

and three daughters, together with eight grandchildren.

He had been in feeble health for the past two or three years, and suffered a broken hip from a fall, toward the end of February. He died on March 11, 1921, at his home in Chicago.

EDWIN B. FROST

YERKES OBSERVATORY,

THE CENTENNIAL EXPEDITION OF INDIANA UNIVERSITY TO PERU

BETWEEN June, 1918, and June, 1919, the Irwin Expedition of Indiana University as a part of its work collected the fishes in the highlands of Peru, particularly in the Urubamba valley from the headwaters at La Raya, elevation 14,150 feet, to Santa Ana, 3,000 feet. This work was done by Dr. C. H. Eigenmann and Miss Adele Eigenmann. Collections were made in the upper Huallaga basin between its headwaters about Cerro de Pasco and Goyllarisquisca down to near Tingo Maria, 1,800 feet, mostly by the present writer. Further collections were made from Lake Junin, 13,500 feet, near Cerro de Pasco, in the Mantaro basin to Huancayo, 10,500 feet, by myself and the Eigenmanns. Collections were also made from the headwaters of the Tarma River at Tarma, 10,000 feet, down to La Merced, about 2,500 feet, by the Eigenmanns. The Irwin Expedition thus collected in the headwaters of the Huallaga and Ucayali Rivers from their sources to the neighborhood of 2,000 feet above sea level.

In May of 1920 I started on the so-called Centennial Expedition of Indiana University to carry the survey of the fish fauna to the lower levels of the rivers of eastern Peru. The expedition was assisted by a grant from the Bache Fund of the National Academy of Sciences, and by the hearty cooperation of the Peruvian government, which provided free transportation and other assistance within Peru.

The writer traveled alone, so far as the English-speaking personnel of the expedition is concerned, depending solely upon local aid.

At times help was volunteered by interested individuals or solicited from the local authorities, civil and military. Three weeks of the initial portion of the trip (from the Perené to the Ucayali) were spent in company with Professor J. Chester Bradley and Dr. W. T. M. Forbes, of the Cornell Entomological Expedition.

The plan of the present expedition has been to collect as exhaustively as possible the fishes of a few suitable, representative localities in the basins of the above-named rivers, comprised for the most part within the great Department of Loreto. Entering by Lima, Tarma and La Merced, the writer began where the Irwin Expedition left off two years ago, and crossed to the head of navigation of the Pichis-Pachitea-Ucayali system by the Via Central. Ten days were required to traverse the final 200 kilometers of this atrocious trail. It is an endless succession of mudholes, yet the principal and almost sole means of communication between coastal Peru and her transandine provinces.

No real hardship is involved in making this journey, thanks to the series of government *tambos*, or shelter houses, at convenient distances, which cater very well to those who come well recommended. This is otherwise a region entirely devoid of inhabitants.

Ten days were spent at Puerto Bermudez. Two days by canoe brought the party to a point on the Pichis to which the steam mail launch could ascend. Thenceforward travel was chiefly by launches, mail and commercial, which abound in Loreto; the shorter trips into tributary streams and lakes were made in dugouts. A month was devoted to the vicinity of Contamana on the lower Ucayali, a fortnight to the Puinahua and Pacaya, and an equal period to the region of Iquitos. The markets of Iquitos are in season very well supplied with fresh fish of great variety. Another month was spent in cruising the upper Marañon from Iquitos to the Pongo de Manseriche, and the tributaries Tigre and Morona. A three-week sojourn in and about Yurimaguas allowed an examination of the lower Huallaga, the third of four great rivers

of Peruvian Amazonia. I had during the Irwin Expedition collected on the upper portion of this river.

These streams, the Ucayali, Marañon, and Huallaga, are comparable in size to the Ohio at flood stage. All arise in the Andes and form a vast confluent flood plain parallel to the mountains, and 500-600 miles in extent. Though 2,000-2,500 miles from the mouth of the Amazon, this plain is only 400 feet above sea level. In all this stretch there is very little topographic relief. The annual fluctuation in level of the Amazon at Iquitos is 40 feet. The annual inundation therefore extends far inland from the rivers. Large numbers of cut-off lakes (*cochas*) with their connecting *cañas* form a network throughout the system, which becomes one body of water with the coming of winter rains. Most of them are dead-water bayous of varying dimensions. There are almost no brooks—all depressions (*quebradas*) only serving to receive the back-water of the rivers. The smaller tributary rivers vary greatly in their flow at all seasons, fluctuating both with the local rainfall and with the level of the outlet. A stream flowing very rapidly now may display almost no current within a few hours, or vice versa.

The extent of the navigable portion of the streams in Peru is much greater than in most Brazilian streams. Many of the latter are interrupted not far from their mouths by impassible rapids. The Brazilian river basins are sharply separated from each other by chains of hills. To the Loretan the slightest rise is a *cerro*—mountain. Any stretch of terrain not inundated is an *altura*. Every riffle is a *pongo*—rapid. Within the past few years even the redoubtable Pongo de Manseriche, by which the Marañon breaks through its last chain of the Andes, has been passed by no fewer than five steam launches. It has always been risked by raft and canoe.

