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INVESTIGATIONS IN THE NATURAL HISTORY OF BAJA CALIFORNIA

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Introduction

The Belvedere Scientific Fund was established in San Francisco on May 13, 1959, to encourage research and make grants in the fields of natural sciences, and for publication of the findings from such activities. Negotiations between the California Academy of Sciences and the founders of the Belvedere Scientific Fund were begun in the spring of 1958 toward planning a long-range program of investigations in the natural history of Baja California. Since its founding in 1853 the California Academy of Sciences had sponsored many field expeditions to the peninsula and to its islands. Academy staff members, and others attached to the expeditions as specialists, had been affiliated with diverse fields of natural science. Scientific papers based on their collections and field observations constituted important portions of the *Proceedings* and, for a few years, of the *Bulletin* of the Academy. Continuation and revitalization of exploration and collecting activities in Baja California as an important aspect of the Academy's research programs seemed both logical and desirable.

By early autumn, 1958, a program of exploration and research had been formulated and a grant sufficient to implement the initial stages of the field

work provided by the founders of the Belvedere Scientific Fund. Without this financial aid, the field work in Baja California would have been impossible. The Academy used part of the grant to purchase an International "Travelall" with four-wheel drive and extra low-speed gears for heavy work over difficult roads, to be used chiefly for field operations in Baja California. Plans were crystallized to send a small expedition the full length of the peninsula during December, 1958, and January, 1959. This expedition was considered a reconnaissance trip, with scientists from several disciplines participating. Tentative plans were made to stage subsequent field expeditions if results obtained on this trip indicated further work would be scientifically profitable. Such later field work would include workers from the California Academy of Sciences and from other organizations as well.

WINTER FIELD TRIP

The first expedition under this program to reach the field was made up of only two scientists when it left San Francisco on December 3, 1958, owing to commitments that kept other keenly interested individuals at their regular duties. Mr. Alan E. Leviton, acting herpetologist at the Academy, was in charge of the expedition, and was accompanied by Mr. Hugh Leech, an entomologist on the Academy staff. The two men drove to San Diego, made final purchases of equipment and supplies, had a few adjustments made to the car after the shake-down drive from San Francisco, and crossed the border into Baja California at Tijuana on December 6. Since Mr. Leviton was anxious to get into the southern part of the peninsula, where the herpetological fauna was of more interest to him than was that in the northern area, and Mr. Leech had the water beetles as his main interest, the two men drove south as rapidly as the condition of the roads permitted. They found the four-wheel drive vehicle equal to the heavy grades and very rough, rocky roads, but rarely were able to make as much as 100 miles in a long day's driving. The new road recently cut through the Sierra de la Giganta between Loreto and the northern end of the Magdalena Plains eliminated some of the worst road between Canipolé and La Purísima, but itself was quite rough and left much to be desired as a through highway.

Leviton and Leech reached La Paz on December 15, placed part of their heavy load of gear in the house rented through the good offices of Mrs. Margaret Waters, and were at the airport to meet the plane on which Ira Wiggins flew to La Paz on December 16. Preparations to begin intensive field work in the Cape Region were begun at once.

A violent storm of hurricane force, locally called a "chubasco," had swept across the southeastern part of the Cape Region on August 8. Consequently, it was known that vegetation would be in excellent condition in

those areas where rainfall had soaked the countryside. Reports as to the western boundary of the rains were conflicting. A reconnaissance flight around the Cape by plane was arranged in order to check conditions and to plan field operations effectively. The party left the La Paz airport at 11:20 A.M. on the 17th, flew southward to Todos Santos, thence along the west coast to Cabo San Lucas, and landed at La Palmilla, near San José del Cabo. Observations from the air clearly showed that there had been heavy rain from Todos Santos southward, as evidenced by the water in most of the major arroyos leading from the Sierra de la Laguna and the Sierra de la Victoria westerly toward the sea. Therefore, favorable conditions for collecting plants existed in all parts of the Cape Region, and pools and running water in the arroyos promised at least a fair amount of collecting for Mr. Leech. The situation with regard to the herpetological collecting became clearer within a few minutes of the landing at La Palmilla, for Mr. Leviton located lively lizards and collected eleven, including representatives of *Callisaurus, Urosaurus,* and *Cnemidophorus.*

After a brief inspection of some of the damage done to the buildings at La Palmilla by the chubasco, the plane took off and flew along the coast to the easterly point beyond San José del Cabo, swung northward to skirt the coast to Las Cruces, where it landed briefly and Leviton got a lizard, Wiggins found a score of plants in good collecting condition, but Leech was empty-handed. The group left Las Cruces at 5:00 P.M. and landed at La Paz fifteen minutes later.

It was obvious that there was much more water than usual in the canyons and arroyos at this time of the year on both the east and west flanks of the Sierras. Both Leech and Wiggins were pleased with the prospects. There was no doubt that reasonably good collecting could be found anywhere in the Cape Region for the botanists, and a number of promising localities were available to the water-beetle specialist and herpetologist.

Mr. Duncan Porter, a senior at Stanford University interested in carrying on work in botany after graduation, joined the field party on December 21, and remained in Baja California until January 1. Following the reconnaissance flight around the Cape Region, the field party carried on field exploration and did routine collecting of plants, insects, herpetological specimens, and land snails (in the interests of Dr. G Dallas Hanna and Mr. Allyn Smith). Their routes radiated from La Paz, with one- or two-day trips taken to Rancho Rodríguez on the southwestern shore of Bahía de la Paz, Puerto Coyote, Bahia Pichilinque, El Sargento on the western shore of Bahía de la Ventana, Los Planes, Bahía de los Muertos, south to about the vicinity of San Juan on the road between La Paz and Todos Santos, to Arroyo Pozo Grande enroute to Las Cruces, and to the vicinity of San Pedro, about eight miles south of Todos Santos. Collecting conditions varied

somewhat, and in general were better in the low, rolling hills between La Paz and Todos Santos than they were to the northwest of La Paz. Some exceptional finds of herpetological material were made at Bahía de los Muertos and good water beetle collecting was found in the rivulets and pools in Arroyo Pozo Grande on the road to Las Cruces.

On December 27, a second reconnaissance flight was made up the west coast of the peninsula as far as La Purísima. It gave added information about the condition of the vegetation along the Magdalena Plains and on the mesas around La Purísima. The plane left La Paz at 8:00 A.M. and headed for the southern end of Magdalena Bay in order that watch might be kept for whales that were early in making the annual southward migration to the sheltered lagoons and coves where they give birth to their young. As on the circuit of the Cape Region, extensive notes were taken on the general appearance of the coastal area and the plains extending inland. Aside from the mangrove swamps that are characteristic features of the partially drowned coast along the islands of Magdalena and Santa Margarita and the adjacent peninsular coast, the vegetation showed little green, and it looked as though the chubasco had brought little, if any, rain to that side of the peninsula north of the latitude of La Paz.

A landing was made on an airstrip on the mesa about five miles from the village of La Purísima, and in about half an hour a car climbed the steep grade to the airstrip. Arrangements were made for all of the party except the copilot to ride to the village and to a fossil site nearby. Approximately two hours were spent selecting representative fossils from the Miocene beds about a mile up the arroyo from the village, and in scouring the adjacent slopes and arroyo banks for botanical and herpetological specimens, both of which were poorly represented. Fossil bones, that appeared to be those of a cetacean or possibly a few belonging to fish, occurred in certain horizons of the extensive exposures northeast of the village. These were difficult to obtain and few could be removed from the matrix with the limited tools available. Only a very small sampling of the fossils could be taken back to the plane. Photographs of the locality were made and a few minnows caught from the stream that flows past the village the year around. Considerable information was voluntereed by the driver of the truck and his associates relative to the village and its activities and trials.

Upon returning to the plane the party flew easterly over San Ignacio, but did not land there, owing to the shortness of the time left during daylight. The return route led past Santa Rosalía, thence down the coast along the east side of the peninsula to La Paz. This route provided a good view of Mulegé, the beautiful Bahía de la Concepción, and a glimpse at Loreto. Water could be seen standing in many of the "lagunas" in the higher parts of the Sierra de la Giganta, something which the pilots of Trans Mar planes

said they rarely see. Areas immediately adjacent to these lagunas were strikingly green. Indications were that the vegetation in such favored localities would be much more luxuriant than one would find during a year of ordinary rainfall.

On New Year's Day, the three biologists flew to La Palmilla for a trip from that resort to Cabo San Lucas by car, without the necessity of making the long, slow drive from La Paz to San José del Cabo with the "Travelall." A driver and car from San José del Cabo were engaged, and a number of stops were made, both westbound en route to Cabo San Lucas and on the return trip, to collect plants, beetles, butterflies, and lizards. At one such stop Mr. Leech collected the second known specimen of a rare water beetle he had in his possession at the California Academy of Sciences. Although he had been skeptical about the authenticity of the locality from which the type specimen was supposed to have come, namely, near Cabo San Lucas, the capture of one more specimen from a muddy little pool beside the road verified the original data, and increased the total number of specimens known to exist in entomological depositories by 100 per cent! A few miles from the pool where Mr. Leech found the rare water beetle, several specimens of the attractive, red-flowered, liliaceous plant *Behria tenuiflora*, endemic in the Cape Region, were collected.

Word came from the California Academy of Sciences that Mr. Allyn C. Smith, Research Malacologist at the Academy, would be landing at La Paz the evening of January 3, but that Mr. Rose, who had expected to bolster the ranks of the botanists, could not come. All were pleasantly surprised, therefore, when Dr. Reid V. Moran, botanist at the San Diego Natural History Museum, got off the Trans Mar plane with Mr. Smith at 10:30 P.M.

From January 4 through 10 the party of five – Leviton, Leech, Moran, Smith, and Wiggins – continued operations in the Cape Region, making one long trip from La Paz to San José del Cabo and return, camping out several nights while making the round trip, both ways being via El Triunfo, Santiago, and Miraflores. Again some very good collecting was enjoyed by each member of the party at one part or another of the area traversed. Mr. Smith made a particularly fine collection of minute land snails in the trash that had collected beside a small stream about one mile east of San José del Cabo. This finely crumbled, vegetable matter intermixed with silt and sand contained many minute shells, one of which was an undescribed species. Mr. Leviton collected a large specimen belonging to the genus *Ctenosaurus* just as camp was made on the evening of January 6. Later the same evening Mr. Smith found a colony of living land snails in a decaying stump. This snail usually is taken only as dead empty shells. His stroboscopic flash enabled him to get a good picture of the colony after dark.

The following quotation from Mr. Smith's report summarizes the malacological results obtained during this, and subsequent, collecting trips in 1959:

"Collections were made at about 50 stations, mostly at low altitudes, there being no opportunities to get into the higher mountains. Many specimens of the various species of *Bulimulus* that are characteristic of the Cape Region of Baja California were taken, and despite the midwinter conditions good collections were made. Many snails were taken alive and in at least one instance one of the rarer species was collected alive for the first time, so far as known. Special efforts were devoted to obtaining as many as possible of the smaller land snails by collecting and sorting stream 'drift,' which in some localities such as San José del Cabo and the Boca de la Sierra near Miraflores produced several new species, and a considerable number of new records for the Cape Region. Snails were also collected at a number of places north of La Paz by Dr. Wiggins and other members of the Expedition.

