Preliminary Report :

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University of Liverpool

PERUVIAN ANDES EXPEDITION 1977

UNIVERSITY OF LIVERPOOL

PERUVIAN ANDES EXPEDITION, 1977.

Preliminary Report
as submitted to the Mount Everest Foundation,
November 1977.

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I. AN EXPEDITION IS BORN - THE PLANNING STAGE

The idea for the University of Liverpool 1977 Peruvian Expedition first came into being in a pub in early October, 1976. A small group of second year geology students started to investigate the possibility of undertaking their undergraduate mapping theses in Peru, together with two final year students who were anxious to organise a geological expedition that summer. W. S. Pitcher, professor of geology at Liverpool University, has been running a project in Peru for the last fifteen years, and thus Peru seemed an obvious, if somewhat ambitious, choice.

Previous university expeditions have usually headed towards Asia and Africa where access is easier and expensive ocean crossings are minimal. It was the high level of expense, together with the uncertainty as to whether the expedition would get off the ground, that led the original second year members of the team to drop out and settle for more secure mapping projects in England. This led to a reorganisation of the team and a further third year geologist and an interpreter were eventually selected.

Our interpreter, from the department of Hispanic Studies, planned to study the effects of the Indian language, Quechua, on Castilian in the Peruvian Andes. Our final number was to be four, three geologists and a linguist, studying two consecutive projects.

The original team was:-

Tim Jefferson, B.Sc. (Hons.) Geology - leader, special interests: palaeontology and sedimentology.

Chris Lynas, B.Sc. (Hons.) Geology - special interests: structural geology and volcanology.

Barry Henry - interpreter, Quechua/Castilian studies. Second year Hispanic Studies.

Dave Gladwell - second year geologist.

Andy Hishton - second year geologist.

Paul Jordan - second year geologist.

Chris Toop - second year geologist.

The final team was:-

Tim Jefferson

Chris Lynas

Nick Sinclair, B.Sc. (Hons.) Geology - special interests: palaeontology and sedimentology.

Barry Henry.

For an expedition of this scale to have a chance of success it is essential to approach the relevant sponsors immediately a project is agreed upon. We approached companies producing dehydrated, tinned and packeted foodstuffs and other basic dietary requisites; also suppliers of camping and technical equipment. For financial aid we approached various banks, educational foundations and other public and private trusts. Air and steamship companies were approached for free or reduced passages and freight carriage to Peru. At the same time it was decided to write to some famous British personalities associated with exploration and science to ask for their

patronage in the hope that their moral backing would act as an inducement to would-be sponsors. We are extremely grateful to the following for kindly lending their names, and for their helpful advice:-

Prof. W. S. Pitcher

Prof. C. T. Smith

Prof. G. W. Ribbans

Dr. David Bellamy

Dr. Cuchlaine King

Prof. R. Shackleton

The aims of the expedition were a) to map geologically the acid volcanic extrusive rocks of the Peruvian coastal batholith in the Nazca and Cordoba region of Central Peru, working in conjunction with W. S. Pitcher's Liverpool team, b) to study the various impacts of the Quechuan language on Peru's Spanish tongue, Castilian, in villages of the Nazca and Cordoba region, and c) to undertake an exploration of archaeological and historical sites.

Elaborate pieces of equipment were considered unnecessary for the purposes of the geological project. Each of us took a compass clinometer, notebooks and a selection of mapping pens and coloured pencils. Geological hammers were included with the food and medical supplies, which were packed into two sturdy crates for shipment.

As the departure date neared, the expedition suffered an unforeseen set-back. We had originally been offered two sea passages to Lima, but a few days before university final

examinations this arrangement was cancelled. Fortunately, another Liverpool shipping company had offered us two passages for Baranquilla on the Colombian coast, but their ship did not leave England until July 9.

Despite the fact that we had missed all the booking deadlines for cheap charter flights, we managed to find two relatively cheap air passages, but the consequent delays and further expense sadly forced Barry Henry, our interpreter, to drop out, so Nick flew alone from Dublin to Lima on July 8, enabling him to liaise with the Peruvian authorities and to notify the British Embassy of our exact plans.

