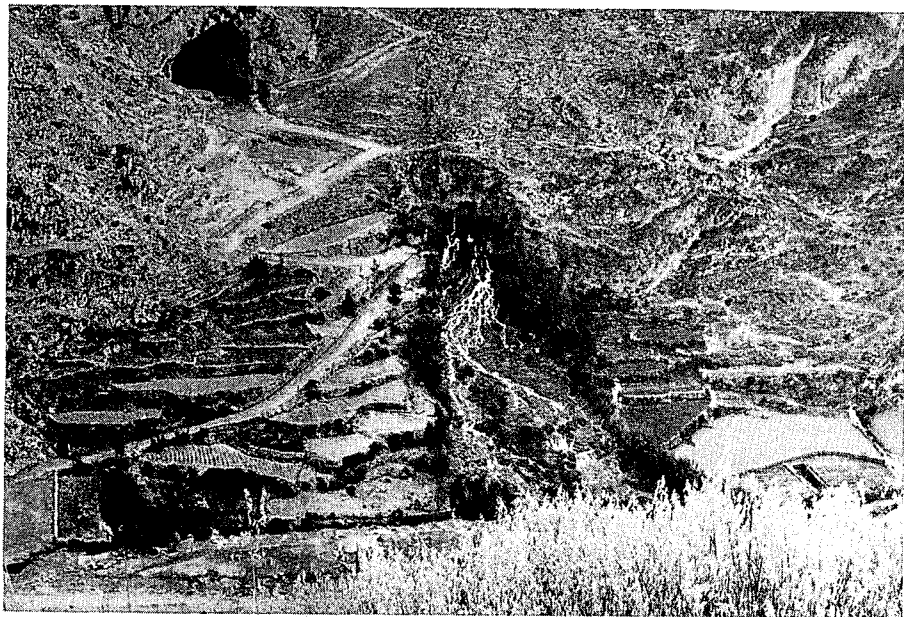


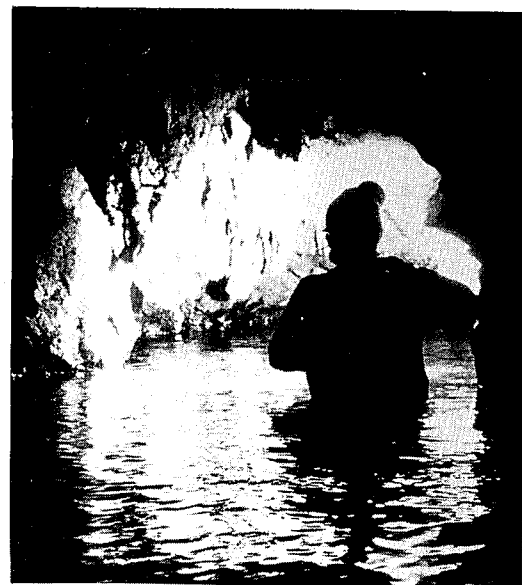
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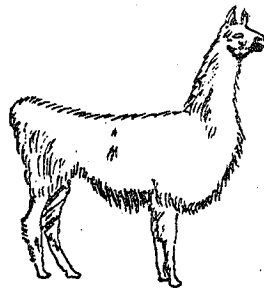
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**SOUTHAMPTON UNIVERSITY
EXPLORATION SOCIETY
PERU EXPEDITION**

July and August 1982



Patron: Professor J B L Howell BSc MB BS PhD FRCP; Dean of the Southampton University Medical School.

Expedition approved by the Scientific Exploration Society.

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Credit for photographs, authorship of text, etc. is indicated by initials
which refer to the expedition members listed on page 1.3. NH did the
translation into Spanish and Joseph Wilson drew the llama.

Enquiries about the expedition or requests for further copies of this report
should be addressed to Jane Wilson, 6 Sparrow Farm Road, Stoneleigh, Epsom,
Surrey, KT17 2JL, U.K.

"Courage is the price that life extracts for granting peace
The Soul that knows it not knows no release
From little things
Knows not the livid loneliness of fear
Nor mountain heights where bitter joy can hear
The sound of wings."

Amelia Earhart

FRONT COVER : Looking out from the Dry Entrance to the Cueva de Huagapo to the
sheer limestone of the opposite valley wall. This, probably the longest cave
system in South America, is 3572m (11716 ft) above sea level near Palcamayo.
Note Mandy for scale and the dangling vegetation where humming birds can
often be seen flying. (JMW)

INSIDE THE FRONT COVER :

1. The path snakes up through the terraces from the footbridge to the dry
entrance La Cueva del Huagapo. The resurgence water from the cave flows
into the Rio Shaca. (AD)
2. Inside Huagapo - one of the deeper sections (JMW)
3. The expedition members : Standing : Ian, Dave, Alison, Mandy, Julian,
Tony; Kneeling : Steve, Dermot, Jane, Mary, Nicky (JMW)
4. Folk dancers. The lady on the left wears the "Paddington" felt hat and
colourful manta. On the right the man has a profile reminiscent of
the Easter Island statues (JMW)
5. The deserted Desempadros Station in Lima (JCP)

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THOSE WHO PARTICIPATED

Alison DENHAM (22) Currently seeking her niche in life after graduating in Modern European and American History. Spanish speaker; kibbutzed in Israel and hitched in Europe extensively. Wished the expedition had involved some sub-aqua diving. Narrow range of disinterests.

Steven J. GONTAREK (18) Completed first year Geophysics. Experienced cyclist, camper and hillwalker in Scottish Highlands. Enjoys eating.

Nicki HALLIDAY (20) About to enter her final year of Spanish with Portuguese. Particular interest in dialects. Survived well on the expedition despite lack of home comforts. Dislikes: sordid lavatories.

David KAY (21) B.Sc. Accounting and Economics 1982. Resident in Argentina (2 years) and Brazil (3 years); Spanish speaker. Sailed round Britain 1980. Climber, caver. Left expedition to join a London chartered accounting firm. Expedition TREASURER.

Dermot MARTIN (28) B.Sc. Chemistry from Southampton 1975, now a reporter on the Southern Evening Echo. London marathon runner. Likes football and chatting to people, especially attractive Peruvian women. Decided to come on the expedition because he couldn't get to the Falklands.

Mandy PATTON (21) Just entering the third year of Physiology and Biochemistry with Nutrition degree course. Dislikes: writing biographies.

Julian Payne (22) B.Sc. Electrical Engineering 1981. Currently employed by British Rail. Enjoys climbing, caving, photography and most sports. Dislikes: Pisco Caliente; ASLEF.

Ian STRONGE (27) Electronics undergraduate with particular loathing for computers (formed during previous career as technical author). Likes: All printed matter, quiet landscape, markets. Skills: None (anyone can go on an expedition) Ambitions: Getting the garden under control. Contributing to Third World development.

Tony White (33) MB ChB Liverpool 1975. Sailor with extensive (including Transatlantic) experience. East African travels (3 months) with Kilimanjaro ascent. Ornithological interest. Concern with excess of beer in the world. Registrar in Psychiatry at Southampton.

Jane WILSON (28) Ecology graduate (biospeleology project); research on transmission of protozoal disease (M.Sc. Oxon 1979); malaria research project (1980); taxonomy of collembola (Paris 1978); 1976 Himalayan speleological expedition (Churchill Fellow), 1981 Madagascar expedition. Cave Rescue Warden (Devon 1973-5), some cave diving. Presently studying medicine (Foulkes Fellow) with ideas of practicing in the tropics. A big fan of 'Fungus the Bogeyman'. Expedition LEADER.

Mary WILSON (21) A year's microbiology laboratory work at Sussex University and also at the London School of Hygiene and Tropical Medicine. Medical Officer to the 1981 Madagascar Expedition (Churchill Fellow). Presently studying medicine with ambition to work in the Third World and then settle in a quiet country practice. Likes: All sports, especially karate. Speaks French. Expedition MEDICAL OFFICER.

Drs. Paul BROWN and John RYAN participated in the Acute Mountain Sickness trials while they were in Peru in July but they did not join the expedition proper.

LA EXPEDICIÓN PERUANA DE LA SOCIEDAD DE EXPLORACIÓN DE LA UNIVERSIDAD
DE SOUTHAMPTON. Julio y agosto 1982.

Viajaron once estudiantes de Southampton, Reino Unido, a la Perú para hacer una variedad de proyectos pesquios en dos regiones de piedra caliza. Se describen los resultados, detalladamente en el informe de la expedición, y los aspectos más destacados se muestran abajo.

5.

LA ESPELEOLOGÍA EN PALCAMAYO. Durante el mes que pasamos acampados a la altura de 3500m, 4 kilometros de Palcamayo, exploramos 3 sistemas principales de cuevas y levantamos un plano de la Gruta de Pacuy Huagen en el distrito de San Pedro de Cajas. Estas cuevas contenían pocos animales, probablemente por el frío perpetual de esta altura.

6. MURCIÉLAGOS Y SUS PARÁSITOS. Cogemos una selección de murciélagos de una diversidad de familias para que los identificásemos y hiciésemos un estudio de su carga de parásitos. Se hizo una colección de ectoparásitos que fueron identificados más tarde en Inglaterra y se tomaron muestras de sangre para establecer si algunos de los murciélagos dela área de Tingo María estaban infectados con hemoprotozoa. Los murciélagos de Tingo María no fueron implicados como depósitos de Trypanosoma y Leishmania.

7. LA ECOLOGÍA DEL GUÁCHARO. Esta sección describe y hace algunas observaciones sobre el Guácharo (Steatonic caripensis) que habita las cuevas en la zona de Tingo María. Hicimos una colección del suelo bajo los nidos de semillas que habían regurgitado los pájaros y las identificamos para establecer que especie comen. Estos comprendían principalmente semillas de palmas pero también había frutas del Laurelaceae y Tiliaceae.

8. LA ESPELEOLOGÍA Y LA BIOLOGÍA DE CUEVAS EN TINGO MARÍA. Durante solamente los 10 días que pasamos acampados 6kms de Tingo María, exploramos 6 sistemas de cuevas, incluso uno en que tuvimos que pasar un sumidero que tenía 6 pies de largo, antes de poder entrar. Hicimos un plano de la cueva del Nido del Guacamayo y sacamos algunas fotografías. Hicimos una colección de muestras representativas de cada organismo que habitaba cada cueva para que se identificaron más tarde. Encontramos 2 especies nuevos de cochinilla (isopoda) en las cuevas.

9. HISTOPLASMOSIS. El Histoplasmosis es endémico en el Perú y este proyecto da más información detallada sobre su distribución por todo el país. Hicimos una colección de muestras de guano de la área de Tingo María y de éstas hicimos un cultivo para crecer el hongo: Histoplasma capsulatum Examinamos los espeleólogos de la expedición mediante la inoculación intradérmica para descubrir si estaban presentes los anticuerpos al Histoplasmosis.

10. LA SOROCHÉ AGUDA. Todos los miembros de la expedición tomaron Acetazolomide o un sustituto no efectivo durante la subida a la altura de 3600m. Tuvieron que llenar un cuestionario sobre los síntomas y hacer una prueba psicológica. Descubrimos que el Acetazolomide fue beneficioso a los efectos físicos de la soroche benigna pero no a los efectos mentales. Se discuten las implicaciones en el informe.

II. LA CONDICIÓN NUTRITIVA Y LOS NIVELES DE COBRE Y ZINCO EN EL CABELLO DE LOS NIÑOS DE TINGO MARÍA. Tomamos medidas de la estatura, el peso y la circunferencia de la cabeza de niños entre los 2 y los 8 años de edad para estudiar las normas de crecimiento relacionamos estas medidas para encontrar metales en muestras de cabello. Hicimos esto con el fin de investigar si el medir de los niveles de cinc es una indicación aceptable de la condición nutritiva.

12. LAS TELECOMUNICACIONES RURALES; UN ESTUDIO LIMITADO SOBRE EL TRÁFICO TELEFÓNICO EN LA SIERRA. En los pueblos más pequeños, los utilizadores domésticos y también los que usan el teléfono por negocios tienen que contar con la posta, un solo teléfono público situado en la tienda de un concesionario. Preguntamos algunas empresas sobre su uso de la posta, y transcribimos las listas de llamadas realizadas. ¿Las postas rurales son significantes por el desarrollo económico? Todavía no. ¿Cómo puede ser mejorado la red telefónica? Planes actuales se comparan con las percepciones y el comportamiento de los utilizadores, aplicando los datos limitados del estudio a algunos modelos de planificación.

13. EL SISTEMA DE FERROCARRIL. Esta sección describe brevemente la historia y condiciones actuales de la red férrea del Perú. Viajamos en el ferrocarril central y también el del sur y no era difícil apreciar los problemas asociados con el construir y administrar de lo que es el sistema de ferrocarril más alto del mundo.



INTRODUCCIÓN

La expedición llegó al Perú después de solamente tres meses de preparación para realizar una gama amplia de proyectos que reflejaban los varios intereses de sus once miembros.

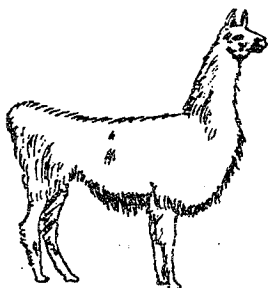
Pasamos el primer mes acampados en la piedra caliza, terciaria y cretácea de Palcamayo en el distrito de Tarma. El sitio estaba localizado a una altura de más de 3500 metros en la Sierra al este de la cuenca de los Andes, y era conveniente por todos los proyectos: estudios sobre la soroche aguda, niveles de alimentación de los niños nativos, los servicios de teléfono y telegrama que existen en la sierra, espeleología y ecología y el colecciona de líquenes, semillas y invertebrados de una gran altitud.

Los habitantes de Palcamayo nos recibieron con entusiasmo y nos dio pena cuando tuvimos que irnos al segundo sitio en la selva cálida y húmeda de Tingo María.

Nuestro campamento idílico en las orillas del río Monzón (a la altura de solamente 660m sobre el nivel del mar) proveó otra base excelente por nuestros proyectos. Allí estudiamos las diferencias entre la fauna y la flora de la selva y las de la sierra y también las diferencias en los niveles de alimentación de la gente. Intentamos contagiarlos de la enfermedad respiratoria, histoplasmosis continuamos a coleccionar especímenes para varias instituciones académicas, y examinamos la posibilidad que los murciélagos servían de depósitos de las enfermedades protozoarias de humanos, (las enfermedades de Uta, Veruga, y Chaga.) Allí también tuvimos la suerte de hacernos amigos de los habitantes de Tingo María y ellos, no solamente lo hicieron más simpático nuestro tiempo allí pero también nos enseñaron el distrito y proveeron muchas buenas ideas sobre el mejor método de realizar nuestros proyectos.

Salimos del Perú eventualmente con algunos resultados muy útiles y una gana impresionante de estadísticas y especímenes biológicos. Nos proponemos a enviar ejemplares de cada especie a Lima con los informes y los resultados.

Todos gozamos de nuestro tiempo en el Perú y, lo más importante de todo, aprendemos mucho de nuestra visita y el contacto con los Peruanos que encontramos que eran, casi excepción, hospitalarios y muy amables.



Eleven students from Southampton U.K. travelled to Perú to work on a variety of research projects centred on two limestone regions. The results are described in detail in the expedition report and abstracts of the most important findings are given below.

ABSTRACTS OF THE MAJOR PROJECTS

5. **CAVING IN PALCAMAYO** During the month we spent camping at 3500m (4 km from Palcamayo) we explored three major cave systems and surveyed la Gruta de Pacuy Huagen in the District of San Pedro de Cajas. These caves contained very few animals, presumably due to the perpetual cold at this altitude.
6. **BATS AND THEIR PARASITES** A selection of bats from a variety of families was caught so that they could be identified and a study made of their parasite load. Ectoparasites were collected for later identification in Britain and blood samples taken to establish whether any of the bats were infected with haemoprotozoa. The bats of the Tingo Maria area were not implicated as reservoirs of human trypanosomiasis or leishmaniasis.
7. **OILBIRD ECOLOGY** This section describes and outlines a few observations on the Guacharo or Oilbird (Steatornis caripensis) that inhabit caves in the Tingo Maria area. Seeds that had been regurgitated by the birds were collected from under their roosts and identified to establish which species are eaten by the birds. These comprised mainly palm seeds but also fruits of the Laurelaceae and Tiliaceae.
8. **CAVING AND CAVE BIOLOGY IN TINGO MARIA** During just ten days camping 6 km from Tingo Maria we explored six cave systems including one which involved negotiating a six feet long sump (water-filled passage) before it could be entered. La Cueva del Nido de Guacamayo was surveyed and photographed. Representative examples of each organism inhabiting each cave were collected for later identification. Two new species of woodlouse (Isopoda) were found in the caves.
9. **HISTOPLASMOSIS** is endemic in Perú and this project gives more detailed information on its distribution in the country. Samples of guano were collected from the Tingo Maria area and cultured for the fungus Histoplasma capsulatum. Cavers of the expedition were skin tested for the presence of antibodies to Histoplasmin.
10. **ACUTE MOUNTAIN SICKNESS** Acetazolamide or placebo was taken during ascent to 3600m. Subjects were assessed with a symptom questionnaire and psychological tests. Acetazolamide proved of benefit for the physical but not the mental effects of mild (benign) AMS. The implications are discussed.
11. **NUTRITIONAL STATUS AND HAIR COPPER AND ZINC LEVELS IN CHILDREN FROM TINGO MARIA.** Height, weight and head circumference measurements were made on children between two and eight years of age to monitor growth patterns and these measurements related to trace metals in hair samples. This was done to investigate whether zinc levels are an acceptable indication of nutritional status.

12. **RURAL TELECOMMUNICATIONS : A LIMITED STUDY OF TELEPHONE TRAFFIC IN THE SIERRA** In the smaller towns both business and domestic users rely on the posta, a single public telephone in a shop. We questioned businesses about their use of the posta and transcribed the logs of calls made. Are rural postas significant in economic growth? Not yet. How should the network be improved? Current plans are compared with the perceptions and behaviour of users, applying the limited survey data to some planning models.
13. **RAILWAY SYSTEM** This section briefly outlines the history and present operating conditions of the rail network in Perú. We travelled on both the Central and Southern railways and it was not difficult to appreciate the problems associated with building and running what is the highest railway system in the world.

2. INTRODUCTION

2.i. The Expedition (JMW)

Perú is a country of striking contrasts: from the slums outside Lima to the snow-capped Andes; from the arid costa which borders the Pacific to the tropical Amazonian selva with its extraordinary wildlife.

The mountain scenery of the Sierra is distinctive but no less magnificent than that of the Himalaya. The sights range from active volcanoes to the world's deepest gorge. You can soak up the spectacular scenery from any minor peak or watch the sun setting over the magnificent expanse of Lake Titicaca.

Our expedition left for Perú in July after barely three months preparation to tackle a diverse range of projects which reflected the contrasting interests of the eleven members of the team.

We spent our first month camping on the Triassic limestone of Palcamayo in the Province of Tarma. The site was over 3500m up in the Sierra, just east of the Andean watershed and suitable for all the projects: studies of Acute Mountain Sickness, nutrition of the local children, the telephone and telegram services available in the Sierra, caving and ecology, and the collection of high altitude lichens, seeds and invertebrates.

We were warmly welcomed by the people of Palcamayo and we were sorry to have to leave for our second site down in the hot humid forests (Selva) of Tingo Maria.

Our idyllic campsite by the Rio Monzón (just 660m above sea level) provided another excellent base. We studied how the flora and fauna contrasted with that in the Sierra and the different nutritional status of the school children in the Selva, tried to catch the respiratory disease histoplasmosis, investigated whether bats were acting as reservoirs of human protozoal disease and continued to collect biological specimens for academic institutions.

Here too we were fortunate in making friends with people who live in Tingo Maria and they not only made our stay more pleasant, but they also showed us around and provided lots of good ideas about how best to cope with our projects.

We eventually came home with some worthwhile results and an impressive range of telecommunication statistics and biological specimens. Representative examples of each species are being returned to Lima with reports and results.

We all thoroughly enjoyed our time in Perú and, on the whole, the group got along very well. More importantly, though, we learned a great deal from our visit and our contact with Peruvians we met who were almost without exception hospitable and overwhelmingly friendly.

2.i.i. An Introduction to Perú (AD)

In the early 1520's there had been a quest by various Spanish colonial citizens of the shipbuilding city of Panama, under the leadership of Pascual de Andagoya, for the Empire of the Virú or Birú tribe which was purported to be established in the vicinity of what is now Columbia and Northern Ecuador. After about 1527, the derivation of "Perú" had come to be officially used in documents to refer to the land further south where the Spanish had discovered the hegemony of the Inca Tribe.

On the death of Andagoya, Francisco Pizarro had resumed the search. As Pizarro sailed southwards from Panama in 1526 along the Pacific coastline, he could hardly have foreseen that probably the largest legacy to the world of the land which he intended to conquer for its gold and silver content was to be the potato.

The indigenous Peruvians, occupied a land which is divided into three distinct regions running North - South: Costa the arid coastal plain; Sierra, the Andean mountain chain and Selva, the Amazonian jungle.

The Costa mainly consists of desert, and encompasses about 10% of Peru. It s inhabitants, 43% of Peru's total population, are concentrated in the river valleys where agriculture is possible, around an isolated fishmeal processing plant, or in the coastal cities such as Lima (which houses 30% of Peru's population itself) or Trujillo or Chimbote, for example. These coastal cities consume most of Peru's imports and produce the largest proportion of her exports.

Peru laments the fact that the larger part of her allocation of water directs itself towards the Atlantic from the eastern side of the Andean watershed. For this reason, combined with the almost total lack of rain in the Costa, Peru is undertaking large-scale irrigation projects for the development of the coast. Irrigated coastal land produces cotton throughout its length, with sugar cane and rice in the north and fruit and olives in the south.

The Sierra begins about 500 metres up in the area west of the watershed, and at about 1,500 to 2,000 metres altitude on the eastern side of the watershed. These heights become more significant if they are recognized as being the most noticeable points of change in the respective climates of the Costa, Sierra and Selva. The highest point in the Sierra is 6,768 metres, with an average of 3,000 metres, and comprises 31% of the area of Peru. About 49% of the population dwell on it.

Although the Inca tribe, during the latter 60 years of its ascendancy, dominated the various Peruvian tribes and civilizations of the Costa and Sierra between present day northern Chile and southern Columbia, it was essentially a mountain tribe. Quechua, the language of the Incas has passed to the Indian descendants of the Sierra tribes subjected to Inca government. The Inca conquerors barely entered the Selva to the east of their dominions, and the reason that Expedition members encountered Quechua during their stay in the Selva around Tingo Maria can be explained by the migration to the Selva of Sierra campesinos*, following the Government and privately sponsored penetration of the Selva beginning in the 1930's.

Many of the agricultural terraces and irrigation systems which were built under Inca organisation are now in disrepair, leaving the slopes of the Sierra dry and stony. However, it is common to see a plot of wheat or oats in some lofty, unlikely mountain reach, which can only be marvelled at. We found the mere act of walking uphill at altitudes of above 3,500 metres work enough. Climbing many hundreds of feet to cultivate some small plot or tend flocks is all in a normal days work for the Sierra campesinos.

* Campesinos: peasants. To call the Peruvian Indians "Los Indios" is equivalent to calling a black man a nigger. I prefer to avoid insult and misunderstanding by not translating the accepted Peruvian terminology.

In contrast to the generally dry Sierra slopes, the valleys are green with beans, maize, onions, carrots, potatoes and the ubiquitous eucalyptus tree that was introduced last century. The isolated development of pre-Conquest Peru resulted in the country having unique plants and animals, for example, the potato family and llamas, and it is only since the Spanish Conquest that Peruvians have enjoyed pork, beef, mutton and vegetables introduced by the Spaniards. Neither did the pre-Conquest Peruvians have draught animals nor (possibly as a result of this and the undulating terrain) the wheel. In some areas campesinos can still be seen tilling the soil using the foot-plough. Housing arrangements have remained largely unaltered too, with mud-brick and adobe houses predominating. However, corrugated-iron roofs are more popular today than pre-Conquest thatch or post-Conquest roofing tiles.

The llama has also found itself supplanted. The donkey came with the Spanish and is the most commonly used pack animal. The llama is only able to carry loads of up to about 22 kilograms, and it's meat, previously rivaled only by that of the guinea-pig, now contends with poultry and pork which are the basis of most of Peru's national dishes.

The Selva region is 59% of the area of Peru and accommodates about 8% of the population. The area has two further divisions, the Selva Alta (the high jungle) and the Selva Baja (the low jungle). The Selva Alta lies between 500 and 1,500 metres above sea level; its valleys have the greatest potential for the development of agriculture and raising livestock. However, those of us who stayed at Tingo Maria found that although the land was well suited to the production of fruit, coffee, cocoa, rice and cattle, preference seemed to be given to coca. Growing and selling coca is legal, but processing the plant into cocaine is not. But the government is as powerless to control the cocaine trade as it is the arms traffic that supplies terrorist strongholds in and around Ayacucho.

Below 500 metres the Selva Baja is much hotter and dwellings crowded on the river banks as a result of the dense and ever-growing vegetation. Oil has recently been tapped in the north east of the Selva and a pipeline connects the Amazon area to the coast. Even the most populated areas of Peru have few metalled roads, and it will indeed be an imposing undertaking to build and maintain a road in such densely vegetated and rainy terrain.

It took us a while to adjust to the length of time it took to achieve simple tasks; for example we spent many hours in post offices. Even at the main Post Office in Lima, there was often a shortage of postage stamps and they would not be sold to us unless the letters on which they were to be used immediately were produced. Often there were no stamps at all, in which case sometimes an inked stamp was offered and at other times we were waved away with our unposted mail for reasons that not even the Spanish-speakers understood.

Shortage of small denomination currency was also much in evidence. It came to be expected that unless the exact money was paid for a purchase, the shopkeeper or stall-holder, without a word of explanation, would wander out of the shop clutching the burdensome note, to ask a succession of further stall-holders for change.

As might be expected in a developing country, professional teachers are the means by which the Peruvian Government tries to centralize and extend its influence in such a regionally diverse and expansive country. (Peru is over twice the size of France)

Teachers are posted by the Government and have little choice in their situation. A teacher could be posted to a remote mountain village where (s)he might join a minority of people earning their livings by means other than subsistence farming. School children wear a statutory national grey school uniform, yet despite the manifest concern which is given to education, we were asked so frequently "whether they spoke English in England" that we dropped our previously held assumption that it was a universally-known fact that we did.

Perhaps this is an indication of the influence of the United States in modern Peru.

2.iii Impressions of the Sierra (I.S.)

Rafael bounded out of the dusk as I was making my way back down the valley. I mistook him for one of the young Indians who had come back from the sheep ranches in California. They come out of the bars in the plazas to show you their expired visa, to ask if you are American, to reassure themselves that you have that in common. What does the sierra hold for them after three years in California?

Rafael hadn't even been to Lima, but he was absorbed with issues of international dimensions. Why was there inflation? Why was Perú poor? Nicki and I attempted to answer without over-simplifying. What had prompted his questions? Seeing white people like us, well-dressed.

We sat on a bench while he called his sheep in from the steep hillside above. The yard was tiny, the house a single room with two small windows and the rafters covered in mattresses. The skins of dead cuy (guinea-pig) were hung out to dry above their cousins, yet to be eaten, who scuttled round the corn sacks in the corner. Indoors, smiling, Rafael's young wife squatted on a stool before a low kerosene store. Rafael lives too far from town to have electricity and Peruanos don't bother with fires for heating - presumably for lack of timber.