"As a result of these efforts and earlier collecting on the islands of the Gulf there is now available perhaps the best representation of the land and fresh-water mollusks of the lower end of the Baja California Peninsula in existence. A report on them will be made in subsequent papers of the Expedition series which will bring up to date the knowledge of the mollusk fauna of the region and will add to the Academy's collections all or nearly all of the species taken by former Academy expeditions in the early 1890's under the direction of Dr. Gustav Eisen and lost in the disastrous fire of 1906.

"Some attention was given to collecting marine shells in the La Paz region in January. A good representation of the chitons of La Paz was taken. During a short visit in November, 1959, an excellent collection of small marine shells was collected by Dr. Myra Keen at Puerta Balandra Bay and other localities near La Paz that produced many new records for the Gulf of California including several finds of special scientific interest. It is expected that a report on this marine work will also be covered in a subsequent report."

The canyon in which the village of San Bartolo is situated provided interesting territory for the botanists, although neither Mr. Leech nor Mr. Leviton was happy owing to the paucity of water beetles and lizards. Dr. Moran found a stunted mistletoe, which appears to be *Phoradendron digueti*, parasitizing the cardon (*Pachycereus pringlei*), apparently the first record of this mistletoe attaching itself to a member of the cactus family.

Wiggins left La Paz on January 10 to return to the Stanford campus. From that time until January 25 the field party consisted of Leviton, Leech, Moran, and Smith. These four continued to work various areas in the Cape Region, but spent most of the time on a trip entirely around the Cape. They

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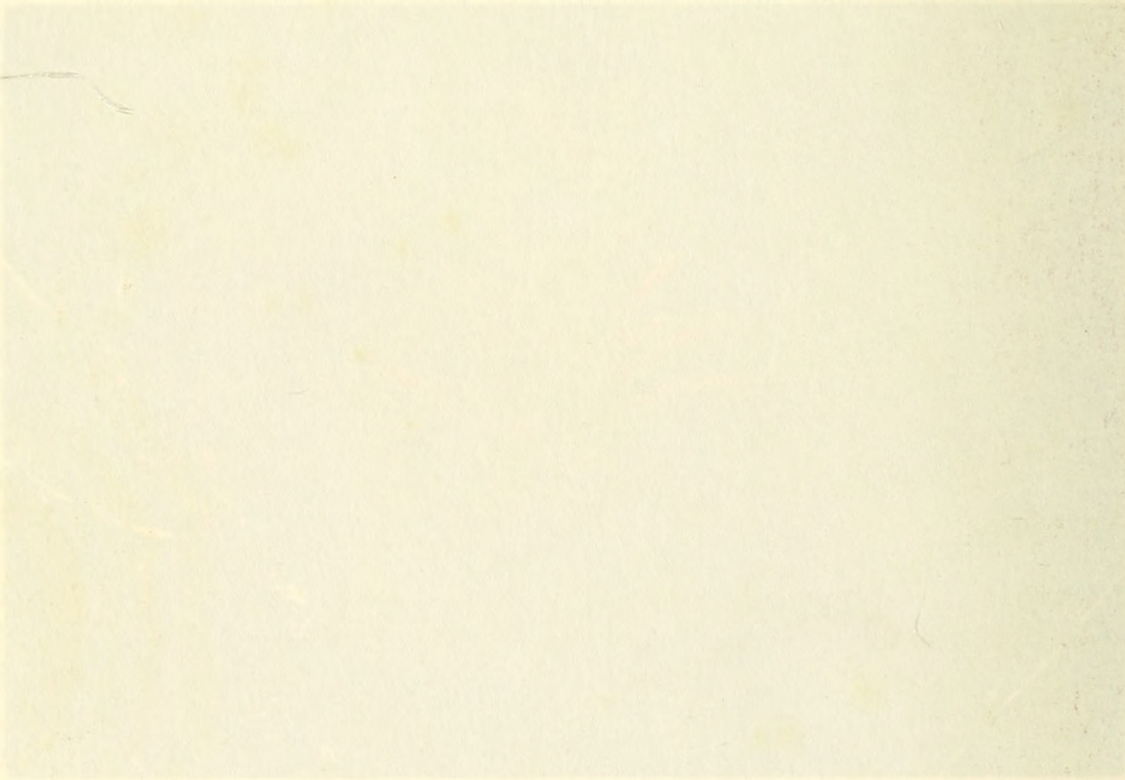
Plate 1 (Upper) Sunrise on Isla San Francisquito. Photographed by Ira L. Wiggins

(Lower) "Palo Adán" (*Fouquieria peninsularis*) near Bahía de Los Angeles. Photographed by G.D. & M.M. Hanna



drove south from La Paz to Todos Santos, thence to Cabo San Lucas, east to San José del Cabo, and from there to La Paz. The exploration of the region between Todos Santos and Cabo San Lucas was particularly illuminating, and helped to fill gaps in the coverage of the fauna and flora. During this circuit excellent collections of plants, snails, and herpetological specimens were made, and fair numbers of beetles were obtained by Mr. Leech. During one day, January 19, Allyn Smith found six species of *Bulimulus,* and Leviton got representatives of eight genera of lizards and snakes. The following day Allyn Smith obtained the first collection of living specimens of *Bulimulus montezumae* taken during field work by this group, and Leech found exceptionally good collecting in a stream swarming with tadpoles and water beetles.

During a visit to Arroyo Saltito Dr. Moran recollected *Bouvardia alexanderae* at the type locality, and collected mature seed of the species for experimental work at the Botanical Garden of the University of California at Berkeley. On the same day, and near the type locality of *B. alexanderae,* Leviton got a specimen of a rare snake, *Hypsiglena slevini,* of interesting taxonomic status.

On January 27 the "Travelall" was loaded on the S.S. *Korrigan IV,* for the voyage to Guaymas. After disembarking at Guaymas late in the afternoon of January 28, the four scientists drove to Nogales, Tucson, and San Diego. Dr. Moran remained there, and the other three continued to San Francisco, arriving at the California Academy of Sciences on January 31.

This first trip into Baja California with support from the founders of the Belvedere Scientific Fund provided valuable firsthand information about field and living conditions in Baja California and produced important collections of specimens of plants, insects, mollusks, snakes, and lizards. Over 8,000 sheets of herbarium specimens were collected by the three botanists. Mr. Leviton got about 200 specimens of lizards, snakes, and toads, representing 21 genera. Leech obtained enough beetles and other insects to occupy him full time for over a year in sorting and classifying them. Mr. Smith's collections of snails and the outstanding finds made by him were mentioned in the quotation from his written report quoted above. In addition to herbarium specimens, the botanists obtained buds of several genera from which chromosome counts have been made. These cytological collections included some of *Argemone* and of *Eschscholzia,* genera belonging in the poppy family and in which Mr. Wallace Ernst, a graduate student at Stanford, has a special interest. Each member of the party took pictures of both general and special subjects. Selected transparencies from the film exposed have been catalogued and cross referenced as the nucleus of a film library on Baja California and are on deposit at the Academy.

In view of the large series of specimens collected and the observations recorded, this trip, which was considered primarily one of reconnaissance, has produced substantial scientific information. Papers dealing with certain aspects of the field collections have been prepared for publication, and others are in progress.

SPRING BOTANICAL FIELD TRIP

Normal precipitation in the Cape Region brings some rain during January and February, or in both months, almost every year. Winter rainfall stimulates growth among certain annual and perennial plants rarely found in shape to collect before March. Accordingly, on April 18 Dr. John H. Thomas left the Stanford campus with the "Travelall" to initiate the first late spring botanical collecting trip under the sponsorship of the California Academy of Sciences in continuation of the program begun in 1958. At San Diego he was joined by Dr. Reid V. Moran. They drove to Tucson, thence southward to Mazatlán, where they obtained passage on the motor vessel *Viosca,* and sailed for La Paz on April 25. After landing at La Paz on the 27th they collected in various parts of the Cape Region adjacent to La Paz until May 4. On that date Mr. Donald Patterson, a member of the California Academy of Sciences interested in moths and butterflies, joined them for a pack trip into the Sierra de la Victoria.

They engaged pack animals and guides at the village of Caduaño, situated near the eastern foot of the Sierra de la Victoria. Dr. Thomas wrote as follows about the pack trip and the conditions of the vegetation: "Very few plants were in flower except in the immediate vicinity of stream beds. We camped at two different places, but spent most of our time at an abandoned ranch known as Potrero el Almenta at an altitude of about 3,400 feet. We returned to Caduaño on May 12 and to La Paz the following day. The cost of mules and/or burros at Caduaño was five pesos per animal per day and the charge per man was 15 pesos per day. The Castros were very pleasant people and we enjoyed having them as guides and packers despite their inexperience with our kind of equipment."

Even though the Sierra de la Victoria was unusually dry that spring, the men got sufficient specimens to make the pack trip worthwhile. Mr. Patterson found the skippers (small, rapidly flying butterflies) inhabiting the arroyos and higher canyons just as difficult to catch as those that had given Mr. Leech considerable trouble in December and January at lower elevations.

Mr. Patterson left La Paz by plane early on May 15, and later the same day Drs. Thomas and Moran started toward the Sierra de la Laguna. At

Rancho la Burrera they arranged for guides, pack mules, and saddle animals to take them and their collecting gear to the meadows that now mark the areas occupied by intermittent lakes said to have occurred in depressions among the higher peaks and ridges of the Sierra de la Laguna about a century ago. The pack trip from Rancho la Burrera to La Laguna required six hours and was made with the help of three guides, four pack mules, and a saddle mule each for Drs. Moran and Thomas. The Sierra de la Laguna, like Sierra de la Victoria, was abnormally dry for that season, but diligent work along the stream beds and in shaded canyons yielded enough botanical material to keep them fully occupied for several days.

On May 19 they returned to La Paz, and packed their equipment and supplies for the return trip up the length of the peninsula. On the morning of May 21 they headed north. Instead of driving over the paved highway from La Paz to Kilometer 212 near the north end of the Magdalena Plains, they used the older, now nearly abandoned roads. In this manner they were able to reach several localities on the Pacific Coast west of the Magdalena Plains, and the estuaries and embayments protected by the islands of Santa Margarita and Magdalena.

At La Purísima, approximately one day's drive north of the end of paved road, they turned inland and followed an abominable road to Canipolé, thence northward along the western shore of Bahía de la Concepción to Santa Rosalía. As they neared Santa Rosalía they discovered that the yoke supporting the rear of the engine had broken from one side of the frame and threatened to allow the motor to fall from the car. Twisting and strains caused while crossing rocky fords in the Arroyo de la Purísima and by the rough road around Bahía de la Concepción had placed too much stress on the cross member. A welder in Santa Rosalia repaired and reinforced the yoke. Henceforth it caused no trouble.

