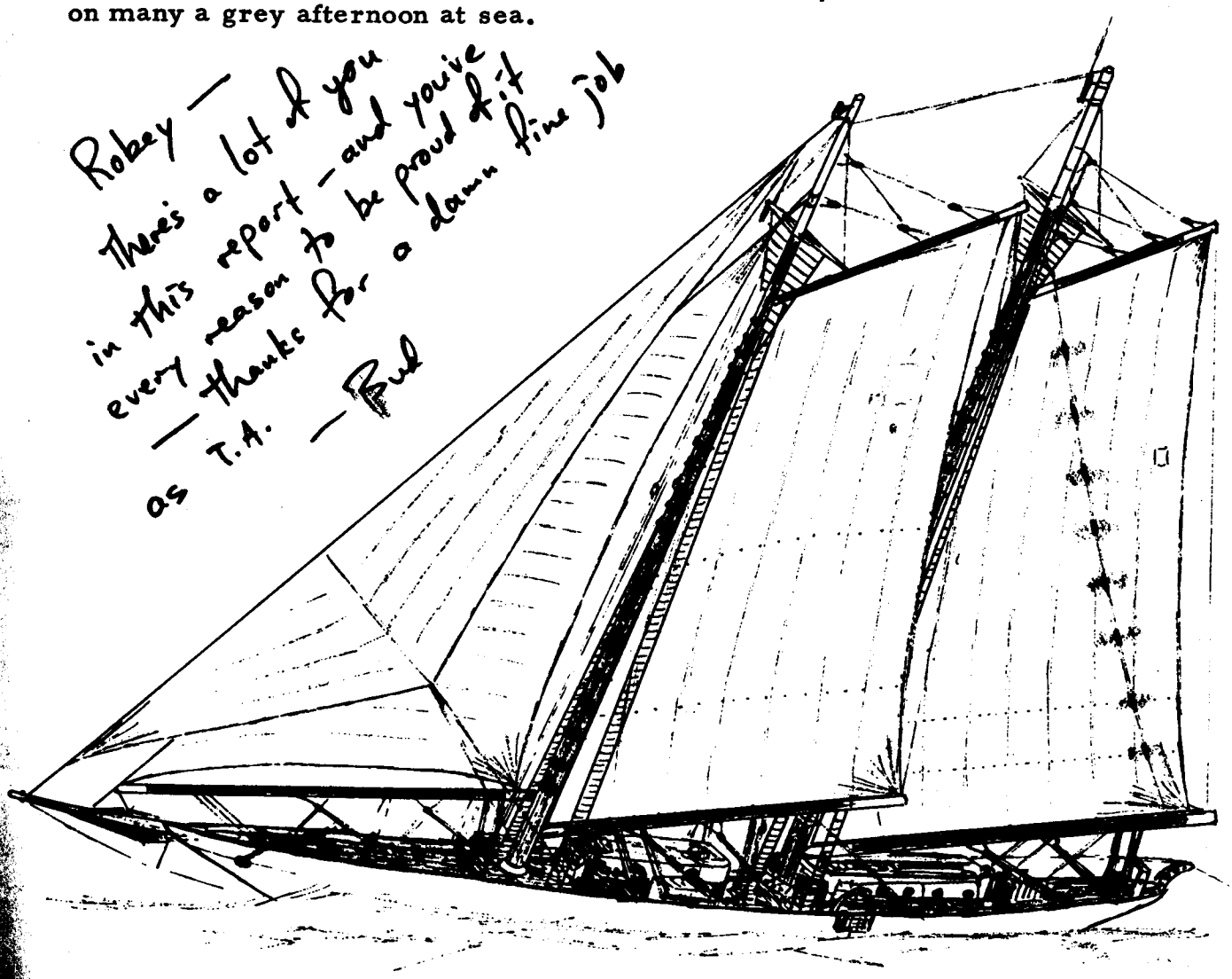
INTRODUCTION

Stanford Oceanographic Expedition 20 was a broad inquiry into the biological oceanography of the Eastern Tropical Pacific. Four distinct surface current regimes were investigated from the standpoint of primary productivity, nitrate-nitrite concentration, zooplankton biomass, and hydrographic characteristics. Four bathymetrically distinct abyssal regions were sampled for sediment analyses, benthic fauna and associated bacteria. The midwater region between the surface and the ocean floor was sampled for deep-sea pelagic zooplankton and midwater fishes. Shallow waters along the cruise track provided additional benthic fauna and specimens for studies on a family of fishes economically important to Central and South America.