A neighbour called to buy Kerosene from the storehouse. Rafael refers to this as his tienda (shop) and indeed it has an Inca Kola advertisement on the outside wall. But Rafael doesn't sell Inca Kola and not many travellers will turn off the road to call here. Anyway for most of the day he and his wife are busy way up the hillside cultivating their terraced chacra or watching the sheep, or fulfilling their obligation to the local farming co-operative. The advertisement signals an intention rather than a fact since they stock whatever they have for sale at the time.

The co-operative is an innovation by the reformist military government (1968-79). Rafael implies that it has just replaced an absentee Hacienda landlord with a local faction which does nothing for the small man. He has ambitious, optimistic, rather unfocussed ideas of changing and improving things but these are not explicitly political. Politicians are only out for what they can get. Tarma remains a conservative province, not the richest area but not a victim of the drought they suffered in Ayacucho to the south, home-base of the guerillas. Flowers and vegetables can be driven down to the Mercado Mayorista in Lima overnight. Rafael's own lorry is parked outside, bought with the help of his father and of a bank loan. Rocks and walls throughout the valleys are daubed the slogans of left and right from the election three years before but perhaps they were only put there by activists from Lima.

We dined round a small table, peeling the skins off the baked papas (potatoes) while the younger child fell asleep and her brother played at loading pebbles onto a battered toy truck. Perú is the home of papas which come in all textures and colours from yellow to purple-striped. They are freeze-dried using the night frosts and stored for up to five years.

Rafael produced an illustrated booklet about herbs and health care. The last chapter showed the benefits of contraception - a nice suburban house with a car in the garage. (I had heard of an equivalent confusion of ideas when the Mormon missionaries show films of prosperous Utah). More conventional birth control posters in the health clinics seem to have little impact.

- Are you here with your family?
- My mother and father are in Inglaterra. They know I am here
- Ah! I thought you might have run away! And your brothers and sisters?
- I have only one brother
- Only one! I have four brothers and three sisters! And another brother who died in his first year.

And I remembered the children's coffins on display in the funeral parlours near the hospital in Tarma.

Rafael thought the contraceptive pill might be poisonous. We tried to distinguish medical risks from Catholic dogma. Before we left we wrote the names of the other expedition members in the back of his picture dictionary.

Rafael gets his books at the twice weekly markets in the provincial capital Tarma : cheap encyclopaedias, agricultural 'how to' books, basic electrical theory, popular histories, the inevitable books about sex. Several newsagents and stationers stock school textbooks and there is also a proper bookshop where the salesman tries to sell me illustrated books of Inca ruins while I'm searching for a catalogue of all the varieties of papa. Later I meet him in a café with his briefcase. He's the representative for a firm that publishes a series illustrated Science books from Spain. The brochure is just like the sort of things Readers Digest send. For some reason he has been to Cusco in the south and he shows me the air ticket, to establish his complicity with the American tourists who go there to see the Inca ruins.

The Latin world comes to the Quechua Indians of the Sierra from Lima. The fashions spread along the bus routes helped along by education, politics, radio and, most recently, television. To gain access to the good life the Indian must turn cholo and join the Latin culture of the Mestizos (Spanish-Indian descendants) who have dominated the Sierra for decades as intermediaries between the Indians and the Spanish elite from the coast.

Outside the towns, the women retain the wide, heavy, embroidered shirts of the Spanish empire and the brightly striped mantas of the Incas, tied like a shawl to carry children and parcels on their backs. But the men have long since abandoned their traditional, bright costumes for western shirts and baggy suits. The markets are full of processed food in tins, mass-produced shoes, printed cottons and radio-cassettes from America and Japan. Ten kilometres down the tarmac road from Tarma there are modern imported saloons in the streets and women wear slacks and perms.

Our host there is at the nexus of this final decline of Quechua culture. His aunt is a very old lady of 70 who lives just up the hill, wears the traditional costume with the long plaited hair and speaks almost no Spanish. He himself has worked in the local schools administration all his life. His eldest sons are studying at university in Lima, one to be a teacher, the other to be a mining engineer. Occasionally he teases them with the little Quechua that he still remembers.

The radio-cassette player is a permanent fixture in his house. Up in the Sierra you can pick up stations from as far away as Chile and Ecuador. On short wave you can hear the Chinese broadcast, the news in Quechua, but for most of our stay we were haunted by the Beatles 'Stars on 45'.

Economic decline and popular aspirations are depopulating the Sierra and swelling the towns, undermining the subsistence of self-sufficiency. Education is the greatest talisman of all and children are sent to stay with relatives in Lima where the best chance of success can be bought.

Less well-supported migrants to Lima find their relatives in one of the barrios that climb the hills to the east of the city. With no basic services, habits of health and hygiene from the more open towns of the Sierra become inappropriate. Litter and worse cover the streets as the houses are cleaned. Water may be pumped up to standing pipes for two hours a day, otherwise it is bought and sold. The ubiquitous 'micro' buses that serve the city centre aren't keen to climb the steep, unpaved streets. This is where the street-sellers (of sweets and trinkets) live and some people can get menial jobs in the service industries.

It is easy to over-dramatise the poverty. Many people have come here to escape drought. In the barrio they live with relatives and neighbours from their home district. There is no ground rent and they can move further up the hill to build their own homes, some of them eventually quite substantial. The city authorities can be persuaded to declare the mature barrio a 'pueblo joven' (young village), a bureaucratic euphemism which entitles the people to basic services like electric light and power but cannot guarantee when ELECTROPERU will install them. Further south in Miraflores, nearer the beach, the prices in the restaurants seem unreal, surrounded by department stores and air-conditioned hotels.

Back in the centre the Presidential Palace seems strangely exposed on all sides. It fronts the Plaza de Armas and a two-lane freeway runs in the valley of the Rio Rimac behind. To one side there is one of many open air markets, to the other the railway terminals for the Tren de la Sierra. The station is called 'Desemparados' (Forsaken). Behind the Palace railings the changing of the guard proceeds with a slow, uncertain goosetstep that seems strangely comic*. From the other side of the Plaza the palace is silhouetted against one of the barrio hills. At its summit there is a huge cross which is illuminated at night. The palace hides the Cristal (Cerveza) brewery on the other side of the Rimac River, the towers rising above the surrounding tenements.

Why is Perú poor? demanded Rafael. His answer is that Peruanos are too fond of cerveza (beer) and fiestas. This view was common in the Sierra and in Lima, where the Indians were often characterised, only half in jest, as show-witted drunkards who lived in huts.

I sense a gnawing inferiority complex behind all the boasting that goes on. This seems to go hand in hand with complaints about how poor Peruanos are at improving their own lot. But what is Perú to do? The principal export is raw materials and the prices of these commodities are the first to fall in a slump. There is no protected home market of a size to nurture manufacturing industry and the profits from foreign capital investment return abroad instead of financing development of roads, irrigation and power schemes, health care, the basic economic infrastructure. Caught in the grip of unrealistic democratic expectations, like so many other countries, Perú accumulates debts and repayments problems.

One of my first impressions in Lima was of guns and uniforms: the guardia with pistols; the military toting sub-machine guns; water cannon mounted on armoured cars by City Hall; the tourist police - slim elegant young women in smart dark green suits and black boots - swinging holsters on their hips. It took me a while to distinguish the private security guards by the PP on their armbands. But you quickly get used to this show of hardware, largely and legacy of the dictatorships of the '30s.

* We tried not to laugh but then looked round to see Peruvians with their fingers in their ears against the discordant bugle playing.

I only read about the guerillas in the press but Steve heard explosions that cut Lima's power supply just before he left at the end of August and the others saw burnt out shops in central Lima. But most of the time the guerillas have little impact; their exploits designed for propaganda rather than de-stabilising. In fact there were rumours that the guerillas were actually paid by the government. Ideologically they seem to have no program. (Admittedly I gather this from the press which seems free enough to discuss inflation, murders, political corruption, bureaucratic blunders, etc.) One can sympathise with the President's complaint that, when the world press does notice Perú, it's to report the irrelevant issue of the guerillas whose main achievement seems to be to stimulate debate among the non-violent left. In truth it is the economy that will bring down the government, just as it undermined the military government before them. Strikes have more impact than bombs.

When you're travelling it's the small things that linger in the memory to frame the more considered reflections. Those baggy trousers. Why do the drunks in the gutter always sleep face downwards? Children on buses being sick over their fellow passengers while their parents look on impassively. Being woken at 5.30 a.m. by the loudspeakers of Radio Municipal in the Plaza at San Pedro de Cajas. The cracked cups and spilt tea that the waiters of Perú specialise in. The holes in the pavements that no one except me ever fell into. The portraits of children on walls, as formal and as drained of expression as Russian icons.

Just before I left they held the World Women's Netball Championships in Lima. Netball is almost as popular as football. Unlike so many travellers I had met, I retained a great affection for Perú. How I was fed up with reading the way the papers reported events: "and Perú came 9th, the best in South America", or "since 1964", I was tired of hearing people run down Perú and its fiestas. I wanted the Peruanos to win, to have something real to boast about, to win some self-respect.

And there it was on the front pages: PERU IN THE FINAL! and they had beaten the Americans to get there! The captain was all over the Sunday papers. The hotel lobby was crowded round the T.V. I couldn't bear to watch the Chinese beat them.



3. THE EXPEDITION LOG

Southampton to Palcamayo (DM)

There had to be a means of conning the Southern Evening Echo editor into financing my annual leave, and when I spotted the ad in the University news sheet I knew I had struck gold. So on 13th July I found myself lugging an awkward rucksack round Heathrow Airport with Julian and Mary at my shoulder asking how I planned to survive with "so little gear". Within minutes, and true to form, I was propping up the bar. Well, I am a reporter. Aeroplanes have always made me nervous but the 10½ hour flight was sheer pleasure, even though we seemed to be continually eating breakfast as we crossed the numerous time zones.

When we arrived in Lima, after stops in Caracas and Bogota, it was like arriving in my home town in Lancashire on a typical summer's day. It was dull and colourless and looked as if it were about to rain at any second. There was no real fear of that happening. They say it hasn't rained properly in Lima since the Suez crisis back in the fifties. The Europa Hotel must be so called in order to attract the wealthy gringos from across the Atlantic. Anyone who falls for that one deserves to spend at least one night there sampling its creature comforts. If you lie on one of the six beds in your room and shut out other conversations it's easy to imagine you are in the Hotel Savoy just round the corner.

Lima turned out to be a dusty city, teeming with life and activity. Not a bit like the shanty town I expected to find. Clearly the dire poverty of the shanties was forced to the outskirts and we were in the thriving commercial heart of the city. The only relief from traffic noise and petrol fumes was in the wide squares like Plaza de Armas two minutes walk from the hotel. Here was the cathedral with its "famous" attraction ... the gruesome remains of the country's founder General Don Francisco Pizarro. What would his mother think if she could see him now ... on show for public gratification? Still, his final resting place is a rather impressive building. I visited the market for postcards and was surprised to find it was a market like any we have in Britain. You could buy anything from a pair of Alpaca socks to the latest Japanese stereo system. I settled for a pair of socks which were a bargain, like everything in Peru, for about 50p (500 soles).

I met Mandy, Nicky, Alison, Jane, Tony and Ian who had arrived one week earlier (on 7.7.82) and we set about sampling the local cuisine which, for me, consisted of a greasy vegetable omelette. I was to see many omelettes in the coming weeks, some of them containing less than the statutory one egg. Everyone was either suffering from, had suffered from, or fully intended to suffer from, various forms of Monty's Revenge. I decided to avoid it at all costs even if it meant omelettes for breakfast, lunch and dinner. Here too I was to fail miserably.

Second day in Lima was punctuated by visits to the Museum of Anthropology and the Inquisition Museum where dastardly deeds were carried out in the name of religion. Julian and I were already discovering that our total ignorance of the language would mean missing out on some of the finer and more subtle aspects of Peruvian life, since so few people in the country speak English. We even met some children who had never heard of Kevin Keegan. There's still a long way to go before the world becomes "civilised"!

We bought our tickets for the train to the mountains and boarded early on the third day, one day after the advance party. These were to be tickets to the stratosphere - passports for an unforgettable train ride which was to take us to an altitude of 4,800 m. along an average gradient of 1:75. It started quietly enough. The train took us through miles of shanty areas. Suddenly we pierced the all-pervading gloom of the Peruvian coastal plain into clear sunlight as the train began its long-haul upwards. This is the highest, and probably the most spectacular, railway in the world. It climbs to the heights in giant spirals through spectacular mountain passes ... but even this is not enough. For much of its 150 km. odd length the line runs up a series of zig-zagging inclines operating like a pendulum which is progressively becoming shorter in length.

As we passed the 10,000 ft. mark funny things started to happen. No longer could I rush madly through the carriages taking snaps, or dangle from the footplate to breathe the mountain air. By this stage there was hardly any mountain air to breathe. Most of us felt our chests heaving; a slight dizziness and nausea without realising immediately what was wrong. When a little man in a white coat came barging through the carriage with a mysterious black bag we were grateful. The black bag contained oxygen designed to prevent Soroche (mountain sickness) sufferers from keeling over. I don't suppose for one moment it did any good. Even Julian was speechless and in the early stages of a swoon. Mary was positively spaced-out.

Mid-afternoon on 16th July saw us slumped over our too ample luggage on the platform at La Oroya. We all felt "nearer my God to thee": not surprising since we were some 13,000 ft. above sea level. La Oroya is what we hacks would call a dive. A busy mining town, dusty and dirty and a blot on the landscape. Fortunately we were soon travelling by bus to Tarma slightly lower down the mountains. I remember little of that bus journey save the lack of independent suspension on the old bus, and the lack of dependent suspension for that matter.

Late in the day, with the sun sinking, we checked in at Tarma's Central Hotel too exhausted to notice the comparative luxury of the place. I was exhausted but couldn't sleep because I was conscious of my breathing. Every few minutes I had to reach for air. Mary felt destroyed but fortunately she soon recovered. Day one in Tarma was spent touring the town. We visited the Town Hall and locked into a conversation with a lady who described herself as a political and economic writer. She seemed extremely shy, maybe because in a country like Peru politics and economics are not subjects people are encouraged to talk about. Incidentally, many Peruvians we met were well informed about the Falklands crisis. Naturally enough they sided with the Argentines, but were always polite in making their point. The guard on the train expressed the typical standpoint. He asked how I would feel if I came home one night to find someone had taken over my garden. The discussion then turned to lighter things.

Tarma was a pretty grid-iron market town with a flavour of being the "local hop" for all the farming Indians for miles around. There was a cinema and sports hall (volley ball is big in Peru) and on Sundays a fantastic market which fills the centre of the town. Julian and I savoured a local football match and appreciated, even at that level, the silky South American skills on show.

At the rear of the Central Hotel we found a splendid astronomical observatory.

At night in the thin atmosphere at altitude you have the classic conditions for star gazing and a small group of amateur astronomers were only too pleased to show visitors their work. Their enthusiasm is just as infectious as Patrick Moore's as they take you on a conducted tour of their cosmos. The group's 105 mm. refracting telescope gave excellent views of Jupiter and Saturn and the more familiar galaxies.

Heading for Palcamayo by bus the next day everyone was transfixed by the scenery. We were now entering some of the most remote parts of the Sierra, but even here there was great activity as the Indians devoted all their efforts to agriculture and crop cultivation. The soil seemed amazingly fertile, especially in contrast to the arid coastal plain we'd just left. We arrived at Palcamayo around lunchtime and met Tony. He had come up earlier in the week with the others to find a suitable camp site and met Dave and Steve recovering from their tour of the south. After sampling the local brew with the town's sheriff we yomped up to the base camp site outside Huagapo, the largest and best known cave in the area. We camped by an icy mountain stream flowing down a steep-sided valley and after a meal of fish and boiled potatoes, bedded down expecting to feel the bitter cold of an Andean winter night. The cold never really came. The tents, sleeping bags and woollies did their job admirably and through the temperature plunged to about minus 10°C (13°F) from a daytime high in the eighties, I personally never felt the cold.

Dawn comes quickly in the Andes as if an invisible hand has thrown a switch in heaven. The sun hurdles over the craggy ridge ... and with it came Tony screeching "Nice cuppa tea" as he brewed up breakfast of porridge, fried bananas and dried egg (Tony eats anything). "Operation Huagapo", our exploration of the magnificent cave, began the first day. Jane quickly proved herself the Sebastian Coe of the potholing world by pacing us over the 2 km. journey to the sump of the wet cave. The cave was sheer delight except for the cold. After much more than two hours immersion in the icy water our limbs began to sieze up and progress became reduced to stumbling. But it was worth the suffering to see the sensational formations the crowds of stalactites and the weird and beautiful calcite deposits which featured throughout Huagapo. Also the contrast of emerging into the hot afternoon sun after two hours or so immersed chest-high in pure mountain melt-water was exhilarating in the extreme.

Each day in the sierra was a distillation of all the seasons of the year. The frost of night gave way to a crisp spring morning. By mid-afternoon the hot "summer" sun was burning overhead ... out with the suncream and shades ... and by evening "autumn" descended in time for a warming vegetable stew. At night, by the glow of half-a-dozen acetylene lamps and the milky way we would play daft games and drink hot coffee.

On 20th July Steve and I decided to check out La Sima de Milpo. It was a 2 hour climb, or a 3 hour climb if you adopted the pensioner's pace, but even after a gentle ascent when we finally arrived at the cave entrance I felt as though I should have been on a ventilator. The entrance to Milpo was disappointing for a cave which is the deepest known in South America. It was blocked by boulders washed down during the rainy season and consisted of a long narrow slit. We tried to get in feet first but we both panicked and thought better of it. Then Steve managed to rearrange the entrance by brute force. After some impromptu stonemasonry he broke through, but thought it was unsafe. I went in, took some snaps of the initial cavern, then beat a

hasty retreat. We agreed it would be unwise to try any kind of descent without real support.

Back at base camp Tony, Alison and Dave told us of the cave of Pacuy Huagen which they had started to explore and survey that day. We decided to concentrate our efforts in this area rather than Milpo. It proved very rewarding with Dave doggedly managing to produce an excellent detailed map of the cave. Even though we were not the first to explore it fully we felt a close attachment to it.

We mounted several excursions from base camp. On one trip into Palcamayo for supplies we came across an apology for a circus. All the village children were there and they were enthralled. As VIPs we were given a place of honour by the ringside and we soon became the main attraction. There were no elephants or lions at this circus - but there were gringos! A rather well proportioned lady called Madelene was the star attraction with her grotesque contortions. Later she bent over backwards to provide us with photographs for the album.

A second outing took us to San Pedro de Cajas, a place never to be forgotten where the children marched the goose-step down the high street and the PA system told people what a lovely government they had (all day and every day). As we walked five abreast down the high street of San Pedro, kicking up dust, we could have been walking onto the set of a spaghetti western. The only things missing were background music and Clint Eastwood. Lunch in a seedy bar ... it was just like home except the local children came in their hoards to gawp at the gringos.

Then we met Carolyn North, a brave anthropologist who had set up home in San Pedro to study the Quechua way of life. She had fascinating stories to tell about a divided community, a corrupt town mayor and of how she had been adopted by a local family. But her strangest stories concerned the Indian witch-doctors and the custom of Curandera. She told us that the Curandera was invoked when a villager was stricken by illness. The patient would lie down and a guinea pig passed over his/her body. Then somehow the creature died. When its guts were extricated from it the witch doctor could apparently tell from what ailment the patient was suffering. It all sounded like hogwash but as Carolyn pointed out, the locals swore by their guinea pigs and her comparisons between diagnosis by Curadera and conventional medicine made the efficacy of the guinea pig method look pretty impressive. All this did not stop them from eating the furry things. Cuy, as the Indians call it, is a real delicacy and they happen to be a convenient way of serving up fresh meat. We decided we could not leave Peru without tasting a succulent guinea pig. The sauce covering the ligaments and tendons was tasty, but it was a bit off-putting to be reminded of how cute the live specimens are after we'd dined. We went without supper that night.

On Saturday 23rd July our minds turned to sporting activities. Our friend Carlos, the policeman, had challenged us to a volley ball match in Palcamayo. Europe versus South America in a best of five games tournament in the school play ground. What we lacked in expertise and skill we made up for in determination. With Julian performing porpoise leaps to knock the ball over the net we managed to hold the agile villagers to a 2-2 draw. We came into our own in the basketball match where Alison "the runaway wardrobe" proved something of a super star and led us to a sensational victory, despite still not being properly acclimatised. In a state of exhaustion we sank a

number of bottles of cerveza (watery lager which is over-fizzy at altitude) before our local bobby took us off to the police station for tuna fish salad with hot chilli peppers. I'll never forget the sight of a poor peasant squatting in the 6 by 9 ft. mud hut which served as a jail. He was locked up for wife battering and there was no question of him being released on bail for at least 48 hours.

We returned to La Cueva de Pacuy Huagen to complete the survey. It took about four hours concerted effort, but we felt well pleased with ourselves. Then on 28th July Jane led a photographic trip into La Cueva del Huagapo. It was also Peruvian Independence Day and the tourists flocked to Huagapo as if it were a "White Scar Cave". They had great fun breaking arms and legs as they scrambled over the slippery rocks in the cave without lights but with tape recorders. The Albert Schweitzers among our party did an excellent job patching them up.

We all needed patching up ourselves after joining in the Peru Day celebrations. They went on for almost a week but reached a crescendo on 28th July when the boys (and girls) of Southampton hit town. The place was alive with noise and colour as bands played and children danced in the streets. Market stalls blocked the side streets and the smell of more exotic Peruvian delicacies filled the air. We were swept along by the tide of joviality and took great care not to step on any of the drunks lying in the gutters. They certainly know how to celebrate, with lots of alcohol, food and bullfights. The evening continued in the same vein with a giant street party at which I declined an offer of marriage to the Mayor's daughter ... it was her mother who came forward with the offer.

Next day we broke camp leaving Ian and Nicky to continue their project on Peruvian telecommunications. The main body of the expedition was due to move down into the rain forests round Tingo Maria and I had an appointment in Southampton with Echo readers.

The farewell from the villagers of Palcamayo was something else. As we waited for transport back to Tarma our friend the policeman dragged us off to the final celebration of the week ... a giant barbecue in the courtyard of a wealthy farmer. So our intended departure at 10 a.m. was put off until sundown.

After a night at the Central Hotel, Tarma and a frustrating afternoon in La Oroya trying to get a lift to Lima alongside a million other people, I reached the capital on Sunday 1st August. I headed straight for the Savoy Hotel and a hot shower, followed by a meal of marinated pork in a rich wine sauce. Twenty minutes later I was doubled up with pain ... my digestive system was unable to cope after weeks of fruit and vegetables.

I filed a story from the Lima office of Associated Press after an unsuccessful attempt at ringing my office direct (a fault in Britain's telecommunications rather than Peru's I later discovered).

All in all an unforgettable experience and with a group of marvellous people, each with his/her interests and idiosyncracies. There was Steve's appetite - "when in doubt get it down your throat". There was Mary's adult education course in how to screw on the top of a Vosene bottle. There was Julian, who still hopes to be able to grow a beard one day. Of course there was Jane. "I'm certain this is a rare specimen of digitalis hitherto unknown in Europe.

I'd recognise it anywhere - I think". Not forgetting Tony "Thanks for the Memory Test" White and Mandy who charges reasonable rates for a half share in her tent (breakfast in bed an optional extra).

Of course there was daredevil Dave who was forced to act as Steve's warden and the delightful and patient Nicky who was not allowed to speak English throughout the whole trip. And put your hands together for Alison, whose prowess on the basketball court was matched only by her artistic washing-up style. And last, but by no means least, there was Ian Stronge who was unswerving in his attempts to fathom out the workings of Peru's telephone system. He remains convinced that Peru needs a Buzby who speaks fluent Quechua.

And what of Paddington Bear? They say he came from darkest Peru. All I can say is ... some people will believe anything.

La Oroya to Tingo Maria (DJK)

We said goodbye to Dermot in La Oroya and set about the much-practised task of finding the way out of the town. After much confusion and broken Spanish we got a lift in a most amazing minibus with eight Peruvians and about half a ton of onions. The most terrifying aspect of the journey was the steering. The driver's manic gyrations of the steering wheel seemed to bear very little relation to the direction in which the bus moved, so we were grateful that there weren't too many sheer drops beside the road.

The road to Cerro de Pasco was almost finished, but had not been opened. Thus we were in the ludicrous situation of rattling along a dirt road beside a marvellous strip of tarmac! We travelled across the high Puñá for about three hours, stopping briefly for lunch (Tony's included a pig's nipple, which he photographed) before reaching the desolate mining town of Cerro de Pasco. We expected to have to spend the night there, but a kindly local yelled to his mates across the plaza and they diverted a bus about to set out for our next port of call, Huánuco - a provincial capital with a population of 80,000. After apparently shoving several locals out of their seats, our self-appointed guardian installed us in the relatively comfortable bus. Beyond Cerro the road follows the Huallaga river and drops sharply (2,450 m. in 100 km. and most of that in the first 32 km). It felt good to be breathing thick air again.

We rolled into the central plaza of Huánuco at around midnight. The bus driver dumped our bags and we huddled around the street light while two hardy souls hunted for a pension. We eventually found one with the usual sleepy night porter who lined up our passports then demanded to know what nationality we were, which bore witness to the fact that few gringos stay in a hotel reminiscent of a prison and patronised by alcoholics. At least it was cheap.

The next morning we set out to explore the town and investigate the natural history museum mentioned in the South American Handbook. It is probably the most weird, unusual and plain ridiculous museum I have ever seen. We were greeted by the guide and museum taxidermist who proudly showed us past a frog playing a guitar and a small monkey playing a flute. There appeared to be a whole band of these stuffed animals, with others dotted around the museum in

jocular poses. The highlight of the tour was a dignified penguin staring at us, an elegant bow tied around its neck! There was also a disgusting case displaying all manner of repulsive animal mutants. I suppose the public gets what the public wants.

Later in the day we took a spectacular ride on the back of a small truck to our ultimate destination - Tingo Maria, down at about 620m above sea level. The scenery was stunning - the mountains covered in dense rain forest, the grey ribbon of the road clinging to the steep slope as it wound its way down to the valley. The pleasure was slightly inhibited by "Los Beatles" which a fellow-traveller was playing all the time (they are very popular in Peru). On our arrival in Tingo we realised we had our first victim of the heat and the unhealthy climate of the jungle. Jane looked really ill. In their turn all the other members of the expedition suffered similarly if not to the same extent.

We were soon installed in the amazingly cheap and clean Hostal Belen and I was able to explore the town. My initial impression was one of filth and squalor but walking down the wide main street, it soon became apparent that beneath the stench and open sewers there was a lot of money associated, we understood, with the coca "industry". This was shown by the large number of hi-fi and camera shops which seemed out of place in a town which was otherwise so backward. There is also an airport, but it is not clear whether this is a cause or effect of wealth.

It was universally agreed that the best thing about the town was the food. When the oppressive heat got unbearable all one had to do was walk a few yards to one of the many cake stalls for a glass of fresh fruit juice or cheecha - a purple coloured drink made from fermented maize. This could be followed by a wide range of fresh cakes or "empanadas" (Cornish pasties filled with meat or chicken) which were great instead of vegetable stews. An alternative for a full meal was the market which was the cheapest place to eat but occasionally pretty unsavoury. In the centre of the market was a huge covered hall filled with stalls, all selling the same basic three dishes - spaghetti, fish and boiled potatoes and chicken and rice. The art of getting a good meal here was to watch for the stall which had just finished cooking, otherwise you got a cold meal. The Peruvians seem to like lots of starch and I saw several people tucking in to potatoes, pasta and rice, all on the same plate.

In general the food in Tingo was much more varied than up in the sierra, but much more expensive.