During the whole journey northward, Moran and Thomas collected along stream courses and arroyos, but in many areas the desert provided little for their presses. While in the field the two botanists collected 525 numbers of herbarium specimens, taking sets of 8 sheets of each number whenever material was sufficient. When the herbarium specimens were ordered up for labeling and distribution, it was found that they had over 3,000 sheets. Representative specimens have been set aside for shipment to the University of Mexico, or to such institution in Mexico as is designated by the Department of Agriculture and Public Works. Other sets will be divided among the California Academy of Sciences, the San Diego Natural History Museum, and Stanford University. Any specimens in excess of those needed to fill these claims will be distributed to selected herbaria on an exchange basis.

In addition to the herbarium specimens, Dr. Moran collected about 100 living succulent plants for cultivation at the San Diego Natural History

Museum, and 25 others that he sent to Dr. Helia Bravo in Mexico City before he left La Paz. Dr. Moran obtained, also, about a dozen collections of *Dudleya,* a genus in the Crassulaceae, in which he has been keenly interested for a number of years. Several of the dudleyas were taken at type localities.

Dr. Thomas collected 25 wood samples from shrubs and trees, one set of which was turned over to Dr. Virginia M. Page, Research Associate in the Department of Geology at Stanford University. Another set was sent to the United States National Herbarium.

Drs. Thomas and Moran placed many samples of plant material for morphological and cytological study in preservatives, most of it to go to Dr. I. W. Bailey (Harvard), Dr. C. H. Uhl (Cornell), Dr. Lincoln Constance (University of California), Mr. Wallace Ernst (Stanford), and to one or two others who had made special requests for material. They also made small collections of mollusks, insects, reptiles, and amphibians. The zoological specimens have been turned over to the appropriate curators at the California Academy of Sciences.

Mr. Patterson was well satisfied with his collection of lepidopterans. Most of these insects were taken in the Sierra de la Victoria, west of Caduaño. He caught 210 specimens, representing 28 species. The skippers were of particular interest in that they showed considerable local variation. Mr. Patterson's collections will be made available to the Academy after they are labeled.

To supplement the herbarium specimens, series of kodachrome transparencies were made. The photographic record included excellent slides showing such rare plants as *Nolina beldingii, Erythea brandegeei, Populus monticola,* an exquisite member of the Lobelia family, *Heterotoma aurita,* and the fragile beauty of a freshly opened blossom of one of the passion flowers (*Passiflora*) native in the Cape Region. Their most prized herpetological specimen was *Trimorphodon lyrophanes* (Lyre Snake), a small rare snake endemic to the Cape Region.

RECONNAISSANCE TRIP TO BAHÍA DE LOS ANGELES

Before Thomas and Moran had reached the International Boundary, a reconnaissance trip to Bahía de los Angeles and vicinity was made from May 15 through May 19. The flight from Oakland airport to Bahía de los Angeles was made quickly and comfortably, with a stop at El Centro for gasoline, another at Mexicali airport for the usual inspection by Mexican Immigration and Custom officials, and to file a flight plan with the authorities at the airport. The plane landed at Bahía de los Angeles at 1:15 P.M. after an interesting flight along the northwestern part of the Gulf. A particularly good

view of Isla de la Guarda was obtained as the pilot brought the plane down from about 7,000 to only 750 feet above sea level while flying past the southern end of the island. Raza Island was circled several times in order to determine whether the bird population on that rookery was up to normal.

The rest of the afternoon of the 15th was spent in exploring the larger canyon leading westward just back of the village, and in collecting such plant specimens as were in satisfactory condition.

An early breakfast permitted the group to leave the resort operated by Sr. Antero Díaz at 7:30 A.M. on the 16th with, Sr. Díaz's son, Sammy, and one of his employees, a chap called "Jackie," driving the two cars that were to take the field party to Misión San Borja for a two-day trip. Several stops to collect specimens and to take photographs were made on the drive to San Borja. A detour to Agua Amarga, a bitterly mineralized spring, permitted Wiggins to collect specimens known from no other locality in the general area. Dr. Hanna had been looking for land snails as he climbed the canyon at Bahía de los Angeles but without success, so he was pleased to find empty shells of *Micrarionta peninsularis* at three different localities, and at least one mature, living animal in a crevice in rocks a few hundred yards from camp the evening of the 16th, about two miles north of Misión San Borja. One small lizard, *Phyllodactylus tuberculatus,* was obtained at the same site.

Botanical collections on the 16th totaled 49 separate collections, with the quantity in each collection varying from barely sufficient for a single herbarium sheet to enough for eight or ten sheets.

Since camp had been made late in the afternoon the day before, there were plants still uncollected the morning of the 17th, so the cars remained at camp while Dorothy and Ira Wiggins inserted plants between sheets of paper and the others walked ahead about two miles. Everyone had an opportunity to observe one of the factors that makes it possible for lichens and *Tillandsia* plants to grow in profusion on many of the shrubs in the central part of the peninsula, in spite of the absence of rain for protracted periods. There was a heavy dew during the night, but brilliant sunshine soon dried most of it by the time breakfast was completed. At about 8:00 A.M. a heavy bank of fog rolled up the arroyo from the west, completely blanketing the area and shutting off the direct rays of the sun as though a curtain had been drawn. Within minutes the shrubs and trees around camp were dripping with water condensed from the fog. Such fog banks are characteristic of the region, although they do not always extend so far to the east.

The return to Bahía de los Angeles was over the same road followed the day before only because there is no other road between San Borja and "La Bahía." At one of the seven collecting stops made on the return

drive, Dr. Hanna enlisted the help of all members of the party to roll rocks from the side of a small hill in search of more land snails. This procedure was encouragingly productive, yielding several living snails and a number of empty shells. Nine or ten brief stops for photography were made in addition to those for collecting plants and snails. Lunch stop was in the scanty shade of an "Elephant Tree" covered with tiny, pink flowers but totally leafless.

The two cars arrived at the Díaz motel at 1:10 P.M. and the remainder of the afternoon was spent putting specimens in press and, from 3:00 P.M. until 5:00 P.M., in collecting shells and plants along the sand spit northeast of the resort. Botanical specimens for the day numbered 27 separate collections, one of the most interesting being specimens of the mangrove, *Rhizophora mangle,* found along the southeasterly shore of the bay. Fine series of several marine snails were obtained by Dr. and Mrs. Hanna during their walk around the sand spit, and they took photographs of general features of the country and close-up pictures of selected flowers during the course of the day.

At 7:00 o'clock on the morning of the 18th, six of the party left the village in two small boats, with the intention of visiting Smith Island, but were forced by strong winds and heavy seas to put into a sheltered cove near the southern end of Isla de la Ventana. The party was divided into three groups so as to cover the island as thoroughly as possible in an effort to determine the condition of the plants and the density of the animal population. Two complete traverses of the island were made. Even the careful search thus made revealed only 15 species of flowering plants in condition to collect, and not a trace of land snails was found. One lizard, *Uta stansburiana elegans,* was captured, and several partial skeletons of a much larger lizard were found in some of the arroyos, but no big lizards were seen alive.

At one place, about a mile from the landing, Dr. Hanna found striking geological features, an unusual contact between the underlying granites and the volcanic cap rock.

At 12:30 the group re-embarked and ran down wind to the cove containing the mangrove colony and explored the vicinity for specimens. Nine species of plants in reasonably good condition were found before a shift in wind made return to the village advisable.

This trip, which terminated at Oakland airport at 1:45 P.M. on May 19, had been partly to determine the facilities and airport conditions at Bahía de los Angeles, which were found adequate. Comparison of the vegetation at the end of a winter during which there had been scanty rainfall (1959) with the plant cover produced by a season of more than average annual

rainfall (1935) showed that not only the total precipitation but its seasonal distribution is important in the responses of plant and animal life. Few land birds were seen on the trip to San Borja, and the plants collected were much smaller than the same species obtained in February, 1935. Many other plants that were common to abundant on the earlier visit were completely lacking in 1959.

Land snails also reflected the harshness of conditions obtaining in the spring of 1959. Even at the localities where shells were found, few living specimens could be obtained, either because they have been reduced in actual numbers or because those that survived the dry conditions had retreated so deeply into the crevices among the rocks that they were beyond reach.

SEPTEMBER RECONNAISSANCE FLIGHT

News reports on September 10, 1959, told of a violent storm that swept up the Gulf of California, veered to the west, and buffeted the towns and countryside of Baja California along the Gulf coast from the general vicinity of La Paz almost to San Felipe. Winds of high velocity were accompanied by downpours of rain, and flash floods of unprecedented ferocity took heavy toll of property and caused a loss of life that was, for a part of the country sparsely populated, quite high. Summer rains are expected each year in the southern part of the peninsula, and heavy storms of hurricane violence, locally known as chubascos, occur at irregular intervals. Such a storm was not anticipated in 1959, for one had devastated parts of the Cape Region in August, 1958. Therefore, the occurrence of heavy rainstorms in the late summer in two successive years indicated that extraordinary vegetational growth would occur in the autumn of 1959. A reconnaissance trip by plane was arranged to get a general idea of the extent to which the precipitation had spread westward past the divide of the principal ranges, and how far to the north its effect would be prominent on the westerly slopes of the foothills of the Sierra Calamajue, Sierra Calmalli, and Sierra de la Giganta.

This flight was accomplished on September 26 through 28. The plane left the Mexicali airport at 12:45 P.M. and landed at Bahía de los Angeles at about 2:00 P.M. Although only two weeks had passed since the rains, a faint sheen of green was becoming visible on the hills, particularly along the arroyos leading easterly to the Gulf of California, about two-thirds of the way from the fishing village of San Felipe to Bahía de los Angeles. This green wash could be detected from an altitude of 7,000 to 9,000 feet.

On the southward flight from Mexicali to Bahía de los Angeles, several patches of the dinoflagellates that cause "red tide" were seen, some of them extending a distance of a mile or more in an irregularly sinuous

pattern more or less parallel to the shore. All such "blooms" of this organism seen were from three to ten miles off shore. These organisms are microscopic in size but reproduce at a terrific rate under favorable conditions, and become so numerous that toxic substances in their bodies may kill thousands of fish in the area where the dinoflagellates are most numerous.

At Bahía de los Angeles two cars again were rented from Antero Díaz, for a drive around the southern arm of the bay and south toward the old ore dump, to determine how effective the rains had been in initiating growth in the perennial plants and in bringing up seeds of annuals. All shrubs, trees, and perennial herbaceous plants were in excellent condition, although insufficient time had elapsed to allow the production of flowers on any save a very few of the shrubs. Thousands of seedlings were present, many no more than 2 or 3 mm. high, and it was the close stand of millions of such seedlings that gave the green tint to the countryside when viewed from the air.

After the foray south of the village, the party rode westward toward Punta Prieta about ten miles in order to see the stage of development of plants in that area. The same conditions obtained west of Bahía de los Angeles that had been found south of the village. *Idria* and *Fouquieria* trees were swollen with an abundant supply of water, and had put out a full crop of leaves. Elephant Trees (*Pachycormus veatchii*), Torote (*Bursera microphylla*), Palo Verde (*Cercidium microphyllum*), Candelilla (*Pedilanthus macrocarpus*), and many small shrubs were beginning to put out leaves or start new growth. Cactus plants were turgid, the ribs of the cardon trees being low and rounded owing to the large quantities of water stored in their tissues.

