed directly under the ship, it was not identified. A Laysan albatross paid us a visit and, fittingly enough now that we are in the tropics, tropic birds have appeared.

We have sighted only three ships so far, LURLINE, the Danish freighter BELGIAN REEFER, and a distant tanker. BELGIAN REEFER paid us the compliment of altering course to come over for a closer look at us under full sail, and to wave. Actually, we were cheating and had the main engine turning over, but I bet we looked pretty anyhow.

July 30, 1963. We are now in Kauai Channel; Diamond Head is visible ahead, and we shall be in Honolulu by 5 o'clock

this afternoon. The intervening days have been passing in the same way; lectures in the morning with Miss Bennett, Dr. Thompson and myself contributing. One successful session was a round-table seminar attempting to squeeze all of the information we could out of our observations of the Vellela community. These organisms disappeared after having been with us for several hundred miles, and the sea surface has become a desert. However, plankton hauls brought new treasures and everyone managed to keep busy. In fact, the pace got so hot, with a number of students in the lab until midnight or later, that we have decided to make Sunday a regular day of rest. It appears that we need some slack time.

The wind that was good to us shortly after sailing lasted only a couple of days and then we were in the semi-permanent Pacific high. This brought only light breezes and cut our speed to four knots. The only cure was the main engine and for days we cruised under power seeking wind, scanning every cloud on the horizon for a promise, and even trying to lure it on by whistling. The high persisted over us with the barometer around or above 1030, and it was not until the 23rd that we were able to cut the motor. Then we had to use it again last night and this morning. When the wind blows, it is wonderful and we roll along at speeds up to 13 knots, with very little noise and vibration. The only trouble is that with the heel of the ship, the deck becomes very hilly; one is either climbing or descending, or wishing for a long or a short leg when moving

fore or aft. On the port tack, the force of gravity is a bit too much for my typewriter and, unless I help it along with an occasional push or type very slowly, the carriage will not climb the hill and the letters pile up on top of one another.

Have to get up and look at Oahu now. The next installment will come from Pago Pago or Suva.

Rolf L. Bolin
Chief Scientist

RLB:bm

TE VEGA EXPEDITIONS

GENERAL NARRATIVE--INSTALLMENT 2

August 5. Hawaii was a very successful stop. After patrolling back and forth outside the harbor entrance waiting for permission to come in, we tied up at Pier 9, just below the Aloha Tower, at 1800 hours on Monday, July 29th. (I made a mistake in the date of my last entry.) The ship was all in order and ready for inspection by expected visitors, and as we secured, Capt. Olsen's wife and daughter and their friends, the Allens, and Norman McLean, husband of one of the students, stepped on board with frangipani leis for the entire ship's company.

The students were given their freedom until 0900 Wednesday in order to provide adequate time for the staff to arrange the local schedule. On Tuesday morning, Dr. Taivo Laevastu drove the faculty to the University for a conference and lunch with Dr. R. W. Hiatt, Vice President for Academic Affairs and himself a marine biologist. Later, we met a number of other members of the University staff and were able to plan a full program of shore activities.

On Wednesday, while work progressed on various parts of the ship's machinery and the new hydrographic wire (which was obtained so quickly only through the very generous cooperation of Scripps Institution of Oceanography) was being reeled on the drum, we inspected the Marine Laboratory on Coconut Island under the guidance of the Director, Mr. Vernon Brock, who kindly arranged for transportation. While at the lab, Dr. P. Helfrich, at our request, gave a most interesting and informative talk on the poisonous fish problem in the Pacific. In the afternoon, we were taken in three of the lab's skiffs to a reef in Kanehoe Bay, where the students were checked out in the use of SCUBA gear and had their first introduction to a coral reef. Everyone was most enthusiastic about the experience.

A visit to the University of Thursday gave an opportunity to inspect the rapidly developing campus and particularly Edmondson Hall, and to hear Drs. Albert Tester, William Gosline, and Allison Kay explain some of the work that was going on.

Friday morning was devoted to a field trip to Nanakula Bay, led by Dr. Kay. The work was in the intertidal zone on a rocky outcrop in the sand beach, and many interesting specimens were collected. Bob Beeman, who is writing his Ph.D. thesis on tectibranches, was particularly elated to get numerous specimens of Aplysia and Dolabifera, the latter genus new to him. In the afternoon, a visit was paid to the Bishop Museum.

Many of the local scientists, including Drs. Hiatt, Helfrich, Gosline, Laevastu, Kay, Maxwell Doty, E. S. Reese, Mr. Brock, Jack Marr and others, including a large group of biology students from the University, visited and inspected the ship. The ship's company spent most evenings visiting

with various old or new friends on shore who, without exception, did all that they possibly could to prove that generosity and hospitality is the trademark of the Aloha State.

A short time before we were to sail on the morning of Saturday, August 3rd, Captain Olsen's friends, the Allens, arrived with a pleasant surprise. Their two daughters had marshalled all of their friends and raided (with the owner's permission, I understand) all the frangipani trees in the neighborhood. They had spent an entire day stringing the blooms to make the grandfather of all leis. The result was a streamer of fragrant creamy flowers 70 ft. long, and this they festooned in graceful curves over the bowsprit of TE VEGA. I am sure that not many ships can sail out of Honolulu so bedecked. When we left, we floated the flowers on the water as an indication that we would return. I am sure that none of us will soon forget Hawaii.

On leaving the harbor, we set a course for Penguin Reef which extends as a broad shoal area southwest of Molokai Island. Having been over very deep water for practically all of our cruise so far, and due for another long stretch of equally deep water, we wanted to try out our bottom gear at conservative depths and work outward gradually before risking our entire cable and testing the strength of the winch at anything near capacity. Although we should have liked to have two or three times as much water, topography dictated that we work in about 26 fathoms. At this depth, we made a hydrographic cast and took a dredge haul. The gear brought up coral boulders and some live coral, mostly Porites. Bright sponges, bryozoans and colonial tunicates painted vivid patches on the dead coral, and the crevices were loaded with worms, crustaceans, echinoderms and molluscs of various kinds. Among the latter was the prize of the haul, a brilliantly red stomatopod about two inches long with its telson armed with a fantastic pincushion of stout spines. We have been speculating that this animal must crawl into holes in the coral and use the telson as an operculum or stout door to keep intruders out. Another interesting animal from this haul was a small very elongate carapid fish living in the mantle cavity of a clam.

Working southward under fair winds, we encountered the subtropical convergence with its overcast sky and frequent heavy rain squalls. It was the object lesson or field demonstration that aptly illustrated one of Dr. Thompson's earlier lessons. Here, on August 6th we made a hydrographic cast. It had been our intention to go to 5000 m., but the fathometer showed a depth of only 1470 m. where the chart indicated that there should be more than three times that much water, so we had cut the cast short. With bottom that close, we tried out the dredge again, but unfortunately, with 3550 m. of wire out and an angle indicating that it should have been safely there, it came up full of plain sea water with no indication that it had touched bottom. We had to be satisfied with a couple of surface hauls using the half-

meter net. These caught bright blue copepods, colonial radiolarians, salps, siphonophores, egg chains and a single fish larva. Then we hurried on.

Unfortunately, our fathometer, which gives beautiful traces while we are not moving, will not register while we are under way. The problem is probably the accumulation of air bubbles around the transducer, and this is a problem that we will not be able to solve until we go into drydock. The sounding while on this station indicated that we were over an uncharted sea mount or guyot. It would have been most desirable to stop and investigate it by soundings and sampling, but our commitment in Singapore forced us to move on. I am more than ever convinced that the uncommitted schedules originally planned for TE VEGA are most desirable, and I am already looking forward to the day when we can really stop and investigate any interesting thing that shows up in our work.

On the 8th, about 200 miles northwest of Palmyra Island, we took another hydrographic station, used the half-meter net on the surface and shot the Tucker trawl with 3000 m. of wire. We estimate that it reached a depth of 1400 m., and it brought in a fine collection of deep-sea fishes, including the gulper eel, Eurypharynx pelecanoides (possibly the most bizarre fish that lives in the sea), snipe eels, melampaeids, myctophids, etc., etc., as well as red shrimps, a large tomopterid worm, various squids, deep-sea jelly fishes and numerous other associated animals. Unfortunately, the gear appears to be too large to handle, and I am afraid that we will have to cut it down. It was a hard and time-consuming task to get the bridle, pipes and depressor in, and while we were doing this, the cod-end and bucket were being given a beating by the surface waves. As a result, a large proportion of the delicate specimens were very severely damaged.