RV TE VEGA departed Guayaquil, Ecuador on 17 September 1968 and arrived in San Diego on 29 November 1968 after an expedition of over 5000 nautical miles and more than 500 separate sampling events.

We wish to thank the officers and men of RV TE VEGA, under the command of Captain Jerzy Chylinski, for endless patience and complete cooperation. Their share in the success of Expedition 20 is a large one and their contribution is gratefully acknowledged here by all members of the scientific party. Our thanks also go to Mr. Brooks Bowhay, Marine Superintendent, and his staff for arranging all the details of ship operation, travel and necessary logistics. The vibrant voice of "WIE, Monterey" was a welcome sound on many a grey afternoon at sea.

Robey —
There's a lot of you
in this report — and you've
every reason to be proud of it
— thanks for a damn fine job
as T.A. — Bud



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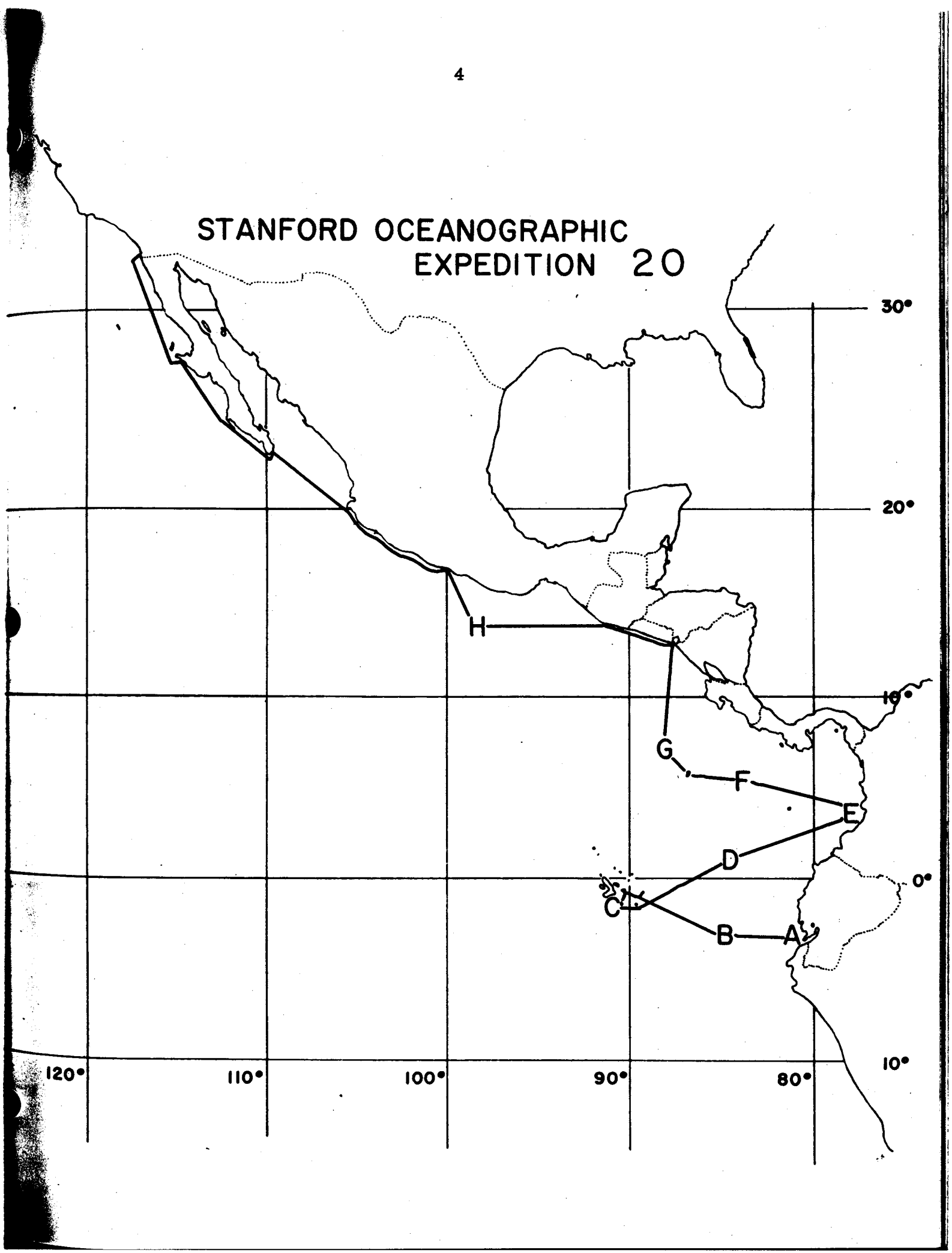
STANFORD OCEANOGRAPHIC
EXPEDITION 20
30°
20°
10°
0°
10°
120°
110°
100°
90°
80°
A
B
C
D
E
F
G
H