Take-off the morning of the 27th was delayed only slightly by the local workmen who refueled the plane for the flight to La Paz. From Bahía de los Angeles the course led slightly west of south, skirting San Ignacio, Good visibility made it possible to see both the Gulf and the Pacific, and the Tres Vírgenes stood out commandingly just north of Santa Rosalía during an hour or more of the flight. At San Ignacio one could see that a great many date palms had been destroyed by the torrents that had swept down the arroyo. The landing field looked too soft for a landing, so the pilot set a course for Mulegé. Santa Rosalía was visible for a few minutes, from an altitude of about 8,000 feet, but too far to the left to permit recognition of damage that occurred there. The course then led over the Gulf just north of Mulegé, and one could see that here also the date palms had suffered extensive damage from wind and high water. The part of town built on low ground along the banks of the estero had been almost demolished.

Plate 2 (Upper) "Granadito" (*Passiflora palmeri*) near Miraflores.
Photographed by Reid Moran
(Lower) "Flor de San Miguel" (*Antigonon leptopus*) near La Paz.
Photographed by G.D. & M.M. Hanna

Between Mulegé and the south end of Bahía de la Concepción, again there was evidence of the destruction done by walls of water, tumbling rocks, trees, and debris that had swept down the canyons and arroyos. Where arroyos entered the bay, fans of rubble extended farther into the water than they had previously, and where roads had crossed mouths of arroyos there was no trace of a thoroughfare. It would take much work to reopen a route to wheeled traffic.

A landing was made at Loreto, where high-water marks in the trees and and shrubs along the runway were three to five feet above the runway's surface. Great heaps of silt and gravel had been cleared from the landing strip only recently. Several cars came from the village to meet the plane, and the entire group drove into town to get firsthand information about the disaster and to see the destroyed, damaged, and water-stained buildings. The toll in physical damage had been staggering. Three hundred fifty of Loreto's 450 houses had been completely destroyed or severely damaged. Virtually every house in town had been flooded to depths varying from a few inches to several feet. The flood roaring down the canyon behind the village spread to make a river three kilometers wide, and one elderly gentleman said the water separating his house from the church was shoulder deep when he waded to the church to take refuge within its stone walls. Thousands of date palm, coconut, orange, mango, fig, and shade trees had been blown down, snapped off, or washed completely away. Trees that had been overturned by the wind, but still had their roots in place, were being lifted upright and guyed in place. There were many accounts of the terror that struck when inhabitants felt the fury of the storm. Despite the harrowing experiences, the death toll had been low. One old man who refused to leave his hut had been drowned. No other lives had been lost. People said Loreto really had been lucky as far as loss of life among its inhabitants was concerned, but that the floods had been much worse at San Ignacio and La Purísima, where the dead were reputed to have numbered nearly a score at each of these places. The Sportsman's Club at Loreto had several buildings unroofed, the fences partially destroyed, and many fine trees broken off or blown down.

The flight from Loreto to La Palmilla was routine, but when the party landed at this attractive resort it was scarcely prepared for the higher temperatures experienced when the door of the plane was opened. The strip there had not been damaged by the storm, or if damage had occurred it had been repaired, for the strip was reasonably smooth and Sr. Rodríguez's small plane was on the parking apron. A car arrived from the resort a half-mile away, and part of the group drove down to the buildings to talk with Sr. Rodríguez and to see what havoc had been wrought by the chubasco. There had been extensive damage in August, 1958, when the wind had

attained such velocities that it beat reinforcing steel, standing vertically 10-12 feet above the concrete of a partially constructed building, to an angle of about 40 degrees.

The vegetation along the airstrip was in virtually full flower, with gorgeous festoons of *Antigonon leptopus* hanging from the upper branches of the larger trees. Several species of *Boerhaavia* made a pink mist, and many less spectacular annuals and perennials were in flower. The display was beautiful, and a large folio was filled to overflowing in less than an hour. No herpetological specimens were obtained, for neither the equipment to make such collections nor preservatives for specimens was available.

The flight back to La Paz required less than half an hour. The taxi driver said that neither the Guaycura nor the Los Cocos resorts were open at this time of the year. Quarters were obtained at Los Arcos, in artistic, two-unit cottages across the street from the main hotel and dining room.

There was still time for Dr. Miller and Ira Wiggins to make a quick inspection of the apartment the Academy had rented on the Malecón and into which Margaret Waters had arranged to have equipment moved from the place near the Plaza. Academy personnel had feared that the chubasco might have blown the roof from the apartment and left the place open to the elements. The damage had been minor; only a single panel of the metal roofing had been blown away. This panel was over the bathroom, in which nothing had been stored, so no supplies or equipment had suffered. The place was littered with leaves, broken branches from the trees outside, pieces of paper and a thick coat of silt that could have been swept in during the chubasco or partially deposited by wind after the rainstorm abated.

Departure from La Paz was accomplished in good time on the morning of the 28th, and a course set directly for La Purísima, in an effort to see whether or not the precipitation had reached the coastal mesas in that vicinity. The light was better for getting a good view of the southern Sierra de la Giganta than it had been the afternoon before, and extensive areas in the "lagunas" among the higher peaks and mesas were seen to contain water. Some of these temporary lakes were several miles long; some of them appeared very muddy, and others contained clear water through which one could see grass and inundated bushes.

The plane "buzzed" La Purísima several times before landing at the strip on the mesa. A brief examination of the mesa immediately adjacent to the strip showed that there had been some rain at that place either in conjunction with the chubasco or sometime in the late summer, for seedlings were present in small numbers, and such things as *Fouquieria peninsularis, Jacquemontia abutiloides, Franseria bryantii,* at least one species of *Peritype* and one of *Passiflora* were in bloom. *Maximowiczia* plants were in

flower and some had nearly ripe fruits, so there probably had been some rain early in the summer. A few *Mammillaria* plants were beginning to flower, also.

In about half an hour two cars came charging up the grade, with so many people in them that it would have been impossible to take the visiting party back to the village had any of the local people ridden back, too. No-one in the plane wanted to take time to make the round trip to the village, so a short conversation with the villagers revealed that the reports heard at Loreto about the number of deaths at La Purísima had been exaggerated – the La Purísima people said five had died there, four of them belonging to one family. However, property damage had been staggering, and apathetic hopelessness seemed to be the general attitude of those who drove to the landing strip.

From La Purísima the course of flight was northwest over Scammon's Lagoon, and a landing was made at Guerrero Negro on the salt field that looked uncertain from the air but was as hard and smooth as concrete when the wheels touched. The group was met by several of the officers of the company, Exportador del Sal, taken on a tour of the evaporating ponds, shown the huge salt-harvesting machine, special trucks and trailers, each of which hauled from 80 to 114 tons of salt at a load, the loading facilities on an arm of Guerrero Negro Lagoon, and returned to the company village for a delightful coffee break. Arrangements were made to use this base as a clearing point during subsequent trips, and to have the company truckers keep alert for possible breakdown of Academy vehicles operating in the Vizcaíno Desert. Almost no plants were in condition to collect, but seedlings promised abundant material later in the autumn.

One objective of the reconnaissance flight had been to check possible landing strips for routine or emergency use on the peninsula. One strip considered for such checking was at Laguna Manuela, about 15 miles north of Guerrero Negro. When the people at the salt company's headquarters reported the strip at Laguna Manuela in good condition, a test landing was no longer necessary and the pilot preferred to use the time and fuel made available in by-passing Laguna Manuela to fly to Cedros Island. The flight to Cedros was less than one hour in length, and the landing made without incident, in spite of a terrific cloud of dust kicked up by the propwash and the wheels. Only a few minutes was spent at this airstrip, for the vicinity was exceedingly dry. Almost no plants were present except along the upper strand where *Salicornia* and *Allenrolfea* made a narrow, irregular strip of grayish green.

The landing at San Diego was made just after dark, so delay in getting United States medical, immigration, and quarantine officials to check the plane and its passengers had been anticipated, but clearance was

accomplished promptly. The flight had been eminently worth while, for it provided information about roads, and the limits of useful precipitation for bringing plant cover into favorable condition for collecting during a trip down the length of the peninsula scheduled for the autumn and to begin within two weeks.

AUTUMN BOTANICAL EXPEDITION

On October 10, 1959, a party of three – Ira L. Wiggins, Dorothy B. Wiggins, and John H. Thomas – departed from Palo Alto at 9:00 A.M. to drive the "Travelall" to San Diego, where final minor purchases were made, the vehicle was checked and serviced, and Mrs. Margaret Waters was added to the group to drive to La Paz. Originally the plans had called for Dr. and Mrs. Hanna to participate in the whole expedition, but pressing obligations at the California Academy of Sciences prevented them from doing so.

Weakness in the design of a luggage rack on the roof of the "Travelall" necessitated rebuilding that piece of equipment, so the party did not get away from San Diego until the forenoon of October 13. Another delay occurred in Ensenada, where the local Immigration Officer was involved in political receptions for the governor-elect, and the Americans were unable to secure his aid in acquiring tourist permits until too late in the evening to permit further driving that day. Rooms were engaged at a motel on the outskirts of Ensenada, and the party was up at 4:30 the following morning and on its way by 5:00 A.M. A lunch stop was made on the mesas a few miles north of El Rosario, a package from Dr. George Lindsay of San Diego for a family in the village was left with Señora Espinosa, gasoline was purchased, and several more miles were put behind before camp was set up near a colony of *Idria* trees 15 miles southeast of El Rosario. During the stop for lunch, and again in the evening, swarms of gnats were particularly troublesome. These noxious midgets continued to pester members of the party throughout most of the trip to the Cape Region and much of the time spent in the field during the autumn.

The first collecting on the autumn trip was done at the noon stop, October 14, between El Aguila and San Augustin. The arroyo at this point had carried some runoff earlier in the summer, and possibly a slight amount as a result of the chubasco, so there were several perennial herbs in flower. None of the annuals were large enough to collect, but they were numerous enough in swales and in the protection of steep banks to give promise of better collecting later in the fall.

Progress southward was steady, although not particularly rapid. Collecting remained scanty past Cataviñá, Laguna Chapala Seca, and Punta Prieta. There was a slight increase in the number and size of the plants in

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Plate 3 (Upper) "Biznaguita" (*Mammillaria evermanniana*) between La Paz and Los Planes. Photographed by G.D. & M.M. Hanna

(Lower) "Biznaguita" (*Mammillaria fraileana*) near Isla Pichilinque. Photographed by Ira L. Wiggins

bud or flower as the route led southward. South of Punta Prieta some of the washes had carried sufficient runoff from the heavy rains in the hills to the east for the flood waters to approach the Pacific Ocean. Along such arroyos were narrow strips of verdure breaking the monotony of the dry, parched mesas and hills between which they ran. Some days no more than 15 or 20 collections could be made; on others, when several large arroyos that had carried heavy freshets were crossed, over 50 were taken. Each collection was made in sets of six to eight sheets when the material was ample, so the presses were kept filled and placed over a gasoline stove each night in order to insure rapid drying and good specimens.