Working southward, we figured we were about in the southern part of the Equatorial Counter Current on the 12th and here we made another hydrographic cast and decided to try the 21-ft. Tucker trawl once more after having provided it with additional lines to aid in hauling it on board, and rigging blocks on the boom rest to take these lines. The trawling wire went through a number of curious contortions. It trailed very sharply to port, straightened out to a degree and then not only led out to port again but ran ahead of the ship as we were hauling in. We must have been passing through the Cromwell Current, which in some places has been reported to run under the surface layers at as much as $3\frac{1}{2}$ knots. If it was moving as fast as this in our area, and if we were drifting to the west at 2 knots, as the Captain estimated, and going ahead at 1 knot, the net may have been pulled through the water at depth at 5 knots or even more. Whatever happened, it proved to be too much of a strain, and the net came up with the pipes bent nearly double (in spite of a triple bridle

on the top one) and the webbing ripped and torn. In spite of the difficulty, we got a beautiful and rich catch. Deep-sea angler fishes, black melanostomiatids, Malacosteus, hatchet fishes, snipe eels, lantern fishes, melamphaeids, etc., lots of the pelagic sea cucumber Plagothuria, magnificent large red prawns of several different kinds, medusae, siphonophores, salps, fantastic amphipods, a very large isopod and numbers of other goodies. The most spectacular catch was probably the largest phyllosome larva of some unknown spiny lobster that I have ever seen. It was flatter than a pancake and transparent as glass, and it measured about three inches across the disk. This beast evoked more interest and comment than any other in the catch.

For a time in the doldrums, the wind died to practically nothing, and we had to use the motor. Now on the 17th we have been under sail for a couple of days. On our best day, we averaged 9.9 knots from noon to noon, but the wind is irregular and while we sometimes do 13 or 14 knots to the delight of everyone, we more often do 6 or 7 or 8. This, together with the fact that we stop periodically to work, makes the passage rather slow.

Time passes in a fairly routine way with daily lectures (Dr. Thompson has now finished with his discussion of physical and chemical oceanography, and a very good series it was) occupying most or all of the morning. Stations use up many hours if they are deep ones, and the chemical work and examination, preparation and packaging of the biological material takes many more. Sometimes special events break the routine, some unpleasant, like the loss of a bathythermograph through the parting of the BT wire (luckily we had purchased a spare wire in Honolulu), most of them pleasant, like the sighting of a whale or the capture of three Portuguese men of war (*Physalia*). One of the students, Don Thompson, got a practical demonstration of its stinging power, but his discomfort was only temporary. Sometimes we take salt water baths in the bos'n's chair slung over the side, which can be a bit exciting if we are making good speed; at one station a number of people went swimming in the clear blue water a couple of miles deep. Pranks are played now and then; the third mate's cap appeared one morning tied to the base of the radio antennae on top of the fore topmast. Its not quite sure who put it there, but there are not many people on board who can go that high, far above the spreaders. The evenings are usually occupied by working up data, reading, writing, cards or chess, and on three occasions we have had illustrated lectures by Miss Bennett who has brought along a fine collection of Kodachromes of birds, coral reefs, marine invertebrates of Australia, etc.

On the trip from San Diego to Honolulu, Captain Olsen tried some amateur psychology. After an original admonition to be careful of water, he said no more until our supply ran low. Then he cut it off except for one hour in the morning

and one in the evening, and permitted no showers. Three days without a bath brought the water problem into sharp focus, and on this leg of the cruise everyone has been careful and we are in fine shape. It appears that we shall have no trouble on that score from now on.

Tutuila is in sight, and we expect to be in Pago Pago by 1700 hours.

Rolf L. Bolin
Chief Scientist

RLB:bm

TE VEGA EXPEDITIONS

GENERAL NARRATIVE--INSTALLMENT 3

American Samoa and the Samoans were kind to us. We cruised into the extinct and flooded volcanic crater that is Pago Pago Harbor just ahead of the Matson Co. freighter SONOMA and tied up to the fuel dock on Saturday afternoon, August 17th. While waiting for completion of the formalities that would permit us to step on shore, friendships were born with a number of the local people who had come down to the dock to look at the ship, and we soon had an invitation for the entire ship's company to attend a Polynesian party at the local club that evening. Most of our group made a quick trip to town for lava-lavas and strings of shell beads for costumes for the evening, and it turned out to be a gay affair; a welcome break after the long run down from Honolulu.

Sunday was a free day. Some of the students went swimming or scouting for favorable places to dive on Monday, but were discouraged from the latter activity by the appearance of large sharks. Practically everyone had an opportunity to take a trip into the countryside and visit some of the native villages. The three faculty members were taken for a jeep ride to the end of the road along the very beautiful southeastern shoreline by Dr. A. H. Banner, of the University of Hawaii, who is conducting a summer institute of science for native Samoan teachers.

On Monday, under the guidance of Mr. Thomas Anastas, the local Fisheries Officer, the entire scientific party occupied a poison station for fishes. Since he is trying to discourage the use of poison by the local inhabitants, Mr. Anastas took us to the only possible place where we would be sure to encounter no natives, and where we could work to our heart's content without providing an unfavorable example. This was immediately adjacent to a recently constructed airstrip, and, unfortunately, the area had suffered from dredging and filling. In order to approach the place, we had to pass through a very narrow pass in the reef, but under the expert pilotage of our guide the whaleboat and three Boston whalers made it without mishap, although we had an exciting bit of surfboarding going in and almost as interesting a time going out. In spite of conditions that were far from perfect, the station yielded about 80 species of colorful reef fishes, butterfly fishes, damsel fishes, surgeon fishes, goat fishes, wrasses, parrot fishes, puffers, gobies, tropical blennies, moray eels, etc., etc., most of them new and strange to students from temperate areas.

During the weekend, individuals and small groups from the ship were entertained by various people from the town, and in return the ship was inspected by teachers of the summer institute, by various administrators and scientists from the Department of Agriculture and the U. S. Bureau of Fisheries, by Dr. Robert Kaufmann, in charge of the Samoan

Hospital (a person who impressed me as being from the same mold as the old surgeon-naturalists of the last century, who did so much to advance our knowledge of the biology of out-of-the-way places), and by numerous other people who were simply interested. Many would have liked to go with us on our continuing journey. On the other hand, we lost one crew member in Samoa. The Chef had become disenchanted with cruising in the South Seas and tendered his resignation. It was accepted and he was put ashore in Pago Pago. Jack, the second cook, became boss man in the galley, and we hired a Samoan by the name of Sam to wash dishes, keep things clean and make himself generally useful.

After getting fresh supplies and water we left Pago Pago on Monday evening, August 19th. Lectures, processing of the fishes from the poison station and discussing the catch, occupation of a hydrographic station and taking a deep plankton tow, which was very poor in contrast to our rich hauls in the region of the equatorial divergence, filled the time on our short run to Suva. On this leg, we lost Thursday Aug. 22nd by crossing the International Date Line, and so we arrived at Fiji's major port in the afternoon of Saturday, August 24th.

Saturday is a very poor day to arrive, since it means that no business can be conducted until Monday, but in Suva we did get one dividend. Sunday was the day of the annual Hindu fire-walking ceremony. Almost all of the ship's company attended. The participants prepared themselves by bathing for a couple of hours in the sea and then, clad in yellow and with yellow dabs of color on their faces and skewers through their cheeks, they jogged and danced along in the wake of two drummers, beating out a cadance with an accent matching a rapid human heart beat. They were led by various priests in colorful garb on a long trek to the temple of their sect. The journey took more than two hours and by the time they arrived, they were in a glassy-eyed frenzy. After a preliminary few minutes of jumping and dancing, they proceeded to walk barefooted across a bed of hot coals about 15 feet long. Faith alone was supposed to protect them from harm, and the faith of each individual seemed to me to be measured by the speed with which he crossed the pit of coals; some danced across in a great hurry, but a few strode deliberately and sedately. At any rate, it was an amazing exhibition of mass hysteria or mass hypnotism, but none of our group was impressed enough to join their sect.

On Monday, the 25th, again under the leadership of the local Fisheries Officer, this time a Mr. Warren, we made an expedition to a mangrove swamp across the bay from Suva. A lecture by Miss Bennett on this type of habitat had laid an excellent foundation, but the strange stillness and gloom of the narrow inlet up which we traveled in our small boats was impressive. The interlocking aerial roots reaching down

into the mud made it almost impossible to get away from the water, although some of the students did penetrate a short distance. Between tide marks, the roots were covered by small acorn barnacles (probably Chthamalus) and provided a foothold for small littorine and neritid snails and grapsoid crabs. A few hermit crabs occupied trochid shells, although how these shells came to this muddy habitat is somewhat of a mystery. They must have been carried up from the cleaner bay by generation after generation of hermit crabs. A few small mangrove mussels and oysters completed the visible and collectable invertebrate fauna. We tried a little fish poison in the opaque muddy water that looked as if no respectable fish would live in it, and we were rewarded with 30 species of fishes belonging to 17 different families. Scatophagus, Monodactylus, mullets, anchovies, gerrids, leiognathids, hemirhamphids, etc., contrasted strongly with the fishes that we had taken on coral reefs, and provided grist for a lecture a couple of days later.