NARRATIVE

Stanford Oceanographic Expedition 20 was entered in the Log of RV TE VEGA at 0000 hrs, 17 September 1968 in Guayaquil, Ecuador. All personnel had arrived and the surface shipment of scientific supplies was in the process of being stowed. Just prior to sailing, Mr. Peter Davoll, Chief Marine Technician, departed the vessel after an excellent job of inventory and preparation. At 1400 hrs, lines were cast off and TE VEGA moved down the Guayas River. That evening a meeting was held to review the objectives of the cruise, safety regulations, and to resolve technical questions such as sampling sequence and station numbering.

Because the focal point of the expedition was a study of deep-sea fauna and its relationship to surface waters of varying productivity, diverse forms of equipment were planned for use. All sampling gear was tested in the Gulf of Guayaquil throughout the evening of 17-18 September to familiarize members of the scientific party with the gear and its operation. While underway for our first deep-sea station (4°30'S, 84°30'W), bathythermograph casts provided a check on surface water characteristics. Our intention was to sample first in the cooler Peru Current. BT traces and surface nitrate concentrations on 20 September indicated that we had moved out of Peruvian water and were in warmer water with a temperature more characteristic of the South Equatorial Current. After changing to a southerly course so as to remain in cooler water we began the first deep-sea station of the Expedition.

A sequence of events was developed that permitted flexibility and yet allowed little wasted ship time during our 5 to 6 day deep-sea stations. A typical 24 hours on station had the following schedule:

TIME	ACTIVITY	SCIENTIST
0600-0700	hydrocast for productivity	Swift
0800-1200	in situ incubation	Swift
0800-1000	Shipek sediment sampler or gravity corer	staff
1000-1200	hydrocast for O_2, ‰, nutrients	Mountain, Chesbrough
1200-2100	Tucker trawl or	Robison, Amesbury
	bongo net or	Littlepage, Wheeler
	otter trawl or	Frame
	epibenthic sled or	Aiello, McFadien, Pearse
	box dredge	Aiello, McFadien, Pearse
2100-0600	same as 1200-2100	

During this 24 hour period, surface zooplankton tows were made at various intervals by Kenagy and Pineda, and microbial populations from bottom sediments and benthic organisms were sampled by Harmon for culturing; frequent BT casts provided a close check on surface layer temperatures. Liason between the scientific party and the ship's officers was maintained by a Senior Scientist's watch: 12 to 4, Dr. Pearse; 4 to 8, Dr. Wheeler; 8 to 12, Dr. Littlepage. The station sequence allowed sufficient time for deep sampling and provided the opportunity for all scientists to participate in the handling of each type of gear.