A normal day of operations began at about 6:00 A.M., with breakfast being prepared while Dr. Thomas and Ira Wiggins opened the press that had been over the heat the night before, removed the sheets that were dry, and put anything that had been held over from the previous night into the warm blotters and ventilators before strapping the presses up for the day. Breakfast finished, clean-up was begun immediately, the gear reloaded into the truck, and the expedition on the road, usually between 7:30 and 9:00 A.M.

Driving was shared by Wiggins and Thomas, each doing about a two-hour stint at the wheel before the other took over. Sometimes an area to reconnoiter and collect in would be found within five minutes of getting under way; other days 10 or 15 miles might pass before a stop was made. Photographs were taken whenever a subject of sufficient interest or novelty was seen, and a complete log of all collecting stops, photographs, general condition of the country and the vegetation was kept. A portable, battery-operated, tape recorder was utilized through the day to record observations on the vegetation, and the geographic distribution of a species seen near its southern limit or when its northern boundaries were reached. The more spectacular features of the terrain were noted and briefly described on the recorder. A noontime break was taken each day, although not always promptly at noon, for it was found that a half-hour in which to eat a light lunch and rest in the sparse shade of a mesquite, *Yucca,* or Elephant Tree helped to reduce excessive weariness before the end of the day. A satisfactory camping site usually was selected about 20 minutes to half an hour before sundown, in an opening in the shrubs, or on a stretch of desert pavement where the cars could be driven at least 100 yards from the road. The two women chose the spot they favored for their cots, usually about 30 to 40 yards apart, rolled out their sleeping bags, mentally marked the spot so they could find their beds after dark, which usually came quickly. John Thomas usually went a greater distance from the truck, and Wiggins slept beside the truck where he could also look at the stove under the plant presses once or twice during the night and pump up the pressure tank so the fire would burn until morning.

While Dorothy and Margaret prepared the evening meal, John and Ira again opened the presses, removed any specimens that were dry, and reinserted those that needed still more heat, together with the ones collected during the day. When that chore was finished, dinner was ready and the heaviest meal of the day was consumed. A few minutes were usually devoted to writing up notes on the day's operations, checking the mileage made, going over the car for any attention it might need, and all hands turned in early. It rarely was later than 9:00 P.M. when all were in their sleeping bags, and some evenings the camp was silent a full hour earlier.

The salt works at Guerrero Negro were reached just after noon on October 20. Rather than arrive at mealtime, the car was driven part way toward the loading dock so collecting could be done on the salt marsh and shells obtained for the malacologists. Company headquarters were approached in midafternoon and arrangements made with Mr. McClory to buy gasoline and call the San Francisco office on their short-wave radio. The call went through promptly and reception was good.

The route from Guerrero Negro led almost due east, along a looping curve through the sandy Vizcaíno Desert to El Arco, which was reached a short time after noon the second day from Guerrero Negro and thence along the main road to San Ignacio. At this desert oasis the devastation caused by the chubasco among the date palm groves, the vineyards, along the arroyo, and in the part of the village that had lain on low ground near the arroyo was appalling. The dam a half-mile or so above town, that had impounded the water for the villagers and orchardists, had been totally destroyed by the flood. Thousands of palm trees had been uprooted, snapped in two, or blown and washed over. Many of the wrecked trees had been carried down the arroyo for miles; others were still attached to the rocky soil but were lying flat on the rocks. Debris was lodged against the upstream side of many of the date palms that had withstood the ravages of the flood and in some instances was still piled to a height of 10 to 15 feet above the ground. These trees, with the trash still piled around their trunks, were growing along the margins of the arroyo. The center of the watercourse was 10 to 15 feet lower than the bases of the marginal trees, so the greatest depth of the rushing flood must have been 20 to 30 feet. It was a depressing sight and one could hardly blame some of the local inhabitants for having a defeatist attitude. Many, however, were busily engaged in clearing away the debris, straightening leaning trees, repairing damaged houses, fences, and irrigation ditches, and hauling boulders with which to rebuild the dam. It will be several years, at least, before the town of San Ignacio can erase the scars of the chubasco of September 9, 1959.

At San Ignacio it also was learned that the reports about the death toll heard at Loreto in September had been grossly overdrawn. Inquiry here

elicited the information that only one person, a mentally retarded girl, had perished in the flood. All others had reached higher ground before the wall of water and its terrifying load of smashed trees, brush, sand, gravel, and boulders reached the area. The power of the flood was vividly attested by the presence of huge boulders, eight, ten, fifteen feet in diameter, strewn along the bed of the arroyo where none had been before.

Each member of the party had hoped there might be word at San Ignacio that the road south via Mulegé and Loreto had been opened to traffic since September 26. A couple of trucks had got to Santa Rosalía over a very bad road, but there was no possibility of driving beyond that town. The road between there and Mulegé was still out and no-one expected the route around Bahía de la Concepción to be passable for at least six weeks.

The only road open ran southwest, on a route none in the party had taken previously. Fortunately, it proved much less difficult than it had been painted, and avoided the steep grades twisting down the eastern escarpment to Santa Rosalía, the long stretches of rocky, bone-jarring road around Bahía de la Concepción, the one down the canyon from Canipolé to La Purísima, and that across the lava-strewn mesa between Canipolé and Comondú.

The "Travelall" got through the sandy areas with no serious difficulty, although a Mexican's truck had to be pulled out of an arroyo with the winch so traffic could get by. One unpleasant forenoon of driving slowly on a silt-floored valley before a tail wind had to be endured on the way inland from the salt flats between Salina Cuarenta and Rancho San José de García. Here the silt had been churned into powder, the ruts were axle-deep, and the dust billowed around the car in clouds so dense that several times it was necessary to stop and let the wind carry away the dust. During the summer months when the sandy areas are very dry, the coastal route is probably difficult to traverse, but in October, 1959, the general condition of that road was better than that on the "main" road.

In the vicinity of La Purísima the collecting conditions were less favorable than they had been 100 miles to the north, for rain on the mesas during the late summer had been very slight, or possibly lacking. It was apparent that the direct precipitation during the chubasco had not extended to the Pacific Coast at that latitude, and good growing conditions occurred only along the arroyos. One wash about eight miles south of Arroyo de la Purísima provided excellent collecting conditions. Shrubs, trees, vines, and herbs were in good condition, and a varied aggregation of plants kept John, Ira, and Dorothy busy much longer than had been anticipated, with the result that a camp site was selected very hurriedly, and not until too late to change was it discovered that camp, on the edge of a mesa, overlooked a small ranch where a tremendous herd of goats had stripped the ground bare

half a mile from the buildings. However, their activities seemed to stop near the foot of the bluff below.

The road from La Purísima south to the northern end of the pavement had been graded, the roadbed divided into two strips separated by a line of cobblestones set into the clay, and, over considerable stretches, some cobbles set from side to side of the road. These cobbles were, apparently, covered with dirt when first laid, but most of the soil had been washed or blown away, so the rough surface hammers a car frightfully. The older roads, which consisted of nothing more than a clearing through the brush, and with a clay or sand base, were generally less trying to drive over and placed a less severe strain on the vehicle.

On October 28, 60 miles were covered before lunch, and the paved highway 212 kilometers from La Paz was reached half an hour later. Almost no stops were made between the beginning of the pavement and La Paz, and the apartment was reached at 7:30 P.M.

The following three days were devoted mainly to organizing supplies and equipment in the apartment, having the vehicle serviced at the International Harvester agency in La Paz, and in purchasing various supplies for use in the field and at headquarters. Most of the 30th was spent in driving back along the paved highway about 45 miles to collect in several arroyos that had been seen on the trip south. The specimens obtained were not as numerous as had been anticipated. The rainfall had dropped off sharply west of the escarpment that bounds the plains on which La Paz stands, so the vegetation west of the divide was nearly at a standstill and very few shrubs or trees bore either flowers or fruits.

SPECIAL FIELD PARTY

In the afternoon of October 31 several more scientists arrived by plane to spend a few days on special projects centered near La Paz. The group included Dr. G Dallas Hanna, geologist, malacologist, and paleontologist at the Academy; Mrs. Hanna, a scientific illustrator who collaborates with her husband in photographic projects; Dr. Myra Keen, malacologist at Stanford University; Dr. Joseph Wood Krutch, naturalist and writer who was gathering material for a general and historical account of the natural history of Baja California; and Mr. Allyn Smith, Research Malacologist at the Academy. During their stay in the Cape Region members of this group collected specimens, took photographs, and secured notes at various localities several directions from La Paz. Their first excursion, on November 1, was to Isla Espíritu Santo, utilizing a landing craft operated by Richard Adcock, a young American living in La Paz. Dick landed first at Bahía San Gabriel, where extensive holding and rearing tanks for pearl oysters had been built

by a French company about the turn of the century, but which never had been operated at full capacity because the project was scuttled during the Mexican Revolutions of 1910-17. The hillsides nearby were covered with many species of plants in flower or fruit, including hundreds of the attractive, red-flowered *Bebria,* not previously reported from the island. Dr. and Mrs. Hanna obtained excellent photographs of several of the plants at this stop, and Allyn Smith found land snail shells high on the ridge above the landing.

Leaving Bahía San Gabriel, the skipper followed the western shore of Isla Espíritu Santo, which displays extraordinary horizons of volcanic ash, basaltic lava flow, and rhyolitic rocks in various shades of pink, buff, gray, black, umber, and red. He put in at Bahía Candelero, near the northwesterly point of the island, where the water was beautifully clear and the canyons leading back into the higher peaks promised good collecting for the botanists, the beach a mecca for the malacologists. High expectations as the LCP entered the cove were fully fulfilled ashore, for Dr. Keen obtained shells and worm tubes that are rare in collections, Allyn Smith found a few land snails on the ridges and in the canyon inland, and the botanists obtained over 50 different species of flowering plants in good condition. Mr. Smith even found a small night snake under a piece of driftwood, thereby contributing to the herpetological knowledge about the island.

The larger of the canyons leading inland from Bahía Candelero had recently contained water in the tinajas only a few hundred yards from the beach, and it is possible that small pools still may have existed higher in its course. Beautiful specimens of a native fig (*Ficus palmeri*) as much as 70 feet tall, and with grotesquely branched and flattened roots, occupied a partially shaded portion of the gorge. Several members of the bean family, both shrubs and small trees, were present along the canyon's walls or near its floor, and several were in flower or fruit. The bright, deep pink masses of flowers of *Antigonon leptopus* cascaded over many of the shrubs or formed attractive blankets where the vines enmeshed huge boulders. Large, golden yellow blooms of the morning-glory, *Merremia aurea,* were scattered along the canyon, but this plant rarely produces more than three or four flowers on any one day, and the blossoms wither by the end of the afternoon, so they rarely make an extensive display.