We left the hotel the next morning (leaving Mandy and Alison behind as they were pursuing their quest for children to weigh) to make the hour's walk up to the cave of the oilbirds (La Cueva de las Lechusas) in the impressive limestone outcrop called The Sleeping Beauty (La Bella Durmiente). It was our first contact with the wild-life of the rain forest. Butterflies of amazing size, colour and variety were everywhere. We caught the occasional glimpse of the brightly coloured weaver birds, toucans and many others I couldn't identify. There were also highly coloured beetles dotted around the branches beside the road, whilst ant trails criss-crossed it. We eventually reached the bridge over the Rio Monzón - a modern suspension bridge which seems strangely out of place next to the thatched roofs of the hamlet nearby and the rolling green of the rain forest. We discovered that

the cave was just inside the National Park. The gate warden, when questioned about other caves in the area, said there weren't any, but we found a reasonable campsite just outside the park. Thus we returned to Tingo pretty non-plussed to meet Mandy and Alison who had also drawn a blank on their visits to the health centre. Added to the prevalent illnesses this was probably the lowest point of the expedition.

The next day we set out to the National Agricultural University of the Selva to try and find a geologist or a caver. The university consists of wood-frame huts and a few prefabricated concrete buildings and does not really convey the impression of a "seat of learning". We wandered into the Department of Biology and met Dr. Juárez, an English speaker and parasitologist (one of Jane's interests). He was very friendly and eager to help and assured us that there were plenty of other caves in the area. One of his technicians knew them and we arranged for him to show them to us the next day. He then proceeded proudly to show off his collection of insects which included bugs of amazing size and variety. He also directed us to the Ministry of Agriculture in Tingo where, after much waiting and waving of letters of introduction, we were able to get permission to work in the National Park.

Thus, at last we could get under way and move out to camp in a clearing by an orange grove (great for breakfast!) In front of us was the luke warm Monzón river, winding its way slowly down to join the Amazon. A dip in the river was one of the greatest luxuries of the expedition, especially after surfacing sweating and covered in guano after a caving trip. There were a couple of cafes a few hundred yards away which provided essential supplies of cerveza (weak lager which was much less fizzy at this altitude) and pisco caliente (hot local spirit) for the needy.

El Doctor and his band from the University appeared the next day and we were shown around the caves within the National Park. The day after we drove over the other side of Tingo to explore other, smaller caves (all caves are described in Chapter 8).

Ian, Nicky and Mary soon caught us up and Mandy's project got off the ground. She made contact with the very helpful district dentist as well as the village schoolteachers who took her, together with Jane and Alison, to the pictures as well as helping grab kids for the nutrition project.

Epilogue (JMW)

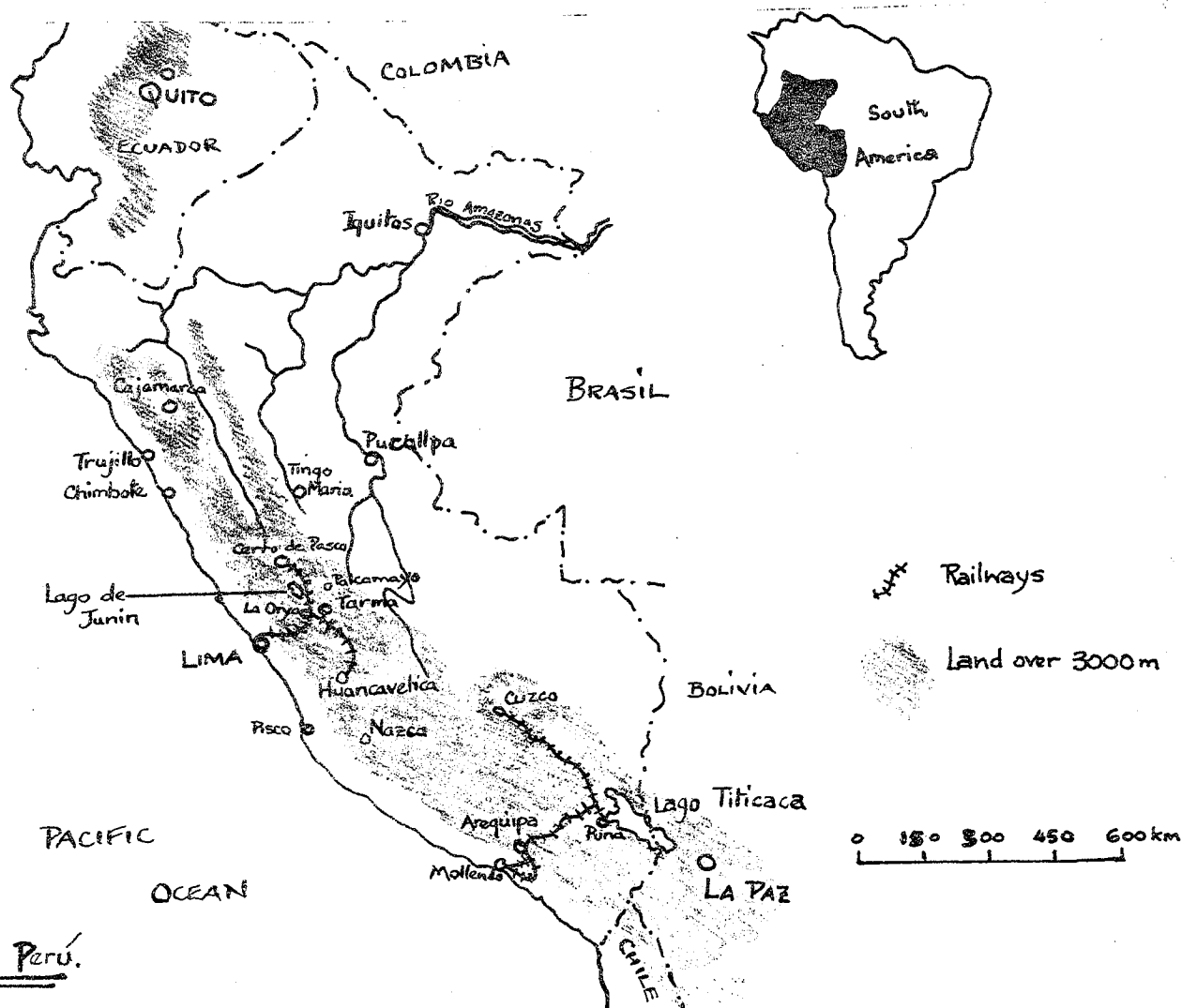
We had less than two weeks in Tingo Maria and spent much of that time getting lost in the jungle, poking around in small caves and swearing at the biting black flies. Dave and co. surveyed the beautiful but filthy Cueva de Nido de Guacamayo while I continued to pursue unsavoury animals and tried to inspire people to get enthusiastic about collecting seeds for Kew. The time passed all too quickly.

The day before Dave's departure he brow-beat me into investigating the impressive looking resurgence at the base of La Cueva de Lechusas. Members of the French expedition (Orville 1977:102) suggested that diving into the resurgence, even with SCUBA gear, was completely impossible. So it was very

pleasing to discover that the first stage of penetrating the resurgence sump was an easy six feet long dive.

Once I had put a line through and found a place shallow enough to put my feet down, I was able to produce the Premier carbide light and matches (in several plastic bags) from my cleavage and light up. The small cave I had entered (followed by Dave who had been life-lining me and later the rest of the expedition and a couple of Peruvian spectators) was christened Fungus's Cave because of all the Fungus Gnats and the clammy Bogey atmosphere. Sadly my nerve gave out while I was trying to push on further upstream so we got in no more than about 50 feet. Next time I will take a mask and an electric light and so be better able to negotiate cave passage with barely 2 inches of air space. I spent the last few days working with the American mammologist Gary Graham.

The end of August was approaching rapidly so we started to think about going our separate ways. Ian and Alison returned to the telecoms work in the Sierra and Dave had to head homewards to start work in London, insisting he was too shy to kiss the leader good-bye. Mandy and Nicky were all set to leave when Mandy's bag containing all her results, hair samples and scales, was snatched from under her nose. But she took the loss philosophically and stayed on to repeat some measurements. Tony went off bird watching in the Montaña and Steve caught the bus back to Lima aiming to sell some of his equipment for the money to leave the country. Mary and I followed close behind on the overnight bus (a 12 hour trip) to allow a few days for souvenir shopping and permit chasing before our rendezvous with Tony to fly home after an all too short two months in Peru. And we left Mandy, Alison and Ian to their travels in southern Peru and Bolivia.

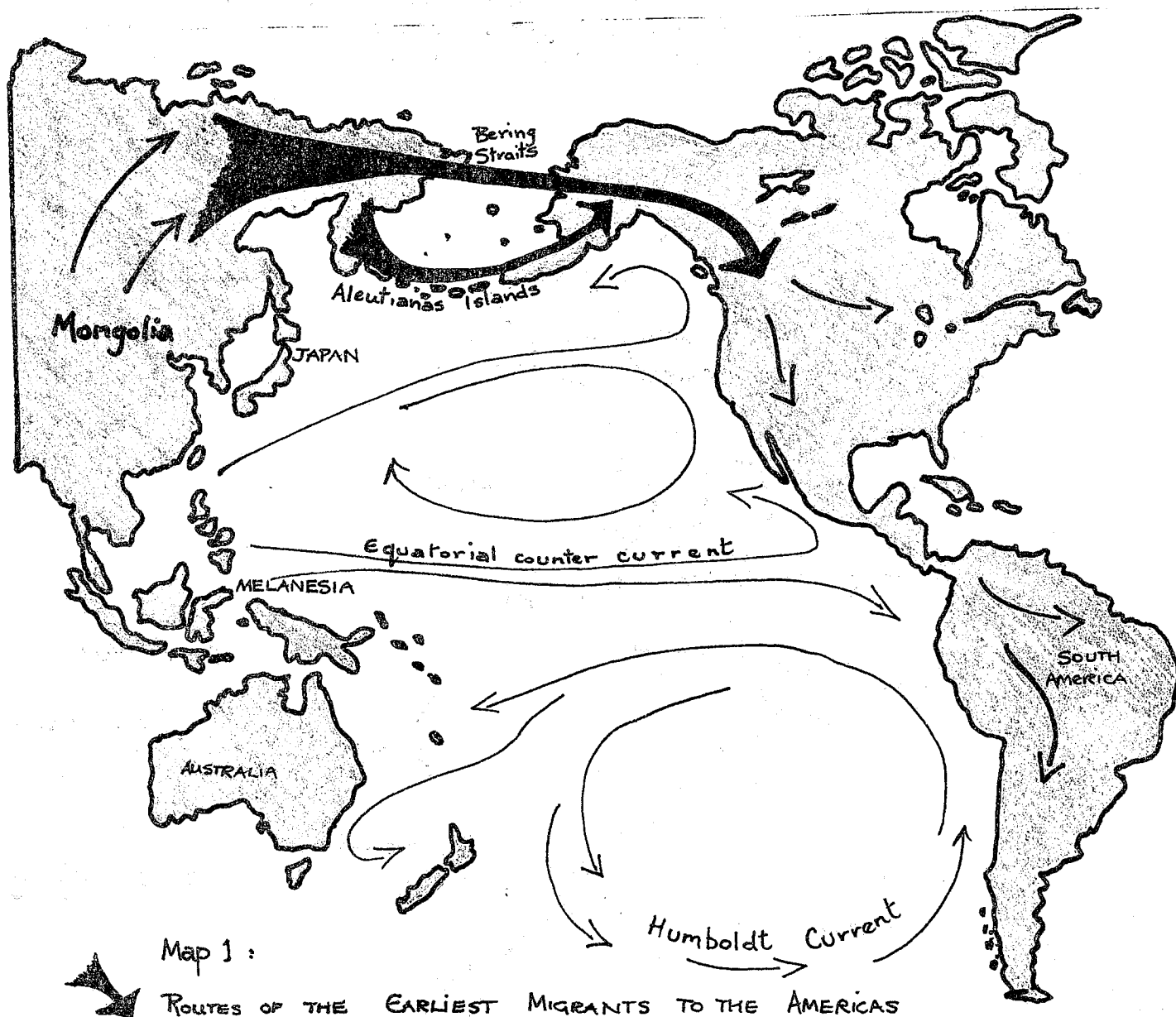


4. AN OUTLINE OF THE HISTORY OF PERU (AD)

The Indian peoples of the American continent are the descendants of successive waves of Mongol hunters who crossed the Bering Straits during the last Ice Age. The American anthropologist, Ales Hrdlicka, thinks this occurred about 40,000 years ago (Map 1, below). Another theory is that the black-skinned race of Melanesia and Australia migrated to the Americas and mixed with the Mongolian race. The French anthropologist, Paul Rivet, maintains that there is Melanesian influence in the indigenous populations of present day S.W. United States and South America. Neither migration route has been proved. Thor Heyerdahl's books on his Kon Tiki and Ra expeditions (see appendix 5) discuss the idea that Polynesia was first populated by a pre-Inca tribe who sailed via the Humboldt Current on balsa rafts and that the Americas could have been populated by people who arrived from north Africa by reed boat.

Ethnology aside, it is undisputed that the length of the Andes was inhabited 10,500 years ago. However, the high Pre-Inca (Pre-Columbian) cultures in South and Central America did not begin to develop until around 1000 B.C.

The Incas are the best known inhabitants of Pre-Conquest Peru. This may be because when the Spanish arrived, the chroniclers found plenty to record in the Inca Empire and by comparison the amount of information available about the Pre-Columbian high cultures is largely restricted to archaeology.



The Inca tribe were remarkable administrators and produced intricate artwork and noteworthy agricultural yields. ^{Their conquests began in 1435}

It has been estimated that at their greatest extent, Inca dominions encompassed about 10 million subjects (c.f. present day Lima with a population of 6 million and Peru 16.8 million) in territory stretching from present day northern Chile and Argentina to southern Columbia. The Inca nobility managed an efficient army, agricultural system, a communications network composed of a series of runners and kept well stocked storehouses. However, the era of the Inca apogee was cut short by The Conquest and lasted less than a century.

It might be appropriate to acknowledge the high cultures of their territorial predecessors, some of whose practices (building techniques for example), and even religion the Incas adopted to a large degree.

The Chavin culture flourished on the northern Costa and Sierra between about 800 and 200 B.C. It can be seen from their burial mummies and their woven and ceramic artwork, that the Chavin culture exerted an influence on the Paracas culture, which developed further south on the coast between about 400 B.C. to 400 A.D. (Map 2).

At about the time when the Paracas culture died, the Nasca culture developed in the valleys of southern Peru and flourished until about 800 A.D. Objects made of gold have been found in Nascaen tombs, giving testimony to their knowledge of gold workings and metallurgy. Possibly the largest wonder and mystery which the Nascaen culture has bequeathed to us are the Nasca Lines. These extensive drawings on the plains can only be fully appreciated from the air, and current opinions hold that the Nasca Lines form some means by which to take astrological readings.

Contemporary with the Nasca culture in the south, the Mochica culture dominated the coast to the north. Its name is derived from the River Moche which flows through the cultural centre. It has also been named, "proto-Chimú" because the Chimú culture, which developed in the same area a few centuries later, inherited much from the Mochica culture. The Mochicas were industrious agriculturalists who increased the amount of arable land by means of canals and aqueducts which brought water from higher in the valleys; they had well-developed weaving skills and worked gold, silver and copper although bronze was unknown to them. The Mochicas, furthermore, spoke Mochica, which continued to be the regional language until the Spanish Conquest. The Chimú culture, although conquered by the mountain Inca tribe from the south in the early 15th century, retained its language despite the demand that all Inca subjects should speak Quechua.

The bulksome buildings of the Tiahuanaco culture surprised the invading Spaniards. The first Spanish conquerors to reach their territory around Lake Titicaca had no knowledge of who built such constructions. The culture predominated in what is now Bolivia, southern Peru and northern Chile from about 800 - 1300 A.D., and at its greatest extent the culture influenced populations in the Costa and Sierra of northern Peru. They used large stone building blocks like those the Incas later came to be famous for, and the largest of their sculptures reaches a height of seven metres.

The myths of the Inca tribe (which were handed down verbally by designated "history relators",) claim the origin of the Inca tribe at Lake Titicaca. It is likely that the Incas learnt much construction and masonry techniques from the Tiahuanaco culture. There are grounds to suggest that the Inca tribe adopted their religion of sun worship from the followers of Kon-Tiki or Viracocha (the sun god) who inhabited the area around Lake Titicaca during the latter part of the first millennium A.D.

It is undoubted that the Nascaen and Tiahuanaco cultures had commercial relations with each other, which practice is fundamental in the transmission of ideas and methods. When the Tiahuanaco culture declined in about the 12th century, various regional lords arose from amongst the previously conquered tribes, retaining much influence from the Tiahuanaco and Nasca cultures. For example, the Chinchu tribe occupied part of the previously Nasca territory.

At the same time, various rival tribes waged battles amongst themselves for territory around Lake Titicaca. These were Aymara speaking peoples, which language is still spoken in the vicinity of Lake Titicaca.

The Chancas occupied territories in the regions around Ayacucho, and formed a Confederation with the Pocras and the Wancas tribes of the same area in the early 1400's. In the ensuing expansionist wars the Confederation attacked the Inca tribe, which had been gradually developing on the other side of the River Apurimac, with the city of Cusco as their cultural centre. The success with which the Inca tribe defended itself marks the end of the Pre-Columbian era; during the following hundred years the Inca rulers gained for themselves an Empire of impressive dimensions. Cusco = Navel in Quechua, due to the form of the upland basin from which the Inca culture spread.

The European attitude towards the discovery of the Americas altered in 1519, with the news that Hernan Cortes had led the Spanish victory over the Aztec Empire in Mexico. Undoubtedly, Francisco Pizarro benefitted from the loosened purse strings of Iberian creditors in his voyages in search of an Empire on the Pacific seaboard. The city of Panama was established in 1519 as a base from which to direct Pacific voyages, and Pizarro first ascertained the existence of the Inca Empire in the latter 1520's. Inca Huayna Capac was currently reigning, although he and the Spaniards never met; when Pizarro returned to Peru in 1532 with a force of about 150 men, he found the Inca Empire engaged in a Civil war following the death of Huayna Capac.

Under Huayna Capac, the Inca Empire had gained its greatest expanse; less than 60 years before the Inca tribe had only localized dominance over an expanding area around Cusco. The problem of governing such an expanse of territories was therefore relatively new, and dealt with by Huayna Capac by naming his son, Huascar, as Inca in Cusco and another son, Atahualpa, as Governor of Quito, in the northern extremity of the Empire. Quite feasibly, the Spaniards hoped to gain strategic capital in their conquest of an Empire divided by Civil War. Indeed, as they later marched to Cusco they sometimes found themselves welcomed, being preferred as Conquerors over "the foreigners from the North". (See also Hemming 1970 in appendix 5).

The Spaniards, not without difficulty, eventually retained Cusco against indigenous attack under the leadership of Gonzalo Pizarro, the brother of Francisco Pizarro. Francisco had installed himself in Lima, the newly-founded Capital of the territories he governed.

Descendants of Huayna Capac continued to lead rebellions against the Spanish conquerors. The ruling Inca in 1572 was Tupac Amaru, and Viceroy Toledo has been criticised for causing Tupac Amaru's martyrdom by having him executed. Nearly every native leader of rebellions against Spanish rule during the 18th century added the name of Tupac Amaru to his own.

The status of Viceroyalty was granted to Lima in 1542, with the territories from Panama to Buenos Aires to the southernmost point of South America under its jurisdiction. In 1776 a separate Viceroyalty of Rio de la Plata was established, which included the territories of present day Argentina, Bolivia, Uruguay and Paraguay.

The Spaniards organized indigenous labour under an adaptation of the system employed by the Inca nobility. This was the 'Mita' system by which subjected Indians served in the Inca army, worked the land, undertook road building or other public works in exchange for the protection that the Inca Empire offered them. The rural Indians were accustomed to subjection, and exchanged Inca overlords for Spanish. Their work assumed substantial importance in mining the mountain of silver discovered at Potosi (Bolivia) in 1545.

The rebellion of Tupac Amaru II in 1780 complained of the exploitation of the indigenous population.

In the later 18th century, Charles III of Spain aimed to centralise crown control over the dominions. The Order of the Jesuits, he considered, exercised too much power and influence and were expelled in 1767.

To reduce the private peculation of Crown dues by imbuing a greater sense of Crown loyalty amongst the officials, Charles III replaced the Creole officials who held high positions in the Viceregal Governments with Spanish-born officials, the Peninsulases. On finding themselves unable to assume any but the more minor administrative posts, the Creole elite became embittered.

The news of the United States of America's Declaration of Independence in 1776 probably helped to shape ideas in Spanish America, as did the wave of philosophies surrounding the French Revolution in 1789.

It is hard to determine how rapidly events in Spanish America would have progressed, had Napoleon not invaded the Iberian Peninsular in 1807. With the Spanish monarch in captivity, provisional Juntas were formed to provide Spain with a native government in the face of the French invaders. Amongst the domestic decisions of the Juntas, concerning the extent of their jurisdiction, there remained the question of the incorporation of the New World dominions into the Juntas, and the extent to which they should be represented.

Although the contributory factors toward Spanish American Independence have by no means been completely covered, it will be understood that the Independence movement was burgeoning. The Independence campaigns took on a continent-wide aspect; Buenos Aires had overthrown its Viceregal Government in May 1810, and under the leadership of José San Martín an Argentinian army marched to the relief of Chile in 1817, and onwards to Peru where San Martín declared Independence on July 28, 1821. However, the Viceroy, La Serna, still commanded strong forces, and the Spanish troops did not capitulate until January 1826, following their defeat by Simón Bolívar of Caracas at Pichincha, Ecuador in 1822 and by Bolívar and his General Sucre at the Battles of Junín and Ayacucho, both in 1824.

The newly-proclaimed Republic of Peru rapidly encountered internal political problems, economic discomforts and ruptures in foreign relations with her neighbours. Peru was embarrassed for several months in 1823 by the concurrent election of two rival Presidents; José de la Agüera in Trujillo and Torre Tagle in Lima. Bolívar rode the crisis by temporarily assuming control of the Peruvian Government.

During the second and third quarters of the century, the Peruvian Government found itself living from hand to mouth, despite the growing guano and nitrate industries in the southern desert and off-shore islands. Peru was verging on bankruptcy and default as she and Bolivia engaged in the War of the Pacific against Chile from 1879 to 1883. The period of warfare marked the collapse of the Peruvian economy.

As a result of the war Bolivia lost her access to the coast to Chile (so her navy is now restricted to sailing Lake Titicaca) together with much valuable nitrate desert. Peru also suffered a reduction of her nitrate territories under the Treaty of Ancón, by which Chile was to have the lease of the previously Peruvian territories from Arica southwards for a hundred years.

Concurrently with the War of the Pacific, Peru was racked by Civil War which seemed to be of more concern to the Peruvians than the Chilean invasion. At one period bitter power struggles amongst the ruling elite resulted in three simultaneous Peruvian Governments, leaving the Chileans unsure who they should negotiate with. Neither was the internal carnage restricted to the elitist factions. The rural labourers rose against their landlords, causing them to abandon their haciendas in large number, and the rural populations themselves enacted prejudices against the Chinese immigrants of their own social grouping, as well as the imported negroes.

It can be asserted with reason that the Peruvian civil war did as much to alter the composition of Peru as the external War of the Pacific. The ruling elite was considerably reduced and the rural land-working populations, after their wartime movements outside their home villages, gained a conception of themselves as members of a nation. Moreover, the Peruvian economy had to be reconstructed, virtually from base.

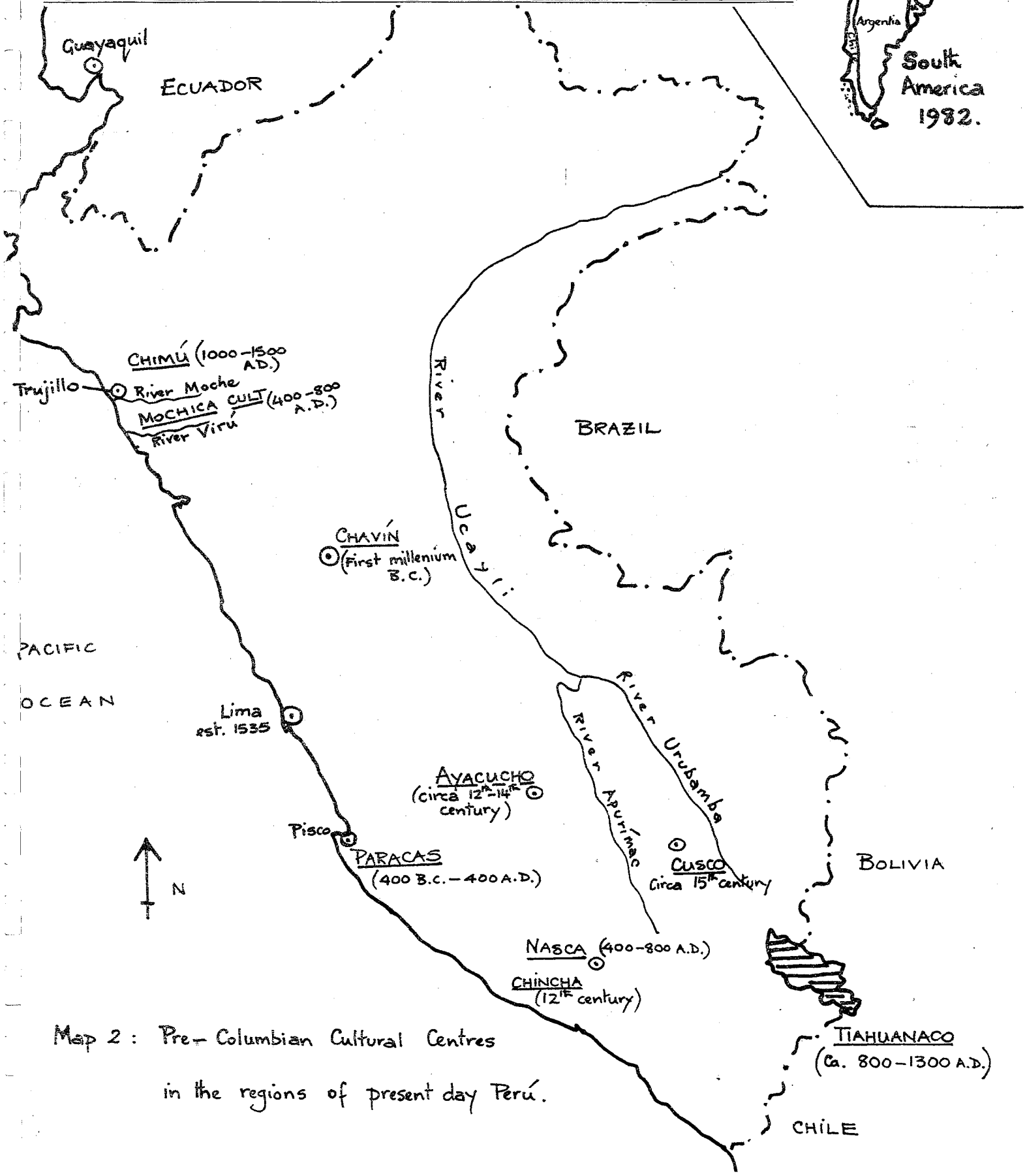
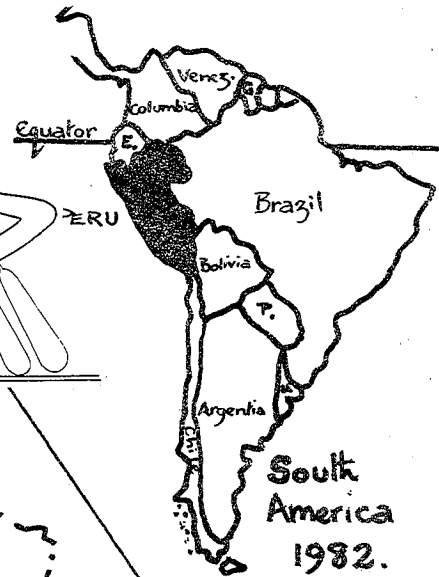
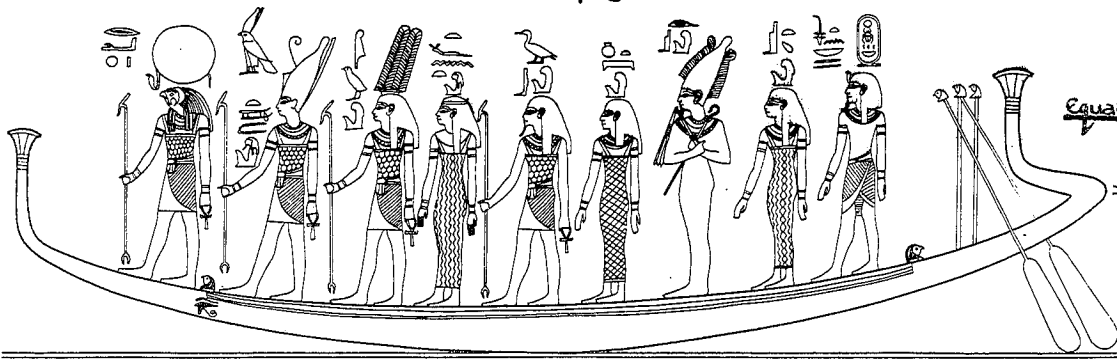
The Grace Contract was signed in 1890 under which overseas (mainly British) bondholders in the defaulted Peruvian Government gained ownership of the remnants of the southern nitrate industry, the railways and the copper mines. The economy expanded during the 1890's, under the Presidency of Piérola who encouraged the inauguration of small native enterprises and legislated unfavourably for foreign-owned companies operating in Peru. Rubber production formed a significant part of the economy until the time of the First World War.