The usual hospitality to visitors that we have learned to expect from the peoples of these Pacific islands was enjoyed by all on board, and in return we displayed the vessel and told of our program to numerous officials, local scientists and teachers, and to a group of Fijian students about to enter universities in New Zealand.

In Suva, we lost two students who had to return to the United States. Robert Beeman had a teaching commitment that he could not be sure of meeting if he continued further, since we are entering an area where air travel is sketchy and distances are long. His departure is one of the unfortunate results of our much delayed start. Richard Conrad has been suffering from intestinal upsets ever since we left Hawaii. It was deemed unwise to take him into the primitive areas that we are entering where medical aid would not be available for long periods, so he too was sent back. Most of the others will have to return from Rabaul in order to enter their home universities for the fall term. We shall reach Singapore with a skeleton crew, the faculty down to two, since Dr. Thompson will also have to leave us in Rabaul, and the students reduced to four.

Shortly after noon on Tuesday, August 27th, necessary repairs and modifications of the refrigeration and fresh-water distillation systems had been made, and we cast off and headed almost due south for Great Astrolabe Reef, which had been recommended to us as a very rich and spectacular coral area. We crept in through the narrow pass in the reef at dusk and anchored for the night in the shelter of Vanuakula Island. Here we took a surface plankton tow as the water drifted past and caught a few fishes with dip nets under a light. However, the wind whipped the surface, and it was difficult to see anything, so the catch was poor.

In the morning, when it was again possible to navigate in the lagoon, we continued on to Mbulia Island which we had been advised to use as a base. Here we split into two parties, Bolin taking one group in the Boston whalers to the outer reef a few miles east of the island, an area that had been particularly recommended, while Miss Bennett and Dr. Thompson led the others to the beach. The outer reef was very beautiful with many different kinds of living corals and myriads of small brilliantly colored reef fishes. The top of the reef was under only about 2 feet of water and sloped back gently into the lagoon, dropping off and giving way to sand at a depth of about 15 feet. This in turn formed a wide flat shelf before it sloped down into dark blue depths of 100 feet and more. We spent considerable time with snorkles or with aqualungs exploring the gulleys cut through the reef by the inflowing water, admiring the massive brown coral heads with tiny iridescent green polyps, the staghorn types of white with blue tips, golden yellow platters that were fragile when touched but which withstood the rapid water flow, small delicate hydrocorals of an appropriate coral pink, and many others. We picked up a few molluscs, but decided against a poison station, since the flow of water from the huge breakers crashing on the outer reef face was far too strong. It was almost as much as one could do to stay in one place, even with swim fins.

The group that went ashore on the island visited the native village and were cordially welcomed by the hundred or so people who lived there. It was very neat and orderly with houses of woven mat walls and thatched roofs. The village dignitaries sent a very formal invitation to a party that evening, as follows:

Bulia
28th August 1963

To,
The Captain of the "Ya TEVEGAR."
Sir,

We invite you and all your companions to be here tonight for dancing and drinking yagona.

We need if you arrive in our invitation you will be arrive onshore at 8 p.m. tonight.

Yours

Faithfull
The Village Adviser
Manka Waga
and the Chief of the
Village Poasa Qeiri

It was with considerable regret that the Captain replied in an equally formal note, accompanied by a gift of cigarettes, that we were somewhat behind schedule and had to sail that evening so it would be impossible for us to attend. It would undoubtedly have been great fun to join in the dancing and the drinking of yagona, whatever that is. Perhaps we can do it some other time.

The party that had been to the outer reef stopped for drinking coconuts at the island on their return, and there met the other group. Everyone then joined forces and we ran a small poison station on a reef about 100 yards off shore. This was in shallow water, not more than eight feet deep, and most of the coral was dead. It appeared barren in comparison with the outer reef, but it yielded about 55 species belonging to 25 families and 11 different orders. Eight of these families, Plotosidae, Synodontidae, Syngnathidae, Acanthoclinidae, Carangidae, Clinidae, Tripterygiidae and Brotulidae were new to our collections, so the time and effort was not wasted. Besides, it was fun!

Off again that evening for Tikopia, or so we thought. We had been requested by the School of Tropical Medicine of the University of Sydney to get blood samples from the natives on Tikopia, the easternmost Pacific island to which malaria has penetrated, for a malarial survey under way. We had clearance for the island from London, but instructions to stop at Vanikoro or some other port of entry first. Pressed as we are for time, it will not be possible to waste three days backtracking from Vanikoro. Messages explaining the matter and presenting a request to stop at Tikopia first, since it lay practically on our course to Vanikoro, were not approved by the British Civil Service. As a result of a message received on the evening of August 29th, we are about to bypass Tikopia en route to Vanikoro. We are much disappointed, because Tikopia is very seldom visited by Europeans and is said to be almost unchanged from the old days. It would have been interesting to see.

On August 29th, we passed for about an hour through an area where there were widely scattered pieces of drifting pumice, probably washed out to sea from Fiji by the heavy rains of early this month. Tom Clarke managed to dip-net a piece of it about twice the size of my doubled fist. Along with it, he caught a few animals that provided a beautiful lesson in ecology. The pumice was black and was speckled with small white lepadid barnacles only about two or three millimeters long. These indicated by their size that the drifting rock had probably not been long in the sea. Perched on the pumice was a small crab, perhaps a shore form off on a journey to distant parts on his own little world. It is interesting to see dispersal mechanisms in action, and not just to talk about them. However, the nicest beast was a three-inch trigger fish (Balistes) that was netted along with the pumice. It was black and had white freckles just the size of the barnacles and spaced as the barnacles were on the pumice. In the aquarium, the fish always stayed immediately adjacent to the pumice and often pressed directly against it. At such times, it was practically impossible to distinguish the fish from a distance of one foot. It was one of the most perfect examples of background picturing on the part of an animal that I have ever seen. The fish blended

perfectly with the pumice and appeared to have small barnacles growing on it; it was simply invisible. A student of biology has to be totally biased not to be impressed by such clear-cut demonstrations of the principles he reads about.

By August 31st, the Mbulia Island collections were pretty well in hand and we stopped for another hydrographic station and tried the modified Tucker net (now cut down to 10 ft. in width). This deep haul was very disappointing; it contained only one astronesthid, two small melanostomiids and a few bedraggled Cyclothone among the fishes, a couple of deep-sea amphipods, some Salpa, and a pteropod or two. A plankton haul on September 1st, with 400 m. of wire out, was much better, with numerous small goodies in it. Most spectacular were a number of Stylophthalmus larvae of the deep-sea fish Idiacanthus. These are small eel-like larvae with the eyes at the ends of slender stalks several times as long as the head--the kind of thing that is pictured in Sunday supplements of questionable newspapers, but that one never believes in until one has actually seen a specimen.

On September 2nd, we arrived off Vanikoro in the Santa Cruz Group and put over the small boats to go ashore and get local information on the tricky passage through the fringing reef and the lagoon which was studded with coral heads. By the time we were at the pass entrance, we were met by a boat from shore carrying Bill Powell, the overseer of the lumbering operations on the island, who remembered me from my visit of six years ago and called me by name. He showed us the curving channel marked only by two oil drums for buoys and some white flags on a few sticks, marking segments of the range, and it was not long before TE VEGA was anchored a few hundred yards off shore in 15 fathoms. Captain Olsen, Miss Bennett and I went ashore in a Boston whaler with the ship's papers, and just before noon, with practically no formality, we were granted entry to the British Solomon Islands. The local European population, consisting of nine men and Mrs. Powell as the lone white woman made us welcome by providing cold beer (Vanikoro has an unsurpassed beer-drinking climate) and arranging a buffet party for the ship's company that evening, replete with music by a number of guitar strumming natives. It was a fine affair.

We are now really in the Southwest Pacific, an area where both sexes go around stripped to the waist, the little children are stark naked, facial tattooing is common and pidgin English is the mode of communication. It is unintelligible to me, but the natives evidently understand that a sign reading "This haus tamboo ol boy." means "No admittance." This example does not give a hint of the complexity, but it is the best that I can do.