Despite a weak pressure fitting on the winch, our first efforts at deep-sea sampling (3300 m) were encouraging. The epibenthic sled brought back a load of sediment; the bongo net and the Tucker trawl worked well. A pod of approximately 25 Pacific Pilot Whales (Globicephala scammoni) observed our activities

from 22 to 24 September and assured Eastman Kodak of continued income. A brief review of our 6 day station was held on 26 September while underway for Wreck Bay, San Cristobal Island of the Galápagos Archipelago.

On 27 September, after clearing Wreck Bay, we diverted our course for an afternoon of skindiving and fishing at the base of Roca Kicker, a large pinnacle of hard rock rising vertically from the water nearly 500 feet. Collections of echinoderms were made and all enjoyed the playfulness of several sea lions (Zalophous californianus) who accompanied the divers. During the evening the beam trawl was lost to the rocky bottom between San Cristobal and Santa Cruz.

Low clouds and mist surrounded Academy Bay, Santa Crus Island when we anchored at 0600 hrs, 28 September. Arrangements were made with Mr. Roger Perry, Director of the Charles Darwin Research Station, for the use of some stable bench space for weighing. Mr. Perry and other members of the Station were most hospitable with coffee and tours of the tortoise rearing pens, as well as answering innumerable questions about the archipelago and its flora and fauna.

That afternoon TE VEGA hosted Mr. Perry and Sir Thomas Barlow, Executive-Secretary of the Charles Darwin Research Foundation, then visiting the Research Station. Sir Thomas is the great-grandson of Charles Darwin. Meanwhile, otter trawling from the longboat brought in fishes of the family Sciaenidae, of special interest to Dave Frame, and nearshore skindiving added to Dr. Pearse's growing collection of echinoderms.

The 29th was spent hiking, skindiving, and relaxing in and around Academy Bay. That evening the Darwin Station made available excellent films on tortoise feeding, marine iguana feeding, swimming and territorial behavior, albatross courtship, and frigate bird nesting behavior. We were underway for Post Office Bay, Floreana Island at 2300 hrs.

The 30th of September was spent SCUBA diving around Corona de Diablo (a jagged outcrop of volcanic material offshore from Post Office Bay), posting letters in the famous barrel, searching for the flamingo rookery, searching for the searcher, and finally steaming around to Black Beach for a brief visit with the Wittmer family, homesteaders on Floreana since the 1930's. Expedition 20 was entered in their visitors log and by 1900 hrs TE VEGA was underway for our next deep-sea station at 1°00'N, 84°30'W. While sailing between major sampling areas, BT casts and surface zooplankton tows were continued by Jim Kenagy and Francisco Pineda, and nitrate determinations by Carrol Mountain.

At 0600 hrs, 2 October, King Neptune and his court boarded TE VEGA and discovered a number of miserable polliwogs who were roused unceremoniously from slumber and dumped into the chain locker for safekeeping. One by one they were extracted, doused, pushed, doused, washed, lathered, shaved, doctored, charged by Davey Jones, sentenced by Neptunus, and finally elevated to the exhalted status of Shellback.....all before breakfast.

Events at 1°00'N, 84°30'W taught us that we had not yet mastered the art of deep-sea sampling without a pinger. Here it was learned that wire-angle calculations are not enough and that slow speed, at least 7500 m of wire, and 8 hours are needed to get the epibenthic sled to sample successfully at 3000 m depth. Other gear worked well; the crew and scientific party functioned effectively. On 6 October the Chief Scientist spoke to the officers and crew on the objectives of Expedition 20 and the types of sampling gear being used. Our sequence of sampling continued until 8 October when we lay a course for Buenaventura, Colombia, our first fuel and water stop.

A rare, sunny day on 9 October prompted an afternoon swim-call with the necessary shark-watch in the rigging. Minutes after the last swimmer was aboard a 6' shark appeared. It was caught, dissected and identified as a female Carcharhinus galapagensis bearing 2 foetal sharks.

TE VEGA arrived in the busy port of Buenaventura at 0500 hrs, 10 October. Here we met Mr. Brooks Bowhay, Marine Superintendent, and learned officially that Expedition 20 would be TE VEGA's last under the Stanford University program .....a difficult moment for those who had become close to the vessel.