Peru also had a border dispute with her northern neighbour, Ecuador, which came to a head in 1941, when Peru occupied much of the Selva territories of Ecuador. The disagreement simmers to this day.

An outline history of Peru would not be complete without reference to the programme of "military socialism" pursued by the Military Government following its coup in 1968 until the convocation of the Constituent Assembly in 1978. It aimed to "promote a higher standard of living compatible with human dignity" and to "firmly defend national sovereignty and dignity". This programme included the implementation of the "Reforma Agraria" under which the large estate-holding haciendas of colonial heritage were disbanded. Locally operated Co-operatives were established in their stead.

A visitor to Peru today cannot fail to notice the grey and white national uniform worn by schoolchildren from city centre to mountain peak. This was a further decree of the Military Government, with the aim that no schoolchild could be discerned as going to a better or worse school than another.

President Fernando Belaúnde Terry, deposed by the military in 1968 and re-elected when they gave up power in 1978 is to hold the Presidency until 1986, according to the 1979 Constitution, the adverse effects of the World Depression permitting.



Map 2: Pre-Columbian Cultural Centres
in the regions of present day Perú.

5. CAVING IN PALCAMAYO

5.i An introduction to caving in Peru (JMW)

A glance at the geological map at the South American Explorer's Club (address appendix 4) shows Peru to have enormous areas of karst, which must be amongst some of the highest limestone in the world. It has been suggested (Balázs 1977) that South America is the poorest continent for known carbonate rocks but the implication is that this may be due to the fact that much of the continent is unmapped. The journey down from the Andean water shed, east of Lima, provides views of magnificent rolling karst* scenery (somewhat reminiscent of the Yorkshire Dales) as far as the eye can see and this, with Rossell's (1965) long inventory of Peruvian caves, left me with the impression that there is more than enough potential in Peru to keep any visitor occupied for years. The fact that South America's deepest cave, La Sima de Milpo (in Peru), is just 407m deep is probably more a reflection of lack of caving activity in the region rather than any dearth of extensive cave systems.

At present there seem to be no active Peruvian cavers and few foreign expeditions have visited the karst of the country. The most successful team to cave in Peru was the 1972 British Expedition (Bowser et al 1973) but there have also been, among others, French (Orville 1977) and Italian (Tavagautti 1979) expeditions.

The area around Palcamayo has been explored by British, French, Polish and Peruvian caving expeditions during the past twenty years but it seems that the most promising area has so far been completely neglected.

Two days before I had to leave Peru I was shown maps of limestone uplands near Cajamarca in northern Peru, and the region is irrigated by numerous disappearing rivers. Rossell (1965:17) mentions many caves including one of great dimensions visited last century: La Gruta de Uscopisco, 20km south of Hualgayoc. This is reputed to contain an underground river 5km long.

Since the climate and scenery in this part of northern Peru would seem to be very attractive, and foreign visitors would not encounter the acclimatisation problems we had at Palcamayo, this region seems to be a must for future cavers. Maps and aerial photographs of the area can be easily purchased from the National Geological Institute in the Plaza San Martin in Lima (address appendix 4).

5.ii Cueva de Huagapó (JMW)

Altitude 3,572m above sea level; passage length 1,698.5m

The cave is a big local tourist attraction; school parties and other Peruvian visitors drive up the hard-top road to within sight of the impressive yawning cave entrance and picnic outside. Few venture more than 100m inside despite the fact that steps have been built down to the river just inside the dry entrance. Stepping stones have been placed so that it is easy to walk along the river to the first pitch without getting the feet wet. Whenever we emerged, soaked and shivering, from a caving trip, people seemed surprised that the system we had been exploring was nearly 2km long.

*karst - limestone scenery

The Dry Bypass

A 10m slippery climb up allows access to the Dry Bypass. This is the most unattractive part of the cave. The floor is hard packed mud tainted with human - and a little bat - excreta and the few pools are loaded with mosquito larvae and cigarette ends and smell of stale urine. This section is roomy and a few holes in the floor lead back down to the river.

The floor above most of the several drops and pitches in this section is slippery and treacherous and presumably explains the occasional deaths in the cave. A few tourists climb up and scramble around the Dry Bypass, often with no lights at all. And a slip at some points would mean a fall of at least 10m onto sharp boulders.

Bats

At the deepest part of the Dry Bypass there is a 10m ladder pitch (which can be free climbed) down to the river. Just beyond this point is found the roost for what seems to be the only bat colony in the area. Nearly all the excreta from these bats falls into the river and is swept out to daylight. I found no guanobious* insects in this section.

Since the cave between the colony and the dry entrance used by the bats is large it was not possible effectively to block the bats' exit with mist nets. I therefore do not know which species roosts in the cave.

The Trip to the Terminal Sump

The easiest way on is to avoid the first climb up and follow the river which passes under the Dry Bypass. However, this involves immersion in one of the deepest sections of the river (it is chest deep here) and it is possible to stay warmer longer by using the Dry Bypass on the way in. The water is extremely cold and wet-suits are really needed, although we managed without by making short (less than 3 hour) fast trips inside and dressing up well in Damart Thermawear and other warm clothes which do not hold too much water.

It takes less than two hours to the Terminal Sump and back (despite Modesto's stories of an 8-hour trip) and this involves a trip through some of the finest cave passage. I tried to capture the beauty of Huagapo with photographs but they do not do this magnificent system justice.

The passage width rarely exceeds 10m but the roof in places is as much as 50m high, and the bats have chosen to roost in one of the highest, most inaccessible places.

The Biology of Huagapo

Dead and living caddis flies (Neuroptera) are found all down the first half of the cave, but this seems to be the only life in Huagapo. I found no sign of any cave adapted forms although there are plenty of local rumours of blind white cave fish. I did not see any and I gather that the 1976 French expedition did not catch any either. There are certainly plenty of (tasty) fish in the River Shaca outside (which takes the Huagapo resurgence) but they could not migrate upstream because there is a 6m waterfall barring the way. So unless fish have been brought in by the birds, which rest in the resurgence entrance, there is a good chance they would be troglobites⁺ and perhaps a new species.

*guanobious - feeding on guano or upon the fungi which grow on it.

⁺troglobite - cave adapted animal that is never found on the surface. An obligate cave dweller

5.iii La Sima de Milpo (DJK)

Altitude 3,992m above sea level; passage length 1,894m; depth 407m.

The most difficult part of this cave is finding it. On the first search we walked for an hour and a half up a spectacular gorge, climbed steeply and eventually reached a small village consisting of a few mud huts and a small, stagnant pool of water. The first person we asked about the cave - an old woman herding her sheep across the valley - did not speak Spanish, so she took us to her husband, who peered at us from the gloom of his hut, guinea pigs scuttling around his feet over the packed mud floor. He categorically denied the existence of any sort of cave near his village and insistently directed us to Huagapo, assuring us that it was "muy lindo" (very nice). We left, mildly surprised that he didn't know he was living on the doorstep of the deepest cave in South America.

Moving back down the valley, we found a small boy who knew a cave nearby. We followed his directions and came across a small fissure at the base of the cliff on the south side of the valley, just below the village. The crack was almost entirely clogged with small stones carried down by the stream which evidently sank there during the rainy season. This bore witness to the fact that nobody had been in the cave for some years, and we were forced to return to camp not sure whether we had found the right cave.

Further consultation with Modesto confirmed that we had found the cave, so some of our pessimism was quashed. Later in the week Steve and Dermot made another attempt and managed to clear enough stones to get into the entrance chamber, after a two metre long squeeze through the crack.

Early the following week Dermot, Steve and myself set out on a third attempt to enter the cave. This time we were equipped with two ladders and 20m of rope. We did not hope to bottom the cave, as there were eight pitches in it, but we intended to reach the high level sump and follow the passage which ended in a question mark on the Imperial College survey (see Bowser et al 1973).

Once through the tight entrance, the entrance chamber was piled with loose boulders, which necessitated careful co-ordination of movement for safety. To the left, down a steep slope, we reached the first pitch. We tackled this with a 6 metre ladder, having to free climb the final 3 metres.

Leaving Steve at the top to belay, we turned sharply to the right down a crawl which then bore left and opened out to a chamber with three ways off. Two of these were in fact just a small circuit, so taking the third, left-hand crawl we continued down steeply, past a large number of stalactites and impressive flow-stone formations. Beyond another 2 metre pitch, the passage opened out to an easy walk over cobbles. After another 150m of steep descent, we reached the top of the so-called 'Polish Pitch'. This was a 7 metre pitch, and we had run out of time, so we were forced to return, with promises to come back one day and bottom the cave. Leaving this cave so late in our stay at Huagapo proved to be a source of regret for a long time. It is a little-known cave containing many beautiful formations in better condition than those in Huagapo. There is also the possibility of a link with Huagapo, since any water which sinks into Milpo is thought to resurge at Huagapo. Still, maybe someday.....

5.iv La Cueva de Pacuy Huagen (DJK)

Altitude 3,950 m., passage length 571 m.

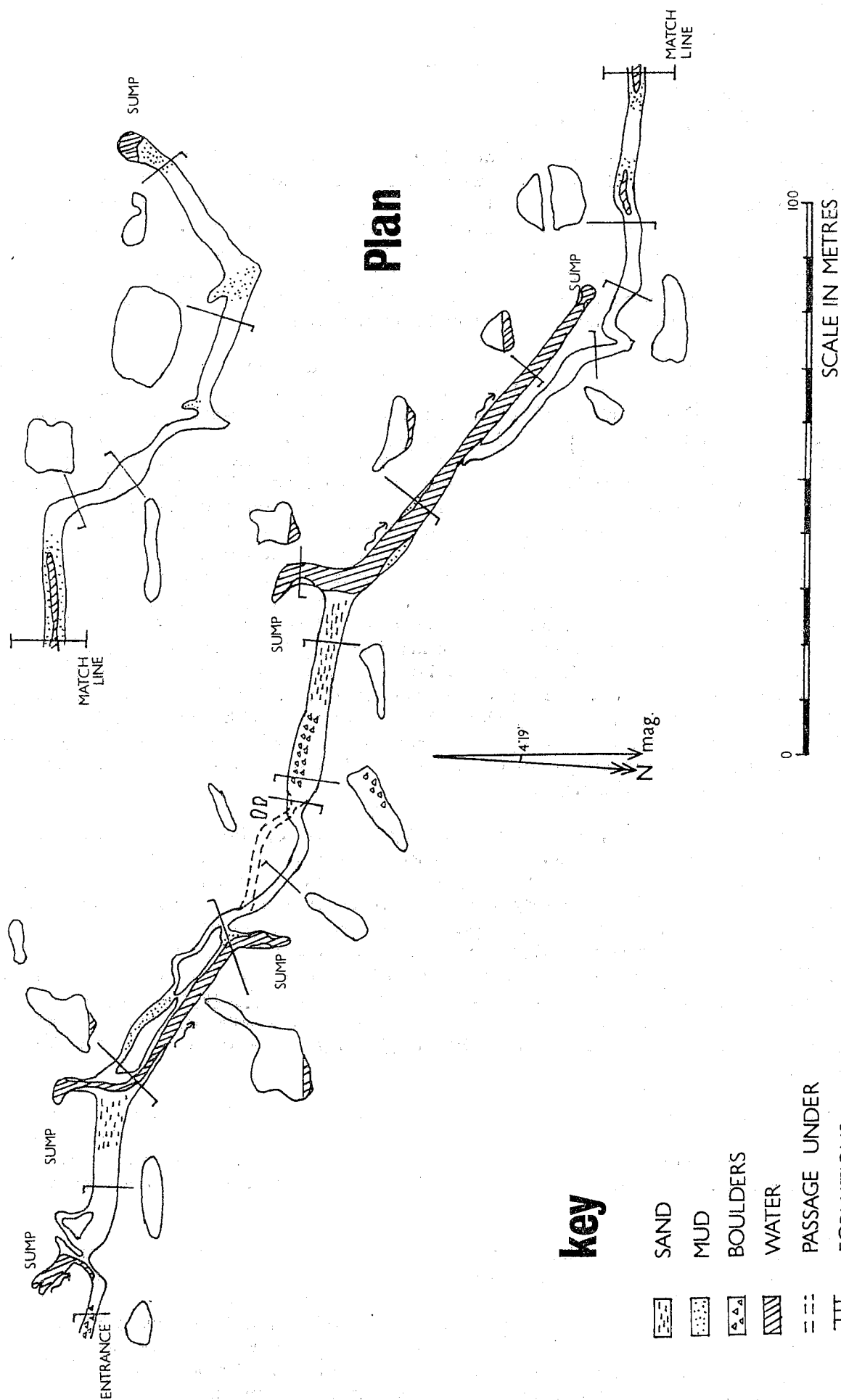
The approach to this cave is considerably easier than to Milpo. It is an hour's uphill walk from Huagapo, towards San Pedro de Cajas. The only problems encountered in getting into the cave were caused by the landowner who keeps his guinea pigs penned in an adjacent rock shelter. He usually demands cigarettes for crossing his land, but was placated with a coin or a packet of Polos. He also has a habit of hanging his washing across the cave entrance, and on one occasion he claimed to be burying a dead body outside the cave! (The area is notorious for witchcraft.)

The entrance to the cave is small, and entry is further hindered by a water-pipe running into the cave for the first four metres. Once past the entrance tunnel we came to an easy 2m climb which took us into a small water chamber where we found (but left in place) a lot of pottery. Keeping dry while climbing the 2m waterfall was facilitated by the additional handholds provided by the water-pipe. Beyond, the passage continues to a blind sump, but there is a narrow chimney above the waterfall, and after a squeeze we got to a chamber which was immediately christened 'Santa's Grotto' because of its beautiful formations. From this chamber there are two alternative routes on - an upper and lower passage, separated by a water shelf, and a narrow worm-hole off to the left. All three meet up after 10m or so. After this there is a gentle slide down a wide low passage with a sandy bottom, leading to the second stream. This stream sumps at either end, its total length being about 50m. A bat skeleton was noticed here by AJW but there was no further evidence that the cave was used by bats. We crossed the stream and followed the passage steeply up to the right, passing through some extensive boulder-fall. The passage then levelled out, but we were forced to crawl along the 1m diameter passage, worming in between lots of delicate stalactites - we had to take great care to avoid any damage.

Coming out of this crawl, we had to chimney out along the top of a rift which led down to the second stream. Once past this rift the passage again divided, with two alternative routes, an upper and a lower, leading to a large cavern with a floor of treacherously loose boulder-fall. In the lower (and tighter) of these two passages we found a perfectly preserved skeleton of what JMW guessed to be a creature akin to a jagurundi, measuring about 30cm long. We also found cat-like footprints in the mud floor in the stream passage, which could have been made by this animal. It is probably Felis pardalus. Finding such a cat so deep inside a cave and beyond a smooth, awkward vertical squeeze is difficult to explain. JMW caught a glimpse of a 'cat' in the entrance.

From the boulder-fall cavern we followed another sandy slide down to the third stream. There is a 4m pitch down to the stream which can be climbed easily despite the treacherous appearance of the loose, sandy area at the top. There is, however, a belay point on the right hand side a few metres back from the pitch.

Wading along the river to the right, knee deep in water and thick mud, we found the continuation of the main passage off to the right 30m along. It continued parallel to the river for some time, staying horizontal. From this point the whole scale of the cave seemed to increase, and we could walk upright along the passage for most of the rest of the way. The passage appears to be an old stream bed with a mud floor. It is possible that during the rainy season there is a substantial amount of water in that part of the cave.



LA CUEVA DE PACUY HUAGEN

DEPARTMENT OF SAN PEDRO DE CAJAS, PERU

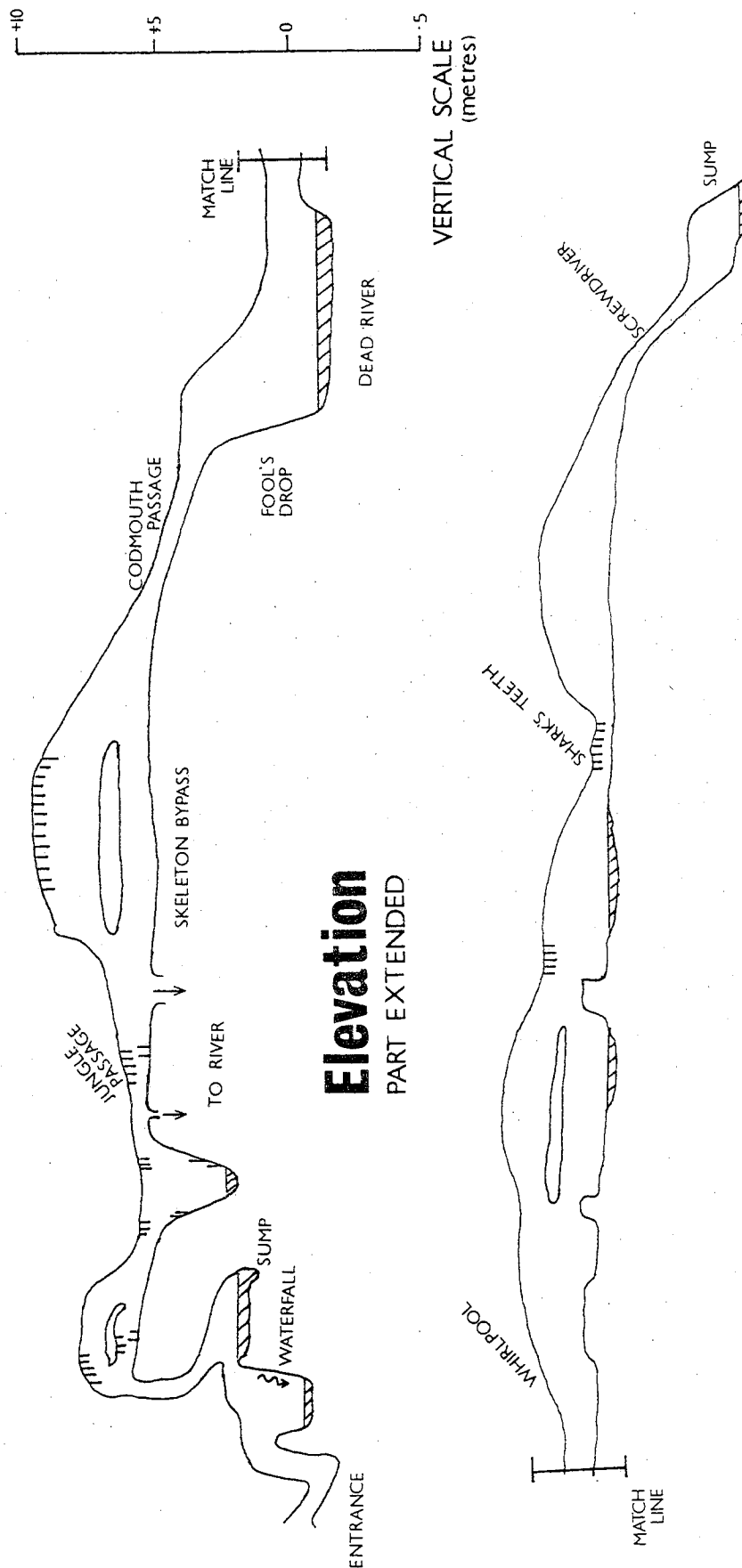
11°14'31" S 76°49'58" W

S.U.E.S.P.E. AUGUST 1982

Surveyed by AD, DIK, DM, JCP, AW. Drawn by DIK.

Notes

1. Altitude 3950m
2. Length of main passage 389m
3. Total surveyed length 571m.
4. Surveyed to C R G grade 3b
5. Sections drawn 4x scale facing entrance
6. Vertical scale of elevation exaggerated 4x



Further on, masses of stalactites are clustered on the gradually dropping roof. The passage continues as a crawl for a few metres, densely forested with stalactites, hence the name 'Shark's teeth'. After crawling past several stalagmites, obviously broken by an earlier expedition, we turned left and found the tightest squeeze of the whole cave. This involved a belly-crawl with an apparently impossible 90° left hand bend in the middle. Thanks to our diet of vegetable stews and the lack of a decent pint, we got through but only after much grunting and wriggling. Once through we followed a gentle muddy slide for 10m down to the final sump. In the mud by the water we found a single footprint, probably left by the French in 1976. This discovery came as a blow, but we realised that we were probably the first English people to bottom the cave, which gave us some comfort, so we returned after planting a Union Jack beside the footprint.

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6 BATS AND THEIR PARASITES (JMW)

6.i. Introduction

Parasitic diseases cause a great deal of morbidity in South America and yet little is known about them. Schistosomiasis, for example, is said not to exist in Perú, but several well informed biologists in the Selva assured me that it does.

Probably the most important parasitic group in South America is the protozoa: including malarias, leishmanias and trypanosomes. All are transmitted by biting insects but in the case of at least one of the leishmanias, it is not known which species of sandfly is its vector. This is a tragic lack of knowledge about a disease which is responsible for such disfigurement and debility in so many Peruvians. This leishmania is locally known as "uta" or "verruca" and is a big problem in the Sierra ; and if some of the Inca pottery is anything to go by has been a problem for centuries. The scanty knowledge on its biology is reviewed by Lainson and Shaw (1978 and 1979 : 91 - 98).

If any realistic attempt is going to be made to control protozoal disease, it is important to know whether the parasite can thrive in an animal reservoir. This is known to happen in leishmanias when "uta" infects domestic dogs and can then be passed on to people via a sandfly vector. Whether animal reservoirs are important in disease due to trypanosomiasis in South America (Chagas Disease) is less well understood.

The point of the bat project was to identify any protozoa present in the bats encountered, attempt to culture and isolate them. Then work towards establishing whether these parasites are likely to be transmissible to man. Such a study should also provide additional taxonomic and biogeographical information on South American protozoa which can only add to the data needed to sort out this much understudied but important group.

6.ii. Methods and Materials

Bats at Altitude

The only bats I managed to find in the Palcamayo region were the colony of one hundred or so about 40m up in the roof of the Cueva de Huagapo. These were too high to reach with anything but a shot-gun (I did not resort to such a barbaric method!) and the dimensions of the cave between the entrance and the colony all too large to make mist netting practicable.

Bats in the Selva

Down in the Tingo Maria area the bats were much more accessible and much more abundant. I took most bats by hand (protected by leather gloves) and a few in mist nets, either draped over cave entrances or erected on poles in places I had noticed bats flying on previous evenings.

Blood Smears were taken by puncturing the largest vein in the leading edge of the wing letting a drop of blood fall onto a microscope slide and a thin smear made using a BDH blood film maker. I found these handy little devices useful in ensuring a good quality blood slide in the often awkward conditions under which I was working.

Ectoparasites were removed and then the bat could be released not much the worse for the loss of his parasites.

Some bats were sacrificed so that cardiac blood could be taken aseptically and inoculated onto blood agar so that the haemoprotozoa could be cultured.

Blood Agar

Due to pressure to time just before we departed for Perú, we did not make up the blood agar until we got into the field. This was almost certainly a mistake. We were fortunate in being provided with Prestige pressure cookers but still found it difficult to maintain any sort of sterile technique in the open and exposed to breeze.

Defibrinating the blood was the first problem. A 10ml screw topped Camlab bottle, containing about 10 clean rounded stones, (3-6mm diameter) was sterilized in a pressure cooker and allowed to cool. In excess of 5ml of the expedition leader's venous blood was taken into a disposable hypodermic syringe by the medical officer (much to the consternation of the Peruvian audience that always seemed to be with us) and this put into the bottle. This was gently agitated for well over five minutes. Drops of the resulting defibrinated blood were then mixed with warm Nutrient Agar Oxoid CM3 (as is suggested by Lainson and Shaw 1979 : 28 and Lumsden et al 1973) in glass bijou bottles and allowed to set at a slant. Two batches of blood agar were made up on separate occasions; some were partially haemolysed (by getting too hot in the sun) before any blood was inoculated.

Coccidia

Wherever possible faecal material was collected and guts complete with contents dissected out and fixed in formalin. It is the intention to look for coccidia in these samples but at present I have no time to take on this work. Any findings will eventually be published. The literature on coccidia of bats has been reviewed Levine and Ivens 1981.

6.iii Results so far

Blood Agar

About half of the cultures were contaminated and so overgrown by fungi that any trypanosomes present could not be detected. This is probably due to the fact that the agar was made up in the field under rather difficult conditions and also that most of the time I was deprived of my star technician (MEW)!

The cultures that were not contaminated were checked for trypanosomes by Dr. David Turner of Imperial College but he found no parasites.

Blood Smears

The fixed blood smears that were brought back were stained by the "Diff-Quick" method and scanned at least twice each for blood parasites. Some portions of the slides were difficult to assess because despite being fixed in the field, thoroughly dried and being subsequently kept sealed in with silica bags, some fungi managed to start growing. However this only affected tiny sections of a few slides.

Series of good quality slides were only obtained from two species Carollia perspicillata and Peropteryx macrotis. Both species were infected with haemoprotozoan parasites, but no trypanosomes were seen.

All individual Carollia examined had haemoprotozoa in the blood in moderately high parasitaemia and this was usually associated with a leucocytosis. A strange protozoan spore and an autorosette (a T-lymphocyte with a rosette of erythrocytes) were also noted on one of the Carollia smears.

Fewer individual Peropteryx bats were infected and those in which haemoprotozoa were seen had far lower parasitaemia and no leucocytosis.

Work is progressing to identify the parasites found.

6.iv Discussion

The absence of demonstrable trypanosome parasites in the bats of Tingo Maria could be explained by the dearth of suitable vectors (e.g. bugs). It has been noted (by Marienkelle who works in Columbia) that incidence of bats with trypanosomes decreases sharply with increasing altitude. We appear not to have been low enough (at 650m a.s.l.) to be in an area rich in biting insects which could transmit trypanosomes. Bats in caves are only rarely infected (D.P. Turner 1982 pers. com.)