Having obtained letters of introduction, and permission for customs duties on our supplies to be waived, from the Ministry of Sports and Education, Nick met up with Prof. Pitcher's team and left Lima for the field, for instruction and for a preliminary survey of the coastal batholith.

Further delays were experienced by Chris and Tim during the voyage to Baranquilla. After a calm and relaxing trans-Atlantic crossing, the M. V. "Inventor" was held up at anchor for two weeks at the small Venezuelan port of El Guamache on the Isla de Margarita, a tax haven for the Venezuelan rich. Whilst there, Chris and Tim tried to reach the summits of an impressive range of mountains on the west side of the island. This attempt was defeated by the intense tropical heat and humidity. Stiff walking, with back-packs, through the cactus and scrub of the island's semi-desert, beneath a fierce sun, proved extremely tiring and after two days they returned to

the "Inventor", suffering from heat exhaustion and mild sunstroke.

Arriving in Baranquilla, on the northern coast of Colombia, the two made their way as quickly as possible to Lima. Using buses of very variable quality and on roads of the same, they travelled south up the valley of the Magdalena, and gradually up into the difficult and rugged terrain of the tropical Andes. In Ecuador the scenery changed as it became drier, and the ubiquitous eucalyptus trees that are characteristic of the dry Andes replaced the banana groves. After resting for two days in Quito, Ecuador's mountain capital, they pressed on into Peru, where, descending to the coast road the scenery changed again to the spectacular cloud-covered sandy desert which stretches south along the coast into Chile.

Arriving in Lima on August 10, it was discovered that Nick had left for the field with Prof. Pitcher's team and would be back a week later. With time in hand, Chris and Tim took the train to Huancayo at 3,231 m. to spend four days acclimatising to the altitude by stiff hill climbing, in preparation for our work, and in the process discovering, in a large gully, a spectacular group of earth pillars.

Meeting Nick back in Lima on August 17, we attempted to collect our supplies from the customs authorities at Callao, Lima's port. Though we had written to inform the customs office at Callao of the scientific nature of our expedition and Nick has submitted all the other documents requested in order to waive customs duty, we were nevertheless required to

pay a customs agent's fee of £100! Since the supplies were already four weeks late, and the time we could spend in the field was reduced, we were forced by our tight budget to abandon them at the dockside and live from food that we were able to buy locally.

Mick Sanderson, a research geochemist at Liverpool, working in Peru, joined the expedition for the first part of our field work, bringing our numbers up to four. After considerable discussion, we decided to transfer our intended project from Nazca to the Huarochiri district of the upper Lurin valley, 90 km. from Lima. This, it was decided, would enable us to make a much more significant contribution to the understanding of the evolution of the Andes, and would involve less time-consuming preparation. At an altitude of 3000 - 4000 m. we worked on rocks of a similar type and age to those at Nazca.

2. THE MYSTERY OF THE CALIPUY IS UNFOLDED : THE GEOLOGY PROJECT

Our object was to draw up as many stratigraphic sections as possible of the acid volcanic rocks in the Huarochiri district of the Lurin valley. This is detailed work which has not been attempted before, and it is hoped that radiometric dating techniques, of fundamental importance for absolute dating of rocks, can now be used with reference to our new stratigraphies. In total, three major stratigraphies, which can be correlated to a certain extent, were completed, involving nine detailed traverses of mountain slopes and dry stream beds, and several minor traverses.

The Peruvian coastal batholith was intruded into sediments and acid volcanics of Casma (Cretaceous) age, and today forms the backbone of the Andes. Over the batholith, and during its intrusion, the acid volcanic rocks of Calipuy (Tertiary) age were extruded. These volcanics are from 40 - 100 million years old and it was with these that we were mainly concerned. These Calipuy volcanics are characteristic deposits of violent eruptions. Deposition was either from great ash clouds covering a vast area, or from ignimbrites, white-hot avalanches of expanding gases and molten lava ejected from a vent. The deposits of both types of eruption are generally known as tuffs.