The following account by Dr. Pearse describes activities on 11 October: Francisco Pineda left us in Colombia after proving to be a delightful and productive shipmate. Many were anxious to see his home and University in Cali. On the second day in port, several of the party (Littlepage, Pearse, Aiello, Harmon, McFadien, Chesbrough, Robison and Swift) were able to accompany Francisco to Cali. Arrangements were made to leave Buenaventura by microbus early in the morning (0500) and return late on the same day (2200). Although the day was long, everyone agreed that it was a splendid trip. The four hour drive to Cali climbed from the coastal lowlands up the side of a spectacular gorge to the lovely Andean valley where Cali is situated. The unpaved narrow road twisted up the gorge, hanging precipitously to sheer cliffs cloaked in rain forest, and passing by and through numerous waterfalls. Heavy truck traffic added to the excitement of the drive. Cali was found to be a modern, clean and very busy metropolis, somewhat in contrast to its steamy port town of Buenaventura. It has the reputation of being the home of the most beautiful women in South America....a reputation well borne out. Several people spent the day shopping while others visited the rapidly expanding Universidad de Valle to meet some of the staff of the biology department, including Drs. Lankaster and Lilly, Visiting Professors from the States, and the energetic Dean of Sciences, Dr. Ramiro Tobon. Francisco, besides being a most cordial host at both the University and in his pleasant home, was indispensable in getting some supplies for the ship; buying tax-free alcohol for scientific purposes on short notice - proving to be as complicated a transaction as in the United States. The party reassembled at 1800 at the central plaza for the long drive down the dark gorge, and all were in agreement that Cali would well be worth a much longer visit.

Dave Frame took advantage of the port stop to increase his collection of Sciaenidae from longboat trawls and the local fish markets. When the vessel was delayed in taking water on 12 October, an exploration of local waters was undertaken. Dr. Pearse describes: Following Dr. Abbott's narrative in the Expedition 18 report, several of the party (Pearse, Amesbury, Frame, Robison and Swift) spent the afternoon examining the coastal region near Buenaventura. They took a Boston whaler up the large mouth of the Rio San Antonio, directly across from Buenaventura. As found by Cruise 18 at nearby Punta Barco, the coast consisted mainly of mudstone banks and cliffs riddled with holes made by boring clams. The bore-holes harbored crabs, calianassid shrimp and eels besides the original clams, and on the surface of the banks were numerous snails. Small coves filled with mangroves were numerous. Because it was low tide at the time, these coves had to be explored by sloshing through the sticky mud on foot. Sprouting mangrove seeds were abundant and a few were brought back to start the Robison Mangrove Swamp on top of the aft deck house of the TE VEGA.

By 1900 hrs sufficient water had been secured from the Port of Buenaventura Fire Department (delivered in a dozen breathless trips by firemen complete with helmets and axes.....a tribute to Captain Chylinski's resourcefulness) to allow TE VEGA to depart for our next deep-sea station at 4°30'N, 84°30'W. Shallow water dredging and trawling began immediately in a torrential downpour. The usual transects of zooplankton tows, BT casts, and nitrate observations also began. On 15 October, progress reports were presented and recommendations for the next station's sampling sequence were worked into the schedule.

Station F was reached about 1530 hrs on 16 October. The echo sounder indicated that we were on the edge of the Cocos Ridge and a course change brought us to suitably deep water (3000 m). Difficulties with ship speed under conditions of squalls and variable winds resulted in a ripped Tucker trawl net. Amesbury and Robison traded sleep for net-mending and made each scheduled tow on time. The bongo net became involved with the bottom during one sudden lull in the wind and one net and most of the flow meter assembly were lost. Pearse, Aiello, McFadien, Swift rigged the box dredge and brought back large chunks of evidence that we were over a rocky bottom. Continued heavy rain squalls brought an adolescent Man-O-War bird (Fregata magnificens) for a visit to the laboratory where it was dry and warm. Raisins from Ed Rolita's bread were popular with our guest. Thus fortified, the bird survived a session with photographers the next morning and then departed. On 21 October, TE VEGA was underway for Cocos Island, legendary haunt of the buccaneers.