The fact that the Polychromophilus type of (malaria-like) parasites were present in the colonies may be explained by the abundance of Aedes mosquitos which could transmit parasites.

Such mosquitos were collected from one of the main Carollia roosts inside La Cueva del Nido de Guacamayo (see page 8.3) and near the mixed Myotis/Noctilio roost mentioned in section 6.vi.

~~There were~~ Differences in parasitaemias and in prevalence of infection with protozoa ^{as well as} in the roosting habits of the two bats. The more heavily infested Carollia prefers to roost close to his fellows while the Peropteryx which hang perhaps 30 cm from the next member of the colony, escape with fewer parasites. They also appear to be less affected by the infection since they show no appreciable leucocytosis.

6.v Conclusions

The bats in Tingo Maria do not appear to be acting as a reservoir of the human Chaga's Disease (trypanosomiasis). The malaria-like parasites with which they are infected are unlikely to be transmissible to man. None of the bats showed any sign of leishmanial infection. No Leishmania parasites were detected and no "uta"-like sores seen on any human or other mammalian hosts in the regions we visited. Nor were we able to find any sandflies which are the chief vector of leishmaniasis.

6.vi. The Bats

There are a great variety of bat species inhabiting the South American lowlands, some surprisingly large animals compared to the microchiroptera of the Old World. The most successful family must be the Phyllostomatidae : the New World leaf nosed bats. They have managed to adopt a variety of feeding habits and so fill many many niches in the Americas. A pretty comprehensive review of the family is to be found in the three volumes edited by Baker, Jones and Carter (1977) and it is the taxonomic guidelines therein that I follow below; additional useful background information is also found in Goodwin and Greenhall (1961) and Tuttle (1970).

Bats encountered in the Tingo Maria region

Phyllostomatidae leaf nosed bats including vampires sub-family Carolliinae.

Carollia perspicillata Linnaeus 1758 A large widespread species found in Panama, Brazil, Ecuador and Bolivia. It is probably not a very specialised feeder. Many consider it is frugivorous* but it may also feed on flowers and insects. Its teeth certainly seem much too sharp for it to be a lotus-eater!

Glossophaginae sub-family of nectar-feeding bats.

Glossophaga soricina This species which was roosting in a small rock shelter in the Monzón Valley about 9km west of Tingo Maria had a long tongue (half the length of its body) with distal papillae presumably useful when taking nectar from flowers.

* Frugivorous = feeding on fruits

Noctilionidae : the fish eating bats.

Noctilio albigentris was roosting in a hollow tree with the Myotis simus close to a river. However as this species is fairly omnivorous, it was just as likely to be feeding on insects as the river fish. This is an attractive fawn-coloured "bulldog" bat (so called because of the bulldog-like face) which had very powerful scent glands. The bag that one of these bats had been kept in, tainted everything it touched with musk.

These bats have disproportionately large feet and interfemoral membranes. The former for catching the fish, the latter probably for breaking in mid-flight.

Vespertilionidae : 'small brown bats'

Myotis simus

Molossidae : mastif bats

Molossops planirostris milleri

This specimen was the first of this sub-species received by the British Museum.

Emballonuridae

Pteropus macrotis macrotis an attractive little piggy-nosed bat that was commonly found in cave entrances but never in dark zones.

I was extremely fortunate to have met and been able to work with Garry Graham, a bat ecologist from the University of New Mexico. He was not only able to identify the species of bats we encountered but also taught me a lot about their ecology. Much more than I could have learnt from the sparse literature on the bats of the region (see Bowles et al 1979; Tuttle 1970 and also Goodwin and Greenhall 1961 for an interesting review of the importance of bats in spreading rabies in Trinidad).

Mr. J. E. Hill of the British Museum did the definitive identifications on the bat specimens and was able to supply the sub-specific names given above.

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7. OILBIRD ECOLOGY (JMW)

One of the few birds that can navigate in the dark by echo-location, and the only New World bird with this talent, is the Guacharo or Oilbird, Steatornis caripensis. This large-eyed hook-billed distant relative of the nightjar is erroneously called an owl ("lechusa") by many Peruvians. We found that asking where we might find "lechasas" was one useful way of locating caves.

To help prevent their youngsters being enjoyed as a delicacy by Peruvians, oilbirds nest high on ledges in limestone caves in lowland Peru. They are also found in Ecuador, Venezuela and Trinidad (Snow 1975; Snow 1979).

The adults fly out each night and it is commonly believed that they feed on fruits of trees of the palm family.

We were able to visit three Oilbird caves near Tingo Maria including the best known : Cueva de las Lechusas. As we entered, each cave seemed to be emitting squelching noises as the birds warned each other of our intrusion; then as they began to fly, it seemed that we had arrived in a busy office as the echo-locating clicks sound like typewriters.

Inside under the roosts habitually used by the Oilbirds, are mountains of dry seeds and other debris.

The birds swallow fruits whole then come home to regurgitate the indigestible stones. So generations of Oilbirds have imported piles of seeds up to 20 metres high and at the summit of each little peak is a "topknot" of young palms that have germinated and have begun struggling up to reach the light.

The seeds in the ejecta under the Oilbird roosts in the Cueva de Castillo (see 8.v.) indicate that the birds mainly feed on the palms listed below (in order of abundance) but also on the two non-palm species. Peruvian names (Ferreyra 1979) for each tree are given in parenthesis. (Seeds were identified by Sr. Miguel Ramirez Rengifo of the Jardin Botanico de Universidad Nat. Agric. de la Selva at Tingo Maria and checked by Dr. Frances Davies of Kew.)

Palmaceae (Palms)

Jessenia polycarpa Karst (Ungurahui)

Euterpe precatoria Mart. (Huasai)

Mauritia flexuosa L. (Aguaje)

Iriatea exorrhiza (Pona)

Weltinia maynensis (Cuyo-corata)

This last species appears to make up only a tiny proportion of the diet.

Laurelaceae (Laurels and rhododendrons)

Nectandra Sp. (Moene)

Tiliaceae (Limes)

Luehea Sp. (Calzoncillo-panga)

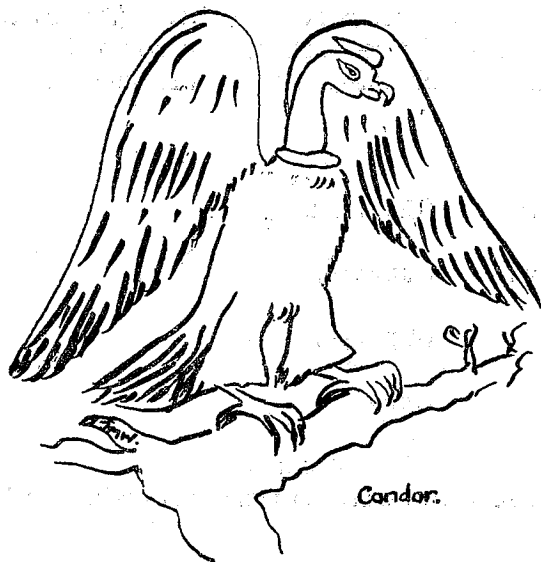
The Oilbirds which roost in the Cueva de las Lechusas and the Cueva de Boca de Lobo were eating a similar diet except that they were not feeding on the palm Mauritia flexulosa, as far as I could see. This is presumably because it was not readily available close to these two caves.

Conclusion

Like Oilbirds in other parts of South America, Oilbirds from Tingo Maria feed predominantly on fruits from trees of the palm family. They also take fruits from other species when these are available.

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8. CAVING AND CAVE BIOLOGY IN TINGO MARIA

8.i Cueva de las Lechusas (Cave of the Oilbirds) (JMW)

Altitude 660 m. above sea level.

This is probably Peru's best known cave and the country's nearest approximation to a show cave. Its large entrance allows light and rich Peruvian tourists (carrying tape recorders blaring out South American pop music) to penetrate to about half the cave's length, that is about 250m in. This is all that was surveyed by Imperial College in 1972 (see Bowser et al 1973:28). The cave is also populated by other disgusting wildlife including the biggest cockroaches imaginable and plenty of impressive looking tailless whip-scorpions.

Blue and white swallows and white eyed parakeets roost in the entrance and the latter leave noisily when the first batch of tourists arrive each morning.

8.ii Fungus's Cave (JMW)

Altitude 640 m. above sea level

Perhaps 100m from the large entrance to La Cueva de las Lechusas is a large resurgence issuing from the base of the limestone and estimated by us, and in 1972, to be flowing at about 1 cumec (Bowser et al 1973:28). The enormous flow, abundance of space and relative coldness of the water implied that this was a sump* worth diving. And at the right side of the resurgence (facing inwards) I found a 15 cm. high airspace within six feet of the outside. This short dive took me into a small attractive chamber where the stal. is illuminated by light streaming in through the deep cloudy water. The most obvious signs of life inside are the fungus gnat threads - strands which look like spiders' webs dangling from the roof as part of the fungus gnat larvae's 'road' system.

A large tailless whip scorpion had also found its way inside, presumably through the boulders that make up the outside wall of the cave.

The water is over 3m deep here and there are few places to hang on to rest. The chamber penetrates the limestone perhaps 20m upstream, then turns into an unpleasant duck⁺, mostly with barely 3 - 4cm of airspace and continuing for as far as I went, just 5 - 7m. Unfortunately I was disinclined to push the duck further as my carbide light would not stay lit and I was out of my depth, floundering in a noticeable current, a long way from home!

This cave is certainly worth pushing but electric lights and a mask would help here. The wide underwater passage (probably more than 30m wide in places) and the cloudy fast-flowing water surely indicate some good caving somewhere beyond, but maybe it is only for exploration by the cave divers.

8.iii La Cueva del Nido de Guacamayo (Macaw's Nest Cave) (DJK)

Altitude 690m a.s.l. Passage length 238m

The approach to this cave proved to be the most difficult of the expedition. It is positioned on the side of the mountain slightly above and to the right of Lechusas and the path up to it is poorly marked through the dense rain forest.

On our first visit with Doctor Juarez and his band, the guide (a technician from

*sump - submerged passage in a cave.

+duck - cave passage where there is less than a few inches of airspace.

the university) wielded a machete, which made progress easier. Progress was further simplified by the large number of creepers hanging from the trees, which provided useful hand grips, and also useful brakes on the way down! After winding our way up this muddy, stony, leaf-covered path for about half an hour, stepping over many rotting tree trunks and avoiding (sometimes) a large number of thorn-covered trees, which gave a nasty sting, we found ourselves at the foot of the cliff leading up to the cave. This was the most hair-raising part of the cave. Technically it was a relatively simple climb of about 5m, but it involved climbing out horizontally over a 15m sheer drop on to sharp limestone spikes on the floor of the rain forest below. After much pushing and raucous verbal encouragement from his pals, the guide managed to scramble up and we rigged a ladder around a large stalagmite just inside the entrance chamber (see survey).

The entrance chamber was stunning - it measured around 20m high and 30m across and was carpeted with a thick layer of guano. To the left of the main entrance was a second entrance. Standing on top of a boulder and looking out from here I could well imagine I was suspended above the forest, its lush, verdant cover sweeping down sheer to the Rio Monzón below, then rising again to meet the distant mountains, made blue by the haze. Directly below, in the forest, incessant bird cries accompanied by the occasional crash of the unseen spider monkeys and the buzz of the insects, (mainly crickets and cicadas) contributed to the sense of unreality conveyed by this panoramic scene viewed from this ageless eyrie.

Back inside the entrance chamber, to the right of the side entrance, a tall narrow passage led sharply down to a series of narrow chambers, the walls of which were virtually covered in bats. When I went inside they were disturbed and flew around in a frantic whirl, crashing into me frequently, which was a pretty unnerving experience in such a confined space.

The main cave continues from the South-Western end of the entrance chamber, turning sharp left and opening up to a tall passage, still mostly carpeted with guano. High on the right hand side, above a huge flowstone formation, there is a small skylight entrance. Progress down this passage was hampered by a series of 2m diameter gour* pools which in effect formed a series of hurdles 30cm high. These continued most of the way down the entrance passage, which opened out above us with a shelf running along either side about 3m above the ground. At the end of this long passage we were confronted with a slippery grovel up a 45 degree slope of rock covered in guano slurry, followed by a drop down to knee-deep water, which appeared to be stagnant with mosquito larvae and lumps of guano floating in it. We could not keep out of the water because of the two ducks, affectionately named Donald and Daffy. The first of these, just at the start of the water, allowed only 15cm of headroom.

Once through the first duck and into the crypt (udder chamber) rafts of guano begin floating up, buoyed by methane, as the bottom gets churned up by feet. Thus the impression changes from that of a tranquil, finely columned crypt, to wading thigh-deep through a bat-infested septic tank! Upwards and to the right there was a passage which led to a vile, stinking chimney which was evidently a roost for vampire-like bats. The chimney was too narrow to ascend and we could not see the end. The main passage on was through a low phreatic⁺ tube, 1.5m in diameter, leading to the second duck. This one allowed only slightly more headroom than the first, and opened out to another chamber bearing round to the left.

*gour or rimstone pools develop when calcite deposits form fine walls around pools which grow in height as the water trickles over these walls.

⁺ phreatic - cave passage formed by dissolution while the limestone in which it formed was beneath the water table (if you believe in water tables!)

Here we were able to get out of the water at last and back onto a slippery mud floor - a marginal improvement! The passage on was to the right with a 2m slope upward, then a squeeze through a 1m high and 2.5m wide passage. We then found ourselves in a large chamber, 17m long, 17m wide and about 15m high. In the centre was a column and other formations were scattered around. The walls seemed to be adorned with ledges, from which hung many incredible formations of flowstone and stalactites. The effect of this place lived up to its name - Devil's Larder. A single stalagmite at the far end of the chamber marked the passage on - a low crawl over the slimy mud floor to the final chamber and what had, at one time, been a sump but was now clogged with mud.

To the right a steep phreatic tube, 2m by 1.5m, rises at an angle of 60° to a 'double beehive' shaped chamber. At the centre of this chamber was a single stalagmite, but it was otherwise devoid of formations, hence the name 'Temple of Fertility'.

This was a fascinating cave with great variety. It encompassed extremes, from the beauty of formations rising from the water in upper chamber to the repulsiveness of the 'vampire' roost. It did, however, suffer from the drawbacks of all the caves in this area - guano, guano and more guano. This, combined with the heat, made our caving trips short, but they were still always fascinating and rewarding.

The Biology of La Cueva del Nido de Guacamayo (JMW)

This, the longest cave system in the Tingo Maria area, provides the classical cave conditions of high humidity, constant temperature and a sizeable dark zone. So it was not surprising that this turned out to be biologically the most interesting. It was also the least trampled and disturbed and I suspect that we were the first to enter the deepest reaches of the cave. We were responsible for the only footprints inside.

Attractive little (5cm long) piggy nosed bats: the Emballonurids: Peropteryx macrotis were abundant in the Entrance and Threshold Zones of the cave. Most were no more than 10m from the jungle outside. The other common bat in the cave was the leaf-nosed Carollia perspicillata. These roosted in several crannies which were particularly unpleasant to visit because of the choking emanations from their perpetually wet excreta.

Light penetrates as far as the first flat-out crawl due to a hole in the roof. But because the hole is thatched over with growing vegetation, this does not cause as dramatic a humidity reduction as would normally be expected in a cave with more than one entrance. So humidity loving troglaphiles*, including polydesmoid centepedes, thrive in this chamber.

Mosquito larvae and pupae live in the water and plenty of adults (Aedes) are to be seen flying or resting on the walls. None made any attempt to bite us and as they seem to be spending their entire life in this section of the cave, I guessed that they must be feeding on the large leaf-nosed bats.

I had considerable difficulty catching these bats. I would slither into one of the low blind passages that they favour as roosts and think I had one cornered. Then it would jump down onto the floor and run away. Then I would give chase and corner it again on the floor and it would jump up onto the roof and fly off. I could not adjust to an animal as agile on all fours

*troglaphile - facultative cave dweller: happy living and reproducing both in caves and on the surface.

(feet and wrists) as in flight. No doubt this is one of the reasons why the leaf-nosed bats are such a successful group and able to fill so many niches in South America.

The bats do not penetrate beyond Daffy Duck and so there is no food for the cave dwelling invertebrates - only lots of glutinous sterile-looking mud. I did not find any animals in this beautifully decorated section of cave. However, in one central muddy hollow, we did find a large pile of long-bones of the Carollia bats. These may have been washed in from the Udder chamber as there was no evidence of a bat roost this far in.

8.iv Cueva de la Boca de Lobo (Wolf's Mouth Cave) (JMW)

Altitude 710m a.s.l.

This is the most impressive of the Oilbird caves in the Tingo Maria area. Part of the cave system is visible from the hardtop road in the Monzón Valley below the cave but navigating up to the cave entrance through the primary tropical rain forest is not easy. And the scramble is made particularly unpleasant by the steep incline, abundance of stinging insects and shrubs, coral snakes (we collected two and just missed a third in the 11 days we were in the area) and the limestone boulders that are all too easily dislodged from their resting places on the slippery mud substrate.

We entered the cave by way of the small low level entrance. This took us into the vast main chamber which is lit by daylight from a roof collapse. The light filters through the vegetation (and often rain) above and gives the effect of green spotlights on the palm seedlings that are trying to grow on the cave floor. Once we had become dark-adapted we could pick out rows of pink eyes as the Oilbirds peered down at us, making their peculiar squelching and clicking noises.

White eyed parakeets, blue and white swallows and frogs add their calls to the din so that at times it becomes impossible to communicate with people operating flashguns (one excuse for my lack of Oilbird photographs). Bats roost in the darker recesses of the cave but I was unable to get close enough to any (they seemed to be forewarned by the Oilbirds' alarm calls) to be able to identify the species.

The birds and bats had built several mountains of excreta and ejecta; the largest was about 20m high and in places too steep and slippery to climb.

The ejecta and guano mixture was seething with a great variety of arthropods: mainly cockroaches, woodlice and cave crickets but also collembola, diplura, beetles, moths, booklice and pseudo scorpions. These are all being identified at present.

There were a few small side passages leading from the main chamber, which housed some more specialised fauna: spiders and fungus gnats and their larvae, and here we found the skull of a tree porcupine: Coendou bicolor.

All the specimens collected have been distributed to various taxonomists so that they can be identified then kept in accessible collections and made available for comparative work.

8.v Cueva de Castillo (Castle Cave) (JMW)

This is a locally well known cave, as are many of the Oilbird caves, and it has a large obvious entrance in the sheer limestone outcrops above the town of Castillo, about 3km roughly north of Tingo Maria.

Although the cave entrance is easily seen from over a mile away, finding the way to it through the jungle is quite difficult. Cueva de Castillo has no dark zone but an impressive entrance 40m wide by 50m high. Inside the cave is perhaps 80m high and 100m wide and 40m deep. The floor is covered with steeply inclined Oilbird ejecta and guano that must be many metres deep and again seething with wildlife.

Bats and parakeets also roost in the cave and these and the Oilbirds provide an abundant food supply for the rich insect fauna within, including 8cm long cockroaches and 3cm long ants.

8.vi Cueva de las Pumas (Pumas' Cave) (JMW)

About half an hours drive north-east of Tingo Maria at Pumahuasi is a small but locally well known limestone cave. It is about 120m long and looks well trampled and is home to many small brown piles of human origin. Leaf-nosed Carollia perspicillata and plenty of cockroaches also live inside. It is an un-noteworthy, but well decorated, cave and worth visiting if you are in the area since it is an easy 100m walk from the metalled road at Pumahuasi Bridge.

I suspect that further searching would reveal many more caves in the area but a cursory glance at the walls of the nearby river gorge showed nothing but rock shelters.

8.vii Other caves

We were told about several other caves which we did not have time to investigate:

Bogueron del Padre Abend is about 2 hours by vehicle from Tingo Maria on the Pulcalpa road.

Cuevas del Rio Aspuzana at Tocoche about three and a half hours from Tingo Maria.

Las Cuevas de las Pavas is a locally well known picnic spot, in a limestone gorge about 10 km. outside Tingo Maria, that is popular for bathing. There are no caves in the gorge and a few hours spent poking around rock shelters in the immediate area revealed no caves of any size but a couple of bat roosts.

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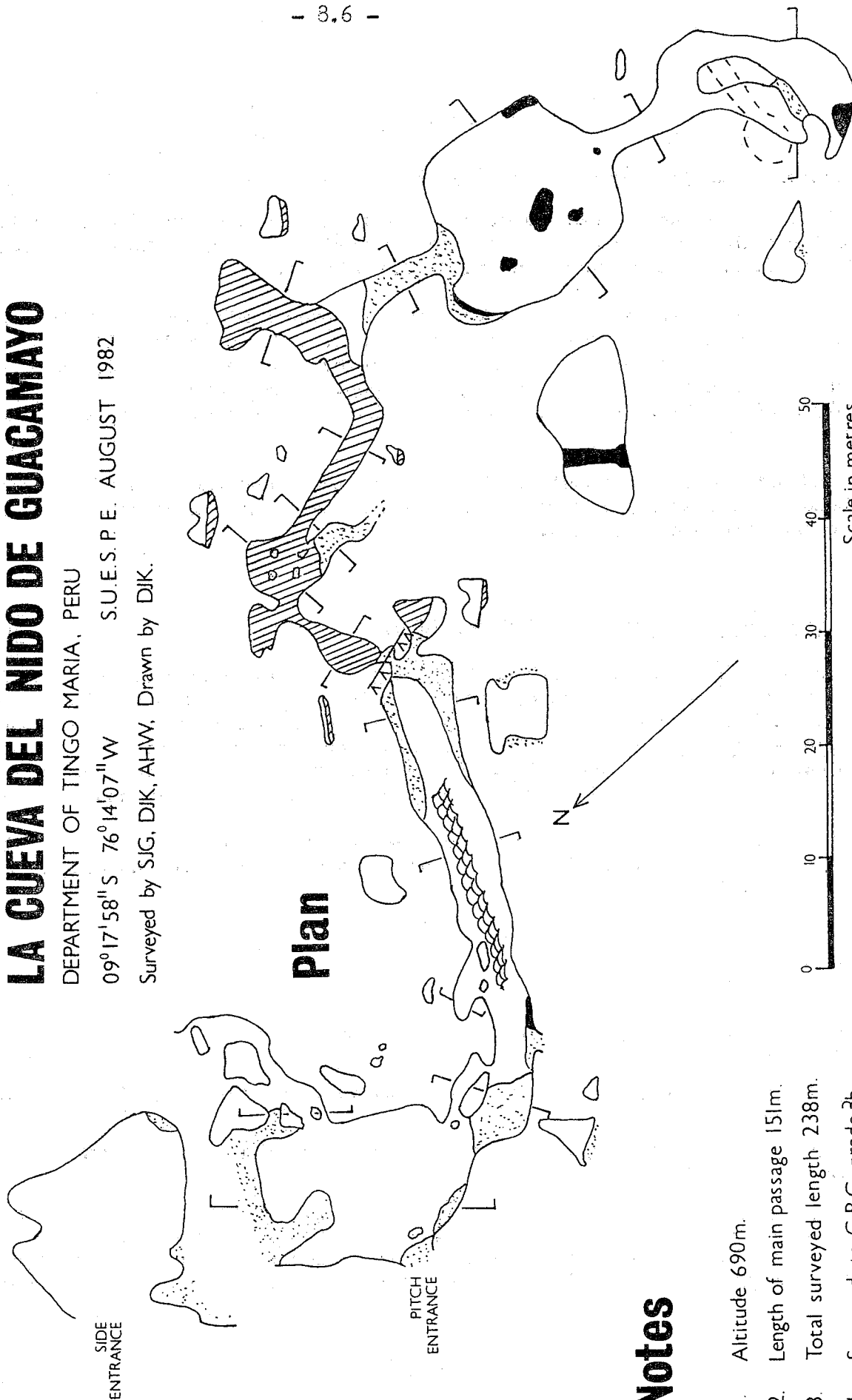
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LA CUEVA DEL NIDO DE GUACAMAYO

DEPARTMENT OF TINGO MARIA, PERU

09°17'58" S 76°14'07" W S.U.E.S.P.E. AUGUST 1982

Surveyed by SJG, DJK, AHW, Drawn by DIK.



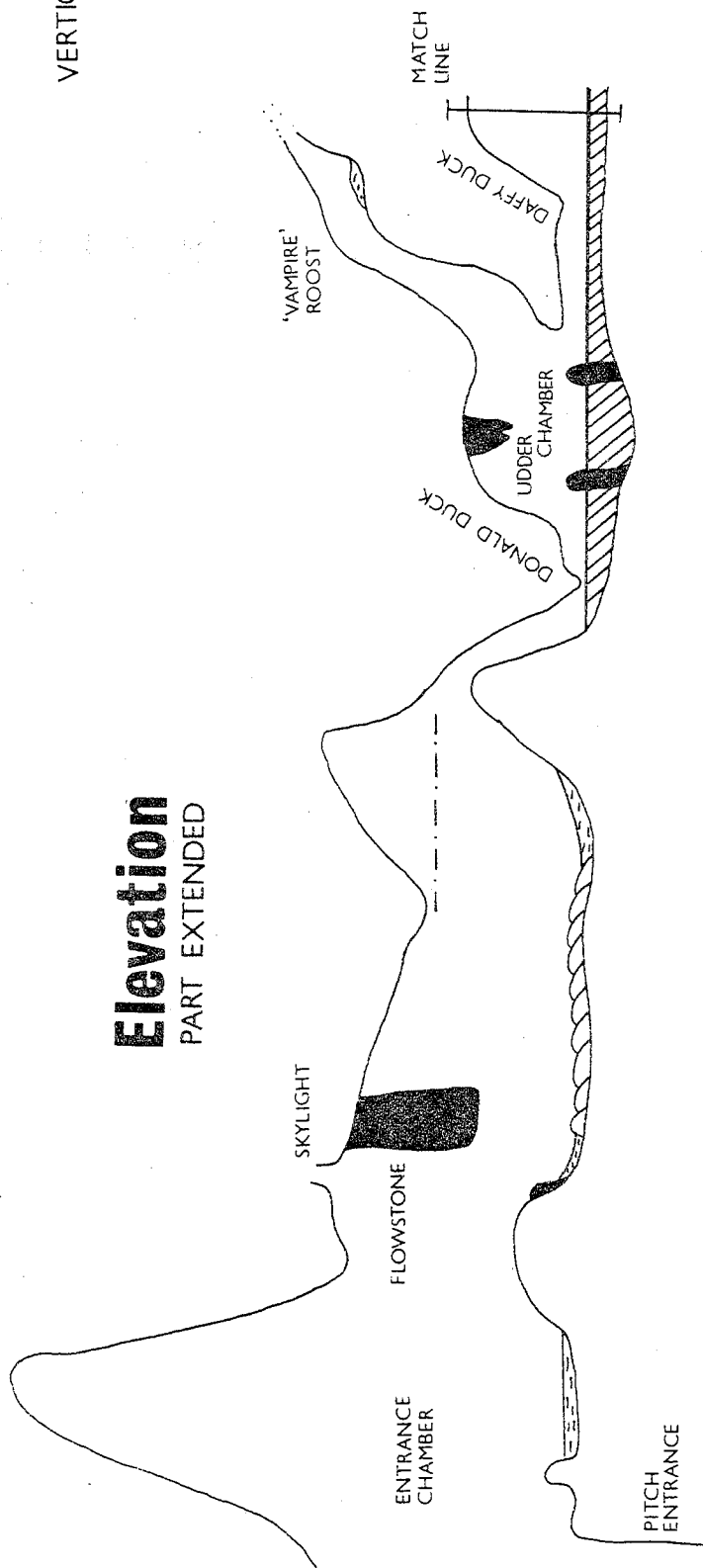
Notes

1. Altitude 690m.
2. Length of main passage 151m.
3. Total surveyed length 238m.
4. Surveyed to C.R.G. grade 3b
5. Cross sections drawn to scale, direction as indicated
6. Vertical scale of elevation exaggerated 3x

VERTICAL SCALE
(metres)

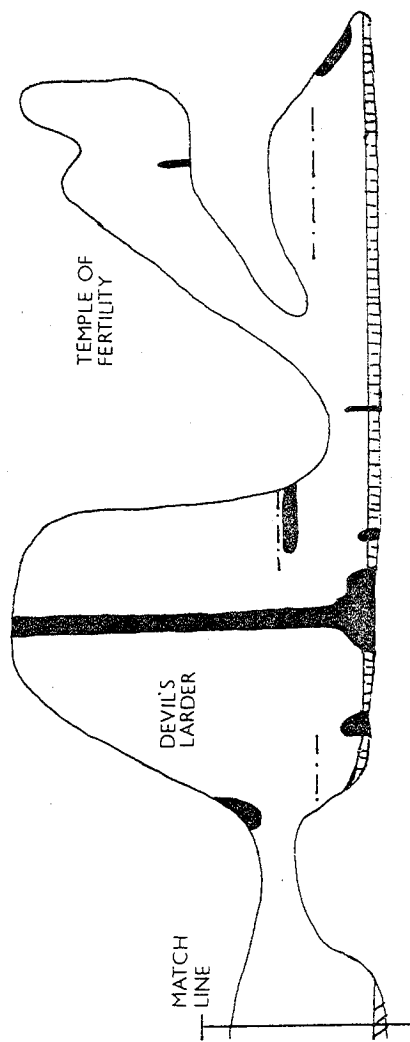
Elevation

PART EXTENDED



Key

- WATER
- ROCK
- GUANO FLOOR
- GOUR POOLS
- PASSAGE OVER
- SHELF
- FORMATION
- LIMIT OF LIGHT PENETRATION
- MUD FLOOR



9. HISTOPLASMOSIS (MEW)

9.1 Introduction

Aims : "The cavers should catch this lung disease". A statement in the prospectus that alarmed some of the cavers (and their friends and relations.) We thought that we were quite likely to develop histoplasmosis by visiting roosts used by oilbirds and various bats. However, no one developed any clinical signs or symptoms. It is possible to develop antibodies and thus immunity to the fungus without any symptoms. We can show this as a positive reaction to histoplasmin reagent in the form of a skin test.