Biological work consisted of taking plankton tows in the lagoon, visiting the mangrove area and making an ex-

pedition to the fringing reef where La Perouse lost his ships. The reef is marked on the charts as the Astrolabe Reef, named after one of these ships, and ashore is a recently erected monument to La Perouse, who met his death on the island. The reef was by far the richest and most spectacular we have seen so far; in fact, it is impossible to imagine anything better. Living corals of dozens of different genera created fantastic submarine gardens through which myriads of colorful fishes swarmed. Several species of crinoids were common, sea cucumbers of at least four kinds were seen, brittle stars and snails crawled here and there, tube worms spread their feathery spirals of tentacles, Tridacna clams displayed their colorful mantles of brown and blue and green but were impossible to pry out of the solid coral in which they were embedded. Trying to place my interest in fishes in the proper perspective, I have been looking for various invertebrates, but on each trip to a reef I am more and more impressed by the dominance of just two groups of animals, the corals and the fishes. They are by far the most conspicuous organisms, and their fantastic forms and eye-catching colors make it difficult to see anything else. While just watching the life around me, I had the fun of observing a small labrid fish, Fissilabris dimidiatus or a closely related form, busily picking parasites off a group of surgeon fishes (Acanthuridea). This is a well known habit of several wrasses, but I had never seen the cleaning operation in the field before. Some of the students reported having seen the same labrid working on groupers and actually picking things from inside the mouth while the larger fishes obligingly gaped widely for them.

We could well have spent many fruitful days at Vanikoro, but the necessity of getting people to Rabaul in time for their planes home forced us to push on, and we left on the evening of September 3rd for Honiara where we will clear British territory.

This is September 5th, and by noon we had pretty well cleaned up the collections made at Vanikoro and were ready for more data and material. Consequently, off Cape Recherche, at the northwest tip of San Cristobal Island, we made another hydrographic station and followed this with two plankton tows, one through a fairly well-defined deep scattering layer and another below it. Both were very successful, and the catches differed markedly. The upper one was heavy with the large pseudothecate pteropod Corolla, which flapped around like butterflies in our dishes and amazed everyone by their large gelatinous shells that were absolutely invisible in water. The lower haul was characterized by beautiful siphonophores and brilliantly luminous pyrosomes. The students are busy with this material as I write.

We are running under power through the Solomon Islands, over a low even swell, with a full moon overhead and just

enough of a breeze to make the weather perfect. During the day, it was hot and humid, but the blue water and the lovely islands on both sides were almost enough to make those who had time to look forget their discomfort. I might add, for the benefit of those at home who envy me, that leading an expedition of this kind may be interesting, but it bears no resemblance to the TV version of a pleasure cruise in the South Seas. There are times when I should like to sit on deck with a tall cool Pimm's No. 1 in my hand and contemplate the folly of the men who turned this idyllic scattering of green islands on a sparkling cobalt sea into a bloody battlefield only a few years ago, or the folly of those who preceded them and sought fortunes at the risk of their necks in the notorious blackbirding expeditions that carried the natives off to virtual slavery. Unfortunately, I have no time for it. The days are taken up in lecturing, planning future schedules and activities, conferences with the Captain, writing letters in answer to the business that catches up with me in each port, supervising trawl hauls or leading field trips to the beaches, checking equipment, and a hundred other matters. There simply are not enough hours in the days, and the time for taking things easy over a drink is just not available. Besides, this is a dry ship.

This narrative is being written hastily for the benefit of numerous people to whom I do not have time to address individual personal letters, much as I would like to. Some might like it to be more detailed on the scientific end, some might like it to be more in the nature of a travelogue; I am simply trying to give you all an inkling of what this unique venture in education is like, in order that you may form some sort of an opinion as to its merit and value. My personal opinion is that it is successful now and will get better in the future when we do not have to worry so much about the miles still to go. To really know what it is like, you would have to be with us, to ogle at the catches as they come up full as Christmas packages of unsuspected treasures, to stand biological watch on deck in blazing sun or drenching downpour, to do chemical determinations while fighting for balance on a canted heaving deck, to glory at the fantasy of coral reefs with the aid of an aqualung, to try to concentrate on lectures while the sweat drips off your nose and the paper on which you are taking notes gets soggy and sticks to your arm, to feel the life of the ship as she heels over and steps out at twelve knots under a brisk wind, to accept the proffered friendship and cooling beer of the European expatriates in the ports of call, or the equally welcome friendship and equally refreshing drinking coconuts offered by the delightful natives who have not been spoiled by too much civilization. If you have any criticisms, suggestions or comments, why not drop me a note, to arrive by October 11th, addressed as follows:

Dr. Rolf L. Bolin
Research Vessel TE VEGA
c/o Mr. W. G. Thurston,
Mezzanine Floor,
6 Cecil Street,
Singapore 1.

TE VEGA EXPEDITIONS

GENERAL NARRATIVE--INSTALLMENT 4

On the morning of Friday, September 6th, we tied up to the new wharf at Honiara on the north shore of Guadalcanal. This seat of government for the British Solomon Islands is a bustling little town with a great deal of building going on. We had intended to conclude our business of clearing as soon as possible and had hoped to depart about noon. However, this was before we met Mr. John C. Grover, Chief Geologist of the Department of Geological Surveys, who climbed on board practically as soon as it was legal to do so. He had other ideas, and was most convincing and insistent. By offering to drive the faculty around town and the adjacent countryside, to provide us with lunch at his home, to show us what the Geological Survey was doing, and to provide a land rover and driver to take the students to Red Beach, to Henderson Field, up into the foothills, around town and to his laboratory, he made his point, and we agreed to delay our departure until 1800 hours. We are glad that we did.

Mr. Grover has been on Guadalcanal for 13 years and was a mine of information about its history, its people, its political situation, its natural resources, its future potential--everything. A man of driving energy, he has an amazing geological survey going. With only a few white colleagues, backed by Micronesians whom he has trained as technicians himself, his department is working the local geology from a number of different angles. He has managed to establish a group of laboratories with equipment that one might expect to find in a good university, has gained the cooperation of geologists in Australia and America, has talked the United Nations and London out of almost as much money as he needs, has convinced the British Navy to assist in a gravimetric survey of the islands and intervening waterways with the frigate COOK, has arranged free color printing of his maps by the British Army, and in general is doing quite well.

One of the interesting things that he showed us in his museum was a photograph of a small new-born volcano that appeared off the southern coast of Vangunu Island in 1960. He said that it had since died and disappeared, but that his seismograph had, a few days ago, registered an earthquake of Richter force 7 with its epicenter very close to the locality and that the volcano might well be active again. He suggested that, since it was almost on our route to Kieta, it might be interesting for us to look the area over. The final consequence of all this was that when we left Honiara that evening Mr. Grover was aboard as our volcanologist and we set our course to the south of the New Georgia Group instead of going straight up The Slot. Then our amazing guest pulled another surprise by announcing that he had brought some kodachromes with him, and we were treated to an unexpected but perfectly fascinating lecture, superbly illustrated, on the geology of the Solomons, stressing particularly seismology and vulcanology.

Shortly before noon the next day, we approached our target and the fathometer was working very well for a change. I watched the trace as it began to climb from about 9000 meters, getting gradually steeper. In the last mile, it rose in a steady line from 6000 to 20 meters. Although this is only a 24° slope (which is plenty steep enough) it showed up as about 60° on the echogram. It was terrifying to watch it swing up out of nowhere, reaching for our keel, and when it began to merge with the outgoing signal I was scared enough to call to Captain Olsen to stop the ship. He did so, although he had the situation well in hand with lookouts on the spreaders and his own navigational fathometer working. We could spot no sign of present volcanic activity, but we did find an area of slick and slightly discolored water, undoubtedly due to upwelling reaching the surface. We cruised back and forth over the area, finding the minimum depth to be 9 fathoms and getting some spectacular contours on our echograms. Several tries with the mud snapper got us only about a tablespoon full of black sand. Then we tried the small dredge and got up some gravel and stones of the same material, all basaltic and without the slightest evidence of anything growing on or among the fragments.

After spending all of the time we could afford, we cruised downstream to the westward a few miles seeking sufficient depth for a deep hydrographic station, and then followed this with a plankton haul at dusk. It was tremendously rich, probably as a result of upwelling induced by the nascent volcano that we had been exploring and had dubbed Te Vega Seamount, since it had no name on the charts. Among the myriads of small copepods, mysids and amphipods in the haul were lots of the grotesque larve of stomatopods and spiny lobsters, and the glass-like leptocephali of eels of several different kinds. There were also several cubomedusae, forms that we were not so happy to see; these are among the most venomous stinging organisms in the sea, and there are several cases reported where they have caused human deaths in about three minutes.

