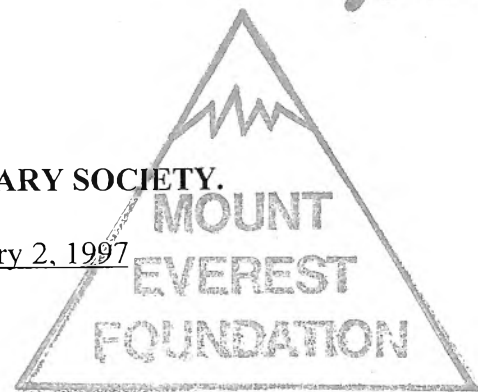


**BIRMINGHAM MEDICAL RESEARCH EXPEDITIONARY SOCIETY.**

Final report – Expedition Chile – January 12 – February 2, 1997

(ME Ref 97/12)

**Aim of the expedition**

1. To study the effects of rapid ascent to high altitude on cerebral oxygenation, measured on a novel Near Infra Red Spectroscope method.
2. To assess the effect on cerebral oxygenation of hyper ventilation with carbon dioxide administration; oxygen supplementation and treatment of subjects in compression bag.
3. To relate changes in cerebral oxygenation to the development of acute mountain sickness.
4. To assess the effect of Medroxyprogesterone in the prevention of acute mountain sickness.

**Subjects and methods**

20 healthy subjects (17 males and 3 females) aged 24-59 years, were randomly allocated to placebo or Medroxyprogesterone 30mg twice daily. Measurements of cerebral oxygenation were undertaken before starting the drug trial and at sea level one week after starting medication. Sequential daily measurements were performed at 2770m, 3650m and 4680m. In addition to cerebral oxygenation, peripheral oxygen saturation and heart rate were measured using a digital pulse oximeter and end-tidal CO<sub>2</sub> was measured with a gas sampling analyser attached to the face mask inlet. Responses to voluntary hyper-ventilation and ambient air enriched with 3% CO<sub>2</sub> were measured. At top camp additional measurements were made of the effect on cerebral oxygenation during oxygen therapy and whilst in a Gamow compression bag.

Acute mountain sickness scores were measured by the Lake Louise self-reporting form and done twice daily and a once daily clinical interview.

Travel from sea level to 4680m was by minibus from La Serena to Paso del Aqua Negra. The hire of buses, provision of a guide and all subsistence was provided by ACE Turismio Ltda Avda B. O'Higgins 949 Suite 1612 Santiago, Chile. This arrangements was made through Mr K Wilkinson of KE Adventure Travel, 32 Lake Road, Keswick, Cumbria CA12 5DQ.

**Results**

Preliminary results show that very satisfactory measurements of cerebral oxygenation were obtained but Progesterone did not have any significant effect. Inhalation of CO<sub>2</sub> and compression in a Gamow bag improved cerebral oxygenation.

## **Route**

A map of the area is enclosed. The access to Paso del Aqua Negra was satisfactory on a dirt road but insufficient vehicle fuel was taken for descent, which necessitated an additional trip to obtain extra supplies. Water was found at high altitude just below the pass but generally this is a very dry area.