At this beach Mr. Smith filled a collecting bag with beach drift to be sorted under a lens after the party got back to the Bay Region. Several extraordinary mollusks later were separated from this accumulation, one of them representing a marine snail not previously known from an American coast. Final research on several of the shells from the drift had not been completed when this report was being written. Special papers will present the results of the investigations on this lot at a later date. The discovery of these marine shells emphasizes the importance of studying comparatively

large quantities of material in a critical manner if one is to reap the greatest possible benefits from opportunities to visit field localities. Separate papers will no doubt be published to report results in other fields of investigation growing out of the few days spent in the Cape Region by this group of California scientists.

On November 2 four members of the party spent the day with the "Travelall" investigating a report that fossil fresh-water snails occurred in a limestone deposit about 35 miles south of La Paz. Dr. Krutch, Dr. Hanna, Allyn Smith, and Ira Wiggins made that reconnaissance trip, found a deposit of limestone that contained a few poorly preserved fresh-water snails and fragments of fossilized plant remains, and took a number of photographs of attractive plants and shrubs in full flower. Others, including Dr. Keen, Mrs. Wiggins, Mrs. Hanna, and Dr. Thomas, flew to La Palmilla, where a car was engaged to take them to Cabo San Lucas and back. While at the southernmost tip of the peninsula, Dr. Keen had an opportunity to see some of the marine mollusks and other sea life just under the lea of the Cape and to collect rare shells. This group returned to La Paz about dusk, and the two field parties compared notes during dinner at the Guaycura Motel that evening.

The morning of November 3, again there were two field parties operating. The Hannas and Wigginses drove the "Travelall" part way to Los Planes in an attempt to get a reasonably good photographic coverage of the flowers and characteristic trees and shrubs in that part of the Sierra Cacachile. The others embarked in Dick Adcock's *El Crepúsculo* to explore the shore of the peninsula east of La Paz. The latter group encountered rougher water than had been experienced on November 1, but was able to land at Balandra Bay and just northwest of Coyote Point. Near the latter locality a large limestone deposit, lying along the upper beach and uncovered by the storm on September 9, contained myriads of well-preserved fossil shells. Inadequate tools for removing the closely cemented material prevented collection of more than fragmentary pieces of the rock, but it was obvious that here was a deposit of great interest, and one that would yield rich dividends if studied intensively.

Dr. and Mrs. Hanna obtained outstanding photographs of several flowers during the course of the day, one of which was a milkweed with delicate, brownish filaments three to five millimeters in length attached to the face of the corolla, and fluttering in the slightest breeze. Another splendid color transparency was of a *Mammillaria* in full fruit, with a ring of bright red, elongate fruits completely encircling the oblong, spine studded body of the plant.

On the same little knoll where the fruiting *Mammillaria* grew, Dr. Hanna found both empty shells and living snails in fair numbers under the slabs of

granitic rock. Three different species were represented among the shells obtained at this locality. Empty shells of land snails are numerous in most parts of the Cape Region, but the living animals are often hard to get, for they retreat far into the crevices among the rocks when drought sets in.

FIELD OPERATIONS: MOSTLY BOTANICAL

Everyone was up at 5:30 A.M. on November 4, had breakfast at 6:00, and the visiting scientists' plane took off at 7:20, taking Dr. Thomas with them, for he had to return to his duties as Assistant Curator in the Dudley Herbarium at Stanford University. The departure of the larger group left only the two Wigginses operating in the field in the Cape Region, and they missed the others greatly.

A number of collections of fruit of cacti, seeds of yuccas, and other botanical specimens needed attention, for if left in the paper bag containers mold would spoil much of the material. The next couple of days were spent in washing the seeds from the pulp of fruits, opening capsules and completing the drying of the seeds, changing the presses and removing specimens, and generally getting things into shape so additional field collecting could be carried on in the Cape Region and in the Sierra de la Giganta.

The morning of the 6th Ira and Dorothy left La Paz to accept an invitation from Mr. Rex Keller to visit the region around a mine in which he has an interest, located at El Valle Perdido, about 40 miles by road from La Paz. Numerous stops to collect were made en route to El Valle Perdido, so the Keller house on the bank of a large arroyo about a half-mile from the village was reached just a short time before sundown. A pleasant evening was spent talking with Mr. Keller and a visiting mining specialist, Arthur Johnson, who was at El Valle Perdido to inspect the mine. The conversation with Mr. Keller paid good dividends, for his suggestions concerning the local environment helped the Wigginses find nearly 50 species of collectible material within a mile of the mine buildings the next forenoon. He also suggested an extension of the trip another five miles up the arroyo past El Valle Perdido and over a low ridge, to a small ranch called La Junta.

There had been a few small pools and an occasional seep in the large arroyo running past La Mina San Antonio (the mine Keller supervised), but no actively running water there. It was, therefore, amazing to encounter a small but beautiful stream of clear, rapidly running water in the sandy bed of the arroyo only two and one-half miles above the village! Marks on the sand showed that the flow of water fluctuated during day and night periods, with the surface water extending fully 200 yards farther down the arroyo in the early morning that it does toward the end of a warm afternoon.

An oak, *Quercus brandegeei,* occurs commonly along the arroyos between El Valle Perdido and La Junta. Several had many shoots six to fifteen inches tall forming a dense carpet under the parent tree. At first glance these shoots appeared to be a huge crop of seedlings, but closer examination revealed that they are shoots from the roots of the tree, and are intricately intertangled three to six inches below the surface of the soil. Almost no true seedlings were found under such trees, although acorns were numerous on the branches and under one of the larger trees having these suckers growing from the roots. The acorns of some trees are reputed to be sweet and edible, and quantities are gathered each year and sold for human food in the La Paz markets.

A short distance above the point where the rill was encountered, the road climbed a ridge, through a low pass, and dropped down the opposite side into another drainage system, where a much larger stream occupied a channel about 20 feet wide, with a flow four to five inches deep over its gravelly bed. Willow trees, many introduced guamuchil trees, shrubs of *Baccharis,* and *Cryptostegia grandiflora* were abundant along the stream. The next morning four different species of morning-glories (*Ipomoaea* and *Merremia)* were in flower within 200 yards of camp. Amazingly, no mosquitoes were noticed during the evening or early morning hours nor had there been the usually abundant swarms of gnats. Hummingbirds were common along the stream and worked over the flowers of the morning-glories and those of a low shrub, *Ruellia californica,* as soon as the sun came up. Several dozen small toads, so recently metamorphosed that some still had vestiges of tails, hopped upward toward granitic boulders along the banks of the arroyo, apparently looking for the protection of overhanging ledges and for moist holes under some of the rocks where they could burrow into the damp soil. Within an hour after the direct rays of the sun struck the bottom of the canyon, not a baby toad was in sight.

Camp was broken in the middle of the forenoon, the car driven slowly back to El Valle Perdido, and many stops made to collect specimens that had not had their flowers open the afternoon before. Several specimens of *Cnemodophorus,* a large *Sceloperus* lizard, and one good-sized racer dead in the road where a passing vaquero had killed it just a few minutes earlier, were added to the herpetological collections.

Fewer collecting stops were made between El Valle Perdido and La Paz, because field work at the altitudes between the mining village and La Paz had been reasonably thorough during December of 1958 and January of 1959. El Valle Perdido is situated at an elevation of approximately 1,500 feet above sea level, and the highest point between there and La Junta only about 150 feet higher. Trails lead from the vicinity of La Junta to the meadows among the higher peaks of the Sierra de la Laguna, so it would be

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Plate 4 (Upper) "Pitahayita" (*Echinocereus brandegeei*) near Punta San Lorenzo. Photographed by Ira L. Wiggins

(Lower) "Biznaga" (*Ferocactus peninsulae*) near La Purísima.

Photographed by Ira L. Wiggins

possible to sample the vegetation and fauna of that range from the 1,500-foot level to over 5,000 feet above sea level in a few days with pack and saddle animals.

On November 11 the Wigginses headed northwest from La Paz to attempt penetration of the Sierre de la Giganta. Several side roads leading toward the northeast and east were investigated in the course of covering the first 100 kilometers, but none of them extended far enough from the highway to further plans for getting into the higher hills and mountains.

At Kilometer 100 is situated a small store and a building erected for government use when the highway was being built. A narrow, mainly ungraded, dirt road leads easterly at a sharp angle to the main highway, and Sr. Sabino, proprietor of the Guaycura Motel, had reported a beautiful oasis existed only four miles away, at Rancho San Hilario. Three miles from the highway, a small clump of fan palms attract attention, and although the arroyo was so dry that there were few plants to collect, fragments of fossil wood occurred as float along its bed. Diligent search revealed a few more pieces, but no log could be found in the slightly consolidated, volcanic ash along the banks of the ravine. The oasis itself lived up to the description given by Sr. Sabino, and one of the men at the ranch said that a little later in the fall there would be many ducks on the ponds that occur intermittently up and down the arroyo a distance of several miles. Collecting, however, was rather poor, because goats had harvested much of the vegetation in all directions from the rancho.

Dorothy and Ira returned to the paved highway, drove north about 10 kilometers, again turned eastward, and by the end of the day had laboriously traversed rocky, rough roads to El Pilar. At this village another beautiful oasis is formed by a spring that flows steadily from beneath a thick layer of tuff and forms several attractive pools at the feet of date and fan palms. Camp was made just after sundown on a bench a couple of hundred yards from a large pond in the bottom of Arroyo Colorado, north of El Pilar. A site any nearer the water would have put one uncomfortably close to the local concentration of mosquitoes.

The morning of the 13th was one of the most beautiful witnessed during the entire stay in Baja California. Rain had been threatening most of the previous day, and just before dawn a light shower occurred. The sun came up behind a huge jumble of clouds, and the play of colors was magnificent. Bright rays broke through a rift in the clouds at 6:05, and a double rainbow almost instantly appeared in the west and northwest, with a backdrop of deep purple clouds edged with rose, gold, and a faint tinge of green. The display was brief, but of sufficient duration to permit exposure of several frames of color film.

Most of the forenoon was devoted to collecting the many interesting things growing along the moist bed of the arroyo and around the pond that stretched for a half-mile upstream. A vial was filled with beetles and other arthropods screened from the water, and several lizards and a small snake were obtained on the sandy slopes high enough above the bed of the arroyo to have escaped inundation during the high water of the chubasco. Thousands of snail shells, belonging to three genera, marked the upper edge of the drift zone. The only birds seen were two pairs of killdeers, a few cliff swallows, and one lone goose flying southwest just after daybreak. It flew high, uttering its lonely call at intervals of about five or six seconds. It was the only goose seen that far south.

Progress the rest of the day was slow and the collecting was even slower, for the effects of the chubasco were almost absent from the lower foothills in that part of the peninsula. That evening's camp was only two miles south of Rancho La Punta del Cerro and dogs, chickens, and burros could be heard from time to time throughout the night.

A brief stop at La Punta del Cerro the next morning disclosed that the road no longer runs directly past the ranch, if it ever did, but is about a quarter of a mile east of the buildings, which are almost totally hidden from sight by trees lining the pools in the arroyo. Patches of corn, pumpkins, and beans occupy most of the arroyo's lower benches, and orange, mango, and avocado trees form a dark green pattern beneath the graceful crowns of a few date palms. Three men were butchering goats at Rancho La Punta del Cerro and were only mildly interested in questions phrased in halting Spanish, so their answers were prefunctory and brief. They had returned to their tasks before the "Travelall" had been fully turned toward the main road.