That evening, Mr. Grover gave another illustrated lecture entitled "A Typical Day in the Life of a Government Geologist." I doubt that it was really typical, but it was certainly interesting and made all of us appreciate the difficulties of working in really rugged tropical areas without any roads and where the annual rainfall is 300 inches and the vegetation so dense that practically nowhere, except in streambeds, can one see a rock or a square inch of soil. All of us would have liked to have been with him in the fantastic moss forests of the higher elevations, of which he showed several good shots, but I don't know how many of us could have stood the gaff of getting there.

At dawn on September 8th, we received from Mr. Grover three long reports on his Solomon Island Surveys (all that have been published so far) for the ship's library; we gave

him in return and to show our appreciation, the echograms and samples from Te Vega Seamount, sent a small boat to put him ashore at Munda, from which place he had to find his way back home as best he could, and wished him the best of luck and every success in his exciting work.

Later in the morning, as we were cruising through Ferguson Passage, Dr. Thompson used the time between the regular lecture and lunch to review for the students the hydrographic data that we had collected on our more or less meridional passage from Hawaii to Fiji and to explain its significance. The discussion was interrupted by an urgent summons to deck. As we hurriedly piled out, we found ourselves in the middle of a pod of six humpback whales. They were a great sight, but we were too late to get a real close-up view of the one that had been within 10 feet of the ship minutes earlier. Nevertheless, the spouts all around, the black backs arching above the water and the show of flukes when they sounded was appreciated by one and all. In the afternoon, as we continued up Vella Gulf between Gizo and Kolobongara Islands, there was plenty of evidence of high fertility of the water. The water itself was discolored a reddish brown, frigate birds were present in unusual numbers and other birds were working over the water here and there, sometimes some unknown fish would jump high in the air and flying fishes skittered out from our bow. For a few minutes we had with us hundreds of dolphins playing and leaping clear of the water--a great sight. This area, also, could have engaged our attention for a long time, but we had to push on for the rather tricky Bougainville Strait that lay ahead.

On the morning of Monday, September 9th, as we were heading for the rather narrow opening in the fringing reef off Kieta, on the north shore of Bougainville, sudden heavy rain concealed our visual landmarks and blanked out the radar so that we had to stand off for a time. When things finally cleared up, we sailed into the lovely harbor that made someone remark that each port of call seemed to be more beautiful than the previous one. Heavily wooded islands and peninsulas, with glistening white beaches and mat huts with thatched roofs here and there, lay on both sides, while behind the little town directly ahead rugged and precipitous mountains of an unbelievable green, crossed by horizontal fragments of grey rain clouds, reared up to a jagged skyline dominated by a thumb-like volcanic plug.

As soon as we had anchored, an outrigger canoe, paddled by two natives and bearing three white men under two umbrellas and one poncho, set out from shore. They were the local port authorities and Gene Ogan, a graduate student of anthropology from Harvard who has been here almost a year doing his field work. As soon as the official entry had been completed, we pulled our hook and sailed around the western peninsula to a new anchorage in Arawa Bay, where we were welcomed by Mr. and Mrs. F. R. McKillop and their four children.

The McKillops were very kind in providing ground transportation for all who could get ashore, as well as light refreshments. We inspected their thousand-acre coconut and cocoa plantation, enjoyed the hospitality of their beautiful home, swam in their pool and marveled at what well may be the finest private orchid collection in the world. Rows of trees, covering at least a couple of acres, were covered with orchid plants, many of them species from Bougainville and New Guinea, South America and Asia, many of them imported hybrids from the United States and Australia, and many of them Mr. McKillop's own crosses. The faculty and Captain Olsen were invited to dinner and enjoyed a most pleasant evening.

Bright and early on Tuesday morning, we all scattered out for biological work, some diving on the deeper coral, some concentrating on collecting molluscs, while the most interesting work was an independent project on a transect perpendicular to shore, carried out by Mary Ann Jordan, Mike Hadfield and Paul Schroeder. These students, raking through the sand of the extreme shallows on the beach itself, combing the eelgrass in a couple of feet of water, turning over dead coral slabs to see what was under them, exploring the interstices of living branched corals, got so many varied forms of invertebrates in about the first 15 yards along their stretched line that they were unable to pay any attention to the forms found farther out. Ordinary clams and huge brittle stars, pin-cushion starfishes and flat green nudibranches, pipe fishes and snails, tectibranches and sea cucumbers, this and that, fill practically all of the available buckets and trays on board. The list, recorded with the exact location of each organisms as it was collected or seen, covered many pages, and I don't know when they will be able to get it all worked up. I intend to see to it that each future class carries out at least one similar survey. It is impossible to leave this subject without mentioning two interesting fishes that they found living in symbiosis with invertebrates. One was the well-known clown fish, Amphiprion, with striking coloration of pearly white and orange vertical bars, that was found snuggling down among the stinging tentacles of the anemone Stoichactis. The other was a specimen of Carapus about a foot long. This slender fish was living in the digestive tract of the green sea cucumber Stichopus chloronotis, with its head sticking out of the cloacal opening. There is no end to the fascinating material that we find at each station, be it along shore or in the open sea, and we are barely scratching the surface.

We learned that the good people of Kieta had gathered to welcome us on Sunday when we were supposed to arrive, and that when on Monday we stayed only about an hour and a half before leaving for Arawa Plantation they were doubly disappointed. Therefore, when we received a formal invitation to a specially planned affair at the Kieta Club on Tuesday evening we could not refuse. The ship made the short trip back to

Kieta at dusk, and we once more enjoyed the outgoing cordiality and hospitality so characteristic of these islands.

Mr. McKillop had had a breakdown in his cocoa-drying machinery and had chartered a plane to bring a man out from Rabaul to do some stainless steel welding. This ill wind blew us some good. Having a chartered plane on his hands, Mr. McKillop invited four of our company, the faculty and Mary Ann Jordan, to take an early morning flight over Bougainville. To be near the airfield in the morning, we all took a blood curdling ride out to Aropa Plantation in a galloping land rover, where we were the guests of Mr. Robin McKay in his fabulous home on the top of a steep bluff. We got practically no sleep, but we did enjoy his refreshments, his talk, his guided tour of only about 20 minutes to his copra shed and dryer, his cocoa and rubber processing plants, and most of all his tremendous view across the tops of the coconut palms and the broad Pacific almost to South America.

After a hearty breakfast we rode down the short distance to the air field and were soon away, over the ship, the town, Arawa Plantation and off to the high mountains with their rugged terrain and deep dense cloak of green, pock-marked here and there by the clearings and huts of the scattered native villages. Ahead loomed the active volcano, Mt. Bagana, 6560 feet high, and still farther on a second one, Mt. Balbi, reaching 10,171 feet into the sky. We circled them both, flying almost directly over the crater rims and getting a good strong whiff of sulfur fumes; we circled again lower down and saw steam rising from fumeroles and smoke from the frozen lava cascades. We looked down on smaller inactive craters, one with a small malachite-green lake in it, and we were struck by the dead grey of the cinder cones, so incongruous in this lush green land. We circled inside one crater, close over the surface of Billy Mitchell Lake, reputed to contain hot water. We came back close to the spine of the island and played tag with numbers of volcanic plugs and almost brushed our wings against the dense foliage clothing the sheer walls, and then we slid down across the jungle and the coastal plantations to the air strip once more. One of the finest hours any of us had ever had was over. Since we are here to study biology and not vulcanology, my conscience hurt a little bit--but not too much. I promise not to go chasing volcanos again.

While we had been away, there had been a number of visitors on board, including a class of young men from the Catholic school, who were impressively knowledgeable. When we had gently shooed everyone off, we got under way again and in the afternoon sailed through a pod of whales of undetermined kind, estimated to number up to 50. I was asleep at the time and nobody awakened me!

On Thursday, September 12th, after the final lecture for most of the students had occupied the morning, they were

subjected to a written examination in the afternoon. It was a hot and sticky day and everyone considered it to be an indignity, but I thought it necessary to get some assessment of the effectiveness of our teaching. For this first group, on what must be considered a shakedown cruise, the trip was of only nine weeks duration. Subsequent voyages will average about two weeks longer. Nevertheless, in spite of our early fumbleings and mishaps, I consider the experiment a success. The students, and the faculty too, have gained an impression of the size and staggering complexity of the ocean, of its multiform inhabitants, of the tremendous differences in the habitats they occupy and of the fierce struggle for existence that they endure. Varying impressions have assaulted us in no logical sequence as we progressed from temperate shorelines to open water and back to shore again, as we have worked the coral regions, the mangrove swamps, the surface layers and the deeps. In the last couple of weeks, through the agency of the continuing lectures, previously isolated bits and pieces have begun to fall into place nicely and to constitute a logical whole. Every one has worked hard and for long hours and fully earned the credits that they will get. In my opinion, the cruise has been a success, and the students who are able to continue with us to Zamboanga or to Singapore will get an additional worthwhile dividend of similar but ever varying experience and information. Score up 1 for TE VEGA!