I also collected samples of guano from the caves we visited. This was limited to the Tingo Maria area as we could find no guano in the caves of the Sierra.

Histoplasma capsulatum is a dimorphic fungus. In one form it grows as a mycelium in bird and bat guano (both are present in the Tingo Maria caves), and in its yeast-like form grows in human lung tissue so causing the disease, histoplasmosis. This is often referred to as benign pulmonary histoplasmosis, it may be sub-clinical or produce a dry cough, fever and other 'flu-like symptoms (Young 1975) Very occasionally the fungus infects the rest of the body and in this form the disease is potentially lethal.

Soil is the natural habitat of Histoplasma capsulatum and its growth is enhanced by soil enriched by droppings of bats and birds. However Stotzky and Post (1967) suggest that "Although the fungus appears to be associated with animal droppings, primarily those of birds and bats, the essentially unrestricted geographic distribution of animal droppings and the high saprophytic ability of the fungus suggest that the type and availability of energy sources are not primary factors responsible for its ecology".

Precautions : There is much folklore associated with histoplasmosis and it has even been suggested that it caused the mysterious deaths of the discoverers of Tutankhamun's tomb, something previously attributed to the "curse of the Pharaohs". Every caver has his own story to tell of the disease.

Infection occurs by inhalation of spores or pieces of the mycelium. So we arrived in Peru armed with smog masks but we never wore them because we found them very restrictive whilst caving in such warm and humid conditions, making it difficult to breathe.

The disease is also well known to the locals. Peruvian tourists and scientists can be seen entering the caves of Tingo Maria with handkerchiefs pressed to their faces.

Treatment

Although the risks of contracting the systemic disease are very small, these risks are worth considering as the treatment is very difficult. There have been some fatalities because of failure to diagnose infection and so effective treatment initiated too late. Histoplasmosis may be confused with tuberculosis on x-ray (Craven and Benatar 1978).

The treatment of severe, systemic disease (Macleod 1981 : 881) is with amphotericin B. dosage 0.5mg/kg body weight, in 500ml of 5% glucose solution given intravenously over six hours. The dose is gradually increased to a maximum of 1.0mg/kg body weight. Treatment is given on alternate days and may have to be continued for a month or longer.

Now : Ketoconazole (Jansen)

The treatment may be badly tolerated and side effects include malaise, anorexia, nausea, fever, headache and venous thrombosis. These may be controlled by the addition of 10mg prednisolone to the intravenous solution.

Geographical Distribution

Histoplasmosis can be found in all continents of the world. Most of the recognised endemic foci are located in tropical and sub-tropical zones, but there are some large foci in temperate regions.

The fungus is endemic throughout most of central and South America, and the table below shows the data available for the distribution of the disease in Peru.

Table 9.1 A table showing patterns of skin sensitivity to histoplasmin reagent.
(from Edwards and Billings 1971)

Location in Peru	Year	Character	Number in Sample	Percent Positive	Reference
<u>Huánuco prov.</u>					
Tingo Maria and rural areas	1956	Schoolchildren 4-18 years	690	42.0	Villa <u>et al.</u>
<u>Ica prov.</u>					
Ica	1955	Schoolchildren and others 1-69 years	873	1.7	Bouroncle <u>et al.</u>
<u>Lima prov.</u>					
Callao	1955	Consultant personnel, Unidad Sanitaria del Callao	89	24.7	Bouroncle <u>et al.</u>
Lima	1953	T.B. patients, schoolchildren and others	618	1.5	Celso <u>et al.</u>
Lima	1955	Schoolchildren 6-17 years	2,352	4.7	Bouroncle <u>et al.</u>
<u>Loreto prov.</u>					
Iquitos	1955	Schoolchildren, prisoners and patients 1-64 years	910	37.0	Bouroncle <u>et al.</u>
Pucallpa and vicinity	1965	Patients, N. American linguists, Shipibo Indians and Mestizos	1,000	7.6	Mirand <u>et al.</u>

Location in Peru	Year	Character	Number in Sample	Percent Positive	Reference
Amazonas, Ancash, Arequipa, Cajamarca, Cuzco, Huanuco, La Libertad, Lambayeque, Lima, Loreto, Piura, San Martin, Tumbes	1958	Naval personnel	1,000	7.6	Mirand <u>et al.</u>

It must be noted that Paracoccidiosis infection is known to cross react with histoplasmin skin tests and both infections are found in Peru.

Also that the highest incidence of histoplasmosis is in the third decade of life and so surveys including schoolchildren may not be comparable with adult surveys. (Mok and Netto 1978)

9.11. Methods

9.11.1 Histoplasma in guano

Ten samples of guano were collected into sterile, plastic 25ml universal tubes.

Table 9.2

Sample	Site	from bat/oilbird
1.	Cueva del Boca de Lobo - dry area	oilbird
2.	Cueva del Boca de Lobo - wet area	oilbird and bat and swifts
3.	Cueva del Nido de Guacamaya	bat, parrot
4.)	Cueva de Lechuzas, in light zone near entrance	oilbird, parrot and bat
5.)		
6.	Rock shelter near Lechuzas	bat
7.	Cave on road from Lechuzas to Tingo Dry area	bat
8.	Cave on road from Lechuzas to Tingo Wet area	bat
9.	Below a hollow tree with mixed colony of fish-eating (<u>Noctillio</u>) and <u>Myotis</u> roost. Botanical Gardnes Tingo Maria	bat
10.	Below insectivorous bat roost in a hollow tree near the hotel de turistas, Tingo Maria	bat

Samples were not refrigerated. At the London School of Hygiene and Tropical Medicine, Dr. Hay inoculated an antibiotic-treated suspension of the guano in saline into the peritoneal cavity of mice. The mice were sacrificed six weeks later and liver, spleen and lungs examined histologically for evidence of histoplasmosis (Hay et al. 1981).

9.11.2 Skin sensitivity to histoplasmin

The cavers were skin tested with an intradermal injection of histoplasmin reagent (supplied by Dr. Hay of the London School of Hygiene and Tropical Medicine). Any induration was measured 48 hours after injection.

9.111 Results

9.111.1 Guano Samples

Dr. R. J. Hay was unable to find Histoplasma capsulatum in any of the samples. None of the inoculated mice were clinically affected and all of their organ cultures were negative.

9.111.2 Skin Tests

Five cavers were tested : A. D., D. K., I. S., A. W., M. W., all had indurations of less than 2mm diameter and so all were histoplasmin negative. J. W., has been shown in a previous study to have already converted to histoplasmin positive.

9.1V Discussion

We found no evidence to suggest the presence of Histoplasma capsulatum in the caves we visited, despite the fact that the Tingo Maria caves are known to harbour the disease. However, this organism is notoriously difficult to culture. Factors affecting this include season, moisture and sample size.

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10.i. RESPONSE TO ACETAZOLAMIDE IN PERU. (AJW)

10.i.i. INTRODUCTION

The use of acetazolamide has been shown repeatedly to be of benefit for acute mountain sickness (AMS) (1:2:3:4:). However, it may cause drowsiness (5:) and other side-effects which are similar to some of the symptoms of AMS and it may be that under certain circumstances these side-effects wholly or partly outweigh the benefit (6:7:). This would be of great importance to those ascending only to altitudes where AMS occurs in its mild or benign form. Many such people are engaged upon tasks which require a sustained level of cognitive functioning and any psychological impairment as a result of drug prophylaxis might easily be greater than that due to the AMS itself.

The trial set out to compare the effects of drug and of mild or moderate AMS on cognitive function by means of a battery of psychological tests (10.ii.). Subjects were assessed both on and off prophylaxis, both during ascent and at constant altitude. By this means an indication of the contribution made by altitude and by drug should be obtainable by multivariate analysis.

10.i.ii. METHOD

Thirteen expedition members aged 20-33 years ascended from sea level to 3,600 metres in a period of 48 hours. Subjects were matched as closely as possible for age and sex and took acetazolamide at a dose of 500 mg. slow-release (Diamox) daily, or placebo, on a double-blind basis. Drug was taken for a period of five days, starting three days prior to ascent. Performance on the psychological test battery was measured on five occasions:

1. Before drug or ascent.
2. One half day after ascent, while taking drug.
3. At least one week after ascent and after ceasing drug.
4. While taking drug at constant low altitude.
5. After altitude and drug.

The timing of the second and subsequent testings was chosen with regard to the following considerations:

1. Recovery from immediate physical exhaustion.
2. Sufficient time for AMS symptoms to develop and subsequent recovery.
3. Subject's drug levels to be at therapeutic level and then eliminated.

During a different period at constant altitude the same subjects also took a five day course of the other drug (acetazolamide or placebo) in a crossover design (8:). Their performance on the test battery was also measured before, during and after this, with time relationship identical to that used when ascent was made. A 56 point symptom questionnaire was completed by each subject after each drug course. An AMS symptom score was totalled from there by simple addition. For use as correlates the following clinical parameters were recorded before and after ascent: pulse, oedema, chest auscultation, dyspnoea, breathing rhythm and proteinuria (by means of Albustix). During the trial chloroquine was taken for malaria prophylaxis. Otherwise no drugs were used.

10.i.iii. RESULTS

Drug compliance was good. One subject omitted the last two capsules, but the rapid ascent meant he would still be under the influence of those he had taken. The results of a further two subjects were stolen. Contrary to the experience of some workers (1:23:) the anonymity of the active ingredient capsules was not threatened by noticeable side-effects; the reason for this is not clear. However, the inevitable inspired guesses by subjects at the identity of their capsules showed no consistent trend.

Nobody was so incapacitated by AMS that they had to drop out. Diarrhoea affected one subject, but did not prevent travel or ability to function. Comparison of symptom scores in each pair showed the acetazolamide to have fared better in every case (Table I; fig 1.). When the appropriate statistical test is applied (Wilcoxon's rank sum) the number of subjects is however too few to reach conventional levels of significance.

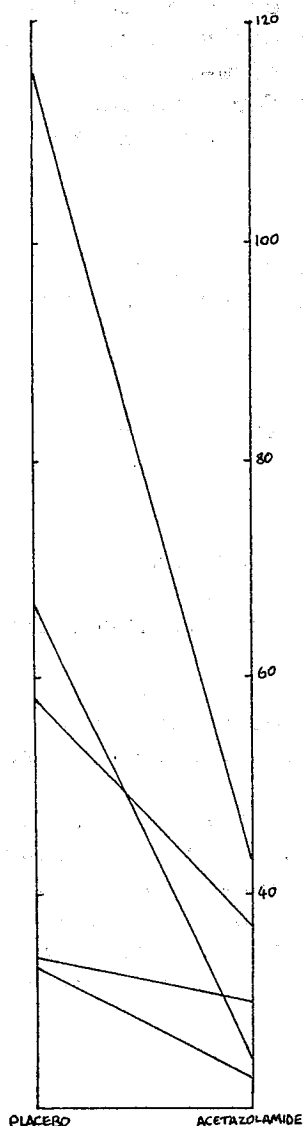


TABLE I

PAIR	ACETAZOLAMIDE	PLACEBO
1	30	34
2	25	67
3	37	58
4	23	33
5	45	116

Fig. 1. SYMPTOM SCORES
FOR EACH PAIR

The results of the psychological test battery can be broken down in different ways. Table 2 shows the individual performances. They are summated both vertically and horizontally to give the mean changes in the performance of the test and of the individual (fig. 2) respectively. The practice effect on some tests was taken into account by using the mean of the before and after results as baseline. The obtained results of the P.A.S.A.T., the Letter-Digit and the Memory Tests were adjusted by factors of 1, 0.5 and 3 respectively to give a pro rata influence to the combined results. The overall percentage performance decrement was calculated. All subjects showed a worse performance at altitude, but there was no significant difference between those taking acetazolamide and placebo, the decrements being 20.2% and 17.9% respectively.

The impairments elicited by individual tests is shown in Table 3. The impairments are concentrated in the P.A.S.A.T., the Cancellation Task and the Memory Test. Practice effects are prominent in the Trail-making, the P.A.S.A.T. and the Letter-Digit Tests, but absent in the Cancellation task and Memory Tests.

10.i.iv. DISCUSSION

The test battery can be analysed to show that the individual tests vary in their discriminatory ability. Performance on the P.A.S.A.T., Cancellation and Memory Tests was markedly impaired, while the Trail and Letter-Digit Tests were surprisingly unaffected. A practice effect was evident in the Trail, P.A.S.A.T. and Letter-Digit Tests. As these tests are increasing in their applications, and in particular serial testing is finding a role, this is important (10:11:12:13:14:15:). In this test battery the Cancellation Test was the most satisfactory, combining sensitivity with freedom from practice effect.

Although not reaching significance due to the small numbers, the convincing trend of the symptom scores in this study supports the previous reports that acetazolamide is an effectively prophylactic drug for AMS. The subjective symptom reporting used has been widely accepted as a valid method in this application (1:2:16:). The expedition deliberately avoided dramatic change in altitude, so preventing severe AMS and objective clinical assessment was therefore not useful. However, the change of altitude was adequate for mild (benign) AMS, as verified by the increased symptom score and the psychological test decrement. The apparent equal cognitive impairment experienced by subjects on acetazolamide as well as placebo is of interest. It could mean that acetazolamide is limited in its usefulness to the somatic symptoms of AMS. Alternatively the psychological side-effects of acetazolamide at therapeutic dosage are of comparable degree to the psychological symptoms of AMS in its benign form. There is an increasing awareness of mental impairment as a side-effect of drug treatment in many spheres (10:-16:). A physiological basis for that of acetazolamide in the form of reduced cerebral metabolic rate of oxygen has recently been demonstrated. (17:).

So the established dangers of taking acetazolamide such as over-confidence leading to over enthusiastic rates of ascent (18:19:) will be the greater if the cognitive abilities of a trekker to altitude are impaired by drug side-effects at the very time that crucial decisions are needed in an inclement mountain environment.

The project is continuing with the aim of demonstrating whether acetazolamide alone, without ascent, causes psychological impairment.

TABLE 2

	TRAIL-MAKING			P.A.S.A.T.			LETTER-DIGIT			CANCELLATION			MEMORY			TOTALS			PERFORMANCE DECREMENT
	0m	3600m	0m	0m	3600m	0m	0m	3600m	0m	0m	3600m	0m	0m	3600m	0m	0m	3600m	0m	
PLACEBO	115	126	104	62	70	44	100	85	84	58	66	74	0	15	0	335	362	306	12.7
PLACEBO	102	91	71	74	70	36	71	71	68	85	79	77	0	45	15	332	356	267	18.6
PLACEBO	102	90	78	22	30	28	88	85	75	86	98	87	30	60	45	328	363	313	13.1
PLACEBO	87	79	72	20	40	28	81	87	88	91	158	91	45	45	0	324	409	279	35.4
PLACEBO	94	87	84	4	4	0	87	81	81	68	67	66	0	45	45	253	284	276	7.2
PLACEBO	112	97	90	0	8	0	86	94	80	56	64	56	45	60	15	295	323	241	20.5
TOTAL	612	570	501	91	115	72	1028	1008	954	444	532	451	120	270	120				
ACETAZOLAMIDE	66	61	44	0	48	0	65	81	60	29	30	33	0	15	15	160	235	152	50.6
ACETAZOLAMIDE	64	73	69	4	32	18	82	88	81	64	92	72	0	15	0	214	300	240	32.1
ACETAZOLAMIDE	76	68	64	0	2	0	74	80	74	53	62	56	15	15	15	218	227	209	6.1
ACETAZOLAMIDE	83	78	69	4	2	0	72	69	64	30	30	29	0	0	0	189	179	162	1.7
ACETAZOLAMIDE	114	95	70	56	88	50	97	86	80	94	104	97	0	15	15	361	373	312	10.6
TOTAL	413	370	316	33	86	34	782	811	722	330	379	350	15	60	45				

INDIVIDUAL AND TOTAL TEST SCORES AND THEIR SENSITIVITY (PERFORMANCE DECREMENT)

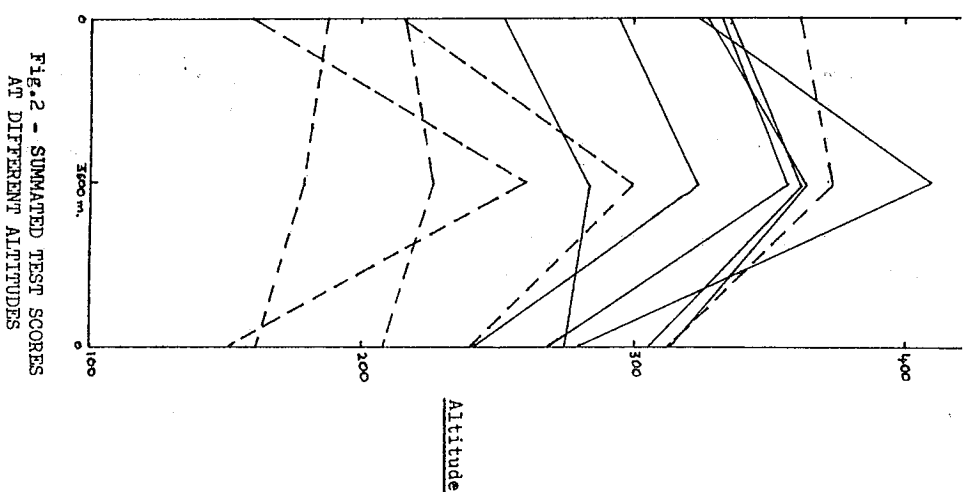


Fig. 2 - SUMMATED TEST SCORES AT DIFFERENT ALTITUDES

		TOTAL SCORE ALL SUBJECTS			% Performance Decrement	% Practice Improvement
		Om	3600m.	Om.		
TRAIL	Placebo	612	570	501	2.3	18.1
	Acetazolamide	413	370	316	1.4	23.5
P.A.S.A.T.	Placebo	91	115	72	10.0	20.9
	Acetazolamide	33	86	34	152.0	3.0
LETTER-DIGIT	Placebo	1028	1008	954	1.7	7.2
	Acetazolamide	782	811	722	7.8	7.7
CANCELLATION	Placebo	444	532	451	18.8	- 1.6
	Acetazolamide	330	379	350	11.5	- 6.1
MEMORY	Placebo	120	245	120	125	0.0
	Acetazolamide	15	60	45	100	200

TABLE 3

SENSITIVITY (% PERFORMANCE DECREMENT) AND
PRACTICE EFFECT OF INDIVIDUAL TESTS

CONCLUSIONS

Slow release acetazolamide 500 mg. daily or placebo was taken by a mixed sex group ascending rapidly to 3600 metres. Those taking acetazolamide had fewer symptoms of AMS than those on placebo. There was no difference between the deterioration in the two groups' performances on a battery of psychological tests carried out before and after ascent. Within the limits of the small numbers in the study, the possible implications are discussed.

10.ii. PSYCHOLOGICAL TEST BATTERY

TRAIL-MAKING TEST.

The test consists of a page containing 26 scattered symbols. Half are consecutive numbers and half are consecutive letters. The subject is required to trace a trail through the symbols in correct order, but alternating between number and letter to make a dual task. The test is timed.

PACED AUDITORY SERIAL ADDITION TEST. (20:21:).

A tape recording of sixty random single numbers is played at the rate of one every two seconds. The subject is required to add them to each other to make a running total. In case of error he is instructed to continue adding to what is thought to be the total so far.

LETTER-DIGIT TEST.

The test sheet is headed by nine pairs of boxes. In these the numbers one to nine are paired in random order with nine letter of the alphabet. The test consists of ninety random single numbers for which the subject has to apply the corresponding letter according to the code. The test is timed.

DUAL TASK CANCELLATION AND SUBTRACTION

The test sheet consists of a series of 200 random letters amongst which an index letter occurs a fixed number of times at random spacing. The subject is required to delete it wherever it occurs, at the same time subtracting verbally in twos from a high number. The test is timed. Penalties are incurred for each error in subtraction or deletion.

MEMORY TEST

A tape recording of twenty simple words is presented at one word every two seconds. One minute is allowed for recall of the words. This is repeated a second and third time to obtain a total recalled after three rehearsals.

10.iii. DESCRIPTION OF ACUTE MOUNTAIN SICKNESS.

Since the first descriptions of the illness, discussion has been hindered by confusion over nomenclature. This is understandable when the geography of the locations where it occurs is considered. Isolated communities have coined their own terms such as soroche for the various presentations. However, in the English speaking world the following classification is proving of use at present. (22:23:).

ACUTE MOUNTAIN SICKNESS	
<u>Benign Acute Mountain Sickness</u>	<u>Malignant Acute Mountain Sickness</u>
	<ul style="list-style-type: none">- Cerebral- Pulmonary- Mixed

BENIGN ACUTE MOUNTAIN SICKNESS.

This is characterised by one or more of headache, drowsiness, anorexia, vomiting, weakness, insomnia, light-headedness, discomfort in the chest and possibly peripheral oedema.

MALIGNANT ACUTE MOUNTAIN SICKNESS.

CEREBRAL: This is characterised by one or more neurological signs or symptoms such as ataxia, irritability, abnormal behaviour, drowsiness, hallucinations, coma, abnormalities of limb tone, papilloedema and urinary incontinence.

PULMONARY: This is characterised by dyspnoea at rest, cough and white frothy sputum. Signs which may be present are basal crepitations, tachypnoea and cyanosis.

PATHOPHYSIOLOGY.

Hypoxia is thought to be the central biochemical lesion in AMS. Tissue hypoxia will clearly occur in parallel with reduced atmospheric partial pressure of oxygen at altitude. Peripheral chemoreceptors respond to this by increasing respiratory drive. This blows off carbon dioxide and reduces circulating carbon dioxide and hydrogen ion concentration (or acidity). Since the same receptors are inhibited by this decreased acidity, the increase in respiratory drive is limited. The resulting inhibition of hyperventilation limits acclimatisation.

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11. NUTRITIONAL STATUS AND HAIR COPPER AND ZINC LEVELS IN CHILDREN
FROM TINGO MARIA. (M.P.)

Zinc deficiency in man was first observed in Iran (Prasad et al 1961) and Egypt (Prasad et al 1963) and has since been reported in many studies (Reinhold et al 1966, Ronaghy and Halsted 1975). Zinc deficiency in adolescents has been shown to be associated with dwarfism, hypogonadism and anaemia and with retarded growth, poor appetite and loss of taste acuity (hypogeusia) in children.

Copper deficiency in man has not been so extensively reported (Graham and Cordano 1969) as it is widely distributed in foods and is found in cooking utensils. Copper deficiency in infants and in cattle grazing on copper deficient pasture is associated with severe derangement of growth and metabolism.

The data on the relationship between zinc levels in hair and malnutrition (Briggs, Briggs and Wakatama 1972, Bradfield et al 1969) and copper levels in hair and malnutrition (Lea and Luttrell 1965, MacDonald and Warren 1966) is very conflicting. If a relationship between these trace elements in hair and malnutrition could be established then, due to its simplicity of collection, hair could be a very useful tool in population studies (Hambridge 1982). This project aims to characterise the growth patterns in Peruvian children and to test the possibility of any relationship between growth and levels of zinc and copper in the hair of these children.

METHODS

The population studied consisted of 165 children from 2 to 8 years old in the Tingo Maria area. The data was collected during August 1982.

Nutritional Status

Weight, height and head circumference measurements were made on the children. The weight and height were compared to the National Center for Health Statistics percentiles. Nutritional status was assigned according to the Gomez system.

Hair Analysis

Hair samples (weighing approximately 30 mg) were taken close to the scalp from the crown of the head. These were cut into 1 cm lengths and washed in 1% Tween 80 non-ionic detergent on a mechanical mixer at room temperature for 30 minutes. The samples were then filtered under vacuum and washed with deionized water until no more bubbles were visible. Then the hair was dried overnight at 110°C. When dry the samples were weighed and 1 ml of concentrated nitric acid was added and allowed to react at room temperature. The digest was then warmed and when cool 0.3 ml of concentrated perchloric acid was added. The resulting solution was warmed until white fumes were evolved. The

solution was diluted to 5 ml with deionized water. Zinc and copper determination was carried out using an atomic absorption spectrophotometer.

RESULTS

The mean and the standard deviation for weight and height were calculated and have been plotted for males in Figs. 1 and 2 and for females in Figs. 3 and 4. The 5th and 50th percentiles of the NCHS standard have also been plotted for comparison in each figure. The Gomez system classified 45 per cent of the males and 51 per cent of the females with first or second degree malnutrition.

The mean \pm s.d levels of zinc and copper were 200.5 ± 80.1 g/g hair and 45.4 ± 30.8 g/g hair respectively. Hair zinc levels below 70 g/g, a value suggested by Strain et al (1966) to indicate the lower limit of zinc adequacy, were found in 13 per cent of the children.

The relationship between hair zinc and copper and nutritional status was studied by comparing the hair zinc and copper levels of the normal children with those with first and second degree malnutrition. The results are shown in Fig. 5. The relationship between head circumference and hair zinc and copper levels was also studied.