The above conditions allow many species of fish from the lower Amazon to become distributed to the very foot of the Andes, and throughout oriental Peru. One finds many fishes extending from one extremity of Loreto to the other.

With the annual subsidence of the water there is of course everywhere a local sorting of species according to preferred habitat. Thus in a given stream one may not obtain more than two, three, or half a dozen species at the same time. Rarely are more than this number brought up in a single haul of a seine. (Bates called attention to this fact seventy years ago.) The *cochas* usually produce more species, but spaced pretty well apart. To get them all one must draw the seine many times in various parts of the lake. The common fish that one is obliged to reject may surfeit even one's native helpers. There is a pretty rigid assorting of fishes into river and lake forms, despite the fluvial origin of the lakes, and despite the inundations.

The great diversity of arboreal animals on the land is paralleled in the water by the large number of families of fishes and of aquatic mammals represented. The region is yet virtually tourist-free. One may journey by steamers and launches without seeing much of the teeming life of forest and river, or of primitive human life. Only in the tributary streams, traveling by canoe, does one encounter them. Here the dolphin, manatee, otter, alligator, capybara, tapir, etc., still abound, and one comes surprisingly near seeing all the animals which he had hoped to encounter.

The year 1920 was remarkable for its unusual rainfall. Not only was the curve for the depth of the Amazon at Iquitos higher throughout April and May than for many years, but also throughout the dry season. The lowest stage reached was some seven feet higher than the mean minimum depth.

The exceptional inundation of April and May had destroyed much of the crops. There was a serious shortage of all staples (plantains, beans, yucca, rice, etc.) and considerable hardship among the improvident. At no time were the sand bars of the Marañon or Amazon exposed. This of course affected the fishing industry. Seining was made much more difficult, while throw-net fishing was probably increased, due to the concentration of the *mijanos*, schools of shore fish. Much

of the time the fish had taken to the *monte*, or thicket, when the overflow of *cocha* and *quebrada* reached into the forest. While the fish are in the woods, the Loretan abandons his diet of fresh fish, and resorts to his supply of the dried.

Certain fishes are very abundant. But there is an increasing scarcity of others. The famed *pirarucú* (*paiche* of Peru) has undoubtedly been exterminated from certain regions. In the Chanchomayo dynamiting has greatly reduced the river fishes. The government has now found it possible to prevent the sale of dynamite to the poor thereabout, but has found no way of curbing the practise of dynamiting on the part of the wealthy and influential. Poisoning streams wholesale by means of the crushed root of the native poison plant *cube* is prohibited by law. But this method continues to prevail wherever *cube* is available, notably in the tributaries of the Huallaga, the smaller of which are nearly depopulated of fish.

Some birds are also rapidly becoming scarce, especially the egrets, whose plumes are marketed. Two brothers Hoyle of Contamana have secured recently a government monopoly of the plume trade of the Ucayali. They are bound by its terms to develop the fisheries of the Ucayali, first as a means of rearing fish to feed the egrets, and secondarily for the sake of restocking the streams. How to enforce respect of their charter, and how to develop a fisheries industry from nothing, without experience, are two large problems confronting the concessionaires. They do not seem to regard it a difficult matter to secure a revocation of the American law forbidding the importation of egret to this country.

Seventy years ago Bates predicted the rapid extinction of the turtles of the Amazon. In spite of an enormous consumption of turtles and eggs that has continued from that day to this, they are still very abundant. Petroleum has replaced turtle oil since that time, but turtle eggs, meat, and viscera continue to be favorite articles of food.

An effort was made by the expedition to confirm the widespread urinophilous reputa-

tion of the *candirú* (*carnero* of Peru). A Briggs' lead-in trap properly baited was frequently placed in rivers in the hope that it might demonstrate such a tropism. This was never successful. Nor did careful inquiry ever lead to the finding of an authentic case of parasitism of man by this fish. That it is strongly tropic to flesh or blood has been demonstrated.

Politically and economically eastern Peru is in an unpromising state. Its isolation from maritime Peru leads to prohibitive transportation costs in that direction. Thus all the business of the region is thrown to the Amazon. The shipping companies of the Amazon and the commercial houses of Iquitos control the economic life of the country. The country is still so new as to be in its period of destructive exploitation, and by reason of its remoteness can not compete in the world markets on any other basis. Due to the low post-war price of cotton, the people are turning from agriculture to the more or less forlorn hope of developing gold and petroleum.

The *Oriente* of Peru was not found by the writer to be, as we are encouraged to believe, wholly a land of dismal forests, swamps, noxious animals, and fevers. All these elements are present in quantity, certainly, but by no means universally distributed. Only once have I seen a large boa, and very few small snakes. Mr. Mitchell of Yurimaguas states that he has seen but four boas in twenty years' residence in Amazonia. Some rivers, *e.g.*, the Pacaya, are full of alligators, but many rivers have almost none. Only one region visited, that of the upper Marañon, was badly infested with fever. Insect pests were numerous, and of many sorts, but not so intolerable as often represented by travelers.

The realization of Humboldt's dream does not seem imminent. Such difficulties as those of transportation, climate, inundation, and an untaught, unambitious population, must be overcome before Peruvian Amazonia shall come to her own.

WILLIAM RAY ALLEN