TE VEGA EXPEDITIONS

GENERAL NARRATIVE--INSTALLMENT 5

We reached Rabaul late on September 12th and had to wait at anchor until the morning of the 13th for clearance by the medical, custom and immigration authorities. A couple of members of our faculty had friends, or friends of friends in New Britain, and some of the people whom we had met briefly on Bougainville had preceded us by air to Rabaul, so that when we could get ashore we were not dependent on strangers but received a cordial welcome with familiar faces to back it up. In addition, the interest in our "beautiful ship" was such that the students, always effective ambassadors, soon established good relations with the hospitable townspeople and were deluged with invitations to teas, to trips into the countryside, to dinners. A courtesy call on the Resident Commissioner, the complex struggle to get airplane reservations for our departing members straightened out, the routine business of checking mail and getting supplies on board, and other necessary odds and ends had to be sandwiched in between other more interesting activities, such as a diving expedition to still another coral reef, a climb, under the guidance of the local government volcanologist, of Matupi, the still active volcano bordering the 7th fairway of the Rabaul Golf Club, together with a descent into the crater, or a trip to the Government Agricultural Experiment Station at Keravat, 25 miles across the Gazelle Peninsula.

Let it be here recorded that I remembered my vow not to go volcano hunting, and instead of climbing Matupi I stayed on board for an appointment with the press.

The trip to Keravat permitted us to learn something of the biological control of insect pests and Japanese snails, and to see the experiments in clonal selection, plant spacing, balance of shade and fertilizer, etc., that is doing so much to increase the yield of cocoa, and the instruction was interspaced by pleasant interludes of conversation during which Dr. and Mrs. Gordon Dunn plied us with delicious red-hot curry or cooling drinks. However, I am sure that the things that most of us will remember longest will not be the specific things that we go to see on such trips, but the fantastic kaleidoscope of impressions that assault us on every hand and merge into a vivid impression of these fascinating islands--the dazzling white stretches of beach, the perfect cones of recent volcanoes and the jagged mountains that are the eroded remnants of old ones, the green sky-rocket bursts of the coconut palms against the bright blue cloud-cluttered sky, the dense grassless shade in the cocoa groves and the blast of light and heat that strikes like a blow when one steps out into the sun, the tangle of aerial roots reaching down from the limbs of the banyan trees, the philodendrons climbing the tallest trunks and competing with the epiphytic ferns and orchids for light, the parrots with their quick-winging flight, the hornbills with their slow swishing

beat, the flying foxes (fruit bats with a wing spread of up to 3 feet) fluttering in the dusk, the neat thatch-roofed mat-walled houses, the dugout outriggered canoes, the dark-skinned people in their bright lava-lavas with tattooed faces and colorful flowers or shiny leaves or bits of tin foil stuck in their hair as an expression of the their joy of life, the bright red lips and black teeth that reveal an addiction to beetlenut chewing, the high-piled cumulus clouds, sometimes white and cottony, sometimes dark and threatening, the sudden descent of rain in torrents and the equally sudden clearing--these are the different, picturesque and strange things that hammer on our eyes to create an impression and vivid memories that I am sure we shall treasure for the rest of our lives.

In spite of its color and interest, Rabaul was a place of sad parting. Before dawn on Sunday morning, September 15th, Dr. Thompson, Bobbie McLean and Tom Clarke flew out on the first leg of their trip home to take up again their routine duties in the United States. Dick Mariscal, Dave Milne, Mike Nesson and Don Thompson were unable to get reservations until Wednesday, but they were all assured of an interesting wait for their plane as houseguests of hospitable families in town. These four, their hosts and hostesses, and many others both European and native, were on hand as we sailed out on Sunday evening to wave farewell and to wish us luck on our continuing voyage.

Rounding the northern tip of New Britain, we turned westward and set a course for Kotabaru. In these tropical waters, the sea is flat and calm, there is little or no wind, and we are tired of slack sails and the throbbing of the main engine. Our depleted company makes TE VEGA seem almost like a ghost ship, and the previous bustling activity everywhere is replaced by single lonely individuals here and there, going about their duties or taking their ease. There are now only four students and two faculty members on board, the equatorial heat and humidity is oppressive and the pace has slackened.

On the afternoon of Monday, September 16th, there came a pleasant diversion. Miss Bennett, who, due to the reduced number of the scientific group, was holding down the biological watch, spotted a strange object about four miles away. We decided to run over and have a look at what appeared to be a very small island far from where any island was supposed to be and a hundred miles from the closest land mass. As soon as it was evident that what we saw was a thicket of bamboo, we named it "Isobel Bennett Bamboo Island." However, I fear that it will never be recorded in any atlas, because it was afloat. Somewhat more than fifty stalks extended some twenty feet straight up out of the water, and as we drew alongside, we could see that they also extended down about twenty-five feet under the surface to a ball of roots and earth about ten or twelve feet in diameter. Circling

around and among the stalks were a number of fishes and when hook and line got no results, we tried a bit of poison. Although we got a small sample, our catch was slim because most of the fishes sank and we were discouraged from diving for them by the presence of sharks. We had sharks on the fishing line twice, but did not succeed in landing one. There were a few small barnacles on the bamboo stalks below the water surface and numerous tiny ants above it, so here was another example of faunal transport of both terrestrial and marine forms by drifting material, this time a "floating island." Its fauna was meager, but the plankton was rich in the surrounding water. A five-minute tow with the half-meter plankton net yielded a multitude of radiolarians, blue copepods, ctenophores, etc. The beautiful Venus girdle (*Cestum*), a transparent ribbon-like ctenophore with iridescent pink marginal combs was common, some of the specimens two feet or more in length. Unfortunately, they are extremely fragile and disintegrated entirely when we tried narcotization. Nevertheless, it was a beautiful and interesting form to see, and one that most biologists know only from the figures in books.

Since we were behind schedule, we kept pushing on as fast as possible, collecting no new data nor specimens beyond those gained during our routine bathythermograph casts. There were a fair number of logs and other items of debris floating in the water, but quick examination of a number of these showed that they were barren and without marine growths on them; they had probably come from the streams of northern New Guinea where the wet season is in progress, and they had been in the water for only a short time.

On the morning of September 19th, we were off Humboldt Bay and working in toward Kotabaru (Hollandia of World War II fame). The land looked dark and grim under black clouds, but as we approached through intermittent showers, the grey-black turned to green, and neat blocks of houses could be seen on the heights. As we rounded Soedja Point, the entire town came into view, complete with native houses on stilts over the water, and soon we were tied up at the modern wharf.

It was long after noon before the formalities of entry were completed and we were free to go ashore. Since our call at Kotabaru was for the sole purpose of taking two Indonesian scientists on board, I was a bit disturbed by the fact that they did not make their appearance, and more so by the fact that none of the officials who boarded us knew anything at all about them. However, Lieutenant S. Pugu, of the Indonesian Navy, offered to drive me to the office of the Vice Governor, Colonel R. Pamudji. There I learned that the scientists were expected, but that the time of their arrival was indefinite. Later, when Col. Pamudji visited and inspected the ship at my invitation, I learned that he

had spent some time at the U. S. Naval Postgraduate School in Monterey, and it was pleasant to discuss with him the Monterey Peninsula, which he knew very well.

Lt. Pugh offered us transportation in his jeep, and when I said that I should like to visit the university that someone had mentioned, he said that he would return at 5:00. Evidently as a concession to the afternoon heat, practically all activity stops at noon and is resumed again at 5:00. After a pleasant ride through some of the spectacular lush green scenery to which we have become accustomed, we arrived at the Universitas Negeri Tjenderwasih, to be very cordially received by the Rektor, Prof. R. Soegarda Poerbakawatja. The University has just been established in new and modern buildings in a pleasant setting about fifteen miles from Kotabaru. It has, at present, Faculties of Law, Education and Anthropology, but the other sciences are not yet represented. We were entertained by the freshman class, in green mortar boards, who presented a program of Indonesian songs and dances. Miss Bennett and I were even induced to join in one dance, which we called the "Indonesian twist," but I fear that among that group of supple young people we contributed little in the way of grace. Anyway, it was an interesting and pleasant evening.