The first and lowest series of sections were made around the village of Santo Domingo de los Olleros, an area only accessible by Land Rover or mule. The sections were exposed in huge cliffs where the first tuffaceous ignimbrite flows and

ash units rest directly on the granodiorite of the batholith. These can be traced upwards, culminating in a complex series of volcanic mudflows (lahars) at the highest point.

The second series of sections were taken through a tufficite dyke complex cutting rocks of Casma age in a seasonal mountain stream, the Rio Seco. It is thought that this feature may have been a feeder pipe for the Calipuy volcanics.

The third series of sections were made at the village of Langa near the head of the Rio Lurin. Here, more tuffs of Calipuy age are exposed, together with an important and unique series of fluvial/lacustrine sediments.

Compiling stratigraphies of the tuffs was a difficult problem. Due to the limited lateral extent of some of the tuff sheets, around a volcano for example, a major unit in one area may be insignificant or absent in another. This effect is heightened because the ancient Andean topography exerted an influence which resulted in preferential deposition of the volcanic ashes in the valleys. This is particularly true for ignimbrite flows which are channelled into valleys. Within the Calipuy tuffs, a thin but important series of mudstones and sandstones, derived from volcanic ash, marks a period of volcanic inactivity in the Langa area. These sediments have been carefully logged and contain certain diagnostic features such as rainpits, desiccation cracks in mud layers, abundant amounts of gypsum and pseudomorphs of halite (salt) crystals. It is hoped that we will be able to determine the exact age of these sediments from collected samples using

palynological (fossil spore analysis) techniques.

In addition, many of the ignimbrite flows of the uppermost part of our measured succession have bases clearly indicative that they were introduced into water. We therefore postulate the existence of a lake basin or series of basins which developed as the Andes evolved. Periodically, vast amounts of sediment, rapidly eroded from the uplifted mountains, accumulated in these lake basins which became shallower and at times dried out. Renewed tectonic activity triggered further phases of volcanism, the ashes of which filled the shallowing lakes.

The full results of our geological findings will be submitted later to a scientific journal with a view to publication.

3. ON THE INCA TRAIL

The final part of the expedition consisted of visits to some selected sites of major geological and archaeological interest in Peru. The first stage, from Lima to Cuzco, the capital and religious centre of the Inca, a journey of some 600 km., involved crossing the Andes between Nazca and Abancay. Travel in an open-topped lorry, through blizzards and sub-zero temperatures, over passes above 4500 m., is far from luxurious but had its compensations, with the spectacular descent into the Apurimac Valley and its Inca suspension bridge. After 48 hours of almost continuous travelling Cuzco was reached. Rich in fine architecture, both Incaic and colonial, it is a centre for some of the most important and spectacular archaeological remains in America. The hilltop fort of Sacsayhuaman is constructed from enormous blocks of granite, (the greatest of which is some 360 tons in weight), cut with incredible precision to fit neighbouring stone. It overlooks the city of Cuzco, "the Navel of the World". The fortress contains a magnificent throne above a central parade ground, from which the omnipotent Inca reviewed his troops. Close by, the Temple of Fountains and other outlying fortresses provide fascinating clues to other facets of the Inca culture. Religious belief was centred around the Sun, and their creator god, Ilya-Ticsi Viracocha Pacayacacic, and at Qenco, a hill in the valley of Cuzco, huge stone monoliths were incorporated into their worship. Seven kilometres from Cuzco is Tambo Machay, a fountain fed by an underground channel which is thought to be

an Inca bathing place. Outlying fortresses, like Puca Pucura, are a continual reminder that the Incas had not assimilated all the tribes of the Andes and Amazonas regions during the seventy-five years of expansion between the time of the Inca conqueror, Yupanqui (1438-1471), and Pizarro's conquest in the 1530's.

Situated in the valley of the mighty Urubamba - Land of the Urus - are the other important remains of Pisac, Ollantaytambo, and Machu Picchu, 32 km., 68 km. and 110 km. respectively from Cuzco. Above the village of Pisac (3000 m.) are three extensive complexes of patas (agricultural terraces), overlooked by formidable fortifications, one of which is cut back into the steep mountainside. The settlement, contained in the topmost defences, commands a superb view of the Urubamba Valley, and from here enemies could be spotted several hours before they arrived. The precision and preservation of the fine mortarless stonework which characterises Inca masonry, is among the best in Peru.