## **Finance**

Individuals 'contribution to the Expeditionary Society

A grant from the Arthur Thompson Trust

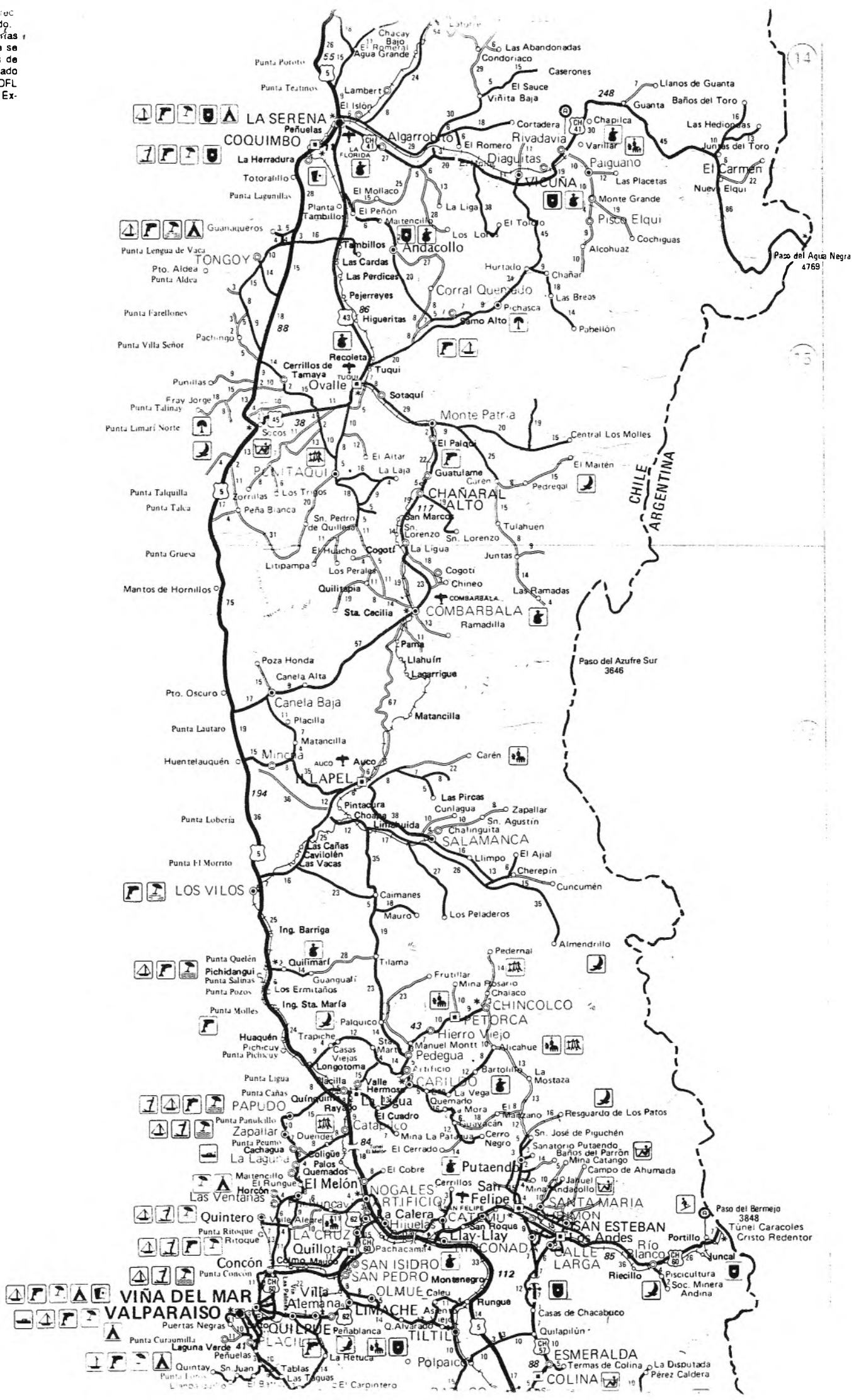
Grant from Mount Everest Foundation

Similar grants from other bodies were obtained.

Dr Peter Dykes (a member) donated £6,000

29.8.97

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- Icons for various road types and conditions.
- LA SERENA
- COQUIMBO
- TONGOY
- PUNTAQUI
- LOS VILOS
- PAPUDO
- VIÑA DEL MAR
- VALPARAISO

CHILE  
ARGENTINA

14

61

62

63

64

65

Paso del Agua Negra  
4769

Paso del Azufre Sur  
3646

Paso del Bermejo  
3848

Túnel Caracoles

Cristo Redentor

Piscicultura

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### Low on Oxygen. High on Onions

The mornings were always the worst. I'm not a mornings person normally and living in a tent at 4700m in the Chilean Andes made them particularly unpleasant. A disturbed night's sleep was accompanied by a splitting headache and the noise of blood thumping through my head. Noticing myself Cheyne-Stokes breathing also induced a mild panic the first time it occurred. The ritual of crawling out of my ice covered tent, vomiting and impatiently waiting for the sun to appear over the mountain tops and warm me up gave me a much better understanding of why the ancient Incas worshipped the sun. I was suffering from acute mountain sickness (AMS) after ascending from sea level to this height in a little over three days as part of a research expedition with the Birmingham Medical Research Expeditionary Society (BMRES).