Since we are so far behind schedule and were impatient to be on our way, we did not dare to stray far from the ship lest our guests should arrive. Therefore, we had to content ourselves with collecting a few odd specimens of medusae, sea urchins and fishes from the wharf. The sea urchins, with very long and slender spines that waved about with remarkable agility, represented two species of the genus Diadema. In both, the body was black, but one was marked by a few small pearly white spots and had a ring of golden yellow around the anus located on top of the test; the other was covered by a sparse tracery of iridescent blue lines so intense that they appeared to be luminous. Both were beautiful, but we handled them with care - since they have nasty reputations.

Shortly after noon, our guests appeared, escorted by Col. Pamudji and Prof. Poerbakawatja. They were Mr. Kesijan Rominohtarto, a carcinologist who has done some work in collaboration with my friend Dr. R. Serene and has had sea experience on the Naga Expedition in the South China Sea, and Mr. Djoko Prawoto, a young man just entering the field of planktonology.

By 1430 hours, our papers were in order, and we were under way once more over almost flat-calm seas with the main engine doing the work of the wind. Soon we had a visit from an old friend from California who came on board by way of the trolling line, a thirty pound yellow-fin tuna (Neothunnus macropterus), our lone sample from a very large school. She was a bit too large for convenient preservation, but she

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made an excellent dinner for all on board, and we found out from her stomach contents that she had been feeding on or near the bottom in shallow water. Whereas most tuna specimens show only one or two species in their stomachs at one time, this one contained two species of squids and at least six species of shallow-water fishes. The following day, Saturday, September 21st, we took a small barracuda (Sphyraena picuda) a little over two feet long. This one went to science instead of to the galley and, as a dividend, yielded a few fish lice (argulids).

On September 22nd, we crossed the equator once more and passed from Spring into Fall. This time the imaginary line was clearly visible, for a current rip had established a long line of foam bubbles extending almost due east and west. We cruised along it for a period, but saw no evidence of any accumulation of organisms, as I had hoped we would.

Although we are hurrying westward as fast as possible, lack of material to keep us busy made it necessary to stop for a little plankton collecting. The half-meter net towed on the surface produced a catch very heavy in diatoms, with prosobranch veligers, copepods and a few isopods, amphipods, heteropod and pteropod molluscs and siphonophores mixed in. We also tried to put the one meter net into a very well defined deep scattering layer at about 330 meters, but evidently did not quite reach it, since the catch was not rich. It too had numerous veligers and copepods, some pteropods and heteropods, a few fish larvae and some salps. The nicest organisms to watch were a couple of the grotesque amphipods, Phronima sedentaria, living in transparent barrel-like houses that they have chewed out of salp tests (the tunicin coats of pelagic sea-squirts). The biggest one had a large family of infants arranged in a perfect wide belt around the equator of her barrel. However, the most interesting organisms were several small worm-like creatures that presented a lot of trouble in our attempts to classify them. Finally, Mike Hadfield, the most competent mollusc man on board, came to the conclusion that they must be aplacophorans. If this is true (and we have no one who can make a better judgement) it is most interesting since, to the best of our knowledge, no pelagic Aplacophora are known. With the bottom about 4400 meters below our net, there can be no doubt that these were pelagic.

That night, we cruised for a time through a concentration of pyrosomes, and every one stayed on deck to watch the sudden bursts of pale green light that they produced when disturbed by the shock wave of the passing ship, and then their fading with time and distance as they passed astern.

On September 23rd, we encountered an area sprinkled with drifting pieces of wood and bamboo. We stopped long enough to pick up a couple of pieces and sample their fauna, consisting largely of the goose-neck barnacle Lepas anserifera,

with a few individuals of another species of the same genus that we could not determine, mixed in. There were also some crabs aboard (probably Pachygrapsus marinus), the very large annelid Amphinome rosstrata which is found only on drifting material, and a couple of other small annelids of the family Serpulidae. Each small stick provided a focus for a surprisingly large group of fishes ranging up to about eight or ten inches in length; a piece of bamboo four feet long and two inches in diameter might be sheltering a dozen or more. They appeared to be largely carangids and balistids, but they were too fast to be caught in the open water despite all our vigorous gymnastic antics with the dip nets.

We awoke on the morning of September 24th to find that TE VEGA had a marked list to starboard, and to feel life in the old ship once more. We were under sail! The flat calm of the last several days had been relieved by a breeze from the south and, although the main engine was still doing most of the work, we appreciated the assistance of the wind. It is remarkable how great an effect a little moving air can have on the psychology of people aboard a sailing vessel.

Teluk Kau is a great bay extending southwestward from the northeast corner of Halmahera for about seventy miles and missing by only a couple of miles cutting the island in two. It was the inner part of this bay that was our goal, since it is marked by a deep depression which is separated from the open sea by a shallow sill half-way up the bay. This situation looked intriguing, and we figured that the deep water in the inner basin would be stagnant like those of the Black Sea and some of the Norwegian fjords. At any rate, it seemed well worth looking into. Hurrying as much as we could, we found that we could not pass the narrows by daylight, and one does not tackle such waters at night in this part of the world where navigational aids such as lighthouses are conspicuous by their absence. In fact, the sun was down before we reached our selected anchorage, and the pale quarter moon was obliterated by a sudden downpour at just the wrong time. Sneaking in slowly, seeking the bottom, we discovered that our two echo sounders had developed a disconcerting disagreement. The Simrad deep-sea research instrument in the radio shack was tracing a fine bottom at about 230 meters, while the Kelvin Hughes navigational sounder near the wheel showed only about 45 fathoms. We switched them off alternately to see if one could be picking up a false return from the other, but this was not the case. The only thing to do was to put out the anchor at the end of a shot of chain and to ooze our way in, feeling for the bottom fifteen fathoms down as we went. Long before the anchor touched, the navigational instrument showed that we were high and dry on a reef, but then it began to behave once more and showed an entirely new and perfect trace that agreed with that of the Simrad. I know now why Captain Olsen's hair is white.

We have both recently finished reading Brett Hilder's "Navigator in the South Seas," which is crowded with vessels on the uncharted reefs of this poorly surveyed area, and I am urging the Captain to write a similar book including a chapter entitled, "The Night the Fathometer Got Drunk."

As soon as we felt secure, lights were put out over the water and the dip nets manned for a fine session of night lighting. Swarms of zoea were taken, together with young clupeids, lots of atherinids, a number of flying fishes, a couple of good sized mullets, and such oddments as a leptocephalus, a pipe fish, a few cubomedusae, some stomatopod larvae, a small octopus, etc. On two occasions, schools of lantern fishes (genus Diaphus) appeared. They were easily recognized in the water since, curiously enough, their backs looked reddish brown under the light, while practically all of the other fishes appeared bluish or greyish. When we caught them in the nets, their ventral surfaces emitted a bright blue luminescence that was much admired by all. Our catch included two species of sea snakes, the first ones taken on the trip, although we had already seen some. I discovered that some of the ship's company did not appreciate these reptiles as much as they did other animals, although some species are beautifully marked in bold patterns of yellow and black. Perhaps it is because they are fairly closely related to the cobras and are just as venomous, although the fact that they are more docile must be counted in their favor.

September 25th was a day when we fervently wished that we had our departed students back, for we were short of manpower for the job we had to do. It began with a haul using the six-foot beam trawl on the sill in the narrows where the water was between twenty-five and thirty fathoms deep. As soon as the trawl deposited its rich haul on deck, we occupied a shallow hydrographic station, and then everyone was busy with water chemistry or picking specimens out of the mud from the trawl haul, as we sailed for the inner basin. These tasks were not finished before we had to make another hydrographic cast to 450 meters in the deepest part of the inner bay, and then do still more chemistry while shooting the trawl once more for a deep haul. Unfortunately, the gear fouled on this attempt, and thus we were saved from the prospect of working all night on the deep catch. Time did not permit another try, and we had just time enough to run in for anchorage in the rapidly falling darkness of the tropics. Night lighting was rather unproductive because everyone was too pooped from the activities of the day and we were also visited by a group of people from the neighboring village. Communication with them would have been rather difficult if we had not had our friends from Djakarta to interpret for us.

In the morning of September 26th, we repeated the trawl haul that we had muffed the previous day. We brought up

a mass of decaying vegetable debris, water-logged wood, leaves, coconut fragments, other nuts of various kinds, segments of palm fronds, but animals were conspicuous by their absence. Two large portunid crabs, probably caught on the way up, and several fair-sized stomatopods constituted the entire catch.