The defences at Ollantaytambo ("The Lodging Place of Ollantay", a character in a favourite Inca play) at 2750 m., are built across a narrow gorge of the Urubamba river. Built as a defence from the Antis Indians (so called by the Incas because their rain forests lay in the eastern quarter of the empire, the Antisuyo), a handful of Inca soldiers could have repelled prolonged attacks, from this impregnable position. The main fort typically incorporates agricultural terraces and six enormous blocks of red porphyry cut to fit precisely

together, and weighing over fifty tons each. These giants were cut from rock on the other side of the valley; how they were brought to Ollantaytambo remains a mystery to this day, for the Incas never discovered the wheel.

On July 24, 1911, Hiram Bingham, the American explorer, discovered the now famous Inca city of Machu Picchu. Situated on a narrow ridge 400 m. above the raging torrent of the Urubamba river in its gorge, which surrounds the city on three sides, this mysterious city which evaded Spanish attention for over three hundred and fifty years is a breathtaking vision of Incaic ingenuity. The almost intact city is dominated at one end of the ridge by the sugarloaf mountain of Huayna Picchu, the "Young Mountain", which is often shrouded by the grey mists characteristic of the tropical jungle.

The Temple of the Sun dominates the city from a central hill, according to its religious significance, and houses the Intihuatana, the "Stone to which the Sun is Tied", cut from the living rock. Beneath and subordinate to it are three other shrines, which suggests that Machu Picchu had a purely religious function. Of one hundred and thirty five skeletons discovered here, three quarters of these were identified as female, and it has been suggested that the city was the haven of the sacred Virgins of the Sun. But its dominating position, invisible to an observer in the Urubamba gorge; the presence of impregnable guard posts, and drawbridges on roads traversing sheer cliff walls, suggest a coexistent military function.

The residential part of the city was rigorously divided

according to rank, the industrial, intellectual, agricultural and gaol sectors occupying distinct districts. The royal quarters comprise some of the city's finest architecture, the centre-piece being a round tower beneath which a complex chamber has been hewn out of the granite.

It is interesting to point out that along with the wheel, the Incas, together with all other pre-Hispanic cultures, did not discover the concept of the arch nor of writing. The lack of the arch and keystone was not a serious set-back, however; being such magnificent builders, Inca masons sloped the sides of doorways and niches inwards to reduce the weight on the lintels. The resulting trapezoidal forms are a hallmark of Inca architecture.

The peak of Huayna Picchu is reached after a strenuous climb up a track which crosses the steepest face. The peak is riddled with an intricate system of tunnels and lookout posts. Just below these is a small but remarkably inaccessible terraced garden which may have had some religious significance. The mountain commands a complete panorama of the city, the Urubamba gorge, and the surrounding peaks of the Urubamba and Vilcabamba cordilleras which are over 6000 m.

From Cuzco, the road south-east along the Upper Urubamba reaches 4300 m. before dropping down to the Collao district of the Titicaca plain. The purpose of this trip was to explore the floating reed islands of the Uru Indians on Lake Titicaca and to visit the island of Taquile. Lake Titicaca, at 3812 m., is the highest navigable lake in the world, its maximum depth

being 230 m., and its size 15 times that of Lake Geneva. The last of the Urus or Kot-suns, the lake people, died in 1955, but their descendants, a mixture of Uru and Aymara continue to live on their raft-islands. Their traditional self-sufficiency is based on the use of the hollow totora reed which is used for constructing their famous reed boats and houses, and in maintaining the islands. The rearing of a handful of fowls and pigs supplements a mainly fish diet. The making and selling of souvenirs to tourists, and gradual westernisation, is increasing the external influences on their way of life, and possibly even threatens their continued unique existence.