The link between Birmingham and the mountains may not be as tenuous as you first think. As well as being the highest city in England, Birmingham was also home to a doctor called Ravenhill. He worked for an Andean mining company at the turn of the century and is accepted as the first person to give a modern scientific account of AMS in a key paper that was largely ignored for fifty years. BMRES was established over twenty years ago and consists of a group of doctors and scientists who are interested in the medical problems of travelling and climbing at high altitude. Over numerous expeditions since 1977 the physiology behind AMS and ways to combat its debilitating effects have been investigated. Most notably the drug acetazolamide (Diamox) has been demonstrated to reduce the possibility of developing AMS, through a respiratory stimulant action, and is now widely accepted as the most useful and safe drug for preventing this condition.

I was lucky enough to be one of two students chosen to join the most recent expedition to Chile in January this year. The party of twenty consisted of doctors from a variety of branches of medicine as well as a nurse, an engineer and an architect. A year of planning and fund-raising had culminated in a series of planned experiments that promised to reveal a great deal.

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However, my main concern before leaving (and that of my wife) was not an accident in the mountains or suffering from AMS, but whether I would return home having grown breasts. The drug trial to be undertaken was to further investigate the efficacy of medroxyprogesterone (also a respiratory stimulant) in the prophylaxis of AMS. We were all entered into a randomised double blind trial comparing the drug with a placebo. Daily medical examinations and questionnaires gave an 'AMS score' that quantified our reactions to altitude and our tablets. As it turned out virtually no side-effects were reported from those taking progesterone, most of whom thought they were on placebo, and it did seem to have a beneficial effect in preventing AMS.

Cerebral dysfunction is an important and serious complication of AMS and until recently, direct measurements of cerebral oxygen delivery at altitude were not practicable. Johnson and Johnson have marketed the Critikon 2020 which uses near infrared spectroscopy (NIRS) technology to measure oxygenated and

deoxygenated haemoglobin levels about 4cm below the surface of the skull via a sensor placed on the forehead. Originally designed for observing cerebral oxygenation during carotid end arterectomy operations, it was also hoped that it would help explain some of the mysteries of AMS. We all underwent tests breathing air, air enriched with carbon dioxide and voluntarily hyperventilated whilst cerebral oxygenation, end tidal carbon dioxide, pulse oximetry and blood gases were monitored. This was done at sea level, 2770m, 3650m and 4700m during our ascent up the Elqui Valley to Pasa del Agua Negra near the Chilean Argentinian border.

The setting for these tests was spectacular and the immensity of the surrounding mountains was quite belittling. The lack of oxygen at altitude also affects vehicles and many passed our camp coughing and choking on unburnt fuel with overheating engines and anxious drivers behind the wheel. The Peruvians are known to stick coca leaves to their foreheads and temples to relieve AMS but the Argentinian drivers that passed were more concerned about their vehicles than cerebral oedema. We discovered that the Argentinian cure for their cars was to put onion in the engine's air filter. One group actually stopped, asking us to donate some of our evening meal to their sick car so they could make it up the last 100m of the pass. Sadly, nobody's Spanish was good enough to understand the reasoning behind this theory.

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We hoped our experiments would produce theories a bit closer to reality and initial analysis of results has proved encouraging. A number of papers are planned to be published following analysis of the mass of data that we brought back with us. Three days of suffering from AMS at the top camp seemed a small price to pay for being involved in such interesting research and spending three weeks in a country so interesting and diverse as Chile. I think all other members of the trip would echo this sentiment, perhaps with the exception of one who needed "an industrial dose of intravenous dexamethasone before descending. We split up as a group to explore the country for a time before the flight to the UK and tales of beautiful mountains, white water rafting, glacial lakes, Patagonian vistas, smouldering volcanoes, hot geysers and Pacific surf abounded when we gathered again for the long trip home.

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