The numerous forks, lateral roads, and total lack of signs caused some inconvenience, but there were no serious delays nor overly long detours, and camp was set up on November 14 at the foot of an impressive remnant of a once large mesa. Much of the forenoon next day was spent exploring the mesa and the caves near its summit. About noon an abundance of *Marsilea* was found growing at the water's edge along an arroyo at Rancho Domicilio. Several ducks were frightened from a pond about a mile below Rancho La Presa, and that tranquil habitation was reached about the middle of the afternoon on November 15. Four and one-half days had been spent traveling 191 miles, the first 62 miles over good pavement! True, many stops had been made to collect, but usually each was for only a short time. The roughness of the "roads" had been the chief factor in reducing the rate of progress.

Within the course of an hour arrangements had been made for a couple of saddle animals, pack burros, and a guide for the trip farther into the

Sierra on the following morning. The welcome extended by the people at the ranch was warm and friendly, with the elderly lady of the hacienda serving coffee and hot milk within ten minutes of the botanists' arrival.

Four days were spent in riding up the trail to Laguna Caquihui, collecting the plants still in good condition there, and returning to Rancho La Presa. The trail was a good one, in fact followed the general route of a road that had just been finished in August of 1959, then destroyed by a rush of water during the chubasco on September 9. In making the gradual ascent into the higher mountains, the trail passed the ruins of Misión de la Pasión, which lie on a rounded knoll removed only a little way from an arroyo tributary to Arroyo La Presa, and which Sr. Ruperto de la Tova claimed always contains water, even when the main arroyo is dry except for scattered tinajas and pools. Several ranches, mostly devoted to raising goats, occur at intervals along this trail, and an attractive cattle and horse ranch is situated at the northern end of Laguna Caquihui, the main laguna between Rancho La Presa and Los Dolores.

The "lagunas" in this part of the Sierra de la Giganta are intermittently dry as dust, and flooded to a depth of several inches to four or five feet. Several years may go by with no water in the lagunas; in others the rainfall is sufficient to fill them deeply enough to permit runoff for a short time. The valleys in which they occur are broad, with very gentle slopes around the periphery of the ponds or lakes, and some are as much as two miles in length and about one-third as wide. Many ducks were rafted in the center of the laguna, but kept too far from shore to permit Ruperto to shoot them. Verdure was abundant on the flats along the laguna, but the number of species was low. A very beautiful delicately hued, purplish morning-glory, tangles of a wild bean (*Rhynchosia*), a weedy member of the hollyhock family, and tremendous numbers of the clover-like plants of the water fern, *Marsilea,* were the most abundant plants around Laguna Caquihui. Patches of ragweed (*Ambrosia*) and one of its near relatives, (*Franseria*) were numerous but not in full bloom.

Among the rocks surrounding the laguna, Ruperto found several plants of more than ordinary interest, among them a cactus that looks like dead twigs, *Wilcoxia striata,* and one plant of a still rarer cactus, *Peniocereus johnstonii. Wilcoxia* has a bundle of dahlia-like roots buried a few inches below the surface of the soil, and *Peniocereus* possesses a root that looks like a large sugar beet and may weigh several pounds. Such subsucculent roots help these peculiar plants to survive long, dry periods by storing water in their fibrous tissues. The spines of neither of these cacti are formidable, and the stems are sometimes severely damaged by rabbits. Cattle avoid them, for their juice is very bitter.

Ruperto said that the Laguna is only about 15 miles from Los Dolores, a cattle ranch and the site of one of the early missions on the gulf just west of Isla San José. However, the trail down the eastern escarpment of the Sierra de la Giganta is very steep, difficult, and in places dangerous, so Ruperto was unwilling to punish his burros and saddle horses by taking them down that trail and back up again.

On the return trip to Rancho La Presa, the second known collection of a delicate little member of the Loasaceae, *Sympetaleia tenella,* was made. It had been found first by Ivan M. Johnston only a few miles farther north in 1921. Only a single plant was found in collectible condition by Johnston, and just one plant was found in Arroyo la Presa. The latter specimen, however, was in full flower, whereas the one collected by Johnston had been past its prime and bore more fruits than flowers. This specimen from Arroyo La Presa provides adequate material for a fuller description of the endemic species.

Sr. de la Tova suggested a day or two of rest at Rancho La Presa to provide opportunities to collect in the immediate vicinity, but inasmuch as the foothills had been covered with considerable thoroughness on the way in and supplies were beginning to run low, his invitation was regretfully declined. Better time was made going out than had been possible on the trip from the highway to La Presa, largely because the owner of the ranch at El Domicilio told about a road running directly from El Obispo to the pavement at Kilometer 126. Consequently La Paz was reached by 5:30 P.M., November 19, only 27 hours after the Wigginses left La Presa, in contrast with the four days needed to make the drive to the ranch.

ECOLOGICAL RECONNAISSANCE

On arrival at the La Paz headquarters November 19, Dorothy and Ira Wiggins learned that Dr. Paul B. Sears, world-renowned plant ecologist from Yale University, had arrived in La Paz that afternoon. While in California to deliver a series of lectures, Dr. Sears had expressed a desire to see the plant cover in the Cape Region, and the Belvedere Scientific Fund had arranged for him to join the Wigginses for a brief examination of several vegetation types in the vicinity of La Paz. Because Dorothy and Ira were away from headquarters more than a week during their trip to the Sierra de la Giganta, Dr. Sears arrived an hour before they received the telegram informing them of his visit. Arrangements were made for a trip to Isla Espíritu during the forenoon of November 20, and the local field workers accompanied Dr. Sears to the island and showed him characteristic vegetation near La Paz following the boat trip.

After an early breakfast the party left the dock at La Paz aboard Dick Adcock's barge at 6:20 A.M. on the 20th, and landed near the southern end of Isla Espíritu Santo at 8:20 A.M. Dorothy and Ira collected on the salt flats behind the beach ridge and on the nearby hills, and Dr. Sears took the opportunity to examine the ecological aspects of the salt flat and strand vegetation, which he found intriguingly different from salt marsh plant communities along the Atlantic coast of the United States.

After the collecting had been completed and ecological notes recorded, Adcock moved the landing craft to one of his favorite skin-diving spots in a quiet cove a mile or so farther north. There, all who wished to attempt it observed marine life with face mask and snorkle. The water was beautifully clear, only slightly ruffled by a light breeze, and the opportunity to watch colorful tropical fish and myriads of invertebrates was a rare one. Among the animals seen were several groupers, a huge marine gar, beautiful gorgonias, purplish and bluish corals, hydrozoans, starfish, an amazing variety of shellfish, sea cucumbers, at least one small shark, and three medium-sized rays. Mrs. Adcock's brother, Victor, brought up two or three small pearl oysters, and Mrs. Adcock obtained one gorgeous cone shell, being careful to hold the animal so it could not reach her fingers with its venomous tooth. A good collection of marine invertebrates, including snails, bryozoans, sea urchins, starfish, and seaweeds was obtained.

As the forenoon advanced, the snorkling members of the party were more and more frequently stung by jellyfish so tiny that they could be seen only as points of light when one looked obliquely through the water. Their stings were not serious, but the cumulative effects finally discouraged even the more rugged divers, and Adcock headed the barge for La Paz, arriving at the dock at 1:55 P.M.

By 2:30 P.M., Dr. Sears was ready to look at the desert vegetation west of La Paz. He and Ira Wiggins drove westerly along the paved highway about 30 miles so Dr. Sears could see the sharp change that occurred at the crest of the low range of hills about 18 miles west of the city. The ground east of this crest received a good soaking during the rain accompanying the chubasco in September, whereas the more gently sloping terrain extending to the Pacific had almost no rainfall at that time. Apparently the up-rising air currents occasioned by the abrupt ascent of the escarpment forming the eastern face of the range had brought about precipitation of nearly all moisture in the masses of air moving ahead of the strong winds, and had heavily watered the area from the escarpment to the eastern side of the Cape. The winds blowing westerly beyond the escarpment carried little uncondensed moisture, so a very remarkable break in the limits of the rainfall allowed heavy growth of the annual and perennial vegetation on the La Paz plains and the adjacent steep slopes to the top of the ridge, but gave little

stimulus to the seeds and aestivating plants west of the crest. Only along a few of the canyons had there been some slight runoff, permitting growth of plants. East of the escarpment the *Bursera* and *Cyrtocarpa* trees were in full leaf and *Jatropha cinerea* was producing numerous flowers and fruits; west of this line, these trees were almost totally devoid of leaves and not a sign of flowers was to be found on the many shrubs of *Jatropha.*

OTHER CAPE REGION LOCALITIES

Following the departure of Dr. Sears on November 21, three days were devoted to drying specimens collected on the La Presa trip, making various arrangements with Mr. Adcock about a boat trip to Los Dolores early in December, and getting ready for a short trip in the "Travelall" to the vicinity of Balandra Bay to obtain, in addition to plant specimens, fossils from the coquina beds for Dr. Keen. Detailed notes covering the trip to Laguna Caquihui were written up, and the data on photographs carefully checked and organized. November 24 was unusual in that there was scarcely a vestige of breeze all day, so the water of the bay was mirrorlike and the gnats were viciously bothersome.

On Wednesday, November 24, Dorothy and Ira left the apartment in La Paz to get a representative collection of the fossil shells seen near Coyote Point by Dr. Keen and Allyn Smith. Little had been learned about the road beyond Pichilinque by talking with local taxi drivers, but the road was unexpectedly good and the beach just east of Punta San Lorenzo was reached early in the afternoon. Several pictures of the yellow morning-glory (*Merremia aurea*), and the bright red flowers of *Cochemia poselgeri,* of an unidentified *Echinocereus,* and other attractive plants were made en route.

Thanksgiving Day was a memorable one, for only the two botanists were on the entire stretch of beautiful beach extending three or four miles from Punta San Lorenzo to Punta Coyote. Two boats, one a turtle-fishing canoe and the other a service tug going to a buoy several miles off shore, passed during the forenoon, but no other craft was seen the whole day.

There are several caves well up the side of Punta San Lorenzo, two of which showed definite evidence of having been used extensively for shelter and had deep deposits of shells, ash, and fragments of partially burned wood covering their floors.

Jatropha palmeri, which possesses mean stinging hairs on the foliage and young twigs, and *Coulterella capitata* are both common on the point. Another botanical feature of more than usual interest is the presence of *Behria tenuiflora,* the red-flowered member of the lily family related to our common blue Brodiaeas of the California foothills and valleys, on the steep slopes of Punta San Lorenzo. Partially dried scraps of *Tradescantia* (a

member of the spiderwort family) were found along a small, dry waterway on the northeast slope of the point. There were insufficient materials available to make identification possible, but ripe capsules contained seeds that may grow, and furnish flowers with which determinations may be made later.