The twelve hour overnight journey, by sailing boat, to the island of Taquile was a refreshing change from the cramped buses and uncomfortable trucks. The whole of this small rocky island has been terraced since the people of the Tiahuanaco culture of pre-Inca times began cultivating it. Taquile is one of the few totally self-sufficient areas still remaining in the Andes. The Incas built here a gaol, admirably sited on top of the island, when it was a penal colony. From here across the lake, in modern Bolivia, can be seen the sacred Island of the Sun, behind which, in the distance, tower some of the highest mountains in the American continent. On this island, according to Inca legend, the Sun God created the first Inca, Capac, who founded the city of Cuzco.

From Puno and Lake Titicaca, the Trans-Andean Railway leads westwards towards Arequipa, founded by the Spanish in 1540, lying in the most recently active volcanic area. Over-

looking the city are the three impressive volcanic cones of Chanchani (6075 m.), Pichu Pichu (5500 m.), and Misti (5835 m.). The visit to Arequipa was for the purpose of climbing and exploring the crater of the classical cinder cone of Misti, the Pointed Summit. It was decided to set off from the Aguada Blanca Dam, at 3200 m. on 25 September. The going was tough all the way because of the unconsolidated nature of the ash and other volcanic ejecta which littered the steep flanks of the cone, which in places approached a slope of 50°. A bivouac site was selected behind a low wall at about 4800 m. Situated above a rock rib of andesite, this was the only shelter against the ferocious winds, and as the sun set temperatures quickly fell below freezing. The last 1000 m. to the summit crater was the most strenuous part of the climb. Reasonable progress over the loose sandy surface at this altitude meant taking long lateral zig-zag traverses. Any forward progress required complete concentration and co-ordination of breath with step due to the rarified air. At last, looking out from the snow-covered crater rim, the 6000 m. peaks of the southern Peruvian Andes could be seen stretching away to the northern and eastern horizons beyond the majestic snow-capped volcanoes above Arequipa. Far below, to the south and west, lay the arid plateaux and low hills and valleys of the mountain desert, punctuated in places by small patches of green, which marked the sites of oases. The main crater overlooks the Aguada Blanca dam, and in a more recent crater of blocky ash and sand, whisps of smoke rose from sulphur-stained mounds testifying

that Misti may only be dormant.

From Arequipa, the journey continued northwards by bus through Lima to the Callejon de Huaylas. This valley lies between the two ranges of the Cordillera Negra (5200 m.) and the spectacular Cordillera Blanca (over 6000 m.) (The Cordilleras are so named because one is below and the other above the snowline.) The Cordillera Blanca is the remnant of a high Tertiary granodioritic pluton of the coastal batholith, stretching 180 km. to the north-east and south-west, and rising to 6768 m., culminating in the magnificent but treacherous peak of Huascaran, the second highest mountain in America. The collapse of a huge hanging glacier on the sheer south-west face during the disastrous 1970 earthquake tragically buried the town of Yungay and all of its 10,000 inhabitants under a flow of mud and debris, 10 m. thick. Because of its high altitude and inaccessibility, very little detailed geological investigation has been completed in the Cordillera Blanca, and it represents something of a gap in the understanding of the evolution of the Peruvian Andes.

Two days were spent investigating the hills, valleys, gorges and small lakes immediately beneath the towering slopes of Huascaran and its twin-peaked neighbour, Huandoy (6356 m.) Another open lorry journey ensued, bouncing and jolting for seven hours across the Cordillera Negra and down to the coast at Casma; once more the "gringos" providing a source of good-natured amusement for the Indians. The final five and a half hour journey lay through the barren coastal desert,

characterized by enormous sand dunes that encroach from the Pacific, with occasional green oases at river mouths. Thus this last journey to Lima ended late in the evening of October 2.

In view of the time that would be taken by a return sea passage to England and various commitments at home, the party of three all flew back from Lima. We were therefore unable to take advantage of the very generous offer of working passages for two members of the expedition by the Pacific Steam Navigation Co.

So it was with some considerable sadness that we left the heat of South America for the cool drizzle of England. We had had a brief glimpse of the fascinating possibilities and prospects that Peru has to offer, which left us all with a very real determination to return in the not so distant future, in particular to the geologically little known Cordillera Blanca, with specialized climbing equipment.