Unfavorable currents and contrary winds prevented our reaching Cocos until the forenoon of 22 October. We approached under full sail and the island's upper peaks were shrouded in mist while sunshine below made the dense, green, tropical rain forest a complete change of pace for wave-weary eyes. As we came about and finally anchored in Chatham Bay the triatic stay was lined with Frigate Birds and Red-footed Boobies. Uninhabited Cocos looked more like a "Treasure Island" than we had anticipated.

The afternoon was full of rain and drizzle but all were eager to go ashore. Frame, Pearse, Littlepage and Wheeler trawled from the longboat with no success due to clumps of coral which snagged the net. The dripping vegetation ashore was nearly impenetrable. Along the surf zone large boulders were found carved by earlier visitors, e.g., "H.B.M. Steam Frigate SAMPSON, 1847". Dr. Pearse added more sea urchins (Diadema) to his collection until a shark interfered.

After getting underway for our next deep-sea station we experienced a unique and somewhat other-wordly evening of shallow-water dredging and trawling. Bruce Robison's account follows: "With the headlands of Cocos Island fading into the evening of 22 October, a strange and curious sight met the eyes of those at work on TE VEGA's stern. Birds.....boobies by the hundreds, began to wheel and circle about the boat in ever increasing numbers. With the death of day, our lights became a beacon for the birds and soon we could see the pale undersides of wing and feather as far as our halo of light extended. The giant flock grew larger and larger until it must have numbered in the thousands. Two species were present, Sula sula....the red-footed booby and Sula leucogaster etesiaca, the Colombian booby. Before long, TE VEGA was covered with roosting birds.... they sat on the deck house, the ratlines, the whale boat; they perched on the hydro wire, the anchors and the A-frame ------birds were everywhere.

As birds are wont to do, they began to deposit the white, processed results of the day's feeding on our ship. As more birds flew in to try and find a place to sit, they thumped into the sails.....and these distressed and stunned numbers began regurgitating their unprocessed squid and fish about our vessel. Hoses were brough into action to wash away the mess but soon the scuppers filled, then clogged, and the decks were awash with the foul stuff.

Curious fellows, these boobies, when we spurned their offerings and attempted to usher them overboard.....they reacted to our inhospitality by biting hands and feet of their launchers. More hands were called into the fray and the battle began in earnest. Sensing our redoubled desire to rid our ship of their presence, the boobies descended upon us in greater numbers, whumping into the sails and thumping into the deck house.....then staggering about the deck, pecking angrily at unprotected legs. Brooms were called for and the birds were unceremoniously pushed off in twos and threes. Still they came. A brave crew member (who shall remain unidentified until the next of kin are notified) ascended to the deck house roof and amidst a maelstrom of flapping wings, squawking beaks and flying feathers, pushed the boobies to the decks below. On deck we were waiting; grabbing them by the necks we flung them overboard. This was the form which the battle took for the next few hours. The boobies came in waves, swarming aboard in heaps while we fought them off. Thump, stomp, smash, bash, flap, squawk, cuss, bite, slip, grab, squawk, fling. God, what a mess! The attack would last for ten minutes, then slack off while both sides regrouped; then begin anew. We brought out water hoses and shovels, which the boobies countered by kamikaze dives into those who wielded them. We darkened the ship but were bitten by hordes of now unseen boobies that waddled about the decks with impunity.

Through the night the battle raged, with neither side gaining an advantage for long. On and on we fought until finally the big boobie in the sky realized we were more than just inhospitable, we were downright rude. The onslaught slackened and morning found the boobies with headaches and sore throats.... and all aboard TE VEGA praying for a heavy rain."