DISCUSSION

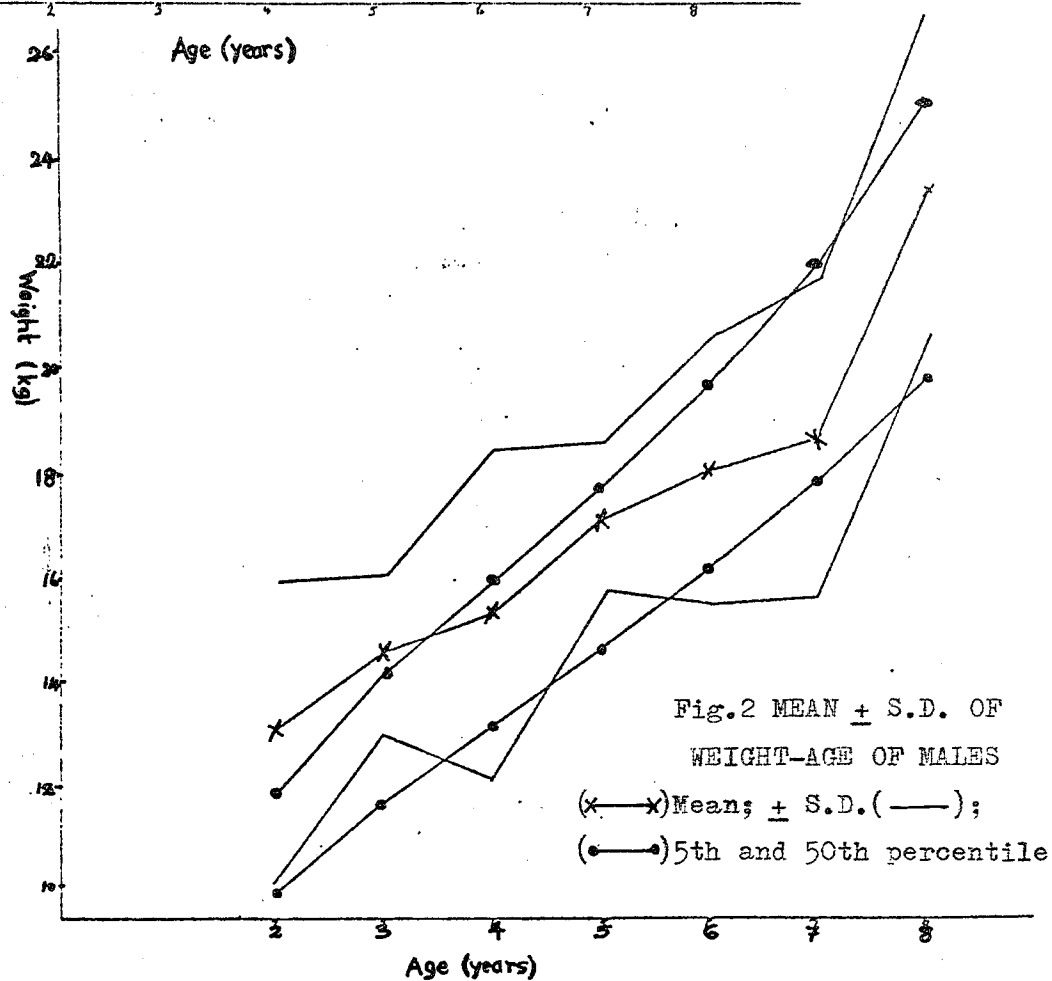
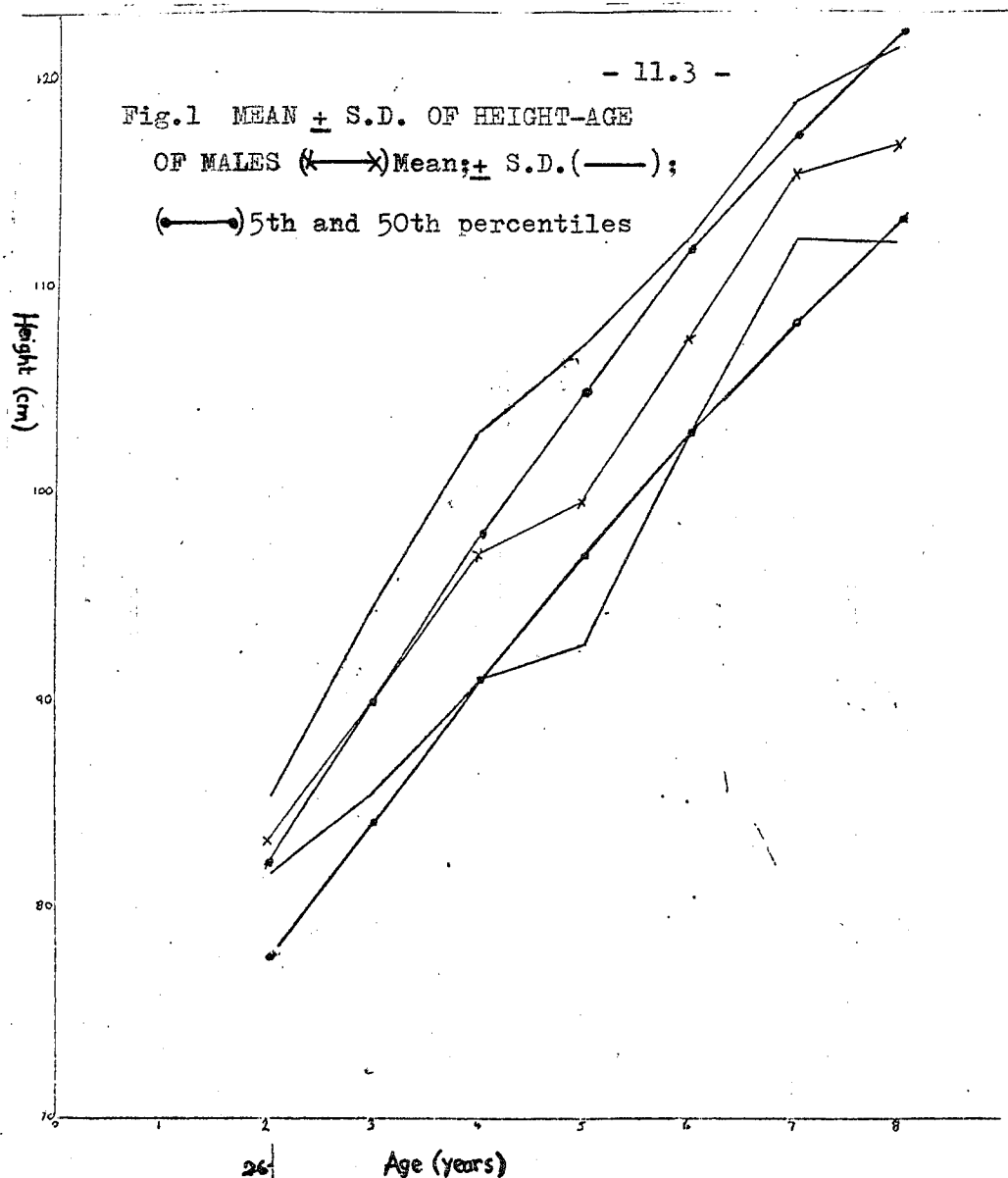
The curves for mean height for males and females are close to the 50th percentile during the first few years of life. The males then stay between the 5th and 50th percentiles but the females approach the 5th percentile and stay close to it.

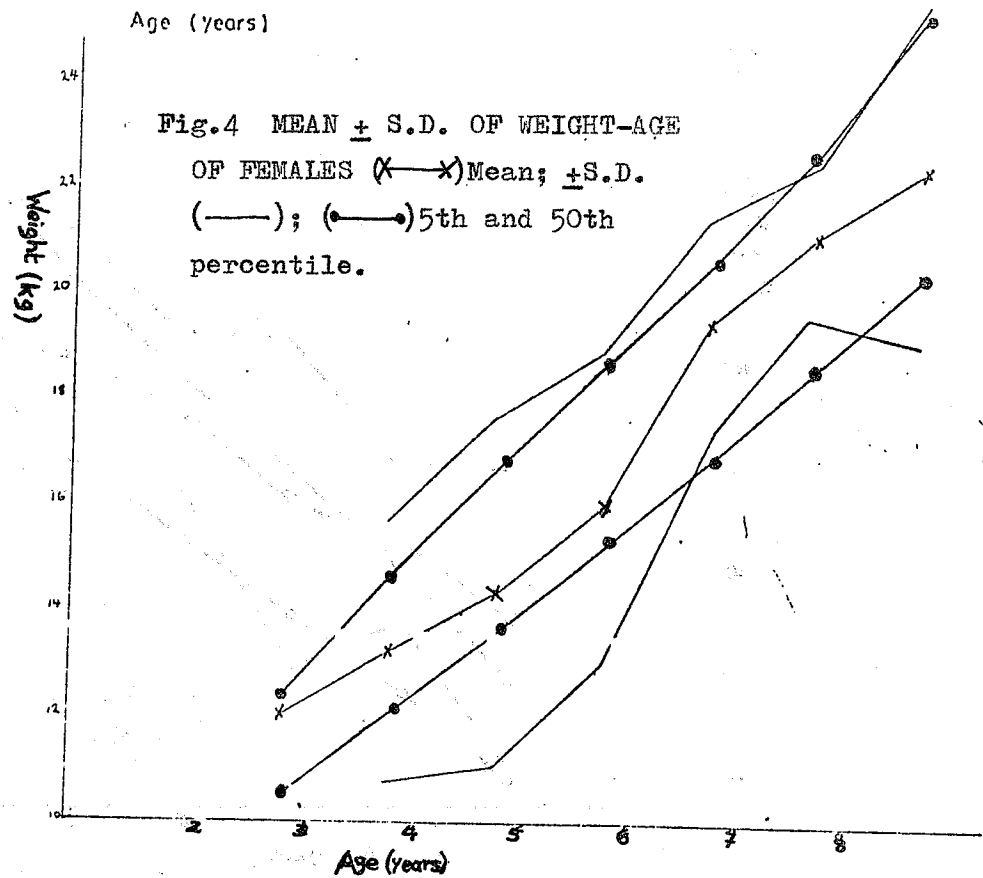
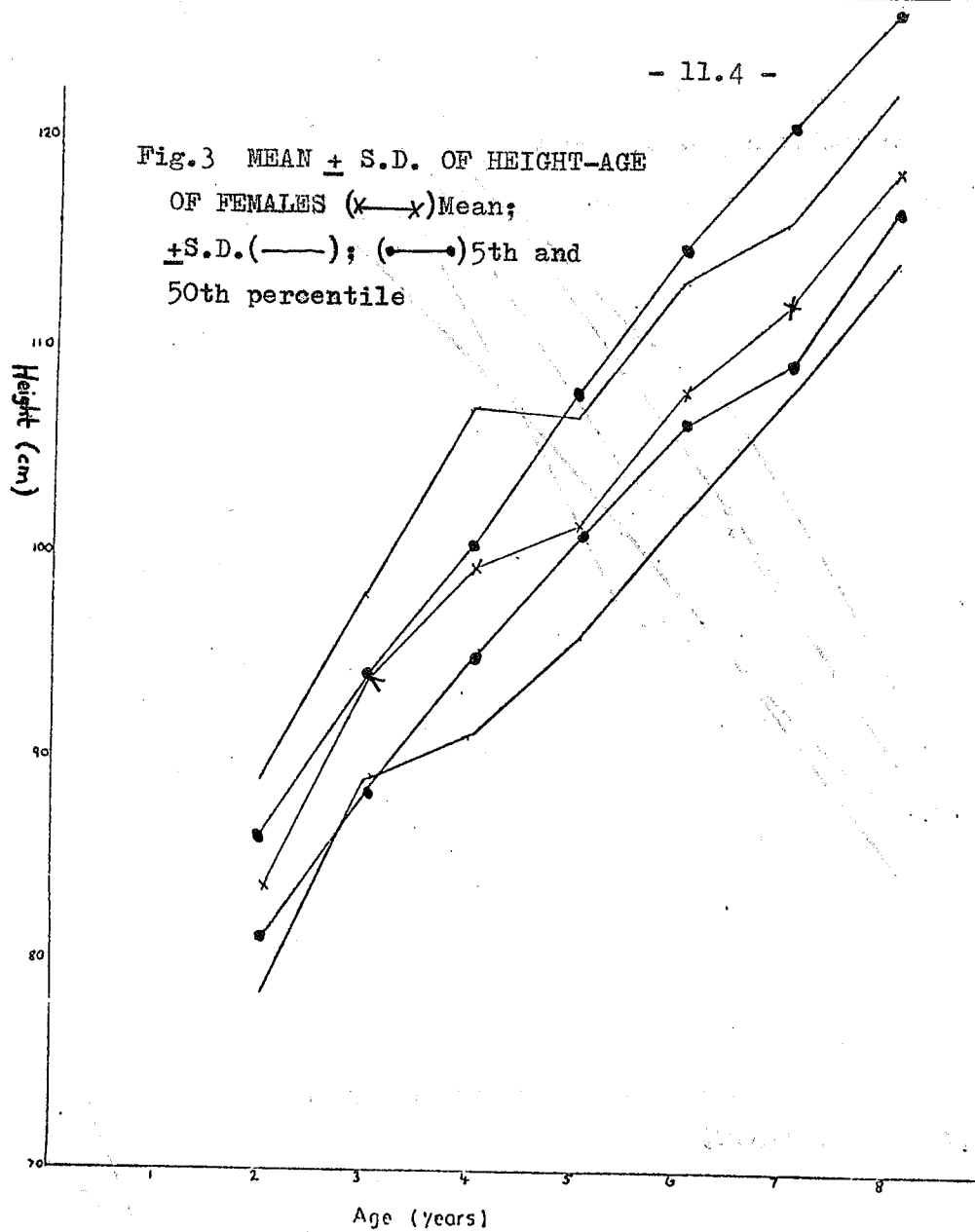
The curve for female weight is above the 50th percentile until the age of three and then it drops towards the 5th percentile curve and then rises sharply at eight years. The curve for male mean weight is below the 50th percentile at all times but is closest to the curve during the first and last years studied.

This decline in weight and height could be explained by the fact that breast feeding continues until the child is well into its second year. The adult diet was observed to be lacking in proteins, fresh milk was scarce and meat was extremely expensive. Diets were based on cassava which has been shown to contribute to protein/energy malnutrition. (Alleyne et al 1977).

The zinc levels reported here are consistent with those observed in other studies (Briggs, Briggs and Wakatama 1972). Fig. 5 shows that in this population there is a decrease in zinc levels with malnutrition.

The copper levels reported here are higher than those reported in other studies (Lea and Luttrell 1965, Goss and Green 1955). Fig. 5 shows that there is no relationship between hair copper levels and malnutrition. No





relationship was found between head circumference and zinc and copper levels. More work needs to be carried out in order to establish any possible relationship as work done so far is very conflicting. Standardisation of methods needs to be achieved as well in order to arrive at a definite conclusion.

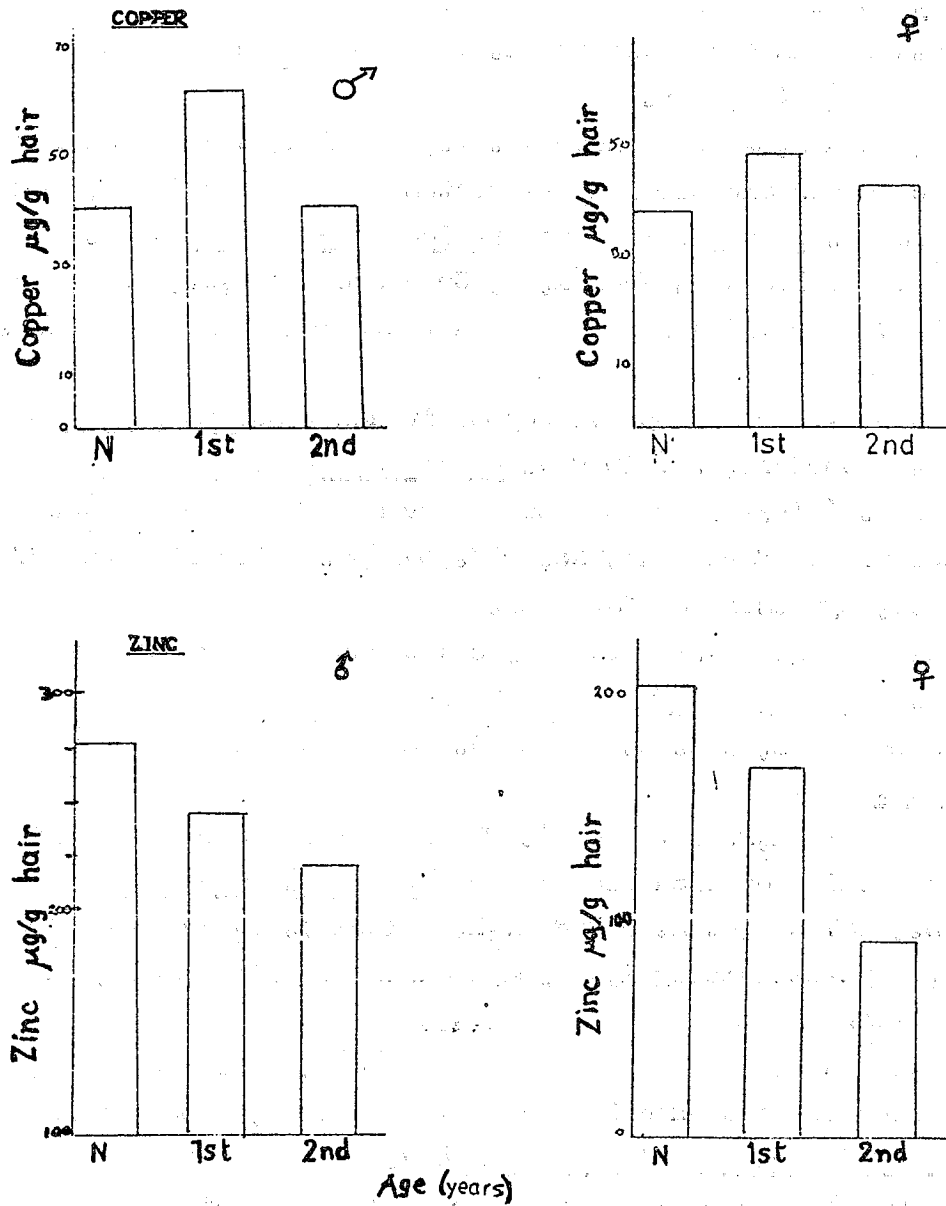
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Fig.5 Nutritional status and zinc and copper levels



12 RURAL TELECOMMUNICATIONS : A LIMITED STUDY OF TELEPHONE TRAFFIC
IN THE SIERRA (I.S.)

Abstract : In the smaller towns (pop. 8000 or less) both business and domestic users rely on the posta, a public telephone operated by a concessionary. We transcribed the logs of calls made and questioned business users. Are these rural postas significant for economic growth? Not yet. How should the network be improved? Current plans are compared with the aspirations and behaviour of users, applying our limited survey data to some planning models.

Contents

- 1 Administracion Zonal, Tarma-Junin
- 2 The survey
- 3 Traffic analysis
- 4 Commentary
- 5 Summary

13. THE PERUVIAN RAILWAY SYSTEM (J.C.P)

13.1 Introduction

There are two separate railway networks in Peru, the Central and the Southern, and they are operated by a State-run organisation called Enafer Peru. Both standard gauge (4 ft) and narrow gauge (3 ft) track are used, and now-a-days the traction power is mostly supplied by diesel locomotives. My personal travelling experience was limited to the Central Mainline and the Southern tourist run between Cuzco and Machupicchu, but even the most dedicated rail enthusiast could feel well satisfied with that.

13.2 The Central Railway

The Central Railway of Peru can be considered unique for a number of reasons. It is easily the highest railway in the world, making it probably the most spectacular and hardest to operate. Peru can be geographically split into three regions with the Andes forming the spine. To the west lies the coastal strip of desert called the Costa, and to the east are the vast areas of jungle, or selva. The high mountainous ranges are known as the Sierra. The Central Railway thus provides a vital link between the rich mining resources of the mountains and the capital Lima on the coast.

The main line from Lima to Huancayo follows the valley of the Rimac river and slowly winds its way up with the help of 9 zig-zags, 66 tunnels and 59 bridges, to its highest point of 4782M in the Galera tunnel, a few kilometres before La Oroya. This line is standard gauge and worked solely by adhesion despite the gradients of 1 in 22. The highest point of the Central Railway is in fact on a mining branch line at Morococha where a height of 4829M is achieved - higher than Mont Blanc ! To complete the Central network, there is a branch line from La Oroya leading north to Cerro de Pasco, and a narrow gauge extension from Huancayo to Huancavelica.

The man who designed and instigated the construction of the Central (and Southern) railway was an American Railway Engineer called Henry Meiggs. Work started in 1870 and wasn't completed until the 1890's, and although Meiggs didn't live to see it finished his name lives on. One problem was financing the project and money was loaned from a French Company causing Peru's public debts to reach over £50 million. It wasn't until 1889 after a period of severe bankruptcy that the British stepped in to form the Peruvian Corporation. Basically the agreement was for the Peruvian Government to hand over the management of the railways for a period of 66 years, and pay the Corporation the sum of £ 80,000, and in return the British agreed to complete the building of the railway and write-off any previous loans.

There is only one passenger train per day between Lima and Huancayo in each direction and the journey takes about $8\frac{1}{2}$ hours (on a very good day) for the 206 miles. There is also the connecting service from La Oroya to Cerro de Pasco. The cost of the full journey is about £2.50 for second class and only a few pence more for first class, which guarantees a seat and the option of a meal. The trains carry oxygen for those in need, but some argue that it is probably the fantastic scenery that leaves one breathless, not the altitude. !

13.3 Operating Problems

An interesting point to note is the use of the zig-zags to quickly gain height. These are double reversers where the train will back up a stretch of track and then continue forward at a higher point. Obviously there is some time lost in this process, but their main disadvantage is that the length of train is governed by the length of the dead-ends into which it reverses. Now that the diesels have taken over there is sufficient power to lengthen the trains but it isn't always possible to extend the dead-ends.

The operators of this railway have other problems to think about. Because the Andes are geologically young they are unstable and prone to earth quakes. In the railway season landslides can totally remove sections of track, so a continual watch has to be kept. There are also problems caused by flooding in the lower valleys of the Rimac river. Hence it is too dangerous to run traffic at night and this results in a congestion of freight trains meeting halfway up which can only pass each other at a few places where there is double track.

When gradients are associated with sharp curves the performance of the locomotive can be reduced. One modification to counter this is to reduce wheel diameter whilst increasing the power capacity, which thus reduces the risk of stalling. The sharp curves can also cause the wheel flanges to get ground away and so occasionally oil is used to lubricate the side of the rails - a risky process when considering the results of getting oil on the top. !

13.4 The Southern Railway

The main line is standard gauge and runs from the industrial town of Mollendo on the coast, through Arequipa which is Peru's second city, and up to Cuzco, the tourist centre of the Country. The line divides at Juliaca with a branch line going to Puno on Lake Titicaca. At present it is necessary to take a steamship across the lake to reach Bolivia. There is also a narrow gauge line from Cuzco to Quillabamba which passes through the ancient Inca township of Machupicchu - visited by thousands of tourists each year. The narrow gauge allows the line to curve very sharply as it gradually wends its tortuous path through the gorges cut into the rock.

13.5 Future Plans

The Government has made several proposals for new lines to be constructed but there is no evidence of this at present. The plans include a coastal link between Chimbote and Nazca via Lima, which would connect iron-ore resources with steel-making areas. It is also hoped to join the Central and Southern railways with a standard gauge railway between Huancayo and Cuzco. This would open up a rail link between Lima and the Capitals of Brazil, Bolivia, Chile and Argentina. At present the only ground route between Huancayo and Cuzco is a very weary 50 hour road journey. Finally, there are plans to extend the La Oroya - Cerro de Pasco line onto Pucallpa situated in the jungle, thus giving access to rich unexploited agricultural and forest lands on the eastern slopes of the Andes and the Amazon basin.

These development plans are controlled by the Ministry of Transport and Enafer Peru acts mainly in an operational role. The Canadian Government has been approached to give technical assistance on such points as data processing, operating procedures and cost control.

13.6 Technical Information

Central Railway Rolling Stock :-

50 Locomotives	- 14 oil
	- 31 diesel-electric
	- 5 diesel-mechanical.
1188 freight wagons.	
68 passenger coaches.	

Southern Railway Rolling Stock :-

57 Locomotives	- 10 oil
	- 43 diesel-electric
	- 4 diesel-mechanical.
900 freight wagons.	
122 passenger coaches.	

Track data :-

Max. curvature	17.5° (Min. radius 100M)
Max. gradient	1 in 22.7 (4.4%)
Max. altitude	4829M
Max. speed at low gradient	80 Km/Hr (50 mph)
Max. speed at high gradient	50 Km/Hr (31 mph).

14 APPENDICES

I. The Medical Report (MEW)

Despite the large orange capsules that Tony was feeding us and the presence of three medics in the team, the group as a whole remained remarkably healthy. We were able to give the majority of our medical supplies to more worthy causes.

I list the problems that we did have and it is worth noting the number of 'Good British Diseases' as well as the tropical ones:-

1. Diarrhoea: Everyone suffered from this at some time but is usually responded 24 hours starvation (a big problem resisting those delicious vegetable stews!) One of the group was treated with a course of metronidazole (Flagyl) for very persistent diarrhoea. Lomotil was very useful to stop the flow while we were travelling as it was impractical to dash behind a bush every 5 minutes.
2. Colds: At altitude many of us suffered with colds and the last minute addition of sore-throat tablets to the medical kit was much appreciated.
The one case of bronchitis responded to septrin.
3. Bites: While camping in the rain forest near Tingo Maria we were plagued by little biting black fly (Simulium) and we soon swapped our shorts for long trousers again. Spreading "Eurax" on the bites proved a useful diversional activity from scratching, but still some bites became infected - I told them not to scratch! - and 'polyfax cream' was useful.
4. Trauma: One sprained ankle, made worse by the weight of a rucksack. One road traffic accident inflicted by an icecream boy on a bicycle.
There were a few problems with cactus thorns, found in the Sierra, they went into human flesh very easily but were not barbed and so fairly easy to extract.
Our chief stove-engineer received paraffin in his eyes from a temperamental primus stove.
5. Chicken Pox: Not the first thing you think of when you come out in spots! Thought at first to be bed bugs or fleas.
6. Soroché: The local word for acute mountain sickness. Most of us had some problems. Details in Section 10.
7. Sun Stroke: A problem at altitude even when the weather was cool.

Hygiene

Hepatitis and typhoid are very common amongst travellers in Perú, even those with immunisations against the diseases. Although we lived entirely on local food (apart from the dreaded dried egg) the more sensible expedition members were careful not to eat uncooked foods such as salads and icecream, and sterilised all water before drinking it. We also tried to keep standards of hygiene as high as possible in camp - but it was not always possible to prevent the local animals from sharing our food.

Immunisations received before travel:-

Tetanus

Polio

Yellow fever

Typhoid

Rabies (donated by Servier laboratories)

Gamma globulin (to protect against hepatitis)

Nivaquine was used for malarial prophylaxis and taken weekly.

Servier Labs. Ltd.

John Heap MA MB BChir DRCOG
Fulmer Hall, Windmill Road
Fulmer Slough SL3 6HH

Medical Supplies taken to Peru

The names of companies have been mentioned, where the drugs had been donated to the Expedition.

* indicates those drugs used on the Expedition.