Tim Jefferson
Chris Lynas
Nick Sinclair

Cambridge, November 1977.

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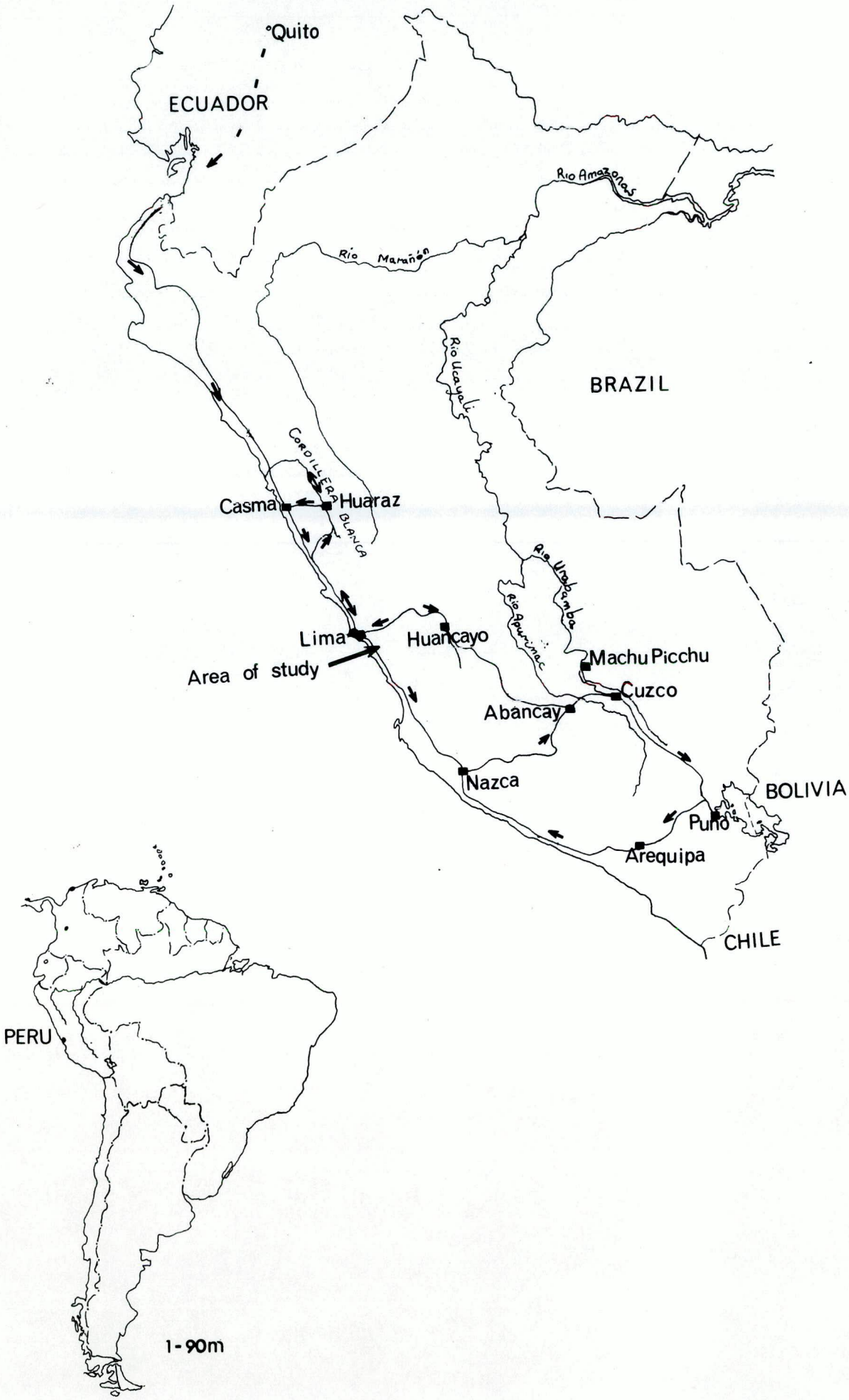
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