A successful epibenthic sled haul initiated our round-the-clock sampling sequence at 7°00'N, 88°00'W in the basin north of the Cocos Ridge. Rain squalls and a day of high winds on 25 October made for marginal conditions; however, the wind eventually slackened (the rain did not) and our sampling continued on schedule for 3 more days despite wet clothes, grey skies, and the dispiriting feeling that the sun had left us forever. Manganese nodules in one dredge haul varied the fare for the benthic people at this station.

On 30 October, just off La Union, El Salvador, our shallow-water dredging and trawling routine began. More Sciaenidae were collected by Frame and every dredge or trawl was eagerly searched for the relict starfish, Platasterias, an important, primitive form taken in these waters some 30 years ago.

The next morning we entered the Gulf of Fonseca which was quiet and serene under a bright sun. After clearing, a small group left for San Salvador to meet Tom Malone and the mail, while others explored La Union and its environs. The inhabitants of the village were most friendly and many happy hours were spent relaxing in their pleasant company while ashore.

TE VEGA departed La Union at 1530 hrs, 2 November and entered the first stretch of good weather in 45 days. Close to the border of El Salvador and Guatemala, continued trawling and dredging failed to produce any Platasterias. On 4 November, Dr. Littlepage dove close inshore and saw none on the bottom. Later, Dr. Pearse boarded a local fishing trawler and upon asking for Platasterias was told that they could be found where we were the day before! Our unsuccessful search continued on into the night.

The first lecture of the TE VEGA Fall Seminar Series was given by Dr. Wheeler on 5 November and dealt with deep-sea, pelagic food chains. After the discussion, all hands listened to election returns from Voice of America. While enroute to our next deep-sea station, Diane Harmon spoke on marine bacteria, and Dr. Pearse discussed reproductive periodicities in marine invertebrates.

The last deep station at 13°30'N, 98°30'W was reached on 8 November. Tom Malone joined the sequence with primary productivity measurements. Continuing good weather was appreciated. Anxious moments with the last box dredge attempt gave way to philosophical shrugs when a shackle apparently parted above the weak link and left our most reliable piece of bottom-sampling gear in 3500 m of water. At 1930 hrs, 11 November, we headed for Acapulco. Three days later after the usual shallow water trawling during our approach to port, we were anchored in Acapulco harbor. During our short stay, a diving party collected gastropods and echinoderms, and observed the fauna in 40 feet of water in the outer harbor.

Our departure from Acapulco the evening of the 15th was memorable for the beauty of the harbor at night and for the fact that we were now homeward bound. The decision was made to stop for a day at Cabo San Lucas to observe the sand falls in the submarine canyon there. In the meantime, everyone turned to the preparation of expedition reports. While underway, Robison and Amesbury continued their trawling for mid-water fishes, Malone kept up productivity studies, and Kenagy extended his series of nightly zooplankton tows.

The Seminar Series resumed with sessions on the Scaphopoda by Peg McFadien, submarine geology by Dr. Littlepage (with particular reference to the Cabo San Lucas canyon), fouling organisms by Dave Frame, and mid-water fishes of the Gulf of California by Bruce Robison. On 21 November, a meeting was held to discuss details of the dive to be made to the sand falls at Cabo San Lucas, and at dawn the next day (22 Nov) we anchored.

The dive was made at 1100 hrs, one group (Littlepage, Swift, Robison, Malone) went to 200 ft to view the lower falls while Wheeler, Amesbury and Chesbrough descended to about 75 ft. Pearse collected echinoderms and others observed the varied marine fauna in the clear water. Octopus, Scorpion Fish and many other species of reef fish were seen. Later that afternoon, cerveza and beans were found in town. Underway for San Diego at 1830 hrs. Halfway up Baja California during the evening of 25 November, winds increased to force 8 and the forestays'l split. Shortly after, the jib-sheet parted and, at 0230 hrs, the fores'l started to split. The next day we put in Tortola Bay for the last echinoderm collections by John Pearse and for necessary sail replacement. After 4 days of calm, gradually cooling weather, during which time expedition reports were finished, TE VEGA docked in San Diego on 29 November. Expedition 20 officially terminated on 1 December with the departure of the scientific party.

Ellsworth H. Wheeler, Jr.