The beach east of Punta San Lorenzo is made up of myriads of tiny fragments of shells. Almost no sand of inorganic origin is present. Intermixed with the fragments are many fresh shells bearing slight evidence of the grinding and churning effects of breakers, so the area would be of great interest to malacologists. Moderately deep water around the rocky point itself might produce a wealth of living shells through skin-divers' activities, although favorable diving conditions might be found only during particularly mild weather.

The coquina beds there are extensive, and contain a remarkably rich fauna, probably of Pliocene age. About 60 pounds of material was obtained from randomly selected parts of the beds exposed along a small channel cut through the inner beach by outflow during the chubasco. This exposure had been wholly covered by sand before the storm. A few months hence it could again be covered, if heavy wave action is not offset by eroding streams from the playa extending inland a mile or more from the beach. Sand dunes, occupying a strip from a few yards to a quarter of a mile wide along much of this beach, present opportunities for botanists and herpetologists.

The distance from La Paz to Punta San Lorenzo is approximately 20 miles by road, and takes a little less than two hours to drive. The road is rough in spots, but can be negotiated by most stock cars if care is taken to avoid stumps, rocks partially hidden by weeds, and occasional abrupt gullies washed across the road since its construction. There was no evidence of appreciable traffic beyond Pichilinque, to which point trucks go regularly to load salt from the evaporating enclosures on the island. Apparently there had been only one other car at Punta San Lorenzo since the chubasco in September.

November 27 through 29 was devoted to a trip to Las Cruces, with many collecting stops en route. Ecological notes were made in more than usual detail, on a ridge 11.5 miles from La Paz near the fork where the road leading to Puerto Mejía diverges from the one to Las Cruces. The detailed work was done at that site because there is a striking contrast between the fairly heavy vegetational cover on the southeasterly side of the ridge as compared with that on its northwesterly face. These notes, together with others taken in various parts of the Cape Region, are planned to furnish material for a separate ecological paper on the area.

November 30 was spent packing the fossils for shipment to Dr. Keen, getting the food supplies for the boat trip to Los Dolores ready, and making final arrangements with Dick Adcock.

On the first of December collecting was done while making a loop from La Paz to the westerly margin of the valley in which Los Planes is located, thence southward along the road that connects with the main one from La Paz to El Triunfo, San Bartolo, and San José del Cabo, and back to La Paz. Comparatively few specimens were obtained but three different areas that appear to hold worth-while potentialities for future detailed investigation were spotted. One was a deep canyon in granitic hills east of La Huerta and lying south of the road, about 22 miles from La Paz. Another was a larger, broader canyon with a wide, sandy floor situated north of the main road and about a mile farther east, and the third region was the arroyo and adjacent hills near the village of Tescalama four miles from the old mining village of San Antonio. A series of well kept, small ranches lined this arroyo, with neat fields in which corn, beans, tomatoes, and other vegetables were grown. A few small patches of sugar cane were seen, and several orchards containing mango, banana, and date palms attested to the reliability of the water sources. Many fan palms had been planted along some of the irrigation ditches, and provided leaves with which to thatch the roofs of the local houses or for sale in La Paz. A feature of the native vegetation near Tescalama was the heavy predominance of the Palo Blanco (*Lysiloma candida*) on the hills above the cultivated fields. It formed relatively heavy stands, with no other accompanying trees attaining the height of the flat-topped Palo Blanco.

Boat Trip to Los Dolores

On December 3 two additional botanists, Miss Annetta Carter, Senior Herbarium Botanist at the University of California in Berkeley, and Mr. Wallace R. Ernst, an advanced graduate student in botany at Stanford University, arrived in La Paz to participate in a trip by boat to Los Dolores and to several peninsular and island localities. Dr. and Mrs. Krutch also joined the party in order to accumulate additional data toward a book on the general characteristics and natural history of Baja California.

Most of the gear and supplies for the four-day trip to Los Dolores was loaded aboard Adcock's boat during the afternoon, and everyone tried to get some rest between dinner and 11:30 P.M., the time set to drive to the dock for a midnight departure. *El Crepúsculo* sailed promptly at midnight, in an almost complete calm, and with a brilliant display of luminescence in the water churned by the propeller and the hull of the boat. Occasionally a flying fish broke water, when the beams of flashlights were swept across its surface, and could be followed in its soaring flight until it again plunged into the bay. There were almost no clouds, so the stars were sparklingly brilliant.

The cruise north was smooth and the beach at Los Dolores was reached at about 8:45 A.M., December 4. Search was made up and down the coast for a mile or more to find a steeply sloping beach providing water deep enough to permit beaching the LCP adjacent to a suitable camp site. Failing to locate a suitable landing other than the one directly in front of the ranch, Adcock returned there and put the gear ashore so the cooks could prepare a belated breakfast.

The remainder of the day was devoted to scouring the hills south of the ranch for collectible plants. The nonbotanical members of the party hiked inland about three or four miles to the tumbled rubble that constitutes the ruins of Misión de los Dolores. Collecting was unexpectedly good on the precipitous hillsides south of the ranch, and the botanists returned to camp barely in time for dinner with their folios crammed with an excellent representation of the native flora of the region.

Ants of two kinds made themselves unwelcome at the beach camp: large, black ones stung viciously, and each person stung nursed a large, smarting, red welt at the site of each sting for two or three days thereafter. The tiny ones, also black, showed a tremendous liking for cake frosting. The frosting was almost completely sacrificed to the ants, for the snowy whiteness of one cake was completely hidden by the thousands of minute, black bodies swarming over it.

Everyone was awakened at the crack of dawn by an ominous increase in the murmur of the low breakers, and a few minutes later Sr. Rodríguez, the owner of the ranch, arrived to say that a heavy wind was on its way. He insisted that gear must be stowed in the LCP as soon as possible or the breakers would be so high that it would be impossible to land the *El Crepúsculo* or take a small boat through the surf. Breakfast preparations were speeded to the utmost, but with all the haste mustered it was impossible to beach the landing craft. Gear, supplies, and passengers had to be transferred from beach to landing craft in a dugout canoe owned by Sr. Rodríguez and manned by him and two of his men.

Dick Adcock cruised south about 10 miles to a sheltered cove. The group landed, with the thought that a move to another cove a little farther south would be made if this one did not provide good collecting. However, collecting was good, and an added incentive to stay more than three or four hours was furnished when a propeller blade was bent when it fouled the anchor chain. Adcock had to work several hours, submerged and wearing an aqualung, to repair the damage. The field workers scoured the hillsides and canyons within a mile of the camp, again obtaining excellent representatives of the native flora hugging the steep slopes of the eastern escarpment. Ample collections of the rare endemic, *Sympetaleia tenella,* of which a single plant had been found in Arroyo de La Presa, were found in the

shade of a cliff having a large cave at its base, and many of the plants were growing inside the cave.

The wind was still blowing stiffly the morning of December 6 when *El Crepúsculo* left the cove to make the run across the channel to Isla San Jose. The crossing was uncomfortable until the boat hauled into the lea of island. A landing was made on a fine, sandy beach about a mile from the headquarters of the salt works, and collecting was good in a nearby arroyo. The botanists were kept so busy with the rich harvest that they delayed the planned departure by nearly an hour.

At 3:00 P.M. on December 6 *El Crepúsculo* left Isla San José and by four o'clock had coasted down the east side of Isla San Francisco. Waves in the cove facing the southeast were too high to permit landing, so Adcock rounded the southern end of the island and landed in a protected embayment opening toward the southwest. Plans had already been made to stay there overnight and spend most of the next day on Isla Espíritu Santo or Isla Partida, so the three botanists began collecting on the salt flat separating the two coves and on the adjacent steep, rocky slopes. They returned to the camp at dark, and after a hasty meal tucked all of the afternoon's take into presses.

Loading gear into the *El Crepúsculo* began before breakfast on the 7th, for Dick noted that the tide started running out shortly after daybreak. As it was, the craft settled on a rounded rock as the loading proceeded, and had to be rocked from side to side, with all hands in the water to their shoulders, to dislodge her. The delay was short, and by 8:20 A.M. the craft was headed for Isla Partida. A moderate sea was running in the open gulf but under the lea of a bird-covered rock just north of Isla Partida the waves were smaller, and flattened practically to a dead calm in a beautiful cove near the north end of the island.

A narrow canyon ran inland from this cove, and a variety of flowering plants was found. One of the most interesting plants there was a colony of *Fouquieria burragei,* which differs from *F. peninsularis* mainly in having pale cream, more widely flaring flowers and puberulent twigs. This species had not been reported previously from Isla Partida. A gnarled tree of *Forchammeria watsoni* grew from a slight cleft in the rocky wall of the canyon, about 200 yards from the beach. Miss Carter noticed faintly visible outlines of letters carved in its trunk. Closer scrutiny showed that, although the bark had completely overgrown the original cuts, the letters, arranged:

F. R.
1886
ENO 26.

were still legible. Unless someone had carved another person's initials and the date he had been at the spot, had died, or otherwise had done something

to warrant this humble type of commemoration, a person whose initials were "F. R." had carved them on the trunk of the *Forchammeria* tree on January 26, 1886! If the latter is the history of these initials, the tree had borne the marks of the visitor nearly 75 years. A photograph of the carving distinctly shows the letters and date.

There are evidences of still earlier occupancy on this part of Isla Partida in caves and on the steep slopes below them across the canyon from the *Forchammeria* tree. Several large caves occur under the volcanic caprock at elevations of 150 to 200 feet above the sea, and about a quarter of a mile from the shore. Several caves show smoke stains on the roofs; others have been breached by seeping water and by spalling of the roof and show little or no evidence of fires. On the floors of some caves and strewn down the slopes below them were tons of shells of oysters, clams, conches, and lesser marine molluscs. Fish bones were present in considerable numbers, but owing to their greater susceptibility to disintegration under exposure there were fewer of them than of the shells. Many of the shells were of a huge, heavily-shelled oyster, with a valve eight to ten inches in length and nearly as wide. No living oysters of such proportions were seen in the cove, and one wonders if these ancient shell heaps contain remains of an oyster no longer existing in the waters around Isla Partida. No artifacts of aboriginal character were found in or near the caves; only the heaps of shells.

In the canyon below the caves was a tinaja containing perhaps 200 gallons of fresh water contaminated slightly by green algae and water striders, but with no evidence of water snails in or around it. Fig trees of moderate size were present, too, and might have been a small source of edible fruit for the Indians who once lived here, or visited the place periodically to dive for the large oysters, clams, and conches with which they had littered the hillsides.

At least four different kinds of lizards were seen along the canyon and on the rocks at its mouth. Representatives of the genera *Sceloporus, Uta, Cnemodophorus,* as well as a larger lizard that resembled a chuckwalla, were seen, but only a large fence lizard (*Sceloporus*) and one specimen of *Uta* were collected.

The cruise down the west side of Isla Espíritu Santo and across the channel to La Paz was comfortable and interesting, for the late afternoon sun showed the many stratified layers of volcanic ash, lava flows, and basaltic caps to advantage, emphasizing the bright colors of the pink, greenish, and gray layers in contrast to the dull gray-black of the basalt. The sea was an indescribable blue, fairly calm, and constantly changing.