As soon as the haul was up, we ran for Kau, the main village on the bay, in order to pay our respects to the Chief and to get his permission to run a poison station on one of the adjacent coral reefs. Even before we landed, the eastward set of the small boats in which we went ashore convinced us that a reef station would be impossible; the tidal current running out of the bay, and enforced by a brisk wind, was far too strong to make such a project feasible. However, two bombed Japanese ships, resting on the bottom about a half-mile off shore with their decks awash, looked as if their holds might provide the quieter water that we needed.

Kau surprised us by its size. Instead of being a collection of a few huts scattered at random, it was marked out in blocks with well defined streets at right angles to each other. There must have been several thousand people living there. Our arrival was evidently a big event, because a large crowd of people met us on the beach and a great and ever-growing mob of children surrounded us like a swarm of mosquitoes on our parade of several blocks to meet the Chief and then back to the boats again.

Our proposed poisoning in one of the sunken ships gained approval from the village dignitaries, but we were told that some of them would accompany us. The Chief, the Deputy Chief and four other men came along to see what we would do. As it turned out, the station was not too successful since the holds, with their overgrowth of barnacles and sharp bivalve molluscs, and the long-spined sea urchins (*Diadema*) clinging to the bulkheads, were not designed for easy climbing in and out, while the light below deck was not adequate for effective diving and, finally, evidently many of the groggy fishes swam or drifted into totally inaccessible parts of the ship. However, we did get a fair number of species, including a nice remora (we never did see the shark to which he was probably attached) and a large spectacular angel fish (family Pomacanthidae), golden brown in color with markings of brilliant blue lines. We also took a good sample of the invertebrate fauna.

At the crack of dawn on the 27th, we set out to take a station outside of the sill to be comparable to the one we had taken in the inside bay. When the fathometer showed 465 meters, the same depth that we had sampled inside, we made our hydrographic cast. During the time that this required, we had drifted into 525 meters. Since the chart

showed only very widely scattered soundings we shot the trawl anyway and headed for the southern shore where indications of shallower water seemed best. However, the bottom continued to deepen gradually to 570 meters and our haul averaged almost twenty per cent deeper than the one of the previous day. The bottom was evidently fine green mud without a trace of plant debris, and with a relatively rich fauna of shrimps, prawns and fishes and, best of all, pogonophorans. It was a delight to take many specimens of at least two species of this recently defined phylum which few zoologists have ever seen, let alone collected. As a dividend, we also took a number of pelagic organisms evidently collected on the way up or down--a jellyfish, a big sea cucumber of the genus Bathyplores and a number of smaller ones belonging to Pelagothuria or related genera, a large but fragile squid (unfortunately in two pieces) with luminous organs on its eyeballs, and a couple of bathypelagic fishes (Nemichthys and Cyclothone).

In addition to the striking differences in the bottom deposits and faunas at the inside and outside stations, we found the hydrographic features to be markedly divergent. For example, outside there was a temperature difference of almost 18° C. from top to bottom, while inside it was less than 1°; the inside station showed a curious oxygen curve with a minimum at about one hundred meters and a marked increase to 450 meters; the phosphate and silicate curves showed reversed trends below about a hundred meters at the two stations. These are features that need a bit of mental digestion on our part, and nowhere else have I been so upset by the necessity for hurrying on. The problems of Teluk Kau could have engaged our attention for months, and two or three weeks would have been the minimum time required to get any decent sort of understanding about what is going on in the bay.

As soon as the last trawl haul was up from Teluk Kau, we scampered for Celebes and arrived at Menado just at dusk on Saturday, September 28th. On Sunday morning we said farewell to our two Indonesian friends who had been most pleasant and helpful colleagues during their visit. They and Captain Olsen, with the blessing of the harbor police, took a small boat ashore to see what could be done about clearance, since we had to push on to Zamboanga in order to get our students back to the U.S. in time for their autumn terms. It proved to be an all-day job, and the rest of us who were not permitted ashore waited on board, tried fishing with hook and line but caught nothing, examined the waterfront of Menado through field glasses, and exchanged pleasantries with the swarm of natives who came out to see us in outriggers, inner tubes, or simply by swimming about half a mile. When the Captain returned at about six o'clock, hot and exhausted from a full day trying to track down the necessary officials, we hauled up the anchor and left in the gathering dusk for the two-day run across the Celebes Sea to the Philippines.

Just before sunset on October 1st we arrived at Zamboanga. Even though it was well after office hours, and in spite of the six-knot current running through Basilan Strait which gave us a rather impressive bow wave even at anchor, the port authorities came out and cleared us for entry, so those who wanted to could go ashore that evening.

Everyone in Zamboanga from Dr. Thomas F. Ferrer, the Mayor, and other officials we encountered, to the private citizens we happened to meet, went out of their way to show us every courtesy and consideration. Again we were deluged with invitations of all kinds. My own time was almost entirely occupied with various people from the Fisheries Office and the Department of Agriculture, visiting their establishments and entertaining them on board the ship. However, there was time for me to take a quick trip around town, to visit the market, and to see a little of the environs in a jeep provided by the Fisheries Office and under the expert guidance of Mr. Caparoz of their staff. I was quite captivated. Nowhere have I seen such a riot of Bougainvillea in bloom; the road leading to the fine city park was a blaze of color in all shades from magenta through red and copper to pale pink and even white. There were other flowers too, hibiscus and orchids and numerous kinds that I cannot name. No wonder that Zamboanga is known as "The City of Flowers." Its title is well earned.

Our main purpose in stopping at Zamboanga was to disembark three of our remaining students, Mary Ann Jordan, Mike Hadfield and Paul Schroeder. We were sorry to lose them and sorry to have to leave the hospitable city and interesting area of which we had only a tantalizing glimpse, but once more we had to push on and mark in our memories still another place to which we would like to return. At about 0300 in the dark morning hours of October 3rd, we hoisted anchor and headed westward across the Sulu Sea.

With only a single student, Joan Gerdts, left on board, and the pressing need to get to Singapore and prepare for the arrival of the next group of students and investigators, scientific work virtually came to a halt. However, it was impossible not to try to collect at least something, so on October 5th, off the north coast of Borneo, we shot the beam trawl in a depth of one hundred meters and were rewarded by a good catch of large hydroids, alcyonarians, bryozoans, worms, crustaceans, echinoderms, fishes, molluscs, etc. from a bottom of fine grey mud. Similarly on the 7th, we stopped long enough to investigate a drifting barnacle-covered log. However, tomorrow, October 9th, we shall arrive in Singapore, and it is time to briefly take stock of the first cruise of TE VEGA.

Our Pacific crossing started in the worst possible way. Our departure was delayed practically a month, the ship was still a shambles from yard work, and morale was at a low ebb, due to interminable waiting -- for things to get done that never seemed to be completed, and for promises to be fulfilled that never were. There had been no time for the shakedown cruise that had been planned, so the voyage itself became a shakedown. We set up and rearranged our laboratories, hunted out missing equipment and improvised when we could not find some of it, tried out the various types of gear, made mistakes and corrected them as best we could, and modified our schedule as we went along.

The end of the voyage was not satisfactory either, with the scientific personnel dwindling at Suva, at Rabaul and at Zamboanga as our delayed schedule made it necessary for more and more people to depart in order to meet previous commitments in the United States. The most fruitful segment was the passage between Suva and Rabaul, when we were set up to do our work, knowledgeable about our tasks, still with enough students on board to carry out a full program without undue strain, and in a rich and fascinating region that simply clamored for investigation.

As I have stated and reiterated before, the necessity of pushing on to cover ten thousand miles so that we could pick up the next group at Singapore in time to give them a reasonably full cruise, was a continuous source of exasperation. Time after time, it robbed us of the opportunity to stop and really investigate fascinating problems that presented themselves.

Nevertheless, in spite of our troubles and difficulties, I think the cruise accomplished its purposes. Although there was some friction of personalities, this never presented a serious problem, and the group worked together in harmony. We occupied twelve hydrographic stations strategically placed, and sixty-one biological stations as opportunity permitted. We are sending home both data and specimens for further study by the students or by other specialists. Twelve graduate students, three faculty members, and a number of the crew as well, have, through lectures, laboratory and field work, gained an intimate knowledge of the oceans, their inhabitants, and some of the techniques for investigating them that could not have been gained in any other way. I believe that each of these will give many others the same experiences vicariously, that each returning TE VEGA Expedition member will serve as a pebble dropped in the American intellectual pond to generate ripples of interest in, and understanding of, the oceans among their colleagues and future students.

To my mind, this cruise, although it fell far short of accomplishing everything that I had hoped, was a success. With experience behind us, a functioning ship to start with, less territory to cover and consequently more time to spend in a few places, the next cruise should be much better.