50 x 250mg	Oxytetracycline	
100 x 250mg	Penicillin V	
500 x 250mg	Amoxycillin	Bencard
*500	Septin	Wellcome
*200 x 400mg	Flagyl	May & Baker
12 x 4g	Chloromycetin Eye Ointment	Parke Davis = Warner
6 x 5ml	Polytrim Eye Drops	
5 x 14	Gyno-Daktarin Pessaries	Janssen
12 x 20g	Canesten cream	Bayer
* 3 x 10	Antiseptic throat lozenges	
10	Fungilin lozenges	Squibb
*500	Neurodyne (Paracetamol and Codeine)	Radiol
*100	Claradin (soluble aspirin)	Nicholas
100 capsules)	Fortral	Winthrop
16 x 2ml solution)		
100	Imodium	
50	Codeine phosphate	
* 50	Enterosan (kaolin & morphine)	
*200	Lomotil	
25g	Metosyn cream	I.C.I
*200 x 200mg	Nivaquine	May & Baker
100 x 12mg	Dimotane L.A.	Robins
100	Piriton	Allen & Hanbury
*100	Stugeron	Janssen
* 50 x 25ml	Savlodil)	I.C.I
* 20 x 30g	Savlon cream)	
	Antepar)	Wellcome
* 10	Polyfax cream)	
*	Bisodol	I.C.C.L.

Eric C. Mc.Gregor Internat. Chem.
Co Ltd., 11 Chenies Street
London WC1E 7ET
(Marketing Director)

*	Maalox Plus	Radiol
* 12	Eurax Ointment	Geigy
*	Fly Repellant Cream	Radiol
* 24 x 100g	Uvistat)	W.B. Pharmaceuticals
* 24	Uvistat-L)	Kirkby-Warrick
*	Puritabs	Pharmaceuticals

Also

* A good supply of plasters, bandages, syringes, needles, sutures, cotton wool. Plasters supplied by Johnson & Johnson.

- * Lilets - Lilia White
- * Antiseptic soap - Cidal
- * Shampoo, toothpast, Horlicks and Horlicks tablets - Beechams.

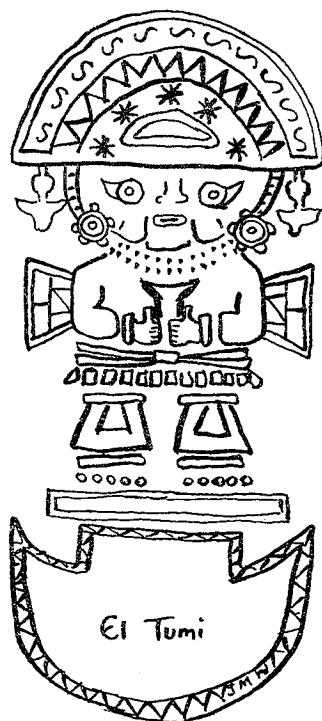
An excellent little book on how to deal with all kinds of medical problems and emergencies on expeditions has been published in the States and is edited by Wilkerson (1975).

ISBN 0-916890-06-6 available from 719 Pike Street Seattle Wa 98101
or via Douglas McIntyre Ltd
1875 Welch St N. Vancouver
B.C. V7P 1B7 Canada

References:

Wilkerson J.A. (ed.) 1975 Medicine for mountaineering (The Mountaineers Seattle Washington 98101) There is now a copy in the Southampton Medical School Library.

Grundy J.H. 1979. Medical zoology for Travellers (Noble Books, Hants.) also makes interesting background reading.



II LOGISTICS

Bus Travel (SJG)

Travelling on buses is probably the most efficient cheap method of getting around Perú. Several bus companies serve different regions of the country.

The most comfortable buses which serve the coastal strip of Peru are run by "Roggero" and for crossing the Andes to Cuzco "Morales Moralites" are reasonable, although all buses break down frequently. In the mountains many small companies run services but "Hidalgo" are comfortable and probably the best for the Lima - Cuzco trip. Between Tingo Maria and Pulcalpa and Lima, "Tepsa" (who also serve North Peru) and La Perla de Oriente are very comfortable buses.

Fares vary very little between all the companies and are comparable to U.K. prices. It is noticeable, however, that fares are higher where non-metalled roads are concerned (mainly the large long-distance companies) and often the buses used to break down. This leads to the fact that the buses are never on time anywhere. We experienced buses being 36 hours late.

The mountain roads are unmetalled, hard top or dirt tracks. Be prepared for lots of dust and very cold nights. Journeys are frequently over-night and buses do not have functional heaters.

The buses are used by locals and the occasional backpacker; hotel-based tourists prefer to fly usually. Screaming, vomiting kids come free with every trip.

Food is no problem; there are frequent stops with plenty of people selling fruit, drinks, hot and cold snacks. Most journeys in the mountains are long so take a book.

Where there are no buses, trucks will pick up many locals and other travellers (some may charge). These are great for seeing the scenery but again very cold if you are travelling after dark.

Internal flights are inexpensive compared to European prices: e.g. Tingo Maria to Lima costs £15 for the daily 45 minute flight. Tourist routes, for example between Lima and Cuzco can be more expensive.

Travelling by Train (JCP)

The railway provides an alternative method of travel in some areas but the service is very limited. There is only one train a day out of Lima (none on Sundays) which leaves at 7.40 a.m. Tickets have to be bought the day before. Time-keeping was good at Lima but became steadily worse as the train wends towards La Oroya and onwards. Prices are very reasonable: about £1.50 between Lima and La Oroya, second class about 15 pence more for first class. First class guarantee a seat and buffet facilities and oxygen are offered to both first and second class passengers. However, many did not feel like eating because of the effects of soroche.

Second class is greatly used by the locals, their luggage and chickens. At some times (e.g. during the fortnight of festivities around Independence Day) the numbers increase and one must be prepared for a fairly uncomfortable and smelly ride (not advisable for those who suffer from altitude sickness). As on the buses it is possible to buy local food and fruit from local traders, who jump on and off whenever the train stops. Needless to say, this is an incredible journey and well worth experiencing. More details in section 13.

Money (JMW)

Dollar bills are the most negotiable form of money after Soles. Travellers cheques (we took American Express U.S. dollars) can be changed at several banks and most bureaux de change (Cambio) in Lima. Outside Lima travellers cheques can be exchanged at (almost) any Banco de la Nacion or Ban. Coop without excessive commission charges. However, in some big towns, (e.g. Ayacucho), travellers cheques cannot be cashed at all. It is therefore sensible to carry some U.S. dollars in case.

The inflation rate is phenomenally high in Peru. The banks offer 55% interest on deposit accounts and at present the dollar is worth about 8 - 10 Soles more each week (1 U.S.\$ = 740 Soles in August 1982).

Security

Thieves are a big problem and everyone warned us to be extra careful but we just assumed that they were all over-reacting to the usual security problems everyone has when travelling abroad. However Perú seems to be one of the worst places for getting luggage and personal belongings stolen. On four occasions people attempted to rip watches off our wrists and there were three attempts (one successful) to snatch bags from under our noses. One of our number also lost all of his luggage in Cuzco - probably the worst place for meeting professional thieves. Concealed money belts are a must.

Food (SJG)

In general fresh food is very cheap and readily available in all places. For best deals stick to the markets and individual street vendors, but shops also offer good value.

Fruit is plentiful and dirt cheap. There are also some exotic types to try e.g. Pepinos - small sweet juicy melons (you can eat the skin) and Soursaps (Guanabara) which are green apple size fruits with a sour taste. Oranges can be bought for between 4 to 7 for 8 pence, bananas - 4 or 5 for 8 pence and advocados 8 - 12 pence each.

When the expedition was together the common meals at night were vegetable-based stews. Combinations of potatoes, rice, pasta, peas, carrots, turnips, onions, tomatoes, cauliflowers etc. It cost as little as 8 pence each to feed 10 people often with second helpings.

Prices vary greatly depending on what area you are in. In general the towns in the mountains were very cheap compared to the larger towns. Tingo Maria proved extremely expensive apart from the local fruits.

Eating in restaurants fulfilled any meat requirements and good dishes (chicken being very popular) with potatoes or rice could be found for around 50 pence in the mountains and as much as £1.50 in Tingo Maria. The soups are very wholesome (often a meal on their own). Fizzy drinks (e.g. Coca Cola, Fanta) can be found in all shops and cafés in the jungle and the mountains.

Luxuries such as chocolate and sweets were very expensive (a Mars bar equivalent being at least 60 pence).

Bottles of spirits are very cheap though, e.g. Rum - £1.50, Creme de Menthe - 60 pence. Beer is revolting, unless you like lager, but one or two of our number developed a liking for the stout they produce.

One word or warning, beware of G.A.T. (Gringo Added Tax) when buying. Prices can jump as much as ten times their normal value especially when it is noticed you are a tourist. In these cases go to another stall or try haggling.

Climate in July and August (JMW)

This is the dry winter season in Perú.

In Lima, where it only rains properly about once in twenty years, it is often dull and overcast because of the 'Garúa'. The sun breaks through sometimes but more often the dull weather develops into a light depressing drizzle which mixes with the grey dust to make the pavements slippery and apparently covered in black slime.

In Palcamayo, the clear cloudless skies make the daytime pleasant shorts and tee-shirt weather. But as soon as the sun disappears behind the mountains (at about 4 o'clock, two hours before dusk) the temperature plummets. Night temperatures can be as low as -10°C. Washing up left to soak over night needs to be chipped out of the ice in the morning! The sun is very powerful at this altitude (3500m) scorches efficiently and makes sunstroke a real risk. The medical officer had mild sunstroke on three separate occasions.

We did not need to use our waterproofs but it is as well to be prepared for the occasional snow storm.

In Tingo Maria, the climate is more constant. The mean annual temperature is 24°C and sleeping bags are not necessary. Even in the dry season it rains perhaps every other day (often extremely heavily; up to 2 inches in a morning) so tents are a useful protection against both the weather and the infuriating little biting blackfly that infest the area.

On occasions the weather was uncomfortably hot and humid so daily baths in the River Monzón were very welcome.

Carbide ("Carburo") is available in Lima and the larger towns (we bought some in a hardware shop in Tingo Maria) since it is used for welding. It burns far more rapidly than the British equivalent.

Permits to Export Specimens (JMW)

Despite what everyone would have had us believe, we did not have much trouble getting permission to collect and export biological specimens from Perú.

As soon as I arrived in Lima I started seeking official permission to conduct biological surveys and collect plant and animal specimens. Letters of introduction (especially those in Spanish) smoothed the way (I was carrying six). Probably the most valuable letter was provided by Miss Teresa Quesada, Cultural Attaché at the Peruvian Embassy in London.

It took about three days to get written permission from the Ministry of Agriculture and Food to collect specimens.

When I returned to Lima, I fulfilled my obligation by giving half of the pressed plants and one third of the zoological collections to the Museo de Historia Natural "Javier Prado" via the very pleasant Museum director Dr. Hernando de Macedo. Once I had a letter from him saying that I had deposited the required number of specimens at the national Museum, work could start on my export permit. I did not allow the three days that it usually takes for the certificate of permission to export to emerge from the system but the very helpful people at the Ministry of Agriculture managed to rush the process so that I had the certificate (costing S/200 or about 15 pence) just about two and a half hours before take-off. Next time I will economise on adrenaline and start the bureaucracy earlier.

I signed an undertaking to let the Museum have copies of reports, reprints of any papers and photographs. They were also pleased to accept all my spare collecting pots and specimen vials.

I made nearly twenty trips to the Ministry for the two permits. The result of most of these visits was to be told that the papers would be ready in two hours (which they never were) or mañana (mañana often seems to turn out to mean next week in Perú) but with constant gentle pestering, all the paperwork went through smoothly and quite quickly. I am glad I ignored the advice that the British Embassy gave me to smuggle out specimens because had I done so (and got away with it!) I would have missed out on a lot of valuable, interesting and pleasant contacts within the Peruvian scientific community. And the Peruvian academic institutions would have missed out on some specimens.

III SPECIMENS COLLECTED BY EXPEDITION MEMBERS (JMW)

Most of the invertebrates collected have been presented to the British Museum (Natural History) in London but are unlikely to be identified for some years. I will work up the apterous insects sometime in the distant future. The millepedes have been passed on to Dr. J.-P. Mauriès of Muséum National D'Histoire Naturelle, Paris. Other specimens are listed here.

ANTS (Insecta; Hymenoptera; Formicoidea) determined and collection held by R.R. Snelling, Los Angeles Co. Natural History Museum, California 90007.

900 EXPOSITION BOULEVARD

Cylindromyzex striatus (Mayr)
Camponotus distinguendus (Spinola)
Camponotus crassus Mayr
Camponotus sp. A. (n. sp?)
Camponotus sp. B. (n. sp?)
Gnamptogenys sulcata (Smith)

Europa Hotel, Central Lima - alt ~ 155m a.s.l.
Huagapo area at 3570m
Cuevas de los Lechusas and
de la Boca de Lobo at 620m
near Tingo Maria

- 14.8 -

Azeteca alfari (Emery)
Odontomachus bauri (Emery)
Solenopsis geminata (Fabricus)
Cyphomyrmex rimosus (Spinola)
Atta cephalotes (Linné)
Dinoponera longipes Emery
Pachycondyla apicalis (Latreille)
P. crassinoda (Latreille)

Forest in the Monzón
Valley near Tingo Maria

The two Camponotus species A and B may well be new species but more work must be done on these to confirm this and describe them.

ISOPODS (Woodlice) det. George A. Schultz of N. Jersey. ^{15 Smith Street} Hampton N.J. 08827.

Ethelium americanum Dollfus 1896 Guanophiles from a bat roost in a hollow fig tree in Tingo Maria. This is a common species that is found in Columbia, Peru and some of the Leeward Islands.

Specimens have been returned to the Museo de Historia Natural in Lima for the national collection.

Venezillo sp. a new species from the family Armadillidae found in the oilbird ejecta in la Cueva de la Boca del Lobo.

Philoscomorph isopods : an undescribed species which has lost body pigment but has eyes. A troglophile which was common in the oilbird ejecta of la Cueva de la Boca del Lobo.

Dr. Schultz is presently working on these new species so that their descriptions can soon be published.

Lichen Collections (MEW)

Collections of lichens, (particularly the high altitude species) were made for the British Museum (Natural History). The specimens are now being identified by Dr. Peter James and his colleagues at the Museum.

Collection sites were in the environs of:-

- a) Palcamayo - San Pedro de Cajas; altitude: 3500 - 4000m.
- b) Cuzco - Machu Picchu; altitude: 2300 - 4000m.
- c) Tingo Maria; altitude: 660m.

Thirty per cent of the collection is to be returned to the Museo de Historia Natural "Javier Prado" in Lima as requested by the authorities there.

DIPTERA : Psychodidae det Derek A Duckhouse (South Australia)

2 ♀ Psychoda alternata Say : Europa Hotel shower

2 ♀ Psychoda parthenogenetica Tonnoir : inside the tent at Huagapo

1 ♀ Clogmia albipunctata (Williston) Cueva del Boca del Lobo D.Z.

IV USEFUL ADDRESSES

British Embassy: Edificio El Pacifico, Piso 12, Plaza Washington, Av. Arequipa, Lima. The Embassy is not primarily concerned with those who travel outside the major cities but they still like you to register with them when you arrive. They will accept mail but so will the South American Explorers Club.

Canning House Library, 2 Belgrave Square, London SW1X 8PJ (01 235 2303/7). Specialist library for South America.

Comision para Intercambio Educativo entre los Estados Unidos y el Peru, Av. Maximo Abril 599, LIMA II (24-54-94) American-Peruvian Educational Exchange Centre. Useful for contacting field researchers. There are also Canadian exchange schemes.

Expedition Advisory Centre at the Royal Geographical Society, 1 Kensington Gore, London SW7 2AR.

Instituto Geographico National, Av. Nicolás de Piérula 947 Lima (Plaza San Martin). Sell high quality maps and aerial photographs. Very helpful.

Instituto Linguistico de Verano, x/n Av. Nicolás de Piérula, CASTILLA 2492, Lima (28-79-93). Ecumenical Bible translation group, American-funded but involved in literacy projects with the Ministry of Education.

Ministerio de Agricultura y Alimentacion, Sub-direccion de Forestal y de Fauna, 3er Piso, Natalio Sánchez 220, Lima II. This is in the same building as the Australian Embassy, across from the British Embassy and just off the Av. Arequipa. Permission to collect and export specimens comes from here.

Modesto Castro Choquehuanca, Correo Central, Palcamayo Provincia de Tarma. The official guide to la Cueva de Huagapo and very knowledgeable about the caves of the Palcamayo area.

Museo de Historia Natural "Javier Prado" (Universidad Nacional Mayor de San Marcos) Av. Arenales 1256, (Casilla 11434) Lima 14. Director: Dr Emma Cerrate de Ferreyra

Pengelly Cave Studies Trust Librarian (Harry Pearman) 24 Sydney Road, Bexleyheath, Kent DA6 8HG.

Peruvian Consultee (Teresa Quesada) 52 Sloane Street, London SW1 9SP. There are also Consulates in Glasgow, Hull and Liverpool.

Peruvian Tourist Board, 10 Grosvenor Gardens, London SW1 ODB.

The Seed Bank (Simon Linington) Royal Botanic Gardens, Wakehurst Place, Ardingly, Haywards Heath, Sussex. RH17 6TN.

South American Explorers Club, Casilla 3714, Lima 100 at Avendia Portugal 146, Belen, (phone 31.44.80). Very helpful, well informed and friendly; will accept mail on behalf of members.

Universidad Nacional Agraria de la Selva, Apartado 156, Tingo Maria, Huanuco, Peru.

Field & Trek Contract Division 23-25 Kings Road Brentwood Essex CM14 4ER

Caving Supplies 19 London Road, Buxton, Derbyshire SK17 9PA.

Zacharyama Travel 22 King Street Cambs CB1 1LN

Univerniku 509 5NH 0703-559122 Telex 47661

V. BACKGROUND READING

Guides

Bradt H and G 1980. Backpacking and trekking in Peru and Bolivia (Bradt Enterprises, Bucks.) 136pp. An excellent and readable little book that is packed with useful background and sensible tips.

Greenberg A. and H. 1981 Frommer's S. America on \$25 a day. Frommer 389pp. Aimed at tourists with more money than we wanted to spend.

Reparaz's Guide to Peru : handbook for travellers (4th ed.) (Ediciones de Arte Rep, Lima) Readily available in bookshops in Lima and Cusco. Useful and cheap.

**The South American Handbook from Trade and Travel Publications Limited, The Mendip Press, Parsonage Lane, Bath BA1 1EN. The most useful book available; very useful and updated each year.

The Petroperu : Mapa vial del Peru is the best readily available map of Peru and can be bought in Lima (esp. Plaza St. Martin) and Cuzco.

General

Berlitz Latin American Spanish for Travellers.

Carlos Castillo, Otto F. Bond 1977. The University of Chicago Spanish Dictionary (3rd edition, Pocket Books paperback, New York).

Kaufman Doig Manual de Arqueologia Peruana (Available in Lima).

Paul L. Doughty 1968 Huaylas : An Andean district in search of progress (Cornell University, New York).

Douglas Gifford, Pauline Hogarth 1976 Carnival and Coca leaf : some Tradition of the Quechua Ayllu (Southern Academic Press, Edinburgh).

D. Heath and D.R. Williams 1981 Man at High Altitude (Churchill Livingstone).

John Hemming 1970 The Conquest of the Incas (Harvest/HBJ).

Thor Heyerdahl 1950 The Kon-Tiki Expedition by raft across the South Seas (Allen and Unwin).

Thor Heyerdahl 1971 The Ra Expeditions (Allen and Unwin) (Also published by Penguin in 1972).

Hammond Innes 1969 The Conquistados : an illustrated history (Collins, London).

Lynn Meisch 1977. A traveller's guide to EL Dorado and the Inca Empire (Headlands Press, San Francisco/Penguin Books, London).

Robin Shoemaker 1981. The Peasants of EL Dorado : conflict and contradiction in a Peruvian frontier settlement (Cornell University, New York).

Observations upon the effects of high altitude on the physiological processes of the human body, carried out in the Peruvian Andes, chiefly at Cerro de Pasco. J. Barcroft et al
Philosophical Trans. of the Royal Society (series B) 211 351-477.

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VI ACKNOWLEDGEMENTS

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- R Brook Bond - Oxo (Oxo cubes)
- R Cidal Products (Soap) Albion House, Station Road, Hampton Mx TW12 2DY
- R Croda Colloids (Dried Egg)(6kg) Falcon Street, Oldham, Lancs OL8 1JU
- R Dylon International (Travel Wash) ACF Turvey Worsley Bridge Rd, Lower Sydenham London SE26 5HD.
- Kirkby-Warrick Pharmaceuticals (Puritabs)
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- ✓ Lederle Labs. (Diamox and Diamox placebo)
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Almost the entire expenses of the expedition were met by the members. Some people were awarded grants for their individual projects and administered these funds themselves.

It cost us £400 each for the return flight to Lima with Viasa Airlines. We needed to spend surprisingly little in addition to this since food is cheap in Peru (unless you like eating as we do in Britain), travel is inexpensive and camping free (see 14.4 et seq.).

INCOME AND EXPENDITURE ACCOUNT

Income

Grants:	£
W A Cadbury Charitable Trust	250
Gilchrist Educational Trust, Miss B. Sinclair Salmon 1 York Street, Baker St., London W1H 1PZ	150
Royal Botanic Gardens (for seed collections)	115.30
Sundry donations	27.29
Sale of equipment	35
Interest from deposit account	3.28
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In Peru (on travel, communal food, carbide, etc.)	122.84
South American Explorers Club membership	14.52
Equipment (most was bought by individuals but stoves and caving gear was purchased from expedition funds)	57.61
Medical (dressings, sutures, etc.)	12.82
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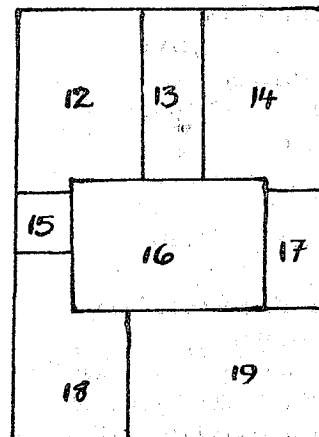
BACK COVER ILLUSTRATIONS

INSIDE:

6. The regimented fields near San Pedro de Cajas at 4000m in the Altiplano. The rolling limestone scenery here is reminiscent of the Yorkshire Dales (IS).
7. The Fiesta in Palcamayo. The more traditionally dressed women wear white hats with a Sally-Army black ribbon and carry their belongings in their mantas (JMW)
8. Huasa Huasi a town in the Sierra nestles in a sheltered valley (IS).
9. Steve thigh-deep in 'guano soup' dodging the black floating rafts in udder chamber of La Cueva del Nido de Guacamayo (JMW)
10. The tailless whip-scorpions we found had leg-spans of well over half a metre (JMW).
11. This long-tongued, leaf-nosed bat, Glossophaga soricina, feeds on nectar (JMW)

OUTSIDE:

12. The river Monzon sweeps around the base of the forest-clad limestone massif of the Sleeping Beauty (La Bella Durmiente) near Tingo Maria. This view is taken from our campsite and shows our favourite batheing spot (JMW).
13. Fiesta in Palcamayo (JMW).
14. Germinating palm trees and calcite formations inside the oilbird cave of the wolf's mouth (La Cueva del Boca de Lobo) (JMW).
15. Llamas, the original beasts of burden in Pre-Conquest Perú, have colourful tassels sewn into their ears when they reach maturity. They can carry just 25kg. or less than some of us carried up to Huagapo. Mules are now much more popular (IS).
16. Steve surveying the mud in the devil's larder chamber deep inside La Cueva del Nido de Guacamayo (JMW).
17. An alpaca - bred for the beautifully fine wool (JMW).
18. Mary collecting lichens on the limestone high above our campsite near Palcamayo. Note the spectacular folding of the Triassic rock and the terracing and tiny fields perched further down the valley (JMW).
19. A view from the train near the Galera Tunnel nearly 4800m above sea level. It takes the train just half a day to reach here from sea level (JMW).



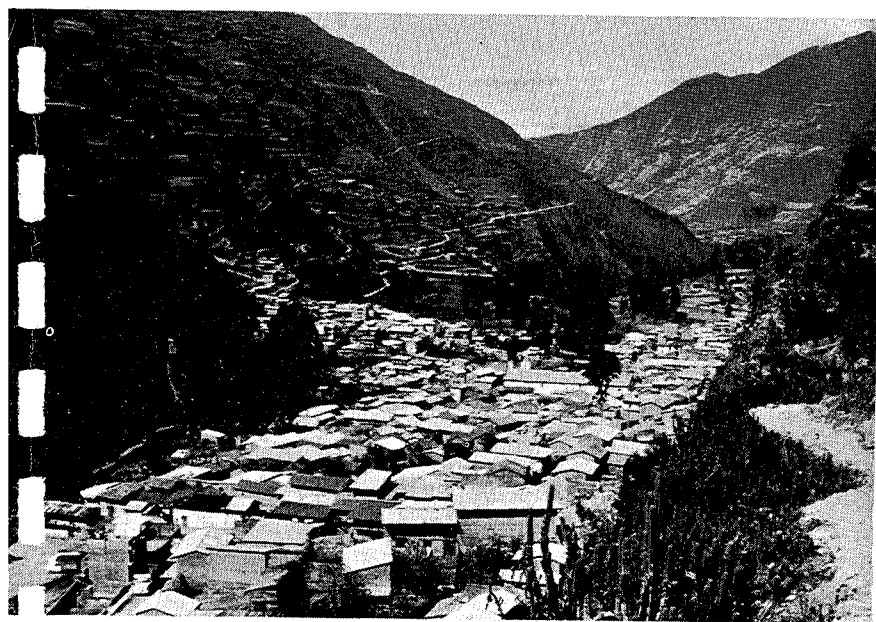


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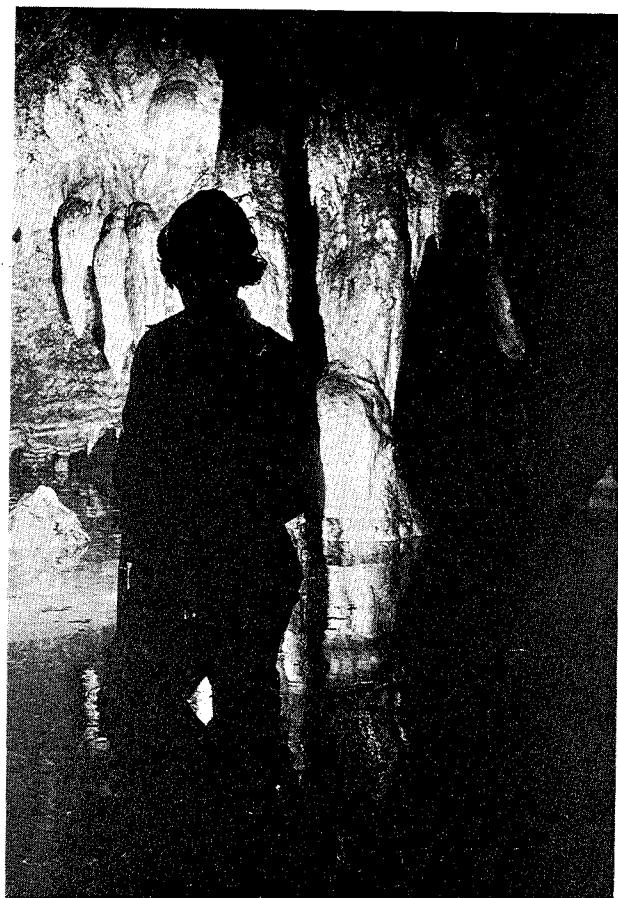


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